

## **NOTICE OF PUBLIC HEARING SUDBURY CONSERVATION COMMISSION**

The Sudbury Conservation Commission will review the Notice of Intent filing under the Wetlands Protection Act and Wetlands Bylaw for replacement of the existing culvert, within wetland resource areas, at Wolbach Road, Sudbury MA. Dan Nason, Director of DPW, applicant. The hearing will be held virtually on Monday, June 7, 2021, at 6:45pm, via Zoom. Please see the Conservation Commission web page for further information.

<https://sudbury.ma.us/conservationcommission/meeting/conservation-commission-meeting-monday-june-7-2021/>

SUDBURY CONSERVATION COMMISSION  
May 24, 2021



## **EcoTec, Inc.**

---

ENVIRONMENTAL CONSULTING SERVICES  
102 Grove Street  
Worcester, MA 01605-2629  
508-752-9666 / Fax: 508-752-9494

# **NOTICE OF INTENT**

**Wolbach Road Culvert Replacement  
Sudbury, MA**

**May, 2021**

### TABLE OF CONTENTS

1. eDEP WPA Form 3 (Notice of Intent)
2. Abutters List
3. Technical Memorandum by Woodard & Curran, Inc. (including project description, alternatives analysis, wetland report, USGS & other map figures)
4. Project Plans

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 #:
eDEP Transaction #:1281326
City/Town:SUDBURY

A.General Information

1. Project Location:

a. Street Address WOLBACH ROAD
b. City/Town SUDBURY c. Zip Code 01776
d. Latitude 42.37422N e. Longitude 71.39233W
f. Map/Plat # N/A g.Parcel/Lot # N/A

2. Applicant:

Individual Organization

a. First Name DANIEL b.Last Name NASON
c. Organization TOWN OF SUDBURY DEPT. OF PUBLIC WORKS
d. Mailing Address 275 OLD LANCASTER ROAD
e. City/Town SUDBURY f. State MA g. Zip Code 01776
h. Phone Number 978-443-2209 i. Fax j. Email nasond@sudbury.ma.us

3.Property Owner:

more than one owner

a. First Name DANIEL b. Last Name NASON
c. Organization TOWN OF SUDBURY DEPT. OF PUBLIC WORKS
d. Mailing Address 275 OLD LANCASTER ROAD
e. City/Town SUDBURY f.State MA g. Zip Code 01776
h. Phone Number 978-443-2209 i. Fax j.Email nasond@sudbury.ma.us

4.Representative:

a. First Name ARTHUR b. Last Name ALLEN
c. Organization ECOTEC, INC.
d. Mailing Address 102 GROVE STREET
e. City/Town WORCESTER f. State MA g. Zip Code 01605
h.Phone Number 508-752-9666 i.Fax j.Email aallen@ecotecinc.com

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

a.Total Fee Paid 0.00 b.State Fee Paid 0.00 c.City/Town Fee Paid 0.00

6.General Project Description:

REMOVE AND REPLACE DILAPIDATED STREAM CULVERT UNDER WOLBACH ROAD.

7a.Project Type:

- Single Family Home Residential Subdivision
Limited Project Driveway Crossing Commercial/Industrial
Dock/Pier Utilities
Coastal Engineering Structure Agriculture (eg., cranberries, forestry)
Transportation Other

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

**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 #:  
 eDEP Transaction #:1281326  
 City/Town:SUDBURY

1.  Yes  No If yes, describe which limited project applies to this project:  
 2. Limited Project

8. Property recorded at the Registry of Deeds for:

<b>a.County:</b>	<b>b.Certificate:</b>	<b>c.Book:</b>	<b>d.Page:</b>
SOUTHERN MIDDLESEX	N/A	N/A	N/A

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

1. Buffer Zone & Resource Area Impacts (temporary & permanent):

This is a Buffer Zone only project - 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)

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
---------------	-----------------------------	-------------------------------

a. <input checked="" type="checkbox"/> Bank	48 1. linear feet	48 2. linear feet
---	----------------------	----------------------

b. <input checked="" type="checkbox"/> Bordering Vegetated Wetland	45 1. square feet	45 2. square feet
--	----------------------	----------------------

c. <input type="checkbox"/> Land under Waterbodies and Waterways	1. Square feet	2. square feet
--	----------------	----------------

	3. cubic yards dredged	
--	------------------------	--

d. <input type="checkbox"/> Bordering Land Subject to Flooding	1. square feet	2. square feet
--	----------------	----------------

	3. cubic feet of flood storage lost	4. cubic feet replaced
--	-------------------------------------	------------------------

e. <input type="checkbox"/> 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 any)

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

**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 #:  
 eDEP Transaction #:1281326  
 City/Town:SUDBURY

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)**

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. <input type="checkbox"/> Designated Port Areas	Indicate size under	Land under the ocean below,
b. <input type="checkbox"/> Land Under the Ocean	1. square feet	
	2. cubic yards dredged	
c. <input type="checkbox"/> Barrier Beaches	Indicate size under Coastal Beaches and/or Coastal Dunes, below	
d. <input type="checkbox"/> Coastal Beaches	1. square feet	2. cubic yards beach nourishment
e. <input type="checkbox"/> Coastal Dunes	1. square feet	2. cubic yards dune nourishment
f. <input type="checkbox"/> Coastal Banks	1. linear feet	
g. <input type="checkbox"/> Rocky Intertidal Shores	1. square feet	
h. <input type="checkbox"/> Salt Marshes	1. square feet	2. sq ft restoration, rehab, crea.
i. <input type="checkbox"/> Land Under Salt Ponds	1. square feet	
	2. cubic yards dredged	
j. <input type="checkbox"/> Land Containing Shellfish	1. square feet	
k. <input type="checkbox"/> 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. <input type="checkbox"/> Land Subject to Coastal Storm Flowage	1. square feet	

**4.Restoration/Enhancement**

Restoration/Replacement

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 entered the additional amount here.

a. square feet of BVW b. square feet of Salt Marsh

**5.Projects Involves Stream Crossings**

Project Involves Streams Crossings

If the project involves Stream Crossings, please enter the number of new stream crossings/number of replacement stream crossings.

□ **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 #:

eDEP Transaction #:1281326

City/Town:SUDBURY

0

a. number of new stream crossings

1

b. number of replacement stream crossings

**C. Other Applicable Standards and Requirements**

**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 of Endangered Species program (NHESP)?

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

b. Date of map:11/18/2020

If yes, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18)...

c. Submit Supplemental Information for Endangered Species Review \* (Check boxes as they apply)

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

3.  Project plans for entire project site, including wetland resource areas and areas outside of wetland 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

c.  MESA filing fee (fee information available at: <http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/mass-endangered-species-act-mesa/esa-fee-schedule.html>)

Make check payable to "Natural Heritage & Endangered Species Fund" 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

d. 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/eea/agencies/dfg/dfw/laws-regulations/cmr/321-cmr-1000-massachusetts-endangered-species-act.html#10.14>; 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 Number

b. Date submitted to NHESP

3.  Separate MESA review completed.

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 #:
eDEP Transaction #:1281326
City/Town:SUDBURY

Include copy of NHESP "no Take" determination or valid Conservation & Management Permit with approved plan.

\* Some projects not in Estimated Habitat may be located in Priority Habitat, and require NHESP review...

- 2. For coastal projects only, is any portion of the proposed project located below the mean high waterline or in a fish run?
a. Not applicable - project is in inland resource area only

b. Yes No

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

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

North Shore - Hull to New Hampshire:

Division of Marine Fisheries -
Southeast Marine Fisheries Station
Attn: Environmental Reviewer
836 S. Rodney French Blvd
New Bedford, MA 02744

Division of Marine Fisheries -
North Shore Office
Attn: Environmental Reviewer
30 Emerson Avenue
Gloucester, MA 01930

If yes, it 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.

- 3. 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 DEP Website for ACEC locations). Note: electronic filers click on Website.

b. ACEC Name

- 4. 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

- 5. 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

- 6. 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, Explain why the project is exempt:

- 1. Single Family Home
2. Emergency Road Repair

**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 #:  
eDEP Transaction #:1281326  
City/Town:SUDBURY

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**

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 by regular mail delivery.

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.
3. Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s)).
4. List the titles and dates for all plans and other materials submitted with this NOI.

**a. Plan Title:                      b. Plan Prepared By:      c. Plan Signed/Stamped By:      e. Scale:**

TECHNICAL  
MEMORANDUM  
WITH PLANS

SCOTT SALVUCCI,  
WOODARD &  
CURRAN

May 24, 2021

ECOTEC WETLAND  
EVALUATION  
REPORT

ARTHUR ALLEN,  
ECOTEC, INC.

February 2, 2021

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.



□ **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 #:  
eDEP Transaction #:1281326  
City/Town:SUDBURY

**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:

2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payer name on check: First Name

7. Payer name on check: Last Name

**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.

1. Signature of Applicant

2. Date

3. Signature of Property Owner(if different)

4. Date

Arthur Allen

5/20/2021

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 Section C, Items 1-3, 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  
**WPA Form 3 - Notice of Wetland Fee Transmittal**  
**Form**

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

Provided by MassDEP:  
 MassDEP File #:  
 eDEP Transaction #:1281326  
 City/Town:SUDBURY

**A. Applicant Information**

1. Applicant:

a. First Name	DANIEL	b. Last Name	NASON		
c. Organization	TOWN OF SUDBURY DEPT. OF PUBLIC WORKS				
d. Mailing Address	275 OLD LANCASTER ROAD				
e. City/Town	SUDBURY	f. State	MA	g. Zip Code	01776
h. Phone Number	9784432209	i. Fax		j. Email	nasond@sudbury.ma.us

2. Property Owner:(if different)

a. First Name	DANIEL	b. Last Name	NASON		
c. Organization	TOWN OF SUDBURY DEPT. OF PUBLIC WORKS				
d. Mailing Address	275 OLD LANCASTER ROAD				
e. City/Town	SUDBURY	f. State	MA	g. Zip Code	01776
h. Phone Number	9784432209	i. Fax		j. Email	nasond@sudbury.ma.us

3. Project Location:

a. Street Address	WOLBACH ROAD	b. City/Town	SUDBURY
-------------------	--------------	--------------	---------

Are you exempted from Fee?  (YOU HAVE SELECTED 'YES')

**Note:** Fee will be exempted if you are one of the following:

- City/Town/County/District
- Municipal Housing Authority
- Indian Tribe Housing Authority
- MBTA

State agencies are only exempt if the fee is less than \$100

**B. Fees**

Activity Type	Activity Number	Activity Fee	RF Multiplier	Sub Total
		City/Town share of filling fee	State share of filing fee	Total Project Fee
		\$0.00	\$0.00	\$0.00

<b>abutters_id_field</b>	<b>abutters_owner1</b>	<b>abutters_owner2</b>
H10-0200	FAIRBANK WILLIAM TRS	REBECCA FAIRBANK LIVING TRUST
H10-0201	DINNO RAMZI SAAD & RAIED TRS	HARVEYS FARM TRUST
H10-0202	DINNO RAMZI SAAD & RAIED TRS	HARVEYS FARM TRUST
H10-0502	STEWART JOHN & CONNIE M TRS	JOHN STEWART TRUST OF 2002
H11-0100	SUDBURY VALLEY TRUSTEES INC	
H11-0101	UNITED STATES OF AMERICA	US FISH & WILDLIFE, REALTY OFF
H11-0102	SUDBURY VALLEY TRUSTEES INC	
H11-0104	SUDBURY VALLEY TRUSTEES INC	
H11-0105	SUDBURY VALLEY TRUSTEES INC	
H11-0201	EISENSTEIN RONALD I & L	CADOGAN CAROL
H11-0300	COMMONWEALTH OF MASSACHUSETTS	DEP OF ENV MGMT& DIV OF FISHER
H12-0002	USA - DEPT OF INTERIOR	TRACT #276A
H12-0100	COMMONWEALTH OF MASSACHUSETTS	DEP OF ENV MGMT&DIV OF FISHERI
J10-0200	TOWN OF SUDBURY	CONSERVATION
J10-0607	HWANG RAYMOND & EMILY	
J11-0001	NEWTON FRANCIS C III &	NEWTON JAMES W TRUSTEES OF THE
J11-0100	UNITED STATES OF AMERICA	U.S. FISH & WILDLIFE
J11-0201	UNITED STATES OF AMERICA	US FISH & WILDLIFE, REALTY OFF
J11-0202	SUDBURY VALLEY TRUSTEES INC	
J11-0300	WOOD DIANA N	
J11-0301	NEWTON JAMES W	
J11-0304	NEWTON FRANCIS C III &	NEWTON JAMES W TRUSTEES OF THE
J11-0501	NEWTON FRANCIS C III &	NEWTON JAMES W TRUSTEES OF THE

**Town of Wayland**  
**Planning Department**  
**41 Cochituate Road**  
**Wayland, MA 01778**

<b>abutters_address</b>	<b>abutters_address2</b>	<b>abutters_town</b>	<b>abutters_state</b>	<b>abutters_zip</b>
136 OLD SUDBURY RD		SUDBURY	MA	01776
35 ARROWHEAD RD		WESTON	MA	02493-1706
35 ARROWHEAD RD		WESTON	MA	02493-1706
115 OLD SUDBURY ROAD		SUDBURY	MA	01776
18 WOLBACH RD		SUDBURY	MA	01776
300 WESTGATE CTR DR		HADLEY	MA	01035
18 WOLBACH RD		SUDBURY	MA	01776
18 WOLBACH RD		SUDBURY	MA	01776
18 WOLBACH RD		SUDBURY	MA	01776
107 OLD SUDBURY ROAD		SUDBURY	MA	01776
100 CAMBRIDGE ST 9TH FLOOR		BOSTON	MA	02114
300 WESTGATE CENTER DR		HADLEY	MA	
100 CAMBRIDGE ST 9th floor		BOSTON	MA	02114
278 OLD SUDBURY ROAD		SUDBURY	MA	01776
86 KATO DR		SUDBURY	MA	01776
132 SCITUATE STREET		ARLINGTON	MA	02476
300 WESTGATE CTR DRIVE		HADLEY	MA	01035
300 WESTGATE CTR DR		HADLEY	MA	01035
18 WOLBACH RD		SUDBURY	MA	01776
46 WOLBACH RD		SUDBURY	MA	01776
42 WOLBACH RD		SUDBURY	MA	01776
132 SCITUATE STREET		ARLINGTON	MA	02476
132 SCITUATE STREET		ARLINGTON	MA	02476

**abutters\_bookpage**

56951-552  
48470-366  
48470-366  
68979-211  
00P2515  
193536  
00P2515  
00P2515  
00P2515  
62634-519  
18737-217  
N-A  
18737-217  
21642-364  
76535-53  
70343-490  
21649-271  
193536  
00P2515  
29922-3  
20366-249  
70343-490  
70343-490

**abutters\_location**

135 OLD SUDBURY RD  
12 HARVEYS FARM LN  
HARVEYS FARM LN  
115 OLD SUDBURY RD  
18 WOLBACH RD  
WOLBACH RD  
WOLBACH RD  
LOT 4 OLD SUDBURY RD  
LOT 5 OLD SUDBURY RD  
107 OLD SUDBURY RD  
WATER ROW  
OLD SUDBURY RD  
WATER ROW  
OLD SUDBURY RD  
86 KATO DR  
50 WOLBACH RD  
91 RIVER RD  
WOLBACH RD  
39 WOLBACH RD  
46 WOLBACH RD  
42 WOLBACH RD  
WOLBACH RD  
WOLBACH RD



## **TECHNICAL MEMORANDUM**

TO: Arthur Allen, EcoTec, Inc.  
PREPARED BY: Dan Pasquale & Kevin Trainor, Woodard & Curran  
REVIEWED BY: Scott Salvucci, Woodard & Curran  
DATE: May 24, 2021  
RE: Wolbach Road Culvert Replacement – Hydraulic Analysis

---

### **1. INTRODUCTION**

The purpose of this memorandum is to summarize Woodard & Curran's hydraulic evaluation of an existing culvert carrying an unmapped intermittent stream beneath Wolbach Road. This memorandum is intended to support development of a Notice of Intent to file an application with the Conservation Commission for authorization to replace the existing culvert. The existing 3-foot by 4-foot opening area concrete box culvert is deteriorating, and the Town has identified the culvert for replacement. Woodard & Curran recommends replacing the existing culvert with a precast concrete box culvert with a 4-foot high by 5-foot wide open area and natural streambed material. Please refer to Figures 1 and 2 for Site Location Map and Project Area.

### **2. EXISTING CONDITIONS EVALUATION**

The existing culvert crossing beneath Wolbach Road is in poor condition and requires replacement. The downstream end headwall is deteriorated and large cracks and holes in the culvert barrel are present, indicating that the existing culvert has a limited remaining service life.

#### **2.1 Survey**

An existing conditions survey of the site was performed by Chappell Engineering Associates in November 2020. The existing box culvert is 24.3 feet long, flowing west to east beneath Wolbach Road. The property upstream of the Wolbach Road crossing is owned by the Sudbury Valley Trustees, and the downstream property is owned by the US Department of the Interior. The existing conditions survey is included as Attachment A.

#### **2.2 Wetland Resource Evaluation**

A wetland resource evaluation was performed by EcoTec, Inc. on November 20, 2020 to evaluate the presence of resource areas within the project area. Wetland flags were delineated for the boundary of bordering vegetated wetlands (BVW) associated with the upstream and downstream wetland complexes, labeled A1-A9 and B1-B9, respectively. Stream bank flags were delineated on the east and west sides of the Wolbach Road crossing, labeled SA1-SA11 and SB1-SB5, respectively. The unnamed stream carried in the culvert is presumed to be intermittent based on stream mapping and watershed area; therefore, regulations pertaining to the Riverfront Area are not applicable to the site. The intermittent stream continues from the culvert outlet through flat, vegetated marshlands ultimately draining to the Sudbury River. The Wetland Resource Evaluation report is included as Attachment B.



### **2.3 Unnamed Stream Channel Conditions**

The unnamed stream channel immediately upstream of the Wolbach Road crossing conveys flow from a hilly, predominantly forested upland tributary area. The slope upstream of the culvert within the surveyed area is approximately 3.92%. The channel downstream of the culvert enters a flatter marshland area with a slope of approximately 2.50%.

There appears to be a small section of the intermittent stream approximately 33 feet upstream of the culvert entrance where pooling occurs during higher flows. The channel width ranges from 3-feet to 12-feet at the widest point of the pool area. The existing culvert is set at a slope of approximately 0.73% with a natural bottom substrate and provides no bank area for wildlife passage.

### **2.4 Geotechnical Exploration**

GZA GeoEnvironmental, Inc. completed subsurface exploration and compiled a geotechnical memorandum dated January 13, 2021 presenting the subsurface findings. Borings B-1 and B-2 were drilled on November 19, 2020 at the Wolbach Road culvert crossing. Subsurface conditions at the site consist of loose to medium-dense sand fill over natural clayey silt and/or silty sand. Groundwater was encountered in the two borings at approximate elevations ranging from 118.3-121.4. The geotechnical exploration report is included as Attachment C.

### **2.5 FEMA FIRM Review**

Review of the Federal Emergency Management Agency (FEMA) flood maps indicates that the site is within an Area of Minimal Flood Hazard as mapped on FEMA Flood Insurance Rate Map (FIRM) Panel 25017C0507F. The culvert crossing is approximately 78 feet upstream of a Zone AE associated with the Sudbury River with a Base Flood Elevation (BFE) of 121 feet, equal to the 1% annual chance flood elevation. From the accompanying Flood Insurance Study (FIS), flood elevations for the 10%, 4%, and 2% annual chance events were also found. The FIRMette is included as Attachment D.

### **2.6 USGS Hydrology Review**

The unnamed stream channel is defined by StreamStats, and United States Geological Survey (USGS) regression equations were used to establish flows used for hydrologic and hydraulic analysis and design purposes. Catchment delineation data from StreamStats indicates that the contributing drainage area to the culvert crossing at Wolbach Road is approximately 0.15 square miles and 53.6% forested. The StreamStats report for this location is attached as Attachment E.

### **2.7 Hydrologic & Hydraulic Analysis**

Woodard & Curran performed a hydraulic analysis of the Wolbach Road culvert using hydrology data obtained from USGS. Flows for 10% annual-chance, 4% annual-chance, 2% annual-chance, and 1% annual-chance peak flow events were simulated for the existing culvert, a replace-in-kind alternative, and a larger culvert replacement alternative. The stream and culvert hydraulics were modeled using the Hydrologic Engineering Center River Analysis System (HEC-RAS) developed by the US Army Corps of Engineers, version 5.0.7, based on field survey data. The boundary conditions simulated are summarized in Table 2-1 below.



**Table 2-1: Wolbach Road Culvert Boundary Conditions**

Peak Flow Event	Flow (cfs)	Downstream Tailwater Elevation (feet NAVD88)
10% Annual-Chance	24.0	119
4% Annual-Chance	33.1	120
2% Annual-Chance	40.7	120.5
1% Annual-Chance	48.9	121

### 3. DESIGN CONSIDERATIONS

The purpose of this project is to improve the structural integrity of the culvert and roadway, while maintaining or improving the hydraulic capacity of the culvert and habitat conditions at the crossing where possible. The design considerations of the culvert replacement concentrated on maintaining existing flood conditions for the 100-year peak flow event. Hydraulic performance, potential for downstream flooding; effect on upstream, downstream, and riparian habitat; potential for erosion and overall effect on stream stability were taken into consideration. Woodard & Curran evaluated a replace-in-kind alternative and an enlarged culvert alternative:

- Alternative 1: 3-foot wide by 6-foot high four-sided pre-cast concrete culvert embedded with 2-feet of natural streambed material, with an effective open area of 3-feet wide by 4-feet high
- Alternative 2: 5-foot wide by 6-foot high four-sided pre-cast concrete culvert embedded with 2-feet of natural streambed material, with an effective open area of 5-feet wide by 4-feet high

Design considerations also included utility and roadway elevation constraints. The existing culvert has a maximum height of 4-feet and invert elevations of 122.43 feet and 122.26 feet at the culvert inlet and outlet, respectively. No subsurface utilities were found near the crossing based a review of available record plans, and no evidence of underground utilities (such as access covers and valves) exists near the crossing as shown on the field survey. Overhead electric utilities are present on the east side of the existing roadway. It is anticipated that existing roadway surface elevations and grading patterns near the culvert crossing will be maintained to the maximum extent feasible under the proposed conditions.

#### 3.1 Hydraulic Analysis Results

Hydraulic conditions in the area immediately upstream and downstream of the Wolbach Road crossing were compared for the 1%-annual chance event for the replace-in-kind and enlarged box culvert alternatives described above.

The existing culvert acts as a flow restriction, impounding water upstream of Wolbach Road. Based on Woodard & Curran’s analysis, the existing culvert does not appear to be hydraulically undersized—the modeled water level upstream of Wolbach Road under existing conditions is below the crown elevation of the culvert.

Increasing the hydraulic capacity at the Wolbach Road Crossing may reduce the water level both upstream and downstream of the culvert during high flow events. Table 3-1 below summarizes the effects of the culvert



replacement on the upstream and downstream water levels during the 100-year (1% annual chance) event. Detailed HEC-RAS results are included in Attachment F.

**Table 3-1: Hydraulic Summary of Options**



Alternative	Description	Approximate Max Upstream Water Level (feet NAVD88)	Approximate Max Downstream Water Level (feet NAVD88)
<b>1: In-Kind Replacement with Embedded Box Culvert</b>	3'W x 6'H closed box (embedded 2.0 feet) @ 0.73% slope	125.84	124.33
<b>2: Enlarged Box Culvert</b>	5'W x 6'H closed box (embedded 2.0 feet) @ 0.73% slope	125.11	124.05

### 3.2 Results Discussion

The following sections address the results in the context of hydraulic performance, upstream and downstream water levels, potential for downstream flooding; effect on upstream, downstream, and riparian habitat; potential for erosion and overall effect on stream stability.

#### 3.2.1 Alternative 1

Alternative 1 will maintain existing hydraulic performance during the 100-year event and will not appreciably change upstream and downstream water levels. Alternative 1 will also continue to restrict movement of habitat upstream and downstream of the culvert.

With respect to the Massachusetts Stream Crossing Standards, Alternative 1:

- Does not meet the structure type general or optimal standards. Alternative 1 is neither an open-bottom structure nor a bridge.
- Meets the embedment general standard. Alternative 1 is embedded a minimum of 2-feet.
- Does not meet the crossing span general or optimal standards. The width of Alternative 1 is 1.0 x the stream's assumed bankfull width of 3 feet.
- Meets the substrate optimal standard. Alternative 1 is embedded with substrate that matches that of the stream.
- Does not meet the water depth and velocity general or optimal standards. Alternative 1 creates a constriction upstream of the crossing, resulting in water depths higher than under natural conditions
- Does not meet the openness general or optimal standards. The openness of Alternative 1 is 0.5 feet.

- Does not meet the banks general or optimal standards. Alternative 1 does not provide banks within the crossing.

### 3.2.2 Alternative 2



Alternative 2 is likely to reduce the water level both upstream and downstream of the culvert during the 100-year event. The widened culvert reduces the amount of flow constriction at the crossing, which in turn reduces water depths within and near the crossing. The tailwater condition associated with the Sudbury River controls flooding conditions downstream of the crossing, and no significant changes to flood elevations are expected downstream of the crossing location. Alternative 2 would provide a habitat connection upstream and downstream of the culvert.

With respect to the Massachusetts Stream Crossing Standards, Alternative 2:

- Does not meet the structure type general or optimal standards. Alternative 2 is neither an open-bottom structure nor a bridge.
- Meets the embedment general standard. Alternative 2 is embedded 2.0 feet.
- Meets the crossing span optimal standard. The span of Alternative 2 is 1.67 x the stream's assumed bankfull width of 3 feet.
- Meets the substrate optimal standard. Alternative 2 is embedded with substrate that matches that of the stream.
- Does not meet the water depth and velocity optimal standard. However, Alternative 2 reduces water depths within the crossing to match upstream water elevations more closely.
- Meets the openness general standard. The openness of Alternative 2 is 0.83 feet.
- Does not meet the banks general standard. Alternative 2 provides additional room on the edges of the stream beyond the bankfull width, and over time, the water course will naturally create a distinct channel within the culvert bottom. However, a constructed bank is not proposed under this alternative.

## 4. RECOMMENDED REPLACEMENT ALTERNATIVE

Based upon the design considerations and hydraulic calculations, the recommended culvert replacement is Alternative 2. Please refer to Figure 3 for a conceptual culvert section.

In Section 3, all alternatives were evaluated to determine the ability to meet the "Replacing or Retrofitting Crossings" section of the latest version of the Massachusetts River and Stream Crossing Standards. There are no practicable and substantially equivalent economic alternatives to the proposed project to meet all of the general standards of the Massachusetts River and Stream Crossing Standards, maintain upstream habitat, and fit within the structural constraints of the site (roadway elevation and width). The proposed alternative was designed to comply with the Massachusetts River and Stream Crossing Standards for culvert replacement projects to the extent practicable.

### 4.1 Anticipated Impacts to Adjacent Upland Resource Areas

The Town of Sudbury Wetlands Administration Bylaw (Article XXII) and its associated Sudbury Wetlands Administration Bylaw Regulations (revised September 25, 2017) establishes jurisdictional Adjacent Upland Resource Areas (AURAs). The Bylaw defines AURAs as land within 100-feet of wetland resource areas, within 200-feet of top of bank, and with varying extent when adjacent to vernal pools, ponds <10,000 square feet in



area, or isolated land subject to flooding. The proposed culvert replacement includes work within 100-feet of Bordering Vegetated Wetlands, considered an AURA under the Bylaw.

The project was designed to minimize the amount of disruption and alteration to the AURAs within the project limits of work. The proposed box culvert is expected to reduce water levels surrounding the roadway during flood events and provide easier wildlife passage through the crossing. Temporary land disturbances will be stabilized and restored to existing conditions. A native New England Conservation/Wildlife seed mix will be applied to temporarily disturbed areas within the AURAs. The blend of species will provide a permanent cover of grasses, forbs, wildflowers, and legumes to control soil erosion and enhance wildlife habitat. The seed mix specifications are included as Attachment G.

The proposed roadway above the crossing will match the width of the existing roadway, and the impervious area associated with the new headwalls is expected to be similar to the existing headwall impervious area. Because of this, no net increase in impervious area relative to existing conditions at the crossing is anticipated.

The Wolbach Road culvert is deteriorating and has been prioritized by the Town for replacement. There is no reasonable alternative that would reduce or eliminate the temporary and permanent impacts associated with the project. Figure 4 shows anticipated project-related impacts to resource areas.

## **5. CONCEPTUAL SEQUENCE OF CONSTRUCTION**

Plans depicting erosion control measures, proposed grading, and other features for the project are currently under development. Because Wolbach Road is a one-lane road, temporary closure of the roadway will be required to facilitate construction. There is no outlet from Wolbach Road south of the crossing, and a limited number of residents would be temporarily unable to drive their vehicles over the crossing for the duration of the road closure. It is anticipated that construction will take place during dry conditions, so that a temporary footpath could be more easily established between the north and south sides of the stream. The anticipated sequence of construction is as follows:

1. Install temporary erosion and sedimentation control measures. Install temporary flow control measures (cofferdam, flow diffuser, and/or flow diversion) as needed;
2. Protection of existing utilities (overhead electric/telecommunications);
3. Position Town of Sudbury fire apparatus on the south side of the crossing in case an emergency response is required. Construct temporary footpath to allow foot travel between the two sides of the culvert. Allow residents affected by the road closure to move their vehicles to the north side of the crossing (allowing access to Old Sudbury Road);
4. Close the roadway;
5. Remove and dispose of the existing culvert and headwalls;
6. Install new culvert and headwall;
7. Once new culvert is established, re-open roadway and allow residents to retrieve their vehicles;
8. Stabilize side slopes;
9. Install erosion control matting, loam, and seed on all disturbed areas; and
10. Remove temporary erosion/sedimentation control measures and temporary flow control measures.

## **6. ATTACHMENTS**

## Figures

Figure 1 – Site Location Map

Figure 2 – Project Area & Conceptual Hydraulic Model

Figure 3 – Replacement Culvert Concept

Figure 4 – Resource Area Impact Figure

## Attachments

Attachment A – Existing Conditions Survey

Attachment B – Wetland Resource Evaluation

Attachment C – Geotechnical Evaluation

Attachment D – FEMA FIRMETTE

Attachment E – StreamStats Report

Attachment F – Culvert Analysis Report

Attachment G – Seed Mix Specifications

## **7. REFERENCES**

USGS StreamStats Peak-Flow Statistics. Accessed electronically December 2020.

Hydraulic Engineering Center – River Analysis System (HEC-RAS) Hydraulic Reference Manual, Version 5.0

Concord River HUC 8 LiDAR FY 2010, Middlesex County, Massachusetts CID 25017C, Worcester County, Massachusetts CID 25027C. Federal Emergency Management Agency. DEM generated from LiDAR by MassGIS. Accessed electronically December, 2020.

