

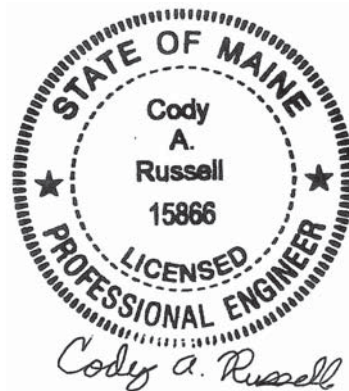
**MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE**

GEOTECHNICAL DESIGN REPORT

For the Replacement of:

**LARGE CULVERT #146244
PORT ROAD
MACHIASPORT, MAINE**

Prepared by:
Cody Russell, P.E.
Geotechnical Engineer



Reviewed by:
Kathleen Maguire, P.E.
Senior Geotechnical Engineer

Washington County
WIN 18834.00

Soils Report 2020-18
May 18, 2020

PROJECT DETAILS

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical design and construction recommendations for the replacement of an existing large culvert (#146244) consisting of twin 71-foot and 82-foot long, 36-inch diameter corrugated metal pipes (CMPs) on Port Road in Machiasport. The existing CMPs are in poor condition, with the end of one separated and filling with sediment and the other unzipped. The culvert is located approximately 0.4 of a mile northerly of Base Road as shown on the attached Location Map. Port Road is a Highway Corridor Priority 4 road.

The proposed replacement structure will be a 116-foot long, 96-inch diameter CMP culvert on a 20-degree skew to the roadway centerline. The invert of the proposed culvert is approximately 16 feet below the existing road grade at the roadway centerline. To facilitate fish passage, Habitat Connectivity Design elements will be used inside the CMP culvert as shown on the Special Details sheets in the Plans. The roadway embankment slopes at the proposed culvert inlet and outlet shall be no steeper than 2H:1V to protect against erosion.

SUBSURFACE INVESTIGATION

One (1) boring (HB-MACH-101) and one (1) probe (HB-MACH-102) were drilled for this project on January 12, 2016 by Northern Test Boring (NTB) of Gorham, Maine using a track mounted drill rig. Exploration locations are shown on the attached Boring Location Plan & Interpretive Subsurface Profile with Boring Logs. Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are shown on the attached boring logs.

Boring HB-MACH-101 was drilled using hollow stem auger drilling techniques. Soil samples were obtained at 5-foot intervals using Standard Penetration Test (SPT) methods. The NTB drill rig is equipped with an automatic hammer to drive the split spoon. The NTB calibrated automatic hammer delivers approximately 47 percent more energy during driving than the standard rope and cathead system. All N-values discussed in this report are corrected values (N_{60}) computed by applying an average energy transfer factor of 0.879 to the raw field N-values. Probe HB-MACH-102 was drilled using solid stem auger techniques. No soils samples were obtained in the probe.

The MaineDOT Geotechnical Team member selected the boring and probe locations, drilling methods, designated type and depth of sampling, reviewed field logs for accuracy and identified field and laboratory testing requirements. A NorthEast Transportation Training and Certification (NETTCP) certified Subsurface Investigator logged the subsurface conditions encountered. The borings were located in the field by taping to surveyed site features after completion of the drilling program.

LABORATORY TESTING

A laboratory testing program was conducted to assist in soil classification, evaluation of engineering properties of the soils and geologic assessment of the project site. Laboratory testing consisted of three (3) standard grain size analyses with natural water content and three (3) grain size analyses with hydrometer and natural water content. The results of the laboratory testing

program are discussed in the following section and are shown on the attached boring logs, Laboratory Testing Summary Sheet and Grain Size Distribution Curves

SUBSURFACE CONDITIONS

Subsurface conditions encountered at the test boring generally consisted of fill underlain by layers of native silt, sand, and silty clay. An interpretive subsurface profile depicting the generalized soil stratigraphy at the boring location is shown on the attached Boring Location Plan & Interpretive Subsurface Profile with Boring Logs.

Boring HB-MACH-101 was drilled to a depth of approximately 27.0 feet below ground surface (bgs) and did not encounter a refusal surface. Probe HB-MACH-102 was drilled to a depth of approximately 26.0 feet bgs and did not encounter a refusal surface.

The table below summarizes the field and laboratory information obtained in boring HB-MACH-101:

Approx. Depth BGS ¹ (feet)	Soil Description	AASHTO ² Classification	USCS ³	WC% ⁴
0.0 – 0.2	Pavement			
0.2– 15.5	Fill: Brown, damp to wet, fine to coarse sand, some gravel, trace to little silt.	A-1-b	SW-SM or SW	4.5 to 10.8
15.5 – 18.0	Dark brown, wet, organic silt, little fine to coarse sand, trace gravel, wood.	A-4	ML	28.8
18.0 – 23.5	Grey, wet, fine to coarse sand, little clay, little silt, trace gravel.	A-2-4	SC-SM	15.5
23.5 – 27.0	Grey, wet, silty clay, trace fine to coarse sand, trace gravel.	A-7-6	CL	21.7

¹BGS = below ground surface

²AASHTO = American Association of State Highway and Transportation Officials

³USCS = Unified Soil Classification System

⁴WC% = Water content in percent

Three (3) corrected N-values obtained in the fill ranged from 6 to 15 blows per foot (bpf), indicating that the fill is loose to medium dense in consistency. One (1) corrected N-values obtained in the silt was 6 bpf, indicating that the silt is medium stiff in consistency. One corrected N-value obtained in the native sand was 21 bpf, indicating that the native sand is medium dense in consistency. One (1) corrected N-value obtained in the silty clay was 25 bpf, indicating that the silty clay is very stiff in consistency.

