Notice of Intent

Sudbury Water District Facility Improvements
Sudbury, MA

June 2018

Prepared for:
Sudbury Water District

Submitted to:
Sudbury Conservation Commission

Weston & Sampson
Five Centennial Drive
Peabody, MA 01960-7985
www.westonandsampson.com
Tel: 978-532-1900
Fax: 978-977-0100

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

Sudbury Water District Facility Improvements
WSE Project No. 2170208

June 29, 2018

Sudbury Conservation Commission
275 Old Lancaster Road
Sudbury, MA 01776

Re: NOI Filing
Sudbury Water District Facility Improvements
199 Raymond Road

Dear Members of the Commission:

On behalf of the Sudbury Water District, Weston & Sampson Engineers, Inc. is hereby enclosing one (1) hard copy of the Notice of Intent submittal (including plans) and one electronic copy to fulfill the requirements of the Massachusetts Wetlands Protection Act, M.G.L. Chapter 131, Section 40 submittal requirements and the Town of Sudbury submittal requirements. As discussed with the Town of Sudbury Conservation Agent, the local fee would be waived if we requested such. Therefore, we are requesting a waiver of fee for this project. This submittal is a formal Notice of Intent for the Sudbury Water District Facility Improvements at 199 Raymond Road.

As part of the filing, we have attached the following:

Appendix A: Project Description
Appendix B: Stormwater Report
Appendix C: Project Maps
Appendix D: Contract Specifications
Appendix E Abutters List / Notice to Abutters
Appendix F: Wetlands Memorandum

If you have any questions regarding this submittal, please contact me at (978) 532-1900.

Very truly yours,

WESTON & SAMPSON

Mel Higgins, PWS
Senior Environmental Scientist

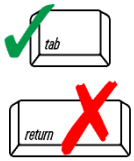
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 3 – Notice of Intent

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
MassDEP File Number
Document Transaction Number
Sudbury
City/Town

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



Note: Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

A. General Information

1. Project Location (**Note:** electronic filers will click on button to locate project site):

199 Raymond Road — a. Street Address
Sudbury — b. City/Town
01776 — c. Zip Code

Latitude and Longitude:
42deg 21'27.52" N — d. Latitude
71deg 25'14.38" W — e. Longitude

L08 — f. Assessors Map/Plat Number
0001 — g. Parcel /Lot Number

2. Applicant:

Vincent — a. First Name
Roy — b. Last Name
Sudbury Water District — c. Organization
199 Raymond Road — d. Street Address
Sudbury — e. City/Town
MA — f. State
01776 — g. Zip Code
(978) 443-6602 — h. Phone Number
i. Fax Number
vroy@sudburywater.com — j. Email Address

3. Property owner (required if different from applicant): ☐ Check if more than one owner

a. First Name
b. Last Name
c. Organization
d. Street Address
e. City/Town
f. State
g. Zip Code
h. Phone Number
i. Fax Number
j. Email address

4. Representative (if any):

Mel — a. First Name
Higgins — b. Last Name
Weston & Sampson Engineers — c. Company
5 Centennial Drive — d. Street Address
Peabody — e. City/Town
MA — f. State
01960 — g. Zip Code
(978) 532-1900 — h. Phone Number
i. Fax Number
higginsm@wseinc.com — j. Email address

5. Total WPA Fee Paid (from NOI Wetland Fee Transmittal Form):

$237.50 — a. Total Fee Paid
$237.50 — b. State Fee Paid
$0 (town to waive fee) — c. City/Town Fee Paid

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

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A. General Information (continued)

6. General Project Description:

Sudbury Water District Facility Improvements (See Appendix A for additional information)

7a. Project Type Checklist: (Limited Project Types see Section A. 7b.)

1. ☐ Single Family Home
2. ☐ Residential Subdivision
3. ☐ Commercial/Industrial
4. ☐ Dock/Pier
5. ☒ Utilities
6. ☐ Coastal engineering Structure
7. ☐ Agriculture (e.g., cranberries, forestry)
8. ☐ Transportation
9. ☐ Other

7b. Is any portion of the proposed activity eligible to be treated as a limited project (including Ecological Restoration Limited Project) subject to 310 CMR 10.24 (coastal) or 310 CMR 10.53 (inland)?

1. ☐ Yes ☒ No

If yes, describe which limited project applies to this project. (See 310 CMR 10.24 and 10.53 for a complete list and description of limited project types)

2. Limited Project Type

If the proposed activity is eligible to be treated as an Ecological Restoration Limited Project (310 CMR10.24(8), 310 CMR 10.53(4)), complete and attach Appendix A: Ecological Restoration Limited Project Checklist and Signed Certification.

8. Property recorded at the Registry of Deeds for:

a. County	b. Certificate # (if registered land)
Middlesex County	
c. Book	**d. Page Number**
8682	449

B. Buffer Zone & Resource Area Impacts (temporary & permanent)

1. ☒ Buffer Zone Only – Check if the project is located only in the Buffer Zone of a Bordering Vegetated Wetland, Inland Bank, or Coastal Resource Area.
2. ☐ Inland Resource Areas (see 310 CMR 10.54-10.58; if not applicable, go to Section B.3, Coastal Resource Areas).

Check all that apply below. Attach narrative and any supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

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B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

For all projects affecting other Resource Areas, please attach a narrative explaining how the resource area was delineated.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Bank	1. linear feet	2. linear feet
b. ☐ Bordering Vegetated Wetland	1. square feet	2. square feet
c. ☐ Land Under Waterbodies and Waterways	1. square feet 3. cubic yards dredged	2. square feet

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
d. ☐ Bordering Land Subject to Flooding	1. square feet	2. square feet
	3. cubic feet of flood storage lost	4. cubic feet replaced
e. ☐ Isolated Land Subject to Flooding	1. square feet	
	2. cubic feet of flood storage lost	3. cubic feet replaced

f. ☐ Riverfront Area

1. Name of Waterway (if available) - **specify coastal or inland**

2. Width of Riverfront Area (check one):

☐ 25 ft. - Designated Densely Developed Areas only

☐ 100 ft. - New agricultural projects only

☐ 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project: _____ square feet

4. Proposed alteration of the Riverfront Area:

a. total square feet _____ b. square feet within 100 ft. _____ c. square feet between 100 ft. and 200 ft. _____

5. Has an alternatives analysis been done and is it attached to this NOI? ☐ Yes ☐ No

6. Was the lot where the activity is proposed created prior to August 1, 1996? ☐ Yes ☐ No

3. ☐ Coastal Resource Areas: (See 310 CMR 10.25-10.35)

Note: for coastal riverfront areas, please complete **Section B.2.f**. above.

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B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

Check all that apply below. Attach narrative and supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below	
b. ☐ Land Under the Ocean	1. square feet 2. cubic yards dredged	
c. ☐ Barrier Beach	Indicate size under Coastal Beaches and/or Coastal Dunes below	
d. ☐ Coastal Beaches	1. square feet	2. cubic yards beach nourishment
e. ☐ Coastal Dunes	1. square feet	2. cubic yards dune nourishment

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
f. ☐ Coastal Banks	1. linear feet	
g. ☐ Rocky Intertidal Shores	1. square feet	
h. ☐ Salt Marshes	1. square feet	2. sq ft restoration, rehab., creation
i. ☐ Land Under Salt Ponds	1. square feet 2. cubic yards dredged	
j. ☐ Land Containing Shellfish	1. square feet	
k. ☐ Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above 1. cubic yards dredged	
l. ☐ Land Subject to Coastal Storm Flowage	1. square feet	

4. ☐ Restoration/Enhancement

If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.2.b or B.3.h above, please enter the additional amount here.

a. square feet of BVW

b. square feet of Salt Marsh

5. ☐ Project Involves Stream Crossings

a. number of new stream crossings

b. number of replacement stream crossings

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C. Other Applicable Standards and Requirements

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section C and complete Appendix A: Ecological Restoration Limited Project Checklists – Required Actions (310 CMR 10.11).

Streamlined Massachusetts Endangered Species Act/Wetlands Protection Act Review

1. Is any portion of the proposed project located in **Estimated Habitat of Rare Wildlife** as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP)? To view habitat maps, see the *Massachusetts Natural Heritage Atlas* or go to http://maps.massgis.state.ma.us/PRI_EST_HAB/viewer.htm.

   a. ☐ Yes ☒ No

   If yes, include proof of mailing or hand delivery of NOI to:

   Natural Heritage and Endangered Species Program
   Division of Fisheries and Wildlife
   1 Rabbit Hill Road
   Westborough, MA 01581

   2018
   b. Date of map

   If *yes*, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18). To qualify for a streamlined, 30-day, MESA/Wetlands Protection Act review, please complete Section C.1.c, and include requested materials with this Notice of Intent (NOI); *OR* complete Section C.2.f, if applicable. *If MESA supplemental information is not included with the NOI, by completing Section 1 of this form, the NHESP will require a separate MESA filing which may take up to 90 days to review (unless noted exceptions in Section 2 apply, see below).*

   c. Submit Supplemental Information for Endangered Species Review*

      1. ☐ Percentage/acreage of property to be altered:

         (a) within wetland Resource Area _____ percentage/acreage

         (b) outside Resource Area _____ percentage/acreage

      2. ☐ Assessor's Map or right-of-way plan of site

2. ☐ Project plans for entire project site, including wetland resource areas and areas outside of wetlands jurisdiction, showing existing and proposed conditions, existing and proposed tree/vegetation clearing line, and clearly demarcated limits of work **

   (a) ☐ Project description (including description of impacts outside of wetland resource area & buffer zone)

   (b) ☐ Photographs representative of the site

* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review (see http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/). Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.

** MESA projects may not be segmented (321 CMR 10.16). The applicant must disclose full development plans even if such plans are not required as part of the Notice of Intent process.

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C. Other Applicable Standards and Requirements (cont'd)

(c) ☐ MESA filing fee (fee information available at http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/mesa/mesa_fee_schedule.htm). Make check payable to "Commonwealth of Massachusetts - NHESP" and ***mail to NHESP*** at above address

*Projects altering **10 or more acres** of land, also submit:*

(d) ☐ Vegetation cover type map of site

(e) ☐ Project plans showing Priority & Estimated Habitat boundaries

(f) OR Check One of the Following

1. ☐ Project is exempt from MESA review.
Attach applicant letter indicating which MESA exemption applies. (See 321 CMR 10.14, http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/mesa/mesa_exemptions.htm; the NOI must still be sent to NHESP if the project is within estimated habitat pursuant to 310 CMR 10.37 and 10.59.)

2. ☐ Separate MESA review ongoing.
a. NHESP Tracking # _____ b. Date submitted to NHESP _____

3. ☐ Separate MESA review completed.
Include copy of NHESP "no Take" determination or valid Conservation & Management Permit with approved plan.

3. For coastal projects only, is any portion of the proposed project located below the mean high water line or in a fish run?

a. ☒ Not applicable – project is in inland resource area only b. ☐ Yes ☐ No

If yes, include proof of mailing, hand delivery, or electronic delivery of NOI to either:

South Shore - Cohasset to Rhode Island border, and the Cape & Islands:

Division of Marine Fisheries -
Southeast Marine Fisheries Station
Attn: Environmental Reviewer
836 South Rodney French Blvd.
New Bedford, MA 02744
Email: DMF.EnvReview-South@state.ma.us

North Shore - Hull to New Hampshire border:

Division of Marine Fisheries -
North Shore Office
Attn: Environmental Reviewer
30 Emerson Avenue
Gloucester, MA 01930
Email: DMF.EnvReview-North@state.ma.us

Also if yes, the project may require a Chapter 91 license. For coastal towns in the Northeast Region, please contact MassDEP's Boston Office. For coastal towns in the Southeast Region, please contact MassDEP's Southeast Regional Office.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

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Sudbury
City/Town

C. Other Applicable Standards and Requirements (cont'd)

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

4. Is any portion of the proposed project within an Area of Critical Environmental Concern (ACEC)?

   a. ☐ Yes ☒ No If yes, provide name of ACEC (see instructions to WPA Form 3 or MassDEP Website for ACEC locations). **Note:** electronic filers click on Website.

   b. ACEC

5. Is any portion of the proposed project within an area designated as an Outstanding Resource Water (ORW) as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00?

   a. ☐ Yes ☒ No

6. Is any portion of the site subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L. c. 131, § 40A) or the Coastal Wetlands Restriction Act (M.G.L. c. 130, § 105)?

   a. ☐ Yes ☒ No

7. Is this project subject to provisions of the MassDEP Stormwater Management Standards?

   a. ☒ Yes. Attach a copy of the Stormwater Report as required by the Stormwater Management Standards per 310 CMR 10.05(6)(k)-(q) and check if:

      1. ☐ Applying for Low Impact Development (LID) site design credits (as described in Stormwater Management Handbook Vol. 2, Chapter 3)

      2. ☐ A portion of the site constitutes redevelopment

      3. ☐ Proprietary BMPs are included in the Stormwater Management System.

   b. ☐ No. Check why the project is exempt:

      1. ☐ Single-family house

      2. ☐ Emergency road repair

      3. ☐ Small Residential Subdivision (less than or equal to 4 single-family houses or less than or equal to 4 units in multi-family housing project) with no discharge to Critical Areas.

D. Additional Information

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section D and complete Appendix A: Ecological Restoration Notice of Intent – Minimum Required Documents (310 CMR 10.12).

Applicants must include the following with this Notice of Intent (NOI). See instructions for details.

Online Users: Attach the document transaction number (provided on your receipt page) for any of the following information you submit to the Department.

1. ☒ USGS or other map of the area (along with a narrative description, if necessary) containing sufficient information for the Conservation Commission and the Department to locate the site. (Electronic filers may omit this item.)

2. ☒ Plans identifying the location of proposed activities (including activities proposed to serve as a Bordering Vegetated Wetland [BVW] replication area or other mitigating measure) relative to the boundaries of each affected resource area.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

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D. Additional Information (cont'd)

3. ☒ Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s), Determination of Applicability, Order of Resource Area Delineation, etc.), and attach documentation of the methodology.

4. ☒ List the titles and dates for all plans and other materials submitted with this NOI.

Water District Facility Improvements
a. Plan Title

Weston & Sampson Engineers
b. Prepared By

Laurence F. Keegan, Jr.
c. Signed and Stamped by

June 2018
d. Final Revision Date

1"=20'
e. Scale

f. Additional Plan or Document Title

g. Date

5. ☐ If there is more than one property owner, please attach a list of these property owners not listed on this form.

6. ☐ Attach proof of mailing for Natural Heritage and Endangered Species Program, if needed.

7. ☐ Attach proof of mailing for Massachusetts Division of Marine Fisheries, if needed.

8. ☐ Attach NOI Wetland Fee Transmittal Form

9. ☒ Attach Stormwater Report, if needed.

E. Fees

1. ☐ Fee Exempt: No filing fee shall be assessed for projects of any city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority, municipal housing authority, or the Massachusetts Bay Transportation Authority.

Applicants must submit the following information (in addition to pages 1 and 2 of the NOI Wetland Fee Transmittal Form) to confirm fee payment:

town to waive fee
2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payor name on check: First Name

7. Payor name on check: Last Name

Massachusetts Department of Environmental Protection
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Provided by MassDEP:

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F. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

Vincent J. Roy, SWD Director — 6-25-2018
1. Signature of Applicant — 2. Date

3. Signature of Property Owner (if different) — 4. Date

6/25/18
5. Signature of Representative (if any) — 6. Date

For Conservation Commission:
Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

For MassDEP:
One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a **copy** of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

Other:
If the applicant has checked the "yes" box in any part of Section C, Item 3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

NOI Wetland Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

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

A. Applicant Information

1. Location of Project:

a. Street Address	b. City/Town
199 Raymond Road	Sudbury
c. Check number	d. Fee amount

2. Applicant Mailing Address:

a. First Name	b. Last Name
Vincent	Roy

c. Organization: Sudbury Water District

d. Mailing Address: 199 Raymond Road

e. City/Town	f. State	g. Zip Code
Sudbury	MA	01776

h. Phone Number	i. Fax Number	j. Email Address
(978) 443-6602		vroy@sudburywater.com

3. Property Owner (if different):

a. First Name	b. Last Name

c. Organization

d. Mailing Address

e. City/Town	f. State	g. Zip Code

h. Phone Number	i. Fax Number	j. Email Address

B. Fees

To calculate filing fees, refer to the category fee list and examples in the instructions for filling out WPA Form 3 (Notice of Intent).

Fee should be calculated using the following process & worksheet. ***Please see Instructions before filling out worksheet.***

Step 1/Type of Activity: Describe each type of activity that will occur in wetland resource area and buffer zone.

Step 2/Number of Activities: Identify the number of each type of activity.

Step 3/Individual Activity Fee: Identify each activity fee from the six project categories listed in the instructions.

Step 4/Subtotal Activity Fee: Multiply the number of activities (identified in Step 2) times the fee per category (identified in Step 3) to reach a subtotal fee amount. Note: If any of these activities are in a Riverfront Area in addition to another Resource Area or the Buffer Zone, the fee per activity should be multiplied by 1.5 and then added to the subtotal amount.

Step 5/Total Project Fee: Determine the total project fee by adding the subtotal amounts from Step 4.

Step 6/Fee Payments: To calculate the state share of the fee, divide the total fee in half and subtract $12.50. To calculate the city/town share of the fee, divide the total fee in half and add $12.50.

Massachusetts Department of Environmental Protection
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NOI Wetland Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

B. Fees (continued)

Step 1/Type of Activity	Step 2/Number of Activities	Step 3/Individual Activity Fee	Step 4/Subtotal Activity Fee
Category 2 (j) (any other activity)			$500

Step 5/Total Project Fee:

Step 6/Fee Payments:

Total Project Fee:	$500.00 (a. Total Fee from Step 5)
State share of filing Fee:	$237.50 (b. 1/2 Total Fee **less $**12.50)
City/Town share of filling Fee:	$262.50 (c. 1/2 Total Fee **plus** $12.50)

C. Submittal Requirements

a.) Complete pages 1 and 2 and send with a check or money order for the state share of the fee, payable to the Commonwealth of Massachusetts.

Department of Environmental Protection
Box 4062
Boston, MA 02211

b.) **To the Conservation Commission:** Send the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and the city/town fee payment.

To MassDEP Regional Office (see Instructions): Send a copy of the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and a **copy** of the state fee payment. (E-filers of Notices of Intent may submit these electronically.)

Appendix A

PROJECT DESCRIPTION

Background

The Sudbury Water District facility has undergone minimal upgrades to support the growing operations. As a result, there are several operational inefficiencies which impact the level of service the Water District staff is able to provide to the community. The water district is looking to address these inefficiencies by expanding their work space.

Site Description

The existing operations are supported out of the existing facility located at 199 Raymond Road. The facility includes a 3,500 square foot main support building and several small support buildings including fabric cover structures to protect some of the equipment.

There are wetlands located along the southern border of the project site.

Scope of Work

The Sudbury Water District has proposed to renovate and add to their existing staff and administration facility at 199 Raymond Road. The Sudbury Water District's current facility serves as administration, customer service, staff support, and vehicle storage and shop space. The proposed project consists of renovation of the existing facility, an addition to the existing building, and a free-standing vehicle storage garage. The proposed facility will provide renovated administration and customer service areas, new staff support, including male and female locker/shower facilities, and new shop space. The proposed new vehicle storage garage will consist of a steel-framed structure and will be heated only to maintain above-freezing temperatures.

Sitework for the project will include new paved parking areas and driveway. A new septic system is proposed for the facility, and a new storm water management system for the site impervious surfaces, including roof drainage. All storm water will be treated before being infiltrated. A below-grade tight tank will be designed to contain interior garage drainage from the vehicle storage garage and from the shop space.

The existing building is 4,255 square feet. The proposed addition is 3,370 square feet. The proposed vehicle storage garage is 5,900 square feet.

Environmental Considerations

No work will occur within wetland resources. Some work will be within the 100-foot buffer zone. Erosion controls will be placed between the work area and wetlands to minimize erosion migration from the work site and into the wetlands.

Appendix B

Stormwater Report

Sudbury Water District Facility
199 Raymond Road
Sudbury, MA

Planning Board
Sudbury, Massachusetts

Sudbury Water District Facility

Submitted for Site Plan Review &
Stormwater Management Permit

July 2018
JOB NO: 2170208

Weston & Sampson.
100 Foxborough Boulevard
Suite 250
Foxboro, MA 02035
www.westonandsampson.com
Tel: 508-698-3034

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Checklist for Stormwater Report

Stormwater Report Summary

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Area Receptors Map
Aerial Map
FEMA Flood Hazard Map
NRCS Soil Map & Description
Test Pit Results

Appendix B - Pre- vs. Post-Flow Summary
Existing HydroCAD Model
Proposed HydroCAD Model

Appendix C - Recharge Calculation
Drawdown Calculation
Water Quality Volume Calculation
TSS Removal Worksheets
Downstream Defender Technology Verification

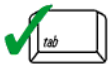
Appendix D - Long Term Pollution Prevention Plan
Construction Period Pollution and Erosion and Sedimentation Control Plan
Illicit Discharge Compliance Statement
Operations and Maintenance Plan

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Laurence F. Keegan Jr. 6.28.18

Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☒ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☒ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

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

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

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

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Stormwater Report Narrative

Project Name: Sudbury Water District Facility

Project Address: 199 Raymond Road, Sudbury, MA

Application Prepared by:

Firm: Weston & Sampson, Inc.

Registered PE: Laurence F. Keegan, Jr.

Introduction

This Stormwater Management Report is prepared to support the redevelopment of Sudbury Water District Facility located at 199 Raymond Road, Sudbury MA. The project site will be located on the property currently occupied with the Sudbury Water District and identified on the Accessors Map as property L08-0001.

The Sudbury Water District has proposed to renovate and add to their existing staff and administrative facility. The Sudbury Water District's current facility serves as administration, customer, service, staff support, and vehicle storage and shop space. The proposed project consists of renovation of the existing facility, an addition to the existing building, and construction of a free-standing vehicle storage garage.

The Sudbury Water District property is located in the RES-A (Residential) zone and is bordered to the east by Raymond Road and the Town of Sudbury recreational land, to the north by commercial development, to the west by a railroad right of way, and to the south by town open space. The access to the site is provided by Raymond Road via two existing driveways. The proposed work area (the Site) is located on the eastern part of the property and encompasses approximately 1.41 acres or 5.66% of the property. The remainder of the property is occupied by the pump station and open space.

Proposed work will include a full renovation of the interior, construction of an addition to the existing administration building and entrance vestibule, as well as construction of a new self-standing vehicle storage garage. Additional site work will include new paved parking areas and driveway, landscaping and utility upgrades, and a new stromwater management system.

As detailed herein, this Stormwater Management Report

- Demonstrates compliance with the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards;

- Demonstrates compliance with the Town of Sudbury Article V (F) Stormwater Management Regulations;
- Details construction-phase erosion and sedimentation controls, inspection requirements and maintenance requirements to protect downstream receiving waters; and,
- Presents a detailed long-term operation and maintenance plan for the stormwater management system and the site.

Existing Drainage Conditions

The existing conditions in the project area of the site consists of approximately 22,870 square feet impervious surface, including existing driveway, building, parking area and few minor support buildings surrounded by grassed and wooded areas. Topography on the site generally slopes from north to south with some steep slope hilly areas north of the Site and immediately south of the developed portion of the site.

Based on the existing drainage pattern – two drainage design areas were delineated, shown graphically in Appendix B.

Drainage Area 1 includes eastern portion of the Site, including part of an existing building roof, existing parking lot in front of the Water District Facility, egress driveways and grassed hilly area adjacent to the main entrance driveway. The stormwater runoff from this area flows overland toward Raymond road and travels south along the roadway gutter past the Site (Design Point 1).

Drainage Area 2 consists of 2 subareas. Subarea 'A' encompasses portion of the existing building roof, pavement area north of the building, including the pump station access driveway, as well as the vegetated areas north of the access driveway. The stormwater runoff from this area flows overland into an existing depression located within wooded area in the western portion the site. From the depression the runoff enters and existing 10" storm pipe which discharges approximately 30 feet south, across the access driveway, into the wooded area surrounding existing wetlands.

Subarea 'B' consists of mostly vegetated areas located south of access driveway and portion of the roof area from existing water district building and other supporting structures located in the southern portion of the site. The stormwater runoff from this area run overland directly to the wooded areas south of the Site, surrounding existing wetlands.

Proposed Drainage Conditions

In the proposed condition the amount of impervious surface on site will increase because of a new building addition, a new vehicle storage garage and new vehicular areas. To mitigate the increase in runoff from Site, three new underground infiltration systems are proposed, which will reduce the proposed peak flows and volumes and allow ground water recharge. The runoff from the building roofs will be conveyed directly into the underground infiltration systems and infiltrated. The stormwater runoff from the paved areas will be directed to the deep sump catch

basins, routed through strormwater treatment units, which will provide required pretreatment and TSS removal prior to infiltration, and finally discharge into the proposed underground infiltration systems to allow groundwater recharge and attenuation of peak flows.

Similarly to the existing condition, the runoff from the Site will contribute to two distinct design points: the gutter along Raymond Road and wooded area south of Site surrounding the wetlands.

Drainage Area A will be significantly reduced as compared to existing condition due to the capture and recharge of runoff from majority of impervious areas. The remaining area, consisting of a small portion of proposed egress driveway and landscaped areas adjacent to Raymond Road will continue to contribute the stormwater runoff towards Raymond Road. The runoff will further travel along the roadway gutter in the southerly direction.

Drainage Area B will increase and will include virtually all impervious area of the Site. The runoff from the pavement areas within drainage area will be collected via catch basins and conveyed to the proposed hydrodynamic separators where the stormwater will be treated to provide the required 44% TSS removal prior to infiltration. A total of three underground infiltration systems are proposed. Infiltration system 1 (INF-1) will treat and recharge the runoff from the proposed garage building as well as the vehicular area located in front of the garage. The INF-1 will discharge via an outlet control structure south of Site near the wooded area. The INF-2 is located under the existing parking lot, in front of the Water District administrative building and will collect the runoff from that area. INF-3 consists of linear underground infiltration chamber located along the perimeter of administrative building and will infiltrate roof runoff from the building. INF-2 and INF-3 are hydrologically connected and discharge via flared end section into the wooded area behind the administrative building.

Stormwater Design

Weston & Sampson utilized HydroCAD computer software to model the stormwater runoff for 1-inch, 2-year, 10-year, 25-year, and 100-year 24-hour storm events. The rainfall amounts for the 2, 10, 25, 100 year storms are based on the Northeast Regional Climate Center ”Atlas of Precipitation Extremes for the Northeastern United Sates and Southeastern Canada” and were as follows: 3.2 inches – 2-year, 4.8 inches – 10 year, 6.0 inches – 25 year, 8.6 inches – 100 year. In order to properly simulate the existing and proposed stormwater conditions at each site, specific data was obtained and/or considered, including topography, site layout, soil composition, and groundwater.

Soil information was obtained from the Natural Resources Conservation Service (NRCS) Middlesex County Web Soil Survey. The soil survey identified the soil type within project area as Windsor Loamy Sand, 8 to 15 percent slopes, and is classified as Hydrologic Soil Group A. The soil map and description are included in Appendix A.

In addition to review of the soil survey, test pits were completed throughout the site in May 2018 to explore the subsurface conditions, including the groundwater elevation. Generally, the test pits confirm the presence of loamy sand soils throughout project site and indicated groundwater at ranging from approximately 5 feet to 7 feet below ground surface. The test pit

logs are included in Appendix A. Based on the reviewed soil surveys and observed test pits, a Rawl's rate of 2.41 inches per hour was used for the design of infiltration BMPs.

Best Management Practices (BMPs) and Low Impact Development (LID) Measures

Low Impact Development (LID) Measures will be incorporated where possible, into this project. Large portion of the proposed project will be constructed within the envelope of the previous development with will result in the lesser increase in impervious area. As a result, this project is considered a mixture of New Development and Redevelopment and must meet standards 1, 2, 3, and the pretreatment and structural stromwater best management practice (BMP) requirements of 4, 5, and 6, only to the maximum extent practicable for the Redevelopment portion of the project. The BMPs used in this project are described hereon.

Deep Sump Hooded Catch Basins

Catch Basins at the Site are to be constructed with sumps (minimum 4-feet) and oil/debris traps to prevent the discharge of sediments and floating contaminants.

Subsurface Infiltration Basin

The subsurface infiltration systems consist of underground Cultec Chambers. The design of the chambers includes a permeable bottom that allows for maximum exfiltration of runoff from the system to the groundwater.

Water Quality Units

The proposed hydrodynamic water quality units proposed on Site separate and trap trash, debris, sediment and hydrocarbons form stromwater runoff.

Regulatory Compliance

This project was design in compliance with Massachusetts Department of Environmental Protection (DEP) – Strormwater Management Standards.

Standard 1: No New Untreated Discharges or Erosion to Wetlands

This project has been designed to comply with Standard 1. The proposed project will create no new untreated discharges. The proposed project was designed to mimic existing conditions as much as possible and improve the condition to the maximum extent practicable. As part of the proposed project, surface runoff from paved areas will be collected in deep sump catch basins and directed to hydrodynamic separators for treatment prior to treatment in the infiltration chambers or discharge off the site via flared end section armored with rip rap to minimize erosion at the outfall.

Standard 2: Peak Rate Attenuation

Post construction peak runoff rates or total volume of runoff will not increase for the, 2-, 10-, 25-, and 100-year storms. Supporting documentation is included with this report. A summary table is provided to illustrate that post-construction peak discharge rates and volumes will nearly mimic or significantly reduce pre-construction rates and volumes. To ensure that the work incorporates the performance standards recommended in the DEP's Stormwater Management Policy, necessary erosion and sedimentation control measures will be utilized during construction. These measures will include compost filter tubes and catch basin sediment controls, as needed.

Standard 3: Recharge

The impervious area within the proposed project limits will increase at the completion of construction, but with the designed improvements, recharge will be provided in the underground infiltration chambers. The recharge volume provided under post-development conditions is greater than the recharge volume required by DEP's Stormwater Management Standards. The recharge requirement calculation is included in this report and illustrates compliance with the current DEP Stormwater policy.

Standard 4: Water Quality

The project has been designed to comply with Standard 4. The proposed stormwater management system implements a reatment train of BMPs that has been designed to provide 80% TSS removal of strormwater runoff from all proposed impervious surfaces as well as 44% pretreatment prior to infiltration BMPs. Computations and supporting information are included in Appendix C.

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

Not applicable

The project site does not have the potential for higher potential pollutant loads.

Standard 6: Critical Areas

The Project will discharge treated stromwater to a critical area (Zone II) and therefore has been designed with suitable BMPs sized to treat the one-inch Water Quality Volume. Proposed source controls and pollution prevention measures have been identified in the Operation and Maintenance Plan included in Appendix D.

For computations and supporting information regarding the sizing of BMP's suitable for treatment of runoff near critical areas, see Appendix C.

Standard 7: Redevelopments and Other Projects Subject to the Standards Only to the Maximum Extent Practicable

This project is a mixture of a new development and redevelopment. The project has been designed to comply with the Stormwater Management Standards as noted above and below. As

permitted for a redevelopment portion of the project, the BMP selection criteria associated with standards 4, 5, and 6 are met only to the maximum extend practical, given limitations associated with groundwater elevations and topographic constraints.

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

The project will disturb more than 1 acre of land and is therefore required to obtain coverage under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Construction General Permit. As required, a draft Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan has been included in Appendix D. To ensure that the work incorporates the performance standards recommended in the DEP's Stormwater Management Policy, necessary erosion and sedimentation control measures will be utilized during construction, as shown on the plans. In addition, the contractor will be required to produce the SWPPP prior to any land disturbance.

Standard 9: Operation and Maintenance Plan

In compliance with Standard 9, a Post Construction Stormwater Operation and Maintenance (O&M) Plan has been developed for the project. The O&M Plan is included in Appendix D.

Standard 10: Prohibition of Illicit Discharges

Illicit discharges will be prevented on the site through the use of spill/discharge prevention measures, along with good housekeeping and BMPs, and in accordance with the Long Term Pollution Prevention Plan and O&M plans. An Illicit Discharge Compliance Statement has been developed for this site and is included in Appendix D.

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Laurence F. Keegan 6.28.18

APPENDIX A

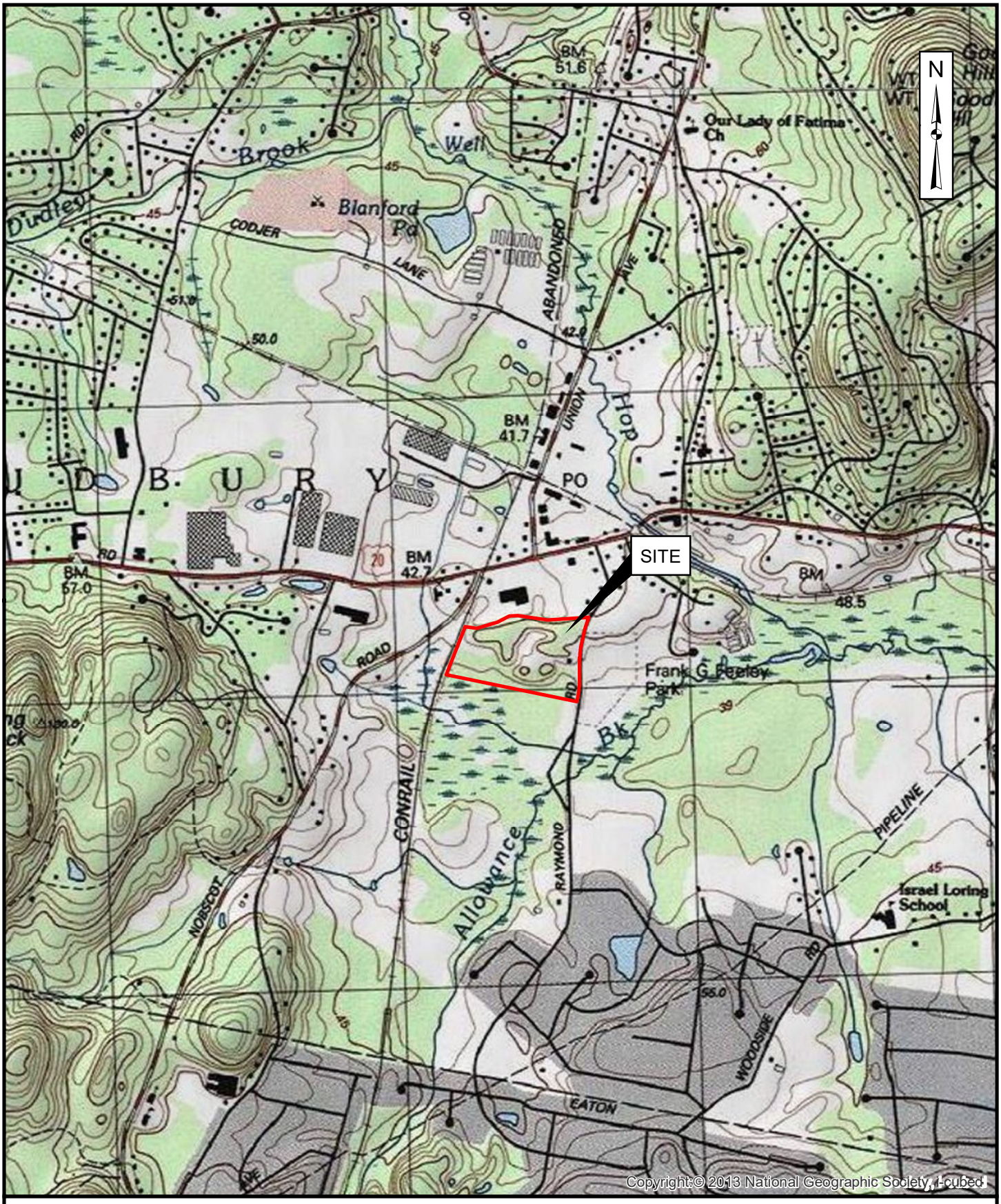


FIGURE 1
199 RAYMOND ROAD
TOWN OF SUDBURY, MASSACHUSETTS
SUDBURY WATER DISTRICT

LOCUS MAP

0 2,000 4,000 **Feet**

Weston & Sampson

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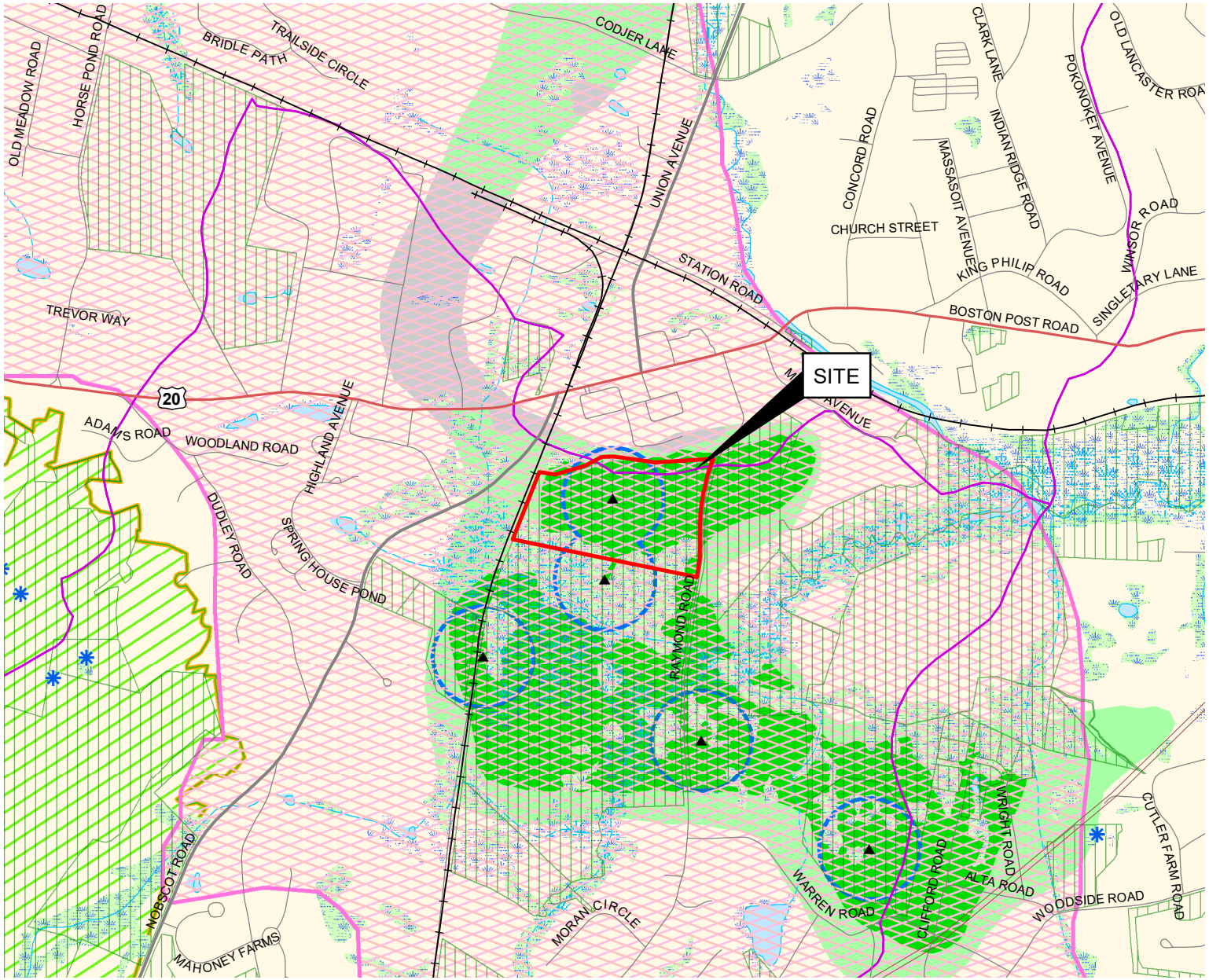

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1,200 600 0 1,200
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0.25 0.125 0 0.25
Miles

Data Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

NOTE: Radii shown are approximately 500-feet and 1/2-mile from center of site.