FEMA FIRM Panel 25017C0366F, effective July 7, 2014

Massachusetts River and Stream Crossing Standards, River & Stream Continuity Partnership





**Figure 1: Site Location Map**

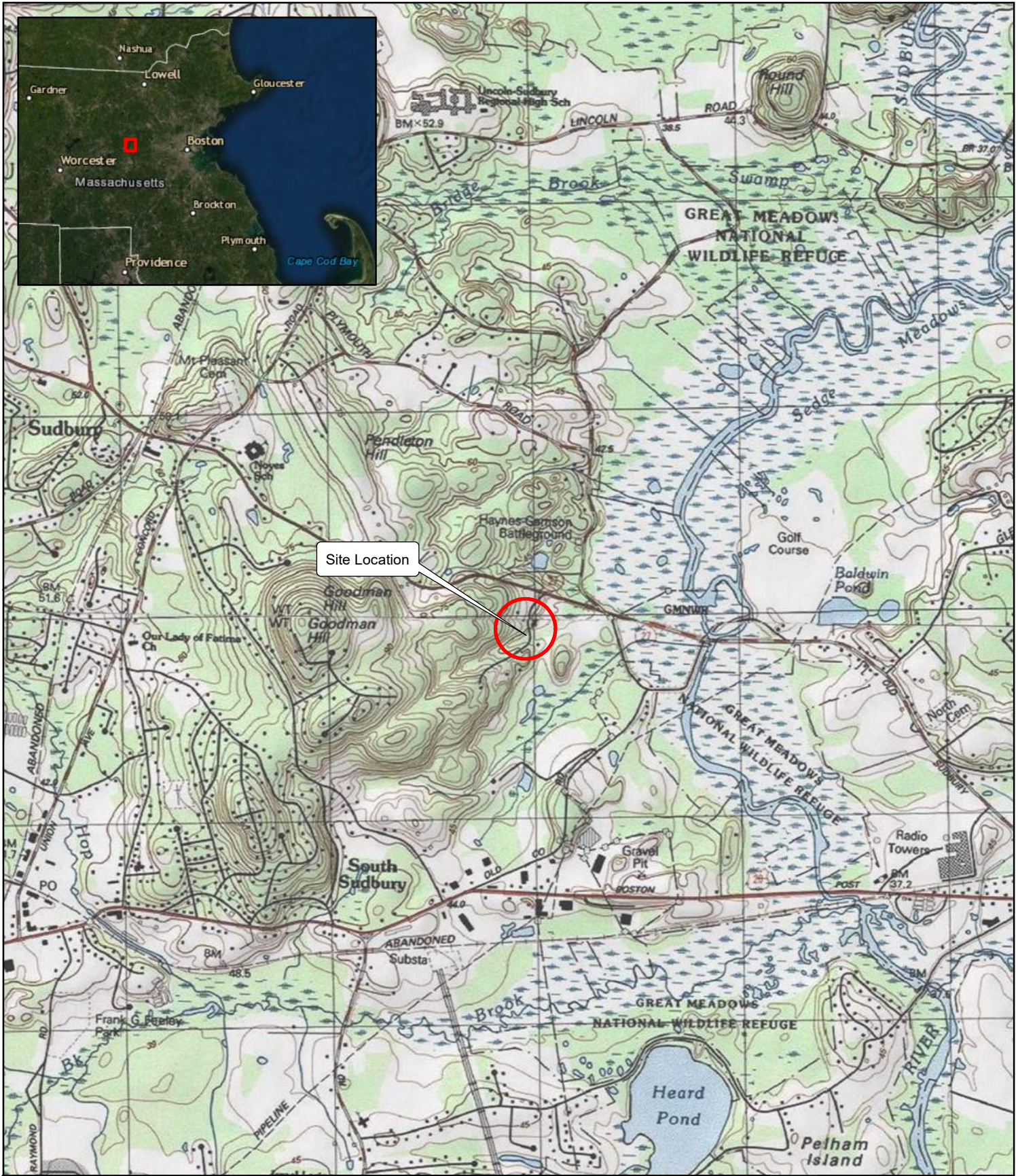


Figure Exported: 1/21/2021 11:45:30 AM. User: dpaasquale. Using: C:\Users\dpasquale\OneDrive - Woodard & Curran\PC\Projects\Documents\H1 - Modeling\Washington Drive\GIS\Projects\Wolbach Rd Site Location.mxd

# WOLBACH ROAD CULVERT REPLACEMENT

SUDBURY, MA  
FIGURE 1 - SITE LOCATION MAP

0 0.1 0.2 0.3 0.4 0.5  
Miles



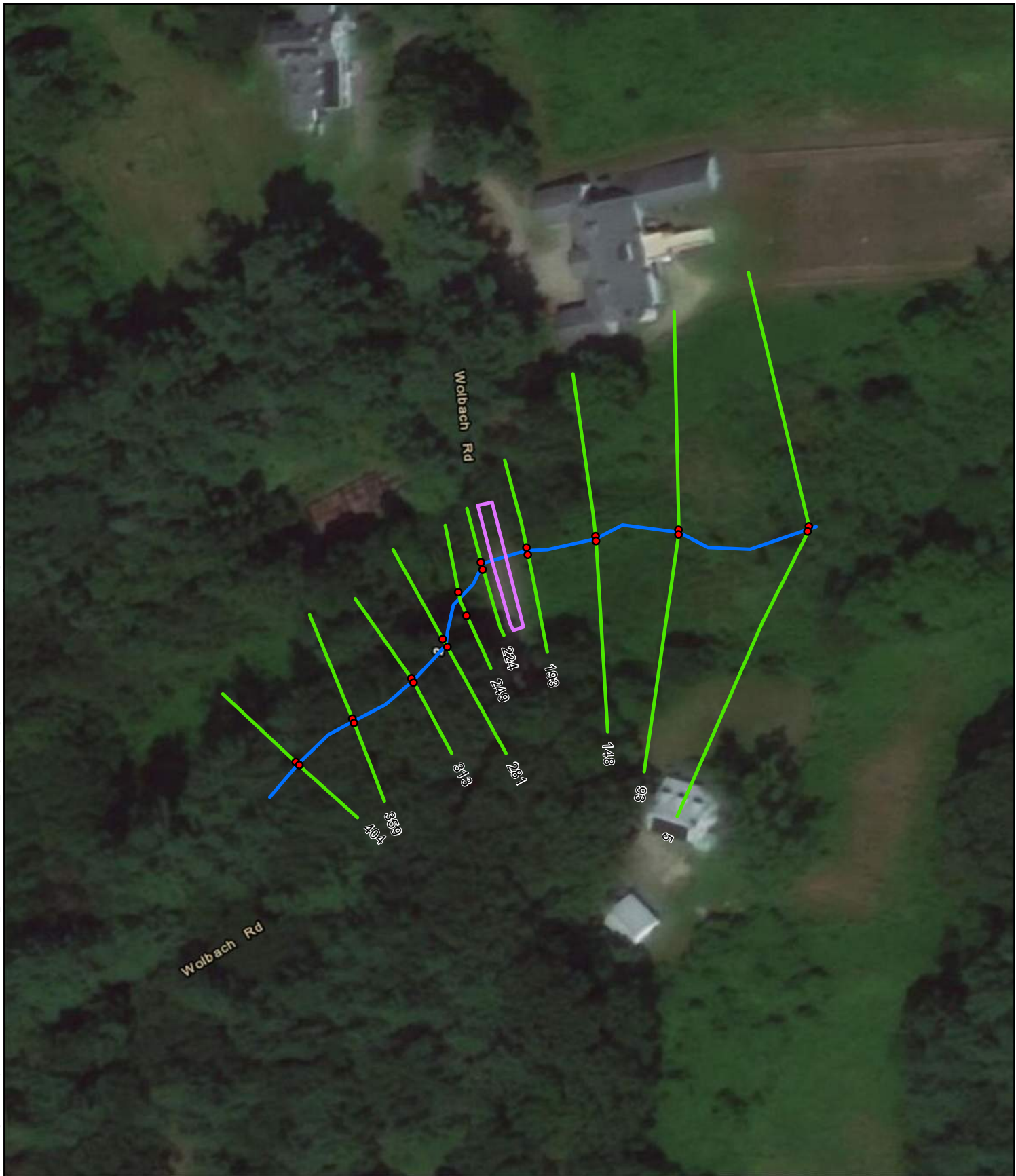
Project #: 0233335.00  
Map Created: January 2021

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. Data Sources: ESRI, National Geographic



**Figure 2: Project Area & Conceptual Hydraulic Model**

Figure Exported: 1/25/2024, By: dpasquale, Using: C:\Users\dpasquale\OneDrive - Woodard & Curran\PC\Folders\Documents\HH\_Modeling\Washington Drive\GIS\Projects\Wolbach Rd\Figures.mxd



**Legend**

- Stream Bank Locations
- ▭ Structure
- Stream
- Cross-Section (Stationing in ft.)

0 0.004 0.008 0.012 0.016 0.02 Miles

## WOLBACH ROAD CULVERT REPLACEMENT

SUDBURY, MA

### FIGURE 2 - PROJECT AREA & CONCEPTUAL HYDRAULIC MODEL





Project #: 0233335.00  
Map Created: January 2021

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources:** ESRI, National Geographic





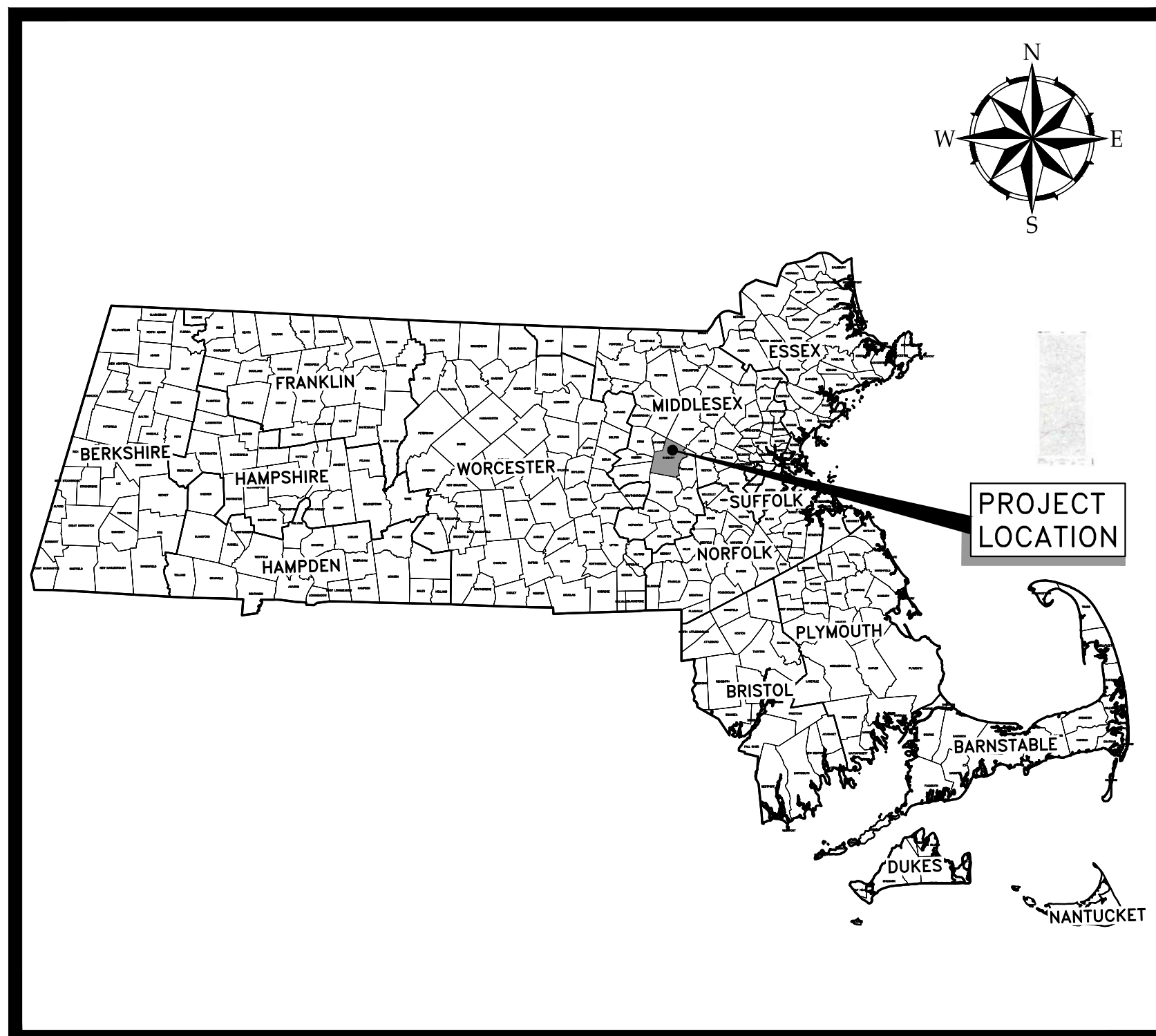
**Figure 3: Replacement Culvert Concept**

# TOWN OF SUDBURY, MA

## PUBLIC WORKS DEPARTMENT

# WOLBACH ROAD CULVERT REPLACEMENT

**PROJECT NO.**  
**0233335.03**  
**MAY 2021**  
**PERMITTING SET**  
**NOT FOR CONSTRUCTION**

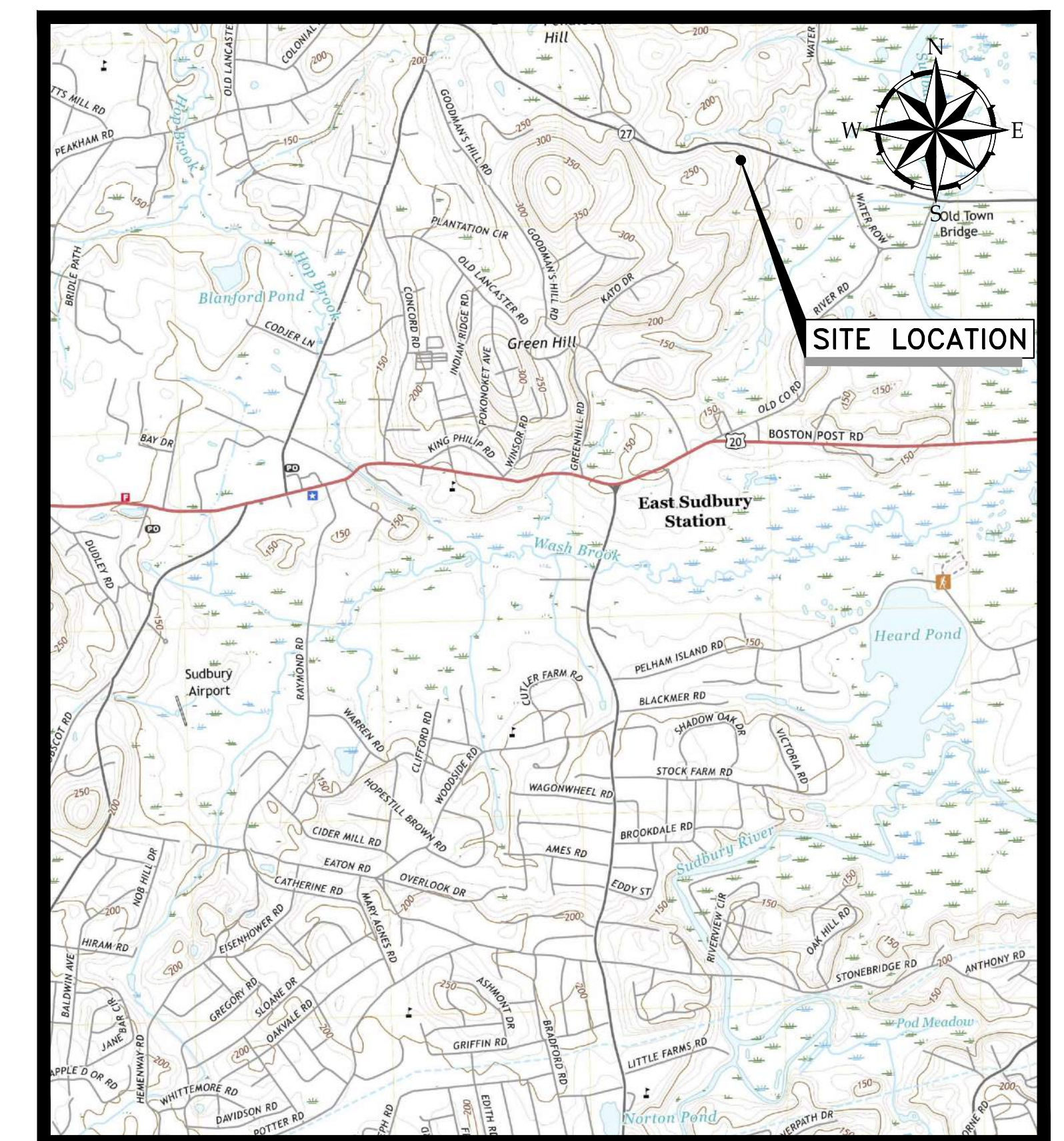


**PROJECT LOCATION MAP**



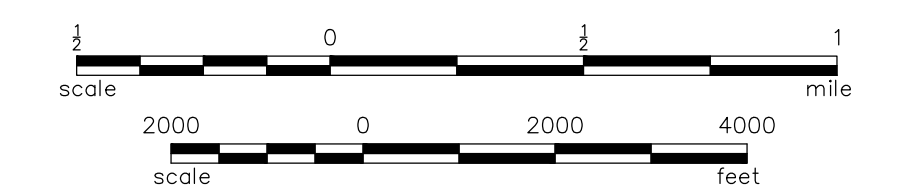
250 Royall Street Suite 200E  
 Canton, Massachusetts 02021  
 800.446.5518 | [www.woodardcurran.com](http://www.woodardcurran.com)

COMMITMENT & INTEGRITY DRIVE RESULTS



SOURCE: USGS MAP

**SITE LOCATION MAP**



GENERAL NOTES:

- 1. EXISTING CONDITIONS ARE BASED ON SURVEYS PERFORMED BY CHAPPELL ENGINEERING ASSOCIATES, DATED JANUARY 19, 2021.
2. CHAPPELL ENGINEERING ASSOCIATES IS LOCATED AT THE FOLLOWING ADDRESS: 201 BOSTON POST ROAD WEST, SUITE 101 MARLBOROUGH, MA 01752 (508) 481-7400 EXT. 118
3. CONTRACTOR SHALL INVESTIGATE EXISTING CONDITIONS AND FIELD VERIFY LOCATIONS, DEPTH, AND SIZE OF UTILITIES AND SUB-SURFACE STRUCTURES PRIOR TO CONSTRUCTION. CONTRACTOR SHALL NOTIFY ENGINEER OF ANY CONFLICTS OR DISCREPANCIES WITH THE EXISTING AND PROPOSED UTILITY LOCATIONS.
4. THE HORIZONTAL DATUM DEPICTED ON THE MAPS HEREON IS BASED ON THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, REFERENCED TO THE NORTH AMERICAN DATUM OF 1983. THE VERTICAL DATUM IS BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
5. ANY PROPERTY AND RIGHT OF WAY LOCATIONS THAT MAY BE SHOWN HEREON ARE APPROXIMATE AND DO NOT REPRESENT A PROPERTY BOUNDARY SURVEY.
6. WOODARD & CURRAN ASSUMES NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES OMITTED OR INACCURATELY SHOWN.
7. COORDINATE CONSTRUCTION ACTIVITY WITH UTILITY COMPANIES, EMERGENCY SERVICES AND TOWN. CONTRACTOR SHALL NOTIFY ALL UTILITIES PRIOR TO COMMENCING WORK, ALLOWING SUFFICIENT TIME TO LOCATE AND MARK THE LOCATION OF BURIED UTILITIES. CONTRACTOR SHALL CONTACT "DIG SAFE", TELEPHONE 811, PRIOR TO EXCAVATION.
8. RESTORE ALL AREAS DISTURBED BY CONTRACTOR'S OPERATIONS TO ORIGINAL FINISH (GRAVEL, PAVEMENT, GRASS, ETC.) UNLESS NOTED OTHERWISE ON THE PLANS. RESTORATION OF PAVED SURFACES, GRAVEL SURFACES, DRIVEWAYS, AND LAWNS DAMAGED BY CONSTRUCTION ACTIVITIES SHALL BE PERFORMED AT NO ADDITIONAL COST TO OWNER. ANY CURB DAMAGED BY CONSTRUCTION ACTIVITIES SHALL BE REPLACED IN KIND AND SHALL CONFORM TO TOWN OF SUDBURY AND MASSACHUSETTS DOT SPECIFICATIONS AT NO ADDITIONAL COST TO OWNER.
9. PROPERLY PROTECT AND DO NOT DISTURB PROPERTY IRONS AND MONUMENTS. IF DISTURBED, THE PROPERTY MONUMENT SHALL BE RESET AT THE CONTRACTOR'S EXPENSE BY A LICENSED LAND SURVEYOR ACCEPTABLE TO THE TOWN.
10. EXISTING FACILITIES (I.E. TREES, POLES, LIGHT POSTS, CATCH BASINS, STONE FROM CULVERT, ETC.) SHALL BE REMOVED AND/OR PROTECTED DURING CONSTRUCTION. THE TOWN RETAINS RIGHT TO KEEP ANY AND ALL REMOVED FACILITIES. CONTRACTOR SHALL DISPOSE OF ANY REMOVED FACILITY AT THE REQUEST OF THE TOWN AT NO ADDITIONAL COST TO OWNER.
11. ALL TREES NOT NOTED TO BE REMOVED OR RELOCATED SHALL BE PROTECTED BY CONTRACTOR DURING CONSTRUCTION.
12. RESTRICT ACCESS TO SITE THROUGH THE USE OF APPROPRIATE SIGNAGE, BARRIERS, FENCES, ETC. SITE SHALL BE LEFT WITH APPROPRIATE SAFETY MEASURES IN PLACE DURING NON-WORKING HOURS. SITE SAFETY IS THE RESPONSIBILITY OF CONTRACTOR, DURING BOTH WORKING AND NON-WORKING HOURS.
13. CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL NECESSARY CONSTRUCTION PERMITS INCLUDING "PERMIT TO CONSTRUCT WITHIN A PUBLIC WAY" FROM THE TOWN. PERMIT APPLICATIONS SHALL BE SUBMITTED WITH ADEQUATE TIME SO AS NOT TO DELAY CONSTRUCTION.
14. ALL WORK ASSOCIATED WITH THE PROJECT SHALL BE COMPLETED IN ACCORDANCE WITH THE TOWN OF SUDBURY BYLAW AND LOCAL REGULATIONS AND MASSACHUSETTS DOT STANDARD SPECIFICATIONS.
15. UPON COMPLETION OF CONSTRUCTION, A COMPLETE SET OF "RECORD" DRAWINGS SHALL BE SUBMITTED TO THE TOWN ENGINEER. THESE DRAWINGS SHALL BE SUBMITTED IN BOTH DIGITAL AND HARD COPY FORMAT AS DEFINED IN THE SPECIFICATIONS PRIOR TO PAYMENT OF FINAL RETAINAGE.
16. PROTECTION OF EXISTING UTILITIES DURING CONSTRUCTION SHALL BE PROVIDED AT NO ADDITIONAL COST.
17. CONTRACTOR SHALL BE RESPONSIBLE FOR SWEEPING OLS SUDBURY ROAD EVERY FRIDAY AND AS NECESSARY DURING THE DURATION OF THE WORK.
18. PRIOR TO CONSTRUCTION, CONTRACTOR SHALL ATTEND A PRE-CONSTRUCTION MEETING HELD AT THE PROJECT SITE WITH THE CONTRACTOR, ENGINEER, OWNER, AND CONSERVATION OFFICE TO REVIEW THE CONSTRUCTION SCHEDULE AND SEQUENCING, ORDER OF CONDITIONS, STOCKPILE LOCATIONS AND CRITICAL ASPECTS OF THE PROJECT.
19. ALL DISTURBED UPLAND AREAS SHALL BE BROUGHT TO FINAL GRADE AND SHALL BE PERMANENTLY STABILIZED WITHIN 30 DAYS AFTER DISTURBANCE. BARE GROUND AND DISTURBED AREAS THAT CANNOT BE PERMANENTLY VEGETATED WITHIN 30 DAYS SHALL BE TEMPORARILY STABILIZED BY AN APPROVED METHOD.
20. CONTRACTOR SHALL DEMARCAT CONSTRUCTION EQUIPMENT AND MATERIAL STORAGE AREAS PRIOR TO CONSTRUCTION.
21. THE CONSTRUCTION SITE SHALL BE MAINTAINED IN CLEAN CONDITIONS AT ALL TIMES AND CONSTRUCTION REFUSE AND DEBRIS SHALL BE DISPOSED OF PROMPTLY AND IN A LEGAL MANNER.
22. STORING, SERVICING, OR CLEANING OF TRUCKS OR EQUIPMENT SHALL BE PERFORMED IN AN UPLAND AREA AT A HORIZONTAL DISTANCE GREATER THAN 100 FEET FROM THE WETLAND RESOURCE AREAS.
23. CONTRACTOR SHALL REFER TO SPECIFICATION XXX MASSACHUSETTS COVID ORDER AND CONSTRUCTION GUIDELINES AND EXECUTE CONSTRUCTION IN COMPLIANCE WITH APPLICABLE SOCIAL DISTANCING PROTOCOLS.
24. GEOTECHNICAL INVESTIGATION WAS CONDUCTED BY GZA GEOENVIRONMENTAL ON NOVEMBER 19, 2020 AND DOCUMENTED IN A REPORT DATED JANUARY 13, 2021.
25. WETLAND DELINEATION WAS PREPARED BY ECOTEC, INC. 102 GROVE STREET, WORCESTER, MA 01605. THE WETLAND RESOURCE EVALUATION REPORT IS DATED XX XX, 2021 AND WETLAND FIELD INSPECTION WAS CONDUCTED ON NOVEMBER 20, 2020.
26. DO NOT PARK, IMPEDE ACCESS TO, OR STORE EQUIPMENT BEYOND LIMIT OF WORK, UNLESS PERMISSION HAS BEEN GRANTED IN WRITING BY TOWN AND/OR LAND OWNER.
27. PRIOR TO THE START OF WORK, CONTRACTOR SHALL CONFIRM EXISTING WETLAND FLAGS ARE IN PLACE AND SHALL BE MAINTAINED DURING CONSTRUCTION. MISSING FLAGS SHALL BE RESET PRIOR TO CONSTRUCTION. AN AUTOCAD FILE OF THE WETLAND FLAG LOCATIONS SHALL BE PROVIDED FOR CONTRACTOR'S USE IN RESETTING WETLAND FLAGS.
28. NO EQUIPMENT IS TO CROSS OR ENTER WETLAND RESOURCE AREAS AT ANY TIME UNLESS THE LOCATION OF DISTURBANCE IS MARKED ON THE PLANS REFERENCED IN THE ORDER OF CONDITIONS AND FLAGGED IN THE FIELD (DEP FILE #XXX-XXXX).
29. THE CONTRACTOR, SITE ENGINEER, OR OTHER INDIVIDUAL IN CHARGE OF WORK ON THE SITE SHALL HAVE A COPY OF THE ORDER OF CONDITIONS AT ALL TIMES (DEP FILE #XXX-XXXX).

EROSION CONTROL NOTES:

- 1. EROSION CONTROL DEVICES SHALL REMAIN IN PLACE, UNTIL ALL DISTURBED SURFACES HAVE BEEN STABILIZED WITH FINAL VEGETATION COVER OR THE COMMISSION HAS AUTHORIZED THEIR REMOVAL.
2. EROSION CONTROL MEASURES AND BARRIERS SHALL BE MONITORED DAILY AND MAINTAINED, OR REINFORCED AS NECESSARY TO ENSURE AND PREVENT EROSION AND SILTATION OF SOILS TO WETLAND RESOURCE AREAS. ADDITIONAL FILTER FABRIC AND STRAW WATTLES SHALL BE STORED ON SITE FOR EMERGENCY USE.
3. DURING ALL PHASES OF CONSTRUCTION, ALL DISTURBED OR EXPOSED AREAS OUTSIDE THE ROADWAY SHALL BE BROUGHT TO FINISHED GRADE AND EITHER A) LOAMED AND SEEDED FOR PERMANENT STABILIZATION, IN ACCORDANCE WITH U.S. SOIL CONSERVATION SERVICE PROCEDURES, OR B) STABILIZED IN ANOTHER WAY APPROVED BY THE COMMISSION. AREAS THAT CANNOT BE PERMANENTLY STABILIZED WITHIN 30 DAYS OF DISTURBANCE SHALL BE STABILIZED WITH HAY, STRAW, MULCH OR ANY OTHER PROTECTIVE COVERING AND/OR METHOD APPROVED BY THE U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE OR BY OTHER TEMPORARY MEASURES ACCEPTABLE TO THE COMMISSION.
4. PROJECT IS SUBJECT TO THE CONDITIONS SET FORTH IN PERMITS ISSUED BY THE US ARMY CORPS OF ENGINEERS, SUDBURY CONSERVATION COMMISSION, AND MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION, SPECIFICALLY RELATED TO LIMITS OF IMPACT, EROSION CONTROL MEASURES, RESTORATION ACTIVITIES, AND TIMEFRAME RESTRICTIONS. CONTRACTOR SHALL READ PERMIT DOCUMENTS FULLY AND CARRY OUT WORK IN ACCORDANCE WITH PERMIT DOCUMENTS. COPIES OF PERMIT DOCUMENTS ARE APPENDED TO THE PROJECT SPECIFICATIONS.
5. AN ADEQUATE STOCKPILE OF EROSION AND SEDIMENTATION CONTROL MATERIALS SHALL BE ON SITE AT ALL TIMES FOR EMERGENCY OR ROUTINE REPLACEMENT.
6. ANY DAMAGE CAUSED AS A DIRECT RESULT OF CONSTRUCTION TO THE WETLAND RESOURCE AREAS SHALL BE REPAIRED, RESTORED AND/OR REPLACED. SEDIMENTATION OR EROSION SHALL BE CONSIDERED DAMAGE TO THE WETLAND RESOURCE AREAS. IF SEDIMENTATION REACHES THESE AREAS, THE CONSERVATION COMMISSION SHALL BE CONTACTED AND A PLAN FOR THE PROPOSED RESTORATION SHALL BE SUBMITTED FOR APPROVAL.
7. THE SILT FENCE AND STRAW BALES MUST BE INSPECTED PRIOR TO THE START OF ANY WORK OR A \$100 PER DAY FINE WILL BE LEVIED ON THE CONTRACTOR.

DEWATERING NOTES

- 1. LOCATE DISCHARGE SITE ON FLAT UPLAND AREAS AS FAR AWAY AS POSSIBLE FROM STREAMS, WETLANDS, OTHER RESOURCES AND POINTS OF CONCENTRATED FLOW.
2. NEVER DISCHARGE TO AREAS THAT ARE BARE OR NEWLY VEGETATED.
3. DIRT BAG MATERIAL BASED ON PARTICLE SIZE IN DIRTY WATER, I.E., FOR COARSE PARTICLES A WOVEN MATERIAL; FOR SILTS/CLAYS A NON-WOVEN MATERIAL.
4. DO NOT OVER PRESSURIZE DIRT BAG OR USE BEYOND CAPACITY.
5. CHANNELS DUG FOR DISCHARGING WATER FROM THE EXCAVATED AREA NEED TO BE STABLE. IF FLOW VELOCITIES CAUSE EROSION WITHIN THE CHANNEL THEN A DITCH LINING SHOULD BE USED.
6. BUCKETED WATER SHOULD BE DISCHARGED IN A STABLE MANNER TO THE SEDIMENT REMOVAL AREA. A SPLASH PAD OF RIPRAP UNDERLAIN WITH GEOTEXTILE MAY BE NECESSARY TO PREVENT SCOURING OF SOIL.
7. DEWATERING IN PERIODS OF INTENSE, HEAVY RAIN, WHEN THE INFILTRATIVE CAPACITY OF THE SOIL IS EXCEEDED, SHOULD BE AVOIDED.
8. INSTALL DIVERSION DITCHES OR BERMS TO MINIMIZE THE AMOUNT OF CLEAN STORMWATER RUNOFF ALLOWED INTO THE EXCAVATED AREA.
9. DURING THE ACTIVE DEWATERING PROCESS, INSPECTION OF THE DEWATERING FACILITY SHOULD BE REVIEWED FREQUENTLY. SPECIAL ATTENTION SHOULD BE PAID TO THE BUFFER AREA FOR ANY SIGN OF EROSION AND CONCENTRATION OF FLOW THAT MAY COMPROMISE THE BUFFER AREA. OBSERVE WHERE POSSIBLE THE VISUAL QUALITY OF THE EFFLUENT AND DETERMINE IF ADDITIONAL TREATMENT CAN BE PROVIDED.
10. EROSION CONTROL REQUIRED AROUND DEWATERING DISCHARGE SEDIMENT CONTROL DEVICE.

ABBREVIATIONS

Table listing abbreviations such as A.G. (AND ABOVE GROUND), BIT (BITUMINOUS), CB (CATCH BASIN), D (STORM DRAIN), etc.

SHEET INDEX table listing sheet numbers and titles: G-001 COVER SHEET, G-002 GENERAL NOTES, ABBREVIATIONS AND LEGEND, C-100 EXISTING CONDITIONS PLAN, C-101 SITE DEMOLITION AND EROSION & SEDIMENT CONTROL PLAN, C-102 SITE PLAN AND PROFILE, C-200 CIVIL DETAILS 1, C-201 CIVIL DETAIL 2.

RESOURCE AREA LEGEND

Legend for resource areas including BORDERING VEGETATED WETLAND (BVW), EDGE OF INTERMITTENT STREAM CHANNEL, FLAGGED BANK OF INTERMITTENT STREAM, FEMA FLOOD ZONE BOUNDARY, COFFERDAM, LIMIT OF WORK, SEDIMENT BARRIER, TURBIDITY CURTAIN. Includes a note: PROPOSED CULVERT IS WITHIN 100' BORDERING VEGETATED WETLAND (BVW) BUFFER ZONE (ADJACENT UPLAND RESOURCE AREA).

LINE TYPES & HATCHES

Table showing line types and hatches for EXISTING and PROPOSED conditions. Includes descriptions like CONTOUR (2' INTERVAL), BITUMINOUS CURB, EDGE OF PAVEMENT, STORM DRAIN LINE, UNDERGROUND GAS, WATER LINE, GUARDRAIL, LIMIT OF WORK, SEDIMENT BARRIER/COFFERDAM, SEDIMENT BARRIER/SILT/SOXX/ SILT FENCE, SAWCUT, RETAINING WALL, STONE WALL, RIPRAP, STONE EMBEDMENT, MILL AND OVERLAY, PAVEMENT TO BE REMOVED.