Groundwater was not recorded in the boring or probe. Groundwater levels can be expected to fluctuate subject to seasonal variations, local soil conditions, topography, precipitation, and construction activity.

GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

CMP Option III Culvert Construction – The proposed replacement structure will be a 116-foot long, 96-inch diameter Corrugated Metal Pipe (CMP) Option III culvert on a 20-degree skew to the roadway centerline. The proposed CMP culvert shall be furnished and installed in accordance with MaineDOT Standard Specification 603.

The invert of the proposed culvert pipe ranges from approximately 15.0 feet at the inlet end to approximately 13.4 feet at the outlet end with a 1.41% slope. To facilitate fish passage, Habitat Connectivity Design elements will be used inside the CMP culvert as shown on the Special Details sheets in the Plans

The proposed structure shall be bedded on a 2-foot thick, geotextile wrapped, geogrid reinforced, crushed stone mat (Underdrain Backfill Material, Type C; Pay Item 203.55, see Special Provision 203, attached). The geogrid reinforcement shall meet the requirements of Special Provision 620, attached. The Reinforcement Geotextile shall meet the requirements of MaineDOT Standard Specification 722.01. The soils at the bedding elevation shall be excavated using a smooth-edged backhoe bucket to limit disturbance. Any disturbed soils at the bedding elevation resulting from excavation activities shall be removed by hand prior to placement of the geotextile wrapped, geogrid reinforced, crushed stone mat. All subgrade surfaces should be protected from construction traffic in order to limit disturbance. Groundwater and surface water levels shall be depressed sufficiently to allow work in the dry.

The soil envelope and backfill shall consist of Granular Borrow (703.19) with a maximum particle size of 4 inches. The Granular Borrow backfill material shall be placed in lifts of 6 to 8 inches loose measure and compacted to the manufacturer's specifications or, in the absence of manufacturer's specifications, to at least 92 percent of the AASHTO T-180 maximum dry density. In no case shall the backfill soil be compacted less than 92 percent of the AASHTO T-180 maximum dry density.

Settlement – No settlement issues are anticipated at the site. No changes to the existing vertical or horizontal alignment are currently planned for this project. The proposed CMP Option III culvert is larger in diameter than the existing culverts and will result in a net unloading of the site soils at the structure location. Any settlement due to elastic compression of the bedding material will be immediate and negligible.

Scour and Riprap – Both the inlet and outlet of the CMP Option III culvert pipe shall be protected against scour with riprap conforming to MaineDOT Standard Specification Section 703.26 Plain and Hand Laid Riprap. Slopes shall be no steeper than 2H:1V. No specific scour protection recommendations are needed other than armoring with riprap. The riprap on the slopes shall be underlain by a non-woven, Class 1 Erosion Control Geotextile meeting the requirements of MaineDOT Standard Specification 722.03 that is underlain by a 1-foot layer of protective aggregate cushion consisting of Granular Borrow Material for Underwater Backfill (703.19). The toe of the riprap sections shall be keyed into the existing soils 1 foot below the streambed elevation.

Construction Considerations – Construction activities will include construction of cofferdams and earth support systems to control stream flow during construction. Construction activities will also include common earth excavation. Construction of the proposed CMP Option III culvert will require deep soil excavation. Earth support systems shall be implemented if laying back slopes is not feasible. It is likely that the use of complex (four-sided) braced excavations with dewatering will be necessary due to the depth of the excavation. If this is the case, adequate embedment into firm soils underlying the native silty clay and silt will be necessary to allow for the excavation and maintenance of a stable excavation bottom. All earth support systems shall be designed by a Professional Engineer licensed in the State of Maine. Regardless of the method of excavation, all excavations and earth support systems shall meet all applicable OSHA regulations.

The soils at the bedding elevation shall be excavated using a smooth-edged backhoe bucket to limit disturbance. Any disturbed soils at the bedding elevation resulting from excavation activities shall be removed by hand prior to placement of the geotextile wrapped, geogrid reinforced, crushed stone mat. All subgrade surfaces should be protected from construction traffic in order to limit disturbance. Groundwater and surface water levels shall be depressed sufficiently to allow work in the dry.

The Contractor shall control groundwater and surface water infiltration using temporary ditches, sumps, granular drainage blankets, stone ditch protection or hand-laid riprap with geotextile underlayment to divert groundwater and surface water as needed to maintain a stable excavation and allow work in the dry.

Using the excavated native soils as backfill around the culvert shall not be permitted. The native soils may only be used as Common Borrow in accordance with MaineDOT Standard Specifications 203 and 703.

The Contractor will have to excavate the existing subbase and subgrade fill soils in the vicinity of the culvert. These materials should not be used to re-base the roadway. Excavated subbase sand and gravel may be used as fill below roadway subgrade level in fill areas provided all other requirements of MaineDOT Standard Specifications 203 and 703 are met.

CLOSURE

This report has been prepared for the use of the MaineDOT Highway Program for specific application to the proposed replacement of large culvert (#146244) under Port Road in Machiasport, Maine in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

In the event that any changes in the nature, design, or location of the proposed project are planned, this report should be reviewed by a geotechnical engineer to assess the appropriateness of the conclusions and recommendations and to modify the recommendations as appropriate to reflect the changes in design. These analyses and recommendations are based in part upon a limited subsurface investigation at discrete exploratory location completed at the site. If variations from the conditions encountered during the investigation appear evident during construction, it may also become necessary to re-evaluate the recommendations made in this report.

