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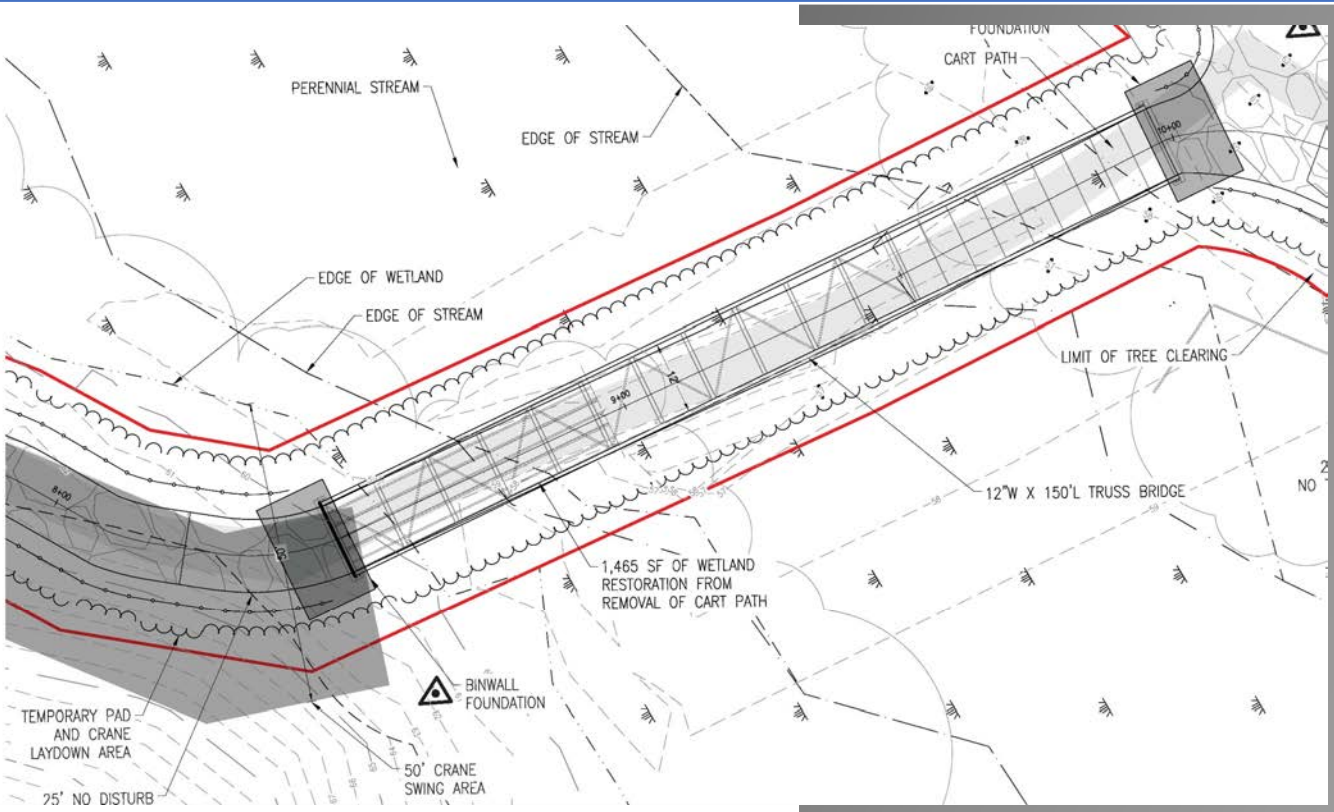
ENGINEERING | EXPLORATION | EXPERIENCE

Geotechnical Report

Proposed Utility Maintenance Bridge
136 Main Street, Newbury, Massachusetts



Client

Waterstone Engineering
9 Gretas Way
Stratham, New Hampshire 03885

Project #21410
Date: 10/26/2022

SUMMIT
GEOENGINEERING SERVICES

210 Maine Avenue, Farmingdale, ME 04344
www.summitgeoeng.com

October 26, 2021
SGS #21410

Robert Roseen
Waterstone Engineering
9 Gretas Way
Stratham, New Hampshire 03885

Reference: Geotechnical Investigation, Proposed Contech Bridge Foundation
135 Main Street, Newbury, Massachusetts

Dear Robert;

Summit Geoengineering Services, Inc. (SGS) has completed a geotechnical investigation for the construction of the proposed bridge at the site referenced above. Our scope of services included the observation of two test pits, laboratory testing, and the preparation of this geotechnical report summarizing our findings and providing geotechnical recommendations.