SYMBOLS

Table of symbols for DESCRIPTION: UTILITY POLE, CATCH BASIN, WETLAND FLAG LOCATION, BENCHMARK, MANHOLE, TREE.

WOODARD & CURRAN logo and contact information: 250 Royal Street, Suite 200E, Canton, MA 02021, 800.426.4262 | www.woodardcurran.com. Includes a commitment to integrity and a disclaimer: THIS DOCUMENT IS THE PROPERTY OF WOODARD & CURRAN, INC. AND ITS CLIENT. REPRODUCTION OR MODIFICATION WITHOUT WRITTEN PERMISSION IS PROHIBITED.

Revision table with columns for REV, DESCRIPTION, DATE, and CHECKED BY. Includes a signature line for DESIGNED BY, DRAWN BY, and CHECKED BY.

GENERAL NOTES, ABBREVIATIONS AND LEGEND

TOWN OF SUDBURY, MA PUBLIC WORKS DEPARTMENT and WOLBACH ROAD CULVERT REPLACEMENT project information.

Job information table: JOB NO: 023335.03, DATE: MAY 2021, SCALE: AS SHOWN, SHEET: 2 OF 7.

G-002

Vertical text on the left margin: W:\woodardcurran\wetland\Projects\023335\03-C-XXX.dwg, Apr 28, 2021 - 12:29pm, MBR:GWN

1

2

3

4

5

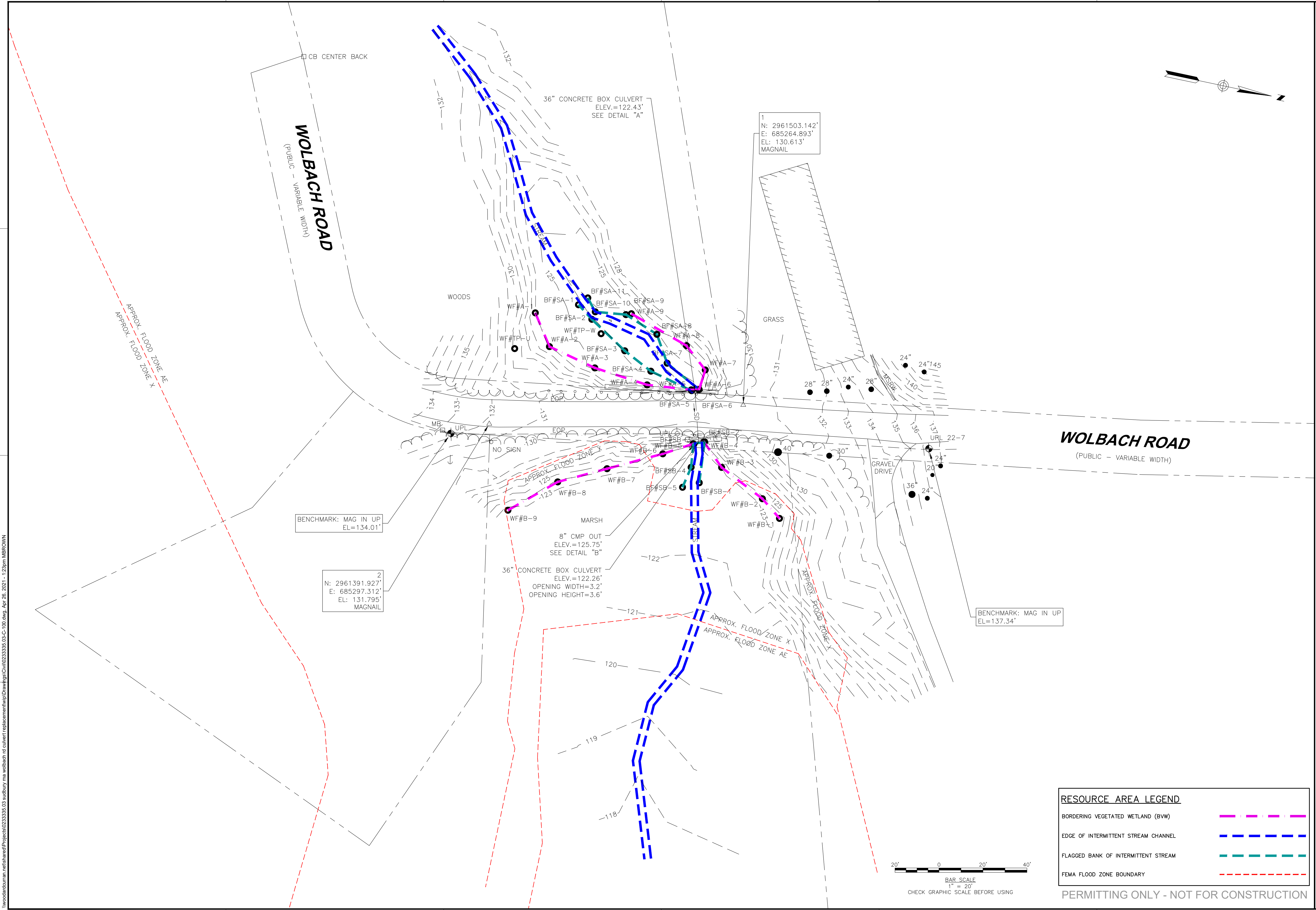
6

A

B

C

D



250 Royal Street, Suite 200E  
 Canton, MA 02021  
 800.426.4262 | www.woodardcurran.com

**WOODARD & CURRAN**  
 COMMITMENT & INTEGRITY DRIVE RESULTS

THIS DOCUMENT IS THE PROPERTY OF WOODARD & CURRAN INC. AND ITS CLIENT. REPRODUCTION OR MODIFICATION WITHOUT WRITTEN PERMISSION IS PROHIBITED.

--	--	--	--	--	--	--	--	--	--

REV	DESCRIPTION	DATE

**EXISTING CONDITIONS PLAN**

TOWN OF SUDBURY, MA  
 PUBLIC WORKS DEPARTMENT

WOLBACH ROAD CULVERT  
 REPLACEMENT

JOB NO: 023335.03  
 DATE: MAY 2021  
 SCALE: AS SHOWN  
 SHEET: 3 OF 7

**C-100**

**RESOURCE AREA LEGEND**

- BORDERING VEGETATED WETLAND (BVW) ----
- EDGE OF INTERMITTENT STREAM CHANNEL ----
- FLAGGED BANK OF INTERMITTENT STREAM ----
- FEMA FLOOD ZONE BOUNDARY ----

PERMITTING ONLY - NOT FOR CONSTRUCTION

W:\woodardcurran\external\Projects\023335\03\_sudbury\_ma\wobach\_rd\culvert\_replacement\wp1\Drawings\Civil\023335-03-C-100.dwg, Apr 28, 2021 1:12pm MBR/COWN



A

B

C

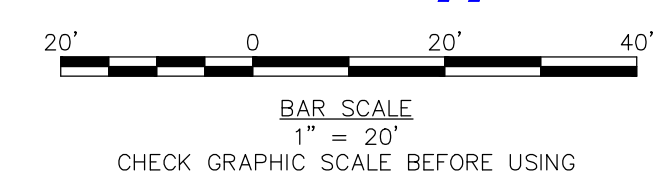
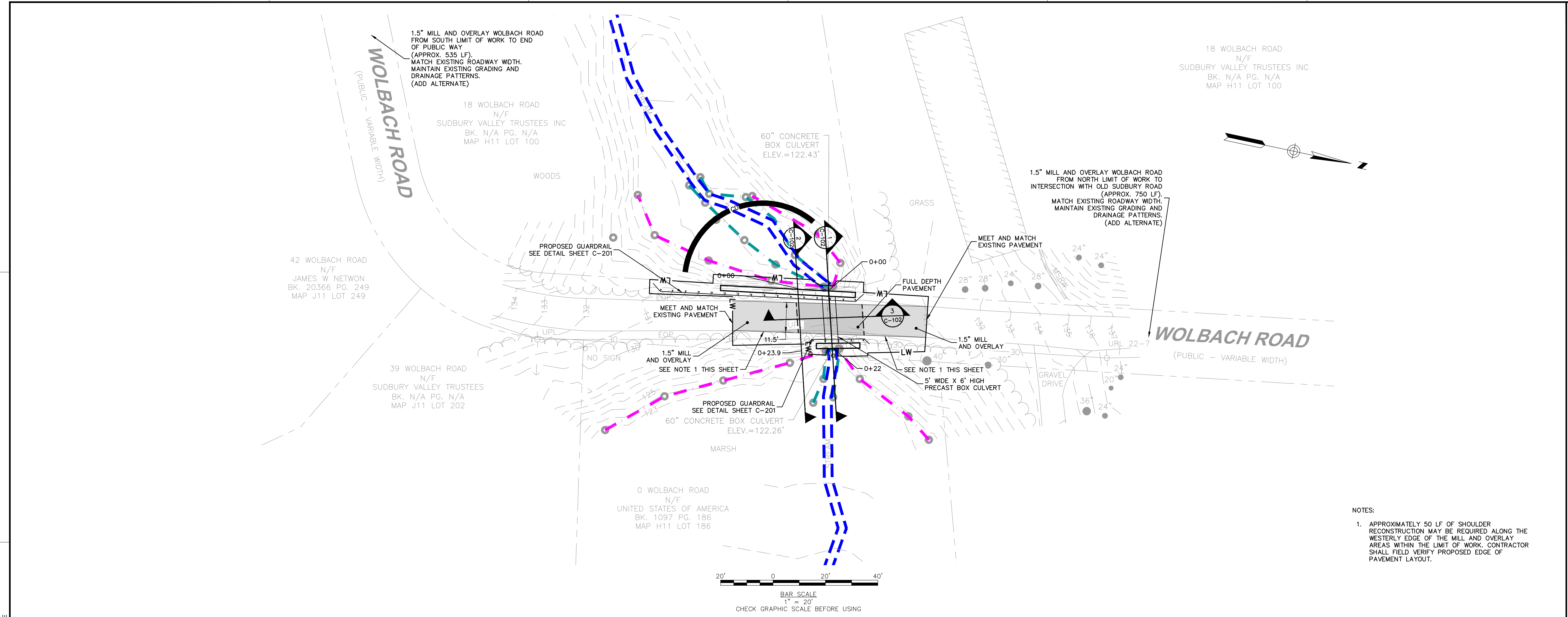
D

A

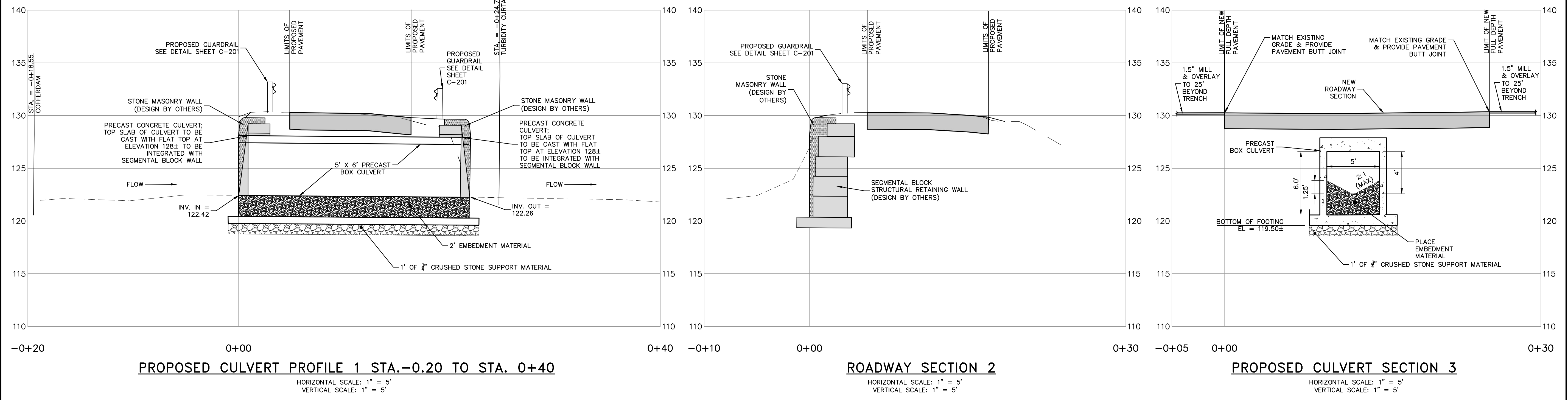
E

C

E



- NOTES:
- APPROXIMATELY 50 LF OF SHOULDER RECONSTRUCTION MAY BE REQUIRED ALONG THE WESTERLY EDGE OF THE MILL AND OVERLAY AREAS WITHIN THE LIMIT OF WORK. CONTRACTOR SHALL FIELD VERIFY PROPOSED EDGE OF PAVEMENT LAYOUT.



250 Royal Street, Suite 200E  
Canton, MA 02021  
800.426.4262 | www.woodardcurran.com

**WOODARD & CURRAN**  
COMMITMENT & INTEGRITY DRIVE RESULTS

THIS DOCUMENT IS THE PROPERTY OF WOODARD & CURRAN, INC. AND ITS CLIENT. REPRODUCTION OR MODIFICATION WITHOUT WRITTEN PERMISSION IS PROHIBITED.

REV	DESCRIPTION	DATE

DESIGNED BY: DLP/MB  
CHECKED BY: HCF/SS  
DRAWN BY: MB

**SITE PLAN AND PROFILE**

TOWN OF SUDBURY, MA  
PUBLIC WORKS DEPARTMENT

**WOLBACH ROAD CULVERT REPLACEMENT**

JOB NO: 023335.03  
DATE: MAY 2021  
SCALE: AS SHOWN  
SHEET: 5 OF 7

**C-102**

PERMITTING ONLY - NOT FOR CONSTRUCTION

**EROSION AND SEDIMENT CONTROL NOTES**

**Temporary Erosion Control**

Measure	Dates For Use	Timing, Activity, and Location
Sedimentation Barrier	ALL	Before soil disturbance, install downhill of areas to be disturbed and around material stockpiles.
Up-slope Diversion	ALL	Before soil disturbance, install uphill of areas to be disturbed and around material stockpiles.
Catch Basin Protection	ALL	Before soil or pavement disturbance, install ACF Environmental, Inc. High Flow Siltsock, SiltSaver Inlet Filter, or equal, installed per manufacturer's requirements.
Dust Control	ALL	During dry weather, apply water and calcium chloride to control dust.
Temporary Seeding	April 15 to Oct. 15	Soil stockpiles that are not covered and disturbed areas that will not be disturbed again within 14 days. If grass growth provides less than 95% soil coverage by Nov. 1, apply mulch and anchor with erosion control blanket.
Mulch	April 15 to Sept. 15	On all areas of exposed soil prior to rain events apply 100-150 lbs (2.5 bales) per 1,000 sq. ft. by mechanical blower.
Winter Mulch	Sept. 16 to Oct. 31 Nov. 1 to April 14	On all areas of exposed soil prior to precipitation apply 150 to 170 lbs. mulch (4 bales) per 1,000 sq. ft. by mechanical blower. Erosion control blanket may be used as a substitute for winter mulch. On all areas of exposed soil, apply 150 to 170 lbs. mulch (4 bales) per 1,000 sq. ft. and anchor with netting at the end of each working day. Erosion control blanket may be used as a substitute for winter mulch.
Inspections	Until site is permanently stabilized	Inspect the erosion and sedimentation control measures daily, and after rainfall of half inch or greater in a 24-hour period, and maintain and repair as necessary.

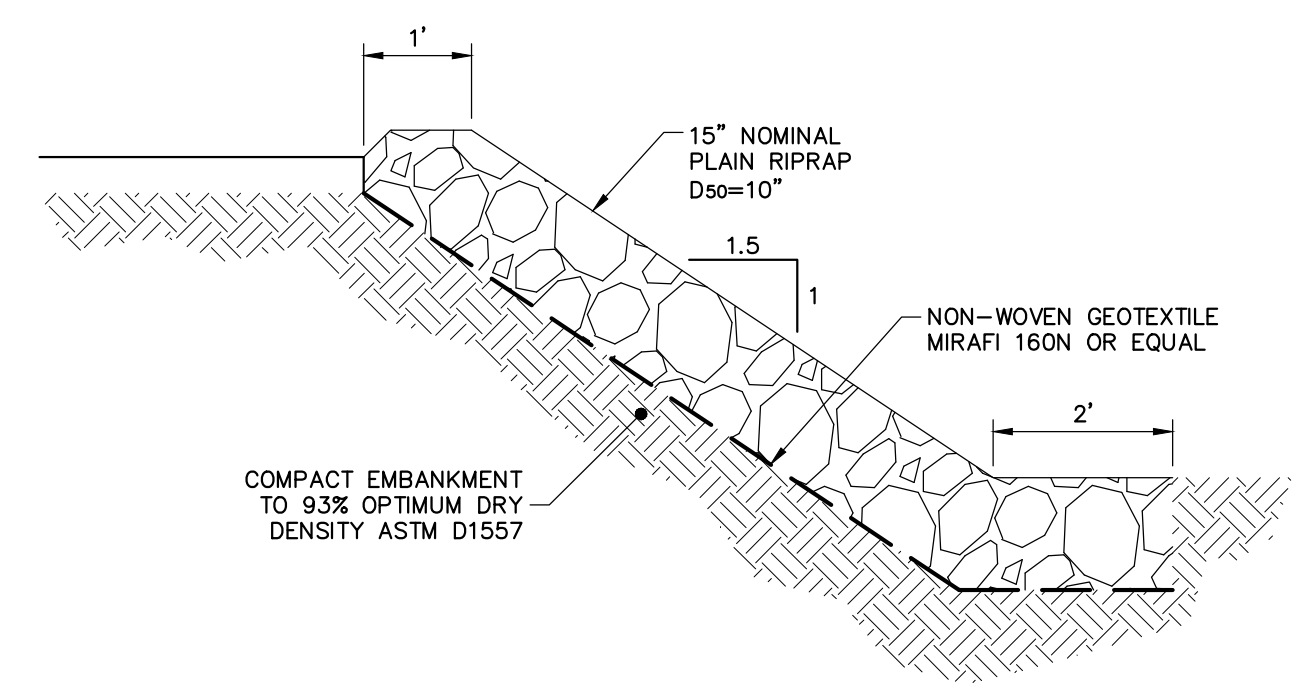
**Permanent Erosion Control:**

Measure	Dates For Use	Timing, Activity, and Location
Pavement - Base Course - Final Course	When no frost is in ground	Install only in areas shown on the plan, shortly after pavement base is brought to final grade. Install near completion of project.
Permanent Seeding	April 15 to Sept. 15	On final grade areas, within 7 days of grade preparation, prepare topsoil, followed by seed and mulch application.
Dormant Seeding	Sept. 16 to April 15	On final grade areas, with prepared topsoil. Apply seed at double the specified rate on bare soil, and follow with an application of winter mulch.
Ground Cover, Trees, Shrubs	April 15 to Nov. 1	Install with final landscaping.
Permanent Mulch	ALL	Install with final landscaping.

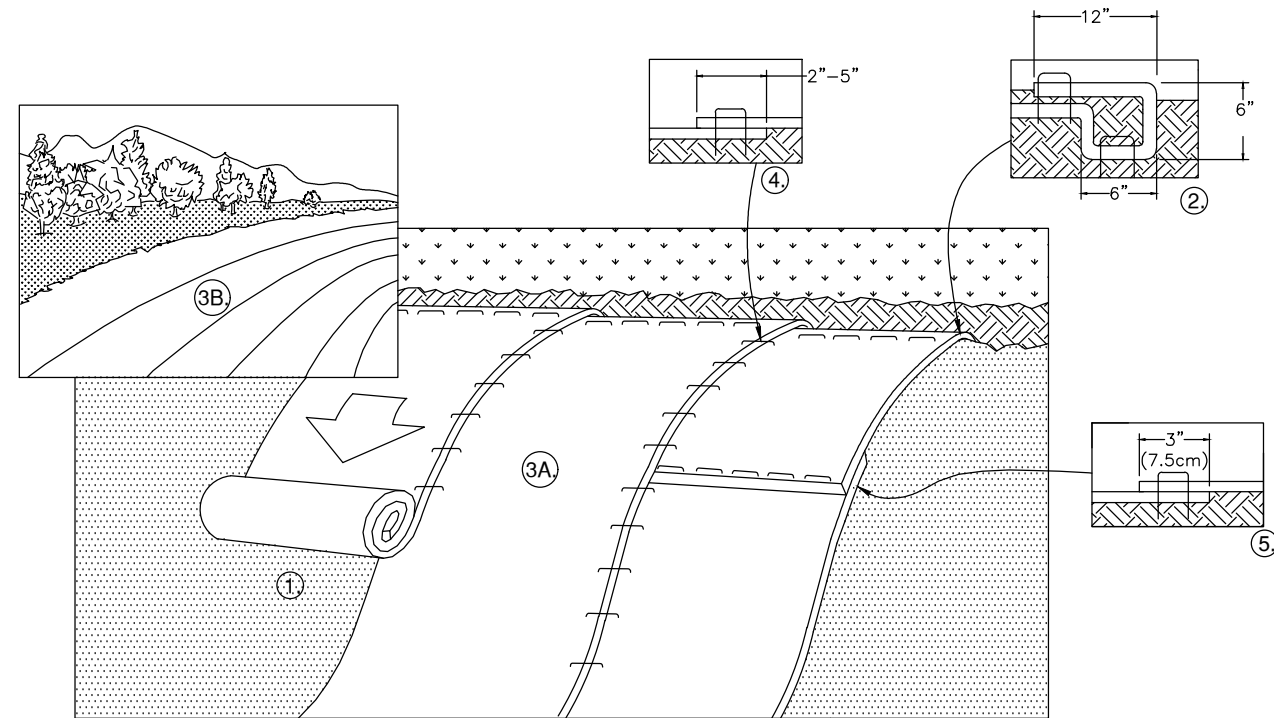
**Inspections:**

Regular inspections of all erosion and sedimentation controls shall be made at least weekly and prior to and following storm events. Minimum inspections shall be made as listed in the table below.

Inspected Item	Look For
Mulched Surfaces	Thin mulch or inadequate application. Wind movement.
Seeded Surfaces	Poor seed germination. Loss of mulch. Development of rivelets.
Sediment Barrier	Sediment build-up to one half the height of the barrier. Undermining of the barrier. Supporting stakes loose, toppled, or unmarked. Breaks in barrier.
Perimeter Diversion	Discharge is to stabilized area. Erosion or breaks in barrier. Supporting stakes loose, toppled or unmarked.
Catch Basin Protection	Sediment build-up and structure blockages. Slow flow/Ponding water. Breaks in fabric or voids in barrier.
Site Roadways	Sedimentation of roadways. Off-site dust complaints.

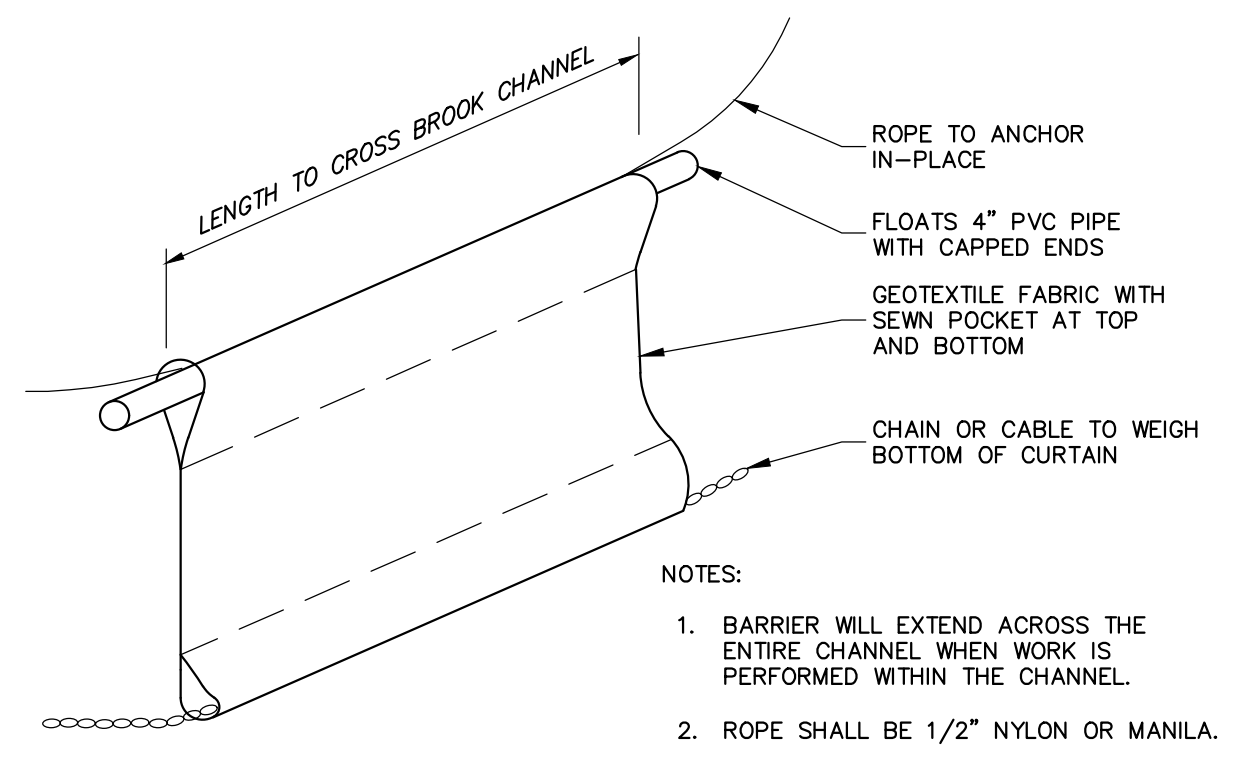


**RIPRAP SLOPE DETAIL**  
N.T.S.

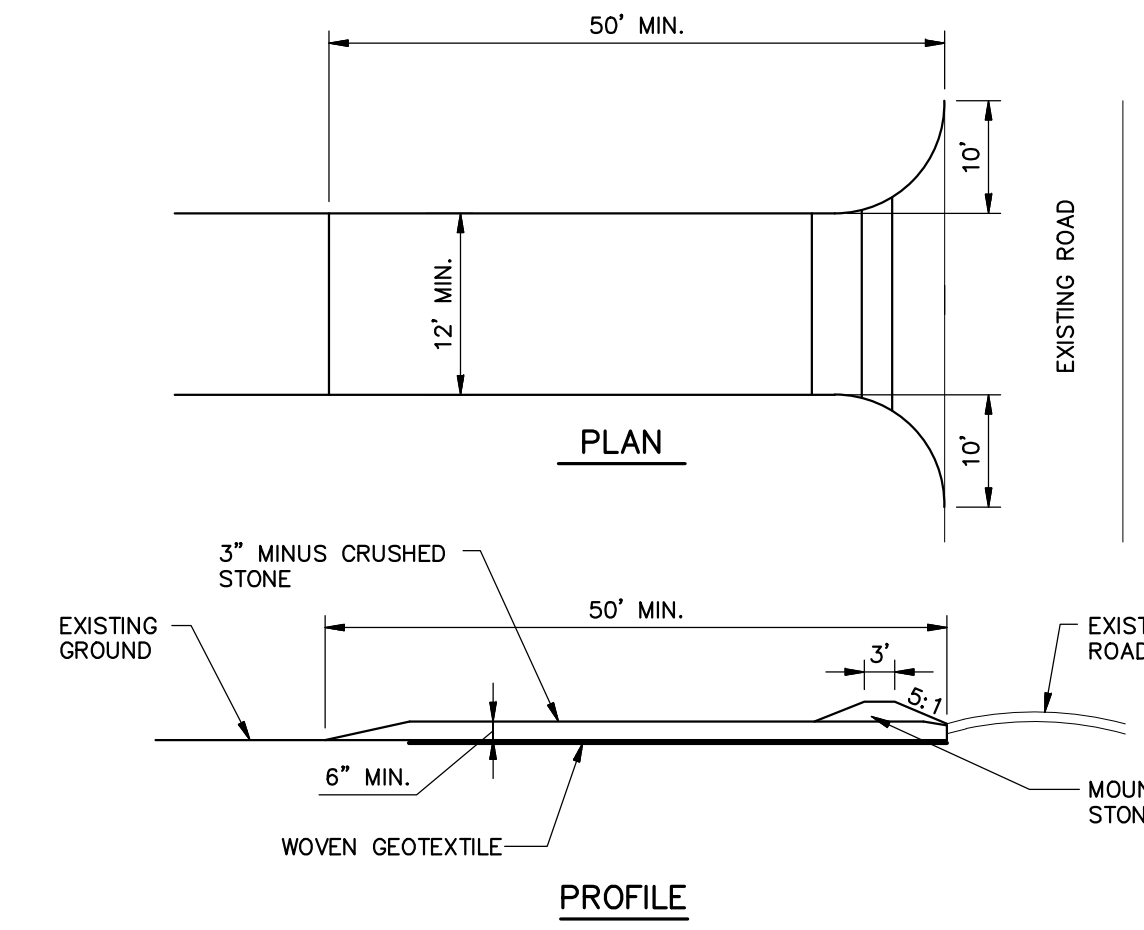


**EROSION CONTROL MATTING**  
N.T.S.

- PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED AS WELL AS REMOVING ANY PROTRUDING ROCKS, STUMPS OR ROOTS. DURING THE GROWING SEASON (APRIL 15 - SEPTEMBER 15) USE RECP'S ON SLOPES HAVING A GRADE GREATER THAN 15%, OR ANYWHERE WHERE HAY MULCH HAS PROVEN TO BE INEFFECTIVE AT CONTROLLING SHEET EROSION. RECP'S ARE A MANUFACTURED COMBINATION OF MULCH AND NETTING DESIGNED TO PREVENT EROSION AND RETAIN SOIL MOISTURE. FOR OVER WINTER PROTECTION, APPLY RECP'S ON SLOPES STEEPER THAN AN 8% GRADE.
- BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE RECP'S IN A 6" DEEP X 6" WIDE TRENCH WITH APPROXIMATELY 12" OF RECP'S EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP'S WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN THE BOTTOM OF THE TRENCH (USE OF METAL STAPLES IS PROHIBITED). BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" PORTION OF RECP'S BACK OVER SEED AND COMPACTED SOIL. SECURE RECP'S OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" APART ACROSS THE WIDTH OF THE RECP'S.
- ROLL THE RECP'S (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. RECP'S WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP'S MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM, STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
- THE EDGES OF PARALLEL RECP'S MUST BE STAPLED WITH APPROXIMATELY 2" - 5" OVERLAP DEPENDING ON RECP'S TYPE.
- CONSECUTIVE RECP'S SPICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" OVERLAP. STAPLE THROUGH OVERLAPPED AREA. APPROXIMATELY 12" APART ACROSS ENTIRE RECP'S WIDTH. NOTE: \*IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" MAY BE NECESSARY TO PROPERLY SECURE THE RECP'S.
- UNTIL GRASS HAS GOOD COVERAGE, INSPECT PERIODICALLY AND AFTER EACH RAINSTORM TO CHECK FOR EROSION, IMMEDIATELY REPAIR AND ADD MORE MULCH UNTIL GRASSES ARE FIRMLY ESTABLISHED. DO NOT MOW THE FIRST YEAR.
- EROSION CONTROL MATTING AND GROUND FASTENERS SHALL BE 100% BIODEGRADABLE.

