MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY/BRIDGE PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE

SOILS MEMO REPORT

For the Construction of:

LARGE CULVERT REPLACEMENT
HIGH STREET
WEST GARDINER, MAINE

Prepared by:
Kalia Breskin, P.E.
Senior Geotechnical Engineer

Kennebec County
WIN 20319.00

Soils Report No. 2014-129

April 9, 2014

Highway Program

Brad Foley, Program Manager
Scott Bickford & Heath Cowan, Assistant Program Managers
Phone: 624-3480 Fax: 624-3481

Memorandum

To: Shawn Smith
From: Kitty Breskin
Date: April 8, 2014
Subject: West Gardiner, WIN 20319.00

MaineDOT proposes to replace an existing culvert that carries Grover Brook under High Street in West Gardiner, at the intersection of High Street with Spears Corner Road and Townhouse Road. The existing culvert is a badly deteriorated 8-foot diameter corrugated metal pipe. It will be replaced with an 8-foot diameter reinforced concrete pipe with sills in the bottom to hold streambed materials in place. The invert elevation on the new pipe will be approximately 3-feet lower than the existing invert to allow year-round flow.

A boring for this project was drilled on April 4, 2014 by Maine Test Borings and logged by I.V. Schonewald, P.E. Drilling was by the cased wash boring method. The boring was located by taping in the field from site features. Soil samples were obtained using Standard Penetration Test (SPT) test methods with a 40 lb. hammer dropped 30”. The standard penetration resistances (N-values) in the boring log have been corrected for average energy transfer. Soils were classified based on visual description; no laboratory testing was done on samples from this boring.

No organic or soft soils were found in this boring. The pavement structural section includes a 6-inch thick layer of Hot Mix Asphalt with gravel approximately 3-feet at this location. The pavement section was underlain by sandy fill soils to a depth of approximately 10-feet, underlain by silty fill soils to a depth of 14.3 feet. Till soils encountered in the lower stratum consist of medium dense to dense sand, with varying amounts of gravel and silt. The boring was extended to a depth of 22.0 feet with no refusal encountered.

Geotechnical engineering design is not required for an 8-foot round pipe. Calculations based on the soils encountered at the site indicate that these soils will be adequate to support the proposed structure.

Attachments:
- Boring Log HB-WGGB-101
- Calculations
- Geoplan

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Strut Replacement carries High Street over Grover Brook
Location: West Gardiner, Maine

Boring No.: HB-WGGB-101
WIN: 20319.00

Driller:	Maine Test Boring	**Elevation (ft.)**	178.4	**Auger ID/OD:**	N/A
Operator:	Leonard/O'Leary	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	Be Schonwald	**Rig Type:**	Moobile 53	**Hammer Wt./Fall:**	140#/30" Safty Hammer
Date Start/Finish:	4/4/2014; 08:45-11:30	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	N/A
Boring Location:	6+39.6, 11.2 ft Rt.	**Casing ID/OD:**	HW	**Water Level*:**	N/A

Definitions:
D = Split Spoon Sample S = Sample off Auger Flight
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
SSA = Solid Stem Auger

Definitions:
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WOH = weight of 140lb. hammer
WOR = weight of rods WOC = weight of casing

Definitions:
WC = water content, percent ≅ = Similar or Equal too
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							177.90	0.5 ft Asphalt PAVEMENT. (0.50)	
	1D	24/15	1.00 - 3.00	12/14/13/12	27			Brown, damp, medium dense, fine to coarse SAND, little gravel, trace silt, (Fill).	
	2D	24/14	3.00 - 5.00	5/2/3/6	5			Brown, damp, loose, fine to medium SAND, trace gravel, trace coarse sand, trace silt, (Fill).	
5	3D/A	24/12	5.00 - 7.00	7/3/5/3	8			3D (5.0-6.7 ft) Brown, damp, loose, fine to medium SAND, trace to little gravel, trace coarse sand, trace silt, (Fill).	
								3D/A (6.7-7.0 ft) Brown, moist, gravelly, fine to coarse SAND, little silt, (Fill).	
						48			
						27			
	4D	24/11	9.50 - 11.50	3/2/2/2	4	WASH AHEAD		Brown, very loose, fine sandy SILT, trace coarse sand, appears disturbed, (Fill).	
10									
							164.10	(14.30)	
15	5D	24/15	15.00 - 17.00	18/21/15/20	36			Greyish-brown, dense, gravelly fine to coarse SAND, little to some silt, (Till).	
20	6D	24/10	20.00 - 22.00	15/14/11/11	25			Greyish-brown, medium dense, fine to medium SAND, some gravel, little silt, trace coarse sand, (Till).	
							156.40	(22.00)	
25								**Bottom of Exploration at 22.00 feet below ground surface.** NO REFUSAL	