1.0 Project Description

The project consists of a new steel bridge with dimensions 12 feet by 150 feet. The bridge will span over and existing wetland. The proposed deck elevation is 63.3 feet. The existing high water is at or near elevation 57 feet. Preliminary plans indicate the bridge abutments will consist of "ell" shaped foundations constructed on top of a bin wall structure. The south abutment approach will be at or near the existing ground surface. Up to 4 feet of fill will be required to construct the approach at the north abutment.

Existing and proposed conditions were referenced from a plan entitled "Notice of Intent and Special Permit Modification, 140 R Main Street, Newbury, MA" dated August 30, 2022, provided by Waterstone Engineering.

2.0 Explorations and Laboratory Testing

2.1 Explorations

Summit Geoengineering Services (SGS) observed the subsurface conditions on October 11, 2022 with the excavation of two test pits. The test pits were completed by Wilkinson Septic using a rubber tracked excavator. Test pits were excavated to depths ranging from 4.5 feet (approximately elevation 55.5 feet) to 5 feet (approximately elevation 53 feet). Soils were visually classified (*ASTM D2488*) and layering was determined from the ground surface using a measuring tape. Each test pit was backfilled after completion.

The exploration locations were determined by SGS the day of the explorations. An exploration location plan and the exploration logs are included in *Appendix A* and *Appendix B*, respectively.

2.2 Laboratory Testing

A grain size analysis (ASTM D6913) was performed on a sample taken at a depth of 4 feet (elevation 56 ft +/-) at the TP-1 location. This test resulted in a composition of 53% gravel, 29% sand, and 18% silt. Detailed results are included in *Appendix C*.

3.0 Subsurface Conditions

The soil at the site consisted of olive-gray fine gravelly sand to sandy gravel. This native soil had frequent cobbles and boulders and was very dense. Based on the gain size analysis, this soil is classified as GM. The moisture content on the sample tested was 7.2%.

No groundwater was observed in the test pits.

Refusal, presumed to be bedrock, was encountered at a depth of 5 feet (elevation 53 feet +/-) at the TP-2 location. Refusal, likely on boulders, was encountered at a depth of 4.5 feet (elevation 55.5 feet +/-).

4.0 Geotechnical Evaluations

Based on the data collected during the field explorations, laboratory testing, and subsequent analyses using the information provided to us, the bridge can be supported on the native soil using the standard “Contech” ell shaped abutments. The abutments would be placed on ¾ inch crushed stone placed on the proof-rolled native soil. Due to the competency of the soil and relative elevations of the abutment base elevation and existing and finished grades, a bin wall structure will not be necessary.

Excavation into the native soils will be difficult with cobbles and boulders frequent. Some additional crushed stone may be necessary to fill voids remaining after the removal of boulders. Based on the refusal elevation encountered at the TP-2 location, bedrock is not anticipated to be encountered above the foundation subgrade elevation.

Given the site conditions scour will not be an issue for the bridge abutment foundations.

5.0 Geotechnical Recommendations

The sections below provide design and construction recommendations for the geotechnical aspects of the proposed bridge. The following recommendations as discussed below:

- Top of bridge deck = EL 63.3 ft.

- Bottom of abutment foundation = EL 56 ft.
- Grade line on front of foundation = EL 59 to EL 60.

If the proposed grades, bridge span, or any other significant component of the project change from the time of submission of this report, Summit Geoengineering Services (SGS) should be notified so we can evaluate the impacts on the recommendations below to determine if changes are needed.