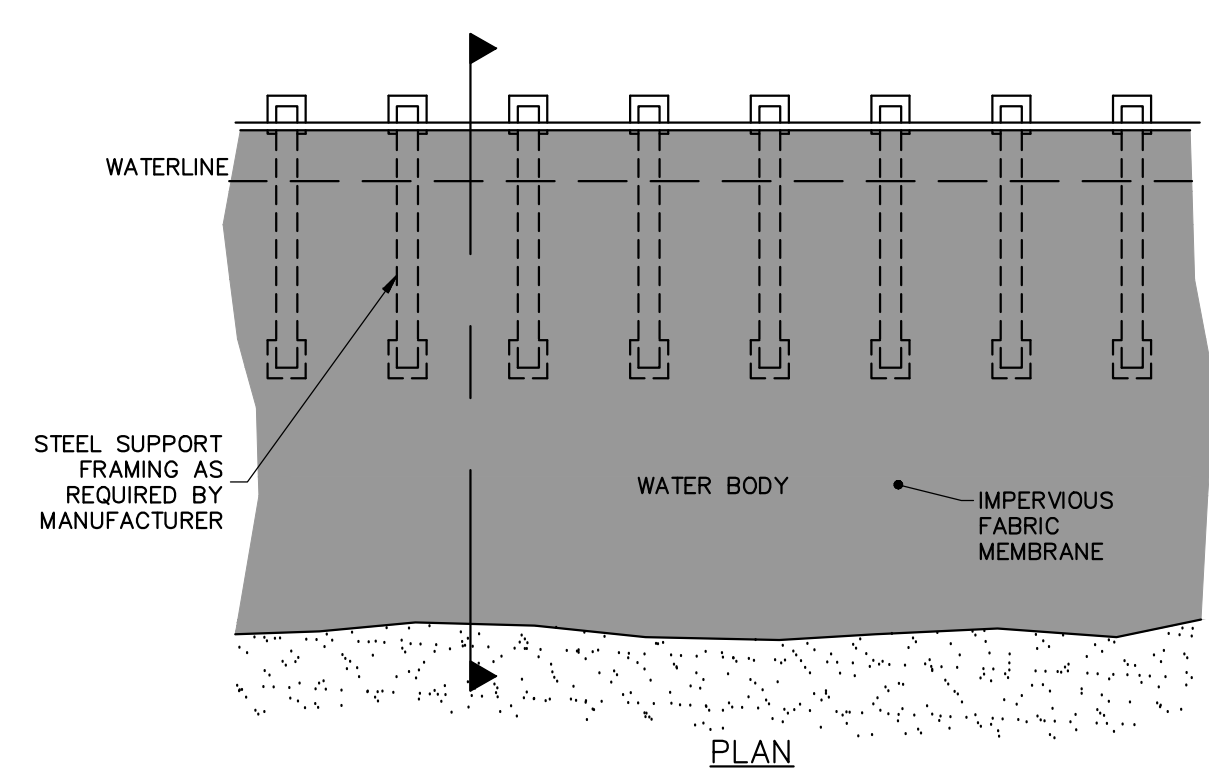


**FLOATING TURBIDITY BARRIER**  
N.T.S.



- NOTES:**
- MAINTENANCE:** INSPECT FOR EFFECTIVE REMOVAL OF SOIL FROM VEHICLES PRIOR TO LEAVING THE SITE. SWEEP ANY SOIL FROM ADJACENT ROADWAYS.
  - REMOVAL:** AT LEAST ONE CONSTRUCTION ENTRANCE SHALL BE MAINTAINED UNTIL ALL AREAS OF THE SITE ARE STABILIZED.

**STABILIZED CONSTRUCTION ENTRANCE**  
N.T.S.



- NOTE:**
- COFFERDAM DETAIL SHOWN FOR REFERENCE PURPOSES. CONTRACTOR SHALL PROVIDE DESIGN OF TEMPORARY COFFERDAMS, STAMPED BY A LICENSED PROFESSIONAL ENGINEER IN THE COMMONWEALTH OF MASSACHUSETTS.

**COFFER DAM DETAIL**  
N.T.S.

TO BE INSTALLED AROUND WORK AREA IN ACCORDANCE WITH CONTRACTOR'S WORK PLAN

PERMITTING ONLY - NOT FOR CONSTRUCTION

250 Royal Street, Suite 200E  
Canton, MA 02021  
800.426.4262 | www.woodardcurran.com

**WOODARD & CURRAN**

COMMITMENT & INTEGRITY DRIVE RESULTS

THIS DOCUMENT IS THE PROPERTY OF WOODARD & CURRAN, INC. AND ITS CLIENT. REPRODUCTION OR MODIFICATION WITHOUT WRITTEN PERMISSION IS PROHIBITED.

REV	DESCRIPTION	DATE

DESIGNED BY: MB/OLP  
CHECKED BY: HCF/SS  
DRAWING NO: 023335.03-C-20A.dwg  
DRAWN BY: MB

**CIVIL DETAILS 1**

TOWN OF SUDBURY, MA  
PUBLIC WORKS DEPARTMENT

**WOLBACH ROAD CULVERT REPLACEMENT**

JOB NO: 023335.03  
DATE: MAY 2021  
SCALE: AS SHOWN  
SHEET: 6 OF 7

**C-200**

W:\woodardcurran\external\Projects\023335.03 - Sudbury MA Wolbach Rd Culvert Replacement\Drawings\Civil\023335.03-C-20A.dwg, May 14, 2021 - 11:22am DP/SJ/DAL/E

1

2

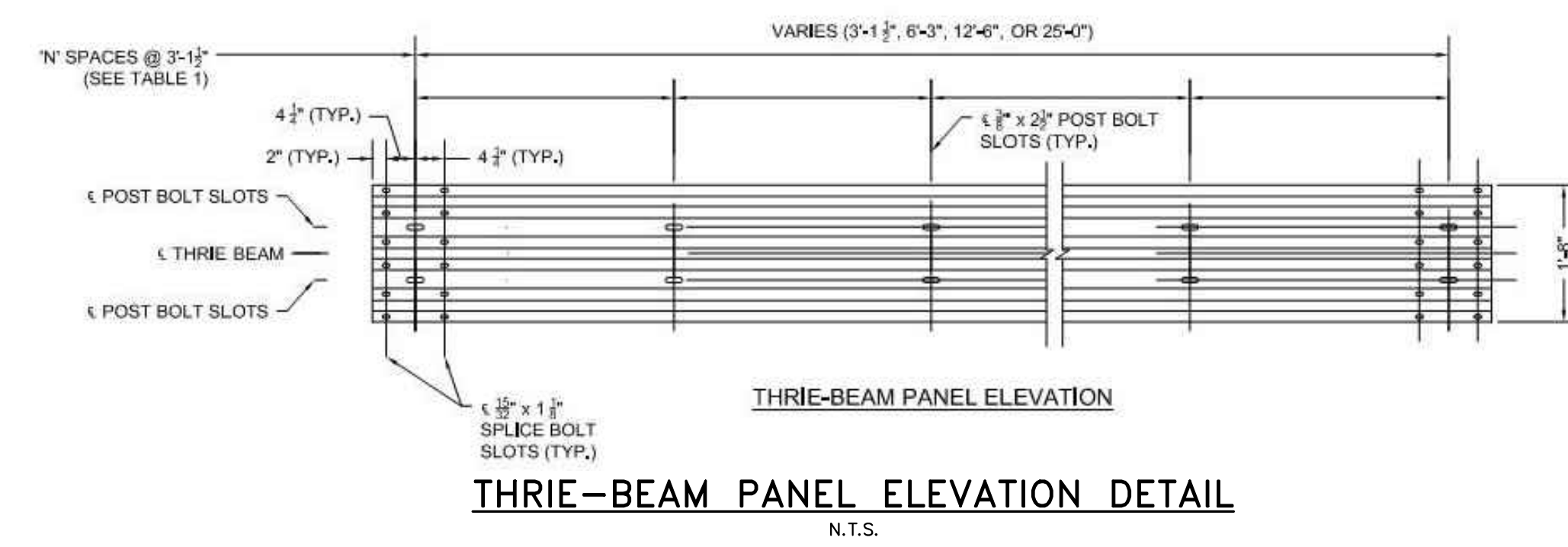
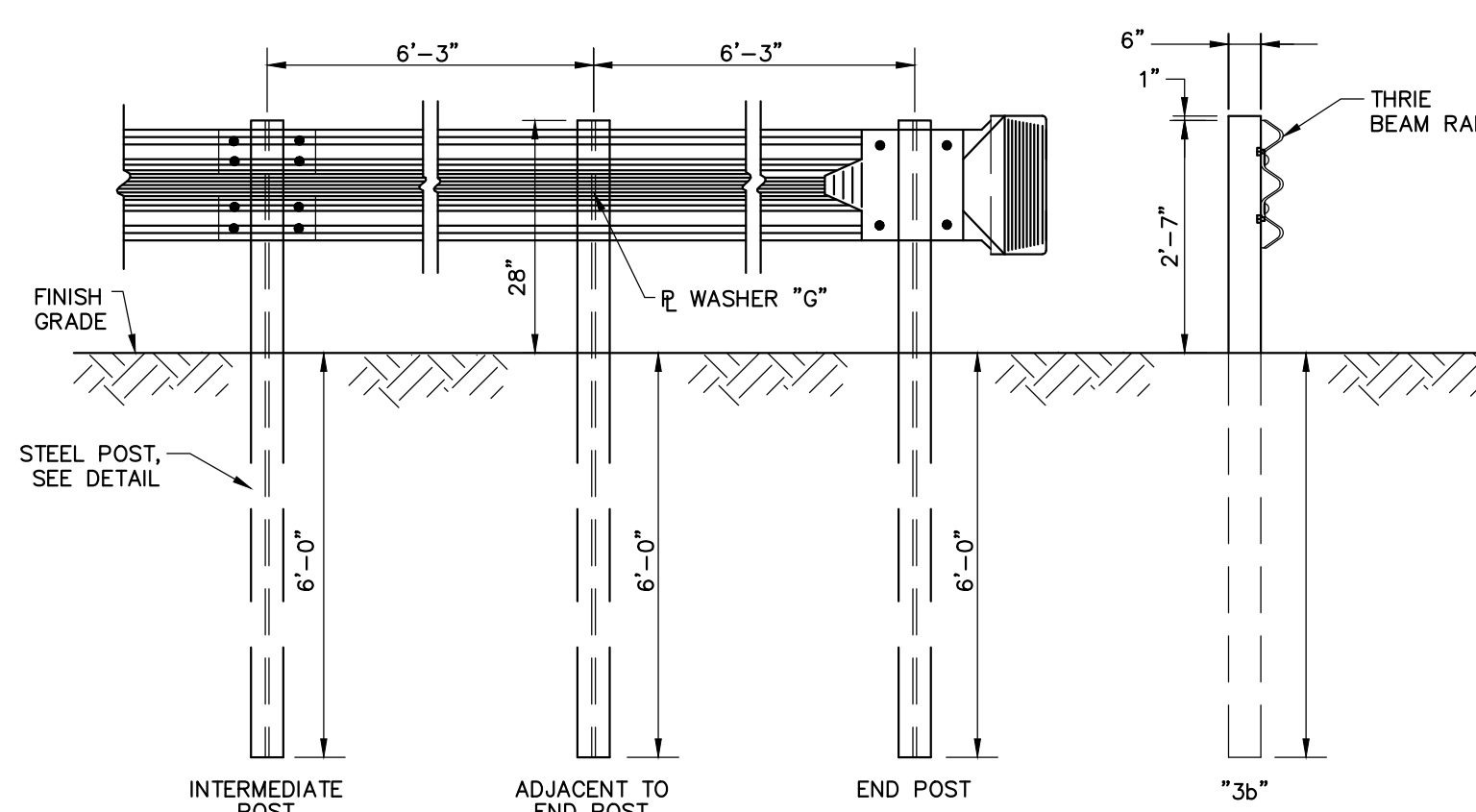
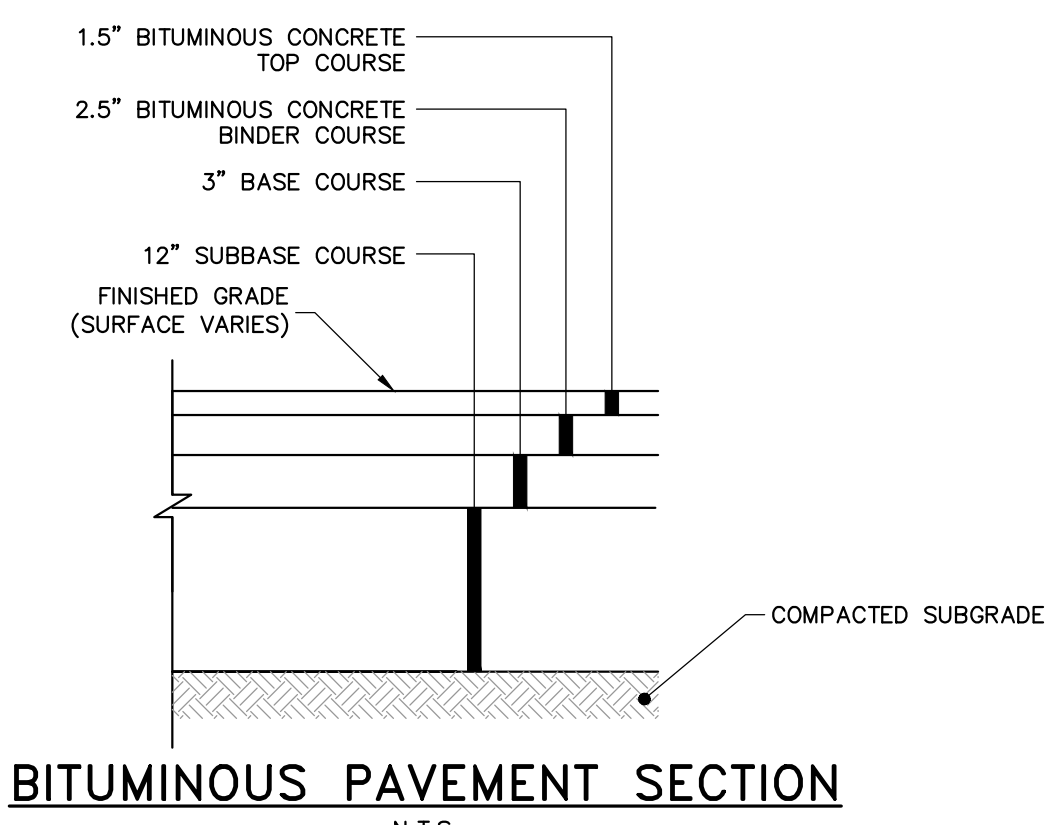
3

4

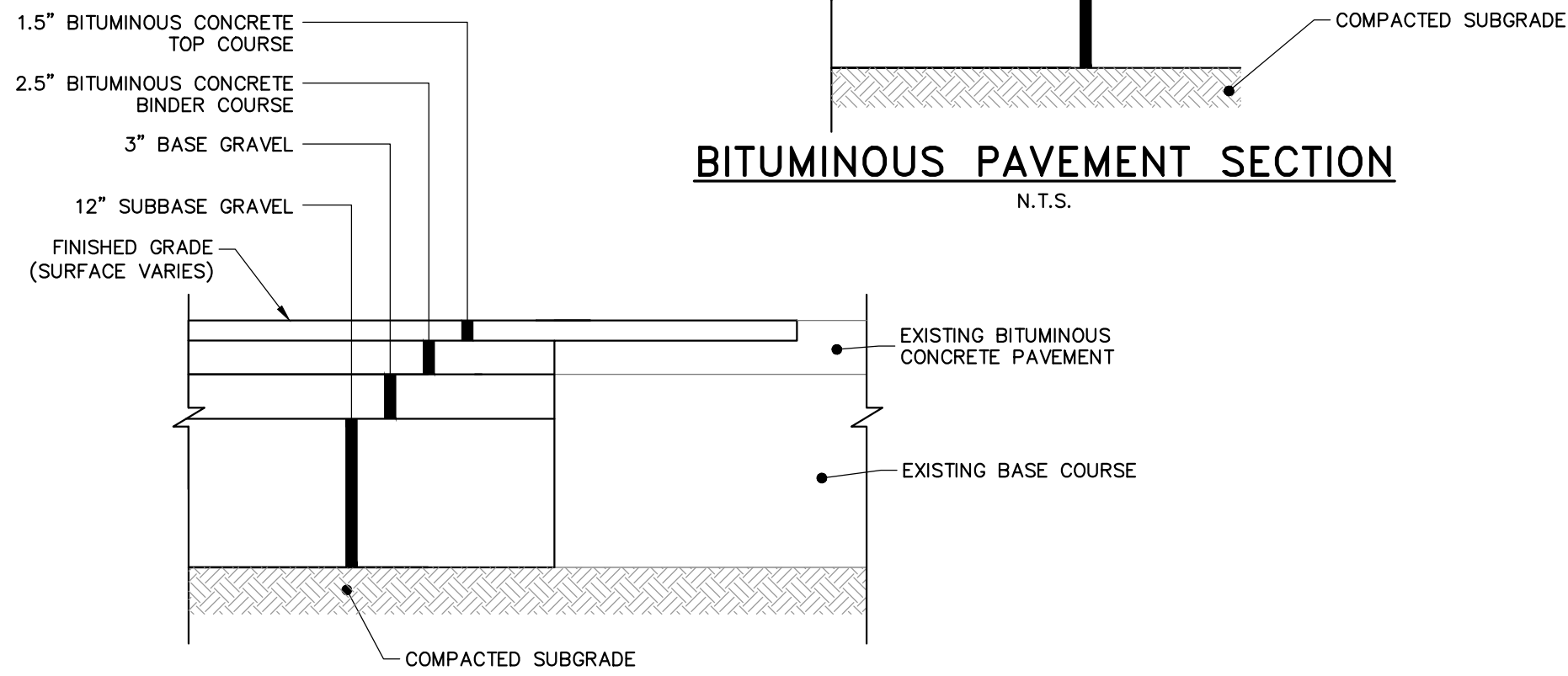
5

6

A

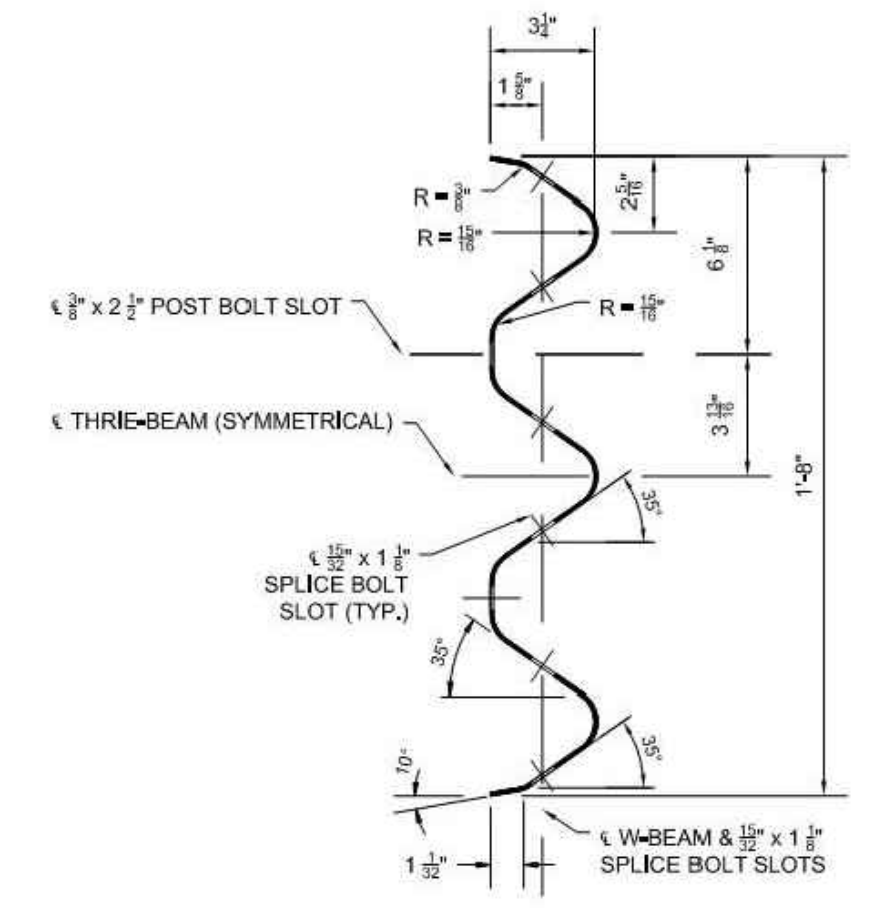
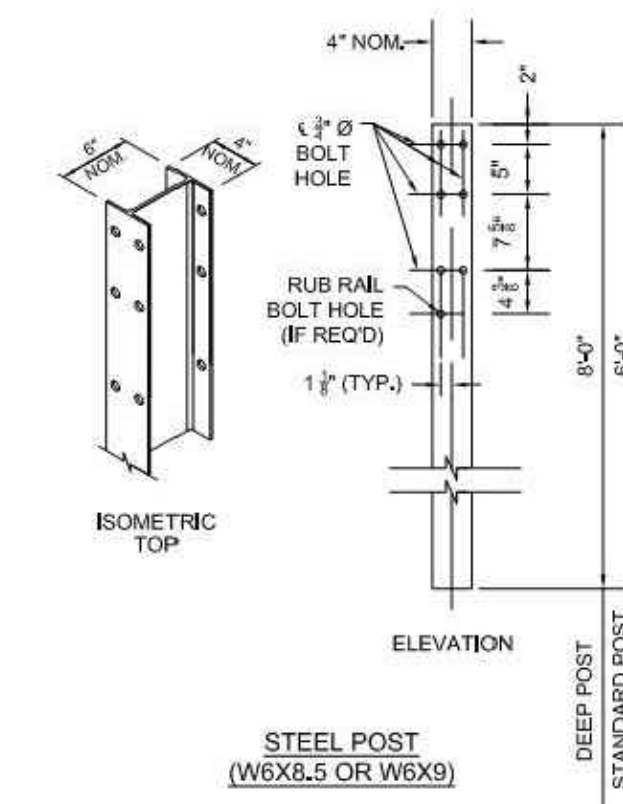


B



- NOTES:**
- ALL POST SPACING SHALL BE 6'-3" UNLESS OTHERWISE DIRECTED BY ENGINEER.
  - GUARDRAILS SHALL BE POWDER-COATED GALVANIZED STEEL. COLOR OF GUARDRAILS SHALL BE FEDERAL STANDARD BROWN COLOR NO. 10075.
  - GUARDRAIL SHALL MEET ALL MASSDOT SPECIFICATIONS
  - ALL HOLES IN BEAM SHALL BE SHOP-PUNCHED BEFORE GALVANIZING.
  - GUARD RAIL SHALL MEET NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM (NCHRP) 350

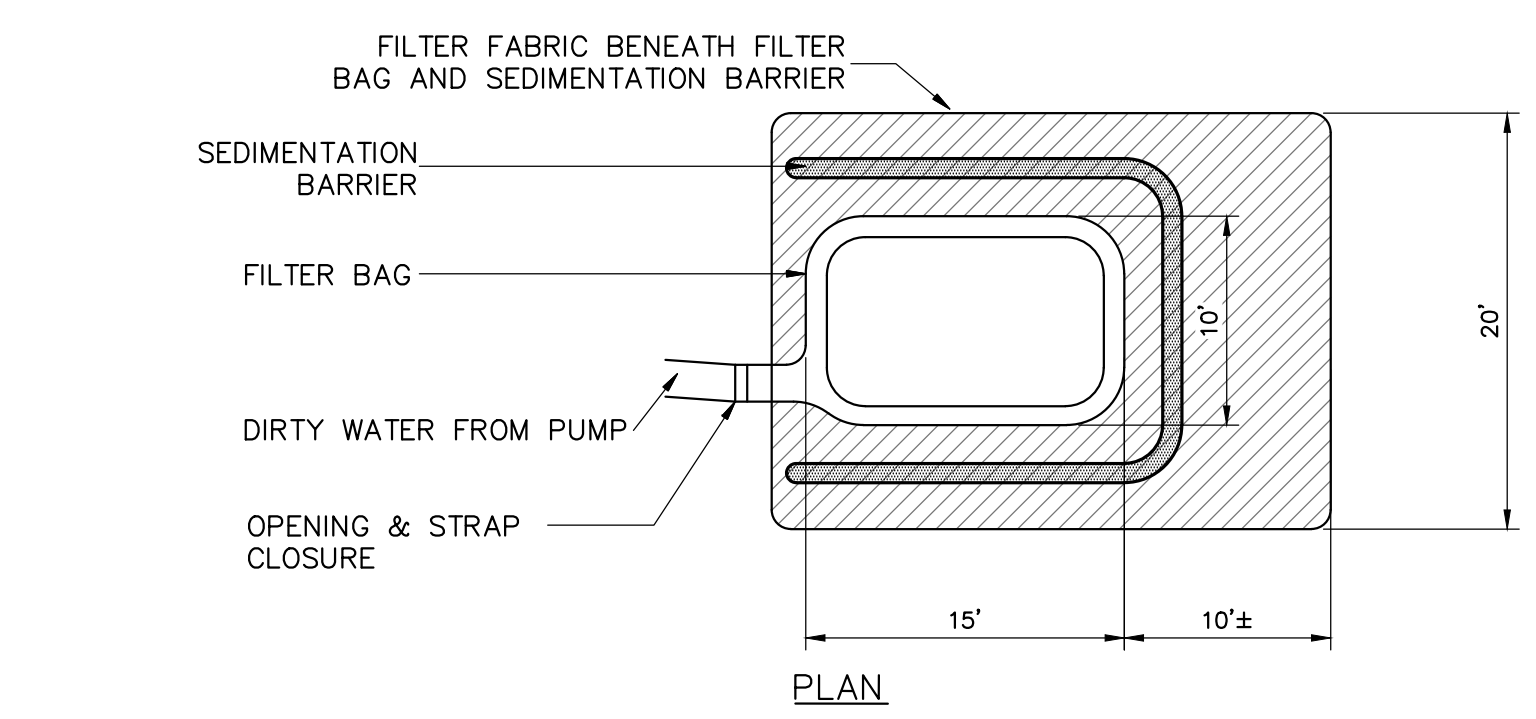
**GUARDRAIL DETAILS**  
N.T.S.



**STEEL POST DETAIL**  
N.T.S.

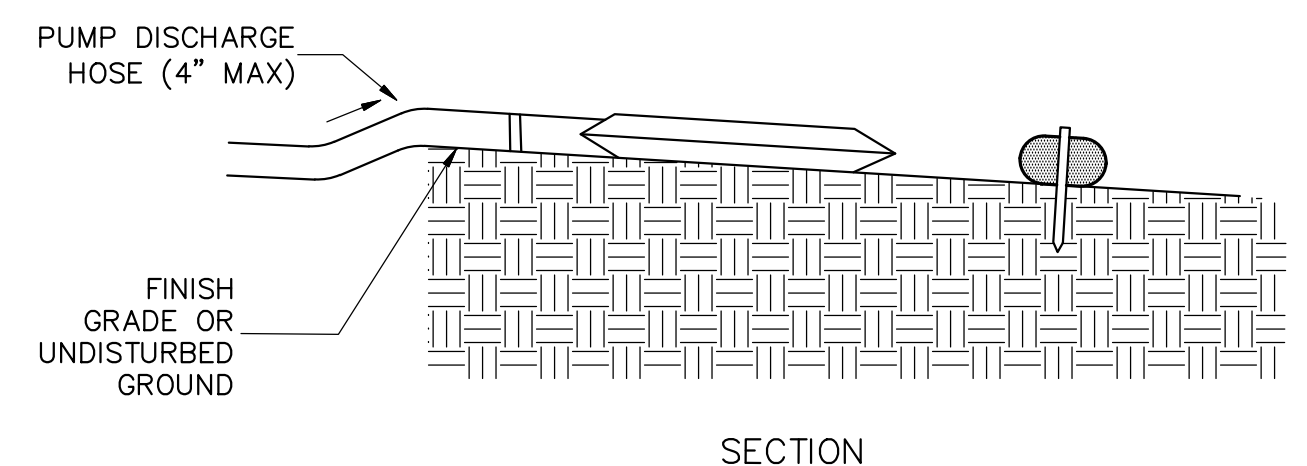
**THRIE-BEAM PANEL SECTION**  
N.T.S.

C



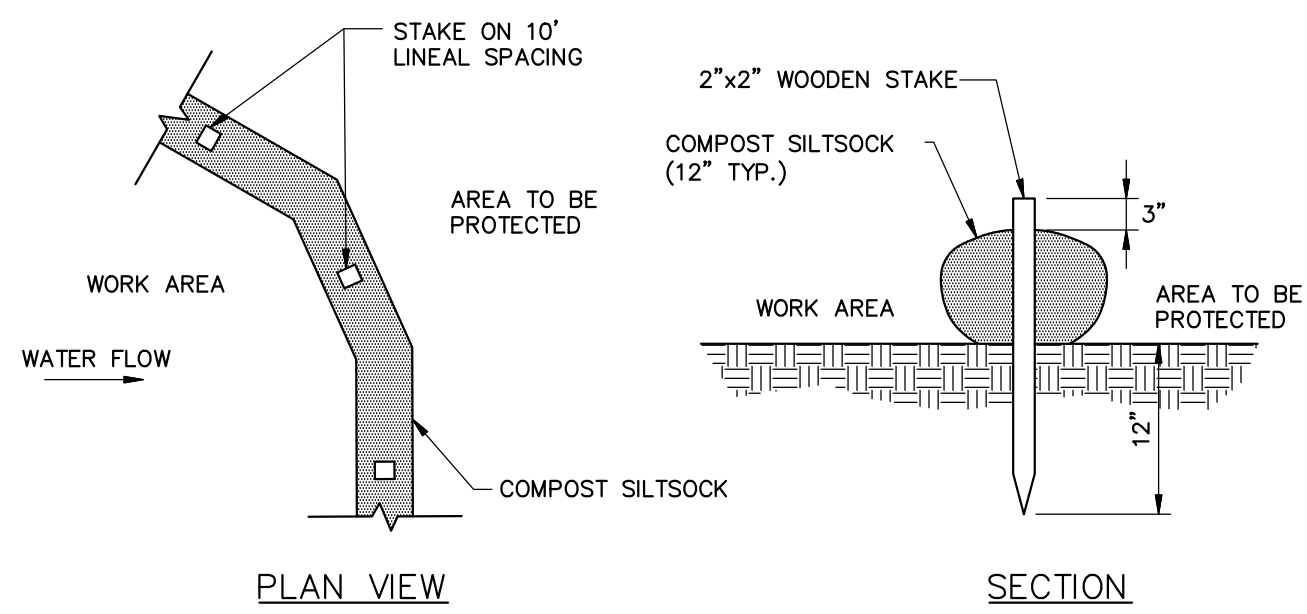
**DEWATERING NOTES**

1. LOCATE DISCHARGE SITE ON FLAT UPLAND AREAS AS FAR AWAY AS POSSIBLE FROM STREAMS, WETLANDS, OTHER RESOURCES AND POINTS OF CONCENTRATED FLOW.
2. DOWNGRADIENT RECEIVING AREA MUST BE WELL VEGETATED OR OTHERWISE STABLE FROM EROSION, I.E. FOREST FLOOR OR COARSE GRAVEL/STONE.
3. NEVER DISCHARGE TO AREAS THAT ARE BARE OR NEWLY VEGETATED.
4. DIRT BAG MATERIAL BASED ON PARTICLE SIZE IN DIRTY WATER, I.E., FOR COARSE PARTICLES A WOVEN MATERIAL; FOR SILTS/CLAYS A NON-WOVEN MATERIAL.
5. DO NOT OVER PRESSURIZE DIRT BAG OR USE BEYOND CAPACITY.
6. CHANNELS DUG FOR DISCHARGING WATER FROM THE EXCAVATED AREA NEED TO BE STABLE. IF FLOW VELOCITIES CAUSE EROSION WITHIN THE CHANNEL THEN A DITCH LINING SHOULD BE USED.
7. BUCKETED WATER SHOULD BE DISCHARGED IN A STABLE MANNER TO THE SEDIMENT REMOVAL AREA. A SPLASH PAD OF RIPRAP UNDERLAIN WITH GEOTEXTILE MAY BE NECESSARY TO PREVENT SCOURING OF SOIL.
8. DEWATERING IN PERIODS OF INTENSE, HEAVY RAIN, WHEN THE INFILTRATIVE CAPACITY OF THE SOIL IS EXCEEDED, SHOULD BE AVOIDED.
9. INSTALL DIVERSION DITCHES OR BERMS TO MINIMIZE THE AMOUNT OF CLEAN STORMWATER RUNOFF ALLOWED INTO THE EXCAVATED AREA.
10. DURING THE ACTIVE DEWATERING PROCESS, INSPECTION OF THE DEWATERING FACILITY SHOULD BE REVIEWED FREQUENTLY. SPECIAL ATTENTION SHOULD BE PAID TO THE BUFFER AREA FOR ANY SIGN OF EROSION AND CONCENTRATION OF FLOW THAT MAY COMPROMISE THE BUFFER AREA. OBSERVE WHERE POSSIBLE THE VISUAL QUALITY OF THE EFFLUENT AND DETERMINE IF ADDITIONAL TREATMENT CAN BE PROVIDED.
11. EROSION CONTROL REQUIRED AROUND DEWATERING DISCHARGE SEDIMENT CONTROL DEVICE.