Legend

- Town Boundaries
- State Boundary
- Ground Water
- Surface Water
- Non-Community
- NHESP Certified Vernal Pools
- Railroads by Ownership
- Pipeline
- Pipeline Arbitrary Extension
- Powerline
- Powerline Arbitrary Extension
- Ski Lift/Tramway
- Substation
- Landing Strip/Airport
- Highway Exit Locations

All Roads

Road Classification

- Limited Access Highway
- Multi-lane Hwy, not limited access
- Other Numbered Highway
- Major Road, Collector
- Minor Road, Arterial
- Sub-basins
- Major Basins
- Landfills
- Dumping Grounds
- Protected Open Space
- ACECs
- Zone A
- IWPAs
- DEP Approved Zone IIs
- River, Stream, Shoreline
- Water
- Wetland
- Sole Source Aquifers
- NHESP Estimated Habitats of Rare Wildlife
- NHESP Priority Habitats of Rare Species

Non Potential Drinking Water Source Area

- High Yield
- Medium Yield

Aquifers

- High Yield
- Medium Yield

MA Towns (from Survey Points)

- MA Towns (from Survey Points)

FIGURE 2

Area Receptors Map
199 RAYMOND ROAD
SUDBURY, MASSACHUSETTS

Weston & Sampson

FIGURE 3
199 RAYMOND ROAD
TOWN OF SUDBURY, MASSACHUSETTS
SUDBURY WATER DISTRICT

AERIAL IMAGE

0 2,000 4,000 **Feet**

Weston & Sampson

National Flood Hazard Layer FIRMette

FEMA

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
- Regulatory Floodway *Zone AE, AO, AH, VE, AR*

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 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/26/2018 at 12:47:18 PM 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: base map 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.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Middlesex County, Massachusetts

Sudbury Water District

June 26, 2018

Preface

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

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

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

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

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

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

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How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,120 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 17, Oct 6, 2017

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	3.1	8.9%
52A	Freetown muck, 0 to 1 percent slopes	10.8	31.4%
255C	Windsor loamy sand, 8 to 15 percent slopes	14.7	42.6%
653	Udorthents, sandy	1.9	5.6%
656	Udorthents-Urban land complex	4.0	11.5%
Totals for Area of Interest		**34.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Middlesex County, Massachusetts

6A—Scarboro mucky fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svky
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Scarboro and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scarboro

Setting

Landform: Depressions, outwash terraces, drainageways, outwash deltas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from schist and/or sandy glaciofluvial deposits derived from gneiss and/or sandy glaciofluvial deposits derived from granite

Typical profile

Oe - 0 to 3 inches: mucky peat
A - 3 to 11 inches: mucky fine sandy loam
Cg1 - 11 to 21 inches: sand
Cg2 - 21 to 65 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 14.17 in/hr)
Depth to water table: About 0 to 2 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Walpole

Percent of map unit: 5 percent
Landform: Deltas, depressions, depressions, outwash plains, outwash terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wareham

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Bogs, depressions, depressions, kettles, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Percent of area covered with surface fragments: 0.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Bogs, depressions, depressions, kettles, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

255C—Windsor loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svkq
Elevation: 0 to 1,260 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Windsor and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: — error in exists on —
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Convex
Across-slope shape: Convex, linear
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
Ap - 1 to 11 inches: loamy sand
Bw - 11 to 31 inches: loamy sand
C - 31 to 65 inches: sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A

Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 10 percent
Landform: Deltas, eskers, kames, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent
Landform: Deltas, outwash plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

653—Udorthents, sandy

Map Unit Setting

National map unit symbol: vr1k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, sandy, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Sandy

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Udorthents, loamy
Percent of map unit: 5 percent
Hydric soil rating: No

Urban land
Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Unnamed
Percent of map unit: 5 percent

656—Udorthents-Urban land complex

Map Unit Setting
National map unit symbol: 995k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Udorthents and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting
Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities
Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Paxton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (Sudbury Water District)

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

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

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

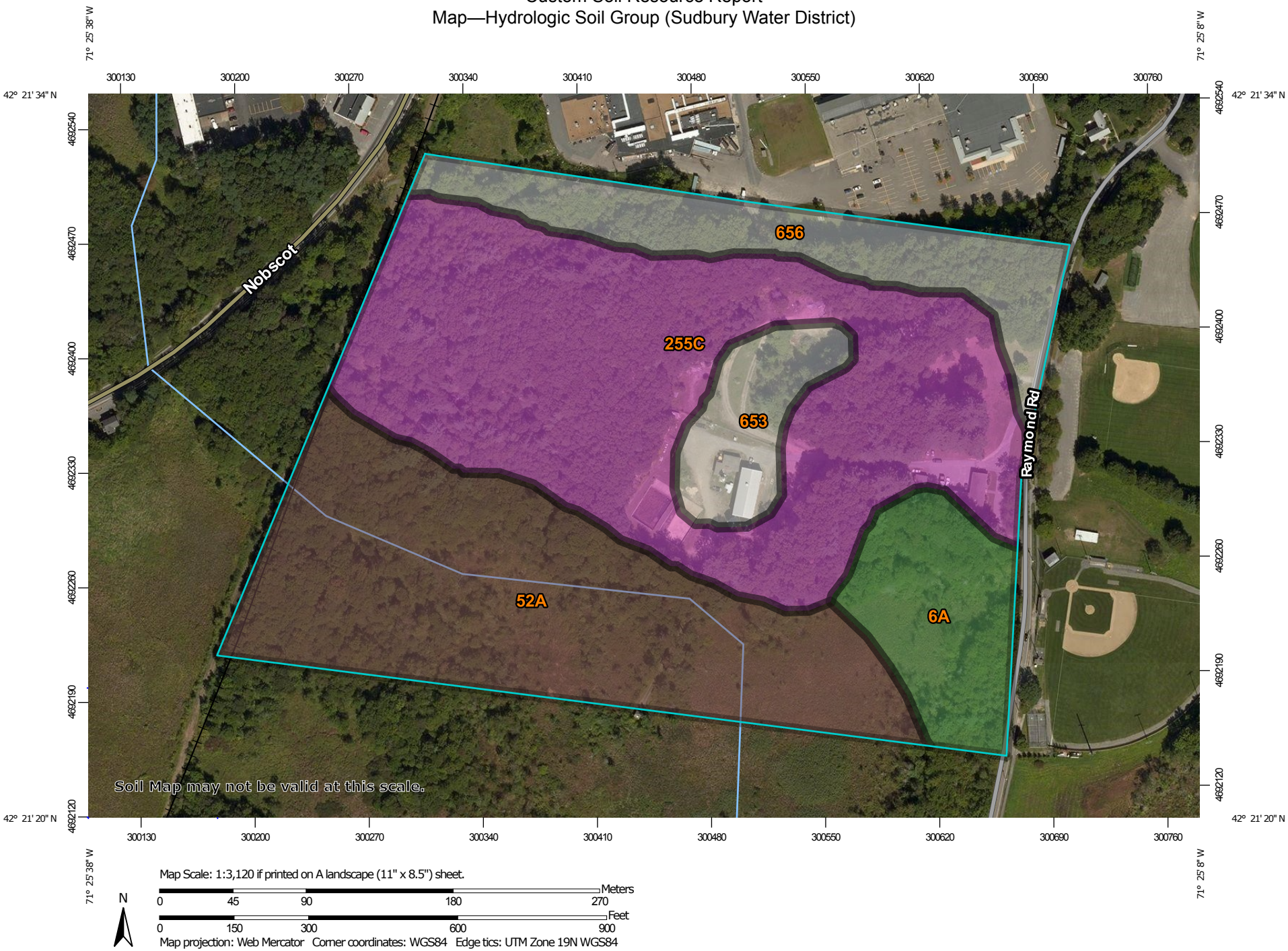
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group (Sudbury Water District)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 17, Oct 6, 2017

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

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

Table—Hydrologic Soil Group (Sudbury Water District)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	3.1	8.9%
52A	Freetown muck, 0 to 1 percent slopes	B/D	10.8	31.4%
255C	Windsor loamy sand, 8 to 15 percent slopes	A	14.7	42.6%
653	Udorthents, sandy		1.9	5.6%
656	Udorthents-Urban land complex		4.0	11.5%
Totals for Area of Interest			**34.4**	**100.0%**

Rating Options—Hydrologic Soil Group (Sudbury Water District)

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie. The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

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MEMORANDUM

TO: Elena Compter

FROM: Mark Mariano, Kyle Elmy

DATE: June 1, 2018

SUBJECT: Sudbury Water District – Test pit results

Test pits were performed at Sudbury Water District located at 199 Raymond Road, Sudbury, MA on May 31, 2018. They were conducted to better understand the subsurface soil and drainage conditions, so that proper precautions could be accounted for during the construction of a building addition and new septic field. The following is a summary of the test pit explorations. Detailed test pit logs and photos are attached to this memorandum. The soil was evaluated by Mark Mariano, of Weston & Sampson, a licensed soil evaluator, SI 13448. The performed test pits were witnessed by Kyle Elmy, of Weston & Sampson.

Five (5) test pits were performed on the site. The test pits were excavated as deep as possible with depths ranging from about 8 feet to 10 feet below ground surface (b.g.s.). Test pits were stopped when standing water was encountered, or the pit wall stability was at risk.

With respect to the site, test pit 1 was located on the right side of the driveway, heading toward the back facility on the western side of the property. Test pit 1 was a loamy sand structure, consistent with glacial stratified deposits. Fill, a loamy sand (Ab), a sandy loam (Bw), and a sandy loam (C1d) were all encountered at this location. The test pit was stopped at 96-inches due to pit stability. It was noted that there were redox features of 2% located at a depth of 58-inches. However, there were no apparent signs of weeping, or standing water within the pit. A percolation test was not performed, and samples were taken at 80-inches below grade.

Test pit 2 was located to the west of test pit 1 further down the driveway heading to the back facility on the right side. Test pit 2 was a loamy sand structure, consistent with glacial stratified deposits. Fill, a loamy sand (Ab), a loamy sand (Bw), a loamy sand (C1), and a medium sand (C2) were all encountered at this location. The test pit was stopped at 108-inches due to pit stability. There were no apparent signs of weeping, redox, or standing water within the pit. A percolation test was not performed, and samples were taken at 70-inches below grade.

Test pit 3 was located to the east of test pit 1 and to the north of the Sudbury water district building, along the entrance driveway. Test pit 3 was a loamy sand structure, consistent with glacial stratified deposits. A loamy sand (Ap), a loamy sand (Bw), and a loamy sand (C) were all encountered at this location. The ground began weeping at a depth of 84-inches, and standing water was encountered at 93-inches. The test pit was stopped at a depth of 103-inches, due to the pit wall stability. It was also noted that there were redox features of 2% located at a depth of 72-inches. A percolation test was not performed, and samples were taken at 80-inches below grade.

Test pit 4 was located to the north of test pit 3 in a small clearing west of Raymond Road and north of the existing building. Test pit 4 was a loamy sand structure, consistent with glacial stratified deposits. A loamy sand (Ap), a loamy sand (Bw), a loamy sand (C1), and a sandy loam (C2) were all encountered at this location. The ground began weeping at a depth of 60-inches, and standing water was encountered at 87-inches. The test pit was stopped at a depth of 103-inches, due to the pit wall stability. It was also noted that there were redox features of 2% located at a depth of 48-inches. A percolation test was performed at a depth of 48-inches below grade. Test pit 4 had a percolation rate of 1 MPI (minutes per inch). Samples were taken at a depth of 48-inches.

Test pit 5 was located to the northwest of test pit 4 in the small field along Raymond Road. Test pit 5 was a loamy sand structure, consistent with glacial stratified deposits. A loamy sand (Ap), a loamy sand (Bw), a loamy sand (C1), and a sandy loam (C2) were all encountered at this location. The ground began weeping at a depth of 80-inches. The test pit was stopped at a depth of 121-inches, due to the pit wall stability. It was also noted that there were redox features of 2% located at a depth of 51-inches. A percolation test was not performed. The Town official agreed that both test pits were identical in material and performing another percolation test was unnecessary. It was agreed to assume both test pits had the same percolation rate of 1 MPI.

The USDA web soil survey indicates that at all test pit locations for this site, 255C Windsor loamy sand with slopes ranging from 8 to 15 percent are present. USDA data also indicates that the depth to restrictive features is estimated to be more than 80-inches with parent material consisting of loose sandy glaciofluvial deposits derived granite, schist or gneiss. The USGS surficial geologic map indicates that in this particular location coarse and fine glacial stratified deposits are present. The test pit data gathered at Sudbury Water District is consistent with the data recorded on the both the USDA and USGS websites. Please refer to the attached maps and test pit results for more information and soil layer ranges.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 1	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	N/A

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION
27"	Fill - (10YR5/3)
42"	Ab - Very dark grey loamy sand (10YR3/1)
60"	Bw - Yellowish brown loamy sand (10YR5/4)
96"	C1d - Grey sandy loam (2.5Y5/1)
	- End of Exploration -

NOTES:

1. Sample taken at 80-inches
2. Redox at 58-inches

TEST PIT NUMBER

TP 1

WESTON & SAMPSON
ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 1	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	N/A

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION

NOTES:

1. Sample taken at 80-inches
2. Redox at 58-inches

TEST PIT NUMBER

TP 1

WESTON & SAMPSON ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 2	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	N/A

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION
36"	Fill (10YR6/6)
48"	Ab - Brown loamy sand (10YR4/3)
67"	Bw - Strong brown loamy sand (7.5YR5/6)
92"	C1 - Yellowish brown loamy sand (10YR 5/6)
108"	C2 - Olive yellow medium sand (2.5YR 6/6)
	- End of Exploration -

NOTES:

1. Sample taken at 70-inches

TEST PIT NUMBER
TP 2

WESTON & SAMPSON ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 2	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	N/A

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION

NOTES:

1. Sample taken at 70-inches

TEST PIT NUMBER

TP 2

WESTON & SAMPSON ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 3	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	84"

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION
12"	Ap - Dark yellowish brown loamy sand (10YR4/4)
19"	Bw - Yellowish Brown loamy sand (10YR5/4)
103"	C - Light brownish grey loamy sand (10YR6/2)
	- End of Exploration -

NOTES:

1. Sample taken at 80-inches
2. Redox at 72-inches
3. Standing at 93-inches

TEST PIT NUMBER

TP 3

WESTON & SAMPSON

ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 3	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	84"

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION

NOTES:

1. Sample taken at 80-inches
2. Redox at 72-inches
3. Standing at 93-inches

TEST PIT NUMBER

TP 3

WESTON & SAMPSON ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 4	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	60"

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION
12"	Ap - Dark yellowish brown loamy sand (10YR4/4)
22"	Bw - Olive Yellow loamy sand (2.5Y6/6)
75"	C1 - Light brownish grey loamy sand (10YR6/2)
103"	C2 - Greyish brown sandy loam (2.5Y5/2)
	- End of Exploration -

NOTES:

1. Sample taken at 48-inches
2. Redox at 48-inches
3. Standing at 87-in

TEST PIT NUMBER
TP 4

WESTON & SAMPSON ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 4	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	60"

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION

NOTES:

1. Sample taken at 48-inches
2. Redox at 48-inches
3. Standing at 87-in

TEST PIT NUMBER

TP 4

WESTON & SAMPSON ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 5	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	80"

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION
12"	Ap - Dark yellowish brown loamy sand (10YR4/6)
36"	Bw - Brownish yellow loamy sand (10YR6/8)
91"	C1 - Light brownish grey loamy sand (2.5Y6/2)
121"	C2 - Greyish brown sandy loam (2.5YR5/2)
	- End of Exploration -

NOTES:

1. Redox at 51-inches

TEST PIT NUMBER

TP 5

WESTON & SAMPSON ENGINEERS, INC.

TEST PIT LOG

PROJECT NAME/NO.	Sudbury Water District - 2170208			**TEST PIT NUMBER**	
LOCATION	Sudbury, MA			TP 5	
CLIENT	Sudbury Water District			GROUND SURFACE	
CONTRACTOR	WSE	FOREMAN:		ELEVATION	see plan
OBSERVED BY	M. Mariano	DATE	5/31/18	DEPTH TO GROUNDWATER BELOW	
CHECKED BY		DATE		SURFACE	80"

DEPTH BELOW GROUND SURFACE (in.)	TEST PIT DIAGRAM AND SOIL DESCRIPTION

NOTES:

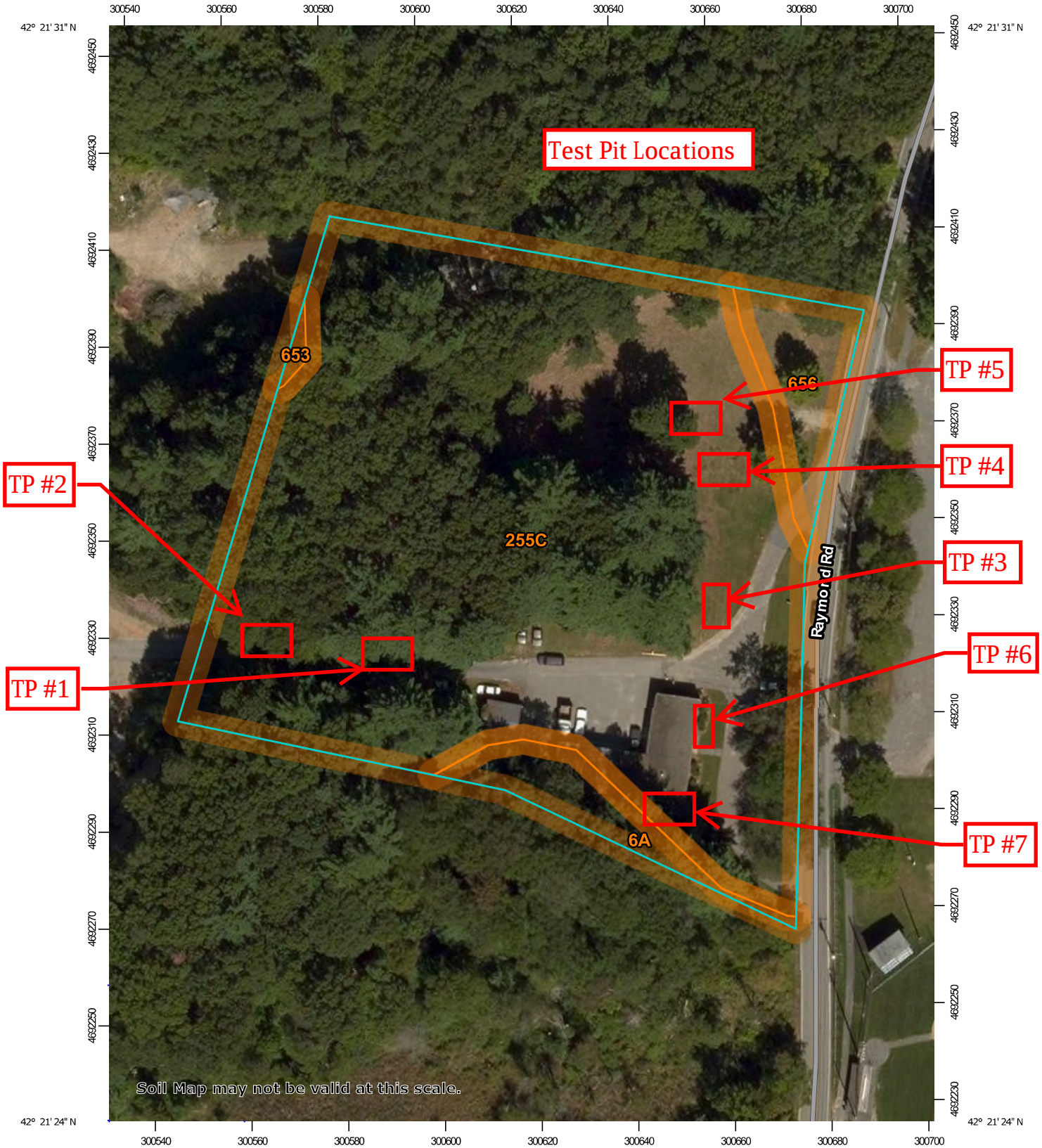
1. Redox at 51-inches

TEST PIT NUMBER

TP 5

WESTON & SAMPSON ENGINEERS, INC.

Soil Map—Middlesex County, Massachusetts
(Sudbury Water District)



Map Scale: 1:1,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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

APPENDIX B

Sudbury Water District Facility
199 Raymond Road, Sudbury, MA

Pre-Development Conditions vs. Post-Development Conditions

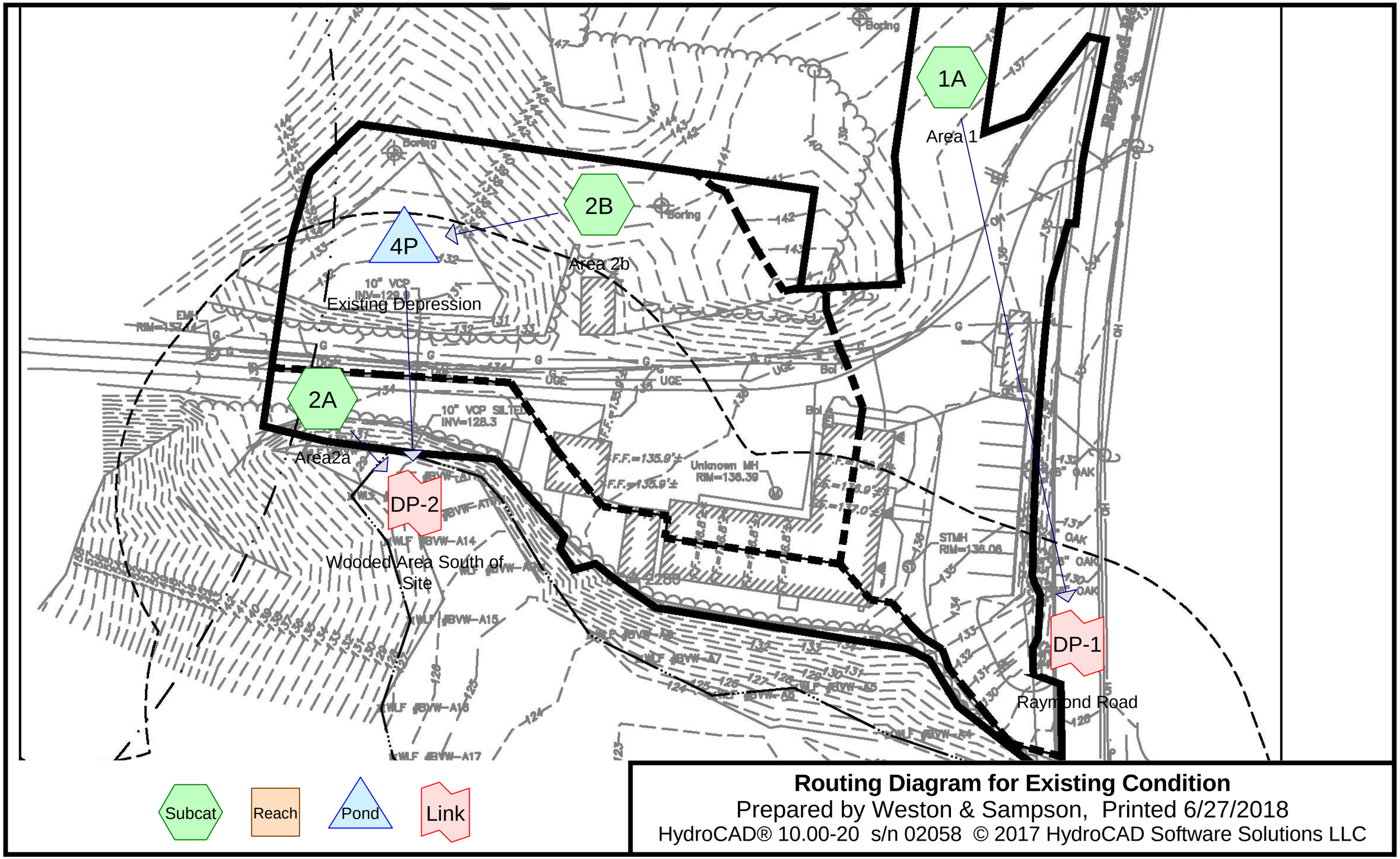
Pre-Development Flows					
Output Subcatchment/Reach	1 inch storm 1.00in Flow (cfs)	2 year storm 3.2 in Flow (cfs)	10 year storm 4.8 in Flow (cfs)	25 year storm 6.0 in Flow (cfs)	100 year storm 8.6 in Flow (cfs)
DP-1 *Raymond Road Gutter*	0	0.43	1.10	1.66	2.96
DP-2 *Wooded Area Southof Site*	0	0.19	0.83	1.43	2.74

Post-Development Flows					
Output Subcatchment/Reach	1 inch storm 1.00in Flow (cfs)	2 year storm 3.2 in Flow (cfs)	10 year storm 4.8 in Flow (cfs)	25 year storm 6.0 in Flow (cfs)	100 year storm 8.6 in Flow (cfs)
DP-1 *Raymond Road Gutter*	0	0.05	0.29	0.55	1.22
DP-2 *Wooded Area Southof Site*	0	0.00	0.41	1.05	2.73

Sudbury Water District Facility
199 Raymond Road, Sudbury, MA

Pre-Development Conditions vs. Post-Development Conditions

Pre-Development Volumes						Post-Development Volumes					
Output Subcatchment/Reach	1 inch storm 1.00in Volume (cf)	2 year storm 3.2 in Volume (cf)	10 year storm 4.8 in Volume (cf)	25 year storm 6.0 in Volume (cf)	100 year storm 8.6 in Volume (cf)	Output Subcatchment/Reach	1 inch storm 1.00in Volume (cf)	2 year storm 3.2 in Volume (cf)	10 year storm 4.8 in Volume (cf)	25 year storm 6.0 in Volume (cf)	100 year storm 8.6 in Volume (cf)
DP-1 *Raymond Road Gutter*	9	1645.00	3755.00	5577.00	9910.00	DP-1 *Raymond Road Gutter*	0	375.00	1212.00	2032.00	4166.00
DP-2 *Wooded Area Southof Site*	0	1266.00	3674.00	5954.00	11745.00	DP-2 *Wooded Area Southof Site*	0	69.00	1859.00	4568.00	11492.00



Routing Diagram for Existing Condition

Prepared by Weston & Sampson, Printed 6/27/2018

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
22,440	49	50-75% Grass cover, Fair, HSG A (1A, 2A, 2B)
16,818	98	Paved parking, HSG A (1A, 2A, 2B)
1,254	98	Roofs, HSG A (1A)
4,799	98	Unconnected roofs, HSG A (2A, 2B)
15,904	36	Woods, Fair, HSG A (1A, 2A, 2B)
61,215	**64**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
61,215	HSG A	1A, 2A, 2B
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
61,215		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
22,440	0	0	0	0	22,440	50-75% Grass cover, Fair	
16,818	0	0	0	0	16,818	Paved parking	
1,254	0	0	0	0	1,254	Roofs	
4,799	0	0	0	0	4,799	Unconnected roofs	
15,904	0	0	0	0	15,904	Woods, Fair	
61,215	**0**	**0**	**0**	**0**	**61,215**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	4P	130.00	128.30	57.0	0.0298	0.013	10.0	0.0	0.0

Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Area 1 Runoff Area=23,889 sf 44.23% Impervious Runoff Depth>0.00"
Flow Length=405' Tc=7.9 min CN=70 Runoff=0.00 cfs 9 cf

Subcatchment 2A: Area2a Runoff Area=8,886 sf 33.14% Impervious Runoff Depth=0.00"
Flow Length=75' Tc=7.8 min CN=63 Runoff=0.00 cfs 0 cf

Subcatchment 2B: Area 2b Runoff Area=28,440 sf 32.91% Impervious Runoff Depth=0.00"
Flow Length=159' Tc=10.9 min CN=59 Runoff=0.00 cfs 0 cf

Pond 4P: Existing Depression Peak Elev=130.00' Storage=0 cf Inflow=0.00 cfs 0 cf
10.0" Round Culvert n=0.013 L=57.0' S=0.0298 '/' Outflow=0.00 cfs 0 cf

Link DP-1: Raymond Road Inflow=0.00 cfs 9 cf
Primary=0.00 cfs 9 cf

Link DP-2: Wooded Area South of Site Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 61,215 sf Runoff Volume = 9 cf Average Runoff Depth = 0.00"
62.64% Pervious = 38,344 sf 37.36% Impervious = 22,871 sf

Summary for Subcatchment 1A: Area 1

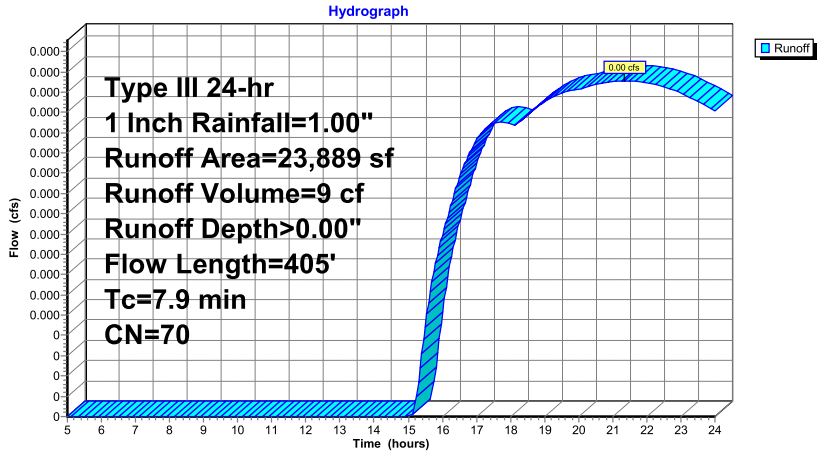
Runoff = 0.00 cfs @ 21.34 hrs, Volume= 9 cf, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Inch Rainfall=1.00"

Area (sf)	CN	Description
12,194	49	50-75% Grass cover, Fair, HSG A
9,313	98	Paved parking, HSG A
1,254	98	Roofs, HSG A
1,128	36	Woods, Fair, HSG A
23,889	70	Weighted Average
13,322		55.77% Pervious Area
10,567		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Road Gutter Line** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1A: Area 1



Summary for Subcatchment 2A: Area2a

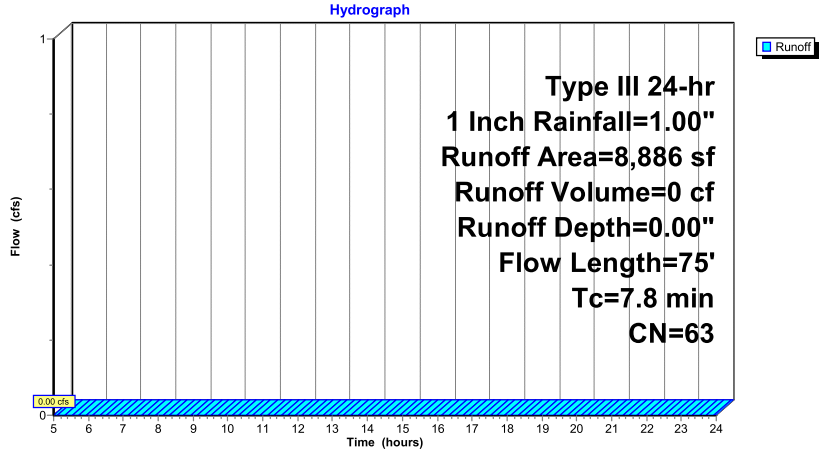
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Inch Rainfall=1.00"

Area (sf)	CN	Description
4,667	49	50-75% Grass cover, Fair, HSG A
783	98	Paved parking, HSG A
2,162	98	Unconnected roofs, HSG A
1,274	36	Woods, Fair, HSG A
8,886	63	Weighted Average
5,941		66.86% Pervious Area
2,945		33.14% Impervious Area
2,162		73.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area2a



Summary for Subcatchment 2B: Area 2b

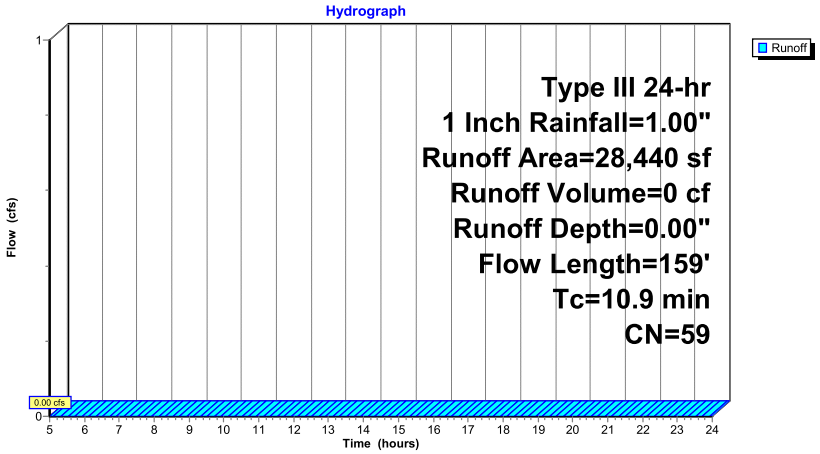
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Inch Rainfall=1.00"

Area (sf)	CN	Description
5,579	49	50-75% Grass cover, Fair, HSG A
6,722	98	Paved parking, HSG A
2,637	98	Unconnected roofs, HSG A
13,502	36	Woods, Fair, HSG A
28,440	59	Weighted Average
19,081		67.09% Pervious Area
9,359		32.91% Impervious Area
2,637		28.18% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	65	0.1080	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	35	0.0700	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.4	35	0.0430	1.45		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	24	0.1670	2.04		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	159	Total			

Subcatchment 2B: Area 2b



Summary for Pond 4P: Existing Depression

Inflow Area = 28,440 sf, 32.91% Impervious, Inflow Depth = 0.00" for 1 Inch event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 130.00' @ 5.00 hrs Surf.Area= 1 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

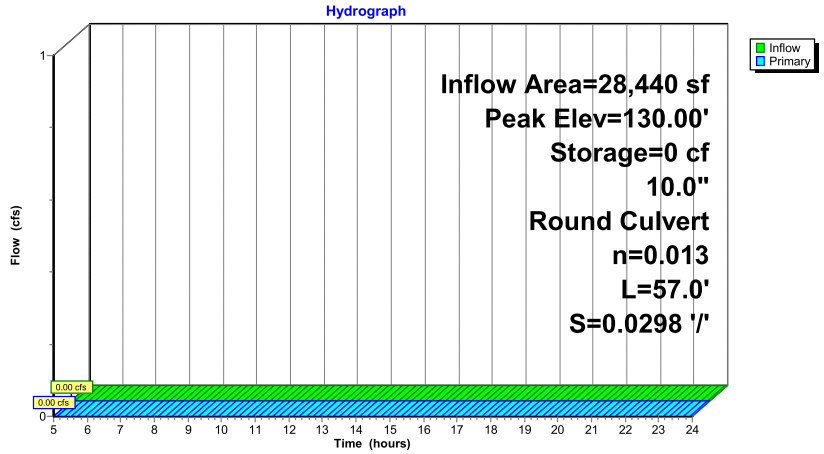
Volume	Invert	Avail.Storage	Storage Description
#1	130.00'	9,528 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
130.00	1	0	0
131.00	676	339	339
132.00	2,196	1,436	1,775
133.00	3,747	2,972	4,746
134.00	5,817	4,782	9,528

Device	Routing	Invert	Outlet Devices
#1	Primary	130.00'	**10.0" Round Culvert** L= 57.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 130.00' / 128.30' S= 0.0298 '/' Cc= 0.900 n= 0.013 Clay tile, Flow Area= 0.55 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=130.00' (Free Discharge)
1=Culvert (Controls 0.00 cfs)

Pond 4P: Existing Depression

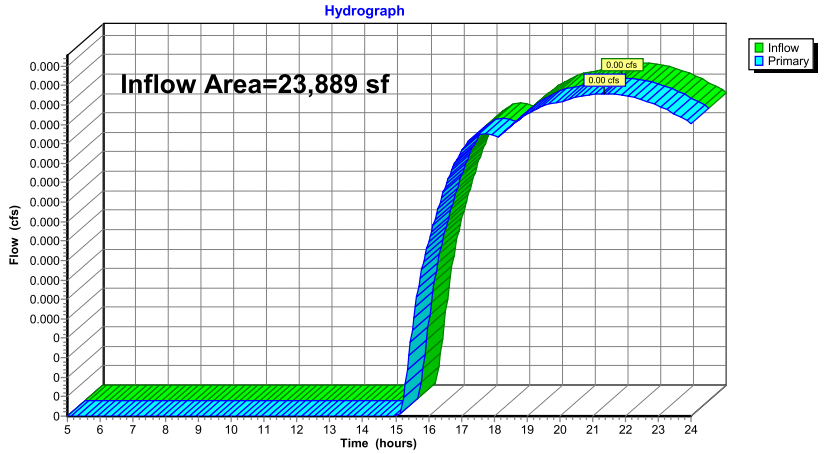


Summary for Link DP-1: Raymond Road

Inflow Area = 23,889 sf, 44.23% Impervious, Inflow Depth > 0.00" for 1 Inch event
Inflow = 0.00 cfs @ 21.34 hrs, Volume= 9 cf
Primary = 0.00 cfs @ 21.34 hrs, Volume= 9 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: Raymond Road