5.1 Allowable Bearing Pressure and Subgrade Preparation

We recommend an allowable bearing pressure of 5,000 psf be used for design of the abutments. This allowable bearing pressure is based on the following foundation subgrade preparation.

- Excavate to a minimum depth of 8 inches below the bottom of the abutment. Remove boulders present above the bottom of the excavation. Any voids remaining after the removal of the boulders should be fill with ¾ inch crushed stone.

- Proof roll the exposed soil by making a minimum of 4 passes using a vibratory plate compactor with a minimum operating weight of 800 pounds.

- Place a minimum of 8 inches of ¾-inch crushed stone (CS) directly on the proof rolled subgrade soil. CS should be compacted to lock the particles together. The abutments can be constructed directly on the CS.

- In no case shall footings be constructed in standing water or frozen soil.

The gradation requirements for CS can be found in *Section 6.2*.

5.2 Frost Protection

The design air freezing index for the Newbury Massachusetts area is 665 degree Fahrenheit days. Based on tis and the composition of the existing soil, the 10 year return period frost penetration depth is 3 feet. Based on this, we recommend that the foundations be constructed at a minimum depth of 3 feet below the finish grade in front of the abutment. The 8 inches of ¾ inch crushed stone can be included in the 3 foot frost protection depth.

Based on the grain size analysis, the existing soil contains too high of a fines content to be considered non-frost susceptible. We recommend that the abutments be backfilled with Gravel Borrow meeting the requirements of the MassDOT Table M1.03.0-1, Type b.

5.3 Groundwater Control

Groundwater was not observed in the test pits and is not anticipated to be encountered in the abutment excavations. Underdrains are not strictly necessary, however, it is generally good practice to install underdrains behind the abutment foundations to control infiltration of rainfall adjacent to foundations.

Underdrains, if used, should consist of 4-inch rigid PVC or flexible ADS pipe surrounded by 6 inches of ¾-inch crushed stone (CS) which is then surrounded by Mirafi 140N or equivalent. Underdrains should be outlet to a free draining location. Where exposed at the ground surface, a screen or other device should be placed over the outlet to prevent the migration of animals into the underdrain system.

6.0 Earthwork Considerations

6.1 Earthwork for Construction

To the extent possible, construction should occur during periods of dry weather to minimize disturbance to excavated subgrade areas. If excavations and construction occur during wet periods, the contractor should employ the necessary measures to eliminate disturbance to the subgrade from heavy rainfall, surface water runoff, freeze/thaw softening, or any other potential weather-related cause of subgrade disturbance.

Excavation of cobbles and boulders is anticipated. Any voids remaining below the bottom of the CS layer should be filled with CS us to 8 inches below the bottom of the foundation.

Groundwater is not anticipated to be encountered during construction of the foundations.

6.2 Materials

The following table presents the recommended grain sizes for the materials to be used at the site:

GRADATION REQUIREMENTS FOR SITE MATERIALS		
Sieve Size	**[1] Crushed Stone (CS)**	**[2] Gravel Borrow (GB)**
4 Inch	---	---
3 Inch	---	100
2 Inch	---	---
1 Inch	100	---
¾ Inch	90 – 100	---
½ Inch	10 – 50	50 - 85
⅜ Inch	0 – 20	---
¼ Inch	---	---
No. 4	0 – 5	40 - 75
No. 50	---	8 – 28
No. 200	---	0 – 10
Maximum Particle Size	1”	3”

[1]Mass DOT Specification M2.01.0-1, Crushed Stone
[2]Mass DOT Specification M1.03.0-1, Gravel Borrow, Type b

Refer to the pertinent report sections for placement and compaction recommendations.

The existing native soil at the site can be used in all areas outside the abutment foundations. Larger cobbles and boulders should be removed to facilitate placement and compaction.

7.0 Closure

Our recommendations are based on professional judgment, generally accepted principles of geotechnical engineering and project information provided by others. Some changes in subsurface conditions from those presented in this report may occur. Should the subsurface conditions, finish grades, or foundation loadings differ materially from those described in this report, SGS should be notified so that we can re-evaluate our recommendations.