It is recommended that a Geotechnical engineer be provided the opportunity for a review of the design and specifications in order that the earthwork and foundation recommendations and construction considerations presented in this report are properly interpreted and implemented in the design and specifications.

Attachments:

Location Map

Boring Location Plan & Interpretive Subsurface Profile with Boring Logs

Key to Soil and Rock Descriptions and Terms

Boring Logs

Laboratory Testing Summary Sheet

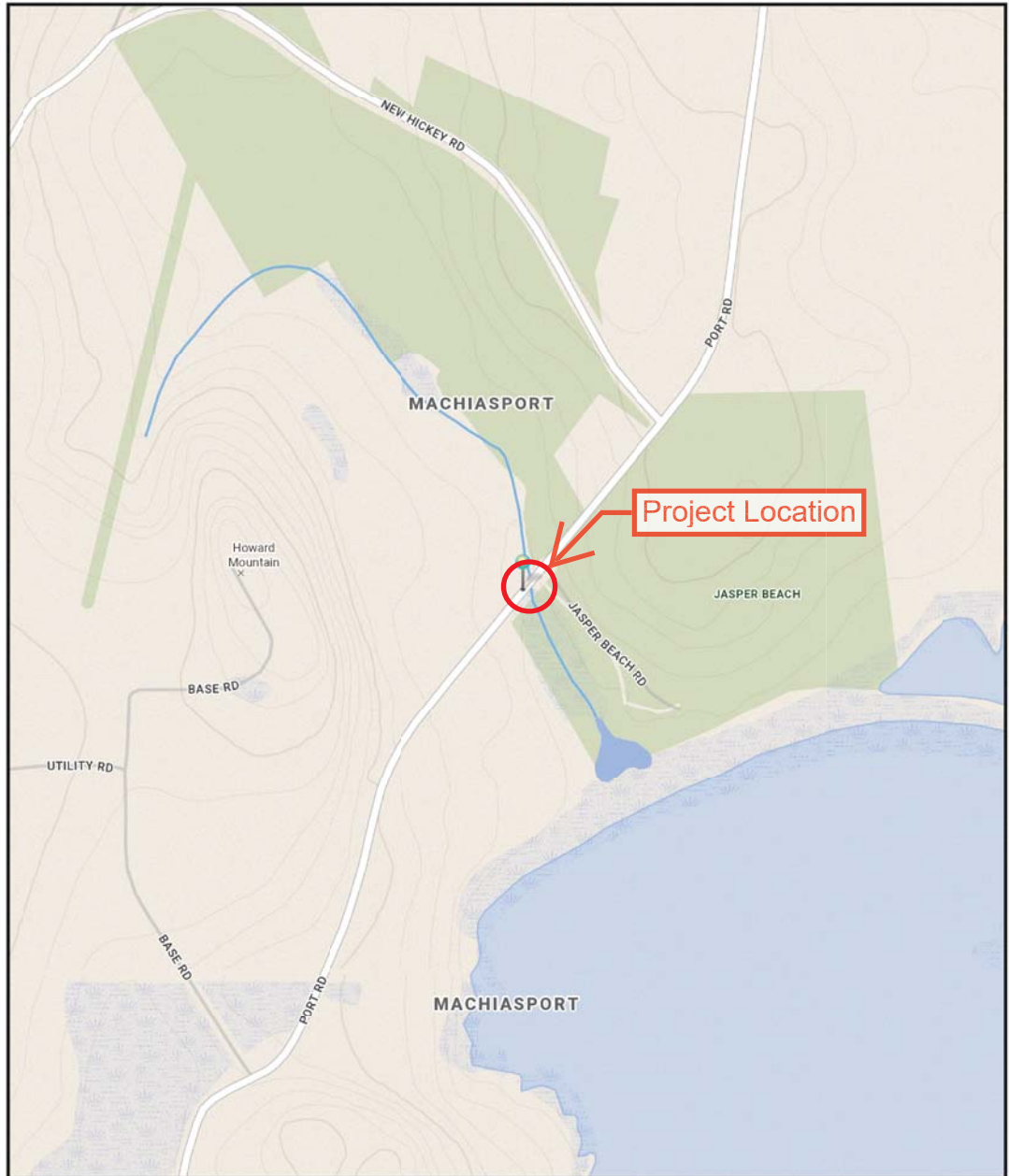
Grain Size Distribution Curve Sheets

Special Provision 203 – Excavation and Embankment (Culvert Bedding Stone)

Special Provision 620 – Geotextile (Reinforcement Geogrid)



