MAINE DEPARTMENT OF TRANSPORTATION
BRIDGE PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE

GEOTECHNICAL REPORT

For:

HAYNESVILLE BRIDGE
U.S. ROUTE 2A OVER MATTAWAMKEAG RIVER
HAYNESVILLE, MAINE

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Aroostook County
WIN 20509.00

Soils Report No. 2015-27
Bridge No. 5623

Fed No. STP-2050(900)X
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Table of Contents

1.0 INTRODUCTION 1

2.0 GEOLOGIC SETTING 1

3.0 SUBSURFACE INVESTIGATION 2

4.0 LABORATORY TESTING 3

5.0 SUBSURFACE CONDITIONS 3

5.1 FILL 3
5.2 ALLUVIUM 3
5.3 GLACIAL STREAM DEPOSITS 4
5.4 GLACIAL TILL 4
5.5 BEDROCK 5
5.6 GROUNDWATER 6

6.0 FOUNDATION PILE EVALUATIONS 6

6.1 PILE INTEGRITY TESTS 6
6.2 PILE STATIC LOAD TESTS 7
6.3 ESTIMATED NOMINAL GEOTECHNICAL PILE RESISTANCES 7
6.4 FACTORED GEOTECHNICAL PILE RESISTANCES FOR STRENGTH LIMIT STATE 8

7.0 SEISMIC PARAMETERS 9

8.0 CLOSURE 10

Tables

Table 1 – Summary of Atterberg Limits Test Results
Table 2 – Summary of Approximate Bedrock Depths and Elevations
Table 3 – Recommended Nominal Geotechnical Pile Resistances
Table 4 – Recommended Factored Geotechnical Pile Resistances for Strength Limit State
Table 5 – Seismic Parameters

Sheets

Sheet 1 – Location Map
Sheet 2 – Boring Location Plan
Sheet 3 – Interpretive Subsurface Profile
Sheet 4 – Boring Logs

Appendices

Appendix A – Boring Logs
Appendix B – Laboratory Test Results
Appendix C – Pile Condition Assessment and Pile Load Test Results
Appendix D – Geotechnical Pile Resistance Estimate
Appendix E – Seismic Parameters

1.0 INTRODUCTION

The purpose of this Geotechnical Report is to present subsurface information and present geotechnical pile evaluations for the bridge superstructure replacement at the Haynesville Bridge which carries U.S. Route 2A over Mattawamkeag River in Haynesville, Maine. A subsurface investigation has been completed at this site. The purpose of the investigation was to explore subsurface conditions at the site in order to develop geotechnical parameters for evaluation of the existing timber pile foundations. This report presents the soil and bedrock information obtained at the site during the subsurface investigation and geotechnical evaluations of the bridge's existing timber pile foundations.

The existing Haynesville Bridge was constructed in 1953. The existing three-span rolled steel girder bridge has spans of approximately 85, 110 and 85 feet. The middle span contains a suspended section connected by pins to the approach span girders which cantilever over the two piers. The substructures consist of mass concrete stub abutments supported on treated timber piles and mass concrete solid wall piers supported on timber piles. 2014 Maine Department of Transportation (MaineDOT) Bridge Maintenance inspection reports indicate the overall superstructure is in fair condition, but the fracture critical pin connections are in serious condition. The structural steel is in poor condition (rating of 4) with areas of moderate to advanced section loss. The substructure is in satisfactory condition (rating of 6). The bridge has a Sufficiency Rating of 57.3.

The current Haynesville Bridge project is scoped as a bridge superstructure replacement with 220 feet of full width approach work. The MaineDOT Bridge Program identified the preferred replacement superstructure alternative to be a three-span, constant depth, weathering steel plate girder bridge with a composite deck. The abutment backwalls will be reconstructed to accommodate new joints and no work is planned for the piers.

Two-way alternating traffic on U.S. Route 2A at the bridge site will be maintained by use of staged construction and traffic signals.

2.0 GEOLOGIC SETTING

Haynesville Bridge in Haynesville carries U.S. Route 2A over Mattawamekeag River as shown on Sheet 1 – Location Map.

The Maine Geologic Survey (MGS) "Surficial Geology of the Amity Quadrangle, Maine, Open-file No. 80-2" (1980) indicates the surficial soils in the vicinity of the existing bridge consist of alluvial deposits (sand, gravel and silt) with nearly contacts to glacial stream deposits (sand, gravel, and occasionally till) with active sand and gravel pits upstream and downstream of the bridge.

The "Bedrock Geologic Map of Maine," MGS (1985), indicates the bedrock in the vicinity of the bridge site as undifferentiated pelites and sandstones, in part of the Allsbury Formation and in part unnamed.

3.0 SUBSURFACE INVESTIGATION

Subsurface conditions were explored by drilling four (4) test borings. Test borings BB-HMR-101 and BB-HMR-104 were drilled from the roadway directly behind the existing Abutment No. 1 and Abutment No. 2. Test boring BB-HMR-102 was drilled through the existing bridge deck on the north side of existing Pier No. 1. Test borings BB-HMR-103 was also drilled through the existing bridge deck on the south side of existing Pier No. 2. The exploration locations are show on Sheet 2 – Boring Location Plan.