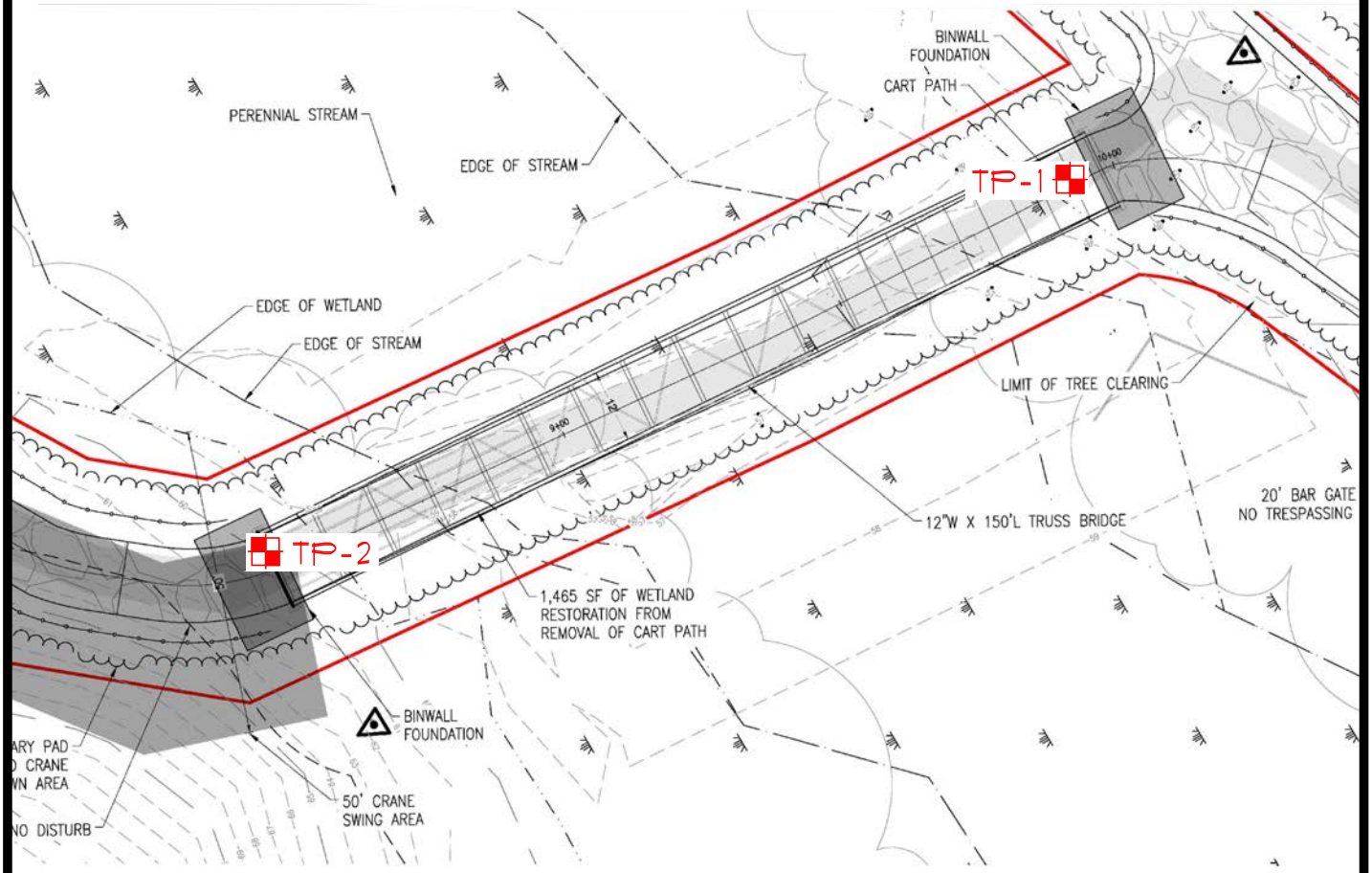
We appreciate the opportunity to serve you during this phase of your project. If there are any questions or if additional information is required, please do not hesitate to contact us.