MACHIASPORT, MAINE

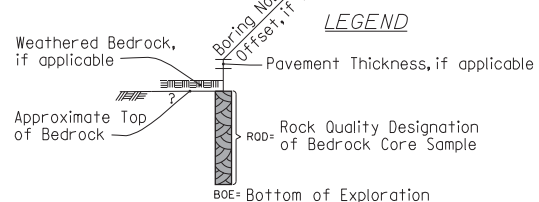
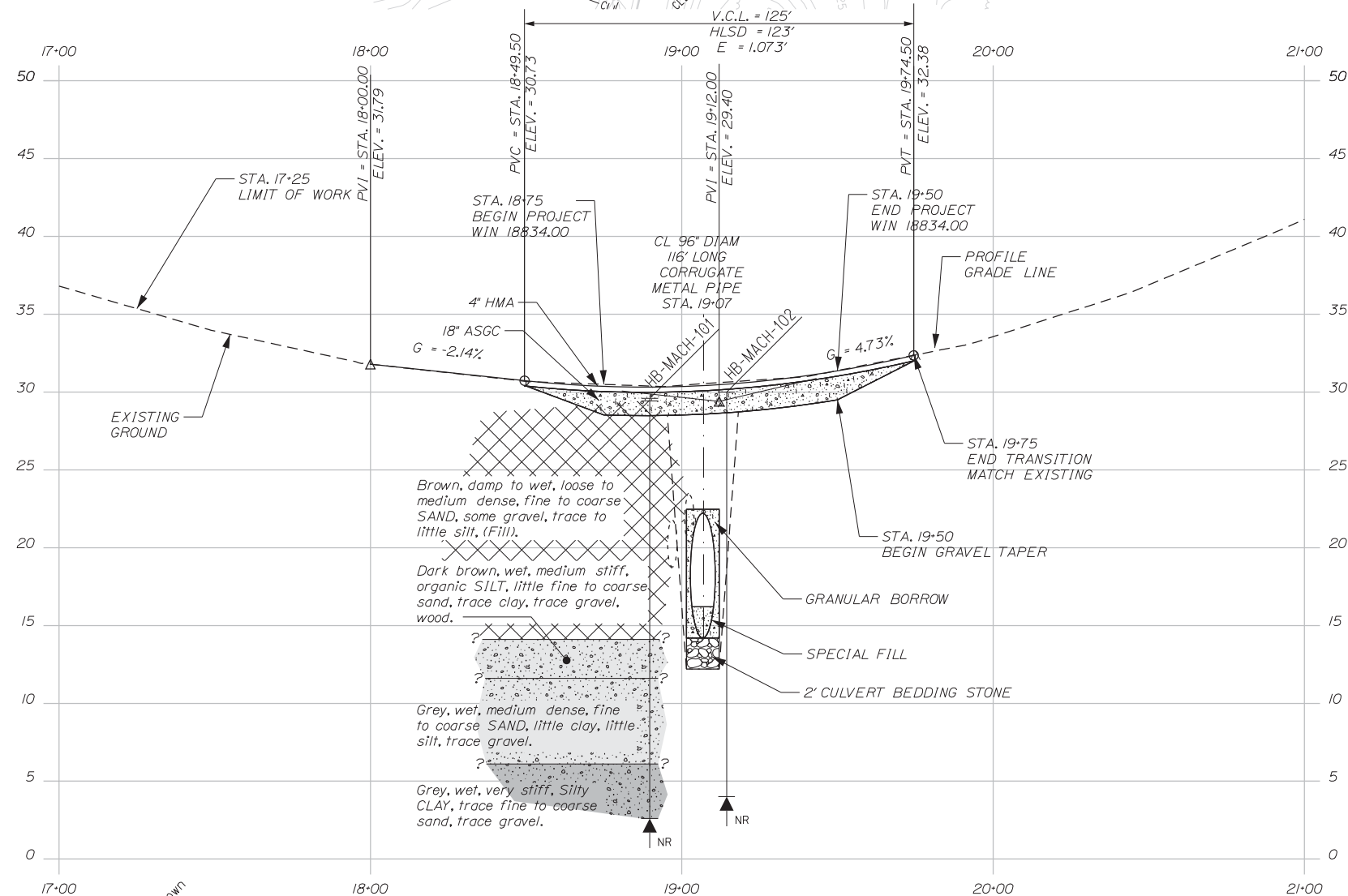
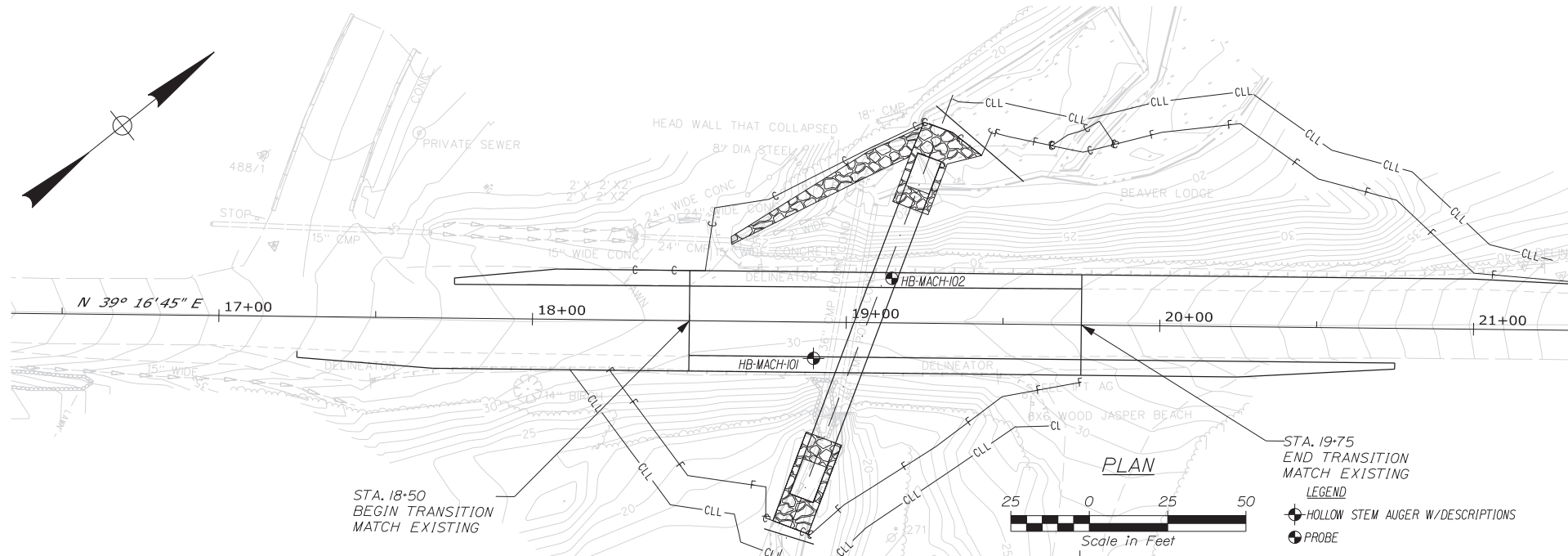