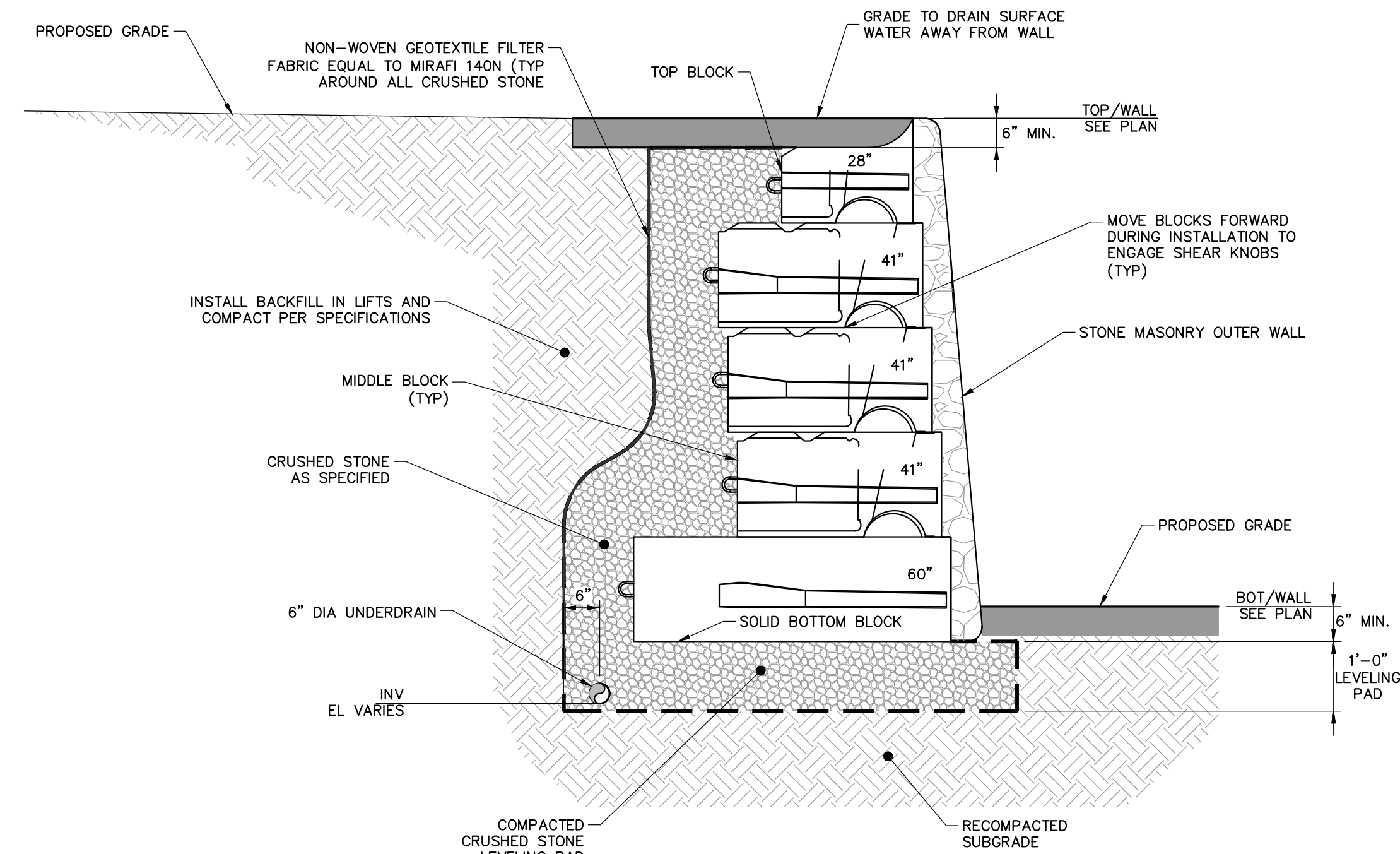


**DEWATERING DISCHARGE SEDIMENT CONTROL DEVICE**  
NOT TO SCALE

**SEDIMENTATION BARRIER - SILT SOCK**  
NOT TO SCALE



- NOTE:**
- WHEN STAKING IS NOT POSSIBLE, HEAVY CONCRETE BLOCKS SHALL BE USED BEHIND THE SEDIMENT CONTROL TO HELP STABILIZE DURING RAINFALL/RUNOFF EVENTS.



- NOTES:**
1. RETAINING WALL SECTIONS ARE CONCEPTUAL IN NATURE AND FOR REFERENCE PURPOSES TO AID IN THE LAYOUT AND DEVELOPMENT OF WALL DESIGN (BY OTHERS). GRAVITY WALL ENGINEER SHALL PROVIDE FINAL WALL DESIGN AND CALCULATIONS, STAMPED AND SIGNED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF MASSACHUSETTS SUBJECT TO REVIEW OF THE ENGINEER.
  2. REFER TO SHEET C-102 FOR PLAN VIEW AND LIMITS OF PROPOSED RETAINING WALL.
  3. REFER TO SPECIFICATION SECTION 31 00 00 FOR MATERIAL GRADATIONS AND REQUIREMENTS.
  4. ELEVATIONS SHOWN ARE APPROXIMATE AND SHALL BE FIELD VERIFIED.
  5. REFER TO SECTIONS AND PLANS FOR BACK FILL INFORMATION.

**RETAINING WALL DETAIL**  
N.T.S.

D

250 Royal Street, Suite 200E  
Canton, MA 02021  
800.426.4262 | www.woodardcurran.com

**WOODARD & CURRAN**  
COMMITMENT & INTEGRITY DRIVE RESULTS

THIS DOCUMENT IS THE PROPERTY OF WOODARD & CURRAN AND ITS CLIENT. REPRODUCTION OR MODIFICATION WITHOUT WRITTEN PERMISSION IS PROHIBITED.

REV	DESCRIPTION	DATE	DESIGNED BY	CHECKED BY	DRAWN BY

CIVIL DETAIL 2

TOWN OF SUDBURY, MA  
PUBLIC WORKS DEPARTMENT

WOLBACH ROAD CULVERT  
REPLACEMENT

JOB NO: 023335.03  
DATE: MAY 2021  
SCALE: AS SHOWN  
SHEET: 7 OF 7

**C-201**

PERMITTING ONLY - NOT FOR CONSTRUCTION

1

2

3

4

5

6

W:\woodardcurran\wfc\sharpe\Projects\023335\03\_sudbury.ma\wobach rd culvert replacement\dwg\C-201.dwg, Apr 26, 2021, 1:12pm MBROWIN





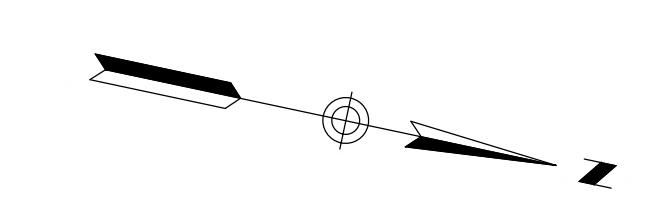
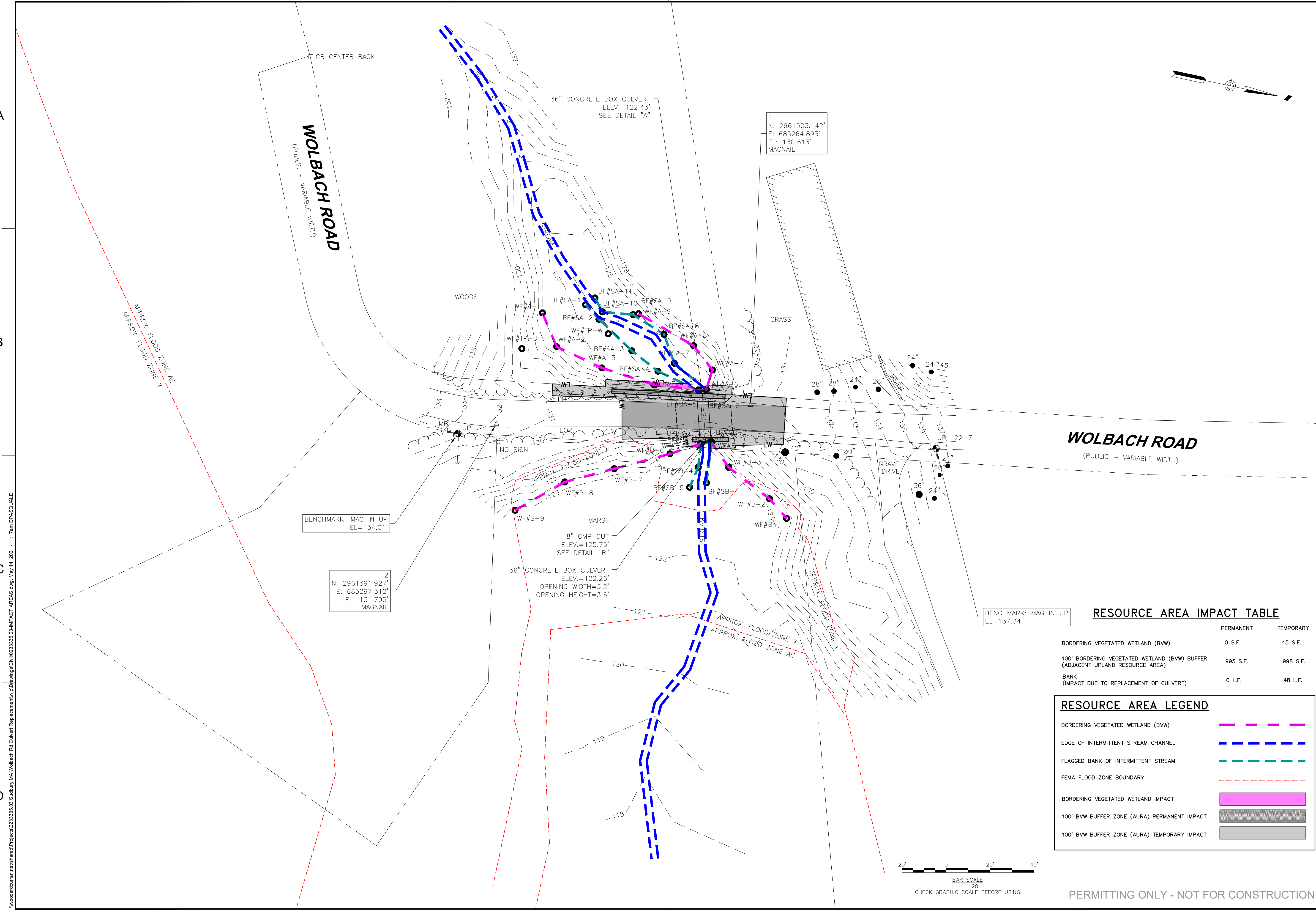
**Figure 4: Resource Area Impact Figure**

A

B

C

D



1  
N: 2961503.142'  
E: 685264.893'  
EL: 130.613'  
MAGNAIL

BENCHMARK: MAG IN UP  
EL=134.01'

2  
N: 2961391.927'  
E: 685297.312'  
EL: 131.795'  
MAGNAIL

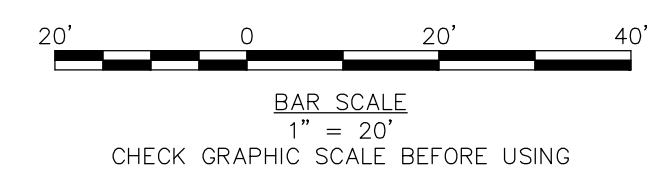
BENCHMARK: MAG IN UP  
EL=137.34'

**RESOURCE AREA IMPACT TABLE**

	PERMANENT	TEMPORARY
BORDERING VEGETATED WETLAND (BVW)	0 S.F.	45 S.F.
100' BORDERING VEGETATED WETLAND (BVW) BUFFER (ADJACENT UPLAND RESOURCE AREA)	995 S.F.	998 S.F.
BANK (IMPACT DUE TO REPLACEMENT OF CULVERT)	0 L.F.	48 L.F.

**RESOURCE AREA LEGEND**

- BORDERING VEGETATED WETLAND (BVW) [Pink dashed line]
- EDGE OF INTERMITTENT STREAM CHANNEL [Blue dashed line]
- FLAGGED BANK OF INTERMITTENT STREAM [Green dashed line]
- FEMA FLOOD ZONE BOUNDARY [Red dashed line]
- BORDERING VEGETATED WETLAND IMPACT [Pink shaded area]
- 100' BVW BUFFER ZONE (AURA) PERMANENT IMPACT [Grey shaded area]
- 100' BVW BUFFER ZONE (AURA) TEMPORARY IMPACT [Light grey shaded area]



250 Royal Street, Suite 200E  
Canton, MA 02021  
800.426.4262 | www.woodardcurran.com

**WOODARD & CURRAN**  
COMMITMENT & INTEGRITY DRIVE RESULTS

THIS DOCUMENT IS THE PROPERTY OF WOODARD & CURRAN INC. AND ITS CLIENT. REPRODUCTION OR MODIFICATION WITHOUT WRITTEN PERMISSION IS PROHIBITED.

REV	DESCRIPTION	DATE
	DESIGNED BY: MB/DLP	
	CHECKED BY: HCF/SS	
	PROJECT NO: 023335.03	
	DRAWN BY: MB	

**IMPACT AREAS FIGURE**  
**WOLBACH ROAD**

TOWN OF SUDBURY, MA  
PUBLIC WORKS DEPARTMENT

WOLBACH ROAD CULVERT  
REPLACEMENT

JOB NO:	023335.03
DATE:	MAY 2021
SCALE:	AS SHOWN
SHEET:	OF

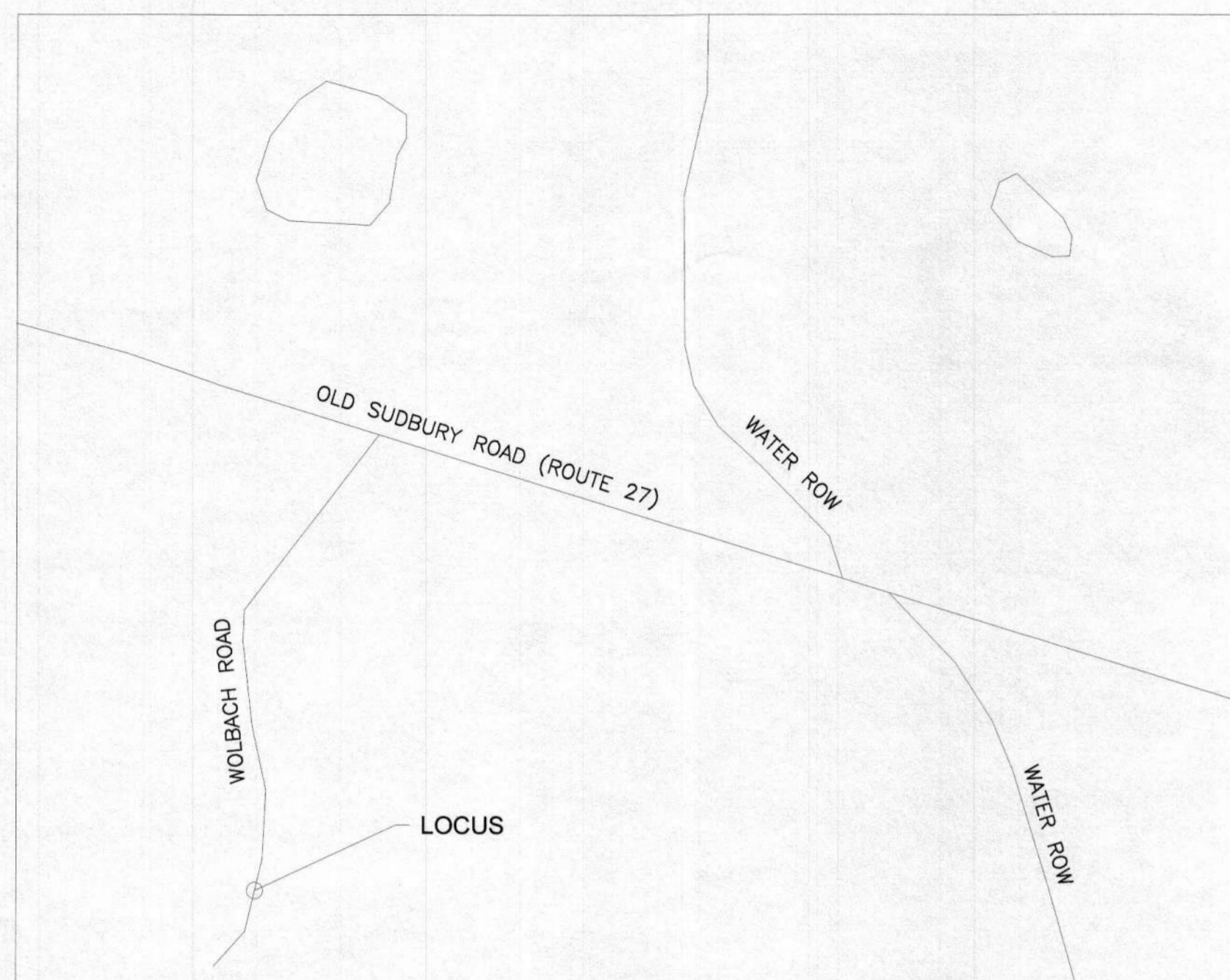
**FIG-4**

PERMITTING ONLY - NOT FOR CONSTRUCTION

I:\woodardcurran\wef\sharad\Projects\023335.03\_Sudbury\_MA\_Wolbach\_Rd\_Culvert\_Replacement\wp\Drawings\Civil\023335.03\_IMPACT\_AREAS.dwg, May 14, 2021 - 11:17am DPAS/DUALLE



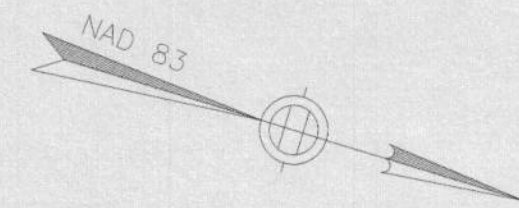
**ATTACHMENT A: EXISTING CONDITIONS SURVEY**



LOCUS MAP

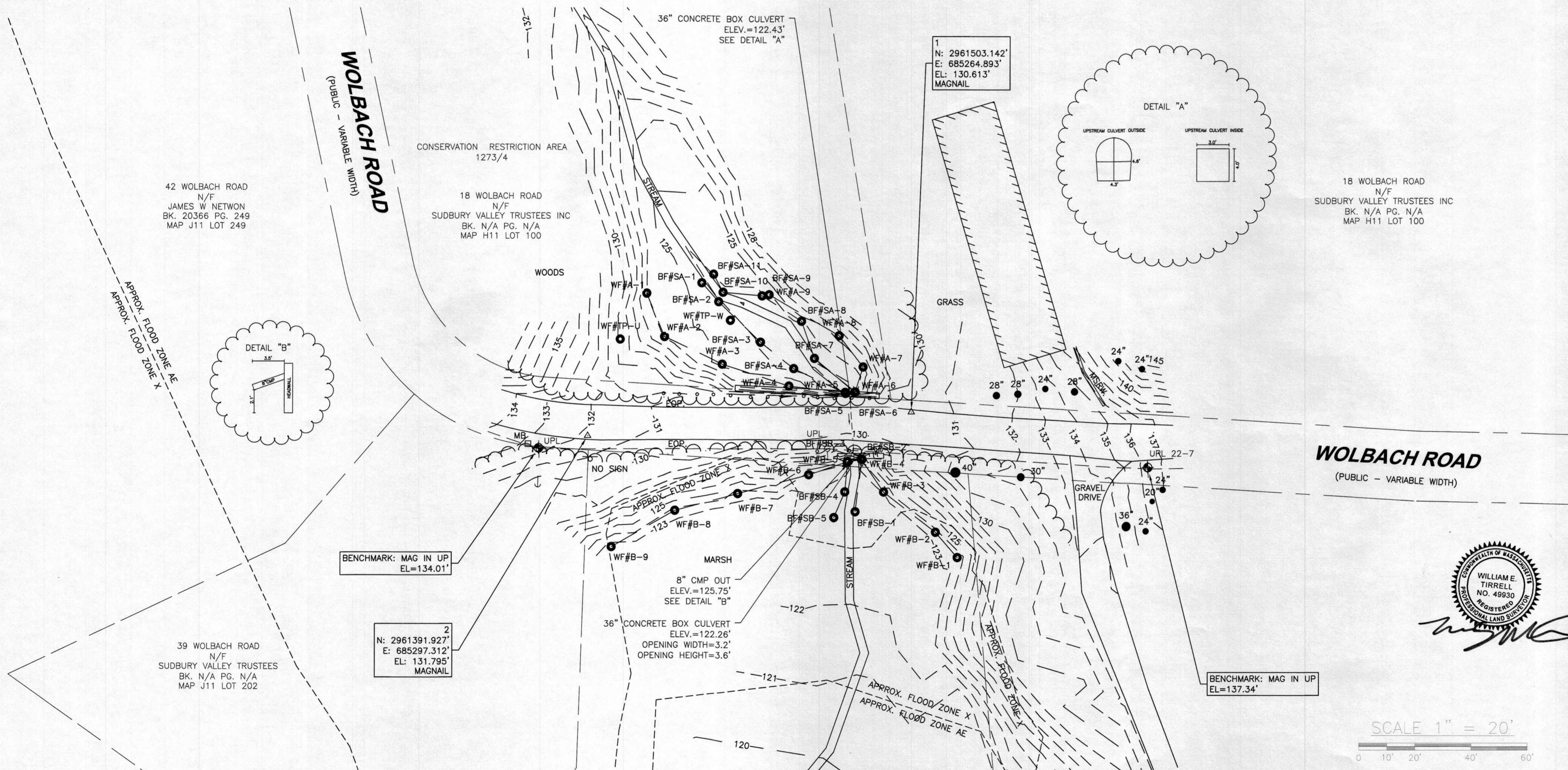
GENERAL NOTES:

1. THE EXISTING CONDITIONS INFORMATION SHOWN HEREON IS THE RESULT OF AN ON-THE-GROUND SURVEY PERFORMED BY CHAPPELL ENGINEERING ASSOCIATES, LLC., BETWEEN NOVEMBER 25TH - 30TH, 2020.
2. ALL DEED/PLAN REFERENCES ARE TO MIDDLESEX REGISTRY OF DEEDS SOUTHERN DISTRICT.
3. THE PROJECT AREA IS LOCATED IN FLOOD ZONE "AE" AS SHOWN ON FLOOD INSURANCE RATE MAP FOR THE TOWN OF SUDBURY, COMMUNITY PANEL NUMBER 25017C 0507F, EFFECTIVE DATE JULY 7, 2014.
4. PROPERTY DOES NOT RESIDE IN A WATER RESOURCE PROTECTION DISTRICT.
5. ZONING DISTRICT RESIDENCE C.
6. LOCATION OF SUBSURFACE UTILITIES SHOWN HEREON ARE APPROXIMATE AND ADDITIONAL UTILITIES MAY EXIST THAT ARE NOT SHOWN ON THIS PLAN. LOCATIONS ARE COMPILED FROM UTILITY PLANS OF RECORD AND DIG-SAFE FIELD MARKINGS. RIM AND INVERT INFORMATION HAS BEEN FIELD VERIFIED WHERE POSSIBLE. THIS INFORMATION IS NOT TO BE USED FOR CONSTRUCTION. PRIOR TO ANY CONSTRUCTION, CONTACT DIG-SAFE (1-800-344-7233) TO FIELD VERIFY LOCATION OF ALL UTILITIES.
7. PLAN REFERENCES: (PLAN NO. / PLAN YEAR)  
OLD SUDBURY ROAD LO 1949 LCC 5224A LCC 5224B LCC 5224C
8. BORDERING WETLAND LOCATION FLAGS SET BY ECOTEC, LLC. ON NOVEMBER 20TH, 2020.
9. HORIZONTAL DATUM: NAD 83 MASS STATE PLANE MAINLAND ZONE HORIZONTAL CONTROL SYSTEM.
10. VERTICAL DATUM: NAVD 88 VERTICAL CONTROL SYSTEM.



LEGEND

- STREET R.O.W. LINE
- ABUTTER PROPERTY LINE
- EASEMENT LINES
- EDGE OF PAVEMENT
- VGC VERT. GRAN. CURB
- IRON HAND RAIL
- CHAIN-LINK FENCE
- PAINTED TRAFFIC LINES
- OVERHEAD WIRES
- GUARD RAIL
- ⊙ DRAIN MANHOLE
- ⊙ SEWER MANHOLE
- ⊙ CATCH BASIN
- ⊙ FIRE HYDRANT
- ⊙ WG WATER GATE
- ⊙ GAS VALVE
- GUY WIRE
- ☀ LIGHT POLE
- ⊙ UTILITY POLE
- 24" ● TREE
- CBDH MONUMENT
- ⊕ BENCHMARK
- ⊙ SIGN
- CONCRETE
- WF#A-14 BORDERING VEGETATIVE WETLAND FLAG
- ⊙ DH DRILL HOLE OR IRON ROD
- STONE OR CONC. BOUND
- TRAVERSE POINT



**CHAPPELL ENGINEERING ASSOCIATES, LLC**  
Civil Structural Land Surveying  
201 BOSTON POST ROAD WEST-SUITE 101  
MARLBOROUGH, MA 01752  
TEL (508) 481-7400  
WWW.CHAPPELLENGINEERING.COM

REVISIONS

REV. #	DATE	DESCRIPTION
1		
0		

EXISTING CONDITIONS SURVEY

WOLBACH ROAD,  
SUDBURY, MASSACHUSETTS

JANUARY 19, 2021  
SHEET 1 OF 1

## ATTACHMENT B: WETLAND RESOURCE EVALUATION



**EcoTec, Inc.**  
**ENVIRONMENTAL CONSULTING SERVICES**  
102 Grove Street  
Worcester, MA 01605-2629  
508-752-9666 – Fax: 508-752-9494

December 5, 2020

Scott Salvucci, P.E.  
Woodard & Curran, Inc.  
980 Washington St., Suite 325  
Dedham, MA 02026

RE: Wetland Resource Evaluation, Wolbach Road Culvert, Sudbury, MA

Dear Scott:

On November 20, 2020, EcoTec, Inc. inspected the above-referenced property for the presence of wetland resources as defined by: (1) the Massachusetts Wetlands Protection Act (M.G.L. Ch. 131, § 40; the “Act”) and its implementing regulations (310 CMR 10.00 *et seq.*; the “Regulations”); and (2) the U.S. Clean Water Act (i.e., Section 404 and 401 wetlands). Arthur Allen, CPSS, CWS conducted the inspection.

The subject site consists of the vicinity of an existing culvert an unmapped, intermittent stream under Wolbach Road in Sudbury. The upland portions of the site consist of a public roadway and vegetated road shoulder slopes. The wetland resources observed on the site are described below.

**Methodology**

The site was inspected, and areas suspected to qualify as wetland resources were identified. The boundary of Bordering Vegetated Wetlands was delineated in the field in accordance with the definition set forth in the regulations at 310 CMR 10.55(2)(c). Section 10.55(2)(c) states that “The boundary of Bordering Vegetated Wetlands is the line within which 50% or more of the vegetational community consists of wetland indicator plants and saturated or inundated conditions exist.” The methodology used to delineate Bordering Vegetated Wetlands is further described in: (1) the BVW Policy “*BVW: Bordering Vegetated Wetlands Delineation Criteria and Methodology*,” issued March 1, 1995; and (2) “*Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act: A Handbook*,” produced by the Massachusetts Department of Environmental Protection, dated March 1995. The plant taxonomy used in this report is based on the *National List of Plant Species that Occur in Wetlands: Massachusetts* (Fish and Wildlife Service, U.S. Department of the Interior, 1988). Federal wetlands were presumed to have boundaries conterminous with the delineated Bordering Vegetated Wetlands. One set of DEP Bordering Vegetated Wetland Delineation Field Data Forms completed for observation plots located in the wetlands and uplands near flag A-3 is attached. The table below provides the Flag Numbers, Flag Type, and Wetland Types and Locations for the delineated wetland resources.

Flag Numbers	Flag Type	Wetland Types and Locations
A-1 to A-9 (Test Plots at A-2)	Blue Flags	Boundary of Bordering Vegetated Wetlands located on the west side of Wolbach Road that are associated with an unnamed, intermittent stream. Flags A-5 & A-6 connect to stream culvert inlet.
B-1 to B-9	Blue Flags	Boundary of Bordering Vegetated Wetlands located on the east side of Wolbach Road that are associated with an unnamed, intermittent stream. Flags B-4 & B-5 connect to stream culvert outlet.
SA-1 to SA-11	Red Flags	Bank of unnamed stream on the west side of Wolbach Road.
SB-1 to SB-5	Red Flags	Bank of unnamed stream on the east side of Wolbach Road.

### Findings

Wetland A/B consists of a shrub swamp that is associated with an unmapped, intermittent stream. Plant species observed include red maple (*Acer rubrum*) and American elm (*Ulmus americana*) trees and/or saplings; poison ivy (*Toxicodendron radicans*) climbing woody vines; highbush blueberry (*Vaccinium corymbosum*), common winterberry (*Ilex verticillata*), arrow-wood (*Viburnum dentatum*), withe-rod (*Viburnum cassinoides*), swamp rose (*Rosa palustris*), speckled alder (*Alnus rugosa*), silky dogwood (*Cornus amomum*), glossy buckthorn (*Rhamnus frangula*), sweet pepper-bush (*Clethra alnifolia*), swamp azalea (*Rhododendron viscosum*), and American elderberry (*Sambucus canadensis*) shrubs; and sheep-laurel (*Kalmia angustifolia*), bristly blackberry (*Rubus hispidus*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), sensitive fern (*Onoclea sensibilis*), subarctic lady fern (*Athyrium filix-femina*), marsh fern (*Thelypteris thelypteroides*), Massachusetts fern (*Thelypteris simulata*), spinulose woodfern (*Dryopteris spinulosa*), skunk-cabbage (*Symplocarpus foetidus*), swamp Jack-in-the-pulpit (*Arisaema triphyllum*), spotted touch-me-not (*Impatiens capensis*) and sphagnum moss (*Sphagnum sp.*) ground cover. Evidence of wetland hydrology, including hydric soils, high groundwater, saturated soils, pore linings, evidence of flooding, and drainage patterns, was observed within the delineated wetland. This vegetated wetland borders an intermittent stream; accordingly, the vegetated wetlands would be regulated as Bordering Vegetated Wetlands and the stream would be regulated as Bank and Land Under Water Bodies and Waterways under the Act. A 100-foot Buffer Zone extends horizontally outward from the edge of Bordering Vegetated Wetlands under the Act.

Bordering Land Subject to Flooding is an area that floods due to a rise in floodwaters from a bordering waterway or water body. Where flood studies have been completed, the boundary of Bordering Land Subject to Flooding is based upon flood profile data prepared by the National Flood Insurance Program. Section 10.57(2)(a)3. states that "The boundary of Bordering Land Subject to Flooding is the estimated maximum lateral extent of flood water which will theoretically result from the statistical 100-year frequency storm." The project engineer should evaluate the most recent National Flood Insurance Program flood profile data to confirm the

location and elevation of Bordering Land Subject to Flooding on the site. Bordering Land Subject to Flooding would occur in areas where the 100-year flood elevation is located outside of or upgradient of the delineated Bordering Vegetated Wetlands boundary. Bordering Land Subject to Flooding does not have a Buffer Zone under the Act.

The Massachusetts Rivers Protection Act amended the Act to establish an additional wetland resource area: Riverfront Area. Based upon a review of the current USGS Map (attached), a stream that is shown as intermittent is located within the delineated wetland. The watershed area for this stream at the site was determined to be 0.15 square miles, which is significantly less than potentially perennial threshold of 0.5 square miles. Therefore the subject stream is presumed to be intermittent and Riverfront Area would not apply. The USGS StreamStats method printout for the stream (attached) depicts the size and location of the watershed for the subject stream. Furthermore, based upon a review of the current USGS Map and observations made during the site inspection, there are no other mapped or unmapped streams located within 200 feet of the site. Accordingly, except as noted above, Riverfront Area would not occur on the site. Riverfront Area does not have a Buffer Zone under the Act, but may overlap other wetland resources and their Buffer Zones.

The Regulations require that no project may be permitted that will have any adverse effect on specified habitat sites of rare vertebrate or invertebrate species, as identified by procedures set forth at 310 CMR 10.59. Based upon a review of the *Massachusetts Natural Heritage Atlas*, 14<sup>th</sup> edition, Priority Habitats and Estimated Habitats from the NHESP Interactive Viewer, valid from August 1, 2017, and Certified Vernal Pools from MassGIS, there are no Estimated Habitats [for use with the Act and Regulations (310 CMR 10.00 *et seq.*)], Priority Habitats [for use with Massachusetts Endangered Species Act (M.G.L. Ch. 131A; "MESA") and MESA Regulations (321 CMR 10.00 *et seq.*)], or Certified Vernal Pools on or in the immediate vicinity of the site. A copy of this map is attached.

The reader should be aware that the regulatory authority for determining wetland jurisdiction rests with local, state, and federal authorities. A brief description of my experience and qualifications is attached. If you have any questions, please feel free to contact me at any time.

Cordially,  
ECOTEC, INC.



Arthur Allen, CWS, CPSS  
Vice President

Attachments (6, 10 pages)

AA/NOI/Sudbury Wolbach EcoTec Wet Report 2.2.2021





# EcoTec, Inc.

## ENVIRONMENTAL CONSULTING SERVICES

102 Grove Street  
Worcester, MA 01605-2629  
508-752-9666 / Fax: 508-752-9494

**Arthur Allen, CPSS, CWS, CESSWI**  
**Vice President**  
**Soil & Wetland Scientist**

Arthur Allen is the Vice President of EcoTec, Inc. and has been a senior environmental scientist there since 1995. His work with EcoTec has involved wetland delineation, wildlife habitat evaluation, environmental permitting (federal, state and local), environmental monitoring, expert testimony, peer reviews, contaminated site assessment and the description, mapping and interpretation of soils. His clients have included private landowners, developers, major corporations and regulatory agencies. Prior to joining EcoTec, Mr. Allen mapped and interpreted soils in Franklin County, MA for the U.S.D.A. Natural Resources Conservation Service (formerly Soil Conservation Service) and was a research soil scientist at Harvard University's Harvard Forest. Since 1994, Mr. Allen has assisted the Massachusetts Department of Environmental Protection and the Massachusetts Association of Conservation Commissions as an instructor in the interpretation of soils for wetland delineation and for the Title V Soil Evaluator program.