Sincerely,
Summit Geoengineering Services, Inc.

William M. Peterlein, P.E.
President & Principal Engineer

Appendix A

Figures



NORTH

LEGEND

TP-1 TEST PIT OBSERVED BY SUMMIT (OCTOBER 11, 2022)

PLAN REFERENCE

"WETLAND CROSSING PLAN AND DETAIL", REVISION DATED AUGUST 30, 2022, PREPARED BY WATERSTONE ENGINEERING.

TEST PIT LOCATION PLAN
UTILITY MAINTENANCE BRIDGE

140R MAIN STREET - NEWBURY, MASSACHUSETTS

PREPARED FOR

WATERSTONE ENGINEERING

DATE: 10-19-2022	DRAWN BY: KRF	CHECKED BY: WMP
JOB: 21410	SCALE: 1" = 30'	FILE: 21410 TP

OFFICE: 210 MAINE AVENUE
FARMINGDALE, MAINE
TEL.: (207) 588-7579

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GARDINER, ME 04345

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Appendix B

Exploration Logs

SUMMIT GEOENGINEERING SERVICES	TEST PIT LOG	Test Pit # TP-1
	Project: Utility Maintenance Bridge 136 Main Street Newbury, MA	Project #: 21410 Groundwater: None Observed
Contractor: Wilkinson Septic	Ground Surface Elevation: 60 ft +/-	
Equipment: Rubber Tracked Excavator	Reference: Exist Conditions Plan, South Wetland, REV 8/30/22	
Summit Staff: B. Peterlein, P.E.	Date: 10/11/2022	Weather: Sunny

Depth (ft)	DESCRIPTION	
	ENGINEERING	**GEOLOGIC/GENERAL**
1	Dark brown SILT, little Sand, trace rootlets, few cobbles and boulders, dry, ML	FOREST DUFF/TOPSOIL
2	Olive-gray fine Gravelly SAND to Sandy GRAVEL, little Silt, Cobbles and Boulders, compact, moist, SM or GM	NATIVE SOIL
3		
4	Very difficult excavating	
5	End of Test Pit at 4.5 feet on dense soil with boulders	BOULDERS
6		
7	Note: See Grain Size Analysis	
8		
9		
10		
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12		
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14		
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16		
17		

SUMMIT GEOENGINEERING SERVICES	**TEST PIT LOG**	Test Pit # **TP-2**
	Project: Utility Maintenance Bridge 136 Main Street Newbury, MA	Project #: 21410 Groundwater: None Observed
Contractor: Wilkinson Septic	Ground Surface Elevation: 58 ft +/-	
Equipment: Rubber Tracked Excavator	Reference: Exist Conditions Plan, South Wetland, REV 8/30/22	
Summit Staff: B. Peterlein, P.E.	Date: 10/11/2022	Weather: Sunny

Depth (ft)	DESCRIPTION	
	ENGINEERING	**GEOLOGIC/GENERAL**
1	Dark brown SILT, little Sand, trace rootlets, few cobbles and boulders, dry, ML	FOREST DUFF/TOPSOIL
2	Olive-brown SILT, trace fine Sand, dry, loose, ML	NATIVE SOIL
3	Olive-gray fine Gravelly SAND to Sandy GRAVEL, little Silt, Cobbles and Boulders, compact, moist,SM or GM	
4		
5	Very difficult excavating. Large boulder at 3.5 ft	
6	End of Test Pit at 5 feet on boulders and bedrock	BOULDERS or BEDROCK
7		
8		
9	Note: Refusal on bedrock appears to range from 3.5 to 5 feet below the existing ground surface	
10		
11		
12		
13		
14		
15		
16		
17		

Appendix C

Laboratory Results

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GRAIN SIZE ANALYSIS - ASTM D6913