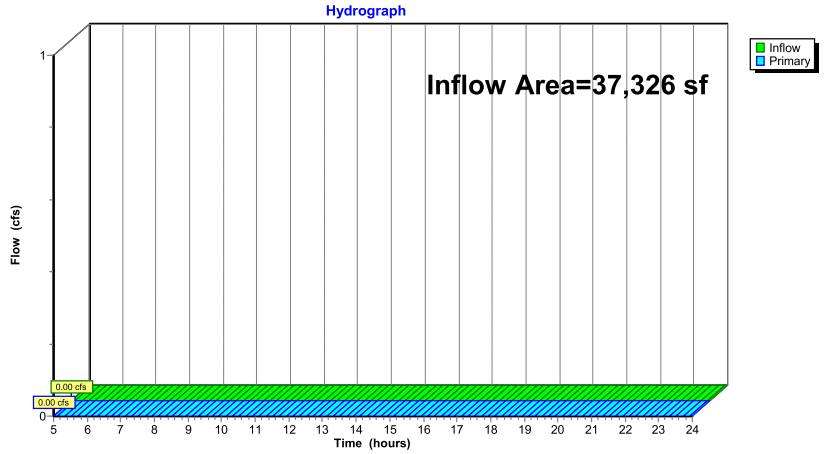


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 37,326 sf, 32.96% Impervious, Inflow Depth = 0.00" for 1 Inch event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Area 1 Runoff Area=23,889 sf 44.23% Impervious Runoff Depth>0.83"
Flow Length=405' Tc=7.9 min CN=70 Runoff=0.43 cfs 1,645 cf

Subcatchment 2A: Area2a Runoff Area=8,886 sf 33.14% Impervious Runoff Depth>0.52"
Flow Length=75' Tc=7.8 min CN=63 Runoff=0.08 cfs 384 cf

Subcatchment 2B: Area 2b Runoff Area=28,440 sf 32.91% Impervious Runoff Depth>0.37"
Flow Length=159' Tc=10.9 min CN=59 Runoff=0.13 cfs 883 cf

Pond 4P: Existing Depression Peak Elev=130.18' Storage=11 cf Inflow=0.13 cfs 883 cf
10.0" Round Culvert n=0.013 L=57.0' S=0.0298 '/' Outflow=0.13 cfs 883 cf

Link DP-1: Raymond Road Inflow=0.43 cfs 1,645 cf
Primary=0.43 cfs 1,645 cf

Link DP-2: Wooded Area South of Site Inflow=0.19 cfs 1,266 cf
Primary=0.19 cfs 1,266 cf

Total Runoff Area = 61,215 sf Runoff Volume = 2,912 cf Average Runoff Depth = 0.57"
62.64% Pervious = 38,344 sf 37.36% Impervious = 22,871 sf

Summary for Subcatchment 1A: Area 1

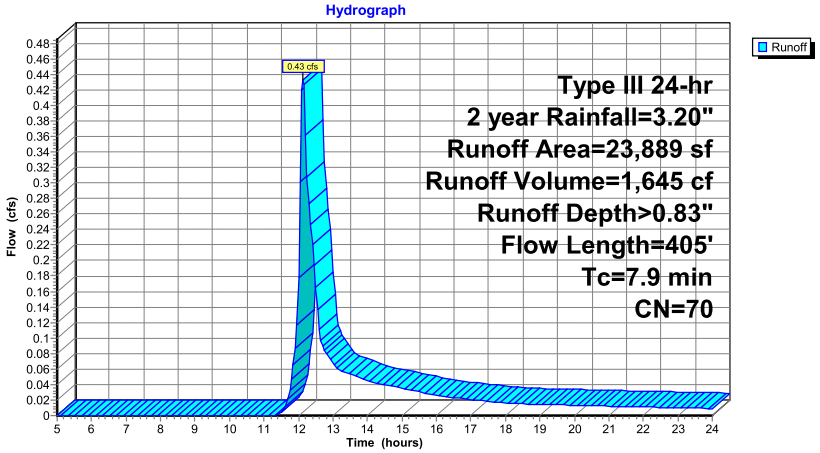
Runoff = 0.43 cfs @ 12.13 hrs, Volume= 1,645 cf, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
12,194	49	50-75% Grass cover, Fair, HSG A
9,313	98	Paved parking, HSG A
1,254	98	Roofs, HSG A
1,128	36	Woods, Fair, HSG A
23,889	70	Weighted Average
13,322		55.77% Pervious Area
10,567		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Road Gutter Line** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1A: Area 1



Summary for Subcatchment 2A: Area2a

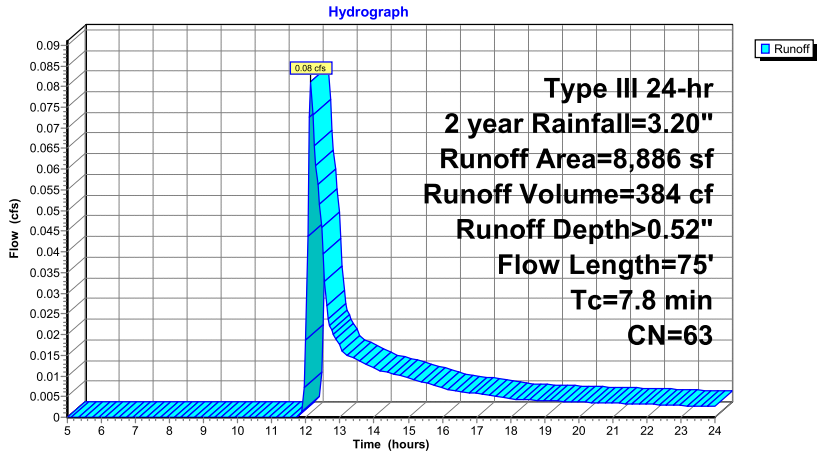
Runoff = 0.08 cfs @ 12.15 hrs, Volume= 384 cf, Depth> 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
4,667	49	50-75% Grass cover, Fair, HSG A
783	98	Paved parking, HSG A
2,162	98	Unconnected roofs, HSG A
1,274	36	Woods, Fair, HSG A
8,886	63	Weighted Average
5,941		66.86% Pervious Area
2,945		33.14% Impervious Area
2,162		73.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area2a



Summary for Subcatchment 2B: Area 2b

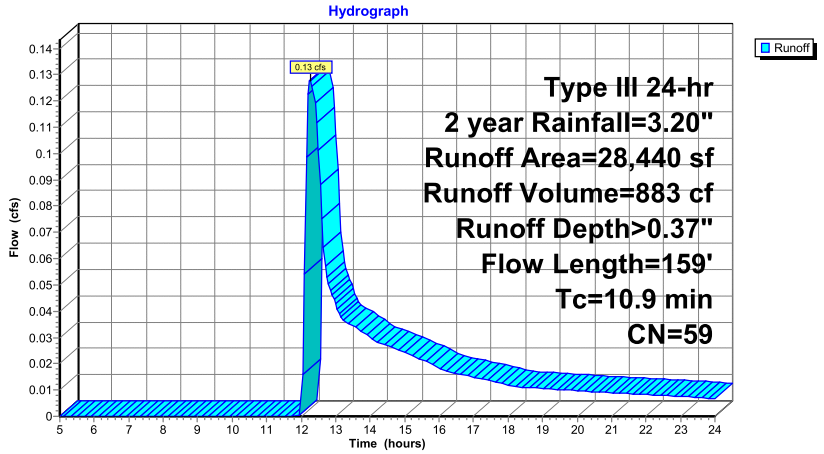
Runoff = 0.13 cfs @ 12.27 hrs, Volume= 883 cf, Depth> 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
5,579	49	50-75% Grass cover, Fair, HSG A
6,722	98	Paved parking, HSG A
2,637	98	Unconnected roofs, HSG A
13,502	36	Woods, Fair, HSG A
28,440	59	Weighted Average
19,081		67.09% Pervious Area
9,359		32.91% Impervious Area
2,637		28.18% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	65	0.1080	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	35	0.0700	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.4	35	0.0430	1.45		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	24	0.1670	2.04		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	159	Total			

Subcatchment 2B: Area 2b



Summary for Pond 4P: Existing Depression

Inflow Area = 28,440 sf, 32.91% Impervious, Inflow Depth > 0.37" for 2 year event
Inflow = 0.13 cfs @ 12.27 hrs, Volume= 883 cf
Outflow = 0.13 cfs @ 12.30 hrs, Volume= 883 cf, Atten= 1%, Lag= 2.1 min
Primary = 0.13 cfs @ 12.30 hrs, Volume= 883 cf

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 130.18' @ 12.30 hrs Surf.Area= 123 sf Storage= 11 cf

Plug-Flow detention time= 1.5 min calculated for 880 cf (100% of inflow)
Center-of-Mass det. time= 1.1 min (930.0 - 928.9)

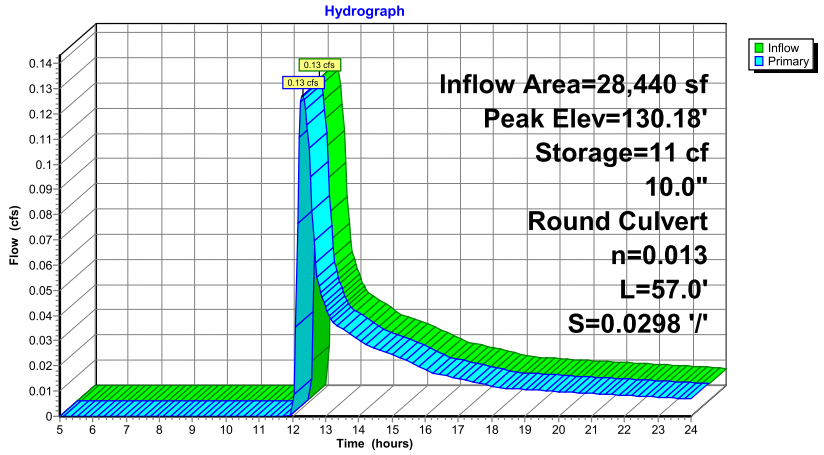
Volume	Invert	Avail.Storage	Storage Description
#1	130.00'	9,528 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
130.00	1	0	0
131.00	676	339	339
132.00	2,196	1,436	1,775
133.00	3,747	2,972	4,746
134.00	5,817	4,782	9,528

Device	Routing	Invert	Outlet Devices
#1	Primary	130.00'	**10.0" Round Culvert** L= 57.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 130.00' / 128.30' S= 0.0298 '/' Cc= 0.900 n= 0.013 Clay tile, Flow Area= 0.55 sf

Primary OutFlow Max=0.13 cfs @ 12.30 hrs HW=130.18' (Free Discharge)
↳**1=Culvert** (Inlet Controls 0.13 cfs @ 1.45 fps)

Pond 4P: Existing Depression

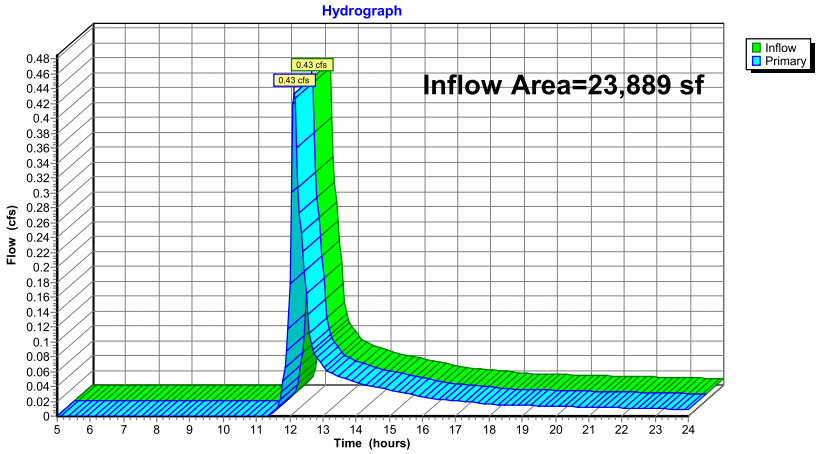


Summary for Link DP-1: Raymond Road

Inflow Area = 23,889 sf, 44.23% Impervious, Inflow Depth > 0.83" for 2 year event
Inflow = 0.43 cfs @ 12.13 hrs, Volume= 1,645 cf
Primary = 0.43 cfs @ 12.13 hrs, Volume= 1,645 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: Raymond Road

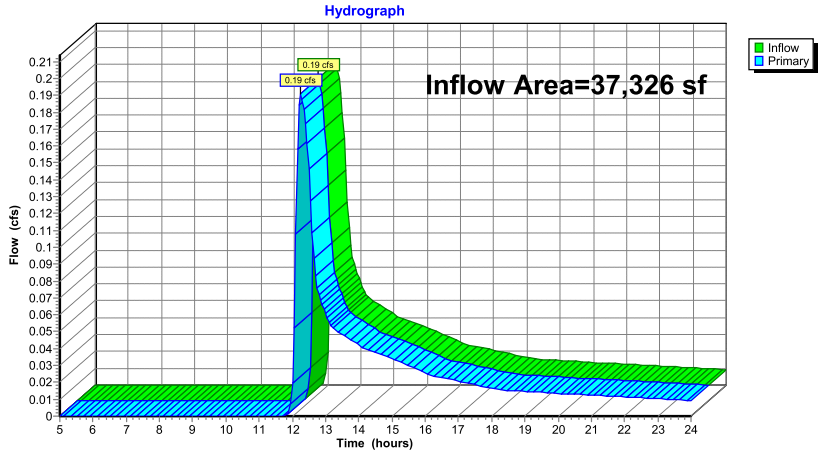


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 37,326 sf, 32.96% Impervious, Inflow Depth > 0.41" for 2 year event
Inflow = 0.19 cfs @ 12.26 hrs, Volume= 1,266 cf
Primary = 0.19 cfs @ 12.26 hrs, Volume= 1,266 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Area 1 Runoff Area=23,889 sf 44.23% Impervious Runoff Depth>1.89"
Flow Length=405' Tc=7.9 min CN=70 Runoff=1.10 cfs 3,755 cf

Subcatchment 2A: Area2a Runoff Area=8,886 sf 33.14% Impervious Runoff Depth>1.38"
Flow Length=75' Tc=7.8 min CN=63 Runoff=0.28 cfs 1,023 cf

Subcatchment 2B: Area 2b Runoff Area=28,440 sf 32.91% Impervious Runoff Depth>1.12"
Flow Length=159' Tc=10.9 min CN=59 Runoff=0.62 cfs 2,653 cf

Pond 4P: Existing Depression Peak Elev=130.42' Storage=59 cf Inflow=0.62 cfs 2,653 cf
10.0" Round Culvert n=0.013 L=57.0' S=0.0298 '/' Outflow=0.60 cfs 2,651 cf

Link DP-1: Raymond Road Inflow=1.10 cfs 3,755 cf
Primary=1.10 cfs 3,755 cf

Link DP-2: Wooded Area South of Site Inflow=0.83 cfs 3,674 cf
Primary=0.83 cfs 3,674 cf

Total Runoff Area = 61,215 sf Runoff Volume = 7,431 cf Average Runoff Depth = 1.46"
62.64% Pervious = 38,344 sf 37.36% Impervious = 22,871 sf

Summary for Subcatchment 1A: Area 1

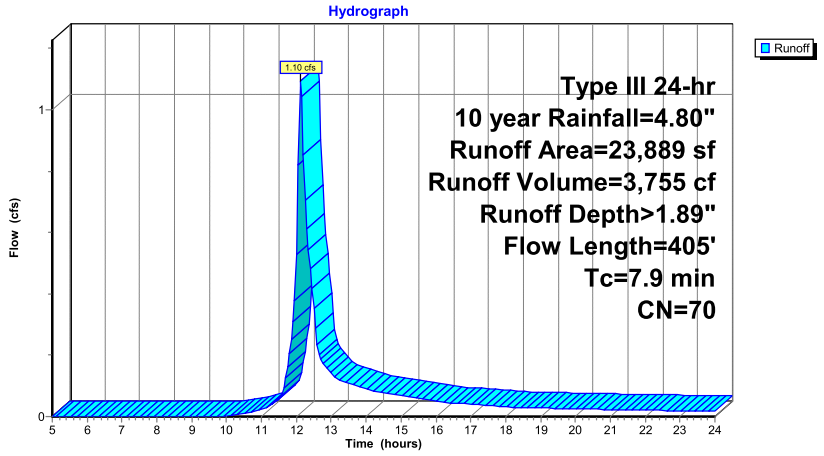
Runoff = 1.10 cfs @ 12.12 hrs, Volume= 3,755 cf, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.80"

Area (sf)	CN	Description
12,194	49	50-75% Grass cover, Fair, HSG A
9,313	98	Paved parking, HSG A
1,254	98	Roofs, HSG A
1,128	36	Woods, Fair, HSG A
23,889	70	Weighted Average
13,322		55.77% Pervious Area
10,567		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Road Gutter Line** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1A: Area 1



Summary for Subcatchment 2A: Area2a

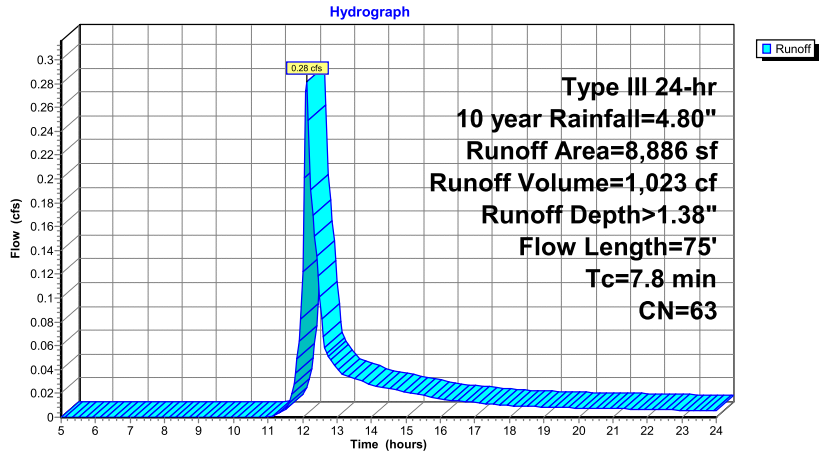
Runoff = 0.28 cfs @ 12.12 hrs, Volume= 1,023 cf, Depth> 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.80"

Area (sf)	CN	Description
4,667	49	50-75% Grass cover, Fair, HSG A
783	98	Paved parking, HSG A
2,162	98	Unconnected roofs, HSG A
1,274	36	Woods, Fair, HSG A
8,886	63	Weighted Average
5,941		66.86% Pervious Area
2,945		33.14% Impervious Area
2,162		73.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area2a



Summary for Subcatchment 2B: Area 2b

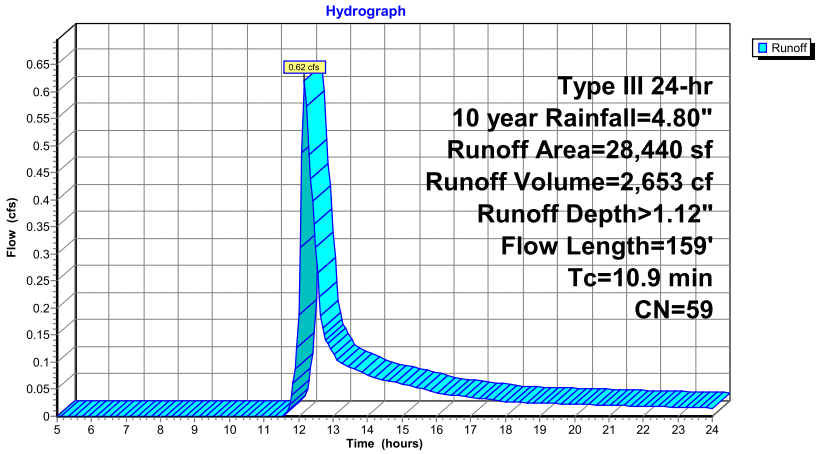
Runoff = 0.62 cfs @ 12.17 hrs, Volume= 2,653 cf, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.80"

Area (sf)	CN	Description
5,579	49	50-75% Grass cover, Fair, HSG A
6,722	98	Paved parking, HSG A
2,637	98	Unconnected roofs, HSG A
13,502	36	Woods, Fair, HSG A
28,440	59	Weighted Average
19,081		67.09% Pervious Area
9,359		32.91% Impervious Area
2,637		28.18% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	65	0.1080	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	35	0.0700	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.4	35	0.0430	1.45		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	24	0.1670	2.04		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	159	Total			

Subcatchment 2B: Area 2b



Summary for Pond 4P: Existing Depression

Inflow Area = 28,440 sf, 32.91% Impervious, Inflow Depth > 1.12" for 10 year event
Inflow = 0.62 cfs @ 12.17 hrs, Volume= 2,653 cf
Outflow = 0.60 cfs @ 12.21 hrs, Volume= 2,651 cf, Atten= 3%, Lag= 2.3 min
Primary = 0.60 cfs @ 12.21 hrs, Volume= 2,651 cf

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 130.42' @ 12.21 hrs Surf.Area= 283 sf Storage= 59 cf

Plug-Flow detention time= 1.5 min calculated for 2,645 cf (100% of inflow)
Center-of-Mass det. time= 1.2 min (886.0 - 884.8)

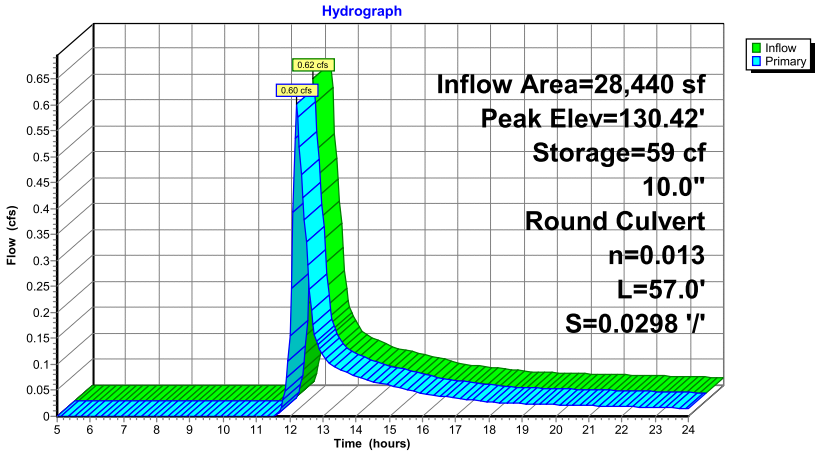
Volume	Invert	Avail.Storage	Storage Description
#1	130.00'	9,528 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
130.00	1	0	0
131.00	676	339	339
132.00	2,196	1,436	1,775
133.00	3,747	2,972	4,746
134.00	5,817	4,782	9,528

Device	Routing	Invert	Outlet Devices
#1	Primary	130.00'	**10.0" Round Culvert** L= 57.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 130.00' / 128.30' S= 0.0298 '/' Cc= 0.900 n= 0.013 Clay tile, Flow Area= 0.55 sf

Primary OutFlow Max=0.59 cfs @ 12.21 hrs HW=130.41' (Free Discharge)
1=Culvert (Inlet Controls 0.59 cfs @ 2.19 fps)

Pond 4P: Existing Depression

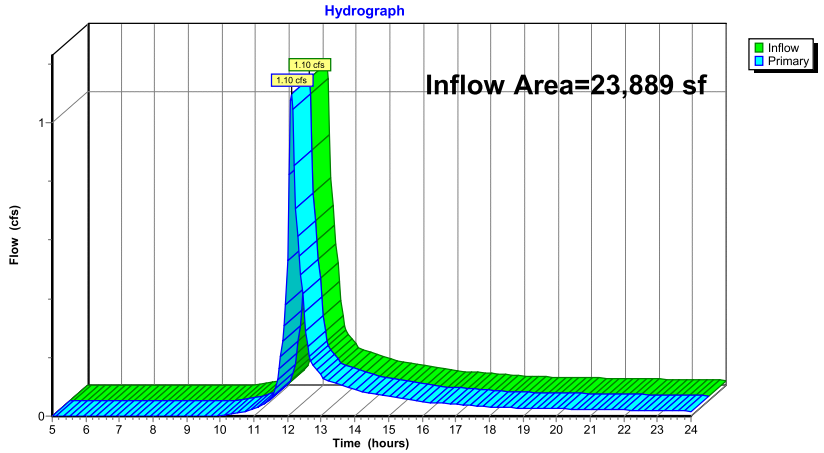


Summary for Link DP-1: Raymond Road

Inflow Area = 23,889 sf, 44.23% Impervious, Inflow Depth > 1.89" for 10 year event
Inflow = 1.10 cfs @ 12.12 hrs, Volume= 3,755 cf
Primary = 1.10 cfs @ 12.12 hrs, Volume= 3,755 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: Raymond Road

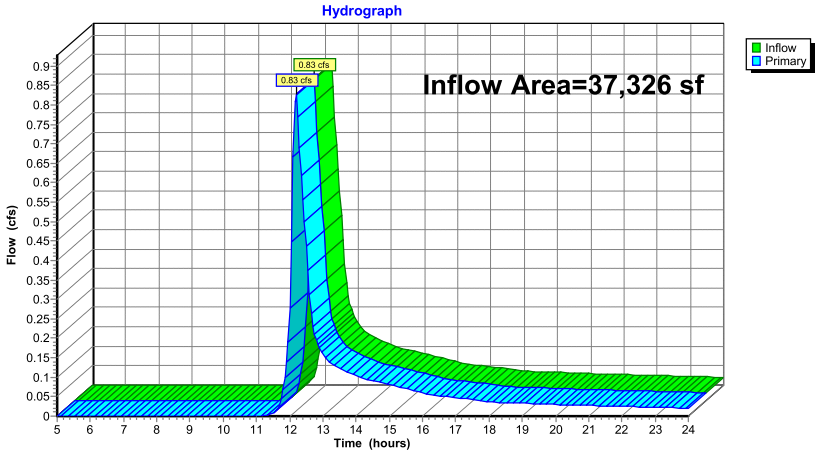


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 37,326 sf, 32.96% Impervious, Inflow Depth > 1.18" for 10 year event
Inflow = 0.83 cfs @ 12.19 hrs, Volume= 3,674 cf
Primary = 0.83 cfs @ 12.19 hrs, Volume= 3,674 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Area 1 Runoff Area=23,889 sf 44.23% Impervious Runoff Depth>2.80"
Flow Length=405' Tc=7.9 min CN=70 Runoff=1.66 cfs 5,577 cf

Subcatchment 2A: Area2a Runoff Area=8,886 sf 33.14% Impervious Runoff Depth>2.17"
Flow Length=75' Tc=7.8 min CN=63 Runoff=0.47 cfs 1,609 cf

Subcatchment 2B: Area 2b Runoff Area=28,440 sf 32.91% Impervious Runoff Depth>1.83"
Flow Length=159' Tc=10.9 min CN=59 Runoff=1.11 cfs 4,346 cf

Pond 4P: Existing Depression Peak Elev=130.58' Storage=115 cf Inflow=1.11 cfs 4,346 cf
10.0" Round Culvert n=0.013 L=57.0' S=0.0298 '/' Outflow=1.06 cfs 4,345 cf

Link DP-1: Raymond Road Inflow=1.66 cfs 5,577 cf
Primary=1.66 cfs 5,577 cf

Link DP-2: Wooded Area South of Site Inflow=1.43 cfs 5,954 cf
Primary=1.43 cfs 5,954 cf

Total Runoff Area = 61,215 sf Runoff Volume = 11,532 cf Average Runoff Depth = 2.26"
62.64% Pervious = 38,344 sf 37.36% Impervious = 22,871 sf

Summary for Subcatchment 1A: Area 1

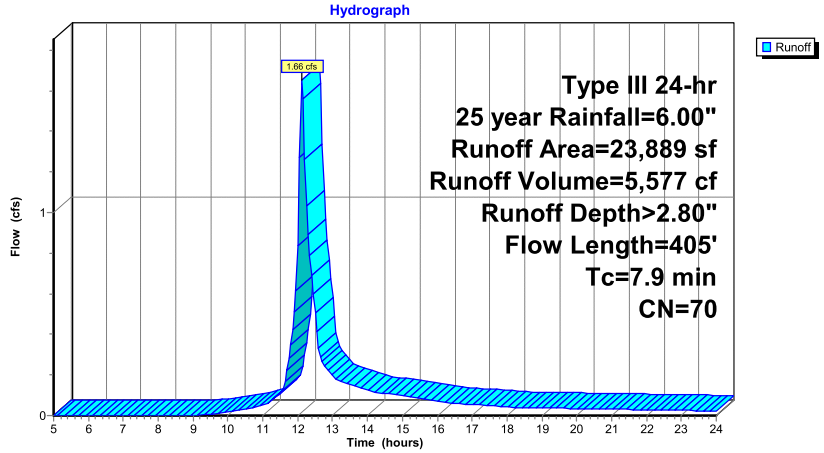
Runoff = 1.66 cfs @ 12.12 hrs, Volume= 5,577 cf, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=6.00"

Area (sf)	CN	Description
12,194	49	50-75% Grass cover, Fair, HSG A
9,313	98	Paved parking, HSG A
1,254	98	Roofs, HSG A
1,128	36	Woods, Fair, HSG A
23,889	70	Weighted Average
13,322		55.77% Pervious Area
10,567		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Road Gutter Line** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1A: Area 1



Summary for Subcatchment 2A: Area2a

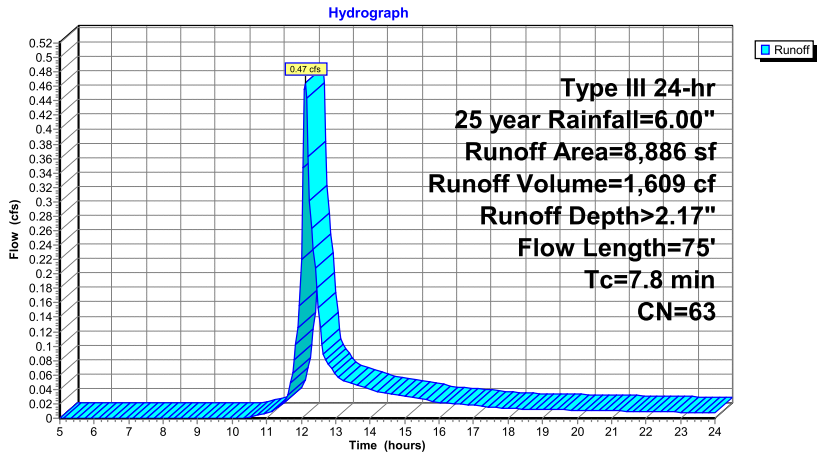
Runoff = 0.47 cfs @ 12.12 hrs, Volume= 1,609 cf, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=6.00"

Area (sf)	CN	Description
4,667	49	50-75% Grass cover, Fair, HSG A
783	98	Paved parking, HSG A
2,162	98	Unconnected roofs, HSG A
1,274	36	Woods, Fair, HSG A
8,886	63	Weighted Average
5,941		66.86% Pervious Area
2,945		33.14% Impervious Area
2,162		73.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area2a



Summary for Subcatchment 2B: Area 2b

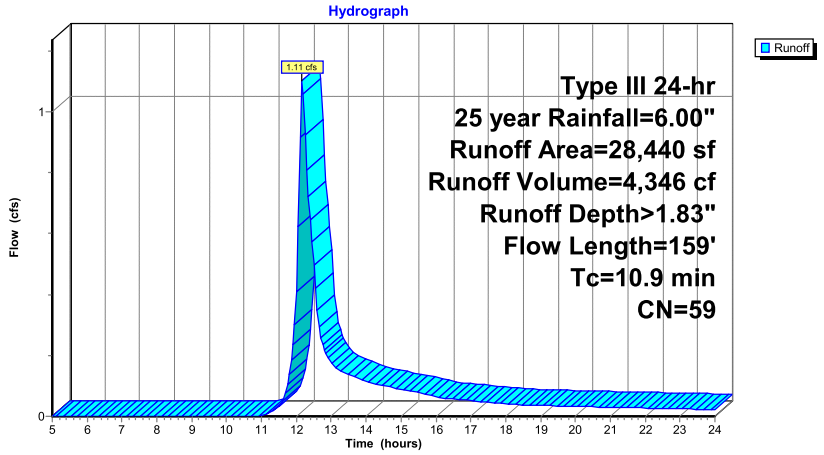
Runoff = 1.11 cfs @ 12.17 hrs, Volume= 4,346 cf, Depth> 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=6.00"

Area (sf)	CN	Description
5,579	49	50-75% Grass cover, Fair, HSG A
6,722	98	Paved parking, HSG A
2,637	98	Unconnected roofs, HSG A
13,502	36	Woods, Fair, HSG A
28,440	59	Weighted Average
19,081		67.09% Pervious Area
9,359		32.91% Impervious Area
2,637		28.18% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	65	0.1080	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	35	0.0700	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.4	35	0.0430	1.45		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	24	0.1670	2.04		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	159	Total			

Subcatchment 2B: Area 2b



Summary for Pond 4P: Existing Depression

Inflow Area = 28,440 sf, 32.91% Impervious, Inflow Depth > 1.83" for 25 year event
Inflow = 1.11 cfs @ 12.17 hrs, Volume= 4,346 cf
Outflow = 1.06 cfs @ 12.21 hrs, Volume= 4,345 cf, Atten= 4%, Lag= 2.4 min
Primary = 1.06 cfs @ 12.21 hrs, Volume= 4,345 cf

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 130.58' @ 12.21 hrs Surf.Area= 394 sf Storage= 115 cf

Plug-Flow detention time= 1.6 min calculated for 4,333 cf (100% of inflow)
Center-of-Mass det. time= 1.3 min (869.9 - 868.6)

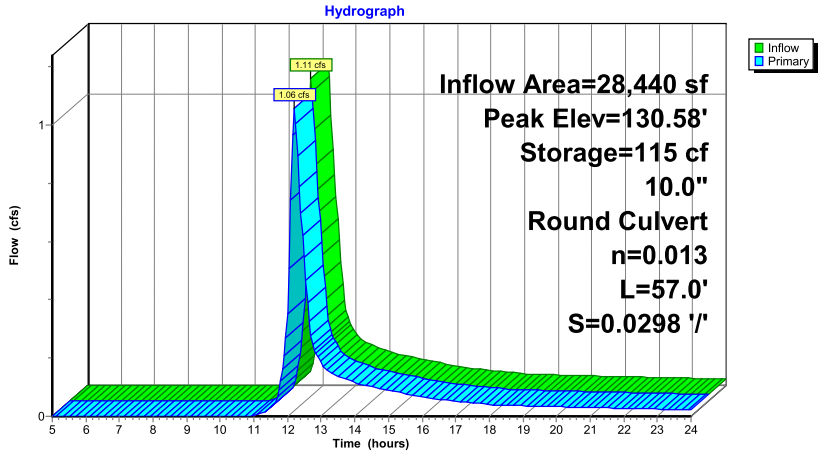
Volume	Invert	Avail.Storage	Storage Description
#1	130.00'	9,528 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
130.00	1	0	0
131.00	676	339	339
132.00	2,196	1,436	1,775
133.00	3,747	2,972	4,746
134.00	5,817	4,782	9,528

Device	Routing	Invert	Outlet Devices
#1	Primary	130.00'	**10.0" Round Culvert** L= 57.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 130.00' / 128.30' S= 0.0298 '/' Cc= 0.900 n= 0.013 Clay tile, Flow Area= 0.55 sf

Primary OutFlow Max=1.05 cfs @ 12.21 hrs HW=130.58' (Free Discharge)
↳**1=Culvert** (Inlet Controls 1.05 cfs @ 2.59 fps)

Pond 4P: Existing Depression

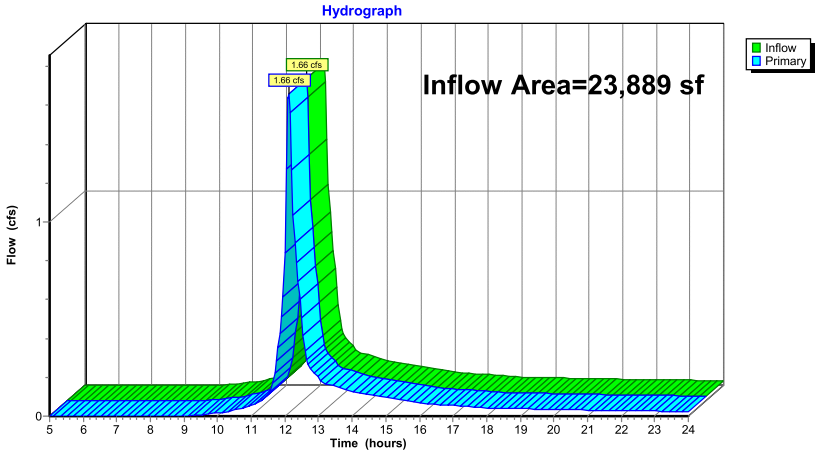


Summary for Link DP-1: Raymond Road

Inflow Area = 23,889 sf, 44.23% Impervious, Inflow Depth > 2.80" for 25 year event
Inflow = 1.66 cfs @ 12.12 hrs, Volume= 5,577 cf
Primary = 1.66 cfs @ 12.12 hrs, Volume= 5,577 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: Raymond Road

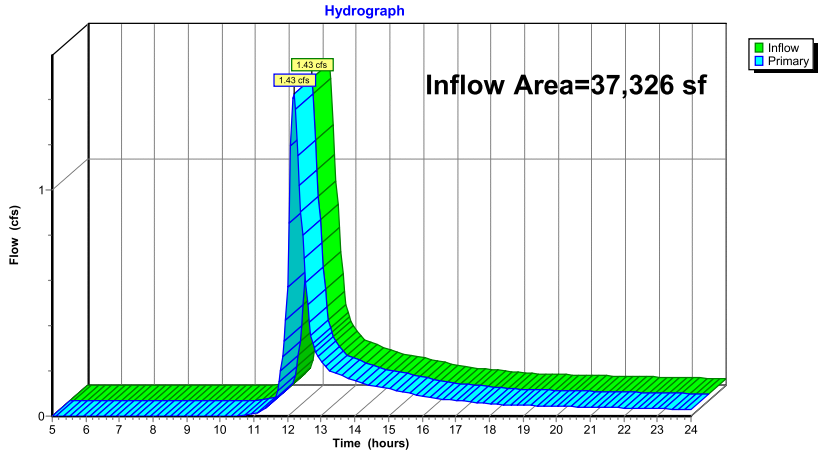


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 37,326 sf, 32.96% Impervious, Inflow Depth > 1.91" for 25 year event
Inflow = 1.43 cfs @ 12.18 hrs, Volume= 5,954 cf
Primary = 1.43 cfs @ 12.18 hrs, Volume= 5,954 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Area 1 Runoff Area=23,889 sf 44.23% Impervious Runoff Depth>4.98"
Flow Length=405' Tc=7.9 min CN=70 Runoff=2.96 cfs 9,910 cf