Remarks:

1. Driller notes little resistance 11.5-14.5 ft bgs, sandy silt in wash water' no evidence of organic material.
2. Material becomes boney at 14.3 ft bgs.
3. Driller notes denser material at 19.4 ft bgs.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Headwall Active Earth Pressures:

Effective active earth pressure coefficient:

Rankine Theory - Active Earth Pressure from MaineDOT Bridge Design Guide Section 3.6.5.2, pg 3-7

$\beta := 0 \cdot deg$ slope angle of backfill soils from horizontal

$\phi_a := 30 \cdot deg$ assumed effective friction angle for medium dense gravelly sand

$$K_a := \tan\left(45 \cdot deg - \frac{\phi_a}{2}\right)^2 \qquad K_a = 0.33$$

$$K_p := \tan\left(45 \cdot deg + \frac{\phi_a}{2}\right)^2 \qquad K_p = 3$$

Service Limit State Bearing Resistance - Medium Dense Sand

Nominal and factored Bearing Resistance

Presumptive Bearing Resistance for Service Limit State ONLY

Reference: AASHTO LRFD Bridge Design Specifications 5th Edition
Table C10.6.2.6.1-1 Presumptive Bearing Resistances for Spread Footings at the Service Limit State Modified after US Department of Navy (1982)

Type of Bearing Material: Assume loose sand because geophysics data indicates SE corner of project area bedrock to be substantially below proposed culvert subgrade.

Bearing Resistance: Ordinary Range (ksf)
4-8 ksf for medium dense, coarse to medium sand

Recommended Value of Use: 6 ksf

Recommended Value: $6 \cdot ksf = 3 \cdot tsf$ $\qquad tsf := g \cdot \left(\frac{ton}{ft^2}\right)$

Note: This bearing resistance is settlement limited (1 inch) and applies only a the service limit state.

Characteristics of Native Soils at foundation level

Brown, medium dense, gravelly f-c SAND, little to some silt

$wc := 0.2$ estimated water content

$e := 0.55$ estimated void ratio

$\gamma_w := 62.4pcf$ unit weight of water

$sp := 2.67$ estimated specific gravity

saturation $\qquad sat := \frac{(wc \cdot sp)}{e} \qquad sat = 0.9709$

total unit weight

$$\gamma_t := \frac{(sp + sat \cdot e) \cdot \gamma_w}{(1 + e)} \qquad \gamma_t = 129 \cdot pcf$$

saturated unit weight $\gamma_{sat} := \frac{(sp + e) \cdot \gamma_w}{(1 + e)}$ $\gamma_{sat} = 130 \cdot pcf$

Strength Limit State Bearing Resistance - Native Granular Soils:

Nominal and factored Bearing Resistance for box culvert and wingwall base slab

Assumptions

1. Culvert will be embedded 3.0 feet below streambed

   $D_f := 3.0ft$

2. Assumed parameters based on granular fill

Moist unit weight	$\gamma_t = 128.9868 \cdot pcf$
Saturated unit weight	$\gamma_{sat} = 129.631 \cdot pcf$
Angle of internal friction	$\phi_b := 34deg$
Undrained shear strength	$c := 0psf$
Depth to groundwater	$D_w := 0ft$

3. L > B, so use Terzaghi strip foundation equations

Terzaghi shape factors	$B := 6ft$ for a round pipe
	$s_c := 1.0$
	$s_\gamma := 1.0$
Meyerhof bearing capacity factors	$N_c := 42.14$
	$N_q := 29.4$
	$N_\gamma := 31.1$