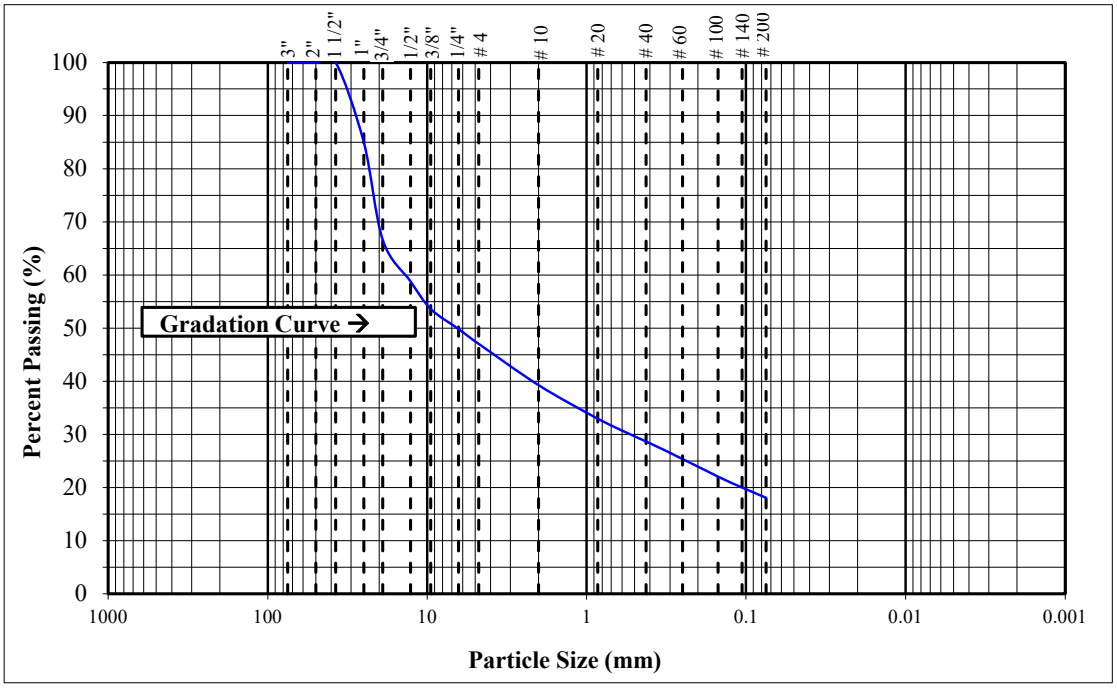
PROJECT NAME:	Utility Access Bridge	PROJECT #:	21410
PROJECT LOCATION:	136 Main Street, Newbury, MA	EXPLORATION #:	TP-1
CLIENT:	Waterstone	SAMPLE #:	S-1
TECHNICIAN:	Colleen Sullivan, E.I.	SAMPLE DEPTH:	4'
SOIL DESCRIPTION:	GRAVEL, some Sand & Silt, GM	TEST DATE:	10/12/2022

TEST PROCEDURE

Sample Source: Test Pit	**Sieve Stack:** Composite	**Specimen Procedure:** Moist
Test Method: Method A	**Separating Sieve(s):** 3/8 Inch	**Dispersion Type:** (NaPO3)6 Solution

DATA

STANDARD SIEVE DESIGNATION (mm)	ALTERNATIVE SIEVE DESIGNATION (in)	PERCENT PASSING (%)
75	(3 in)	100
50	(2 in)	100
37.5	(1-1/2 in)	100
25.0	(1 in)	85
19.0	(3/4 in)	67
12.7	(1/2 in)	59
9.5	(3/8 in)	54
6.35	(1/4 in)	50
4.75	(No. 4)	47
2.00	(No. 10)	39
0.850	(No. 20)	33
0.425	(No. 40)	29
0.250	(No. 60)	25
0.150	(No. 100)	22
0.106	(No. 140)	20
0.075	(No. 200)	18



REMARKS: Moisture Content = 7.2%

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