Subcatchment 2A: Area2a Runoff Area=8,886 sf 33.14% Impervious Runoff Depth>4.14"
Flow Length=75' Tc=7.8 min CN=63 Runoff=0.92 cfs 3,066 cf

Subcatchment 2B: Area 2b Runoff Area=28,440 sf 32.91% Impervious Runoff Depth>3.66"
Flow Length=159' Tc=10.9 min CN=59 Runoff=2.33 cfs 8,682 cf

Pond 4P: Existing Depression Peak Elev=131.01' Storage=348 cf Inflow=2.33 cfs 8,682 cf
10.0" Round Culvert n=0.013 L=57.0' S=0.0298 '/' Outflow=2.03 cfs 8,679 cf

Link DP-1: Raymond Road Inflow=2.96 cfs 9,910 cf
Primary=2.96 cfs 9,910 cf

Link DP-2: Wooded Area South of Site Inflow=2.74 cfs 11,745 cf
Primary=2.74 cfs 11,745 cf

Total Runoff Area = 61,215 sf Runoff Volume = 21,658 cf Average Runoff Depth = 4.25"
62.64% Pervious = 38,344 sf 37.36% Impervious = 22,871 sf

Summary for Subcatchment 1A: Area 1

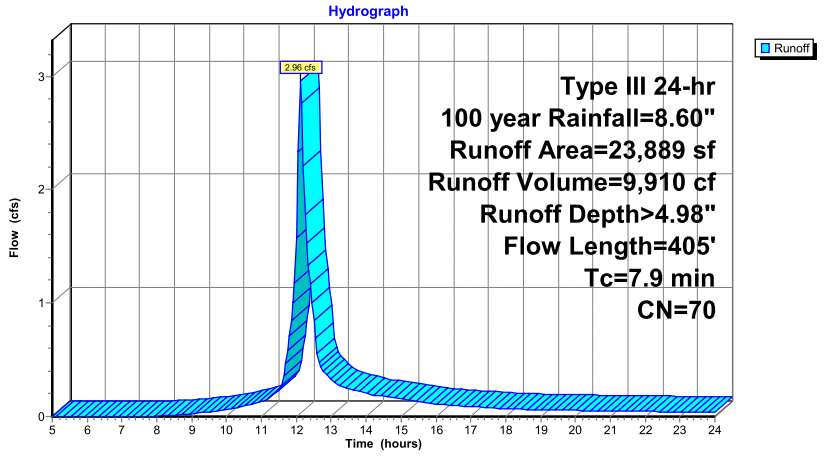
Runoff = 2.96 cfs @ 12.11 hrs, Volume= 9,910 cf, Depth> 4.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=8.60"

Area (sf)	CN	Description
12,194	49	50-75% Grass cover, Fair, HSG A
9,313	98	Paved parking, HSG A
1,254	98	Roofs, HSG A
1,128	36	Woods, Fair, HSG A
23,889	70	Weighted Average
13,322		55.77% Pervious Area
10,567		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Road Gutter Line** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1A: Area 1



Summary for Subcatchment 2A: Area2a

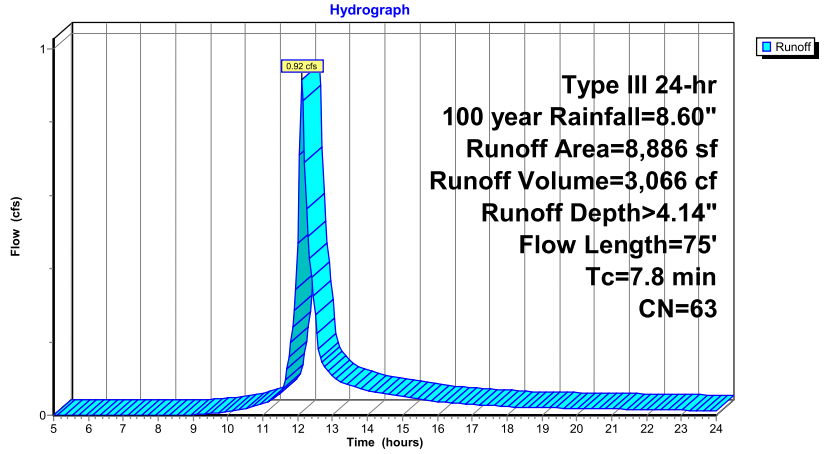
Runoff = 0.92 cfs @ 12.12 hrs, Volume= 3,066 cf, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=8.60"

Area (sf)	CN	Description
4,667	49	50-75% Grass cover, Fair, HSG A
783	98	Paved parking, HSG A
2,162	98	Unconnected roofs, HSG A
1,274	36	Woods, Fair, HSG A
8,886	63	Weighted Average
5,941		66.86% Pervious Area
2,945		33.14% Impervious Area
2,162		73.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area2a



Summary for Subcatchment 2B: Area 2b

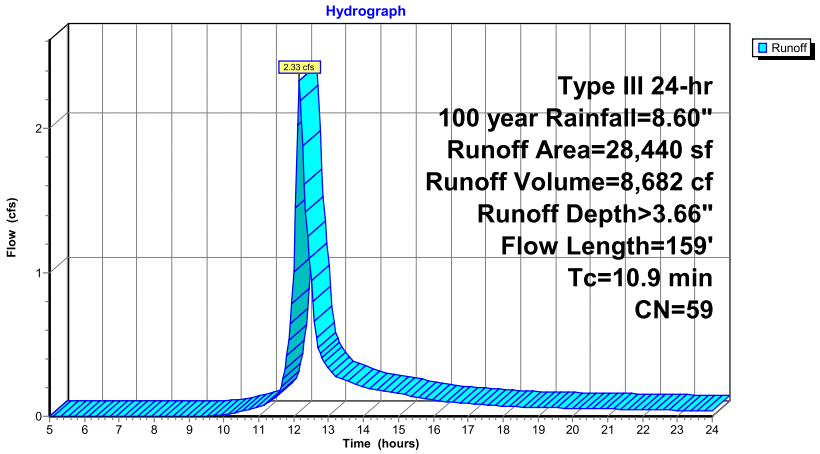
Runoff = 2.33 cfs @ 12.16 hrs, Volume= 8,682 cf, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=8.60"

Area (sf)	CN	Description
5,579	49	50-75% Grass cover, Fair, HSG A
6,722	98	Paved parking, HSG A
2,637	98	Unconnected roofs, HSG A
13,502	36	Woods, Fair, HSG A
28,440	59	Weighted Average
19,081		67.09% Pervious Area
9,359		32.91% Impervious Area
2,637		28.18% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	65	0.1080	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.6	35	0.0700	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.4	35	0.0430	1.45		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	24	0.1670	2.04		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	159	Total			

Subcatchment 2B: Area 2b



Summary for Pond 4P: Existing Depression

Inflow Area = 28,440 sf, 32.91% Impervious, Inflow Depth > 3.66" for 100 year event
Inflow = 2.33 cfs @ 12.16 hrs, Volume= 8,682 cf
Outflow = 2.03 cfs @ 12.23 hrs, Volume= 8,679 cf, Atten= 13%, Lag= 4.1 min
Primary = 2.03 cfs @ 12.23 hrs, Volume= 8,679 cf

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 131.01' @ 12.23 hrs Surf.Area= 698 sf Storage= 348 cf

Plug-Flow detention time= 1.8 min calculated for 8,656 cf (100% of inflow)
Center-of-Mass det. time= 1.6 min (849.3 - 847.7)

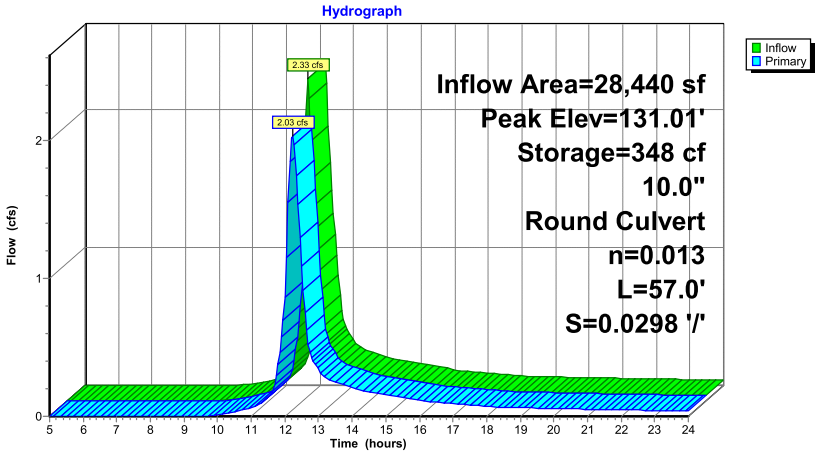
Volume	Invert	Avail.Storage	Storage Description
#1	130.00'	9,528 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
130.00	1	0	0
131.00	676	339	339
132.00	2,196	1,436	1,775
133.00	3,747	2,972	4,746
134.00	5,817	4,782	9,528

Device	Routing	Invert	Outlet Devices
#1	Primary	130.00'	**10.0" Round Culvert** L= 57.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 130.00' / 128.30' S= 0.0298 '/' Cc= 0.900 n= 0.013 Clay tile, Flow Area= 0.55 sf

Primary OutFlow Max=2.02 cfs @ 12.23 hrs HW=131.01' (Free Discharge)
1=Culvert (Inlet Controls 2.02 cfs @ 3.70 fps)

Pond 4P: Existing Depression

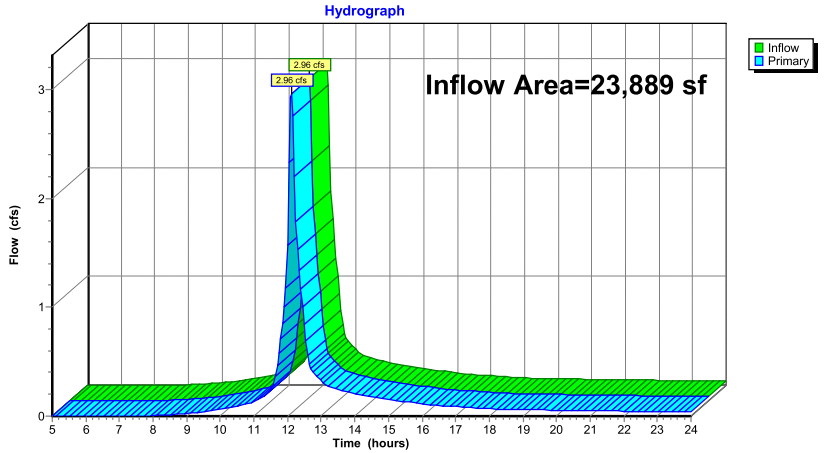


Summary for Link DP-1: Raymond Road

Inflow Area = 23,889 sf, 44.23% Impervious, Inflow Depth > 4.98" for 100 year event
Inflow = 2.96 cfs @ 12.11 hrs, Volume= 9,910 cf
Primary = 2.96 cfs @ 12.11 hrs, Volume= 9,910 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: Raymond Road

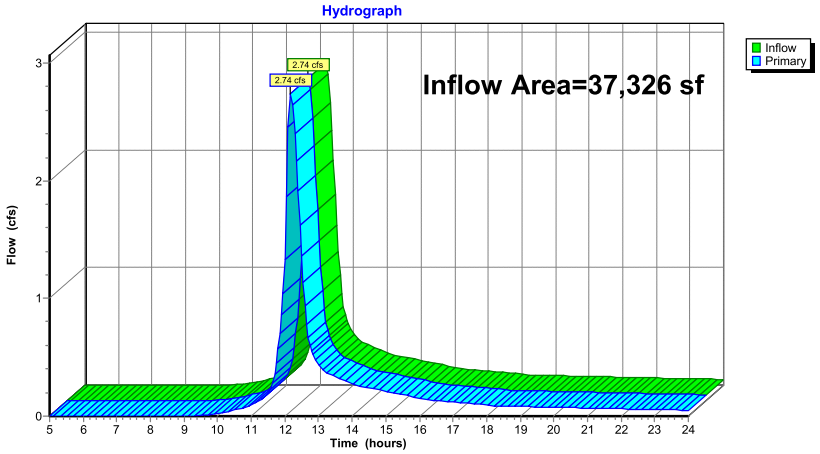


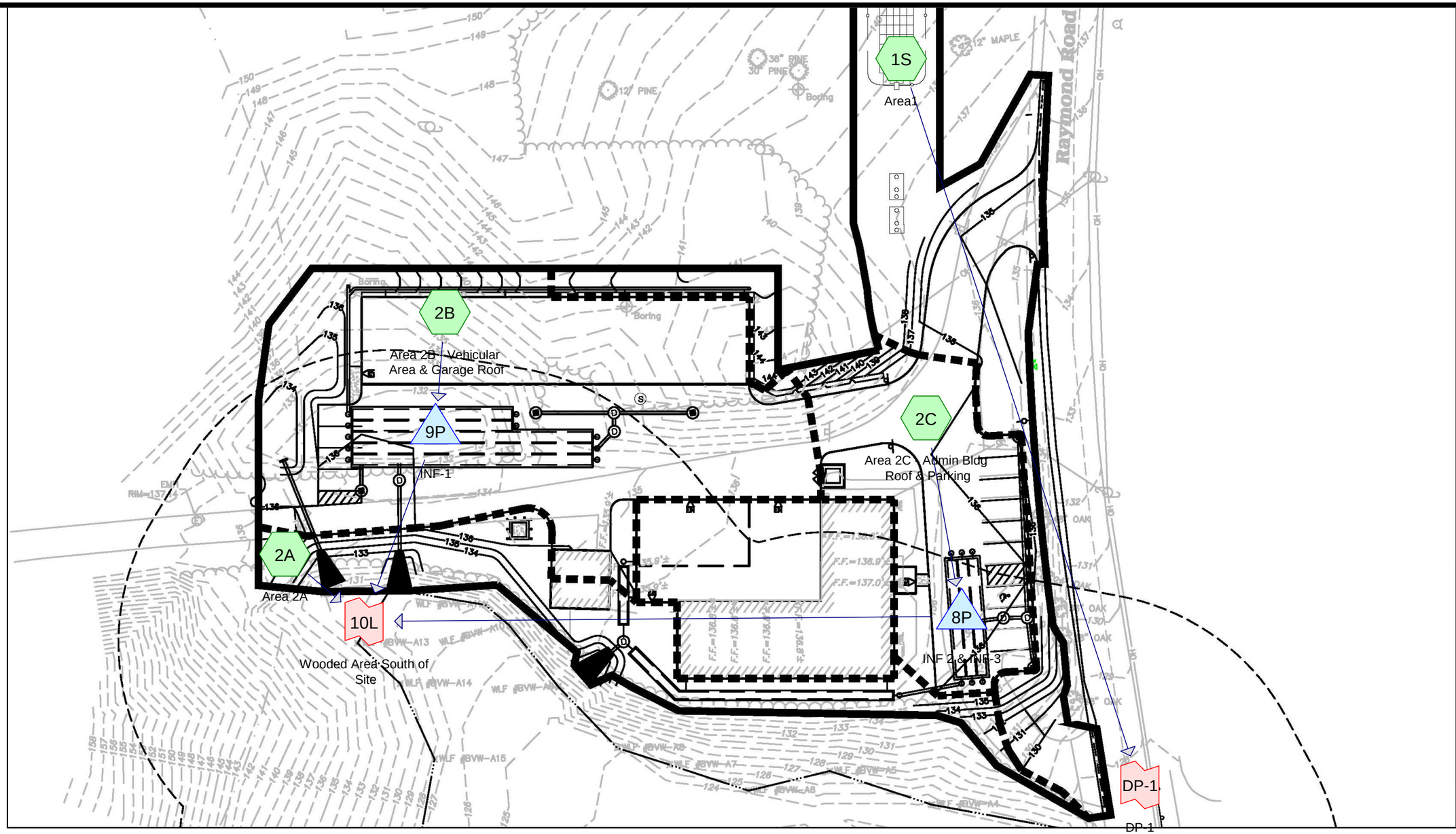
Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 37,326 sf, 32.96% Impervious, Inflow Depth > 3.78" for 100 year event
Inflow = 2.74 cfs @ 12.17 hrs, Volume= 11,745 cf
Primary = 2.74 cfs @ 12.17 hrs, Volume= 11,745 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site





Subcat Reach Pond Link

Routing Diagram for Proposed Condition-alt

Prepared by Weston & Sampson, Printed 6/27/2018

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
24,533	49	50-75% Grass cover, Fair, HSG A (1S, 2A, 2B)
2,474	39	>75% Grass cover, Good, HSG A (2C)
1,012	76	Gravel roads, HSG A (2B)
20,261	98	Paved parking, HSG A (1S, 2A, 2B, 2C)
14,128	98	Unconnected roofs, HSG A (2A, 2B, 2C)
625	36	Woods, Fair, HSG A (2A)
63,033	**76**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
63,033	HSG A	1S, 2A, 2B, 2C
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
63,033		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
24,533	0	0	0	0	24,533	50-75% Grass cover, Fair	
2,474	0	0	0	0	2,474	>75% Grass cover, Good	
1,012	0	0	0	0	1,012	Gravel roads	
20,261	0	0	0	0	20,261	Paved parking	
14,128	0	0	0	0	14,128	Unconnected roofs	
625	0	0	0	0	625	Woods, Fair	
63,033	**0**	**0**	**0**	**0**	**63,033**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	8P	133.00	132.50	50.0	0.0100	0.010	12.0	0.0	0.0
2	9P	131.70	131.55	30.0	0.0050	0.010	12.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area1 Runoff Area=14,573 sf 15.78% Impervious Runoff Depth=0.00"
Flow Length=405' Tc=7.9 min CN=57 Runoff=0.00 cfs 0 cf

Subcatchment 2A: Area 2A Runoff Area=7,643 sf 4.61% Impervious Runoff Depth=0.00"
Flow Length=75' Tc=7.8 min UI Adjusted CN=49 Runoff=0.00 cfs 0 cf

Subcatchment 2B: Area 2B - Vehicular Runoff Area=24,194 sf 72.70% Impervious Runoff Depth>0.20"
Tc=6.0 min CN=86 Runoff=0.10 cfs 398 cf

Subcatchment 2C: Area 2C - Admin Bldg Runoff Area=16,623 sf 85.12% Impervious Runoff Depth>0.28"
Tc=6.0 min CN=89 Runoff=0.12 cfs 394 cf

Pond 8P: INF 2 & INF-3 Peak Elev=131.53' Storage=22 cf Inflow=0.12 cfs 394 cf
Discarded=0.10 cfs 394 cf Primary=0.00 cfs 0 cf Outflow=0.10 cfs 394 cf

Pond 9P: INF-1 Peak Elev=131.22' Storage=0.000 af Inflow=0.10 cfs 398 cf
Discarded=0.09 cfs 397 cf Primary=0.00 cfs 0 cf Outflow=0.09 cfs 397 cf

Link DP-1: DP-1 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP-2: Wooded Area South of Site Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 63,033 sf Runoff Volume = 792 cf Average Runoff Depth = 0.15"
45.44% Pervious = 28,644 sf 54.56% Impervious = 34,389 sf

Summary for Subcatchment 1S: Area1

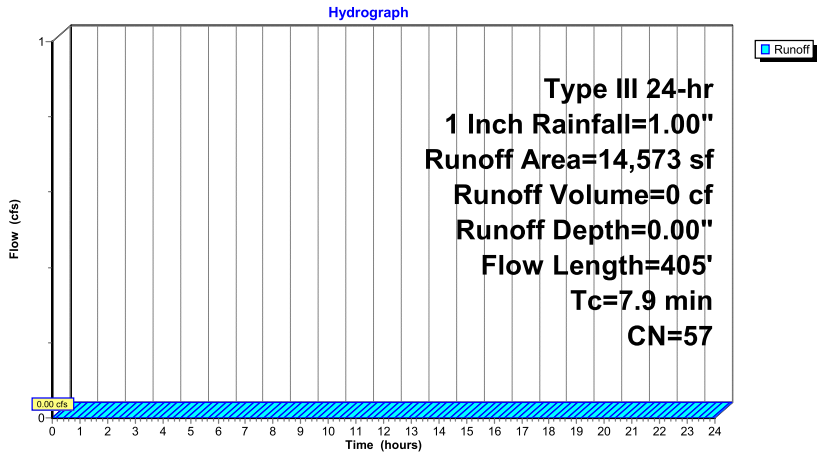
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Inch Rainfall=1.00"

Area (sf)	CN	Description
12,274	49	50-75% Grass cover, Fair, HSG A
2,299	98	Paved parking, HSG A
14,573	57	Weighted Average
12,274		84.22% Pervious Area
2,299		15.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Roadway Gutter** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1S: Area1



Summary for Subcatchment 2A: Area 2A

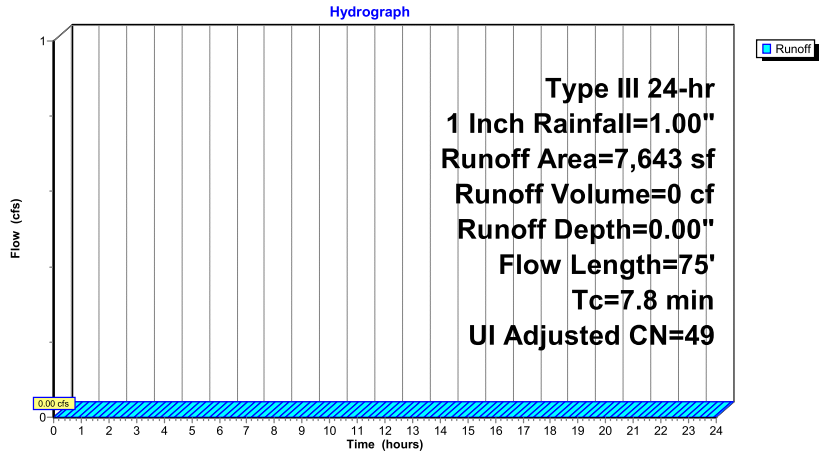
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Inch Rainfall=1.00"

Area (sf)	CN	Adj	Description
6,666	49		50-75% Grass cover, Fair, HSG A
52	98		Paved parking, HSG A
300	98		Unconnected roofs, HSG A
625	36		Woods, Fair, HSG A
7,643	50	49	Weighted Average, UI Adjusted
7,291			95.39% Pervious Area
352			4.61% Impervious Area
300			85.23% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area 2A



Summary for Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof

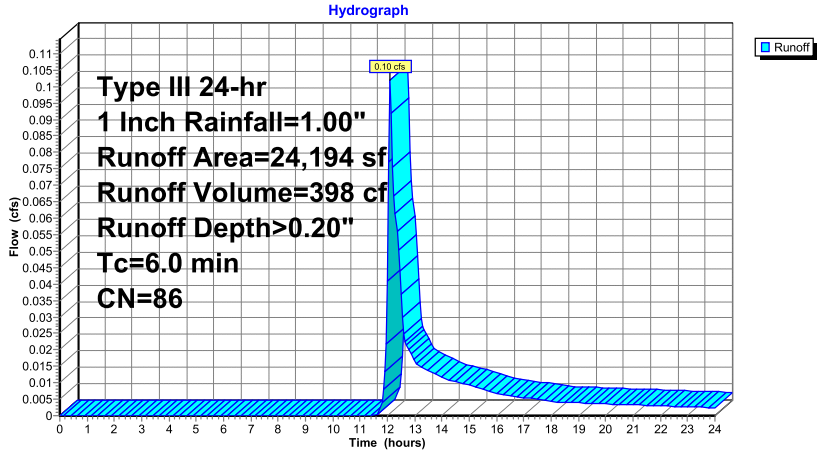
Runoff = 0.10 cfs @ 12.11 hrs, Volume= 398 cf, Depth> 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Inch Rainfall=1.00"

Area (sf)	CN	Description
5,593	49	50-75% Grass cover, Fair, HSG A
11,381	98	Paved parking, HSG A
6,208	98	Unconnected roofs, HSG A
1,012	76	Gravel roads, HSG A
24,194	86	Weighted Average
6,605		27.30% Pervious Area
17,589		72.70% Impervious Area
6,208		35.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Sheet Flow over Impervious Area**

Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof



Summary for Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking

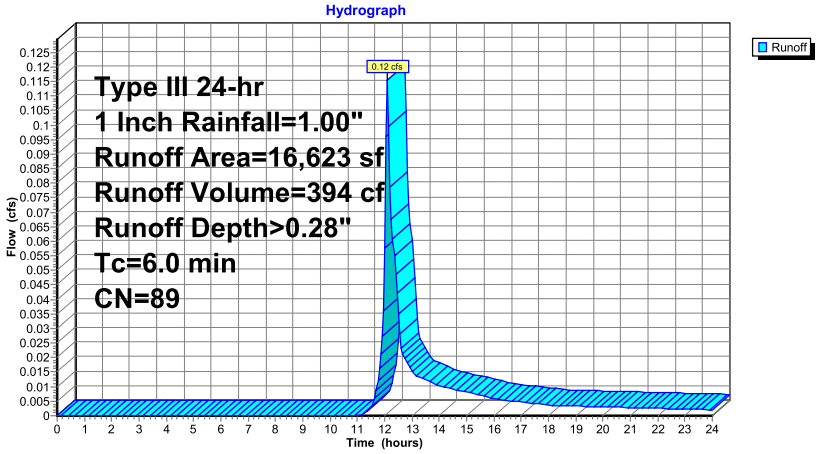
Runoff = 0.12 cfs @ 12.10 hrs, Volume= 394 cf, Depth> 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Inch Rainfall=1.00"

Area (sf)	CN	Description
7,620	98	Unconnected roofs, HSG A
6,529	98	Paved parking, HSG A
2,474	39	>75% Grass cover, Good, HSG A
16,623	89	Weighted Average
2,474		14.88% Pervious Area
14,149		85.12% Impervious Area
7,620		53.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking



Summary for Pond 8P: INF 2 & INF-3

Inflow Area = 16,623 sf, 85.12% Impervious, Inflow Depth > 0.28" for 1 Inch event
Inflow = 0.12 cfs @ 12.10 hrs, Volume= 394 cf
Outflow = 0.10 cfs @ 12.16 hrs, Volume= 394 cf, Atten= 14%, Lag= 3.4 min
Discarded = 0.10 cfs @ 12.16 hrs, Volume= 394 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 131.53' @ 12.16 hrs Surf.Area= 1,676 sf Storage= 22 cf

Plug-Flow detention time= 3.6 min calculated for 393 cf (100% of inflow)
Center-of-Mass det. time= 3.0 min (872.2 - 869.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.50'	866 cf	**6.33'W x 143.50'L x 3.54'H Field A** 3,219 cf Overall - 1,054 cf Embedded = 2,164 cf x 40.0% Voids
#2A	132.00'	1,054 cf	**Cultec R-330XLHD** x 20 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	131.50'	620 cf	**14.75'W x 52.00'L x 3.21'H Field B** 2,461 cf Overall - 911 cf Embedded = 1,550 cf x 40.0% Voids
#4B	132.00'	911 cf	**Cultec R-280HD** x 21 Inside #3 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 3 rows
		3,451 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**2.810 in/hr Exfiltration over Horizontal area**
#2	Primary	133.00'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 133.00' / 132.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	133.10'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	134.40'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.11 cfs @ 12.16 hrs HW=131.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=131.50' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 8P: INF 2 & INF-3 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

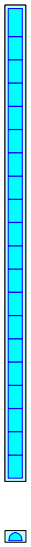
20 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 141.50' Row Length +12.0" End Stone x 2 = 143.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 1,054.3 cf Chamber Storage

3,218.8 cf Field - 1,054.3 cf Chambers = 2,164.5 cf Stone x 40.0% Voids = 865.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,920.1 cf = 0.044 af
Overall Storage Efficiency = 59.7%
Overall System Size = 143.50' x 6.33' x 3.54'

20 Chambers
119.2 cy Field
80.2 cy Stone



Pond 8P: INF 2 & INF-3 - Chamber Wizard Field B

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 3 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

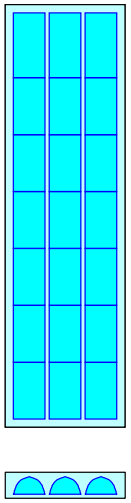
7 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 50.00' Row Length +12.0" End Stone x 2 = 52.00' Base Length
3 Rows x 47.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 14.75' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

21 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 3 Rows = 910.8 cf Chamber Storage

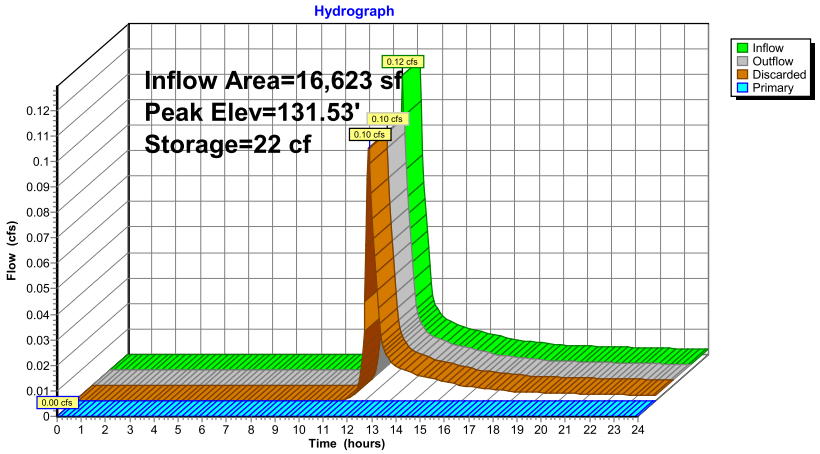
2,460.8 cf Field - 910.8 cf Chambers = 1,550.0 cf Stone x 40.0% Voids = 620.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,530.8 cf = 0.035 af
Overall Storage Efficiency = 62.2%
Overall System Size = 52.00' x 14.75' x 3.21'

21 Chambers
91.1 cy Field
57.4 cy Stone



Pond 8P: INF 2 & INF-3



Summary for Pond 9P: INF-1

Inflow Area = 24,194 sf, 72.70% Impervious, Inflow Depth > 0.20" for 1 Inch event
Inflow = 0.10 cfs @ 12.11 hrs, Volume= 398 cf
Outflow = 0.09 cfs @ 12.17 hrs, Volume= 397 cf, Atten= 14%, Lag= 3.6 min
Discarded = 0.09 cfs @ 12.17 hrs, Volume= 397 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 131.22' @ 12.17 hrs Surf.Area= 0.051 ac Storage= 0.000 af

Plug-Flow detention time= 3.6 min calculated for 397 cf (100% of inflow)
Center-of-Mass det. time= 2.9 min (894.3 - 891.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.20'	0.033 af	**25.67'W x 66.50'L x 3.54'H Field A** 0.139 af Overall - 0.055 af Embedded = 0.084 af x 40.0% Voids
#2A	131.70'	0.055 af	**Cultec R-330XLHD** x 45 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 5 rows
#3C	131.20'	0.010 af	**16.00'W x 31.50'L x 3.54'H Field C** 0.041 af Overall - 0.015 af Embedded = 0.026 af x 40.0% Voids
#4C	131.70'	0.015 af	**Cultec R-330XLHD** x 12 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		0.114 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.20'	**2.810 in/hr Exfiltration over Surface area**
#2	Primary	131.70'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 131.70' / 131.55' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	132.20'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	133.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	134.20'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.14 cfs @ 12.17 hrs HW=131.22' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=131.20' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  ├**4=Orifice/Grate** (Controls 0.00 cfs)
  └**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9P: INF-1 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 5 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

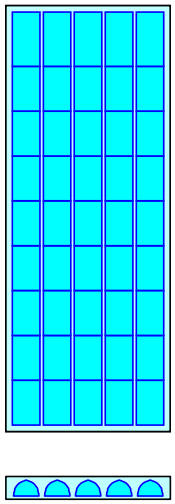
9 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 64.50' Row Length +12.0" End Stone x 2 = 66.50' Base Length
5 Rows x 52.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.67' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

45 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 5 Rows = 2,402.9 cf Chamber Storage

6,045.0 cf Field - 2,402.9 cf Chambers = 3,642.1 cf Stone x 40.0% Voids = 1,456.8 cf Stone Storage

Chamber Storage + Stone Storage = 3,859.8 cf = 0.089 af
Overall Storage Efficiency = 63.9%
Overall System Size = 66.50' x 25.67' x 3.54'

45 Chambers
223.9 cy Field
134.9 cy Stone



Pond 9P: INF-1 - Chamber Wizard Field C

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

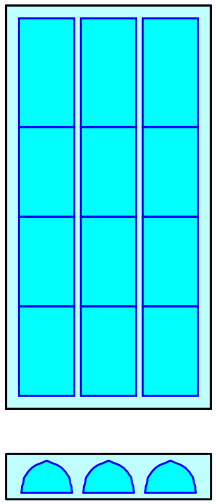
4 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 29.50' Row Length +12.0" End Stone x 2 = 31.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

12 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 659.4 cf Chamber Storage

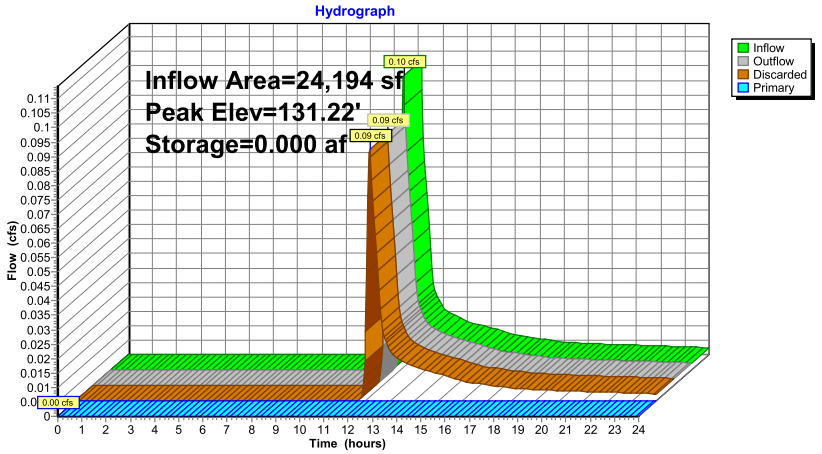
1,785.0 cf Field - 659.4 cf Chambers = 1,125.6 cf Stone x 40.0% Voids = 450.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,109.6 cf = 0.025 af
Overall Storage Efficiency = 62.2%
Overall System Size = 31.50' x 16.00' x 3.54'

12 Chambers
66.1 cy Field
41.7 cy Stone



Pond 9P: INF-1

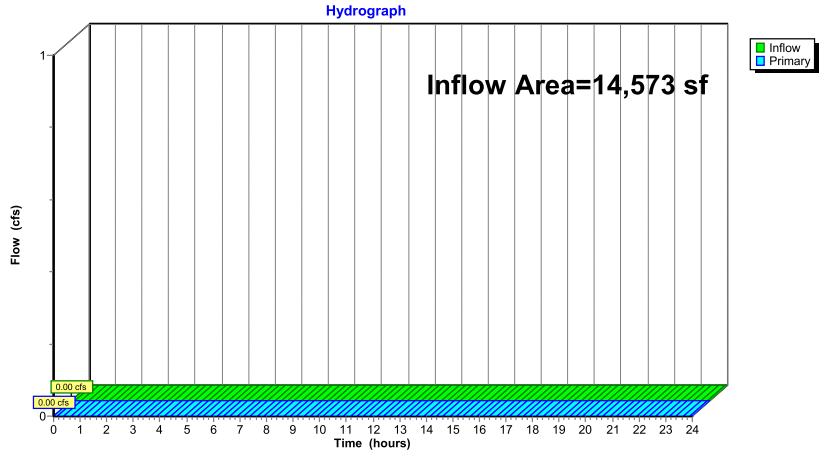


Summary for Link DP-1: DP-1

Inflow Area = 14,573 sf, 15.78% Impervious, Inflow Depth = 0.00" for 1 Inch event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: DP-1

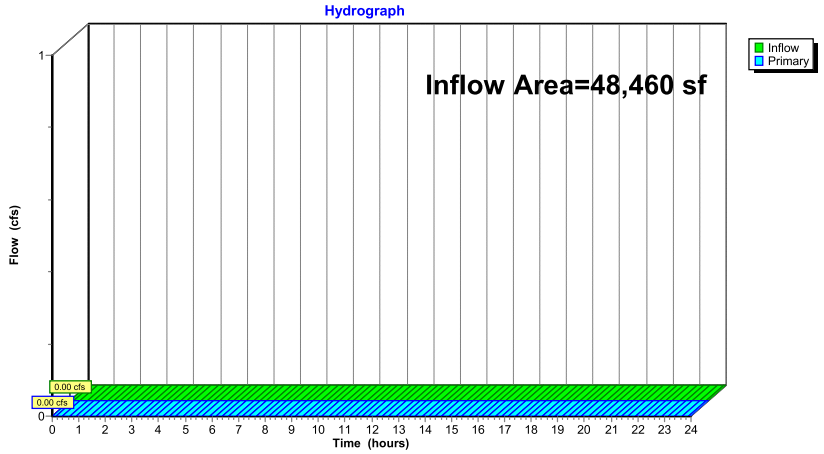


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 48,460 sf, 66.22% Impervious, Inflow Depth = 0.00" for 1 Inch event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area1 Runoff Area=14,573 sf 15.78% Impervious Runoff Depth>0.31"
Flow Length=405' Tc=7.9 min CN=57 Runoff=0.05 cfs 375 cf

Subcatchment 2A: Area 2A Runoff Area=7,643 sf 4.61% Impervious Runoff Depth>0.11"
Flow Length=75' Tc=7.8 min UI Adjusted CN=49 Runoff=0.00 cfs 69 cf

Subcatchment 2B: Area 2B - Vehicular Runoff Area=24,194 sf 72.70% Impervious Runoff Depth>1.83"
Tc=6.0 min CN=86 Runoff=1.17 cfs 3,697 cf