Mr. Allen has a civil service rating as a soil scientist, an undergraduate degree in Natural Resource Studies and a graduate certificate in Soil Studies. His work on the Franklin County soil survey involved interpretation of landscape-soil-water relationships, classifying soils and drainage, and determining use and limitation of the soil units that he delineated. As a soil scientist at the Harvard Forest, Mr. Allen was involved in identifying the legacies of historical land-use in modern soil and vegetation at a number of study sites across southern New England. He has a working knowledge of the chemical and physical properties of soil and water and how these properties interact with the plants that grow on a given site. While at Harvard Forest he authored and presented several papers describing his research results which were later published. In addition to his aforementioned experience, Mr. Allen was previously employed by the Trustees of Reservations as a land manager and by the Town of North Andover, MA as a conservation commission intern.

### **Education:**

1993-Graduate Certificate in Soil Studies, University of New Hampshire  
1982-Bachelor of Science in Natural Resource Studies, University of Massachusetts

### **Professional Affiliations:**

Certified Professional Soil Scientist (ARCPACS CPSS #22529)  
New Hampshire Certified Wetland Scientist (#19)  
Registered Professional Soil Scientist – Society of Soil Scientists of SNE [Board Member (2000-2006)]  
Certified Erosion, Sediment & Stormwater Inspector (#965)  
Massachusetts Approved Soil Evaluator (#13764)  
Massachusetts Arborists Association-Certified Arborist (1982 – 1998)  
New England Hydric Soils Technical Committee member  
Massachusetts Association of Conservation Commissions member  
Society of Wetland Scientists member

### **Refereed Publications:**

*Soil Science and Survey at Harvard Forest.* A.Allen. In: Soil Survey Horizons. Vol. 36, No. 4, 1995, pp. 133-142.  
*Controlling Site to Evaluate History: Vegetation Patterns of a New England Sand Plain.* G.Motzkin, D.Foster, A.Allen, J.Harrold, & R.Boone. In: Ecological Monographs 66(3), 1996, pp. 345-365.  
*Vegetation Patterns in Heterogeneous Landscapes: The Importance of History and Environment.* G.Motzkin, P.Wilson, D.R.Foster & A.Allen. In: Journal of Vegetation Science 10, 1999, pp. 903-920.

# DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant

Prepared by: EcoTec, Inc

Project Location: Wolbach Rd., Sudbury

DEP File #

**Section I. Vegetation**

Number: TPU

Transect # A-2

Date of Delin: 11/20/2020

A. Sample layer and plant species (Enter largest to smallest % cover by layer)		Percent Cover (or basal area)	Percent Dominance	Dominant Plant?	Wetland Indicator Category
Tree	Red Oak	Quercus rubra	15	15.0 YES	FACU-
	Red Maple	Acer rubrum	10	10.0 YES	FAC *
	Black Birch	Betula lenta	60	60.0 YES	FACU
	White Pine	Pinus strobus	15	15.0 NO	FACU
Sapling	Sugar Maple	Acer saccharum	10	50.0 YES	FACU-
	American Elm	Ulmus americana	10	50.0 YES	FACW- *
Shrub	Black Cherry	Prunus serotina	10	100.0 YES	FACU
Ground	none				
Vine					

<b>Vegetation Conclusions</b>	
Number of dominant wetland indicator plants	2
Number of dominant non-wetland indicator plants	4
Is the number of dominant wetland plants equal or greater than the number of dominant non-wetland plants?	NO

# DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant [REDACTED]

Prepared by: EcoTec, Inc

Project Location: Wolbach Rd., Sudbury

DEP File #

**Section II. Indicators of Hydrology**

Number: TPU

Transect # A-2

Date of Delin: #####

**1. Soil Survey**

Is there a published soil survey for this site? [REDACTED]

title/date [REDACTED]

map number [REDACTED]

soil type mapped [REDACTED]

hydric soil inclusions [REDACTED]

Are field observations consistent with soil survey? [REDACTED]

Remarks: [REDACTED]

**2. Soil Description**

Horizon	Depth (inches)	Matrix Color	Mottle Color
Litter	3	[REDACTED]	[REDACTED]
O	1-0	10YR 3/1	[REDACTED]
A	0-5	10YR 3/3	[REDACTED]
Bw	5-13	10YR 4/6	[REDACTED]

Remarks: Fine sandy loams

**3. Other** [REDACTED]

**Conclusion: Is the soil hydric?** No

**Other Indicators of hydrology (check all that apply):**

- Site Inundated [REDACTED]
- Depth to free water in observation hole [REDACTED]
- Depth to soil saturation in observation hole [REDACTED]
- Water marks [REDACTED]
- Drift lines [REDACTED]
- Sediment Deposits [REDACTED]
- Drainage patterns in BVWs [REDACTED]
- Oxidized rhizospheres [REDACTED]
- Water stained leaves [REDACTED]
- Recorded data (stream, lake, or tidal gauge; aerial photo; other): [REDACTED]
- Other: [REDACTED]

<b>Vegetation and Hydrology Conclusion</b>		
	Yes	No
Number of wetland indicator plants ≥ number of non-wetland indicator plants	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Wetland hydrology present:		
Hydric soil present	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Other indicators of hydrology present	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sample Location is in a BVW	<input type="checkbox"/>	<input checked="" type="checkbox"/>

# DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant

Prepared by: EcoTec, Inc

Project Location: Wolbach Rd., Sudbury

DEP File #

**Section I. Vegetation**

Number: TPW

Transect # A-2

Date of Delin: 11/20/2020

A. Sample layer and plant species (Enter largest to smallest % cover by layer)			Percent Cover (or basal area)	Percent Dominance	Dominant Plant?	Wetland Indicator Category
Tree	Eastern Hemlock	<i>Tsuga canadensis</i>	20		33.3 YES	FACU* *
	Red Maple	<i>Acer rubrum</i>	20		33.3 YES	FAC *
	Black Birch	<i>Betula lenta</i>	20		33.3 YES	FACU
Sapling	White Ash	<i>Fraxinus americana</i>	10		100.0 YES	FACU
Shrub	silky dogwood	<i>Cornus amomum</i>	30		100.0 YES	FACW *
Ground	False Nettle	<i>Boehmeria cylindrica</i>	20		100.0 YES	FACW+ *
Vine						

<b>Vegetation Conclusions</b>	
Number of dominant wetland indicator plants	<b>4</b>
Number of dominant non-wetland indicator plants	<b>2</b>
Is the number of dominant wetland plants equal or greater than the number of dominant non-wetland plants?	
YES	

# DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant: [redacted] Prepared by: EcoTec, Inc Project Location: Wolbach Rd., Sudbury DEP File #

**Section II. Indicators of Hydrology** Number: TPW Transect # A-2 Date of Delin: #####

### 1. Soil Survey

Is there a published soil survey for this site? [redacted]

title/date [redacted]

map number [redacted]

soil type mapped [redacted]

hydric soil inclusions [redacted]

Are field observations consistent with soil survey? [redacted]

Remarks: [redacted]

### 2. Soil Description

Horizon	Depth (inches)	Matrix Color	Mottle Color
Litter	2	[redacted]	[redacted]
A	0-4	10YR 3/1	[redacted]
Cg	4-6	2.5Y 5/2	5% 7.5YR 4/6
Ab	6-10	10YR 2/1	[redacted]
2Cg	10-14	2.5Y 6/2	10% 7.5YR 4/4

Remarks A&Cg: Fine Sandy Loams; Ab&2Cg: Silt Loams

3. Other [redacted]

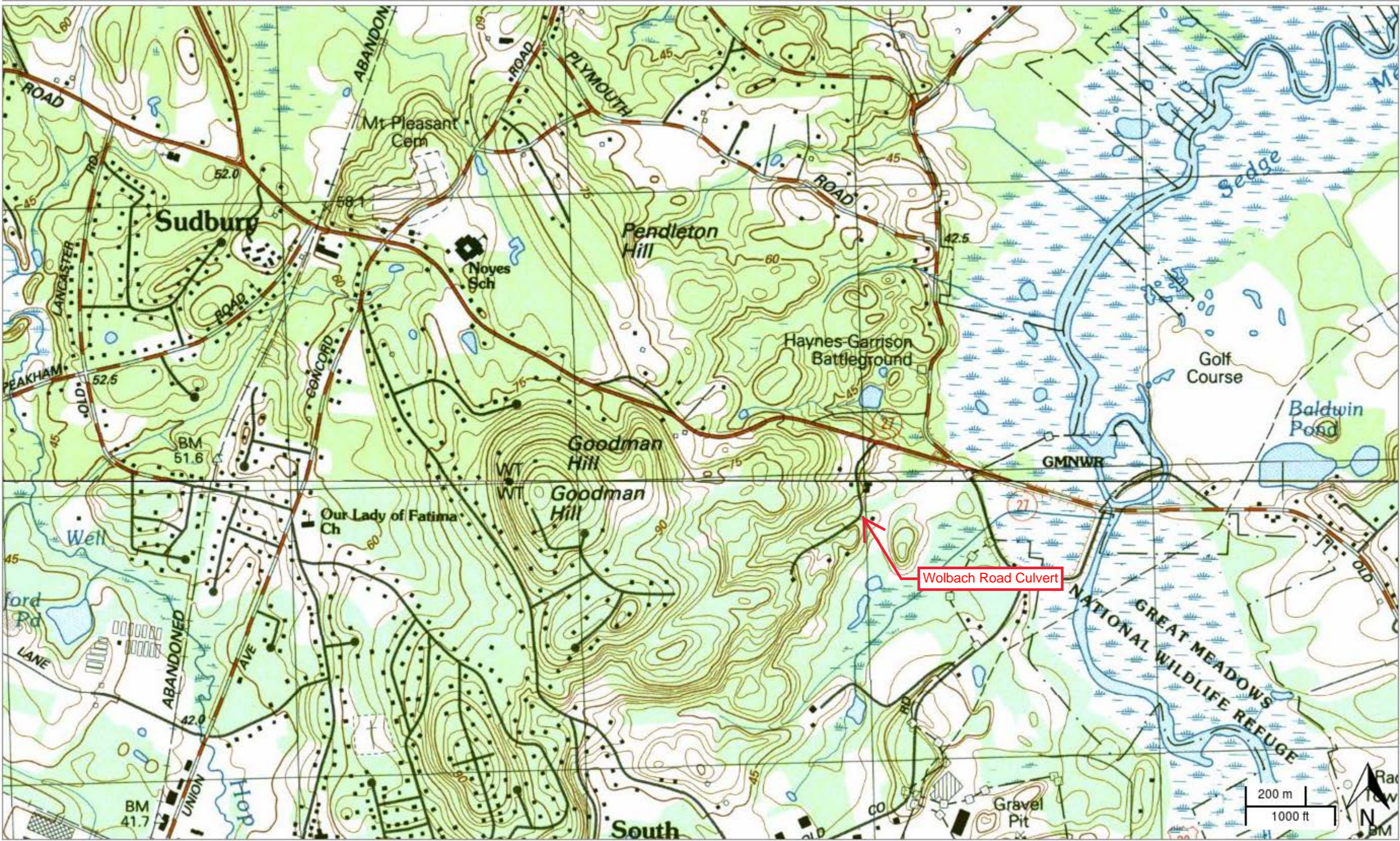
**Conclusion: Is the soil hydric?** Yes

### Other Indicators of hydrology (check all that apply):

- Site Inundated [redacted]
- Depth to free water in observation hole [redacted]
- Depth to soil saturation in observation hole [redacted]
- Water marks [redacted]
- Drift lines [redacted]
- Sediment Deposits [redacted]
- Drainage patterns in BVWs [redacted]
- Oxidized rhizospheres [redacted]
- Water stained leaves [redacted]
- Recorded data (stream, lake, or tidal gauge; aerial photo; other): [redacted]
- Other: [redacted]

### Vegetation and Hydrology Conclusion

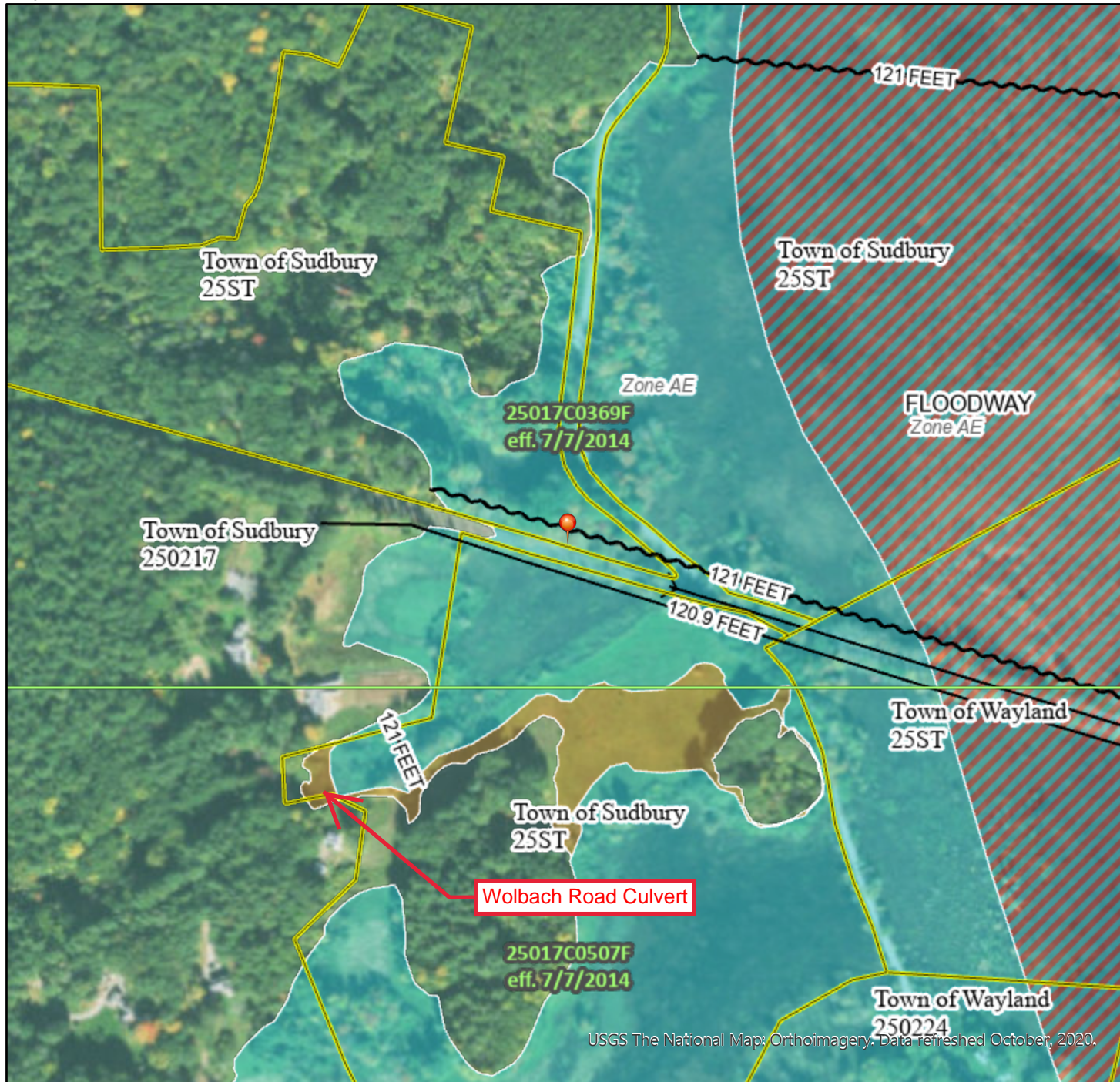
	Yes	No
Number of wetland indicator plants ≥ number of non-wetland indicator plants	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Wetland hydrology present:		
Hydric soil present	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Other indicators of hydrology present	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sample Location is in a BVW	<input checked="" type="checkbox"/>	<input type="checkbox"/>



# National Flood Hazard Layer FIRMette



71°23'41"W 42°22'47"N



71°23'4"W 42°22'20"N

## Legend

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

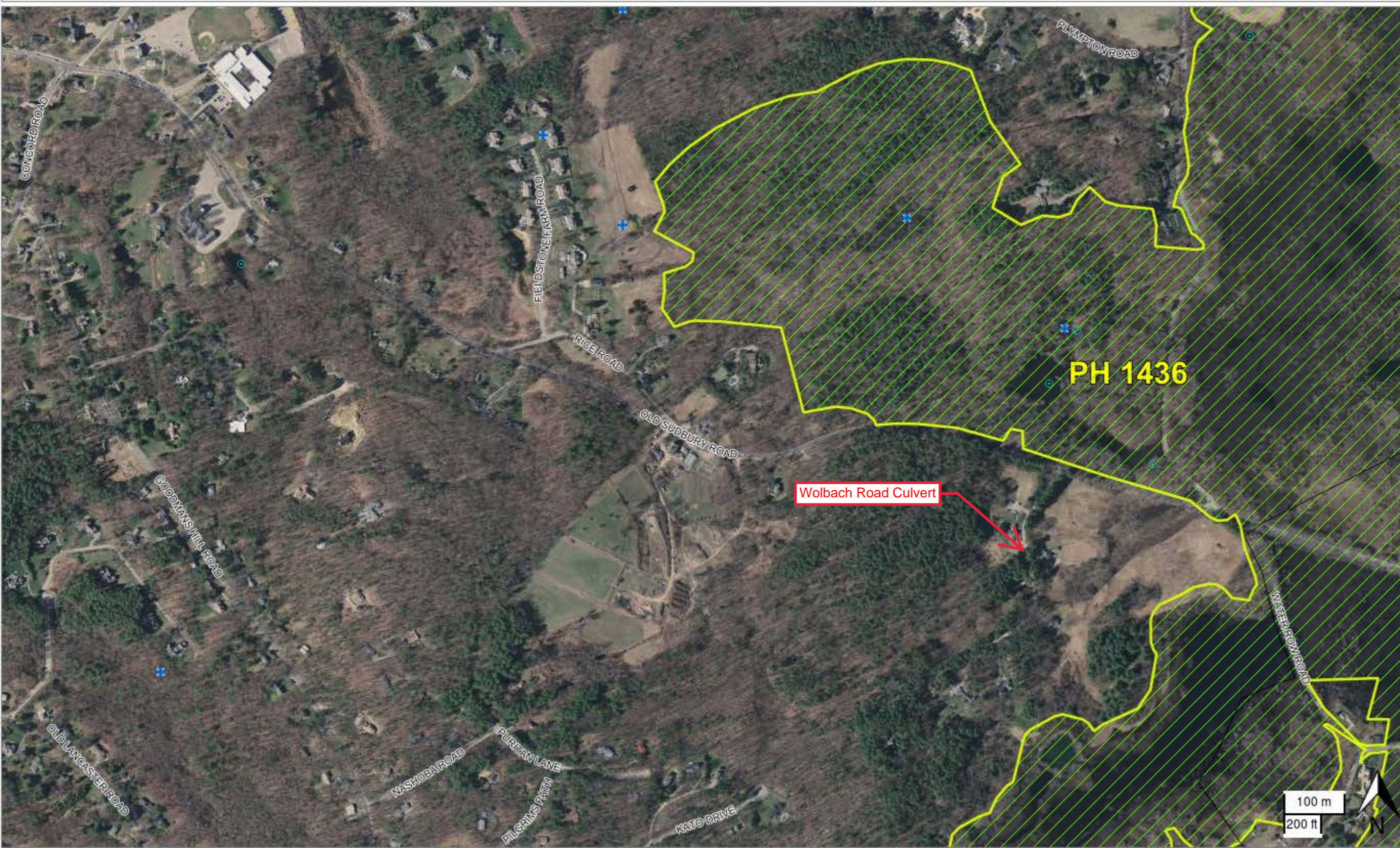
- |                                    |  |   |
|------------------------------------|--|---|
| <b>SPECIAL FLOOD HAZARD AREAS</b>  |  | Without Base Flood Elevation (BFE)<br>Zone A, V, A99  |
|                                    |  | With BFE or Depth Zone AE, AO, AH, VE, AR   |
|                                    |  | Regulatory Floodway   |
| <b>OTHER AREAS OF FLOOD HAZARD</b> |  | 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  |
| <b>OTHER AREAS</b>                 |  | NO SCREEN Area of Minimal Flood Hazard Zone X   |
|                                    |  | Effective LOMRs   |
|                                    |  | Area of Undetermined Flood Hazard Zone D  |
| <b>GENERAL STRUCTURES</b>          |  | Channel, Culvert, or Storm Sewer  |
|                                    |  | Levee, Dike, or Floodwall   |
| <b>OTHER FEATURES</b>              |  | 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation   |
|                                    |  | 17.5 Coastal Transect   |
|                                    |  | Base Flood Elevation Line (BFE)   |
|                                    |  | Limit of Study  |
|                                    |  | Jurisdiction Boundary   |
|                                    |  | Coastal Transect Baseline   |
|                                    |  | Profile Baseline  |
|                                    |  | Hydrographic Feature  |
| <b>MAP PANELS</b>                  |  | Digital Data Available  |
|                                    |  | No Digital Data Available   |
|                                    |  | Unmapped  |
- The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/3/2020 at 5:13 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: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

USGS The National Map; Orthoimagery. Data refreshed October, 2020.



- Potential Vernal Pools
- NHESP Certified Vernal Pools
- MassDOT Roads Street Names
- Major MassDOT Routes
  - Interstate Highways
  - US Roads
  - State
- Massachusetts Towns
- NHESP Estimated Habitats of Rare Wildlife
- NHESP Priority Habitats of Rare Species
- 2013-2014 Color Orthos (USGS)
- Orthos 2019
- 2019 Color Orthos (USGS)



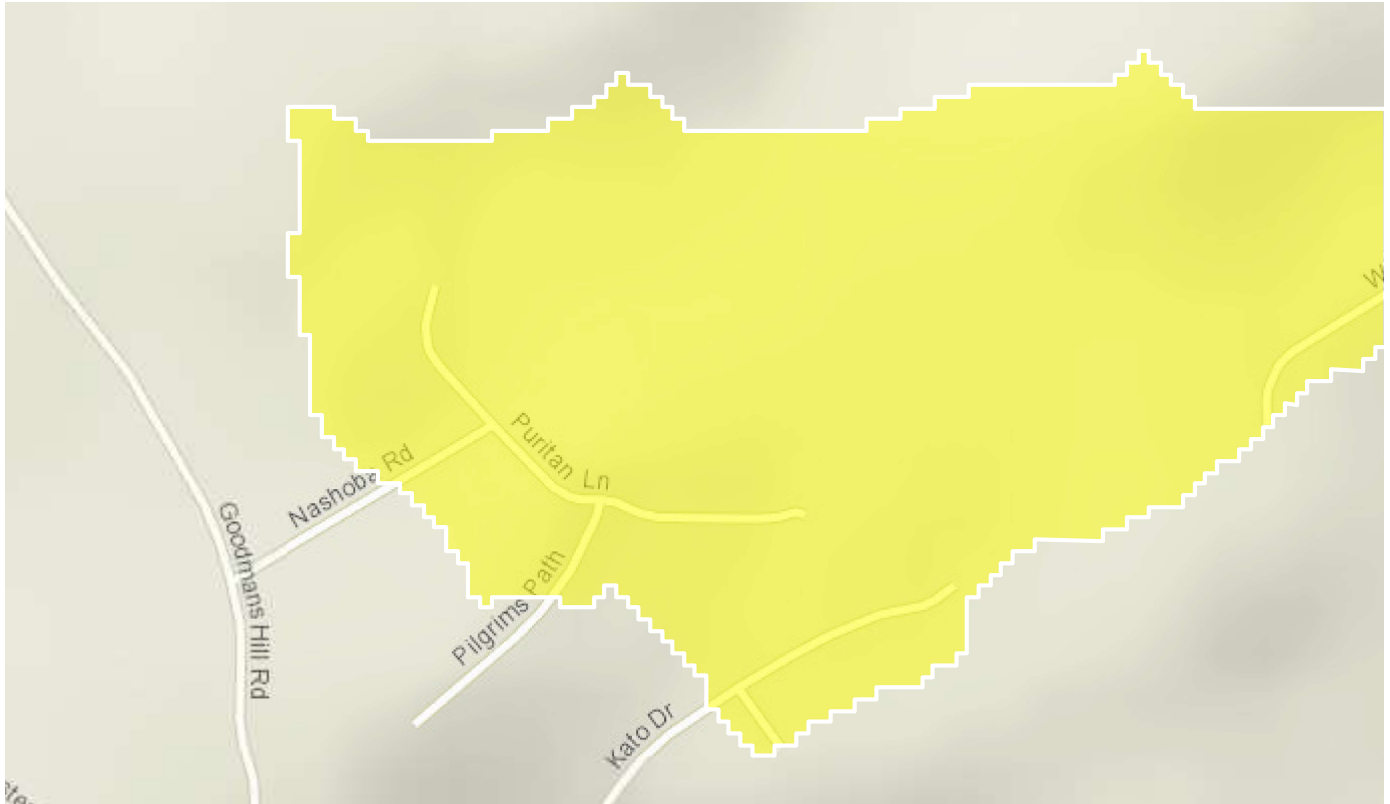
# StreamStats Report

**Region ID:** MA

**Workspace ID:** MA20201118215659707000

**Clicked Point (Latitude, Longitude):** 42.37429, -71.39206

**Time:** 2020-11-18 16:52:47 -0500



Wolbach Road, Sudbury, MA

## Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.15	square miles
BSLDEM250	Mean basin slope computed from 1:250K DEM	6.554	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	-100000	square mile per mile
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless

Low-Flow Statistics Parameters<sup>[Statewide Low Flow WRIR00 4135]</sup>

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.15	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	6.554	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	-100000	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Flow Report<sup>[Statewide Low Flow WRIR00 4135]</sup>

Statistic	Value	Unit
-----------	-------	------

*Low-Flow Statistics Citations*

Sauer, Vernon B.; Thomas, W. O., Jr.; Stricker, V. A.; Wilson, K. V., 1983, Flood characteristics of urban watersheds in the United States: U.S. Geological Survey Water-Supply Paper 2207, 63 p. (<http://pubs.er.usgs.gov/publication/wsp2207>)

Anderson, B.T., 2020, Magnitude and frequency of floods in Alabama, 2015: U.S. Geological Survey Scientific Investigations Report 2020-5032, 148 p. (<https://doi.org/10.3133/sir20205032>)

Hedgecock, T.S., 2004, Magnitude and Frequency of Floods on Small Rural Streams in Alabama: U. S. Geological Survey Scientific Investigations Report 2004-5135, 10 p. (<http://pubs.usgs.gov/sir/2004/5135/>)

Hedgecock, T.S., 2010, Magnitude and Frequency of Floods for Urban Streams in Alabama, 2007: U.S Geological Survey Scientific Investigations Report 2010-5012, 17p. (<https://pubs.usgs.gov/sir/2010/5012/>)

Feaster, T.D., Kolb, K.R., Painter, J.A., and Clark, J.M. 2020, Methods for estimating selected low-flow frequency statistics and mean annual flow for ungaged locations on Streams in Alabama: U.S. Geological Survey Scientific Investigations Report 2020-5099, 21 p. (<https://doi.org/10.3133/sir20205099>)

Wiley, J.B., and Curran, J.H., 2003, Estimating annual high-flow statistics and monthly and seasonal low-flow statistics for ungaged sites on streams in Alaska and conterminous basins in Canada: U.S. Geological Survey Water-Resources Investigations Report 03-4114, 61 p. ([http://water.usgs.gov/pubs/wri/wri034114/pdf/wri034114\\_v1.10.pdf](http://water.usgs.gov/pubs/wri/wri034114/pdf/wri034114_v1.10.pdf))

Brabets, Timothy P., 1996, Evaluation of the streamflow-gaging network of Alaska in providing regional streamflow information: U.S. Geological Survey Water-Resources Investigations Report 96-4001, 98 p. (<https://pubs.usgs.gov/wri/wri96-4001/>)

Curran, J.H., Barth, N.A., Veilleux, A.G., and Ourso, R.T., 2016, Estimating Flood Magnitude and Frequency at Gaged and Ungaged Sites on Streams in Alaska and Conterminous Basins in Canada, Based on Data through Water Year 2012: U.S. Geological Survey Scientific

## ATTACHMENT C: GEOTECHNICAL EVALUATION





Known for excellence.  
Built on trust.

GEOTECHNICAL

ENVIRONMENTAL

ECOLOGICAL

WATER

CONSTRUCTION  
MANAGEMENT

5 Commerce Park North  
Suite 201  
Bedford, NH 03110  
T: 603.623.3600  
F: 603.624.9463  
www.gza.com



## MEMORANDUM

To: Mr. Scott Salvucci  
Woodard & Curran, Inc. (W&C)

From: Mirsad Alihodzic and Bruce W. Fairless, P.E.  
GZA GeoEnvironmental, Inc. (GZA)

Date: January 13, 2021

File No: 04.0191170.00

Re: Geotechnical Engineering Memorandum  
Wolbach Road Culvert  
Sudbury, Massachusetts

---

This memorandum presents the results of the subsurface exploration program performed at the above-referenced site by GZA. The subsurface exploration program was completed in accordance with GZA's Proposal for Geotechnical Services dated July 21, 2020. GZA's objectives were to evaluate subsurface conditions and provide geotechnical recommendations for the proposed culvert replacement. The contents of this report are subject to the **Limitations** contained in **Appendix A** and the Terms and Conditions of our agreement. Note that elevations in this memorandum are in feet referenced to the North American Vertical Datum of 1988 (NAVD 88).

### BACKGROUND/SITE DESCRIPTION

Based on discussions with you, we understand that the existing culvert located to the south of 18 Wolbach Road needs to be replaced because of the deteriorating condition of the current culvert.

The existing stone and concrete lined culvert allows the intermittent stream to pass under the roadway and move between the Great Meadows National Wildlife Refuge wetlands located to the west and downstream to the east. The current culvert is approximately 24 feet long and spans the width of the roadway and slopes down from the west to the east.

Based on the survey plan provided to us by W&C on December 2, 2020, the culvert invert on the west (inlet) side is at about Elevation 122.4 and the east (outlet) side is at about Elevation 122.2. Based on a review of the plans provided and our visual observations in the field, an approximately 1-foot-wide, 25-foot-long, stacked stone retaining/headwall with a varying height is located on the upstream side of the culvert. A 5-foot-diameter stone lined culvert opening is located at the inlet side of the culvert, while at the outlet side the culvert is incorporated into an approximately 5-foot-wide, 5-foot-tall concrete and stacked stone structure with a 3.5-foot-square outlet opening and stone stacked wingwalls, with an 8-inch-diameter corrugated metal pipe (CMP)



which outlets at top of the culvert on the south side. The CMP pipe does not appear to connect to an existing drainage structure in the road.

The 5-foot-diameter inlet opening and stacked stone retaining/headwall at the upstream (west) side of the culvert can be seen on **Photograph 1**, while the 3.5-foot-square concrete/stone outlet opening and retaining wall at the downstream (east) is shown in **Photographs 2 and 3** below.

An overhead utility is present on the east side of the roadway and based on the plans and information provided by the Town of Sudbury and W&C, underground utilities are not present in this section of the Wolbach Road. The roadway at this culvert area currently slopes from the north and the south into a low spot near the existing utility pole on the east side of the road. During our subsurface exploration program, localized erosion around the utility pole was observed. Outward leaning triangular concrete posts were observed along each side of the road near the culvert, what we believe to be the remnants of a guardrail system. Pavement cracking and recent pavement patching repairs were observed to the south side of the culvert and following the existing culvert from the west to the east as shown in **Photograph 4** below.

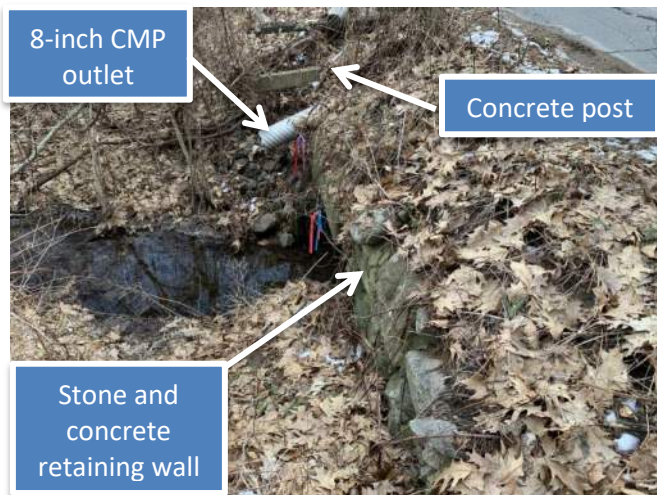


Photograph 1 – stacked stone headwall inlet



8-inch CMP outlet

Photograph 2 – concrete and stone outlet opening



Photograph 3 – retaining wall and downstream outlet



Photograph 4 – localized erosion and cracking



Based on our communications with you, we understand that the proposed culvert replacement being considered for the Wolbach Road culvert is a concrete box culvert with a 4-foot-high and 4- to 5-foot-wide opening. The concrete box culvert would be embedded approximately 2 feet and would be installed at approximately Elevation 120, and in the same approximate alignment as the existing culvert. The existing stacked stone/concrete headwalls would be replaced with precast modular block retaining walls on both the inlet and outlet sides.