Effective stress at footing level

$q_{eff} := D_w \cdot \gamma_t + (D_f - D_w) \cdot (\gamma_{sat} - \gamma_w)$

$q_{eff} = 202 \cdot psf$

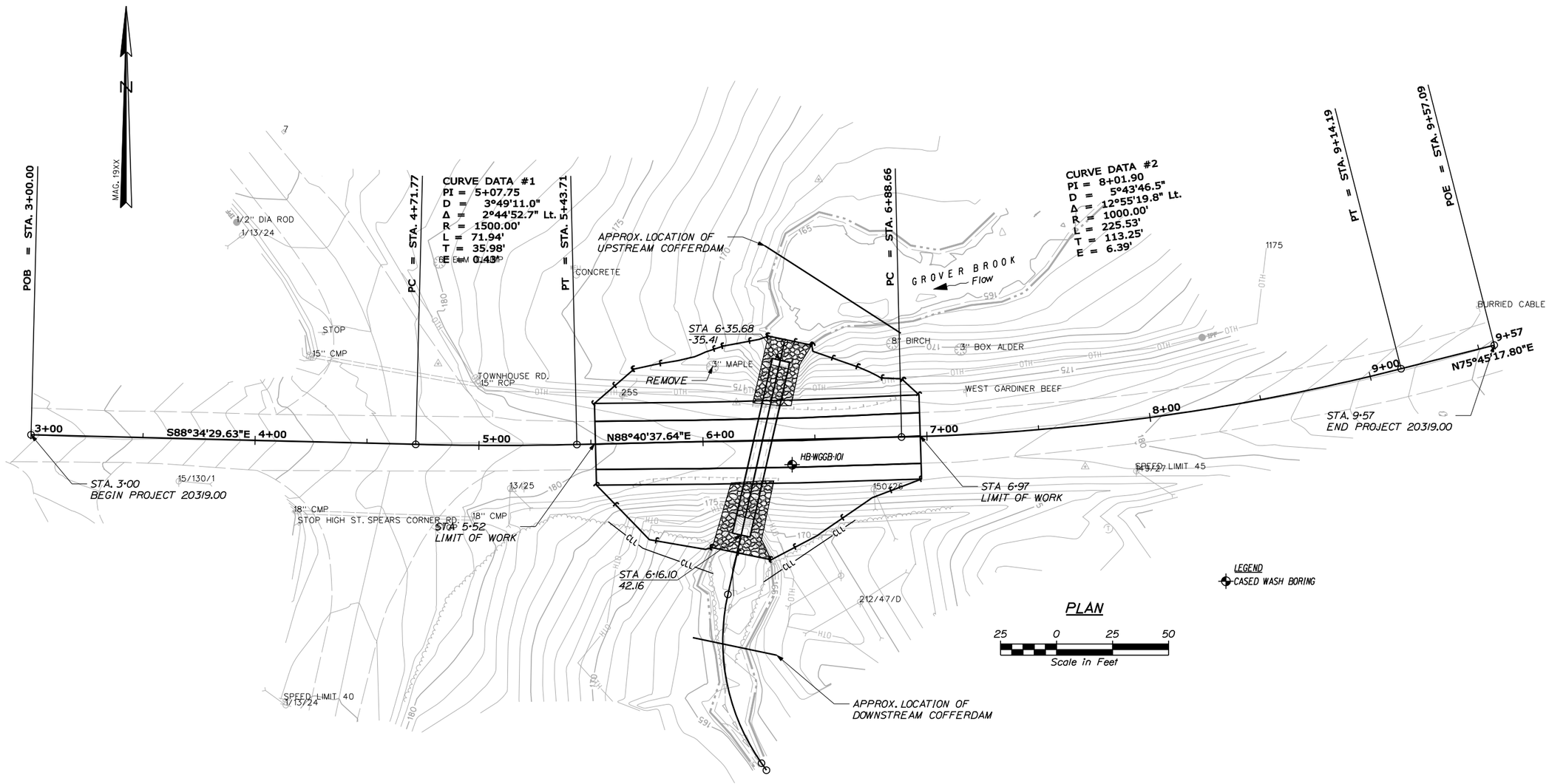
Nominal Bearing Resistance

$q_{nom} := c \cdot N_c \cdot s_c + q_{eff} \cdot N_q + 0.5 \cdot (\gamma_{sat} - \gamma_w) \cdot B \cdot N_\gamma \cdot s_\gamma$

$q_{nom} = 12.202 \cdot ksf$

Resistance Factor from LRFD Table 10.5.5.2.2-1, pg 10-32 $\Phi_b := 0.45$

$q_{factored} := q_{nom} \cdot \Phi_b$ $q_{factored} = 5.491 \cdot ksf$



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

–

WIN
20319.00

HIGHWAY PLANS

PROJ. MANAGER	SHAWN SMITH	BY	DATE
DESIGN-DETAILED	N. HARTLEY	------	------
CHECKED-REVIEWED	------	------	------
DESIGN2-DETAILED2	K.BRESKIN	T.WHITE	APR 2014
DESIGN3-DETAILED3	------	------	------
REVISIONS 1	------	------	------
REVISIONS 2	------	------	------
REVISIONS 3	------	------	------
REVISIONS 4	------	------	------
FIELD CHANGES	------	------	------

SIGNATURE

P.E. NUMBER

DATE

WEST GARDINER
HIGH STREET

GEOPLANS

SHEET NUMBER

1

OF _

Filename: ...\GEOTECH\MSTA\001_Geoplan1.dgn Division: GEOTECH Username: Kitty.Breskin Date:4/8/2014