Subcatchment 2C: Area 2C - Admin Bldg Runoff Area=16,623 sf 85.12% Impervious Runoff Depth>2.08"
Tc=6.0 min CN=89 Runoff=0.91 cfs 2,881 cf

Pond 8P: INF 2 & INF-3 Peak Elev=132.49' Storage=988 cf Inflow=0.91 cfs 2,881 cf
Discarded=0.11 cfs 2,879 cf Primary=0.00 cfs 0 cf Outflow=0.11 cfs 2,879 cf

Pond 9P: INF-1 Peak Elev=132.14' Storage=0.029 af Inflow=1.17 cfs 3,697 cf
Discarded=0.14 cfs 3,694 cf Primary=0.00 cfs 0 cf Outflow=0.14 cfs 3,694 cf

Link DP-1: DP-1 Inflow=0.05 cfs 375 cf
Primary=0.05 cfs 375 cf

Link DP-2: Wooded Area South of Site Inflow=0.00 cfs 69 cf
Primary=0.00 cfs 69 cf

Total Runoff Area = 63,033 sf Runoff Volume = 7,022 cf Average Runoff Depth = 1.34"
45.44% Pervious = 28,644 sf 54.56% Impervious = 34,389 sf

Summary for Subcatchment 1S: Area1

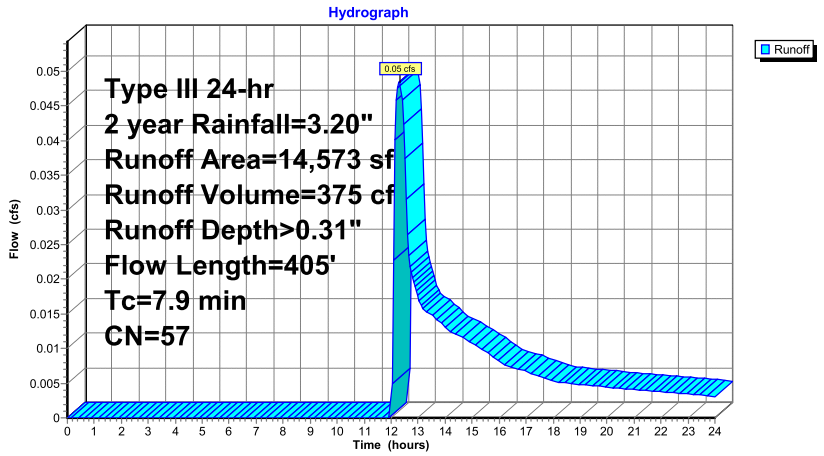
Runoff = 0.05 cfs @ 12.31 hrs, Volume= 375 cf, Depth> 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
12,274	49	50-75% Grass cover, Fair, HSG A
2,299	98	Paved parking, HSG A
14,573	57	Weighted Average
12,274		84.22% Pervious Area
2,299		15.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Roadway Gutter** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1S: Area1



Summary for Subcatchment 2A: Area 2A

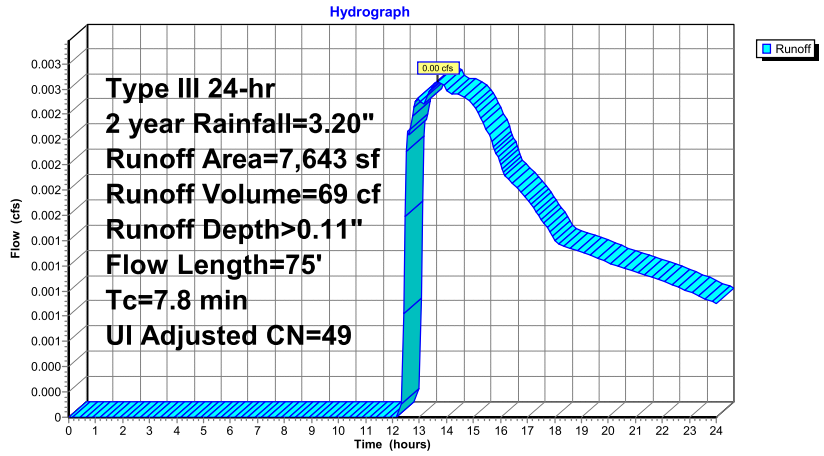
Runoff = 0.00 cfs @ 13.69 hrs, Volume= 69 cf, Depth> 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Adj	Description
6,666	49		50-75% Grass cover, Fair, HSG A
52	98		Paved parking, HSG A
300	98		Unconnected roofs, HSG A
625	36		Woods, Fair, HSG A
7,643	50	49	Weighted Average, UI Adjusted
7,291			95.39% Pervious Area
352			4.61% Impervious Area
300			85.23% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area 2A



Summary for Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof

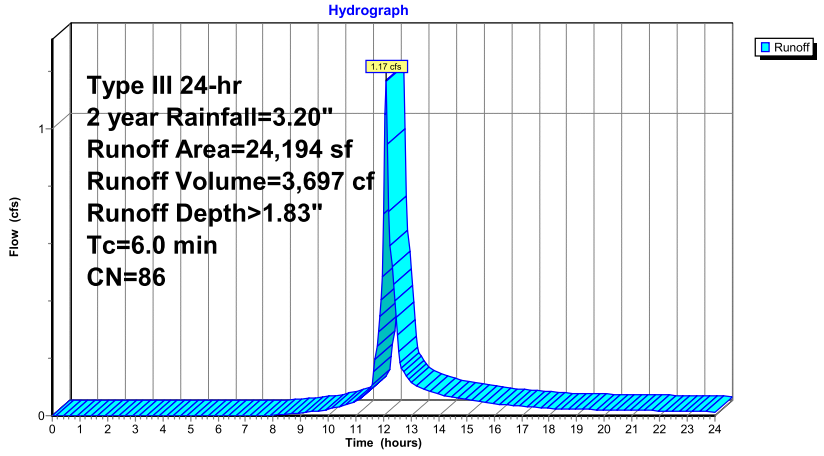
Runoff = 1.17 cfs @ 12.09 hrs, Volume= 3,697 cf, Depth> 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
5,593	49	50-75% Grass cover, Fair, HSG A
11,381	98	Paved parking, HSG A
6,208	98	Unconnected roofs, HSG A
1,012	76	Gravel roads, HSG A
24,194	86	Weighted Average
6,605		27.30% Pervious Area
17,589		72.70% Impervious Area
6,208		35.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Sheet Flow over Impervious Area**

Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof



Summary for Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking

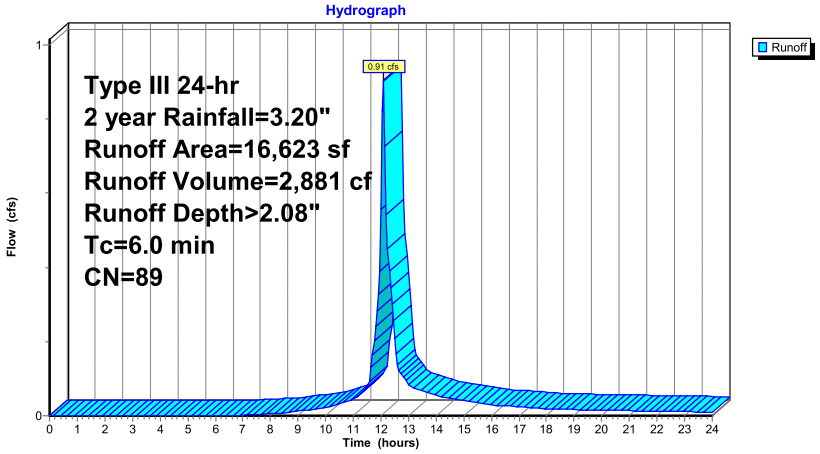
Runoff = 0.91 cfs @ 12.09 hrs, Volume= 2,881 cf, Depth> 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
7,620	98	Unconnected roofs, HSG A
6,529	98	Paved parking, HSG A
2,474	39	>75% Grass cover, Good, HSG A
16,623	89	Weighted Average
2,474		14.88% Pervious Area
14,149		85.12% Impervious Area
7,620		53.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking



Summary for Pond 8P: INF 2 & INF-3

Inflow Area = 16,623 sf, 85.12% Impervious, Inflow Depth > 2.08" for 2 year event
Inflow = 0.91 cfs @ 12.09 hrs, Volume= 2,881 cf
Outflow = 0.11 cfs @ 11.70 hrs, Volume= 2,879 cf, Atten= 88%, Lag= 0.0 min
Discarded = 0.11 cfs @ 11.70 hrs, Volume= 2,879 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 132.49' @ 12.77 hrs Surf.Area= 1,676 sf Storage= 988 cf

Plug-Flow detention time= 68.0 min calculated for 2,873 cf (100% of inflow)
Center-of-Mass det. time= 67.4 min (878.0 - 810.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.50'	866 cf	**6.33'W x 143.50'L x 3.54'H Field A** 3,219 cf Overall - 1,054 cf Embedded = 2,164 cf x 40.0% Voids
#2A	132.00'	1,054 cf	**Cultec R-330XLHD** x 20 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	131.50'	620 cf	**14.75'W x 52.00'L x 3.21'H Field B** 2,461 cf Overall - 911 cf Embedded = 1,550 cf x 40.0% Voids
#4B	132.00'	911 cf	**Cultec R-280HD** x 21 Inside #3 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 3 rows
		3,451 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**2.810 in/hr Exfiltration over Horizontal area**
#2	Primary	133.00'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 133.00' / 132.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	133.10'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	134.40'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.11 cfs @ 11.70 hrs HW=131.54' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=131.50' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 8P: INF 2 & INF-3 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

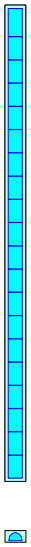
20 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 141.50' Row Length +12.0" End Stone x 2 = 143.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 1,054.3 cf Chamber Storage

3,218.8 cf Field - 1,054.3 cf Chambers = 2,164.5 cf Stone x 40.0% Voids = 865.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,920.1 cf = 0.044 af
Overall Storage Efficiency = 59.7%
Overall System Size = 143.50' x 6.33' x 3.54'

20 Chambers
119.2 cy Field
80.2 cy Stone



Pond 8P: INF 2 & INF-3 - Chamber Wizard Field B

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 3 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

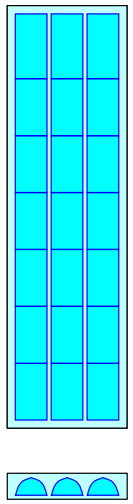
7 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 50.00' Row Length +12.0" End Stone x 2 = 52.00' Base Length
3 Rows x 47.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 14.75' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

21 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 3 Rows = 910.8 cf Chamber Storage

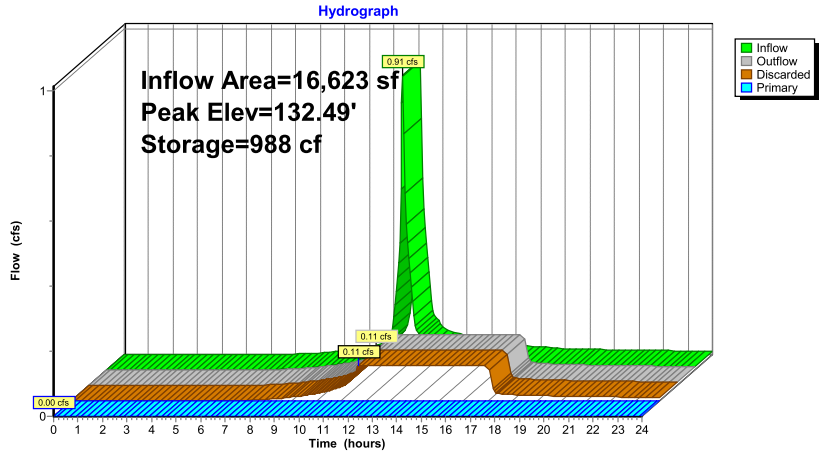
2,460.8 cf Field - 910.8 cf Chambers = 1,550.0 cf Stone x 40.0% Voids = 620.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,530.8 cf = 0.035 af
Overall Storage Efficiency = 62.2%
Overall System Size = 52.00' x 14.75' x 3.21'

21 Chambers
91.1 cy Field
57.4 cy Stone



Pond 8P: INF 2 & INF-3



Summary for Pond 9P: INF-1

Inflow Area = 24,194 sf, 72.70% Impervious, Inflow Depth > 1.83" for 2 year event
Inflow = 1.17 cfs @ 12.09 hrs, Volume= 3,697 cf
Outflow = 0.14 cfs @ 11.70 hrs, Volume= 3,694 cf, Atten= 88%, Lag= 0.0 min
Discarded = 0.14 cfs @ 11.70 hrs, Volume= 3,694 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 132.14' @ 12.79 hrs Surf.Area= 0.051 ac Storage= 0.029 af

Plug-Flow detention time= 67.5 min calculated for 3,694 cf (100% of inflow)
Center-of-Mass det. time= 67.0 min (889.0 - 822.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.20'	0.033 af	**25.67'W x 66.50'L x 3.54'H Field A** 0.139 af Overall - 0.055 af Embedded = 0.084 af x 40.0% Voids
#2A	131.70'	0.055 af	**Cultec R-330XLHD** x 45 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 5 rows
#3C	131.20'	0.010 af	**16.00'W x 31.50'L x 3.54'H Field C** 0.041 af Overall - 0.015 af Embedded = 0.026 af x 40.0% Voids
#4C	131.70'	0.015 af	**Cultec R-330XLHD** x 12 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		0.114 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.20'	**2.810 in/hr Exfiltration over Surface area**
#2	Primary	131.70'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 131.70' / 131.55' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	132.20'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	133.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	134.20'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.14 cfs @ 11.70 hrs HW=131.24' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=131.20' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  ├**4=Orifice/Grate** (Controls 0.00 cfs)
  └**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9P: INF-1 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 5 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

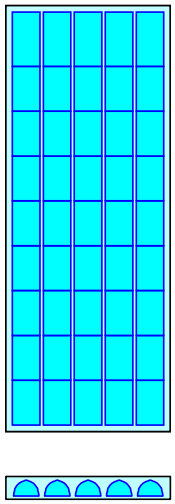
9 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 64.50' Row Length +12.0" End Stone x 2 = 66.50' Base Length
5 Rows x 52.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.67' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

45 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 5 Rows = 2,402.9 cf Chamber Storage

6,045.0 cf Field - 2,402.9 cf Chambers = 3,642.1 cf Stone x 40.0% Voids = 1,456.8 cf Stone Storage

Chamber Storage + Stone Storage = 3,859.8 cf = 0.089 af
Overall Storage Efficiency = 63.9%
Overall System Size = 66.50' x 25.67' x 3.54'

45 Chambers
223.9 cy Field
134.9 cy Stone



Pond 9P: INF-1 - Chamber Wizard Field C

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

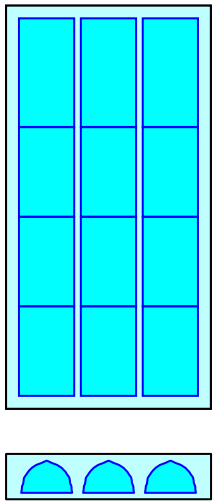
4 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 29.50' Row Length +12.0" End Stone x 2 = 31.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

12 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 659.4 cf Chamber Storage

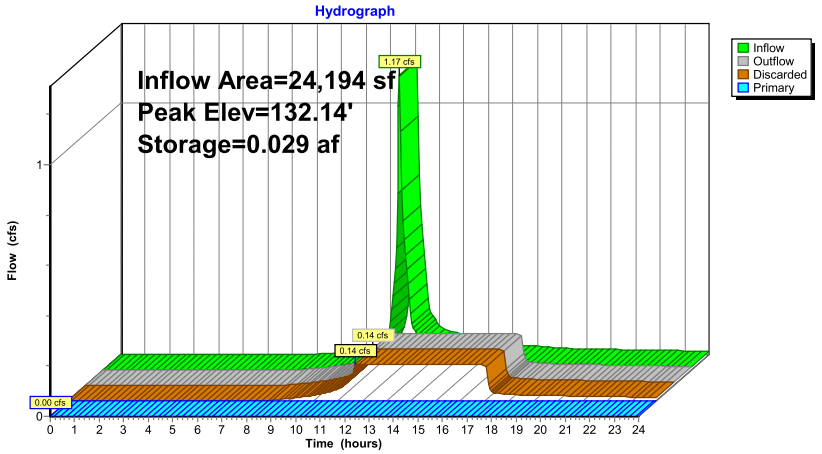
1,785.0 cf Field - 659.4 cf Chambers = 1,125.6 cf Stone x 40.0% Voids = 450.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,109.6 cf = 0.025 af
Overall Storage Efficiency = 62.2%
Overall System Size = 31.50' x 16.00' x 3.54'

12 Chambers
66.1 cy Field
41.7 cy Stone



Pond 9P: INF-1

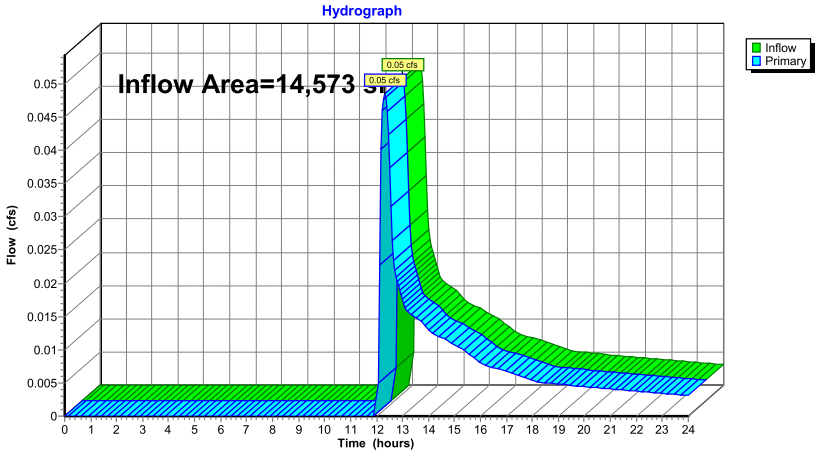


Summary for Link DP-1: DP-1

Inflow Area = 14,573 sf, 15.78% Impervious, Inflow Depth > 0.31" for 2 year event
Inflow = 0.05 cfs @ 12.31 hrs, Volume= 375 cf
Primary = 0.05 cfs @ 12.31 hrs, Volume= 375 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: DP-1

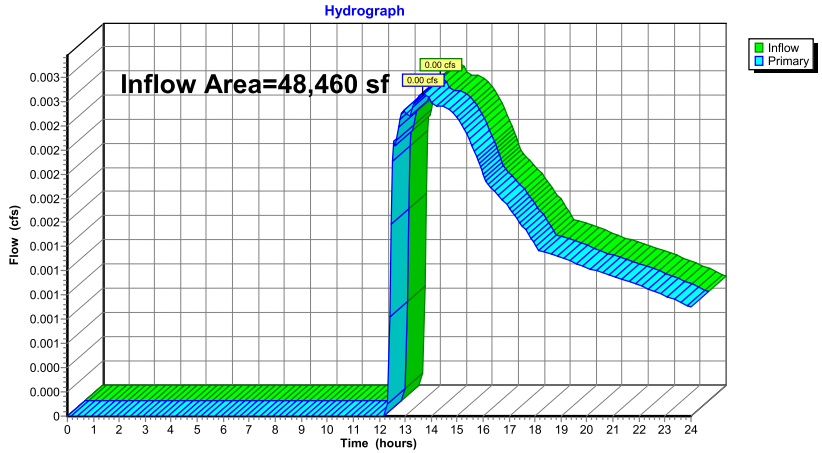


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 48,460 sf, 66.22% Impervious, Inflow Depth > 0.02" for 2 year event
Inflow = 0.00 cfs @ 13.69 hrs, Volume= 69 cf
Primary = 0.00 cfs @ 13.69 hrs, Volume= 69 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area1 Runoff Area=14,573 sf 15.78% Impervious Runoff Depth>1.00"
Flow Length=405' Tc=7.9 min CN=57 Runoff=0.29 cfs 1,212 cf

Subcatchment 2A: Area 2A Runoff Area=7,643 sf 4.61% Impervious Runoff Depth>0.56"
Flow Length=75' Tc=7.8 min UI Adjusted CN=49 Runoff=0.06 cfs 358 cf

Subcatchment 2B: Area 2B - Vehicular Runoff Area=24,194 sf 72.70% Impervious Runoff Depth>3.28"
Tc=6.0 min CN=86 Runoff=2.07 cfs 6,609 cf

Subcatchment 2C: Area 2C - Admin Bldg Runoff Area=16,623 sf 85.12% Impervious Runoff Depth>3.58"
Tc=6.0 min CN=89 Runoff=1.53 cfs 4,957 cf

Pond 8P: INF 2 & INF-3 Peak Elev=133.25' Storage=1,957 cf Inflow=1.53 cfs 4,957 cf
Discarded=0.11 cfs 4,735 cf Primary=0.06 cfs 219 cf Outflow=0.17 cfs 4,953 cf

Pond 9P: INF-1 Peak Elev=132.68' Storage=0.051 af Inflow=2.07 cfs 6,609 cf
Discarded=0.14 cfs 5,321 cf Primary=0.34 cfs 1,283 cf Outflow=0.48 cfs 6,605 cf

Link DP-1: DP-1 Inflow=0.29 cfs 1,212 cf
Primary=0.29 cfs 1,212 cf

Link DP-2: Wooded Area South of Site Inflow=0.41 cfs 1,859 cf
Primary=0.41 cfs 1,859 cf

Total Runoff Area = 63,033 sf Runoff Volume = 13,135 cf Average Runoff Depth = 2.50"
45.44% Pervious = 28,644 sf 54.56% Impervious = 34,389 sf

Summary for Subcatchment 1S: Area1

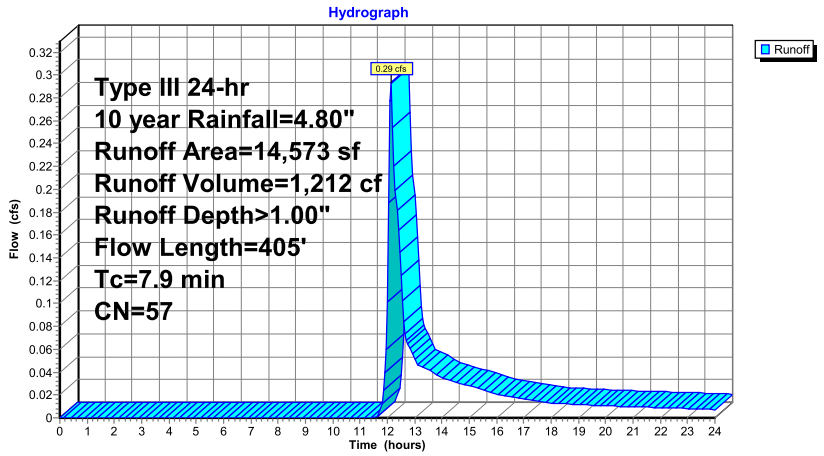
Runoff = 0.29 cfs @ 12.14 hrs, Volume= 1,212 cf, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.80"

Area (sf)	CN	Description
12,274	49	50-75% Grass cover, Fair, HSG A
2,299	98	Paved parking, HSG A
14,573	57	Weighted Average
12,274		84.22% Pervious Area
2,299		15.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Roadway Gutter** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1S: Area1



Summary for Subcatchment 2A: Area 2A

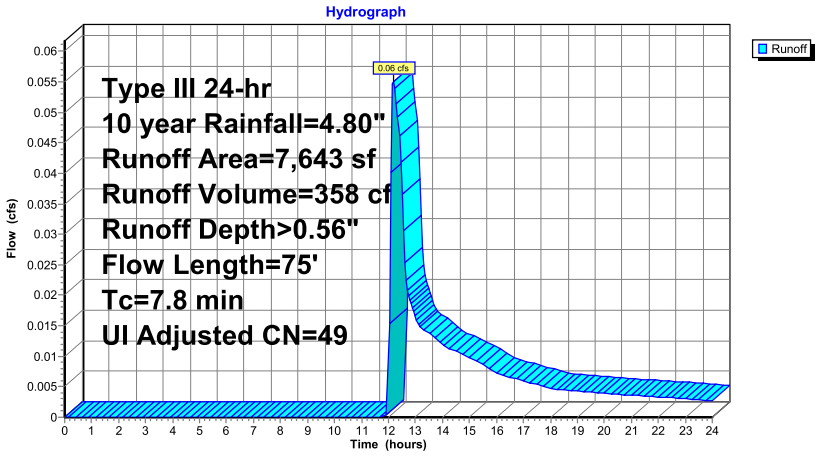
Runoff = 0.06 cfs @ 12.18 hrs, Volume= 358 cf, Depth> 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.80"

Area (sf)	CN	Adj	Description
6,666	49		50-75% Grass cover, Fair, HSG A
52	98		Paved parking, HSG A
300	98		Unconnected roofs, HSG A
625	36		Woods, Fair, HSG A
7,643	50	49	Weighted Average, UI Adjusted
7,291			95.39% Pervious Area
352			4.61% Impervious Area
300			85.23% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area 2A



Summary for Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof

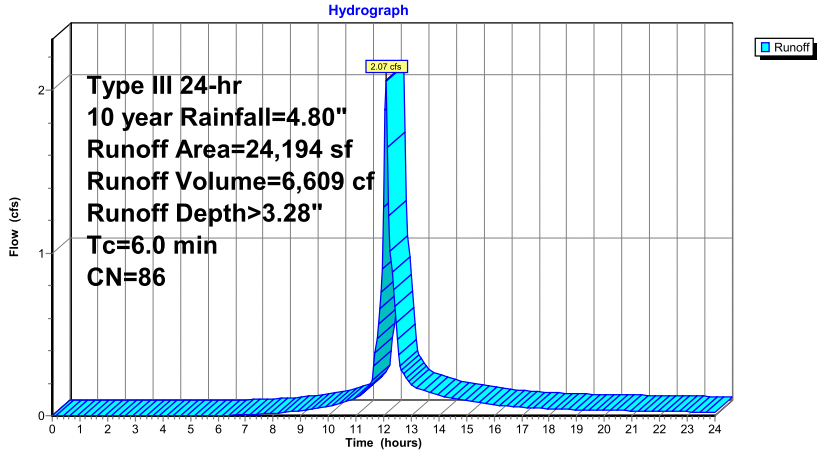
Runoff = 2.07 cfs @ 12.09 hrs, Volume= 6,609 cf, Depth> 3.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.80"

Area (sf)	CN	Description
5,593	49	50-75% Grass cover, Fair, HSG A
11,381	98	Paved parking, HSG A
6,208	98	Unconnected roofs, HSG A
1,012	76	Gravel roads, HSG A
24,194	86	Weighted Average
6,605		27.30% Pervious Area
17,589		72.70% Impervious Area
6,208		35.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Sheet Flow over Impervious Area**

Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof



Summary for Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking

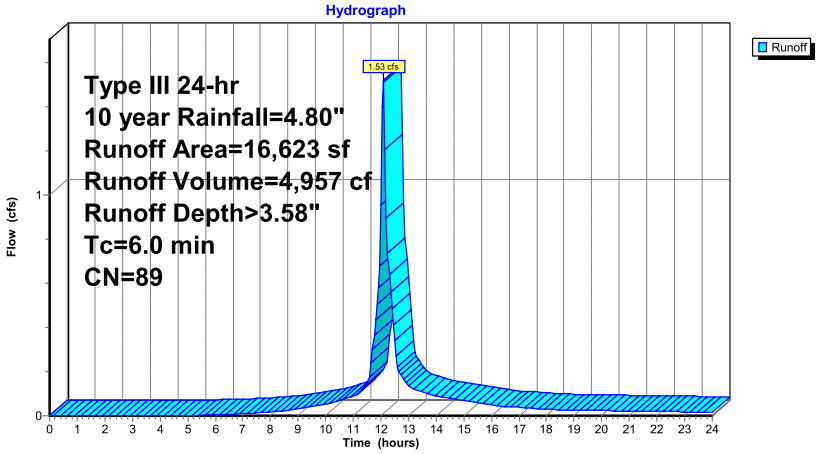
Runoff = 1.53 cfs @ 12.09 hrs, Volume= 4,957 cf, Depth> 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.80"

Area (sf)	CN	Description
7,620	98	Unconnected roofs, HSG A
6,529	98	Paved parking, HSG A
2,474	39	>75% Grass cover, Good, HSG A
16,623	89	Weighted Average
2,474		14.88% Pervious Area
14,149		85.12% Impervious Area
7,620		53.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking



Summary for Pond 8P: INF 2 & INF-3

Inflow Area = 16,623 sf, 85.12% Impervious, Inflow Depth > 3.58" for 10 year event
Inflow = 1.53 cfs @ 12.09 hrs, Volume= 4,957 cf
Outflow = 0.17 cfs @ 12.80 hrs, Volume= 4,953 cf, Atten= 89%, Lag= 42.6 min
Discarded = 0.11 cfs @ 11.30 hrs, Volume= 4,735 cf
Primary = 0.06 cfs @ 12.80 hrs, Volume= 219 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 133.25' @ 12.80 hrs Surf.Area= 1,676 sf Storage= 1,957 cf

Plug-Flow detention time= 138.6 min calculated for 4,953 cf (100% of inflow)
Center-of-Mass det. time= 138.1 min (933.5 - 795.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.50'	866 cf	**6.33'W x 143.50'L x 3.54'H Field A** 3,219 cf Overall - 1,054 cf Embedded = 2,164 cf x 40.0% Voids
#2A	132.00'	1,054 cf	**Cultec R-330XLHD** x 20 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	131.50'	620 cf	**14.75'W x 52.00'L x 3.21'H Field B** 2,461 cf Overall - 911 cf Embedded = 1,550 cf x 40.0% Voids
#4B	132.00'	911 cf	**Cultec R-280HD** x 21 Inside #3 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 3 rows
		3,451 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**2.810 in/hr Exfiltration over Horizontal area**
#2	Primary	133.00'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 133.00' / 132.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	133.10'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	134.40'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.11 cfs @ 11.30 hrs HW=131.54' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.06 cfs @ 12.80 hrs HW=133.25' (Free Discharge)
└**2=Culvert** (Passes 0.06 cfs of 0.20 cfs potential flow)
  └**3=Orifice/Grate** (Orifice Controls 0.06 cfs @ 1.30 fps)
  └**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 8P: INF 2 & INF-3 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

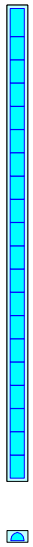
20 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 141.50' Row Length +12.0" End Stone x 2 = 143.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 1,054.3 cf Chamber Storage

3,218.8 cf Field - 1,054.3 cf Chambers = 2,164.5 cf Stone x 40.0% Voids = 865.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,920.1 cf = 0.044 af
Overall Storage Efficiency = 59.7%
Overall System Size = 143.50' x 6.33' x 3.54'

20 Chambers
119.2 cy Field
80.2 cy Stone



Pond 8P: INF 2 & INF-3 - Chamber Wizard Field B

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 3 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

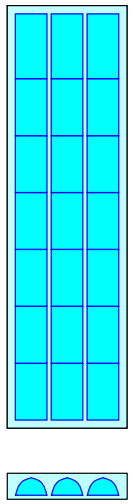
7 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 50.00' Row Length +12.0" End Stone x 2 = 52.00' Base Length
3 Rows x 47.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 14.75' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

21 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 3 Rows = 910.8 cf Chamber Storage

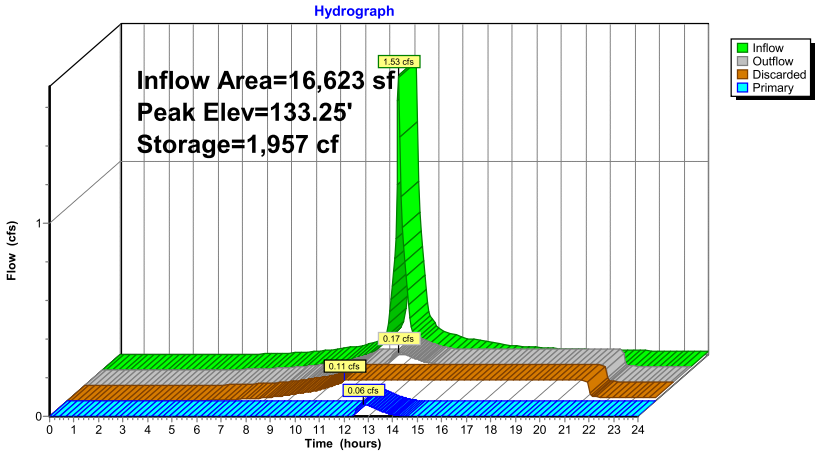
2,460.8 cf Field - 910.8 cf Chambers = 1,550.0 cf Stone x 40.0% Voids = 620.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,530.8 cf = 0.035 af
Overall Storage Efficiency = 62.2%
Overall System Size = 52.00' x 14.75' x 3.21'

21 Chambers
91.1 cy Field
57.4 cy Stone



Pond 8P: INF 2 & INF-3



Summary for Pond 9P: INF-1

Inflow Area = 24,194 sf, 72.70% Impervious, Inflow Depth > 3.28" for 10 year event
Inflow = 2.07 cfs @ 12.09 hrs, Volume= 6,609 cf
Outflow = 0.48 cfs @ 12.49 hrs, Volume= 6,605 cf, Atten= 77%, Lag= 24.3 min
Discarded = 0.14 cfs @ 11.35 hrs, Volume= 5,321 cf
Primary = 0.34 cfs @ 12.49 hrs, Volume= 1,283 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 132.68' @ 12.49 hrs Surf.Area= 0.051 ac Storage= 0.051 af

Plug-Flow detention time= 79.5 min calculated for 6,605 cf (100% of inflow)
Center-of-Mass det. time= 79.0 min (884.5 - 805.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.20'	0.033 af	**25.67'W x 66.50'L x 3.54'H Field A** 0.139 af Overall - 0.055 af Embedded = 0.084 af x 40.0% Voids
#2A	131.70'	0.055 af	**Cultec R-330XLHD** x 45 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 5 rows
#3C	131.20'	0.010 af	**16.00'W x 31.50'L x 3.54'H Field C** 0.041 af Overall - 0.015 af Embedded = 0.026 af x 40.0% Voids
#4C	131.70'	0.015 af	**Cultec R-330XLHD** x 12 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		0.114 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.20'	**2.810 in/hr Exfiltration over Surface area**
#2	Primary	131.70'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 131.70' / 131.55' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	132.20'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	133.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	134.20'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.14 cfs @ 11.35 hrs HW=131.24' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.34 cfs @ 12.49 hrs HW=132.68' (Free Discharge)
└**2=Culvert** (Passes 0.34 cfs of 2.03 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.34 cfs @ 2.49 fps)
  ├**4=Orifice/Grate** (Controls 0.00 cfs)
  └**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9P: INF-1 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 5 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

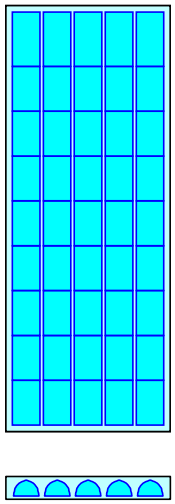
9 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 64.50' Row Length +12.0" End Stone x 2 = 66.50' Base Length
5 Rows x 52.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.67' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

45 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 5 Rows = 2,402.9 cf Chamber Storage

6,045.0 cf Field - 2,402.9 cf Chambers = 3,642.1 cf Stone x 40.0% Voids = 1,456.8 cf Stone Storage

Chamber Storage + Stone Storage = 3,859.8 cf = 0.089 af
Overall Storage Efficiency = 63.9%
Overall System Size = 66.50' x 25.67' x 3.54'

45 Chambers
223.9 cy Field
134.9 cy Stone



Pond 9P: INF-1 - Chamber Wizard Field C

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

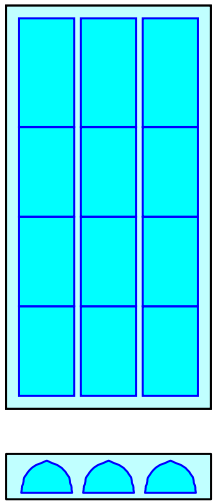
4 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 29.50' Row Length +12.0" End Stone x 2 = 31.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

12 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 659.4 cf Chamber Storage

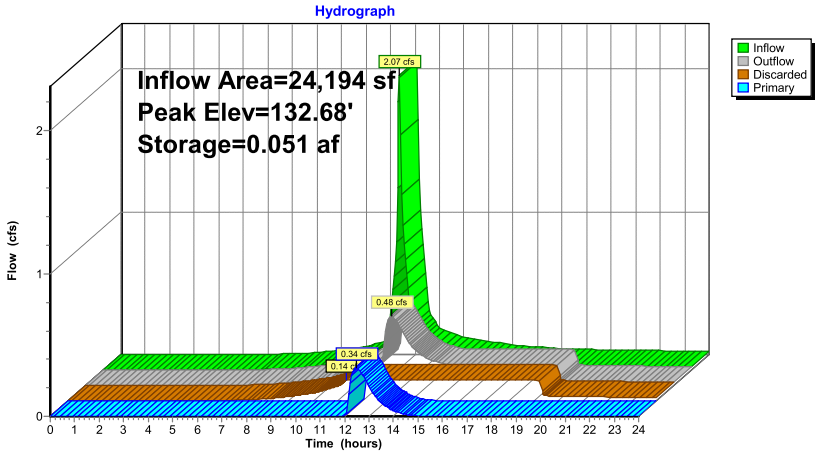
1,785.0 cf Field - 659.4 cf Chambers = 1,125.6 cf Stone x 40.0% Voids = 450.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,109.6 cf = 0.025 af
Overall Storage Efficiency = 62.2%
Overall System Size = 31.50' x 16.00' x 3.54'