**SUBSURFACE EXPLORATIONS**

GZA performed a subsurface exploration program to evaluate subsurface conditions in the vicinity of the proposed culvert. New England Boring Contractors (NEBC) of Derry, New Hampshire coordinated utility clearance and drilled test borings B-1 and B-2 on November 19, 2020. Boring B-1 was drilled in the roadway to the north of the existing culvert and extended to a depth of about 19 feet below ground surface (bgs). Boring B-2 was drilled in the roadway to the south of the existing culvert and extended to a depth of about 28 feet bgs. GZA field personnel located the test borings by tape measurements from prominent site features. The approximate locations of the test borings are shown on **Figure 1 – Exploration Location Plan**.

Boring B-1 was drilled using a truck-mounted drill rig with 2.25-inch inside-diameter (ID), hollow stem augers. Boring B-2 was drilled using a truck-mounted drill rig with 4-inch-ID, flush-joint casing and drive-and-wash drilling methods. Standard Penetration Testing and split spoon sampling were performed at 5-foot intervals. Samples were classified in accordance with the Modified Burmister System. The test borings were backfilled with drill cuttings upon the completion of the drilling and repaired at the surface with cold-patch asphalt. GZA field personnel monitored the drilling and prepared the test boring logs which are included in **Appendix B**.

**GEOTECHNICAL LABORATORY TESTING**

Four soil samples obtained from the test borings were submitted to GZA’s geotechnical laboratory subcontractor, Thielsch Engineering, for grain size distribution analyses (gradation). Laboratory test results for these samples are attached as **Appendix C** and are summarized in the table below.

Test Boring No.	Sample ID	Depth Below Grade (feet)	Stratum	Soil Description	Test Performed
B-1	S-2	4-6	Fill	Brown, fine to medium SAND, some Silt, little fine Gravel.	Index (Gradation, Moisture)
B-1	S-4	14-16	Sand	Brown, fine to coarse SAND and SILT, trace Gravel.	Index (Gradation, Moisture)
B-2	S-3	9-11	Sand	Gray, CLAYEY SILT, trace fine to medium Sand.	Index (Gradation, Moisture)
B-2	S-6	24-26	Sand	Brown, fine to coarse SAND, some fine Gravel, little Silt.	Index (Gradation, Moisture)

**GENERALIZED SUBSURFACE CONDITIONS**

Based on the completed test borings, subsurface conditions at the site consist of loose to medium dense sand fill over natural clayey silt and/or silty sand. Descriptions of the geologic units encountered are as follows, in general order of occurrence below ground surface at each culvert location.



GENERALIZED SUBSURFACE CONDITIONS		
Soil Unit	Approx. Depth Range (feet)	Generalized Description
Asphalt	0.3 to 0.4	4 to 5 inches of bituminous asphalt pavement was encountered at the ground surface at borings B-1 and B-2.
Sand Fill	0.4 to 7.5	Approximately 7 feet of Sand Fill was encountered directly below the asphalt in borings B-1 and B-2. The material generally consisted of loose to medium dense, brown, fine to medium SAND, with up to about 35 percent Silt and up to 10 percent Gravel.
Natural Clayey Silt	7.5 to 12.5	Approximately 5 feet of Natural Clayey Silt was encountered directly below the Sand Fill in boring B-2. The material generally consisted of very stiff, gray, Clayey Silt, and up to 10 percent Sand.
Natural Silty Sand	7.5 to 27.9	Approximately 11 feet of Natural Silty Sand was encountered at a depth of 7.5 feet bgs in boring B-1; the Sand was not fully penetrated as the boring was terminated in the Sand. Approximately 15.4 feet of Natural Silty Sand was encountered at a depth of 12.5 feet bgs in Boring B-2 and extending to a depth of about 28 feet. The Sand generally consisted of medium dense, brown, fine to coarse SAND, with up to 50 percent of Silt and up to 20 percent of Gravel.

Detailed descriptions of the materials encountered are presented on the boring logs in **Appendix B**.

GROUNDWATER

Groundwater was measured in test boring B-1 at approximately 12 feet bgs (corresponding to Elevation 118.3) and at approximately 9 feet bgs (corresponding to Elevation 121.4) in test boring B-2, as shown on the boring logs included in **Appendix B**. These groundwater depths and elevations are approximate representations of the hydrostatic groundwater level. The drive-and-wash method of drilling at boring B-2 introduced drill water to stabilize the borehole during drilling and remove drill spoils. There was no drilling water introduced during drilling of boring B-1. The observed groundwater levels observed in the test borings may not represent stabilized groundwater levels. Note that the stream was dry at the time the borings were completed in this area. As noted above, the ground surface grade at the inlet and outlet of the culvert is at about Elevation 122.

Water level readings were made in the borings at the time and under conditions stated on the logs. Note that fluctuations in the level of the groundwater will occur due to variations in season, rainfall, temperature, construction, and other factors occurring since the time measurements were made.

BEDROCK

Based on observed drill action, probable bedrock was encountered in test boring B-2 at approximately 27.9 feet bgs, corresponding to approximately Elevation 102.6. A roller bit was advanced into the top of probable bedrock to 28.3 feet bgs; a penetration of 0.4 feet. Bedrock underlying the site area is mapped as quartzite, schist, calc-silicate quartzite, and amphibolite which are part of the Westboro Formation.

**IMPLICATIONS OF SUBSURFACE CONDITIONS**

As noted above, subsurface conditions at the site consist of loose to medium dense sand fill over natural clayey silt and/or silty sand. Based on plans provided by W&C, the estimated bottom of the proposed culvert will be about Elevation ±120. Based on the borings, soils at this elevation are likely to be within the natural clayey silt and/or silty sand. Based on the boring data, both soil types are adequate bearing materials provided the box culvert is placed on 1 foot of crushed stone over the natural clayey silt and/or silty sand. It is likely observation of the excavated subgrade “in the dry” can be performed in the drier time of the year when the stream is dry.



## **RECOMMENDATIONS**

### **CULVERT SUPPORT**

Support the four-sided box culvert on 1 foot of ¾-inch crushed stone over undisturbed Natural Clayey Silt and/or Natural Silty Sand. Excavation should be performed with a smooth-edged excavator bucket, taking care not to overexcavate.

### **DEWATERING**

Culvert construction should be performed when the stream is dry to increase the chance of observing the excavated subgrade “in the dry”. Temporary construction dewatering may be required to control groundwater seepage, precipitation and surface inflow in excavations, to maintain the integrity of soil bearing surfaces, and allow foundation construction “in the dry”. However, the anticipated sandy excavated subgrade can become unstable if exposed to high dewatering gradients; care will be required to maintain a stable excavation bottom.

Temporary lateral earth support systems may be needed to support adjacent travel ways, wetlands, structures and control water infiltration.

Temporary dewatering and/or lateral earth support systems should be designed by a Professional Engineer licensed in the Commonwealth of Massachusetts.

### **FROST PROTECTION**

Typical frost depth in the Commonwealth of Massachusetts is 4 feet bgs. We recommend that spread footings for abutments and wingwalls be supported a minimum of 4 feet below the lowest adjacent ground surface to provide frost protection.

### **BEARING PRESSURE**

The proposed concrete box culvert can be supported on at least 1 foot of ¾-inch crushed stone placed over the undisturbed Natural Clayey Silt and/or Natural Silty Sand. Recommended maximum net allowable bearing pressure for the proposed abutments and wingwalls bearing on at least 1 foot of ¾-inch crushed stone is 1,500 pounds per square foot. At this bearing pressure, total potential foundation settlement is estimated to be less than 1 inch and differential settlements across the foundation estimated to be less than ½ inch.

### **RETAINING WALLS**

Based on the information provided by you, a precast modular block gravity wall system will be utilized to maintain the current top of slope elevations and will be incorporated into the concrete box culvert replacement construction. The proposed modular block wall should bear on at least 1 foot of ¾-inch crushed stone over the Natural Clayey Silt and/or Natural Silty Sand.

A precast modular block gravity wall, such as Redi-Rock, uses interlocking precast concrete cells to construct the wall from the bottom up. Construction would involve excavating to the natural soil surface, placement of a leveling pad, and construction of a conventional modular block wall system. Precast block walls typically require a base width that is 0.5 to 0.7 times the height of the wall.





January 13, 2020

04.0191170.00

Memorandum – Wolbach Road Culvert, Sudbury, Massachusetts

Page | 6

Precast modular block walls have several significant advantages over other wall types, including speed of construction, ability to construct “in-the-wet”, and sometimes lower construction cost. Precast block walls also required less select backfill as compared to MSE walls.

The precast modular block walls should be designed to prevent hydrostatic pressure buildup behind the wall. This may require installation of free-draining structural fill behind the wall, the installation of drains through the face of the wall, weep-holes and/or affixing a drainage board to the back of the precast wall.

## CONCLUSION

We appreciate the opportunity to work with Woodard & Curran, Inc. on this project. If you have any questions regarding this memorandum, please contact Mirsad Alihodzic at 603-232-8755 or Bruce Fairless at 781-603-2254.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Handwritten signature of Mirsad Alihodzic in black ink.

Mirsad Alihodzic  
Project Manager

Handwritten signature of David G. Lamothe in black ink.

David G. Lamothe, P.E.  
Consultant/Reviewer

Handwritten signature of Bruce W. Fairless in black ink.

Bruce W. Fairless, P.E., LEED AP  
Associate Principal

MA/BWF/DGL:kr

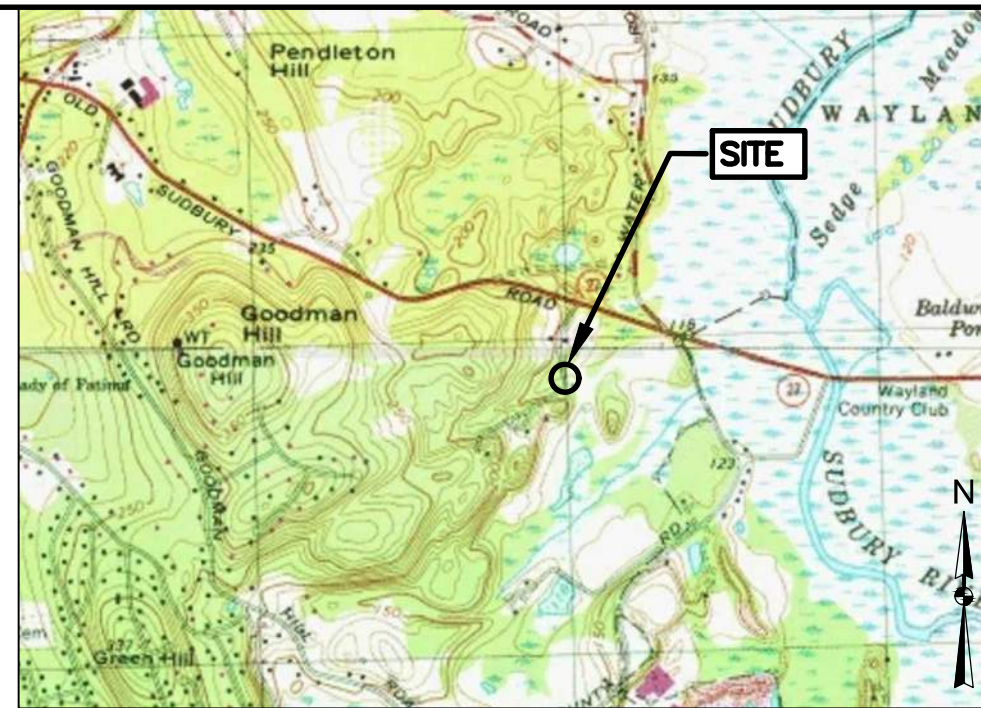
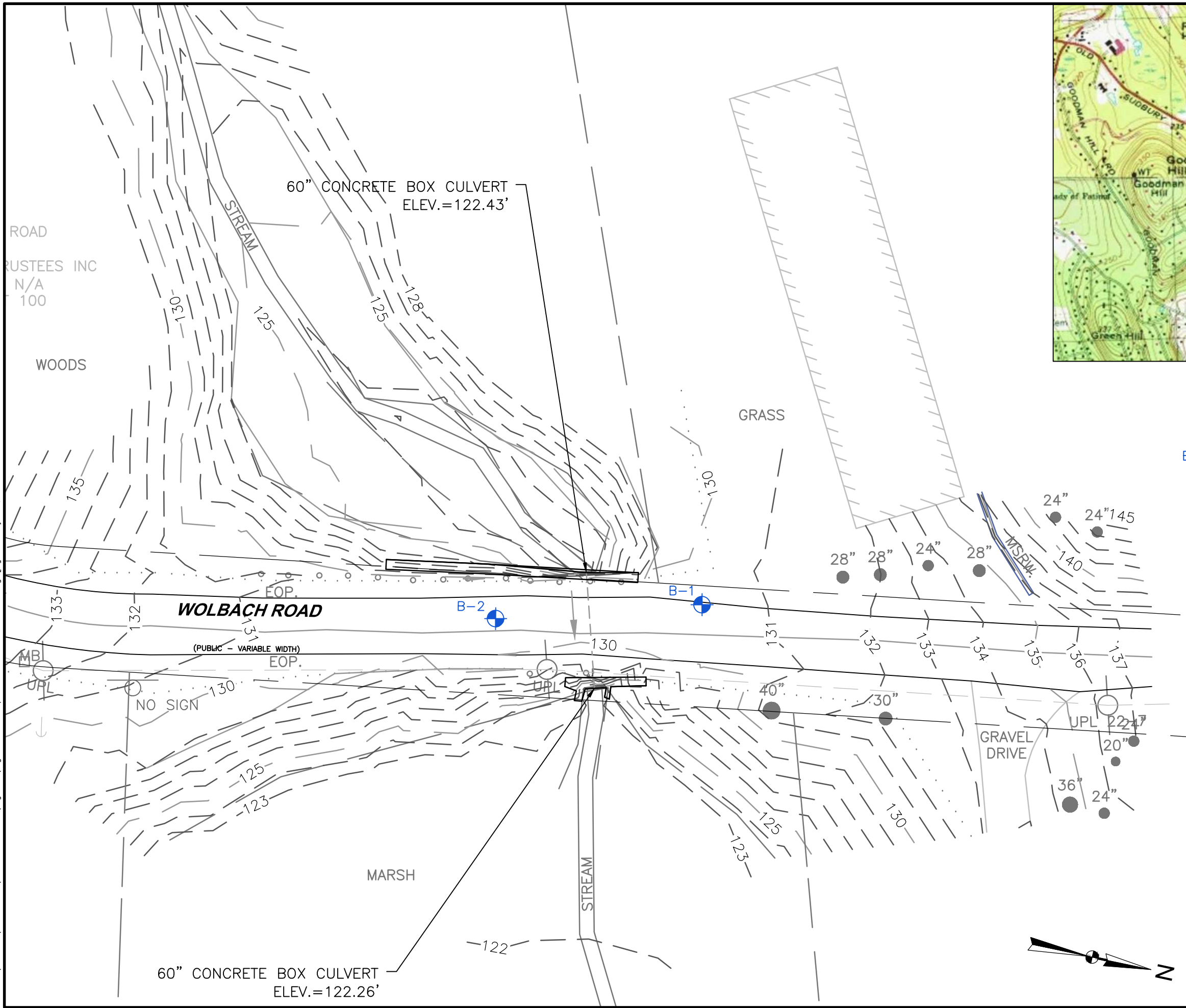
\\gzabedford\jobs\04\jobs\0191100s\04.0191170.00\report\final 04.0191170.00 geotech memo 01132021.docx

Attachments: Figure 1 – Exploration Location Plan  
Appendix A – Limitations  
Appendix B – Boring Logs  
Appendix C – Laboratory Test Results



**Figure 1 – Exploration Location Plan**

GZA-P:\04\jobs\04.0191170.00\Figures\Figure 1 - Exploration Location Plan.dwg [1] January 11, 2021 - 6:20am mrsad.ajhodzic



**LOCUS**  
1 inch = 2,000 feet

**LEGEND:**  
B-1 [Symbol] APPROXIMATE BORING LOCATION AND DESIGNATION

**NOTES:**  
BASE PLAN WAS DEVELOPED FROM AN ELECTRONIC BASE PLAN ENTITLED "WOLBACH ROAD CULVERT TOPO" DATED DECEMBER 2, 2020; PREPARED BY CHAPPELL ENGINEERING ASSOCIATES, LLC OF MARLBOROUGH, MASSACHUSETTS PROVIDED BY WOODARD AND CURRAN VIA EMAIL ON DECEMBER 2, 2020.

TEST BORINGS B-1 AND B-2 WERE PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF DERRY, NEW HAMPSHIRE ON NOVEMBER 19, 2020 AND WERE OBSERVED AND LOGGED BY GZA PERSONNEL.

THE LOCATIONS OF THE BORINGS, WERE APPROXIMATELY DETERMINED BY TAPE MEASUREMENTS, FROM EXISTING TOPOGRAPHIC AND MAN-MADE FEATURES. THE DATA SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.



THE INFORMATION SHOWN ON THE DRAWING IS SOLELY FOR USE BY NATIONAL GRID OR THE NATIONAL GRID'S DESIGNATED REPRESENTATIVE FOR THE SPECIFIC PROJECT AND LOCATION IDENTIFIED ON THE DRAWING. THE DRAWING SHALL NOT BE TRANSFERRED, REUSED, COPIED, OR ALTERED IN ANY MANNER FOR USE AT ANY OTHER LOCATION OR FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF GZA AND NATIONAL GRID. ANY TRANSFER, REUSE, OR MODIFICATION TO THE DRAWING BY OTHERS, WITHOUT THE PRIOR WRITTEN EXPRESS CONSENT OF GZA AND NATIONAL GRID, WILL BE AT THE USER'S SOLE RISK AND WITHOUT ANY RISK OR LIABILITY TO GZA AND NATIONAL GRID.

<b>PROPOSED WOLBACH ROAD CULVERT REPLACEMENT SUDBURY, MASSACHUSETTS</b>		
<b>EXPLORATION LOCATION PLAN</b>		
PREPARED BY: <b>GZA GeoEnvironmental, Inc.</b> Engineers and Scientists www.gza.com	PREPARED FOR: <b>WOODARD AND CURRAN</b>	
PROJ MGR: MA	REVIEWED BY: BWF	CHECKED BY: DGL
DESIGNED BY: MA	DRAWN BY: MA	SCALE: AS NOTED
DATE: JANUARY 2021	PROJECT NO. 04.0191170.00	REVISION NO.
		<b>FIGURE 1 SHEET NO.</b>



## **Appendix A – Limitations**



## USE OF REPORT

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the contract documents, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

## STANDARD OF CARE

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report, as appropriate, to reflect the unanticipated changed conditions .
3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.
4. In conducting our work, GZA relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

## SUBSURFACE CONDITIONS

5. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs. The nature and extent of variations between these explorations may not become evident until further exploration or construction. If variations or other latent conditions then become evident, it will be necessary to reevaluate the conclusions and recommendations of this report.
6. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.
7. Water level readings have been made in test holes (as described in this Report) and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.



8. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.
9. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

#### **COMPLIANCE WITH CODES AND REGULATIONS**

10. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

#### **COST ESTIMATES**

11. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

#### **ADDITIONAL SERVICES**

12. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.



## **Appendix B – Boring Logs**

### TEST BORING LOG



**GZA**  
**GeoEnvironmental, Inc.**  
*Engineers and Scientists*

Woodard and Curran  
Wolbach Road Culvert  
Sudbury, MA

**EXPLORATION NO.:** B-1  
**SHEET:** 1 of 1  
**PROJECT NO:** 04.01911170.00  
**REVIEWED BY:** MA

**Logged By:** J. Szmyt  
**Drilling Co.:** New England Boring Contractors  
**Foreman:** P. Schofield

**Type of Rig:** Truck  
**Rig Model:** MB-48  
**Drilling Method:** HSA

**Boring Location:** See Plan  
**Ground Surface Elev. (ft.):** 130.5  
**Final Boring Depth (ft.):** 19  
**Date Start - Finish:** 11/19/2020 - 11/19/2020

**H. Datum:** NAD83  
**V. Datum:** NAVD88

**Hammer Type:** Automatic Hammer  
**Hammer Weight (lb.):** 140  
**Hammer Fall (in.):** 30  
**Auger or Casing O.D./I.D Dia (in.):** 2.25

**Sampler Type:** SS  
**Sampler O.D. (in.):** 2.0  
**Sampler Length (in.):** 24  
**Rock Core Size:** None

**Groundwater Depth (ft.)**

Date	Time	Water Depth	Stab. Time
11/19/20	11:28 a.m.	12.2	10 min.

Depth (ft)	Casing Blows/ Core Rate	Sample					Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)						
5		S-1	0.4-2.4	24	6	5 6 7 3	S-1: Medium dense, brown, fine to medium SAND, little Silt, trace Gravel, dry.	1		0.4	ASPHALT	130.1
		S-2	4-6	24	13	3 4 5 5	S-2: Loose, brown, fine to coarse SAND and Silt, trace Gravel, dry.			7.5	FILL	123.0
		S-3	9-11	24	8	6 11 10 10	S-3: Medium dense, brown, fine to coarse SAND, some Silt, trace Gravel, moist.					
		S-4	14-16	24	16	3 4 9 12	S-4: Medium dense, brown, fine to coarse SAND and Silt, trace Gravel, wet.	2				
20						End of exploration at 19 feet.	3		19		111.5	

**REMARKS**

- 1 - The ground surface elevation at this test boring was based on interpolation of topographic contours shown on the Figure 1 - Exploration Location Plan.
- 2 - Loose sands encountered at approximately 19 feet below ground surface b.g.s., split spoon observed to start at approximately 16 feet b.g.s. inside the hollow stem augers while attempting to collect sample S-5 at 19 feet b.g.s.
- 3 - Test boring terminated at 19 feet b.g.s. due to observed loose sand. Borehole was backfilled with drill cuttings upon completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Exploration No.:**  
**B-1**



**TEST BORING LOG**



**GZA**  
**GeoEnvironmental, Inc.**  
*Engineers and Scientists*

**Woodard and Curran**  
**Wolbach Road Culvert**  
**Sudbury, MA**

**EXPLORATION NO.: B-2**  
**SHEET: 1 of 1**  
**PROJECT NO: 04.01911170.00**  
**REVIEWED BY: MA**

**Logged By:** J. Szynt  
**Drilling Co.:** New England Boring Contractors  
**Foreman:** P. Schofield

**Type of Rig:** Truck  
**Rig Model:** MB-48  
**Drilling Method:** Drive  
& Wash

**Boring Location:** See Plan  
**Ground Surface Elev. (ft.):** 130.5  
**Final Boring Depth (ft.):** 28.5  
**Date Start - Finish:** 11/19/2020 - 11/19/2020

**H. Datum:** NAD83  
**V. Datum:** NAVD88

**Hammer Type:** Automatic Hammer  
**Hammer Weight (lb.):** 140  
**Hammer Fall (in.):** 30  
**Auger or Casing O.D./I.D Dia (in.):** 4.0

**Sampler Type:** SS  
**Sampler O.D. (in.):** 2.0  
**Sampler Length (in.):** 24  
**Rock Core Size:** None

**Groundwater Depth (ft.)**

Date	Time	Water Depth	Stab. Time
11/19/20	2:41 p.m.	9.1	15 min.

Depth (ft)	Casing Blows/ Core Rate	Sample					Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Depth (ft.)	Stratum Description	Elev. (ft.)
		No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)						
		S-1	0.3-2.3	24	5	8 7 7 3	S-1: Medium dense, brown, fine to medium SAND, little Silt, trace Gravel, wet.	1		0.3	ASPHALT	130.2
5		S-2	4-6	24	8	2 2 4 3	S-2: Loose, brown, fine to medium SAND, some Silt, trace Gravel, wet.			7.5	FILL	123.0
10		S-3	9-11	24	17	5 8 9 10	S-3: Very stiff, gray, CLAYEY SILT, trace fine to medium Sand, wet.			12.5	SILT	118.0
15		S-4	14-16	24	15	4 7 8 8	S-4: Medium dense, brown, fine to coarse SAND and Silt, trace Gravel, wet.					
20		S-5	19-21	24	17	5 5 6 7	S-5: Medium dense, brown, fine to coarse SAND and Silt, trace Gravel, wet.					
25		S-6	24-26	24	13	6 10 13 26	S-6: Medium dense, brown, fine to coarse SAND, little Silt, little Gravel, wet.					
30							End of exploration at 28.5 feet.	2 3 4		27.9		102.6
										28.5 P.	BEDROCK	102.0

**REMARKS**

1 - The ground surface elevation at this test boring was based on interpolation of topographic contours shown on the Figure 1 - Exploration Location Plan.  
 2 - Drilling difficulty increased at approximately 27 feet b.g.s.  
 3 - Possible bedrock or boulder encountered at 27.9 feet b.g.s., roller bit advanced to approximately 28.3 feet b.g.s.  
 4 - Borehole was backfilled with drill cuttings upon completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Exploration No.:**  
**B-2**



## **Appendix C – Laboratory Test Results**



195 Frances Avenue  
 Cranston RI, 02910  
 Phone: (401)-467-6454  
 Fax: (401)-467-2398  
[thielsch.com](http://thielsch.com)  
*Let's Build a Solid Foundation*

Client Information:  
 GZA GeoEnvironmental  
 Bedford, NH  
 PM: Mirsad Alihodzic  
 Assigned By: Mirsad Alihodzic  
 Collected By: Josh S.

Project Information:  
**Wolbach Road Culvert**  
**Sudbury, MA**  
 GZA Project Number: 04.0191170.00  
 Summary Page: 1 of 1  
 Report Date: 12.02.2020

**LABORATORY TESTING DATA SHEET, Report No.: 7420-L-177**

Boring No.	Sample No.	Depth (Ft)	Laboratory No.	Identification Tests								Proctor / CBR / Permeability Tests							Laboratory Log and Soil Description	
				As Received Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G <sub>s</sub>	Dry unit wt. pcf	Test Water Content %	$\gamma_d$ MAX (pcf) / $W_{opt}$ (%)	$\gamma_d$ MAX (pcf) / $W_{opt}$ (%) (Corr.)	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"		Permeability cm/sec
				D2216	D4318		D6913			D2974	D854			D1557						
B-1	S-2	4-6	20-S-3626	8.1			14.4	63.9	21.7											Brown f-m SAND, some Silt, little fine Gravel
B-1	S-4	14-16	20-S-3627	21.7			3.5	59.0	37.5											Brown f-c SAND and SILT, trace fine Gravel
B-2	S-3	9-11	20-S-3628	25.4			0.0	6.9	93.1											Gray CLAYEY SILT, trace f-m Sand
B-2	S-6	24-26	20-S-3629	9.8			30.1	52.1	17.8											Brown f-c SAND, some fine Gravel, little Silt

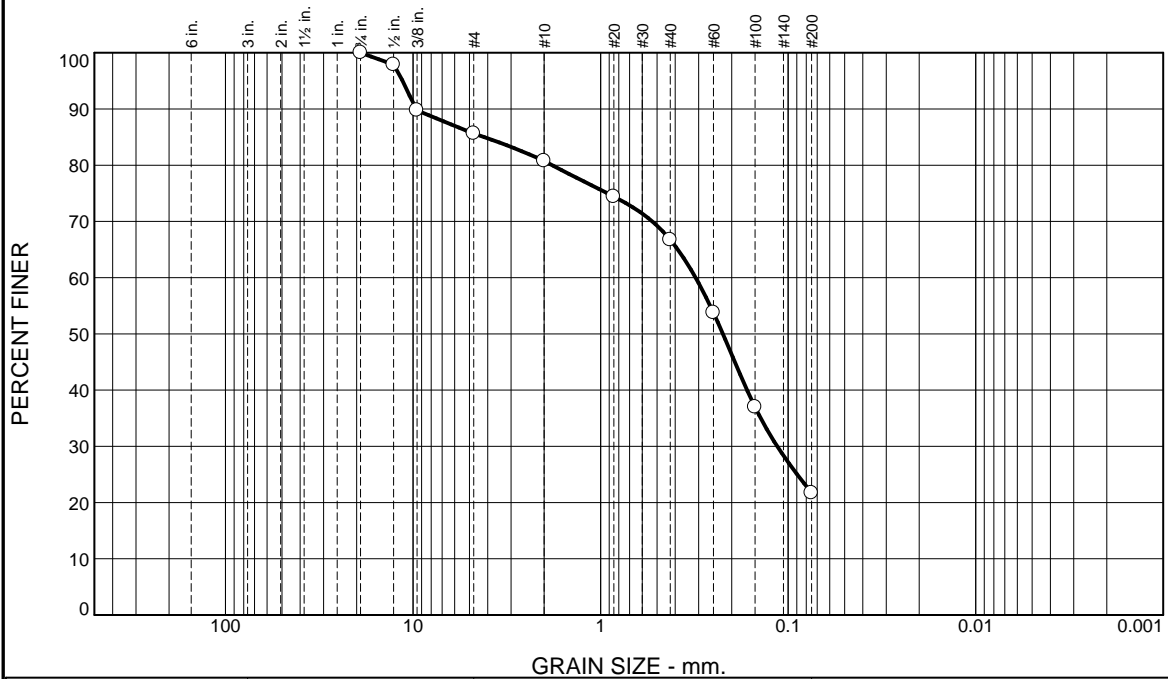
Date Received: 11.30.2020

Reviewed By: *SKW*

Date Reviewed: 12.04.2020

This report only relates to items inspect and/or tested. No warranty, expressed or implied, is made.  
 This report shall not be reproduced, except in full, without prior written approval from the Agency, as defined in ASTM E329.

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.4	4.8	14.1	45.0	21.7	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	97.9		
0.375"	89.8		
#4	85.6		
#10	80.8		
#20	74.4		
#40	66.7		
#60	53.7		
#100	37.0		
#200	21.7		

**Material Description**

Brown f-m SAND, some Silt, little fine Gravel

**Atterberg Limits (ASTM D 4318)**

PL= NP                      LL= NV                      PI= NP

**Classification**

USCS (D 2487)= SM                      AASHTO (M 145)= A-2-4(0)

**Coefficients**

D<sub>90</sub>= 9.6127                      D<sub>85</sub>= 4.1711                      D<sub>60</sub>= 0.3113  
D<sub>50</sub>= 0.2228                      D<sub>30</sub>= 0.1143                      D<sub>15</sub>=  
D<sub>10</sub>=                                      C<sub>u</sub>=                                      C<sub>c</sub>=

Remarks

---

Date Received: 11.30.2020      Date Tested: 12.02.2020

Tested By: JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

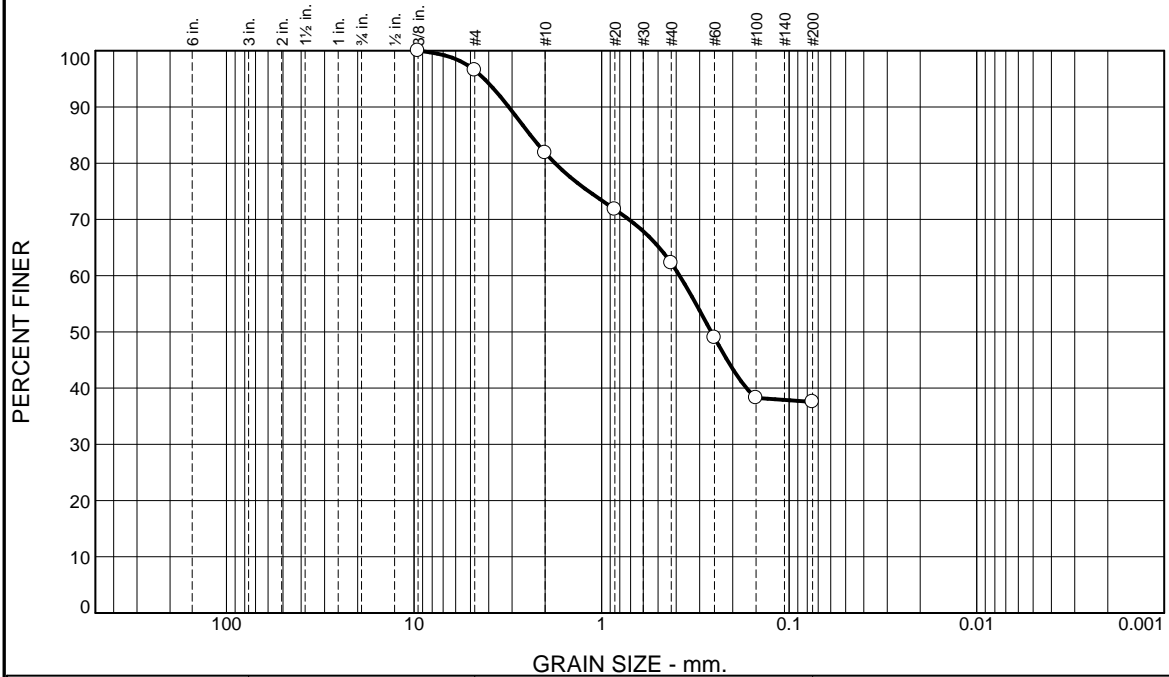
\* (no specification provided)

Source of Sample: Boring                      Depth: 4-6'  
Sample Number: B-1 / S-2

Date Sampled:

<b>Thielsch Engineering Inc.</b>	Client: GZA GeoEnvironmental
<b>Cranston, RI</b>	Project: Wolbach Road Culvert Sudbury, MA
	Project No: 04.0191170.00
	Figure 20-S-3626

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.5	14.6	19.7	24.7	37.5	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375"	100.0		
#4	96.5		
#10	81.9		
#20	71.8		
#40	62.2		
#60	49.0		
#100	38.3		
#200	37.5		

\* (no specification provided)

**Material Description**

Brown f-c SAND and SILT, trace fine Gravel

**Atterberg Limits (ASTM D 4318)**

PL= NP                      LL= NV                      PI= NP

**Classification**

USCS (D 2487)= SM                      AASHTO (M 145)= A-4(0)

**Coefficients**

D<sub>90</sub>= 3.1293                      D<sub>85</sub>= 2.3959                      D<sub>60</sub>= 0.3837  
D<sub>50</sub>= 0.2600                      D<sub>30</sub>=                                      D<sub>15</sub>=  
D<sub>10</sub>=                                      C<sub>u</sub>=                                      C<sub>c</sub>=

**Remarks**

Sample visually classified as non-plastic.