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0.1
Miles
1 inch = 0.13 miles

Date: 5/4/2020
Time: 7:05:50 AM

SHEET NUMBER 1 OF 2	MACHIASPORT PORT ROAD	STATE OF MAINE DEPARTMENT OF TRANSPORTATION
	LOCATION MAP	018834.00
		WIN 18834.00 HIGHWAY PLANS



Note: This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

Maine Department of Transportation Soil/Boring Exploration Log US CUSTOMER UNITS		Project: Large Culvert Replacement on the Port Road Location: Machiasport, Maine		Boring No.: HB-MACH-101 WIN: 18834.00	
Drilling Contractor: Northern Test Boring	Elevation (ft.): 29.6	Auger ID/OD: 5" Dia.	Operator: Mike Adam	Date: 5/18/20	Soil: 18834.00
Logged By: B. W. Leader	Rig Type: NAV088	Sampler: Standard Split Spoon	Core Barrels: N/A	Water Levels: None Observed	Notes: None
Date Started/Finished: 12/12/2016 12:30-15:00	Drilling Method: Solid Stem Auger	Core Barrels: N/A	Notes: None	Notes: None	Notes: None
Boring Location: 18+89.7, 11.6 ft R/L	Costing ID/OD: N/A	Notes: None	Notes: None	Notes: None	Notes: None
Header Efficiency Factor: 0.879	Header Type: Automatic	Header ID: N/A	Header Material: Hydraulic	Header Size: 5"	Header Weight: N/A
Soil Sample No.	Pen./Rec. (ft.)	Sample Depth (ft.)	Blow (1/5 in. Stroke) (blows/ft)	Moisture (%)	Grain Size Analysis
10	24/15	1.00 - 3.00	3/3/2/2	5	7
20	24/7	5.00 - 7.00	2/2/2/4	4	6
30	24/8	10.00 - 12.00	3/5/5/5	10	15
40	24/18	15.00 - 17.00	3/2/2/2	4	6
50	24/17	20.00 - 22.00	6/6/8/10	14	21
60		25.00 - 27.00	5/7/10/10	17	25
Bottom of Exploration at 27.0 feet below ground surface. NO REFUSAL.					

Maine Department of Transportation Soil/Boring Exploration Log US CUSTOMER UNITS		Project: Large Culvert Replacement on the Port Road Location: Machiasport, Maine		Boring No.: HB-MACH-102 WIN: 18834.00	
Drilling Contractor: Northern Test Boring	Elevation (ft.): 30.0	Auger ID/OD: 5" Dia.	Operator: Mike Adam	Date: 5/18/20	Soil: 18834.00
Logged By: B. W. Leader	Rig Type: NAV088	Sampler: N/A	Core Barrels: N/A	Water Levels: None Observed	Notes: None
Date Started/Finished: 12/12/2016 12:30-15:00	Drilling Method: Solid Stem Auger	Core Barrels: N/A	Notes: None	Notes: None	Notes: None
Header Efficiency Factor: 0.879	Header Type: Automatic	Header ID: N/A	Header Material: Hydraulic	Header Size: 5"	Header Weight: N/A
Soil Sample No.	Pen./Rec. (ft.)	Sample Depth (ft.)	Blow (1/5 in. Stroke) (blows/ft)	Moisture (%)	Grain Size Analysis
Soils similar to HB-MACH-101.					
Bottom of Exploration at 25.0 feet below ground surface. NO REFUSAL.					

**STATE OF MAINE
DEPARTMENT OF TRANSPORTATION**

018834.00

WIN 18834.00

HIGHWAY PLANS

**MACHIASPORT
PORT ROAD**

**BORING LOCATION PLAN &
INTERPRETIVE SUBSURFACE PROFILE
WITH BORING LOGS**

PROJ. MANAGER	BY	DATE	REVISIONS	SIGNATURE	P.E. NUMBER	DATE
C. RUSSELL	T. WHITE	MAY 2020	1			

SHEET NUMBER **2** OF 2

Driller: Northern Test Boring	Elevation (ft.): 29.6	Auger ID/OD: 2.75/6.5"
Operator: Mike/Adam	Datum: NAVD88	Sampler: Standard Split Spoon
Logged By: B. Wilder	Rig Type: Diedrich D-50	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 1/12/2016; 12:30-15:00	Drilling Method: Hollow Stem Auger	Core Barrel: N/A
Boring Location: 18+89.7, 11.6 ft Rt.	Casing ID/OD: N/A	Water Level*: None Observed

Hammer Efficiency Factor: 0.879 **Hammer Type:** Automatic Hydraulic Rope & Cathead