12 Chambers
66.1 cy Field
41.7 cy Stone



Pond 9P: INF-1

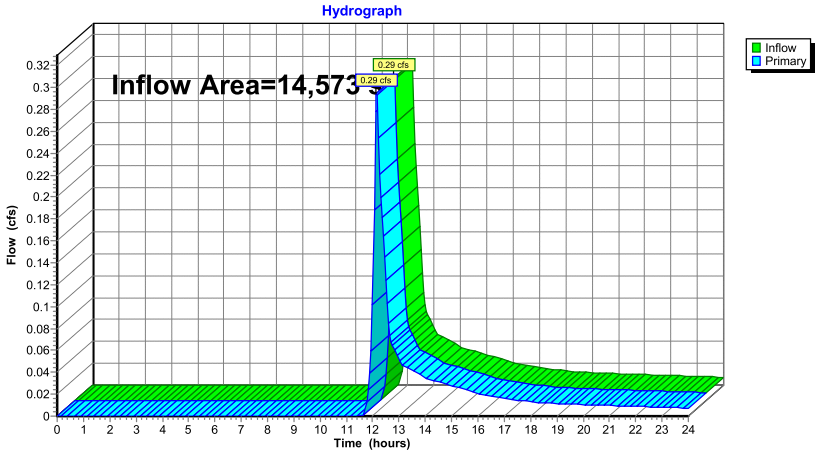


Summary for Link DP-1: DP-1

Inflow Area = 14,573 sf, 15.78% Impervious, Inflow Depth > 1.00" for 10 year event
Inflow = 0.29 cfs @ 12.14 hrs, Volume= 1,212 cf
Primary = 0.29 cfs @ 12.14 hrs, Volume= 1,212 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: DP-1

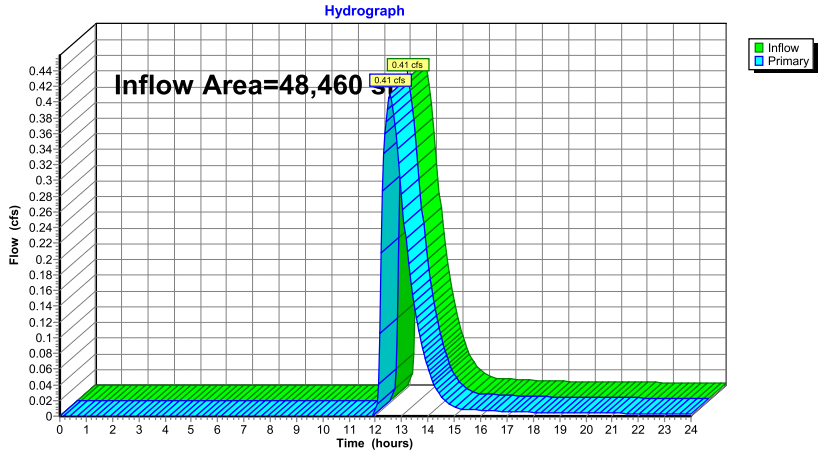


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 48,460 sf, 66.22% Impervious, Inflow Depth > 0.46" for 10 year event
Inflow = 0.41 cfs @ 12.55 hrs, Volume= 1,859 cf
Primary = 0.41 cfs @ 12.55 hrs, Volume= 1,859 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area1 Runoff Area=14,573 sf 15.78% Impervious Runoff Depth>1.67"
Flow Length=405' Tc=7.9 min CN=57 Runoff=0.55 cfs 2,032 cf

Subcatchment 2A: Area 2A Runoff Area=7,643 sf 4.61% Impervious Runoff Depth>1.07"
Flow Length=75' Tc=7.8 min UI Adjusted CN=49 Runoff=0.15 cfs 681 cf

Subcatchment 2B: Area 2B - Vehicular Runoff Area=24,194 sf 72.70% Impervious Runoff Depth>4.41"
Tc=6.0 min CN=86 Runoff=2.74 cfs 8,883 cf

Subcatchment 2C: Area 2C - Admin Bldg Runoff Area=16,623 sf 85.12% Impervious Runoff Depth>4.73"
Tc=6.0 min CN=89 Runoff=1.99 cfs 6,555 cf

Pond 8P: INF 2 & INF-3 Peak Elev=133.55' Storage=2,315 cf Inflow=1.99 cfs 6,555 cf
Discarded=0.11 cfs 5,371 cf Primary=0.42 cfs 1,180 cf Outflow=0.53 cfs 6,551 cf

Pond 9P: INF-1 Peak Elev=133.10' Storage=0.068 af Inflow=2.74 cfs 8,883 cf
Discarded=0.14 cfs 6,170 cf Primary=0.55 cfs 2,707 cf Outflow=0.69 cfs 8,877 cf

Link DP-1: DP-1 Inflow=0.55 cfs 2,032 cf
Primary=0.55 cfs 2,032 cf

Link DP-2: Wooded Area South of Site Inflow=1.05 cfs 4,568 cf
Primary=1.05 cfs 4,568 cf

Total Runoff Area = 63,033 sf Runoff Volume = 18,151 cf Average Runoff Depth = 3.46"
45.44% Pervious = 28,644 sf 54.56% Impervious = 34,389 sf

Summary for Subcatchment 1S: Area1

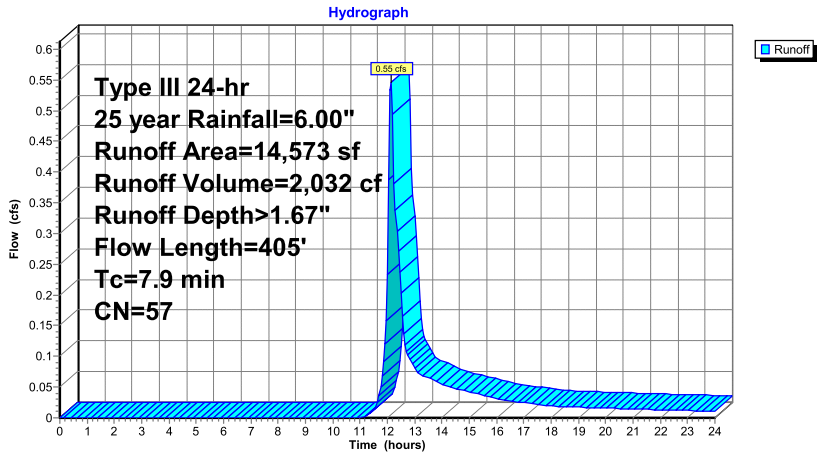
Runoff = 0.55 cfs @ 12.13 hrs, Volume= 2,032 cf, Depth> 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=6.00"

Area (sf)	CN	Description
12,274	49	50-75% Grass cover, Fair, HSG A
2,299	98	Paved parking, HSG A
14,573	57	Weighted Average
12,274		84.22% Pervious Area
2,299		15.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Roadway Gutter** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1S: Area1



Summary for Subcatchment 2A: Area 2A

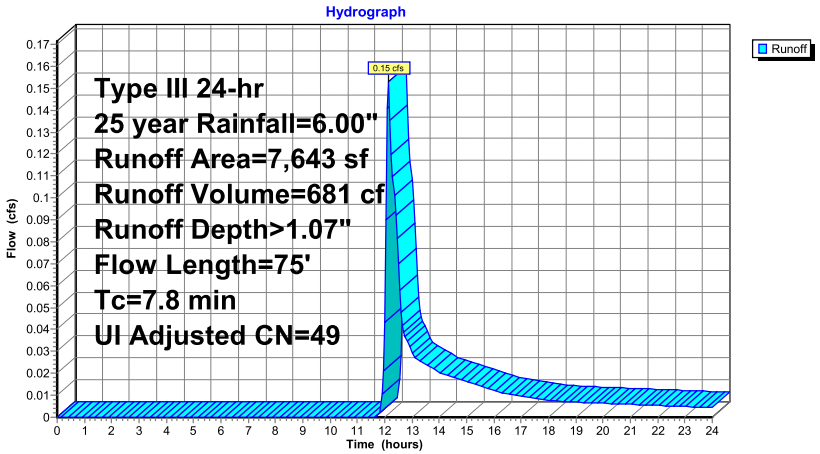
Runoff = 0.15 cfs @ 12.15 hrs, Volume= 681 cf, Depth> 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=6.00"

Area (sf)	CN	Adj	Description
6,666	49		50-75% Grass cover, Fair, HSG A
52	98		Paved parking, HSG A
300	98		Unconnected roofs, HSG A
625	36		Woods, Fair, HSG A
7,643	50	49	Weighted Average, UI Adjusted
7,291			95.39% Pervious Area
352			4.61% Impervious Area
300			85.23% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area 2A



Summary for Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof

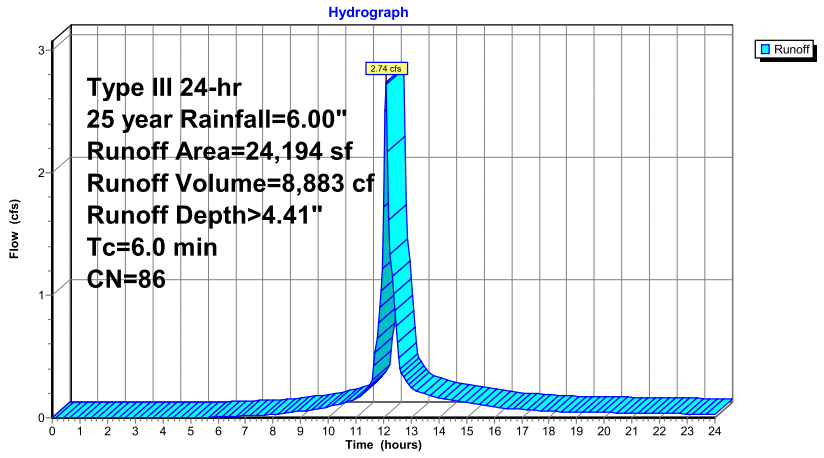
Runoff = 2.74 cfs @ 12.09 hrs, Volume= 8,883 cf, Depth> 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=6.00"

Area (sf)	CN	Description
5,593	49	50-75% Grass cover, Fair, HSG A
11,381	98	Paved parking, HSG A
6,208	98	Unconnected roofs, HSG A
1,012	76	Gravel roads, HSG A
24,194	86	Weighted Average
6,605		27.30% Pervious Area
17,589		72.70% Impervious Area
6,208		35.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Sheet Flow over Impervious Area**

Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof



Summary for Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking

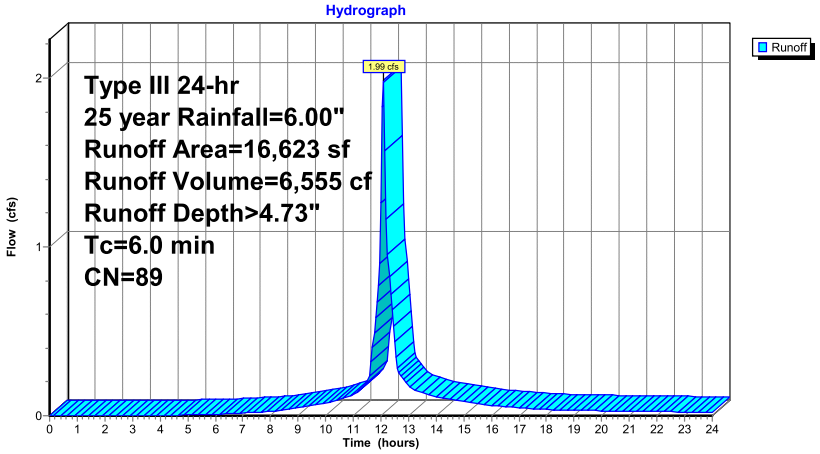
Runoff = 1.99 cfs @ 12.09 hrs, Volume= 6,555 cf, Depth> 4.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year Rainfall=6.00"

Area (sf)	CN	Description
7,620	98	Unconnected roofs, HSG A
6,529	98	Paved parking, HSG A
2,474	39	>75% Grass cover, Good, HSG A
16,623	89	Weighted Average
2,474		14.88% Pervious Area
14,149		85.12% Impervious Area
7,620		53.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking



Summary for Pond 8P: INF 2 & INF-3

Inflow Area = 16,623 sf, 85.12% Impervious, Inflow Depth > 4.73" for 25 year event
Inflow = 1.99 cfs @ 12.09 hrs, Volume= 6,555 cf
Outflow = 0.53 cfs @ 12.45 hrs, Volume= 6,551 cf, Atten= 73%, Lag= 21.9 min
Discarded = 0.11 cfs @ 10.85 hrs, Volume= 5,371 cf
Primary = 0.42 cfs @ 12.45 hrs, Volume= 1,180 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 133.55' @ 12.45 hrs Surf.Area= 1,676 sf Storage= 2,315 cf

Plug-Flow detention time= 124.7 min calculated for 6,537 cf (100% of inflow)
Center-of-Mass det. time= 124.0 min (911.7 - 787.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.50'	866 cf	**6.33'W x 143.50'L x 3.54'H Field A** 3,219 cf Overall - 1,054 cf Embedded = 2,164 cf x 40.0% Voids
#2A	132.00'	1,054 cf	**Cultec R-330XLHD** x 20 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	131.50'	620 cf	**14.75'W x 52.00'L x 3.21'H Field B** 2,461 cf Overall - 911 cf Embedded = 1,550 cf x 40.0% Voids
#4B	132.00'	911 cf	**Cultec R-280HD** x 21 Inside #3 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 3 rows
		3,451 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**2.810 in/hr Exfiltration over Horizontal area**
#2	Primary	133.00'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 133.00' / 132.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	133.10'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	134.40'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.11 cfs @ 10.85 hrs HW=131.54' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.42 cfs @ 12.45 hrs HW=133.55' (Free Discharge)
└**2=Culvert** (Passes 0.42 cfs of 0.87 cfs potential flow)
  └**3=Orifice/Grate** (Orifice Controls 0.42 cfs @ 2.27 fps)
  └**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 8P: INF 2 & INF-3 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

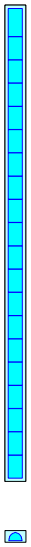
20 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 141.50' Row Length +12.0" End Stone x 2 = 143.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 1,054.3 cf Chamber Storage

3,218.8 cf Field - 1,054.3 cf Chambers = 2,164.5 cf Stone x 40.0% Voids = 865.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,920.1 cf = 0.044 af
Overall Storage Efficiency = 59.7%
Overall System Size = 143.50' x 6.33' x 3.54'

20 Chambers
119.2 cy Field
80.2 cy Stone



Pond 8P: INF 2 & INF-3 - Chamber Wizard Field B

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 3 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

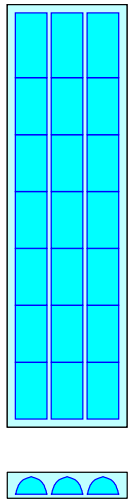
7 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 50.00' Row Length +12.0" End Stone x 2 = 52.00' Base Length
3 Rows x 47.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 14.75' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

21 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 3 Rows = 910.8 cf Chamber Storage

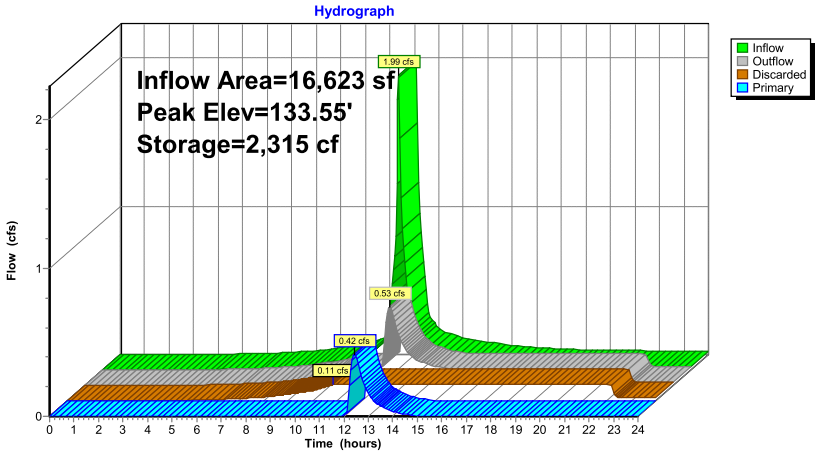
2,460.8 cf Field - 910.8 cf Chambers = 1,550.0 cf Stone x 40.0% Voids = 620.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,530.8 cf = 0.035 af
Overall Storage Efficiency = 62.2%
Overall System Size = 52.00' x 14.75' x 3.21'

21 Chambers
91.1 cy Field
57.4 cy Stone



Pond 8P: INF 2 & INF-3



Summary for Pond 9P: INF-1

Inflow Area = 24,194 sf, 72.70% Impervious, Inflow Depth > 4.41" for 25 year event
Inflow = 2.74 cfs @ 12.09 hrs, Volume= 8,883 cf
Outflow = 0.69 cfs @ 12.47 hrs, Volume= 8,877 cf, Atten= 75%, Lag= 22.9 min
Discarded = 0.14 cfs @ 10.95 hrs, Volume= 6,170 cf
Primary = 0.55 cfs @ 12.47 hrs, Volume= 2,707 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 133.10' @ 12.47 hrs Surf.Area= 0.051 ac Storage= 0.068 af

Plug-Flow detention time= 75.9 min calculated for 8,859 cf (100% of inflow)
Center-of-Mass det. time= 75.3 min (872.5 - 797.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.20'	0.033 af	**25.67'W x 66.50'L x 3.54'H Field A** 0.139 af Overall - 0.055 af Embedded = 0.084 af x 40.0% Voids
#2A	131.70'	0.055 af	**Cultec R-330XLHD** x 45 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 5 rows
#3C	131.20'	0.010 af	**16.00'W x 31.50'L x 3.54'H Field C** 0.041 af Overall - 0.015 af Embedded = 0.026 af x 40.0% Voids
#4C	131.70'	0.015 af	**Cultec R-330XLHD** x 12 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		0.114 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.20'	**2.810 in/hr Exfiltration over Surface area**
#2	Primary	131.70'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 131.70' / 131.55' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	132.20'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	133.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	134.20'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.14 cfs @ 10.95 hrs HW=131.24' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.55 cfs @ 12.47 hrs HW=133.10' (Free Discharge)
└**2=Culvert** (Passes 0.55 cfs of 2.83 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.55 cfs @ 4.00 fps)
  ├**4=Orifice/Grate** (Controls 0.00 cfs)
  └**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9P: INF-1 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 5 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

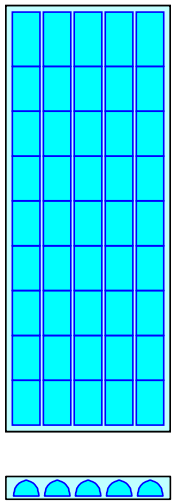
9 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 64.50' Row Length +12.0" End Stone x 2 = 66.50' Base Length
5 Rows x 52.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.67' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

45 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 5 Rows = 2,402.9 cf Chamber Storage

6,045.0 cf Field - 2,402.9 cf Chambers = 3,642.1 cf Stone x 40.0% Voids = 1,456.8 cf Stone Storage

Chamber Storage + Stone Storage = 3,859.8 cf = 0.089 af
Overall Storage Efficiency = 63.9%
Overall System Size = 66.50' x 25.67' x 3.54'

45 Chambers
223.9 cy Field
134.9 cy Stone



Pond 9P: INF-1 - Chamber Wizard Field C

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

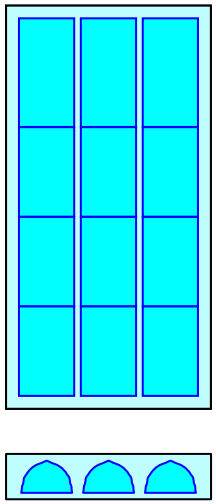
4 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 29.50' Row Length +12.0" End Stone x 2 = 31.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

12 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 659.4 cf Chamber Storage

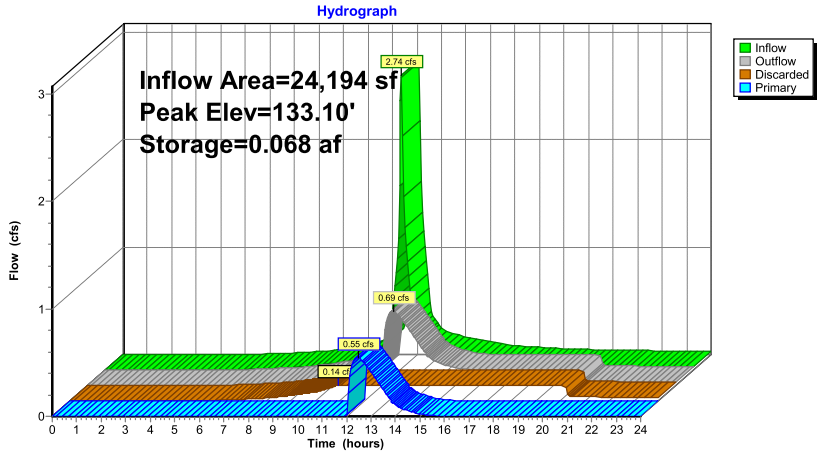
1,785.0 cf Field - 659.4 cf Chambers = 1,125.6 cf Stone x 40.0% Voids = 450.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,109.6 cf = 0.025 af
Overall Storage Efficiency = 62.2%
Overall System Size = 31.50' x 16.00' x 3.54'

12 Chambers
66.1 cy Field
41.7 cy Stone



Pond 9P: INF-1

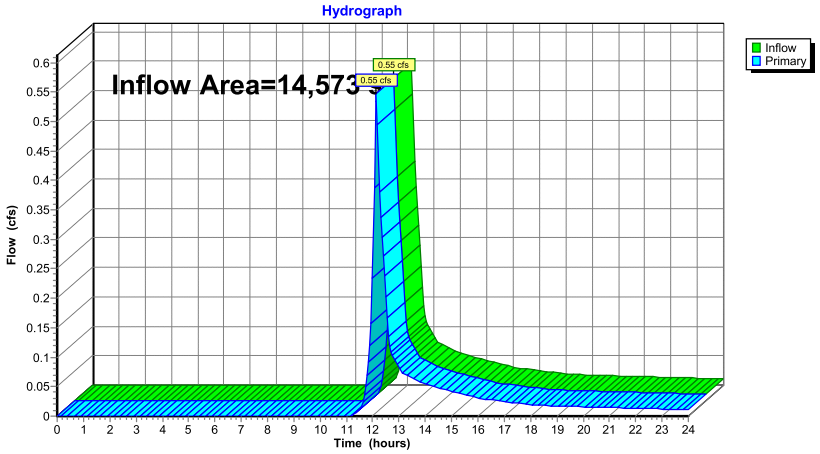


Summary for Link DP-1: DP-1

Inflow Area = 14,573 sf, 15.78% Impervious, Inflow Depth > 1.67" for 25 year event
Inflow = 0.55 cfs @ 12.13 hrs, Volume= 2,032 cf
Primary = 0.55 cfs @ 12.13 hrs, Volume= 2,032 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: DP-1

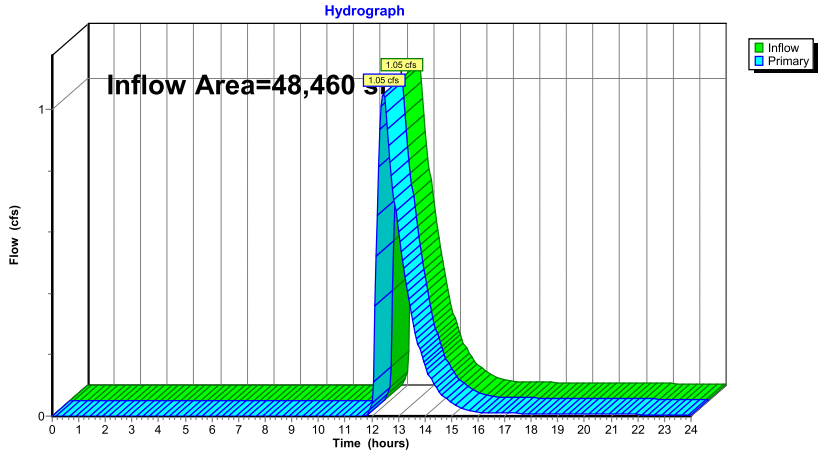


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 48,460 sf, 66.22% Impervious, Inflow Depth > 1.13" for 25 year event
Inflow = 1.05 cfs @ 12.44 hrs, Volume= 4,568 cf
Primary = 1.05 cfs @ 12.44 hrs, Volume= 4,568 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area1 Runoff Area=14,573 sf 15.78% Impervious Runoff Depth>3.43"
Flow Length=405' Tc=7.9 min CN=57 Runoff=1.22 cfs 4,166 cf

Subcatchment 2A: Area 2A Runoff Area=7,643 sf 4.61% Impervious Runoff Depth>2.51"
Flow Length=75' Tc=7.8 min UI Adjusted CN=49 Runoff=0.44 cfs 1,596 cf

Subcatchment 2B: Area 2B - Vehicular Runoff Area=24,194 sf 72.70% Impervious Runoff Depth>6.91"
Tc=6.0 min CN=86 Runoff=4.20 cfs 13,930 cf

Subcatchment 2C: Area 2C - Admin Bldg Runoff Area=16,623 sf 85.12% Impervious Runoff Depth>7.27"
Tc=6.0 min CN=89 Runoff=2.98 cfs 10,073 cf

Pond 8P: INF 2 & INF-3 Peak Elev=134.46' Storage=3,163 cf Inflow=2.98 cfs 10,073 cf
Discarded=0.11 cfs 6,438 cf Primary=1.17 cfs 3,604 cf Outflow=1.28 cfs 10,042 cf

Pond 9P: INF-1 Peak Elev=134.23' Storage=0.104 af Inflow=4.20 cfs 13,930 cf
Discarded=0.14 cfs 7,630 cf Primary=1.37 cfs 6,292 cf Outflow=1.51 cfs 13,921 cf

Link DP-1: DP-1 Inflow=1.22 cfs 4,166 cf
Primary=1.22 cfs 4,166 cf

Link DP-2: Wooded Area South of Site Inflow=2.73 cfs 11,492 cf
Primary=2.73 cfs 11,492 cf

Total Runoff Area = 63,033 sf Runoff Volume = 29,765 cf Average Runoff Depth = 5.67"
45.44% Pervious = 28,644 sf 54.56% Impervious = 34,389 sf

Summary for Subcatchment 1S: Area1

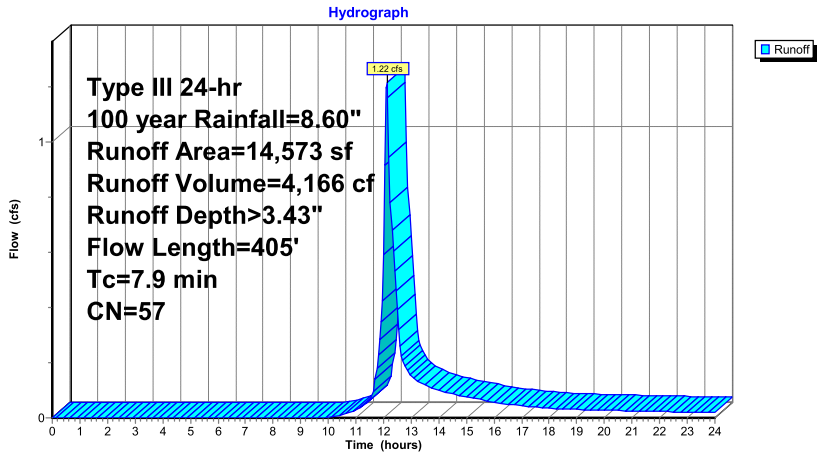
Runoff = 1.22 cfs @ 12.12 hrs, Volume= 4,166 cf, Depth> 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=8.60"

Area (sf)	CN	Description
12,274	49	50-75% Grass cover, Fair, HSG A
2,299	98	Paved parking, HSG A
14,573	57	Weighted Average
12,274		84.22% Pervious Area
2,299		15.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	99	0.0600	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	306	0.0260	3.27		**Shallow Concentrated Flow, Roadway Gutter** Paved Kv= 20.3 fps
7.9	405	Total			

Subcatchment 1S: Area1



Summary for Subcatchment 2A: Area 2A

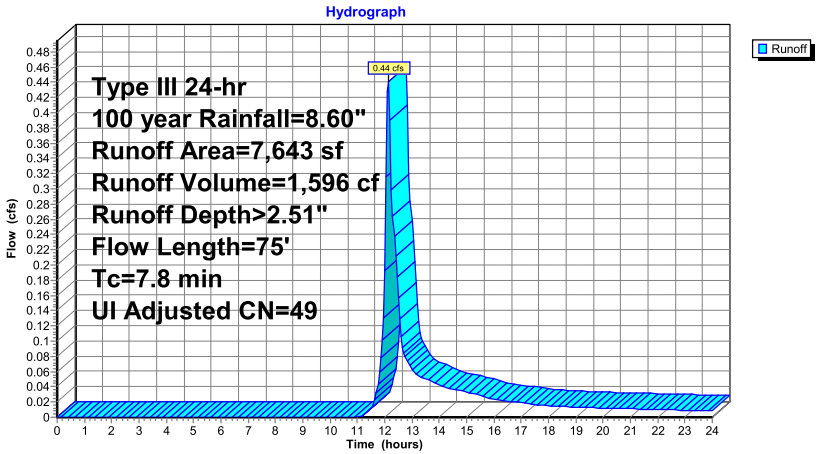
Runoff = 0.44 cfs @ 12.12 hrs, Volume= 1,596 cf, Depth> 2.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=8.60"

Area (sf)	CN	Adj	Description
6,666	49		50-75% Grass cover, Fair, HSG A
52	98		Paved parking, HSG A
300	98		Unconnected roofs, HSG A
625	36		Woods, Fair, HSG A
7,643	50	49	Weighted Average, UI Adjusted
7,291			95.39% Pervious Area
352			4.61% Impervious Area
300			85.23% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	11	0.0450	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	15	0.0690	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
6.4	49	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
7.8	75	Total			

Subcatchment 2A: Area 2A



Summary for Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof

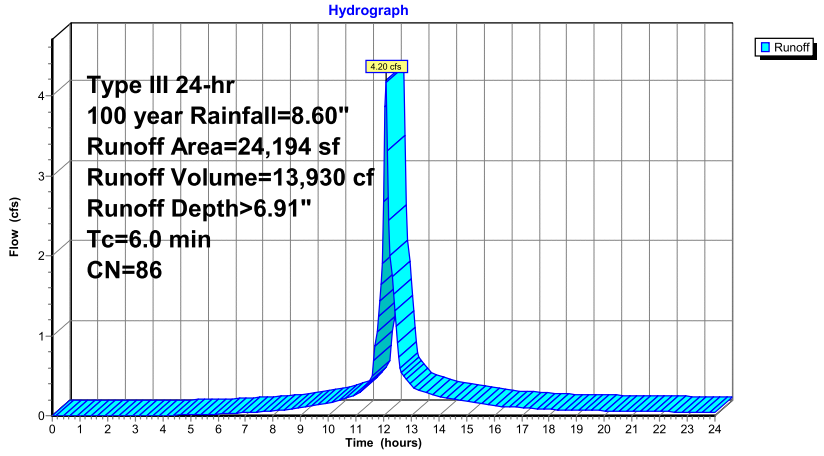
Runoff = 4.20 cfs @ 12.09 hrs, Volume= 13,930 cf, Depth> 6.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=8.60"

Area (sf)	CN	Description
5,593	49	50-75% Grass cover, Fair, HSG A
11,381	98	Paved parking, HSG A
6,208	98	Unconnected roofs, HSG A
1,012	76	Gravel roads, HSG A
24,194	86	Weighted Average
6,605		27.30% Pervious Area
17,589		72.70% Impervious Area
6,208		35.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Sheet Flow over Impervious Area**

Subcatchment 2B: Area 2B - Vehicular Area & Garage Roof



Summary for Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking

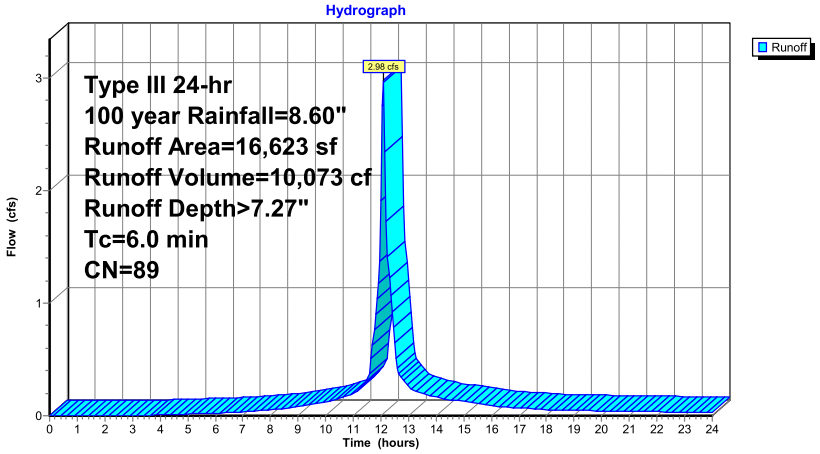
Runoff = 2.98 cfs @ 12.09 hrs, Volume= 10,073 cf, Depth> 7.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=8.60"

Area (sf)	CN	Description
7,620	98	Unconnected roofs, HSG A
6,529	98	Paved parking, HSG A
2,474	39	>75% Grass cover, Good, HSG A
16,623	89	Weighted Average
2,474		14.88% Pervious Area
14,149		85.12% Impervious Area
7,620		53.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 2C: Area 2C - Admin Bldg Roof & Parking



Summary for Pond 8P: INF 2 & INF-3

Inflow Area = 16,623 sf, 85.12% Impervious, Inflow Depth > 7.27" for 100 year event
Inflow = 2.98 cfs @ 12.09 hrs, Volume= 10,073 cf
Outflow = 1.28 cfs @ 12.30 hrs, Volume= 10,042 cf, Atten= 57%, Lag= 12.7 min
Discarded = 0.11 cfs @ 9.75 hrs, Volume= 6,438 cf
Primary = 1.17 cfs @ 12.30 hrs, Volume= 3,604 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 134.46' @ 12.30 hrs Surf.Area= 1,676 sf Storage= 3,163 cf

Plug-Flow detention time= 106.7 min calculated for 10,021 cf (99% of inflow)
Center-of-Mass det. time= 104.5 min (881.0 - 776.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.50'	866 cf	**6.33'W x 143.50'L x 3.54'H Field A** 3,219 cf Overall - 1,054 cf Embedded = 2,164 cf x 40.0% Voids
#2A	132.00'	1,054 cf	**Cultec R-330XLHD** x 20 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	131.50'	620 cf	**14.75'W x 52.00'L x 3.21'H Field B** 2,461 cf Overall - 911 cf Embedded = 1,550 cf x 40.0% Voids
#4B	132.00'	911 cf	**Cultec R-280HD** x 21 Inside #3 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 3 rows
		3,451 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**2.810 in/hr Exfiltration over Horizontal area**
#2	Primary	133.00'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 133.00' / 132.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	133.10'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	134.40'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.11 cfs @ 9.75 hrs HW=131.54' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=1.16 cfs @ 12.30 hrs HW=134.46' (Free Discharge)
└**2=Culvert** (Passes 1.16 cfs of 2.93 cfs potential flow)
  └**3=Orifice/Grate** (Orifice Controls 1.00 cfs @ 5.08 fps)
  └**4=Broad-Crested Rectangular Weir** (Weir Controls 0.17 cfs @ 0.69 fps)

Pond 8P: INF 2 & INF-3 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

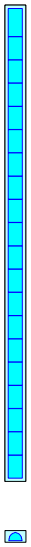
20 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 141.50' Row Length +12.0" End Stone x 2 = 143.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 1,054.3 cf Chamber Storage

3,218.8 cf Field - 1,054.3 cf Chambers = 2,164.5 cf Stone x 40.0% Voids = 865.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,920.1 cf = 0.044 af
Overall Storage Efficiency = 59.7%
Overall System Size = 143.50' x 6.33' x 3.54'

20 Chambers
119.2 cy Field
80.2 cy Stone



Pond 8P: INF 2 & INF-3 - Chamber Wizard Field B

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 3 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

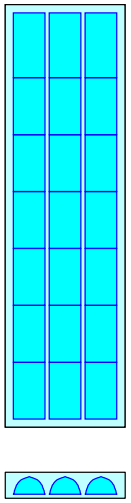
7 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 50.00' Row Length +12.0" End Stone x 2 = 52.00' Base Length
3 Rows x 47.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 14.75' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

21 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 3 Rows = 910.8 cf Chamber Storage

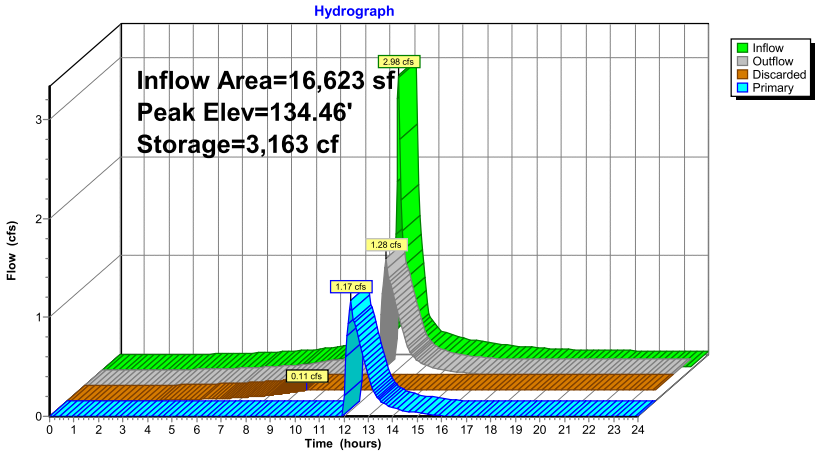
2,460.8 cf Field - 910.8 cf Chambers = 1,550.0 cf Stone x 40.0% Voids = 620.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,530.8 cf = 0.035 af
Overall Storage Efficiency = 62.2%
Overall System Size = 52.00' x 14.75' x 3.21'

21 Chambers
91.1 cy Field
57.4 cy Stone



Pond 8P: INF 2 & INF-3



Summary for Pond 9P: INF-1

Inflow Area = 24,194 sf, 72.70% Impervious, Inflow Depth > 6.91" for 100 year event
Inflow = 4.20 cfs @ 12.09 hrs, Volume= 13,930 cf
Outflow = 1.51 cfs @ 12.36 hrs, Volume= 13,921 cf, Atten= 64%, Lag= 16.1 min
Discarded = 0.14 cfs @ 9.85 hrs, Volume= 7,630 cf
Primary = 1.37 cfs @ 12.36 hrs, Volume= 6,292 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 134.23' @ 12.36 hrs Surf.Area= 0.051 ac Storage= 0.104 af