Date Received: 11.30.2020      Date Tested: 12.02.2020

Tested By: JM

Checked By: Steven Accetta

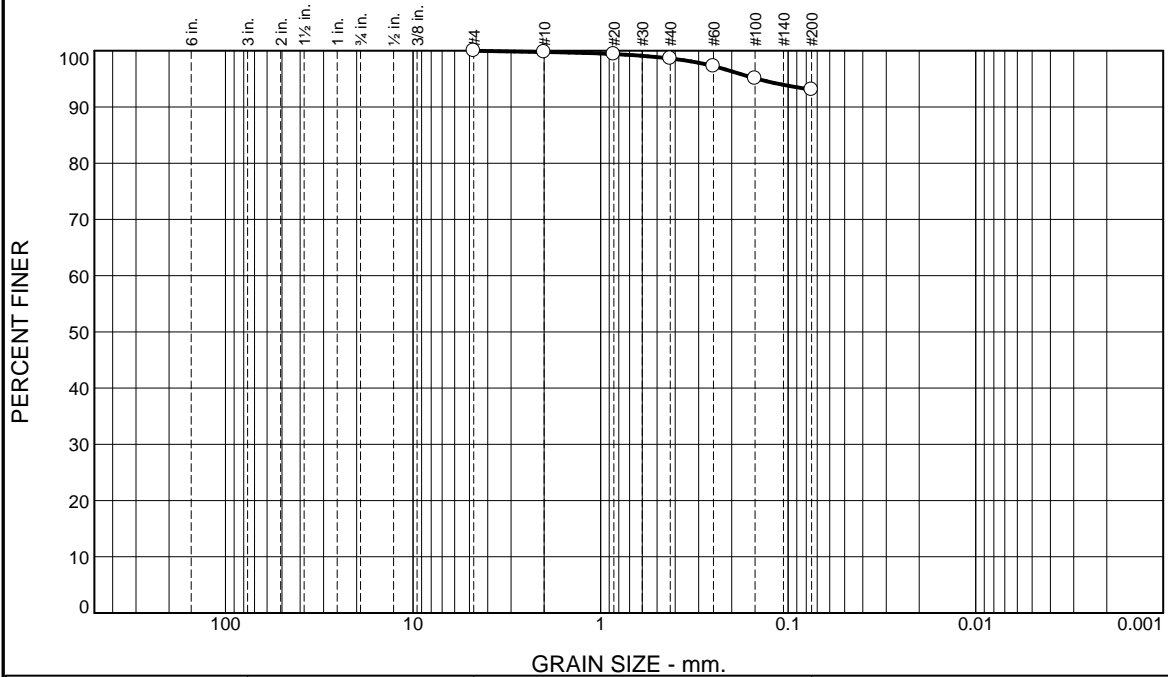
Title: Laboratory Coordinator

Source of Sample: Boring      Depth: 14-16'  
Sample Number: B-1 / S-4

Date Sampled:

<b>Thielsch Engineering Inc.</b>	Client: GZA GeoEnvironmental	
<b>Cranston, RI</b>	Project: Wolbach Road Culvert Sudbury, MA	
	Project No: 04.0191170.00	Figure 20-S-3627

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	1.2	5.5	93.1	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.8		
#20	99.4		
#40	98.6		
#60	97.3		
#100	95.1		
#200	93.1		

**Material Description**

Gray CLAYEY SILT, trace f-m Sand

**Atterberg Limits (ASTM D 4318)**

PL= \_\_\_\_\_ LL= \_\_\_\_\_ PI= \_\_\_\_\_

**Classification**

USCS (D 2487)= ML      AASHTO (M 145)= A-4(0)

**Coefficients**

D<sub>90</sub>= \_\_\_\_\_ D<sub>85</sub>= \_\_\_\_\_ D<sub>60</sub>= \_\_\_\_\_  
D<sub>50</sub>= \_\_\_\_\_ D<sub>30</sub>= \_\_\_\_\_ D<sub>15</sub>= \_\_\_\_\_  
D<sub>10</sub>= \_\_\_\_\_ C<sub>u</sub>= \_\_\_\_\_ C<sub>c</sub>= \_\_\_\_\_

**Remarks**

Sample visually classified as plastic. Sample rolled to 1/4".

Date Received: 11.30.2020      Date Tested: 12.02.2020

Tested By: JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

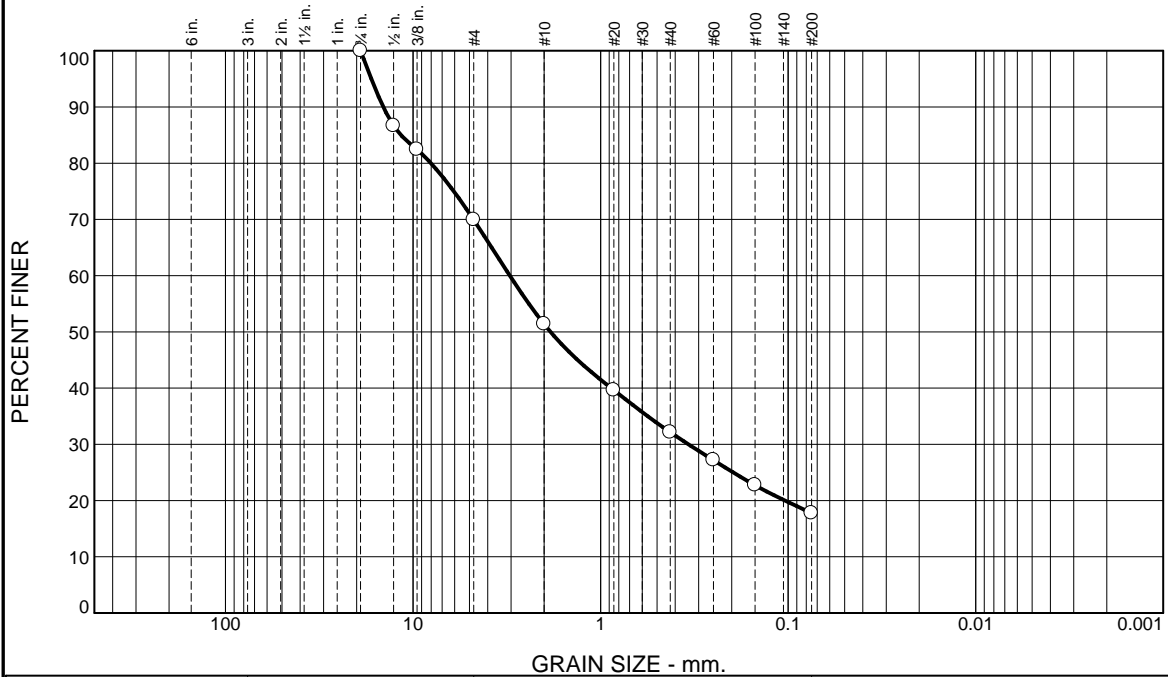
\* (no specification provided)

Source of Sample: Boring      Depth: 9-11'  
Sample Number: B-2 / S-3

Date Sampled: \_\_\_\_\_

<b>Thielsch Engineering Inc.</b>  <b>Cranston, RI</b>	<b>Client:</b> GZA GeoEnvironmental <b>Project:</b> Wolbach Road Culvert Sudbury, MA <b>Project No:</b> 04.0191170.00
<b>Figure</b> 20-S-3628	

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	30.1	18.5	19.3	14.3	17.8	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	86.7		
0.375"	82.4		
#4	69.9		
#10	51.4		
#20	39.6		
#40	32.1		
#60	27.2		
#100	22.7		
#200	17.8		

**Material Description**

Brown f-c SAND, some fine Gravel, little Silt

**Atterberg Limits (ASTM D 4318)**

PL= NP                      LL= NV                      PI= NP

**Classification**

USCS (D 2487)= SM                      AASHTO (M 145)= A-1-b

**Coefficients**

D<sub>90</sub>= 14.4145                      D<sub>85</sub>= 11.6060                      D<sub>60</sub>= 3.0480  
D<sub>50</sub>= 1.8489                      D<sub>30</sub>= 0.3400                      D<sub>15</sub>=  
D<sub>10</sub>=                      C<sub>u</sub>=                      C<sub>c</sub>=

Remarks

Date Received: 11.30.2020      Date Tested: 12.02.2020

Tested By: JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

\* (no specification provided)

Source of Sample: Boring      Depth: 24-26'  
Sample Number: B-2 / S-6

Date Sampled:

<b>Thielsch Engineering Inc.</b>	Client: GZA GeoEnvironmental
<b>Cranston, RI</b>	Project: Wolbach Road Culvert Sudbury, MA
	Project No: 04.0191170.00
	Figure 20-S-3629

## ATTACHMENT D: FEMA FIRMETTE

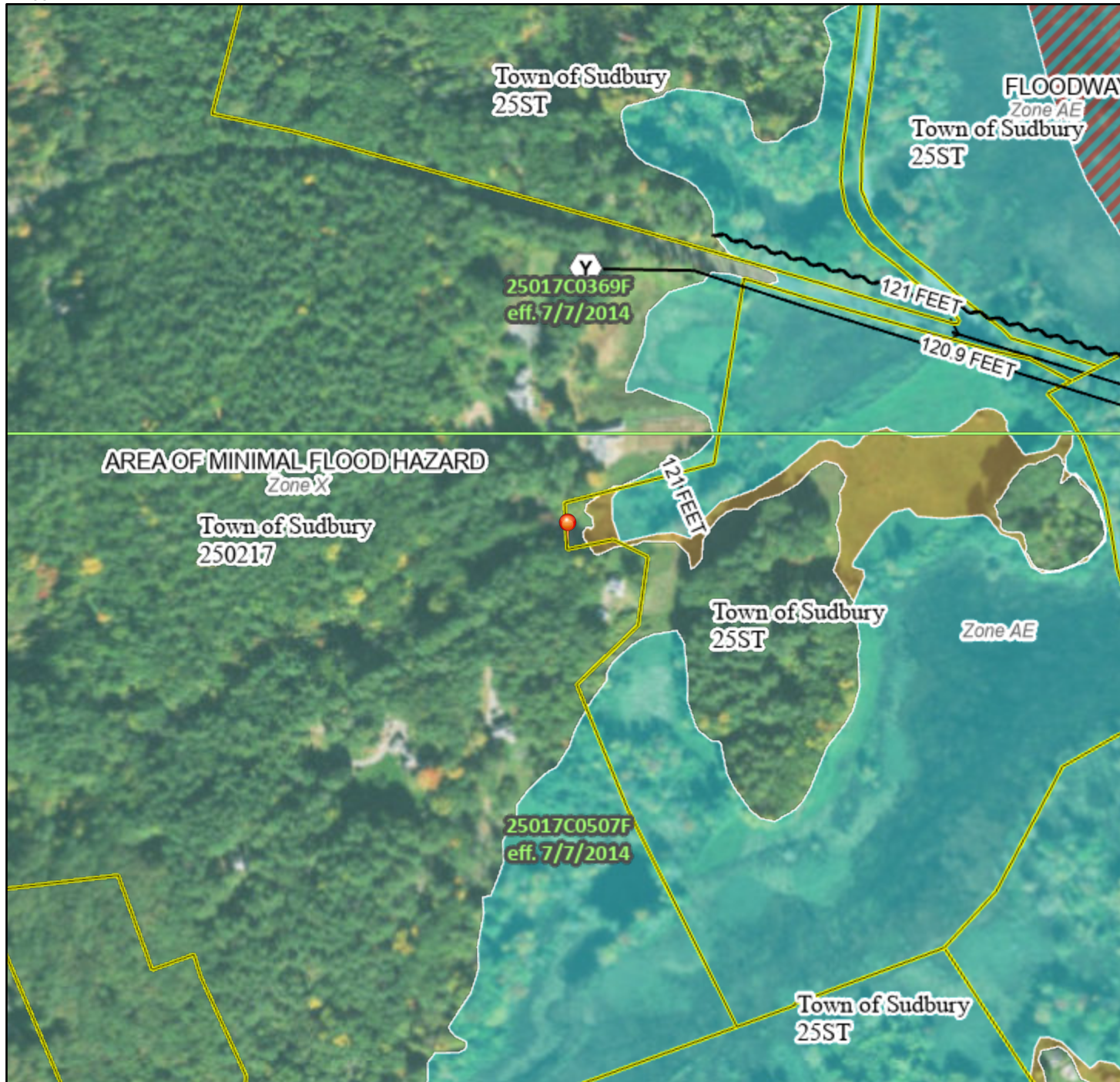




# National Flood Hazard Layer FIRMMette



71°23'51"W 42°22'41"N



Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

## Legend

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

<p><b>SPECIAL FLOOD HAZARD AREAS</b></p>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: cyan; border: 1px solid black; margin-right: 5px;"></span> Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: lightblue; border: 1px solid black; margin-right: 5px;"></span> With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, red 2px, red 4px); border: 1px solid black; margin-right: 5px;"></span> Regulatory Floodway</li> </ul>
<p><b>OTHER AREAS OF FLOOD HAZARD</b></p>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: orange; border: 1px solid black; margin-right: 5px;"></span> 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 <i>Zone X</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background: repeating-linear-gradient(-45deg, transparent, transparent 2px, gray 2px, gray 4px); border: 1px solid black; margin-right: 5px;"></span> Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, gray 2px, gray 4px); border: 1px solid black; margin-right: 5px;"></span> Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background: repeating-linear-gradient(-45deg, transparent, transparent 2px, gray 2px, gray 4px); border: 1px solid black; margin-right: 5px;"></span> Area with Flood Risk due to Levee <i>Zone D</i></li> </ul>
<p><b>OTHER AREAS</b></p>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: #f0f0f0; border: 1px solid black; margin-right: 5px;"></span> NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; border: 2px solid blue; margin-right: 5px;"></span> Effective LOMRs</li> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: #f0e68c; border: 1px solid black; margin-right: 5px;"></span> Area of Undetermined Flood Hazard <i>Zone D</i></li> </ul>
<p><b>GENERAL STRUCTURES</b></p>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 20px; border-bottom: 2px dashed black; margin-right: 5px;"></span> Channel, Culvert, or Storm Sewer</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px dashed gray; margin-right: 5px;"></span> Levee, Dike, or Floodwall</li> </ul>
<p><b>OTHER FEATURES</b></p>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid black; margin-right: 5px;"></span> <span style="font-size: 0.8em; vertical-align: middle;">B</span> 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px dashed black; margin-right: 5px;"></span> 17.5 Coastal Transect</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px dashed gray; margin-right: 5px;"></span> Base Flood Elevation Line (BFE)</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid red; margin-right: 5px;"></span> Limit of Study</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid yellow; margin-right: 5px;"></span> Jurisdiction Boundary</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px dashed black; margin-right: 5px;"></span> Coastal Transect Baseline</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid blue; margin-right: 5px;"></span> Profile Baseline</li> <li><span style="display: inline-block; width: 20px; border-bottom: 2px solid blue; margin-right: 5px;"></span> Hydrographic Feature</li> </ul>
<p><b>MAP PANELS</b></p>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; border: 1px solid black; background-color: #d4edda; margin-right: 5px;"></span> Digital Data Available</li> <li><span style="display: inline-block; width: 15px; height: 15px; border: 1px solid black; background-color: #fff3cd; margin-right: 5px;"></span> No Digital Data Available</li> <li><span style="display: inline-block; width: 15px; height: 15px; border: 1px solid black; background-color: #fff; margin-right: 5px;"></span> Unmapped</li> </ul>



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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **1/26/2021 at 5:41 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: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

## ATTACHMENT E: STREAMSTATS REPORT



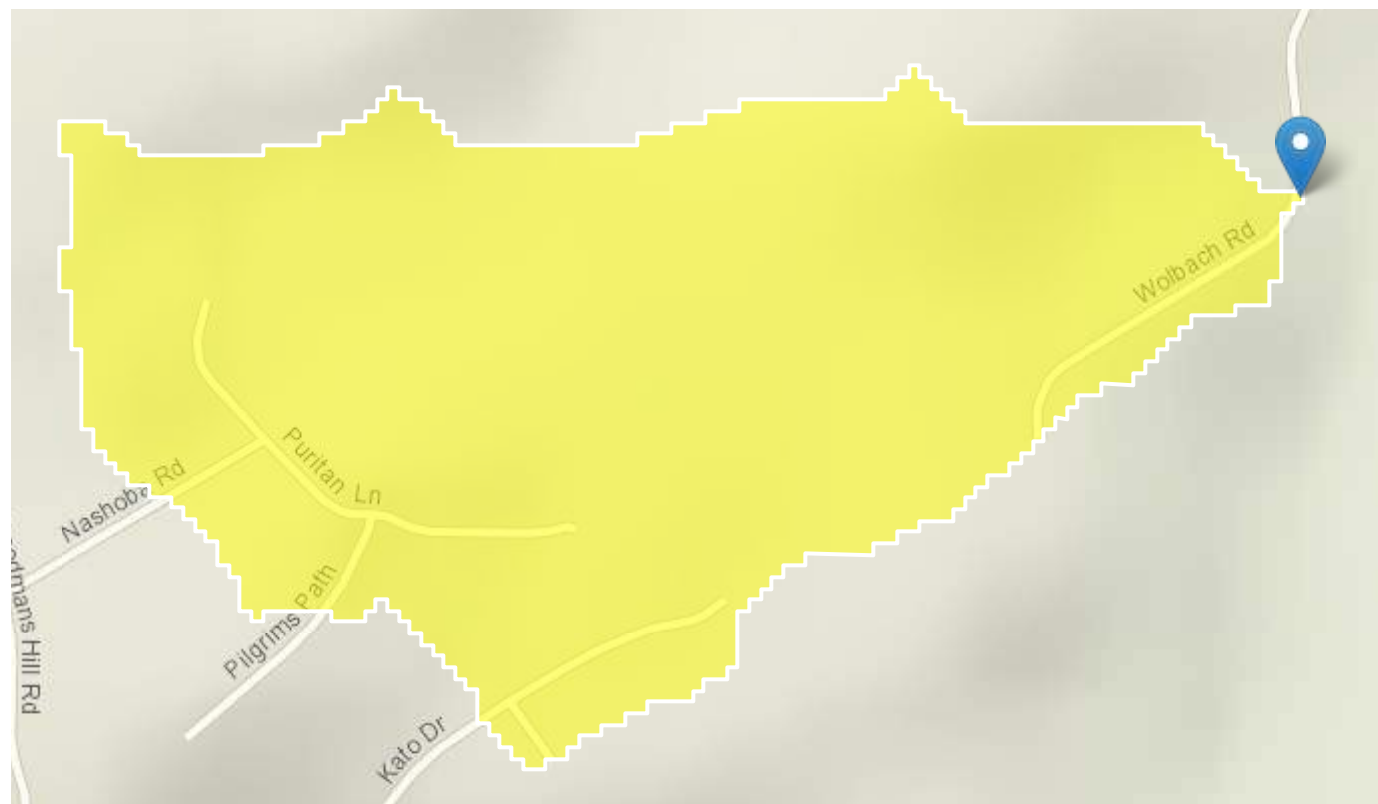
# Wolbach Rd Crossing - StreamStats Report

Region ID: MA

Workspace ID: MA20201206215638171000

Clicked Point (Latitude, Longitude): 42.37418, -71.39240

Time: 2020-12-06 16:56:53 -0500



## Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.15	square miles
ELEV	Mean Basin Elevation	270	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	0	percent
BSLDEM10M	Mean basin slope computed from 10 m DEM	9.887	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	0.73	percent
FOREST	Percentage of area covered by forest	53.59	percent

Parameter Code	Parameter Description	Value	Unit
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless

Peak-Flow Statistics Parameters<sup>[Peak Statewide 2016 5156]</sup>

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.15	square miles	0.16	512
ELEV	Mean Basin Elevation	270	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	0	percent	0	32.3

Peak-Flow Statistics Disclaimers<sup>[Peak Statewide 2016 5156]</sup>

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report<sup>[Peak Statewide 2016 5156]</sup>

Statistic	Value	Unit
2 Year Peak Flood	10.5	ft <sup>3</sup> /s
5 Year Peak Flood	17.9	ft <sup>3</sup> /s
10 Year Peak Flood	24	ft <sup>3</sup> /s
25 Year Peak Flood	33.1	ft <sup>3</sup> /s
50 Year Peak Flood	40.7	ft <sup>3</sup> /s
100 Year Peak Flood	48.9	ft <sup>3</sup> /s
200 Year Peak Flood	57.9	ft <sup>3</sup> /s
500 Year Peak Flood	71.1	ft <sup>3</sup> /s

*Peak-Flow Statistics Citations*

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (<https://dx.doi.org/10.3133/sir20165156>)

## Bankfull Statistics Parameters[Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.15	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	9.887	percent	2.2	23.9

## Bankfull Statistics Disclaimers[Bankfull Statewide SIR2013 5155]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

## Bankfull Statistics Flow Report[Bankfull Statewide SIR2013 5155]

Statistic	Value	Unit
Bankfull Width	7.55	ft
Bankfull Depth	0.575	ft
Bankfull Area	4.27	ft <sup>2</sup>
Bankfull Streamflow	11.4	ft <sup>3</sup> /s

*Bankfull Statistics Citations*

**Bent, G.C., and Waite, A.M., 2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (<http://pubs.usgs.gov/sir/2013/5155/>)**

## Probability Statistics Parameters[Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.15	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	0.73	percent	0	100
FOREST	Percent Forest	53.59	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

## Probability Statistics Flow Report[Perennial Flow Probability]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

<b>Statistic</b>	<b>Value</b>	<b>Unit</b>	<b>PC</b>
Probability Stream Flowing Perennially	0.424	dim	71

*Probability Statistics Citations*

**Bent, G.C., and Steeves, P.A., 2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006-5031, 107 p. ([http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR\\_2006-5031rev.pdf](http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf))**

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

USGS Software Disclaimer: This software has been approved for release by the U.S. Geological Survey (USGS). Although the software has been subjected to rigorous review, the USGS reserves the right to update the software as needed pursuant to further analysis and review. No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the software and related material nor shall the fact of release constitute any such warranty. Furthermore, the software is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.4.0

# ATTACHMENT F: CULVERT ANALYSIS REPORT



HEC-RAS Plan: PropWide River: River 1 Reach: Reach 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	404	10_pct_ac	24.00	129.98	131.14	131.14	131.42	0.010815	5.15	8.72	17.51	0.90
Reach 1	404	4_pct_ac	33.10	129.98	131.29	131.29	131.60	0.010622	5.62	11.73	20.86	0.91
Reach 1	404	2_pct_ac	40.70	129.98	131.40	131.40	131.73	0.010471	5.92	14.19	23.34	0.92
Reach 1	404	1_pct_ac	48.90	129.98	131.51	131.51	131.85	0.010441	6.23	16.70	25.62	0.93
Reach 1	359	10_pct_ac	24.00	126.73	127.79	127.79	128.09	0.019199	5.50	7.38	13.62	1.11
Reach 1	359	4_pct_ac	33.10	126.73	127.94	127.94	128.29	0.018273	6.06	9.58	15.30	1.12
Reach 1	359	2_pct_ac	40.70	126.73	128.06	128.06	128.43	0.017523	6.41	11.39	16.57	1.12
Reach 1	359	1_pct_ac	48.90	126.73	128.17	128.17	128.57	0.016874	6.74	13.30	17.80	1.12
Reach 1	313	10_pct_ac	24.00	124.19	125.06	125.06	125.26	0.016602	5.01	9.64	22.36	1.05
Reach 1	313	4_pct_ac	33.10	124.19	125.18	125.16	125.40	0.016007	5.44	12.32	23.70	1.05
Reach 1	313	2_pct_ac	40.70	124.19	125.24	125.24	125.51	0.017507	5.98	13.83	24.42	1.12
Reach 1	313	1_pct_ac	48.90	124.19	125.31	125.31	125.61	0.017568	6.32	15.74	25.20	1.13
Reach 1	281	10_pct_ac	24.00	123.73	124.52	124.52	124.75	0.014148	4.44	8.30	18.34	0.96
Reach 1	281	4_pct_ac	33.10	123.73	124.63	124.63	124.91	0.014320	4.97	10.50	19.97	1.00
Reach 1	281	2_pct_ac	40.70	123.73	124.89	124.89	125.07	0.007075	4.22	16.06	24.14	0.73
Reach 1	281	1_pct_ac	48.90	123.73	125.19	125.19	125.31	0.003607	3.58	24.12	29.31	0.55
Reach 1	249	10_pct_ac	24.00	123.30	124.33	124.33	124.37	0.001654	1.73	16.27	28.85	0.34
Reach 1	249	4_pct_ac	33.10	123.30	124.68	124.68	124.72	0.000805	1.54	27.97	37.11	0.25
Reach 1	249	2_pct_ac	40.70	123.30	124.95	124.95	124.98	0.000536	1.45	38.71	41.77	0.21
Reach 1	249	1_pct_ac	48.90	123.30	125.23	125.23	125.25	0.000390	1.39	51.06	47.99	0.19
Reach 1	224	10_pct_ac	24.00	122.68	124.24	123.61	124.32	0.001774	2.64	12.05	15.74	0.39
Reach 1	224	4_pct_ac	33.10	122.68	124.58	123.78	124.68	0.001549	2.85	15.49	18.05	0.38
Reach 1	224	2_pct_ac	40.70	122.68	124.84	123.91	124.95	0.001433	3.00	18.11	19.83	0.37
Reach 1	224	1_pct_ac	48.90	122.68	125.11	124.06	125.23	0.001339	3.15	20.77	21.10	0.36
Reach 1	210		Bridge									
Reach 1	193	10_pct_ac	24.00	122.39	123.59	123.59	123.95	0.014901	5.16	6.31	10.71	1.00
Reach 1	193	4_pct_ac	33.10	122.39	123.78	123.78	124.19	0.013593	5.65	8.41	11.87	0.99
Reach 1	193	2_pct_ac	40.70	122.39	123.91	123.91	124.37	0.013121	6.02	10.03	12.69	1.00
Reach 1	193	1_pct_ac	48.90	122.39	124.05	124.05	124.55	0.012386	6.32	11.84	13.49	0.99
Reach 1	148	10_pct_ac	24.00	122.09	122.47	122.45	122.55	0.029962	4.42	15.33	75.48	1.28
Reach 1	148	4_pct_ac	33.10	122.09	122.52	122.51	122.62	0.028709	4.78	20.27	91.31	1.29
Reach 1	148	2_pct_ac	40.70	122.09	122.56	122.56	122.66	0.027962	4.99	23.74	92.93	1.29
Reach 1	148	1_pct_ac	48.90	122.09	122.58	122.58	122.70	0.032892	5.55	25.52	93.75	1.40
Reach 1	93	10_pct_ac	24.00	120.23	120.52	120.52	120.59	0.042080	4.40	14.90	81.85	1.45
Reach 1	93	4_pct_ac	33.10	120.23	120.56	120.56	120.65	0.044744	4.93	18.02	82.54	1.53
Reach 1	93	2_pct_ac	40.70	120.23	120.58	120.58	120.69	0.046227	5.30	20.39	83.06	1.58
Reach 1	93	1_pct_ac	48.90	120.23	120.99	120.99	121.01	0.002859	2.20	55.73	92.58	0.45
Reach 1	5	10_pct_ac	24.00	117.45	119.00	118.02	119.00	0.000123	0.72	92.85	97.50	0.10
Reach 1	5	4_pct_ac	33.10	117.45	120.00	118.11	120.00	0.000025	0.45	225.49	154.98	0.05
Reach 1	5	2_pct_ac	40.70	117.45	120.50	118.15	120.50	0.000015	0.40	305.24	163.24	0.04
Reach 1	5	1_pct_ac	48.90	117.45	121.00	118.20	121.00	0.000010	0.37	388.33	168.70	0.03





## ATTACHMENT G: SEED MIX SPECIFICATIONS

## Attachment: Seed Specifications

### New England Conservation/Wildlife Mix

The New England Conservation/Wildlife Mix provides a permanent cover of grasses, forbs, wildflowers, legumes and grasses to provide both good erosion control and wildlife habitat value. This mix is designed to be a no maintenance seeding, and it is appropriate for cut and fill slopes, detention basins, and disturbed areas adjacent to commercial and residential projects.

**Application Rate:** 25 LBS/ACRE (1750 SQ. FT./LB)

**Price:** \$30.00/LB\*\*

**Species \*:** Big Bluestem (*Andropogon gerardii*), Switchgrass (*Panicum virgatum*), Little Bluestem (*Schizachyrium scoparium*), Canada Wild Rye (*Elymus canadensis*), Fox Sedge (*Carex vulpinoidea*), Partridge Pea (*Chamaecrista fasciculata*), Fringed Bromegrass (*Bromus ciliatus*), Pennsylvania Smartweed (*Polygonum pennsylvanicum*), Common Milkweed (*Asclepias syriaca*), Showy Tick-Trefoil (*Desmodium canadense*), New England Aster (*Aster novae-angliae*), Flat-top Aster (*Aster umbellatus*), Nodding Bur-Marigold (*Bidens cernua*).

### New England Erosion Control/Restoration Mix for Detention Basins and Moist Sites

The New England Erosion Control/Restoration Mix contains a selection of native grasses and wildflowers designed to colonize generally moist, recently disturbed sites where quick growth of vegetation is desired to stabilize the soil surface. It is an excellent seed mix for ecologically appropriate restorations on moist sites that require quick stabilization as well as long-term establishment of native vegetation. This mix is particularly appropriate for detention basins that do not normally hold standing water. The plants in this mix can tolerate infrequent inundation, but not constant flooding.

**Seeding:** The mix may be applied by hydroseeding, by mechanical spreader, or on small sites it can be spread by hand. When applying on bare soil, rake the soil to create grooves, apply seed, then lightly rake over. In New England, the best results are obtained with a Spring or early Fall seeding. Summer and late Fall seeding will benefit with a light mulching of weed-free straw to conserve moisture. Late Fall and Winter dormant seeding require a slight increase in the seeding rate. Fertilization is not required unless the soils are particularly infertile.

**Application Rate:** 35 LBS/ACRE (1250 SQ. FT./LB.)

**Price:** \$26.00/LB\*\*

**Species \*:** Switchgrass (*Panicum virgatum*), Virginia Wild Rye (*Elymus virginicus*), Creeping Red Fescue (*Festuca rubra*), Fox Sedge (*Carex vulpinoidea*), Creeping Bentgrass (*Agrostis stolonifera*), Soft Rush (*Juncus effusus*), New England Aster (*Aster novae-angliae*), Grass-leaved Goldenrod (*Euthamia graminifolia*), Nodding Bur Marigold (*Bidens cernua*), Green Bulrush (*Scirpus atrovirens*), Joe-Pye Weed (*Eupatorium maculatum*), Boneset (*Eupatorium perfoliatum*), Blue Vervain (*Verbena hastata*).