 Definitions: R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) T_v = Pocket Torvane Shear Strength (psf)
 D = Split Spoon Sample SSA = Solid Stem Auger S_u(lab) = Lab Vane Undrained Shear Strength (psf) WC = Water Content, percent
 MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) LL = Liquid Limit
 U = Thin Wall Tube Sample RC = Roller Cone N-uncorrected = Raw Field SPT N-value PL = Plastic Limit
 MU = Unsuccessful Thin Wall Tube Sample Attempt WOH = Weight of 140lb. Hammer Hammer Efficiency Factor = Rig Specific Annual Calibration Value PI = Plasticity Index
 V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency G = Grain Size Analysis
 MV = Unsuccessful Field Vane Shear Test Attempt WO1P = Weight of One Person N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected C = Consolidation Test

Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
0							29.4		2" PAVEMENT		
	1D	24/15	1.00 - 3.00	3/3/2/2	5	7			Brown, damp, loose, fine to coarse SAND, some gravel, trace silt, (Fill).	G#303554 A-1-b, SW-SM WC=4.5%	
5											
	2D	24/7	5.00 - 7.00	2/2/2/4	4	6			Brown, damp, loose, fine to coarse SAND, some gravel, trace silt, (Fill).	G#303555 A-1-b, SW WC=4.6%	
10											
	3D	24/8	10.00 - 12.00	3/5/5/5	10	15			Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	G#303556 A-1-b, SW-SM WC=10.8%	
15											
	4D	24/18	15.00 - 17.00	3/2/2/2	4	6	14.1		Dark brown, wet, medium stiff, organic SILT, little fine to coarse sand, trace clay, trace gravel, wood.	G#303557 A-4, ML WC=28.8%	
20											
	5D	24/17	20.00 - 22.00	6/6/8/10	14	21	11.6		Grey, wet, medium dense, fine to coarse SAND, little clay, little silt, trace gravel.	G#303558 A-2-4, SC-SM WC=15.5%	
25							6.1				


Remarks:
Hammer #283

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Large Culvert Replacement on the Port Road Location: Machiasport, Maine	Boring No.: HB-MACH-101 WIN: 18834.00
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Driller: Northern Test Boring	Elevation (ft.): 29.6	Auger ID/OD: 2.75/6.5"
Operator: Mike/Adam	Datum: NAVD88	Sampler: Standard Split Spoon
Logged By: B. Wilder	Rig Type: Diedrich D-50	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 1/12/2016; 12:30-15:00	Drilling Method: Hollow Stem Auger	Core Barrel: N/A
Boring Location: 18+89.7, 11.6 ft Rt.	Casing ID/OD: N/A	Water Level*: None Observed

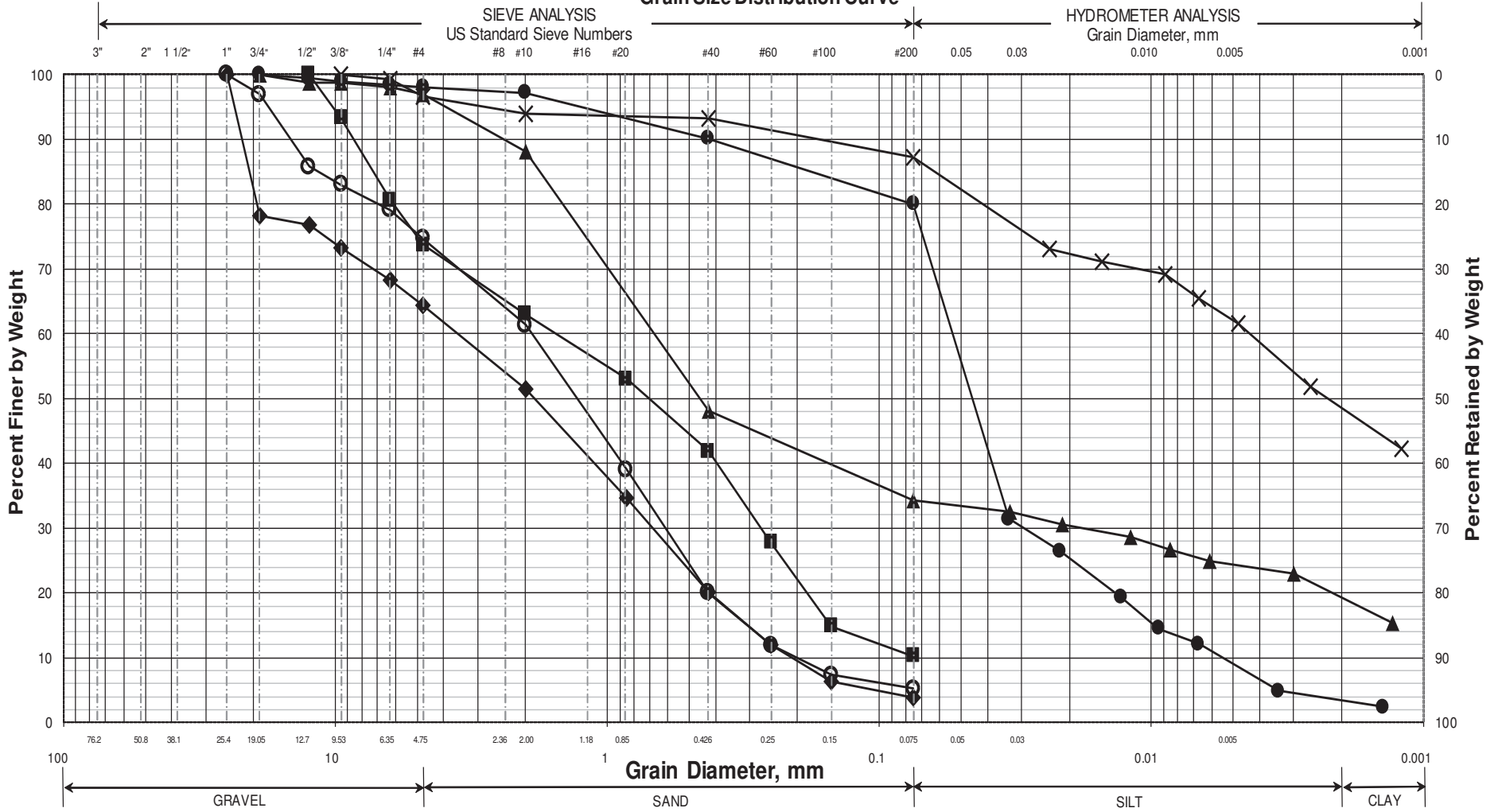
Hammer Efficiency Factor: 0.879	Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>
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Definitions: R = Rock Core Sample, SSA = Solid Stem Auger, HSA = Hollow Stem Auger, RC = Roller Cone, WOH = Weight of 140 lb. Hammer, WOR/C = Weight of Rods or Casing, WO1P = Weight of One Person
 S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf), S_{u(lab)} = Lab Vane Undrained Shear Strength (psf), q_u = Unconfined Compressive Strength (ksf), N-uncorrected = Raw Field SPT N-value, Hammer Efficiency Factor = Rig Specific Annual Calibration Value, N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency, N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected
 D = Split Spoon Sample, MD = Unsuccessful Split Spoon Sample Attempt, U = Thin Wall Tube Sample, MU = Unsuccessful Thin Wall Tube Sample Attempt, V = Field Vane Shear Test, PP = Pocket Penetrometer, MV = Unsuccessful Field Vane Shear Test Attempt
 T_v = Pocket Torvane Shear Strength (psf), WC = Water Content, percent, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index, G = Grain Size Analysis, C = Consolidation Test

Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows /6 in. Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
25	6D		25.00 - 27.00	5/7/10/10	17	25		2.6		Grey, wet, very stiff, Silty CLAY, trace fine to coarse sand, trace gravel.	G#303559 A-7-6, CL WC=21.7%
										Bottom of Exploration at 27.0 feet below ground surface. NO REFUSAL	
30											
35											
40											
45											
50											

Remarks:
Hammer #283

Maine Department of Transportation Grain Size Distribution Curve



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-MACH-101/1D	18+89.7	11.6 RT	1.0-3.0	SAND, some gravel, trace silt.	4.5			
◆	HB-MACH-101/2D	18+89.7	11.6 RT	5.0-7.0	SAND, some gravel, trace silt.	4.6			
■	HB-MACH-101/3D	18+89.7	11.6 RT	10.0-12.0	SAND, some gravel, little silt.	10.8			
●	HB-MACH-101/4D	18+89.7	11.6 RT	15.5-17.0	SILT, little sand, trace clay, trace gravel.	28.8			
▲	HB-MACH-101/5D	18+89.7	11.6 RT	20.0-22.0	SAND, little clay, little silt, trace gravel.	15.5			
×	HB-MACH-101/6D	18+89.7	11.6 RT	25.0-27.0	Silty CLAY, trace sand, trace gravel.	21.7			

WIN
018834.00
Town
Machiasport
Reported by/Date
WHITE, TERRY A 3/3/2020

SPECIAL PROVISION
SECTION 203 – EXCAVATION AND EMBANKMENT
(Culvert Bedding Stone)

Description This work shall consist of constructing a foundation pad of Culvert Bedding Stone in accordance with these specifications and in reasonably close conformity with the width, length, grade and thickness shown on the Plans or established by the Resident.

Materials Culvert Bedding Stone shall meet the requirements of Standard Specification Section 703.22, Underdrain Backfill Material, Type C.

Construction Requirements The Culvert Bedding Stone shall be placed and graded as shown on the Plans or as directed by the Resident, and shall be compacted as required to ensure that all voids in the stone are filled, as approved by the Resident.

Method of Measurement Culvert Bedding Stone will be measured by the cubic yard, complete, in place.

Basis of Payment The accepted quantity of Culvert Bedding Stone will be paid for at the Contract unit price per cubic yard, complete, in place.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
203.55 Culvert Bedding Stone	Cubic Yard

SPECIAL PROVISION
SECTION 620 – GEOTEXTILES
(Reinforcement Geogrid)

Amend Standard Specification 620 – GEOTEXTILES to include the following:

620.01 Description This work shall consist of furnishing and installing Reinforcement Geogrid within the Culvert Bedding Stone in accordance with these specifications and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or as directed by the Resident.

620.02 Material Reinforcement Geogrid shall consist of a regular network of integrally connected, polymeric tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil, aggregate or other material. The Reinforcement Geogrid structure shall be dimensionally stable to retain its geometry under construction stresses and shall have high resistance to damage during construction, ultraviolet degradation, and all forms of chemical and biological degradation encountered in the soil being reinforced.

The Reinforcement Geogrid shall meet or exceed the Minimum Average Roll Values (MARV) of the properties in Table 1. Acceptable manufacturers for Reinforcement Geogrids must be approved by the Resident.