Plug-Flow detention time= 72.0 min calculated for 13,921 cf (100% of inflow)
Center-of-Mass det. time= 71.6 min (856.6 - 784.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	131.20'	0.033 af	**25.67'W x 66.50'L x 3.54'H Field A** 0.139 af Overall - 0.055 af Embedded = 0.084 af x 40.0% Voids
#2A	131.70'	0.055 af	**Cultec R-330XLHD** x 45 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 5 rows
#3C	131.20'	0.010 af	**16.00'W x 31.50'L x 3.54'H Field C** 0.041 af Overall - 0.015 af Embedded = 0.026 af x 40.0% Voids
#4C	131.70'	0.015 af	**Cultec R-330XLHD** x 12 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		0.114 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.20'	**2.810 in/hr Exfiltration over Surface area**
#2	Primary	131.70'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 131.70' / 131.55' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	132.20'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	133.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	134.20'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.14 cfs @ 9.85 hrs HW=131.24' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=1.36 cfs @ 12.36 hrs HW=134.23' (Free Discharge)
└**2=Culvert** (Passes 1.36 cfs of 4.25 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.89 cfs @ 6.49 fps)
  ├**4=Orifice/Grate** (Orifice Controls 0.42 cfs @ 3.11 fps)
  └**5=Broad-Crested Rectangular Weir** (Weir Controls 0.05 cfs @ 0.45 fps)

Pond 9P: INF-1 - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 5 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

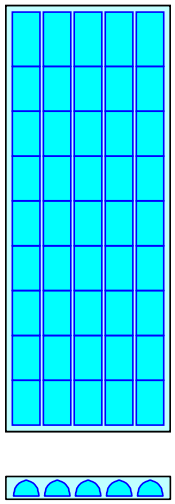
9 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 64.50' Row Length +12.0" End Stone x 2 = 66.50' Base Length
5 Rows x 52.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.67' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

45 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 5 Rows = 2,402.9 cf Chamber Storage

6,045.0 cf Field - 2,402.9 cf Chambers = 3,642.1 cf Stone x 40.0% Voids = 1,456.8 cf Stone Storage

Chamber Storage + Stone Storage = 3,859.8 cf = 0.089 af
Overall Storage Efficiency = 63.9%
Overall System Size = 66.50' x 25.67' x 3.54'

45 Chambers
223.9 cy Field
134.9 cy Stone



Pond 9P: INF-1 - Chamber Wizard Field C

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

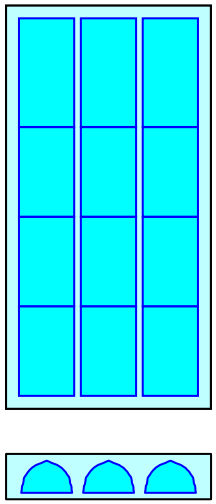
4 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 29.50' Row Length +12.0" End Stone x 2 = 31.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

12 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 659.4 cf Chamber Storage

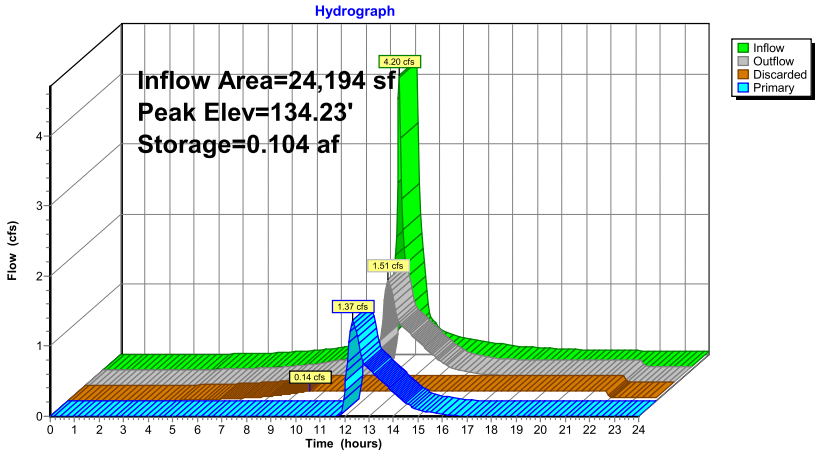
1,785.0 cf Field - 659.4 cf Chambers = 1,125.6 cf Stone x 40.0% Voids = 450.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,109.6 cf = 0.025 af
Overall Storage Efficiency = 62.2%
Overall System Size = 31.50' x 16.00' x 3.54'

12 Chambers
66.1 cy Field
41.7 cy Stone



Pond 9P: INF-1

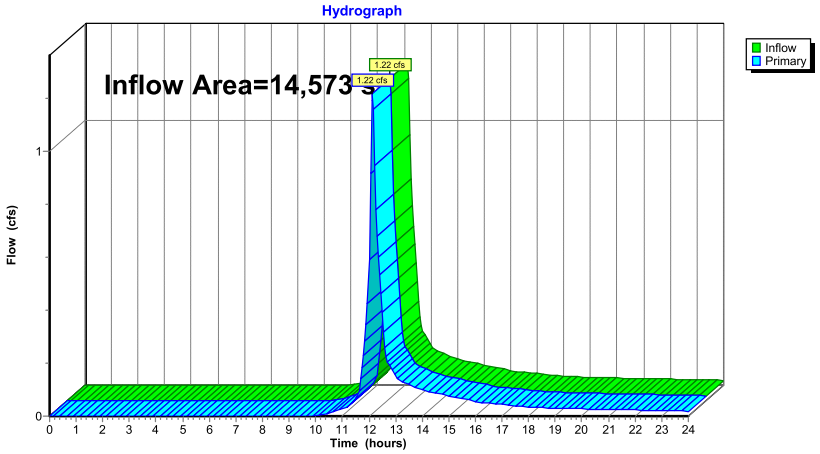


Summary for Link DP-1: DP-1

Inflow Area = 14,573 sf, 15.78% Impervious, Inflow Depth > 3.43" for 100 year event
Inflow = 1.22 cfs @ 12.12 hrs, Volume= 4,166 cf
Primary = 1.22 cfs @ 12.12 hrs, Volume= 4,166 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-1: DP-1

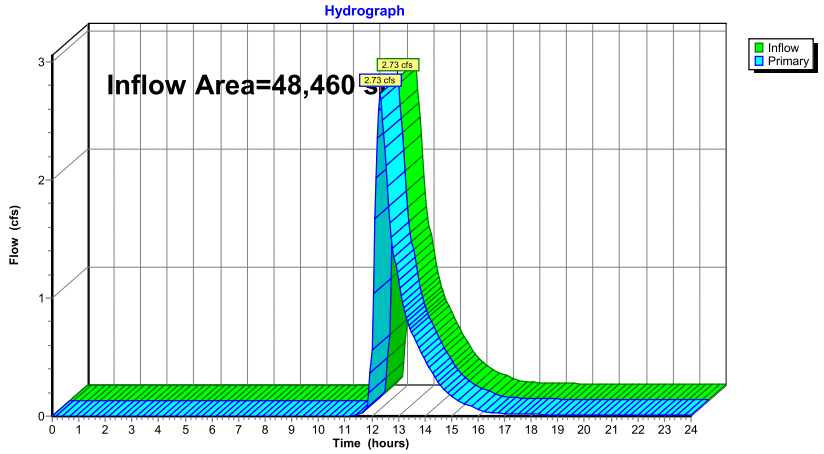


Summary for Link DP-2: Wooded Area South of Site

Inflow Area = 48,460 sf, 66.22% Impervious, Inflow Depth > 2.85" for 100 year event
Inflow = 2.73 cfs @ 12.31 hrs, Volume= 11,492 cf
Primary = 2.73 cfs @ 12.31 hrs, Volume= 11,492 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link DP-2: Wooded Area South of Site



APPENDIX C

Sudbury Water District
Recharge Calculation

Required Recharge

Area Summary	
	Area (SF)*
Existing Impervious	22,871
Proposed Impervious	34,389
Required Recharge Area *(Proposed - Existing)*	11,518

* Areas calculated in HydroCAD

Note: Site consists of sandy soils; therefore, soils are HSG A.

Hydrologic Soil Group Summary		
Group	Target Depth Factor (in)	Area (SF)
A	0.6	11,518
B	0.35	0
C	0.25	0
D	0.1	0

Required Recharge (*Rv*) Calculation:

Rv = Target Depth Factor x Δ Impervious Area
Rv = 0.6 x (1/12) x 11,518
Rv = 576 CF

Proposed Recharge Summary
Detailed calculations on following pages

Location	Volume (CF)
Infiltrtion System -1 (INF-1)	1,284
Infiltrtion System - 2 (INF-2)	828
Infiltration System - 3 (INF-3)	879
Total	2,990

Rv = 576 CF
Provided recharge = 2,990 CF

Recharge Requirement is exceeded.

Proposed Recharge

Infiltration System - 1 (9P)
Cultec R-330XLHD

Base stone area	2,211	SF	
Stone storage height	1.00	FT	
Gross Stone storage volume	2,211	CF	
Stone void ratio	33%		
Net Stone storage volume	730	CF	
Avail. Cultec R-33XLHD Storage	2,116.2	CF	(57 chambers)
Total cross-sectional area	59.60	SF	
Cultec R-330XLHD elevation	131.70	FT	
Orifice elevation	132.20	FT	
Chamber storage height	0.50	FT	
Cross-sectional area @ 132.2 FT	15.60	SF	
Effective chamber volume	554	CF	
Stone and Chamber storage volume	1,284	CF	

Infiltration System - 2 (8P)
Cultec R-280HD

Base stone area	767	SF	
Stone storage height	1.00	FT	
Gross Stone storage volume	767	CF	
Stone void ratio	33%		
Net Stone storage volume	253	CF	
Avail. Cultec R-280 HD Storage	910.8	CF	(21 chambers)
Total cross-sectional area	18.21	SF	
Cultec R-330XLHD elevation	132.00	FT	
Orifice elevation	133.10	FT	
Chamber storage height	1.10	FT	
Cross-sectional area @ 133.1 FT	11.49	SF	
Effective chamber volume	575	CF	
Stone and Chamber storage volume	828	CF	

Infiltration System - 3 (8P)
Cultec R-330XLHD

Base stone area	905	SF	
Stone storage height	1.00	FT	
Gross Stone storage volume	905	CF	
Stone void ratio	33%		
Net Stone storage volume	299	CF	
Avail. Cultec R-330XLHD Storage	1,054.3	CF	20 Chambers
Total cross-sectional area	7.45	SF	
Cultec R-330XLHD elevation	132.00	FT	
Orifice elevation	133.10	FT	
Chamber storage height	1.10	FT	
Cross-sectional area @ 133.1 FT	4.10	SF	
Effective chamber volume	580	CF	
Stone and Chamber storage volume	879	CF	

Sudbury Water District
Drawdown Calculations

-- Maximum drawdown time is 72 hours --

Time to drawdown calculation

$$\text{Time} = \frac{Rv}{k * \text{bottom area}}$$

where,

Rv =	storage volume
k =	saturated hydraulic conductivity rate
bottom area =	average surface storage area of recharge structure

Proposed Storage Drawdown Calcuations

Infiltrtion System 1 (Pond 9P)			
Net storage volume		1,284	CF
Bottom area		2,211	SF
k		2.41	in/hr *
Time =	2.89	hours	

Proposed drawdown time is acceptable.

Infiltration System 2 (Pond 8P)			
Net storage volume		828	CF
Bottom area		767	SF
k		2.41	in/hr *
Time =	5.37	hours	

Proposed drawdown time is acceptable.

Infiltration System 3 (Pond 8P)			
Net storage volume		879	CF
Bottom area		905	SF
k		2.41	in/hr *
Time =	4.83	hours	

Proposed drawdown time is acceptable.

Note: Test Pits indicated loamy sand soil; therefore, the Rawl's rate of 2.41 in/hr was used.

Sudbury Water District
Water Quality Volume

Standard 4 Water Quality

As stated in the Stormwater Handbook, the required water quality volume equals 1.0 inches of runoff times the total impervious area of the post-development site.

Proposed Impervious Area						34,389	SF
Req'd Water Quality Volume							
34,389	sf	x	1"	x	1'/12"	= 2,866	CF
Provided Recharge Volume					=	2,990	CF

WQV Requirement is exceeded.

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Infiltration System 1 (INF-1)

TSS Removal Calculation

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Hydrodynamic separator	**0.50**	**0.75**	**0.38**	**0.37**
Infiltration Basin	**0.80**	**0.37**	**0.30**	**0.07**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Sudbury Water District

Prepared By: Elena Compter

Date: 6/27/2018

*Equals remaining load from previous BMP (E) which enters the BMP

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Infiltration System 2 & 3 (INF-2 & INF-3)

TSS Removal Calculation

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Hydrodynamic separator	**0.50**	**0.75**	**0.38**	**0.37**
Infiltration Basin	**0.80**	**0.37**	**0.30**	**0.07**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Sudbury Water District

Prepared By: Elena Compter

Date: 6/27/2018

*Equals remaining load from previous BMP (E) which enters the BMP

NJCAT TECHNOLOGY VERIFICATION

Downstream Defender® Stormwater Treatment Device

Hydro International

August, 2015

(Revised Table A-2 January 2017)

Stormwater Solutions

Hydro International

Turning Water Around...®

July 2, 2015

Dr. Richard Magee, Sc.D., P.E., BCEE
Technical Director
New Jersey Corporation for Advanced Technology
c/o Center for Environmental Systems
Stevens Institute of Technology
One Castle Point on Hudson
Hoboken, NJ 07030

Re: Verification of Downstream Defender to NJDEP HDS Laboratory Testing Protocol

Dear Dr. Magee:

Hydro International's Downstream Defender® vortex separator for stormwater treatment recently underwent verification testing according to the NJDEP HDS Laboratory Testing Protocol. As required by the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology", this letter serves as Hydro International's statement that all procedures and requirements identified in the aforementioned protocol and process document were met or exceeded. The 4-ft Downstream Defender removal efficiency and scour testing at Hydro International's laboratory facility in Portland, Maine was conducted under the direct supervision of FB Environmental Associates. Analysis of all water quality samples was conducted by the independent analytical laboratory, Maine Environmental Laboratory. The particle size gradations of all sediment samples were analyzed by the independent analytical laboratory, GeoTesting Express. Additionally, the preparation of the verification report and the documentation contained therein fulfill the submission requirements of the process document and protocol.

If you have any questions or comments regarding the verification of the Downstream Defender, please do not hesitate to contact us.

Sincerely,

Lisa Lemont, CPSWQ
Business Development Manager

Andrew Anastasio
Product Development Engineer

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Center for Environmental Systems
Stevens Institute of Technology
One Castle Point
Hoboken, NJ 07030-0000

July 20, 2015

Lisa Schafer
Environmental Engineer
New Jersey Department of Environmental Protection
Bureau of Nonpoint Pollution Control
401-02B, PO Box 420
Trenton, NJ 08625-0420

Dear Ms. Schafer,

Based on my review, evaluation and assessment of the testing conducted on the Downstream Defender® Stormwater Treatment Device by Hydro International and observed by FB Environmental Associates, the test protocol requirements contained in the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" (NJDEP HDS Protocol) were met or exceeded. Specifically:

Test Sediment Feed

The mean PSD of Hydro Internationals test sediments comply with the PSD criteria established by the NJDEP HDS protocol. The Hydro International removal efficiency test sediment PSD analysis was plotted against the NJDEP removal efficiency test PSD specification. The test sediment was shown to be slightly finer than the sediment blend specified by the protocol. The Hydro International scour test sediment PSD analysis was plotted against the NJDEP removal efficiency test PSD specification and shown to be much finer than specified by the protocol.

Removal Efficiency Testing

In accordance with the NJDEP HDS Protocol, removal efficiency testing was executed on the 4-ft. laboratory unit in order to establish the ability of the Downstream Defender to remove the specified test sediment at 25%, 50%, 75%, 100% and 125% of the target MTFR. Prior to the start of testing Hydro International reviewed existing data and decided to utilize a target MTFR

of 1.12 cfs. This target was chosen based on the ultimate goal of demonstrating greater than 50% annualized weighted solids removal as defined in the NJDEP HDS Protocol. The flow rates, feed rates and influent concentration all met the NJDEP HDS test protocol's coefficient of variance requirements and the background concentration for all five test runs never exceeded 20 mg/L.

Scour Testing

In order to demonstrate the ability of the Downstream Defender to be used as an online treatment device scour testing was conducted at greater than 200% of MTFR in accordance with the NJDEP HDS Protocol. The average flow rate during the online scour test was 2.28 cfs, which is equivalent to 263% of the MTFR (MTFR = 1.12 cfs). Background concentrations ranged from 5 mg/L to 7 mg/L with a mean of 6 mg/L, which complies with the 20 mg/L maximum background concentration specified by the test protocol. Unadjusted effluent concentrations ranged from 10 mg/L to 16 mg/L with a mean of 13 mg/L. When adjusted for background concentrations, the effluent concentrations range from 4 to 10 mg/L with a mean of 7 mg/L. These results confirm that the 4-ft. Downstream Defender did not scour at 263% MTFR and meets the criteria for online use.

Maintenance Frequency

The predicted maintenance frequency for all models exceeds 6 years.

Sincerely,

Richard S. Magee, Sc.D., P.E., BCEE

8. References

ASTM D422-63. *Standard Test Method for Particle-size Analysis of Soils.*

ASTM D3977-97. *Standard Test Methods for Determining Concentrations in Water Samples*.

Hydro International 2015. *Quality Assurance Project Plan for Downstream Defender® NJDEP Testing.* Prepared by H.I.L. Technology, Inc. dba Hydro International. March 20, 2015.

Hydro International 2015. *Verification Testing Report for the Downstream Defender Stormwater Treatment Device*. Prepared by H.I.L. Technology, Inc. dba Hydro International. July 2, 2015

New Jersey Corporation for Advanced Technology. *Downstream Defender® Stormwater Treatment Device: Hydro International.* January 2015.

NJDEP 2013a. *New Jersey Department of Environmental Protection Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology*. Trenton, NJ. January 25, 2013.

NJDEP 2013b. *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device.* Trenton, NJ. January 25, 2013.

VERIFICATION APPENDIX

Introduction

- Manufacturer – Hydro International, 94 Hutchins Drive, Portland, ME 04102. *General Phone: (207)756-6200. Website:* www.hydro-int.com/us.

- MTD – Downstream Defender Stormwater Treatment Device. Verified Downstream Defender Models are shown in Table A-1

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- TSS Removal Rate – 50%

- On-line installation

Detailed Specification

- NJDEP sizing tables are attached as Table A-1 and A-2.

- Pick weights and installation procedures vary slightly with model size. Hydro International provides contractors with project-specific unit pick weights and installation instructions prior to delivery.

- Maximum recommended sediment depth prior to cleanout is 9 inches.

- For a reference maintenance plan, download the Downstream Defender Operation & Maintenance Manual at: http://www.hydro-int.com/UserFiles/downloads/DD-Operation%20And%20Maintenance%20Manual_0.pdf

- Under N.J.A.C. 7:8-5.5, NJDEP stormwater design requirements do not allow a hydrodynamic separator such as the Downstream Defender to be used in series with another hydrodynamic separator to achieve an enhanced total suspended solids (TSS) removal rate.

Table A-1 MTFRs and Required Sediment Removal Intervals for Downstream Defender Models

Downstream Defender Model	Manhole Diameter (ft)	NJDEP 50% TSS Maximum Treatment Flow Rate (cfs)	Treatment Area (ft^2)	Hydraulic Loading Rate (gpm/ft^2)	50% Max Sediment Storage Volume (ft^3)	Required Sediment Removal Interval[1] (Months)
4-ft	4-ft	1.12	12.6	40.0	9.45	60
6-ft	6-ft	2.52	28.3	40.0	28.35	80
8-ft	8-ft	4.49	50.3	40.0	62.78	99
10-ft	10-ft	7.00	78.5	40.0	117.45	119
12-ft	12-ft	10.08	113.1	40.0	198.45	140

[1] Required sediment removal interval was calculated using the equation specified in Appendix B Part B of the NJDEP Laboratory Protocol for HDS MTDs:

Sediment Removal Interval (months) = (50% HDS MTD Max Sediment Storage Volume * 3.57) / (MTFR * TSS Removal Efficiency)

Table A-2 Standard Dimensions for Downstream Defender Models (Revised January 2017)

Downstream Defender Model and Manhole Diameter (ft)	Chamber Depth (ft)	Treatment Chamber Depth* (ft)	Total Wet Volume (ft^3)	Aspect Ratio Treatment Chamber Depth:Dia	Detention Time at MTFR (sec)	Maximum Pipe Diameter (in)	Sediment Sump Depth (ft)	50% Max Sediment Storage Volume (ft^3)
4-ft	4.08	3.33	51.5	0.83	46	12	1.5	9.45
6-ft	5.83	4.83	167.1	0.81	66	18	2.0	28.35
8-ft	7.67	6.42	385.6	0.80	86	24	2.5	62.78
10-ft	9.42	7.92	740.8	0.79	106	30	3.0	117.45
12-ft	11.17	9.42	1264.7	0.79	125	36	3.5	198.45

*Treatment chamber depth is the chamber depth minus ½ the sediment sump depth. Larger models (>250% MTFR of the tested unit) must be geometrically proportionate to the tested unit. A variance of 15%in aspect ratio is allowable.

APPENDIX D

Long-Term Pollution Prevention Plan
Water Department Facility
Sudbury, MA

To meet the requirements of Standard 4 of the Massachusetts Stormwater Handbook, this Long-Term Pollution Prevention Plan is provided to identify the proper procedures of practices for source control and pollution prevention.

Storage and Handling of Oil and other Hazardous Materials

No oil or other hazardous materials will be stored at this site.

Vehicle Washing

There will be no vehicle washing on site.

Operation and Maintenance of Stormwater Control Structures

Included in this appendix is the Operation and Maintenance plan for this site, which includes street sweeping of the paved areas and periodic removal of sediment from catch basins and other stormwater structures. The Sudbury Water Department will be responsible for the implementation of the plan.

Landscaping

The landscaped areas will be maintained by the Sudbury Water District. Fertilizers, if stored on site, will be stored under cover and no fertilizers will be stored within the buffer zone.

Pet Waste Management

Pets are not expected to be accessing the Police Facility; therefore, no measures for pet waste management are implemented in the proposed design.

Septic System

Wastewater will be generated from the building and a new septic system will be installed including a septic tank, pump tank, and leaching chambers. In addition a tight tank will be installed to collect runoff from floor drains in the proposed garage building. Tight tank and septic tank will be pumped out as needed.

De-icing & Snow Disposal

The DPW intends to utilize salt and sand to treat the paved surfaces of the driveways and main circulation areas during snow and ice events.

Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan

SECTION 1: Introduction

The project consists of renovation of an existing Sudbury Water District facility located at 199 Raymond Road to support the operation of the facility and to provide adequate space for administrative and maintenance staff, as well as storage of vehicles. The project will include a complete renovation of existing 4,255 square feet building, a 3,370 square feet addition and a new, self-standing, 5,900 square feet vehicle storage garage. Additional site improvements include new parking and driveway areas, new septic system, and new stromwater management system and various site utilities.

As part of this project, this "Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan" has been developed to ensure that no disturbance to wetland resource areas are created during the construction of these repairs.

SECTION 2: Construction Period Pollution Prevention Measures

Best Management Practices (BMPs) will be utilized as Construction Period Pollution Prevention Measures to reduce potential pollutants and prevent any off-site discharge. The objectives of the BMPs for construction activity are to minimize the disturbed areas, stabilize any disturbed areas, control the site perimeter, and retain sediment. Both erosion and sedimentation controls and non-stormwater best management measures will be used to minimize site disturbance and ensure compliance with the performance standards of the Wetlands Protection Act (WPA) and MassDEP Stormwater Standards. Measures will be taken to minimize the area disturbed by construction activities to reduce the potential for soil erosion and stormwater pollution problems. In addition, good housekeeping measures will be followed for the day-to-day operation of the construction site under the control of the contractor to minimize the impact of construction. This section describes the control practices that will be in place during construction activities. All recommended control practices will comply with the standards set in the MassDEP Stormwater Handbook.

2.1 Minimize Disturbed Area and Protect Natural Features and Soil

To minimize disturbed areas, all work will be completed within well-defined work limits. These work limits are shown on the site plans included with this submission. The Contractor shall not disturb native vegetation without prior approval from the Engineer. The Contractor will be responsible to make sure that all workers know the proper work limits and do not extend their work into the undisturbed areas. The protective measures are described in more detail in the following sections.

2.2 Control Stormwater Flowing onto and through the project

The Contractor will be required to install straw wattles where shown in the attached plan set.

2.3 Stabilize Soils

The Contractor shall limit the area of land which is exposed and free from vegetation during the project. The soils will be exposed for no longer that one week.

2.4 Proper storage and cover of any stockpiles

The location of the Contractor's storage areas for equipment and/or materials shall be upon cleared portions of the job site, or areas to be cleared as a part of this project, and shall require written approval of the Engineer.

Adequate measures for erosion and sediment control, such as the placement of straw wattles around the downstream perimeter of stockpiles, shall be employed to protect any downstream areas from siltation.

There shall be no storage of equipment or materials in areas designated as wetlands.

The Engineer may designate an area, or areas, where the Contractor may store materials used in his operations.

2.5 Perimeter Controls and Sediment Barriers

Erosion control lines as described in Section 5 will be utilized to ensure that no sedimentation occurs outside the perimeter of the work area.

2.6 Storm Drain Inlet Protection

Catch basin protection will be implemented for all catch basins affected by the work area. Silt sacks will be placed in the catch basin to minimize sediment loading into the catch basin.

2.7 Retain Sediment On-Site

The Contractor will be responsible to monitor all erosion control measures. Whenever necessary, the Contractor will clear all sediment from the straw wattles and/or silt fence. Daily monitoring should be conducted using the attached Inspection Form.

2.8 Material Handling and Waste Management

All materials stored on-site will be stored in a neat, orderly manner in appropriate containers. All materials will be kept in their original containers with the original manufacturer’s label. Substances will not be mixed with one another unless recommended by the manufacturer.

All waste materials will be collected and stored in a securely lidded metal container from a

licensed management company. The waste and any construction debris from the site will be hauled off-site daily and disposed of properly. The Contractor will be responsible for all waste removal. Manufacturer's recommendations for proper use and disposal will be followed for all materials.

2.9 Designated Washout Areas

The Contractor shall use washout facilities at their own plants, unless otherwise directed by the Engineer.

2.10 Proper Equipment/Vehicle Fueling and Maintenance Practices

On-site vehicles will be monitored for leaks and receive regular preventative maintenance to reduce the risk of leakage. To ensure that leaks on stored equipment do not contaminate the site oil-absorbing mats will be placed under all equipment during storage. Regular fueling and service of the equipment may be performed using approved methods and with care taken to minimize chance of spills. Repair of equipment or machinery within a 100-foot water resources buffer area shall not be allowed without the prior approval of the Engineer. Any petroleum products will be stored in tightly sealed containers that are clearly labeled.

2.11 Equipment/Vehicle Washing

The Contractor will be responsible to ensure that no equipment is washed on-site except to remove sediments prior to transport from the site.

SECTION 3: Spill Prevention and Control Plan

The Contractor will be responsible for preventing spills in accordance with the project specifications and applicable federal, state and local regulations. The Contractor will identify a properly trained site employee, involved with the day-to-day site operations to be the spill prevention and cleanup coordinator. The name(s) of the responsible spill personnel will be posted on-site. Each employee will be instructed that all spills are to be reported to the spill prevention and cleanup coordinator.

3.1 Spill Control Equipment

Spill control/containment equipment will be kept in the work Area. Materials and equipment necessary for spill cleanup will be kept either in the work Area or in an otherwise accessible on-site location. Equipment and materials will include, but not be limited to, absorbent booms/mats, brooms, dust pans, mops, rags, gloves, goggles, sand, plastic and metal containers specifically for this purpose. It is the responsibility of the Contractor to ensure the inventory will be readily accessible and maintained.

3.2 Notification

All workers will be directed to inform the on-site supervisor of a spill event. The supervisor will assess the incident and initiate proper containment and response procedures immediately upon notification. Workers should avoid direct contact with spilled materials during the containment procedures. Primary notification of a spill should be made to the local Fire Department and Police Departments. Secondary Notification will be to the certified cleanup contractor if deemed necessary by Fire and/or Police personnel. The third level of notification is to the DEP. The specific cleanup contractor to be used will be identified by the Contractor prior to commencement of construction activities.

3.3 Spill Containment and Clean-Up Measures

Spills will be contained with granular sorbent material, sand, sorbent pads, booms or all of the above to prevent spreading. Certified cleanup contractors should complete spill cleanup. The material manufacturer's recommended methods for spill cleanup will be clearly posted and on-site personnel will be made aware of the procedures and the location of the information and cleanup supplies.

3.4 Hazardous Materials Spill Report

The Contractor will report and record any spill. The spill report will present a description of the release, including the quantity and type of material, date of the spill, circumstances leading to the release, location of spill, response actions and personnel, documentation of notifications and corrective measures implemented to prevent reoccurrence.

This document does not relieve the Contractor of the Federal reporting requirements of 40 CFR Part 110, 40 CFR Part 117, 40 CFR Part 302 and the State requirements specified under the Massachusetts Contingency Plan (M.C.P) relating to spills or other releases of oils or hazardous substances. Where a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR Part 110, 40 CFR Part 117 or 40 CFR Part 302, occurs during a twenty-four (24) hour period, the Contractor is required to comply with the response requirements of the above mentioned regulations. Spills of oil or hazardous material in excess of the reportable quantity will be reported to the National Response Center (NRC).

SECTION 4: Contact Information/Responsible Parties

Owner/Operator:
Vincent J. Roy
Director of Operations
199 Raymond Road
Sudbury, MA
978-443-6602

Engineer:
Larry Keegan, PE
Weston & Sampson
100 Foxboro Blvd., Suite 250
Foxboro, MA 020351960
508-698-3034

Site Inspector:
TBD

Contractor:
TBD

SECTION 5: Erosion and Sedimentation Control

Erosion and Sedimentation Control details and layout can be found in the attached plan set.

SECTION 6: Site Development Plan

The Site Development Plan is included in the attached plan set.

SECTION 7: Operation and Maintenance of Erosion Control

The erosion control measures will be installed as detailed in the attached plan set. If there is a failure to the controls, the Contractor will be required to stop work until the failure is repaired.

Periodically throughout the work, whenever the Engineer deems it necessary, the sediment that has been deposited against the controls will be removed to ensure that the controls are working properly.

SECTION 8: Inspection Schedule

During construction the erosion and sedimentation controls will be inspected daily. Once the contractor is selected, an on-site inspector will be selected to work closely with the Engineer to ensure that all erosion and sedimentation controls are in place and working properly. An Inspection Form is included.

Inspection Form

Inspected By: _____ Date: _____Time:_____

YES	NO	DOES NOT APPLY	ITEM
			Do any erosion/siltation control measures require repair or clean out to maintain adequate function?
			Is there any evidence that sediment is leaving the site and entering the wetlands?
			Are any temporary soil stockpiles or construction materials located in non-approved areas?
			Are on-site construction traffic routes, parking, and storage of equipment and supplies located in areas not specifically designed for them?

Specific location, current weather conditions, and action to be taken:

_____

_____

_____

_____

_____

Other Comments:

_____

_____

Pending the actions noted above I certify that the site is in compliance with the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan.

Signature: _____ Date: _____

Illicit Discharge Compliance Statement

Section I – Purpose/Intent

The purpose of this document is to provide for the health, safety, and general welfare of the citizens of Sudbury, Massachusetts through the regulation of non-stormwater discharges into existing outstanding resource areas near the proposed Sudbury Water District facility site to the maximum extent practicable, as required by federal and state law. This document establishes methods for controlling the introduction of pollutants into existing outstanding resource areas to comply with requirements of the National Pollutant Discharge Elimination System (NPDES) permit process.

Section II - Definitions

For the purposes of this statement, the following shall mean:

Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, general good housekeeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to stormwater, receiving waters, or stormwater conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or water disposal, or drainage from raw materials storage.

Clean Water Act: The federal Water Pollution Control Act (33 U.S.C § 1251 et seq.), and any subsequent amendments thereto.

Construction Activity: Activities subject to the Massachusetts Erosion and Sedimentation Control Act or NPDES Construction Permits. Such activities include but are not limited to clearing and grubbing, grading, excavating, and demolition.

Hazardous Materials: Any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Illegal Connection: An illegal connection is defined as either of the following:

a. Any pipe, open channel, drain or conveyance, whether on the surface or subsurface, which allows an illicit discharge to enter the outstanding resource area including but not limited to any conveyances which allow any non-stormwater discharge including sewage, process wastewater, and wash water, regardless of whether said drain or connection has been previously allowed, permitted, or approved by an authorized enforcement agency; or

b. Any pipe, open channel, drain or conveyance connected to the Town of Bourne storm water treatment system which has not been documented in plans, maps, or equivalent records and approved by an authorized enforcement agency.

Illicit Discharge: Any direct or indirect non-stormwater discharge to the Town of Bourne stormwater treatment system, except as exempted in Section II of this ordinance.

Industrial Activity: Activities subject to NPDES Industrial Permits as defined in 40CFR, Section 122.26 (b) (14).

National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit: A permit issued by MassDEP under authority delegated pursuant to 33 USC § 1342 (b) that authorizes the discharge of pollutants to waters of the United States, whether the permit is applicable on an individual, group, or general area-wide basis.

Town of Sudbury Stormwater Treatment System: Any facility, owned or maintained by the town, designed or used for collecting and/or conveying stormwater, including but not limited to roads with drainage systems, Town of Sudbury streets, curbs, gutters, inlets, catch basins, piped storm drains, pumping facilities, infiltration, retention and detention basins, natural and man-made or altered drainage channels, reservoirs, and other drainage structures.

Non-Stormwater Discharge: Any discharge to the storm drain system that is not composed entirely of stormwater.

Person: Any individual, association, organization, partnership, firm, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, city, county or other political subdivision of the State, interstate body, or any other legal entity.

Pollutant: Anything which causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; petroleum hydrocarbons; automotive fluids; cooking grease; detergents (biodegradable or otherwise); degreasers; cleaning chemicals; non-hazardous liquid and solid wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; liquid and solid wastes; sewage, fecal coliform and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; concrete and cement; and noxious or offensive matter of any kind.

Pollution: Contamination or other alteration of any water's physical, chemical, or biological properties by addition of any constituent including but not limited to a change in temperature, taste, color, turbidity, or odor of such waters, or the discharge of any liquid, gaseous, solid, radioactive, or other substance into any such waters as will or is likely to create a nuisance or render such waters harmful, detrimental, or injurious to the public health, safety, welfare, or environment, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

Premises: Any building, lot, parcel of land, or portion of land whether improved or unimproved including adjacent sidewalks and parking strips.

Stormwater: Any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting from such precipitation.

Wastewater: Any water or other liquid discharged from a facility, that has been used, as for washing, flushing, or in a manufacturing process, and so contains waste products.

Section III - Prohibitions

Prohibition of Illicit Discharges:

No person shall throw, drain, or otherwise discharge, cause or allow others under its control to throw, drain, or otherwise discharge into the Town of Sudbury stormwater treatment system or watercourses any materials, including but not limited to, any pollutants or waters containing any pollutants, other than stormwater. The commencement, conduct, or continuance of any illicit discharge to the storm drain system is prohibited except as described as follows:

1. Water line flushing performed by a government agency, other potable water sources, landscape irrigation or lawn watering, diverted stream flows, rising ground water, ground water infiltration to storm drains, uncontaminated pumped ground water, foundation or footing drains (not including active groundwater dewatering systems), crawl space pumps, air conditioning condensation, springs, natural riparian habitat or wetland flows, and any other water source not containing pollutants;

2. Discharges or flows from fire fighting, and other discharges specified in writing by the Town of Sudbury as being necessary to protect public health and safety;

3. Dye testing is an allowable discharge, but requires a verbal notification to the Town of Sudbury prior to the time of the test;

4. Any non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the Federal Environmental Protection Agency, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for a discharge to the Town of Bourne stormwater treatment system.

Section IV - Industrial or Construction Activity Discharges

Any person subject to an industrial or construction activity NPDES stormwater discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the Town of Sudbury Department of Public Works prior to allowing discharges to the Sudbury stormwater treatment system.

Section V - Notification of Spills and Accidental Discharges

Notwithstanding other requirements of law, as soon as any person responsible for a facility, activity or operation, or responsible for emergency response for a facility, activity or operation has information of any known or suspected release of pollutants or non-stormwater discharges from that facility, activity, or operation which are resulting or may result in illicit discharges or pollutants discharging into stormwater, the Town of Sudbury stormwater treatment system, State Waters, or Waters of the U.S., said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release so as to minimize the effects of the discharge. In the event of such a release of hazardous materials, said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. In the event of a release of non-hazardous materials, said person shall notify the Town of Sudbury Department of Public Works in person or by phone no later than the next business day, including the nature, quantity and time of occurrence of the discharge. Notifications in person or by phone shall be confirmed by written notice, via certified mail return receipt requested addressed to the Town of Sudbury Department of Public Works within three (3) business days of the initial notice. If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least three years.

IN WITNESS WHEREOF the parties hereto have executed copies of this Agreement on the _____ day of _____, _____.

_____

Vincent J. Roy
Director of Operations
Sudbury Water Department

Operations and Maintenance Plan

Sudbury Water District Facility

199 Raymond Road
Sudbury, Massachusetts

July 2018

Weston & Sampson.
100 Foxborough Boulevard
Suite 250
Foxboro, MA 02035
www.westonandsampson.com
Tel: 508-698-3034

1.0 Introduction

The following document has been written to comply with the stormwater guidelines set forth by the Massachusetts Department of Environmental Protection (MassDEP). The intent of these guidelines is to encourage Low Impact Development techniques to improve the quality of the stormwater runoff. These techniques, also known as Best Management Practices (BMPs) collect, store, and treat the runoff before discharging to adjacent environmental resources.

2.0 Purpose

This Operation and Maintenance Plan (O&M Plan) is intended to provide a mechanism for the consistent inspection and maintenance of each BMP installed on the project site. Included in this O&M Plan is a description of each BMP type and an inspection form for each BMP. The Sudbury Water District is the owner and operator of the system and is responsible for its upkeep and maintenance. This work will be funded on an annual basis through the facilities operating budget. The estimated budget to maintain these BMPs utilizing is approximately $12,000 per year.

In the event the Sudbury Water District sells the property, it is the Districts responsibility to transfer this plan, as well as the past three years of operation and maintenance records, to the new property owner.

3.0 BMP Description and Locations

3.1 Deep Sump Catch Basins

Deep sump catch basins will be located throughout the site and used as pre-treatment before entering the hydrodynamic separators. The deep sump catch basins are collection systems that are designed to remove trash, debris, and coarse sediment from the stormwater runoff.

3.2 Stormwater Treatment Structures

There are three stormwater treatment structures on site. These structures are hydrodynamic separators, designed to slow stormwater down and allow oil and debris to rise and sediment to settle out.

3.3 Subsurface Infiltration Systems

There are three underground infiltration chamber system that will receive stormwater. These BMPs store and/or attenuate runoff from the storm event until it exfiltrates through the basin/chamber floor or discharges over the spillways.

4.0 Inspection, Maintenance Checklist and Schedule

4.1 Deep Sump Catch Basins

Inspect and/or clean catch basins at least four times per year and at the end of foliage and snow removal seasons. Sediments must be removed whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Each catch basin should be cleaned a minimum of four times per year regardless of the amount of sediment in the basin. They shall be cleaned using clamshell buckets or vacuum trucks.

In the event of contamination by a spill or other means, all cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000 and handled as hazardous waste.

In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept Solid Waste without any prior approval by MassDEP. Please note that current MassDEP regulations prevent landfills from accepting materials that contain free-draining liquids.

4.3 Stormwater Treatment Structures

Stormwater treatment structures shall be inspected every six months for the first year. Following the first year, the structures can be inspected a minimum of once per year or as first year data indicates. After a hazardous spill, structures shall be inspected immediately. The structures shall be cleaned a minimum of once per year or when the sediment depth is 15% of its capacity. Polluted water, sediments, and debris should be disposed of in accordance with local, state, and federal regulations.

4.4 Subsurface Infiltration Structures

Subsurface Infiltration structures should be inspected at least twice per year and after any storm event in which the drainage discharges through the highest outlet. Once a basin is in use, it should be inspected after every major storm for the first few months to ensure it is stabilized and is functioning properly. Take corrective actions if the system is not functioning properly.

Upon establishing that the system is functioning properly, the basin shall be inspected at least twice per year. The following items should be checked:

- Signs of differential settlement
- Cracking
- Erosion
- Leakage in embankments
- Tree growth on the embankments
- Condition of riprap

- Sedimentation accumulation
- Health of the turf
- Draining completely within 72 hours of rain events

All accumulated sediment and debris in the infiltration basins and subsurface structures should be removed and disposed of according to local, state and federal regulations. During the growing season, vegetation should not exceed six inches in height in the infiltration basin and should be mowed as necessary. Any grassed areas near areas that use salt in deicing applications should be re-seeded in the spring. Bare spots should be re-seeded as needed.

4.5 Inspections and Record Keeping

- An inspection form should be filled out every time maintenance work is performed.

- A binder should be kept at the Police Station that contains all the completed inspection forms and any other related materials.

- A review of all Operation & Maintenance actions should take place annually to ensure that these Stormwater BMPs are being taken care of in the manner illustrated in this Operation & Maintenance Plan.

- All operation and maintenance log forms for the last three years, at a minimum, shall be kept on site at the Sudbury Water District facility.

- The inspection and maintenance schedule may be refined in the future based on the findings and results of this operation and maintenance program or policy.

Water District Facility
Town of Sudbury
Permanent BMP Inspection Checklist

☐ **Street Sweeping**

Frequency: Monthly, primarily in the spring and fall.

Location: Parking Lots and Driveways

Inspected By: _____ Date: _____

Observations: _____
_____
_____

Actions Taken: _____
_____
_____

Instructions: Sweep parking lot using street sweeping machine. All trash, debris, and sediments should be disposed of in accordance with local, state, and federal regulations.

☐ **Deep Sump Catch Basins**

Frequency: Inspect and clean deep sump catch basins in March, June, September and December.

Structure Number: _____

Inspected By: _____ Date: _____

Observations: _____
_____
_____

Actions Taken: _____
_____
_____

Instructions: Clean units four times per year or whenever the depth of the deposits is greater than or equal to one half the depth from the bottom of the invert to the lowest pipe in the structure.

☐ **Stormwater Treatment Structure**

Frequency: Inspect every six months for the first year and as necessary following the first year. After a hazardous spill, structures shall be inspected immediately.

Structure Number: _____

Inspected By: _____ Date: _____
Observations: _____
_____
_____

Actions Taken: _____
_____
_____

Instructions: Clean unit when the sediment depth is 15% of its capacity. Dispose of sediment and debris in accordance with local, state, and federal laws.

☐ **Stormwater Basins and Subsurface Infiltration Structures**

Frequency: The stormwater basins and subsurface infiltration structures should be inspected at least twice per year and after any storm event in which drainage discharges through the highest outlet.

Structure No.: _____

Inspected By: _____ Date: _____

Observations: _____
_____
_____

Actions Taken: _____
_____
_____

Instructions: Inspect grassed area. Mow grass as needed in stormwater basins. Remove accumulated trash and debris. Remove sediment and re-seed bare spots as needed.

Inspect chambers via manholes or inspection ports. Clean units whenever the depth of the deposits is greater than or equal to one half the depth from the bottom of the invert to the pipe in the manifold. Use reverse water jet to pull sediment back into manhole. Remove sediment, trash and debris as noted above.

Check that the stormwater basins and subsurface infiltration structures are draining completely within 24 hours of rain events. All trash, debris, and sediments should be disposed of in accordance with local, state, and federal regulations.

Appendix C

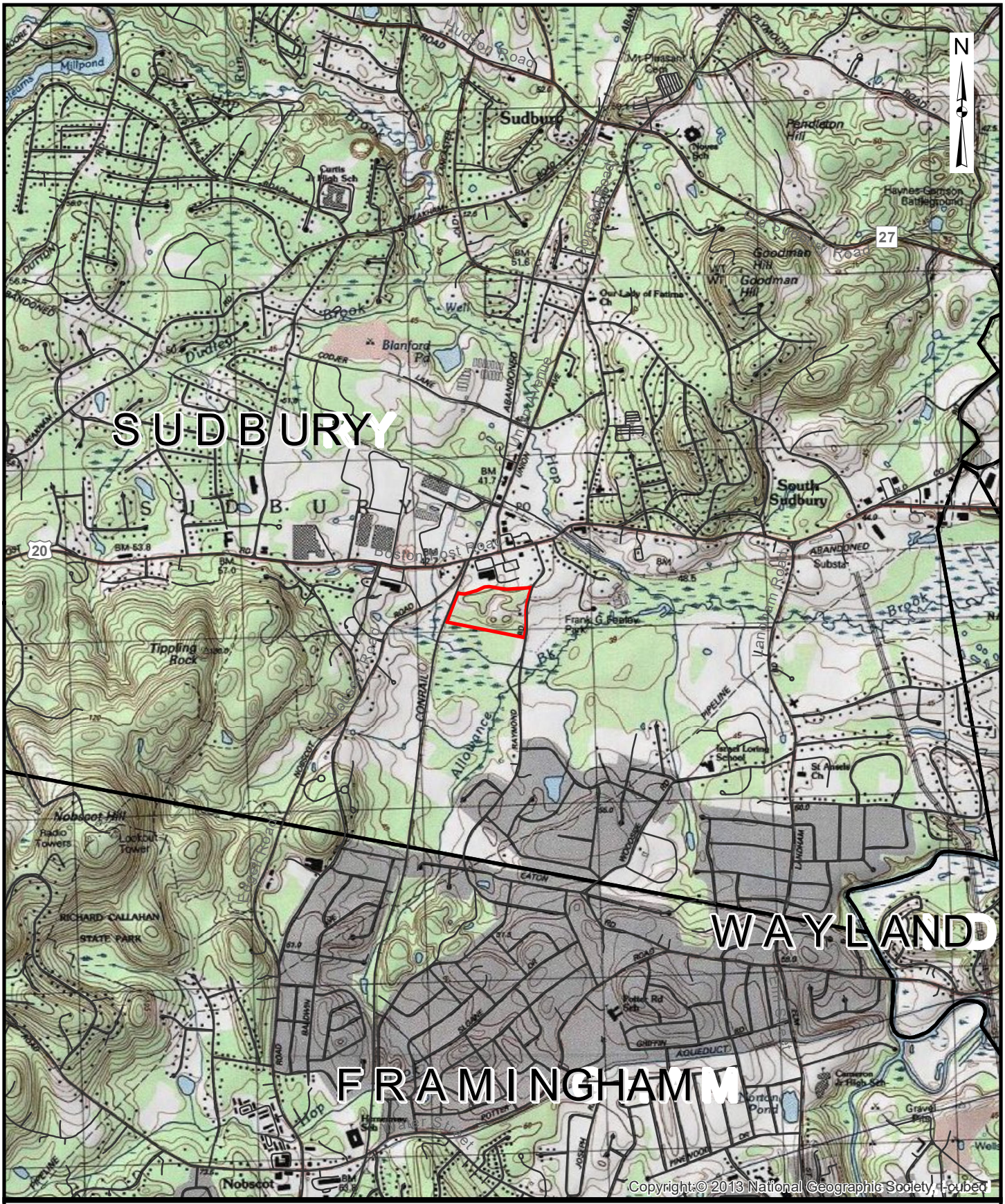

FIGURE 1
199 Raymond Road
Sudbury, Massachusetts

Locus Map

2,000 0 2,000

Scale In Feet

Weston & Sampson

Path: \\wse03.local\WSE\Depts\Water\ERMAP\GIS - Constraints Mapping\Sudbury\199 Raymond Road\Figure 1 - Locus.mxd User: GasparA Saved: 5/25/2018 11:05:54 AM Opened: 5/25/2018 11:06:07 AM

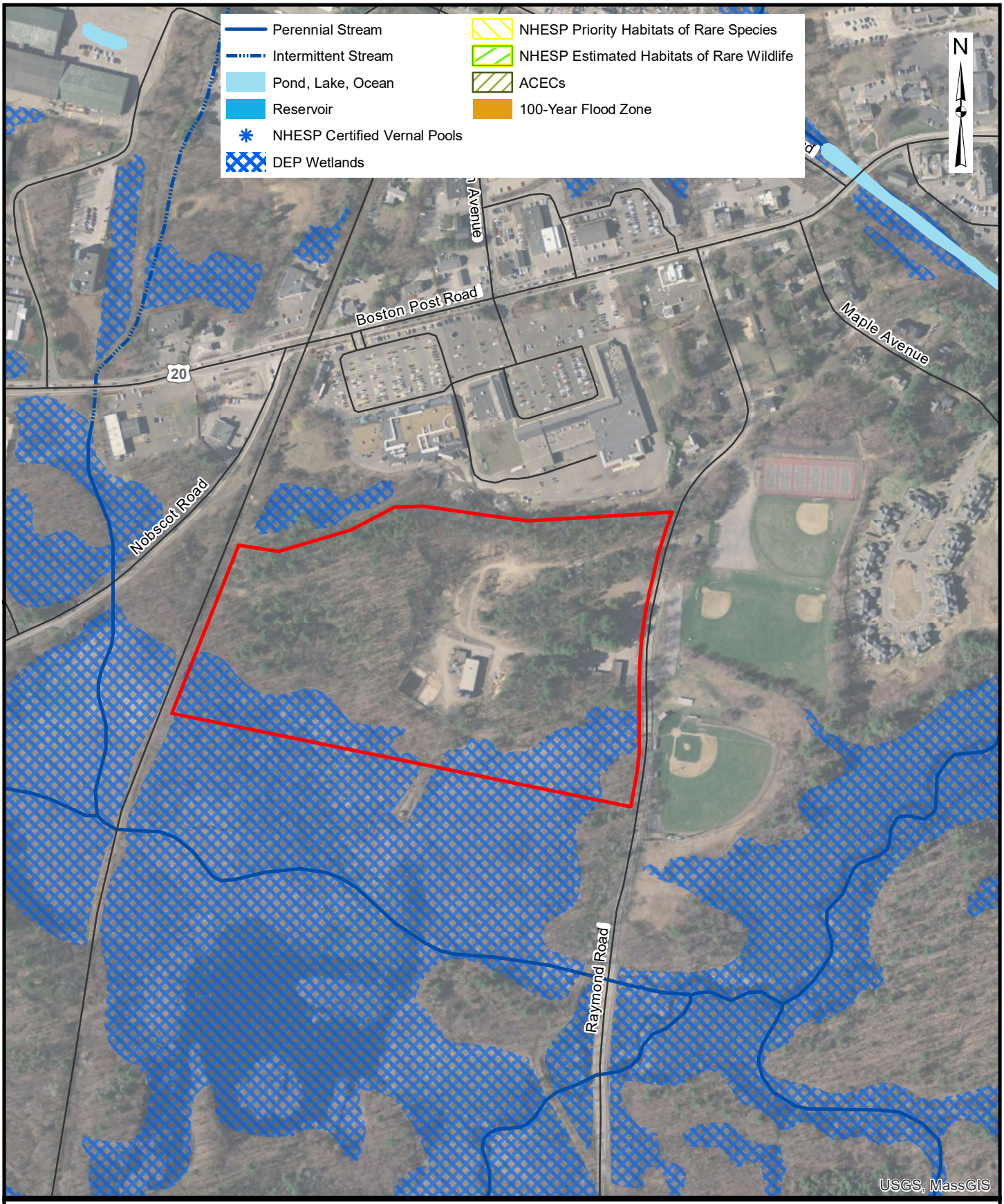

FIGURE 2
199 Raymond Road
Sudbury, Massachusetts

ENVIRONMENTAL RESOURCES MAP

500 0 500
Scale In Feet

Weston & Sampson

National Flood Hazard Layer FIRMette

FEMA

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
- Regulatory Floodway *Zone AE, AO, AH, VE, AR*

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 / 17.5 Cross Sections with 1% Annual Chance / 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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/18/2018 at 2:12:04 PM 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: base map 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.

Appendix D

SECTION 01570

ENVIRONMENTAL PROTECTION

PART 1 – GENERAL

1.01 DESCRIPTION:

A. The work covered by this section of the specifications consists of furnishing all labor, materials, tools and equipment and performing all work required for the prevention of environmental pollution during and as a result of construction operations under this contract.

B. The requirements set forth in this section of the specifications apply to construction in and adjacent to wetlands, unless otherwise specifically stated.

C. All work under this Contract shall be in accordance with the Conservation Commissions' Orders of Conditions as well as any conditional requirements applied.

D. Prior to commencement of work, the Contractor shall meet with representatives of the Engineer to develop mutual understandings relative to compliance of the environmental protection program.

1.02 SUBMITTALS:

A. The Contractor shall submit for approval six sets of details and literature fully describing environmental protection methods to be employed in carrying out construction activities within 100 feet of wetlands or across areas designated as wetlands.

PART 2 - PRODUCTS

2.01 STRAW BALES:

A. Straw bales shall consist of certified seed free stems of agricultural grain and cereal crops and shall be free of grasses and legumes. Standard bales shall be 14-inches high, 18- inches wide and 36- to 40-inches long tied with polypropylene twine and weigh within 5 percent of 7 lbs. per cubic ft.

2.02 CATCH BASIN PROTECTION:

A. To trap sediment and to prevent sediment from clogging drainage systems, catch basin protection in the form of a siltation sack (Siltsack as manufactured by ACF Environmental, Inc. or approved equal) shall be provided as approved by the Engineer.

2.03 COMPOST FILTER TUBES:

A. Silt socks shall be a tubular filter sock of mesh fabric. The fabric will have openings of between 1/8" to ¼" diameter. The mesh material will either photo degrade within one year or be made of nylon with a life expectancy of 24 months. The sock shall be filled

with a mix of composted leaf mulch, bark mulch and wood chips that have been composted for at least one year. The sock will have a minimum diameter of 12-inches.

PART 3- EXECUTION

3.01 NOTIFICATION AND STOPPAGE OF WORK:

A. The Engineer will notify the Contractor in writing of any non-compliance with the provisions of the Order of Conditions. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails to act promptly, the Owner may order stoppage of all or part of the work through the Engineer until satisfactory corrective action has been taken. No claim for an extension of time or for excess costs or damage incurred by the Contractor as a result of time lost due to any stop work orders shall be made unless it was later determined that the Contractor was in compliance.

3.02 AREA OF CONSTRUCTION ACTIVITY:

A. Insofar as possible, the Contractor shall confine his construction activities to those areas defined by the plans and specifications. All land resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their present condition or be restored to a condition after completion of construction at least equal to that which existed prior to work under this contract.

3.03 PROTECTION OF WATER RESOURCES:

A. The Contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumens, calcium chloride, acids or other harmful materials. It is the Contractor's responsibility to comply with all applicable Federal, State, County and Municipal laws regarding pollution of rivers and streams.

B. Special measures should be taken to insure against spillage of any pollutants into public waters.

3.04 CONSTRUCTION IN AREAS DESIGNATED AS WETLANDS ON THE DRAWINGS:

A. Insofar as possible, the Contractor shall make every effort to minimize disturbance within areas designated as wetlands or within 100-feet of wetland resource areas. Total easement widths shall be limited to the widths shown.

B. The Contractor shall perform his work in such a way that these areas are left in the condition existing prior to construction.

3.05 PROTECTING AND MINIMIZING EXPOSED AREAS:

A. The Contractor shall limit the area of land which is exposed and free from vegetation during construction. In areas where the period of exposure will be greater than two (2) months, temporary vegetation, mulching or other protective measures shall be provided

as specified.

B. The Contractor shall take account of the conditions of the soil where temporary cover crop will be used to insure that materials used for temporary vegetation are adaptive to the sediment control. Materials to be used for temporary vegetation shall be approved by the Engineer.

3.06 LOCATION OF STORAGE AREAS:

A. The location of the Contractor's storage areas for equipment and/or materials shall be upon cleared portions of the job site or areas to be cleared as a part of this project, and shall require written approval of the Engineer. Plans showing storage facilities for equipment and materials shall be submitted for approval of the Engineer.

B. No excavated materials or materials used in backfill operations shall be deposited within a minimum distance of one hundred (100) feet of any watercourse or any drainage facility. Adequate measures for erosion and sediment control such as the placement of straw wattles around the downstream perimeter of stockpiles shall be employed to protect any downstream areas from siltation.

C. There shall be no storage of equipment or materials in areas designated as wetlands.

D. The Engineer may designate a particular area or areas where the Contractor may store materials used in his operations.

3.07 PROTECTION OF LANDSCAPE:

A. The Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without written authority from the Owner. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorages unless specifically authorized by the Engineer. Excavating machinery and cranes shall be of suitable type and be operated with care to prevent injury to trees which are not to be removed, particularly overhanging branches and limbs. The Contractor shall, in any event, be responsible for any damage resulting from such use.

B. Branches, limbs, and roots shall not be cut except by permission of the Engineer. All cutting shall be smoothly and neatly done without splitting or crushing. When there is unavoidable injury to branches, limbs and trunks of trees, the injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.

C. Where, in the opinion of the Engineer, trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment or by his blasting or other operations, the Engineer may require the Contractor to adequately protect such trees by placing boards, planks, poles or fencing around them. Any trees or landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the expense of the Contractor. The Engineer will decide what method of restoration shall be used, and whether damaged trees shall be treated and healed or removed and disposed of.

D. Cultivated hedges, shrubs, and plants which could be injured by the Contractor's operations shall be protected by suitable means or shall be dug up, balled and temporarily replanted and maintained. After construction operations have been substantially completed, they shall be replanted in their original positions and cared for until growth is re-established. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of a kind and quality at least equal to that existing at the start of the work.

3.08 CLEARING AND GRUBBING:

A. The Contractor shall clear and grub only on the Owner's land or the Owner's easements, and only the area required for construction operations, as approved by the Engineer.

3.09 DISCHARGE OF DEWATERING OPERATIONS:

A. Any water that is pumped and discharged from the excavation as part of the Contractor's water handling shall be filtered by an approved method prior to its discharge into a receiving water or drainage system.

B. Under no circumstances shall the Contractor discharge water to the areas designated as wetlands. When constructing in a wetlands area, the Contractor shall discharge water from dewatering operations directly to the nearest drainage system, stream, or waterway after filtering by an approved method.

C. The pumped water shall be filtered through filter fabric and baled straw, a vegetative filter strip or a vegetated channel to trap sediment occurring as a result of the construction operations. The vegetated channel shall be constructed such that the discharge flow rate shall not exceed a velocity of more than 1 foot per second. Accumulated sediment shall be cleared from the channel periodically.

3.10 DUST CONTROL:

A. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, to minimize creation and dispersion of dust. If the Engineer decides it is necessary to use calcium chloride for more effective dust control, the Contractor shall furnish and spread the material, as directed.

B. Calcium Chloride shall not be used for dust control within a drainage basin or in the vicinity of any source of potable water.

3.11 CATCH BASIN PROTECTION:

A. Catch basin protection shall be used for every catch basin, shown on the plans or as required by the Engineer, to trap sediment and prevent it from clogging drainage systems and entering wetlands. Siltation sacks shall be securely installed under the catch basin grate. Care shall be taken to keep the siltation sacks from breaking apart or clogging. All deposited sediment shall be removed periodically and at times prior to predicted precipitation to allow free drainage flow. Prior to working in areas where catch basins are to be protected, each catch basin sump shall be cleaned of all debris and protected. The contractor shall properly dispose of all debris at no additional cost to the Owner.

3.12 COMPOST FILTER TUBES:

A. The silt socks will be staked in the ground using wooden stakes driven at 4-foot intervals. The wooden stakes will be placed at a minimum depth of 24-inches into the ground.

END OF SECTION

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SECTION 01740

CLEANING UP

PART 1 - GENERAL

1.01 DESCRIPTION:

The Contractor must employ at all times during the progress of its work adequate cleanup measures and safety precautions to prevent injuries to persons or damage to property. The Contractor shall immediately, upon request by the Engineer provide adequate material, equipment and labor to cleanup and make safe any and all areas deemed necessary by the Engineer.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

3.01 DAILY CLEANUP:

A. The Contractor shall clean up, at least daily, all refuse, rubbish, scrap and surplus material, debris and unneeded construction equipment resulting from the construction operations and sweep the area. The site of the work and the adjacent areas affected thereby shall at all times present a neat, orderly and workmanlike appearance.

B. Upon written notification by the Engineer, the Contractor shall within 24 hours clean up those areas, which in the Engineer's opinion are in violation of this section and the above referenced sections of the specifications.

C. If in the opinion of the Engineer, the referenced areas are not satisfactorily cleaned up, all other work on the project shall stop until the cleanup is satisfactory.

3.02 MATERIAL OR DEBRIS IN DRAINAGE FACILITIES:

A. Where material or debris has washed or flowed into or has been placed in existing watercourses, ditches, gutters, drains, pipes, structures, such material or debris shall be entirely removed and satisfactorily disposed of during progress of the work, and the

ditches, channels, drains, pipes, structures, and work shall, upon completion of the work, be left in a clean and neat condition.

3.03 REMOVAL OF TEMPORARY BUILDINGS, STRUCTURES AND EQUIPMENT:

A. On or before completion of the work, the Contractor shall, unless otherwise specifically required or permitted in writing, tear down and remove all temporary buildings and structures it built; shall remove all temporary works, tools and machinery or other construction equipment it furnished; shall remove all rubbish from any grounds which it has occupied; shall remove silt fences and hay bales used for trapping sediment; and shall leave the roads and all parts of the property and adjacent property affected by its operations in a neat and satisfactory condition.

3.04 RESTORATION OF DAMAGED PROPERTY:

A. The Contractor shall restore or replace, when and as required, any property damaged by its work, equipment or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall do as required all necessary highway or driveway, walk and landscaping work. Materials, equipment, and methods for such restoration shall be as approved by the Engineer.

3.05 FINAL CLEANUP:

A. Before acceptance by the Owner, the Contractor shall perform a final cleanup to bring the construction site to its original or specified condition. This cleanup shall include removing all trash and debris off of the premises. Before acceptance, the Engineer shall approve the condition of the site.

END OF SECTION

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Appendix E

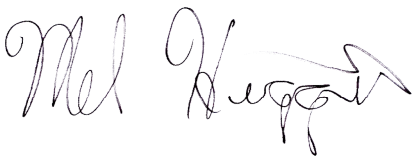
AFFIDAVIT OF SERVICE

Under the Massachusetts Wetlands Protection Act

I, Mel Higgins, hereby certify under the Pains and Penalties of Perjury that on June 29, 2018 I gave notification to abutters in compliance with the second paragraph of Massachusetts General Laws, Chapter 131, Section 40, and the DEP Guide to Abutter Notification dated, April 8, 1994, in connection with the following matter:

> A Notice of Intent has been filed under the Massachusetts Wetlands Protection Act by the Sudbury Water District with the Sudbury Conservation Commission on June 29, 2018 for property located at 199 Raymond Road in Sudbury.

The completed notification and a list of the abutters to whom it was given and their addresses, are attached to this Affidavit of Service.



June 29, 2018
DATE

Name: Mel Higgins
Title: Senior Environmental Scientist
Organization: Weston & Sampson Engineers, Inc

Notification to Abutters Under the Massachusetts Wetlands Protection Act

In accordance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40, you are hereby notified of the following:

A. The name of the applicant is: Sudbury Water District
199 Raymond Road
Sudbury, MA

B. The name of the owner is: same as above

C. The applicant has filed a Notice of Intent with the Sudbury Conservation Commission seeking permission to alter an Area Subject to Protection under the Wetlands Protection Act (General Laws Chapter 131, Section 40). The work includes renovations and additions to the existing administration facility at the site.

D. The address of the lot(s) where the activity is proposed: 199 Raymond Road

E. Copies of the Notice of Intent may be examined at 275 Old Lancaster Road between the hours of 8:00 AM and 5:00 PM on Monday – Friday. For more information call the Sudbury Conservation Commission at (978) 440-5471.

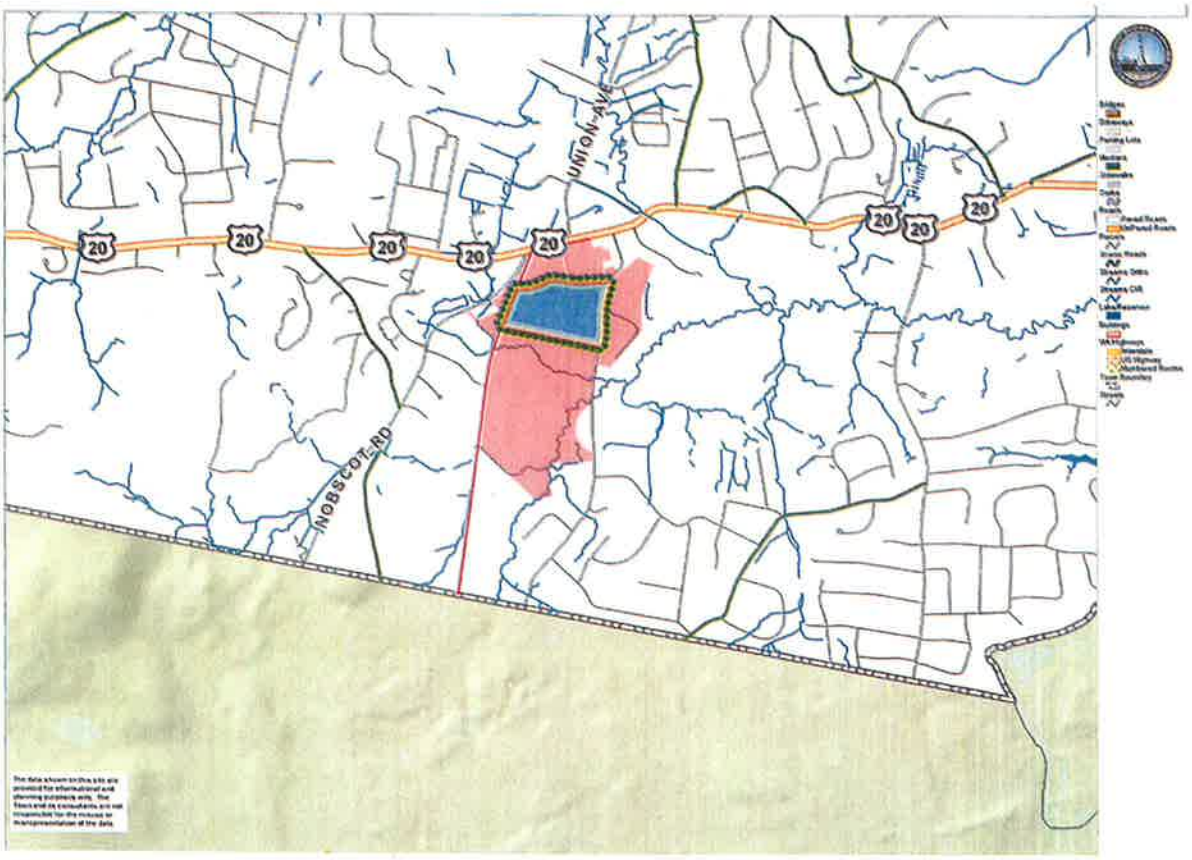
F. Information regarding the project, date, time and place of the public hearing may be obtained from Weston & Sampson Engineers, by contacting Mel Higgins at 978-532-1900 ext. 2332 between the hours of 8:00 – 5:00 on the following days of the week: Monday – Friday or the Sudbury Conservation Commission at (978) 440-5471between the hours of 8:00 AM and 5:00 PM on Monday – Friday.

NOTE: Notice of the public hearing, including its date, time, and place, will be published at least five (5) days prior to the hearing date in the local paper.

NOTE: Notice of the meeting of the Conservation Commission, including its date, time and place will be posted in the Town Hall not less than forty-eight (48) hours in advance of the meeting.

NOTE: You also may contact your local Conservation Commission or the Department of Environmental Protection Regional Office for more information about this application or the Wetlands Protection Act.

abutters_id_field	abutters_owner1	abutters_owner2	abutters_address	abutters_town	abutters_state	abutters_zip	abutters_bookpage	abutters_location
K08-0003	1776 PLAZA LIMITED PARTNERSHIP		89 ACCESS RD SUITE 1	NORWOOD	MA	02062	20083-348	457 BOSTON POST RD
K08-0003	1776 PLAZA LIMITED PARTNERSHIP		89 ACCESS RD SUITE 1	NORWOOD	MA	02062	20083-348	447 BOSTON POST RD
K08-0004	SUDBURY CROSSING INC	TR SUDBURY CROSSING ASSOCIATES REALTY TRUST II	651 WASHINGTON ST #200	BROOKLINE	MA	02446	70449-270	421 BOSTON POST RD
K08-0004	SUDBURY CROSSING INC	TR SUDBURY CROSSING ASSOCIATES REALTY TRUST II	651 WASHINGTON ST #200	BROOKLINE	MA	02446	70449-270	435 BOSTON POST RD
K08-0004	SUDBURY CROSSING INC	TR SUDBURY CROSSING ASSOCIATES REALTY TRUST II	651 WASHINGTON ST #200	BROOKLINE	MA	02446	70449-270	437 BOSTON POST RD
K08-0093	DAGOSTINO MATTHEW T & LAURA A		225 RAYMOND RD	SUDBURY	MA	01776	65469-80	225 RAYMOND RD
L07-0015	TOWN OF SUDBURY		278 OLD SUDBURY ROAD	SUDBURY	MA	01776	9115-555	NOBSCOT RD
L08-0001	SUDBURY WATER DISTRICT		RAYMOND RD	SUDBURY	MA	01776	8682-449	199 RAYMOND RD
L08-0002	TOWN OF SUDBURY	CONSERVATION	278 OLD SUDBURY ROAD	SUDBURY	MA	01776	9847-105	RAYMOND RD
L08-0012	TOWN OF SUDBURY FEELEY FIELD	PARK & RECREATION	278 OLD SUDBURY ROAD	SUDBURY	MA	01776	9847-105	200 RAYMOND RD
L07-0009	HAM MARY ANNE TRS	PORTSIDE REALTY TRUST	P O BOX 515	SUDBURY	MA	01776	32298-39	0 NOBSCOT RD
L07-9200	CSX		500 WATER ST C910	JACKSONVILLE	FL	32202	N-A	RAILWAY


UNION AVE
NOBSCOT RD
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MapsOnline

Appendix F

Weston & Sampson

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

MEMORANDUM

TO: Jean-Pierre Parnas

FROM: Nathaniel Parker

DATE: 06/18/2018

SUBJECT: Wetland Delineation
199 Raymond Road
Sudbury, Massachusetts

On June 06, 2018, the presence of wetland resources was investigated at 199 Raymond Road within a parcel of land owned by the Sudbury Water District. The parcel is approximately 25 acres in size. The site is composed primarily of loamy sand in the elevated locations that contain buildings and utility roads and mucky material within the southern portion of the site. The area immediately around the site is composed of forest, wetlands, and recreational facilities for the Town of Sudbury. Approximately 0.25 miles north of the site are commercial areas dedicated to storefronts and businesses along Boston Post Road. South of the site, beyond the woodlands and wetlands, are residential neighborhoods.

Wetland resource areas were identified and flagged in the field using pink flagging by a Weston & Sampson employee who is trained in the wetland delineation process using the Massachusetts Department of Environmental Protection (MassDEP) manual "*Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act*" and the US Army Corps of Engineers' *Wetland Delineation Manual*. The location and flag numbering system of each resource area can be seen on the attached field map. A further description of these wetland resource areas is presented below.

Bordering Vegetated Wetlands

BVW-A Series

The "A" series, located in the southern portion of the work area, is approximately 1400 feet in length and associated with a network of perennial streams that surround the area. Wetland flags left in the field to identify BVW limits were labeled BVW-A1 through BVW-A45.

Dominant vegetation within this resource area included red maple (*Acer rubrum*), highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifollia*) and cinnamon fern (*Osmunda cinnamomea*), all species that thrive in wet conditions. Soil consisted of a histic epipedon. Indicators of wetland hydrology included depth to free water in the observation hole at 8 inches below ground surface, soil saturation at the surface and water-stained leaves.

Dominant upland vegetation next to this BVW included red oak (*Quercus rubra*), eastern white pine (*Pinus strobus*), black cherry (*Prunus serotina*), Canada mayflower (*Maianthemum canadense*), Virginia creeper (*Parthenocissus quinquefolia*) and oriental bittersweet (*Celastrus orbiculatus*). Soil in the upland area consisted of dry loamy sandy with no evidence of mottling within the top 12 inches.

Attached please find a field map showing the wetland limits flagged in the field with associated wetland flag numbers. Completed MassDEP BVW Field Data Forms are also attached to this memorandum.

FIGURE 1
199 Raymond Road
Sudbury, Massachusetts

WETLANDS FIELD MAP

150 0 150

Scale In Feet

Weston & Sampson

Path: \\wse03.local\WSE\Depts\Water\ERMAP\GIS - Constraints Mapping\Sudbury\199 Raymond Road\wetlands field map 2018.mxd **User:** parkem **Saved:** 6/18/2018 10:47:22 AM **Opened:** 6/18/2018 10:48:05 AM

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Sudbury Water District Prepared by: Weston &Sampson Project location: 199 Raymond Road Sudbury, MA DEP File #:_____

Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- X Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number: 1		Transect Number: BVW-A6 WET	Date of Delineation: 6/6/18
A. Sample Layer & Plant Species (by common/scientific name)	**B. Percent Cover (or basal Area)**	**C. Percent Dominance**	**D. Dominant Plant (yes or no)**	**E. Wetland Indicator Category***
Tree Layer:				
red maple (*Acer rubrum*)	60%	60%	Yes	FAC*
eastern white pine (*Pinus strobus*)	40%	40%	Yes	FACU
Shrub layer:				
highbush blueberry (*Vaccinium corymbosum*)	30%	50%	Yes	FACW*
sweet pepperbush (*Clethra alnifollia*)	30%	50%	Yes	FAC*
Cover layer:				
cinnamon fern (*Osmunda cinnamomea*)	70%	78%	Yes	FACW*
poison ivy (*Toxicodendron radicans*)	10%	11%	No	FAC*
jewelweed (*Impatiens capensis*)	10%	11%	No	FACW*
Trailing layer:				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 3 Number of dominant non-wetland indicator plants: 1

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? **yes**

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes
title/date: Middlesex County
map number: MA017
soil type mapped: Scarboro mucky fine sandy loam/Windsor loamy sand
hydric soil inclusions:

Are field observations consistent with soil survey?
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0-8”	10YR 2/1	
B/C	8-16”	10YR 5/2	10YR 6/8, 10YR 6/1

Remarks:
Concentrations and reduced matrix at 10”. Concentrations 10YR 6/8
Reduced matrix 10YR 6/1

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- X Site Inundated: _____
- ❑ Depth to free water in observation hole: 8”
- ❑ Depth to soil saturation in observation hole: ground surface
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- X Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other:

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	__x__	____
Wetland hydrology present:		
Hydric soil present	__x__	_____
Other indicators of hydrology present	__x__	_____
Sample location is in a BVW	__x__	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Sudbury Water District Prepared by: Weston &Sampson Project location: 199 Raymond Road Sudbury, MA DEP File #:_____

Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- X Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number: 1		Transect Number: BVW-A6 UPL	Date of Delineation: 6/6/18
A. Sample Layer & Plant Species (by common/scientific name)	**B. Percent Cover (or basal Area)**	**C. Percent Dominance**	**D. Dominant Plant (yes or no)**	**E. Wetland Indicator Category***
Tree Layer:				
red oak (*Quercus rubra*)	50%	37%	Yes	FACU
eastern white pine (*Pinus strobus*)	50%	37%	Yes	FACU
black cherry (*Prunus serotina*)	20%	15%	No	FACU
red maple (*Acer rubrum*)	15%	11%	No	FAC*
Shrub layer:				
Saplings:				
black cherry (*Prunus serotina*)	15%	60%	Yes	FACU
red oak (*Quercus rubra*)	10%	40%	Yes	FACU
Cover layer:				
cinnamon fern (*Osmunda cinnmamomea*)	15%	27%	Yes	FACW*
poison ivy (*Toxicodendron radicans*)	15%	27%	Yes	FAC*
Canada mayflower (*Maianthemum canadense*)	25%	46%	Yes	FACU
Trailing layer:				
Virginia creeper (*Parthenocissus quinquefolia*)	30%	60%	Yes	FACU
oriental bittersweet (*Celastrus orbiculatus*)	20%	40%	Yes	UPL

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 2 Number of dominant non-wetland indicator plants: 7

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? **no**

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes
title/date: Middlesex County
map number: MA017
soil type mapped: Windsor loamy sand
hydric soil inclusions:

Are field observations consistent with soil survey? yes
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0-5”	10YR 3/2	
B_1	5-10”	10YR 4/4	
B_2	10-20”	10YR 5/8	

Remarks:

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: ground surface
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other:

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	__x__
Wetland hydrology present:		
Hydric soil present	____	__x___
Other indicators of hydrology present	____	__x___
Sample location is in a BVW	____	__x___

Submit this form with the Request for Determination of Applicability or Notice of Intent.