Table 1 - Physical Property Requirements
(Biaxial Reinforcement Geogrid)

Reinforcement Geogrid Mechanical Property	Test Method	Minimum Average Roll Value (MARV) ¹
Tensile strength at 5% Strain MD or XD	ASTM D 6637	1,200 lb/ft
Rib Junction Strength	GRI-GG2	1,000 lb/ft in both directions
Aperture Openings		Between 0.75 and 3 inches
Percent Open Area		50 to 80%

¹ Values are minimum average roll values determined in accordance with ASTM D 4759

A biaxial Reinforcement Geogrid shall be used in this application.

620.03 Placement Reinforcement Geogrid shall be installed, in accordance with the manufacturer's recommendations, unless otherwise modified by this Special Provision. The Reinforcement Geogrid shall be placed within the layers of Crushed Stone Bedding at the proper elevation and alignment as shown on the Plans or as directed by the Resident.

1. The Reinforcement Geogrid shall be placed in continuous longitudinal strips. Splicing along the length will not be allowed. Reinforcement Geogrid shall be oriented such that the roll length runs either parallel or perpendicular to the construction centerline. The Contractor shall verify correct orientation of the Reinforcement Geogrid.

2. Reinforcement Geogrid may be temporarily secured in-place with staples, pins, sand bags or backfill as required by fill properties, fill placement procedures, or weather conditions, or as directed by the Resident.

3. Coverage of less than 100 percent shall not be allowed.
4. The Reinforcement Geogrid shall be lightly anchored and pulled taut to reduce any slack as directed by the Resident.
5. Fill shall not be dumped directly onto the Reinforcement Geogrid. It shall be dumped at the edge of the Reinforcement Geogrid or on a previous course of fill with a minimum compacted depth of 8 inches.
6. The Reinforcement Geogrid shall be covered with fill materials within 7 days of placement to protect against unnecessary exposure.
7. Fill may then be pushed onto the Reinforcement Geogrid using a track mounted bulldozer. At no time shall construction equipment be allowed directly onto the Reinforcement Geogrid. Track mounted equipment shall be allowed on previous courses of fill with a minimum compacted depth of 8 inches. Smooth drum roller compaction equipment shall be allowed on previous courses of fill with a minimum compacted depth of 8 inches and spread fill with a minimum depth of 12 inches, loose measure. At no time shall rubber tired or sheeps-foot rollers be allowed onto the reinforced fill. Turning of vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the Reinforcement Geogrid. Sudden breaking and sharp turning shall be avoided. Equipment speeds over 10 MPH shall not be allowed.
8. Placement, spreading, and compaction of soil on top of the Reinforcement Geogrid shall advance from one end of the Reinforcement Geogrid and move towards the other. Care shall be taken to minimize the development of wrinkles and to ensure that the Reinforcement Geogrid doesn't move from its position during fill placement. A spotter shall observe all fill placement operations to ensure the Reinforcement Geogrid does not slip, achieves the minimum coverage specified on the Plans, and is not damaged by the work.
9. Fill shall be compacted as specified in (1) the Standard Specifications or (2) to at least 90 percent of the maximum dry density determined in accordance with AASHTO T-180, whichever is greater. Density testing shall be made at a minimum frequency of one (1) test per lift or as otherwise specified in the Standard Specifications. Care shall be taken not to drive test apparatus through the Reinforcement Geogrid tensile elements.
10. All rutting formed during construction shall be filled with new Culvert Bedding Stone. In no case shall rutting be filled by blading down

620.04 Overlap Adjacent rolls of Reinforcement Geogrid shall be overlapped a minimum of 1 foot.

620.05 Seams Seams along adjacent lengths of Reinforcement Geogrid shall be tied together with hog rings or cable ties every 3 to 6 feet.

620.06 Certification Prior to construction the Contractor shall submit to the Resident the Manufacturer's certification that the Reinforcement Geogrid supplied has been evaluated in full compliance with this Specification and is fit for long-term, critical soil reinforcement applications.

The Contractor's submittal package shall include, but not be limited to, actual tests for tension/creep, durability/aging, construction damage, and quality control tensile testing.

620.08 Shipment, Storage, Protection, and Repair of Fabric The Contractor shall check the Reinforcement Geogrid upon delivery to ensure that the proper material has been received. Each Reinforcement Geogrid roll shall be shipped in a protective bag and clearly marked with roll number, lot number, geogrid style and principle strength direction. During all periods of shipment and storage, the Reinforcement Geogrid shall be protected from temperatures greater than 140°F and all deleterious materials that might otherwise become affixed to the Reinforcement Geogrid and effect its performance. The manufacturer's recommendations shall be followed with regard to protection from direct sunlight. The Reinforcement Geogrid shall be stored off the ground in a clean, dry environment out of the pathway of construction equipment.

Any Reinforcement Geogrid damage shall be repaired or replaced in accordance with the manufacturer's recommendations. The Contractor shall replace any Reinforcement Geogrid damaged during installation at no additional cost to the Department.

620.09 Method of Measurement Reinforcement Geogrid will be measured by the number of Square Yards of surface area installed. Overlaps for connections, splices, patches, and repairs of damaged Reinforcement Geogrid, etc. are incidental to this Pay Item.

620.10 Basis of Payment Reinforcement Geogrid placement will be paid for per Square Yard in-place which shall be full compensation for all off-loading, inspection, storage, labor, materials, equipment, tools and any incidentals to complete the installation.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
620.65 Reinforcement Geogrid	Square Yard