The test borings were drilled between June 4 and 17, 2014 by the MaineDOT Materials Testing and Exploration (MTEx) drill crew using a truck mounted CME 45 drill rig. The test borings were drilled using solid stem auger, cased wash boring and rock coring techniques. Soil samples were typically obtained at 5-foot intervals using Standard Penetration Test (SPT) methods. During SPT sampling, the sampler is driven 24 inches and the hammer blows for each 6-inch interval of penetration are recorded. The sum of the blows for the second and third intervals is the N-value, or standard penetration resistance. The MaineDOT drill rig used for the exploration program is equipped with an automatic hammer to drive the split spoon. The hammer used for the 2014 test borings was calibrated in July 2013 and was found to deliver approximately 45 percent more energy during driving than the standard rope and cathead system. The N-values discussed in this report are corrected values computed by applying an average energy transfer of 0.867 to the raw field N-values. The hammer efficiency factor (0.867) and both the raw field N-value and corrected N-value (N_{60}) are shown on the boring logs.

The four (4) test borings were advanced to bedrock and were terminated with bedrock cores. Where bedrock was encountered, the bedrock was cored using an NQ-2 inch core barrel and the Rock Quality Designation (RQD) of the core was calculated.

The MaineDOT Geotechnical Team member selected the boring locations and drilling methods, designated type and depth of sampling techniques, and identified field and laboratory testing requirements and reviewed field logs for accuracy. A MaineDOT Subsurface Inspector certified by the Northeast Transportation Technical Certification Program (NETTCP) logged the subsurface conditions encountered in the borings. The drill crew determined the boring locations in the field by taping to site features. The ground elevations are based on the NAVD88 datum.

Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are presented on the boring logs provided in Appendix A – Boring Logs and graphically on Sheet 3 - Interpretive Subsurface Profile.

4.0 LABORATORY TESTING

A laboratory testing program was conducted on selected soil samples recovered from the test borings to assist in soil classification, evaluation of engineering properties of the soils, and geologic assessment of the project site. Laboratory testing consisted of sixteen (16) standard grain size analyses with natural water content, one (1) grain size analysis with hydrometer and water content, one (1) Atterberg Limits test and one (1) direct shear test. The results of soil tests are included as Appendix B – Laboratory Test Results. Moisture content information and other soil test results are also shown on the boring logs provided in Appendix A – Boring Logs.

5.0 SUBSURFACE CONDITIONS

Subsurface conditions encountered in the test borings consisted of fill soils, alluvium, stratified glacial stream deposits and glacial till, all underlain by bedrock. The boring logs are provided in Appendix A – Boring Logs. A generalized subsurface profile is shown on Sheet 3 – Interpretive Subsurface Profile. The following paragraphs discuss the subsurface conditions encountered:

5.1 Fill

Granular fill was encountered in the two (2) test borings drilled in the existing bridge approaches. The fill soils encountered consisted of:

- Brown, damp, gravelly, fine to coarse sand, little silt, occasional cobbles;
- Brown, damp, fine to coarse sand, some gravel, some to little silt, occasional cobble; and
- Brown, moist, silty, fine to coarse sand, some gravel.

The encountered thickness of the fill unit ranged from approximately 14 to 15 feet at the boring locations. SPT N-values ranged from 22 to greater than 50 blows per foot (bpf) indicating the consistency of the deposit is medium dense to very dense.

Two (2) grain size analyses resulted in the fill soils being classified as A-1-b under the AASHTO Soil Classification System and SM under the Unified Soil Classification System (USCS). The natural water contents of the samples tested ranged from approximately 5 to 7 percent.

5.2 Alluvium

Alluvial deposits were encountered in all of the test borings. The alluvial deposits encountered consisted of:

- Brown, wet, fine to coarse sand, some to little gravel, some to little silt;

- Brown, wet, fine to medium sand, some silt, trace coarse sand, some gravel;
- Brown, wet, fine to coarse sandy, gravel, little silt;
- Grey, wet, fine sand, trace silt;
- Grey, wet, gravelly sand, trace silt;
- Grey-brown, fine sand, some silt, trace medium to coarse sand, trace gravel; and
- Grey, wet, silty, fine sand, little gravel, trace medium to coarse sand.

The encountered thickness of the alluvium ranged from approximately 10 to 14.5 feet at the boring locations. SPT N-values ranged from 3 to 27 blows per foot (bpf) indicating the consistency of the deposit is very loose to medium dense.

Five (5) grain size analyses resulted in the alluvium being classified as A-1-a, A-1-b, A-4, and A-2-4 under the AASHTO Soil Classification System and SM and GM under the USCS. The natural water contents of the samples tested ranged from approximately 12 to 28 percent. One (1) direct shear test performed on a sample of the alluvial soils resulted in an internal angle of friction of 30.5°.

5.3 Glacial Stream Deposits

Glacial stream deposits were encountered in boring BB-HMR-104. The glacial stream deposit encountered consisted of:

- Grey, wet, gravelly, fine to coarse sand, some silt, occasional cobble; and
- Grey, wet, fine to medium sand, little to trace silt, trace coarse sand, trace gravel, trace wood.

The encountered thickness of the deposit was approximately 19 feet at the boring location. SPT N-values ranged from 7 to 14 blows per foot (bpf) indicating the consistency of the deposit is loose to medium dense.

Two (2) grain size analyses resulted in the glacial stream deposit being classified as A-3 and A-2-4 under the AASHTO Soil Classification System and SM and SP-SM under the USCS. The natural water contents of the samples tested ranged from approximately 21 to 23 percent.

5.4 Glacial Till

Glacial till was encountered in the four (4) borings below the alluvium and glacial stream deposits. The encountered thickness of the layer ranged from approximately 12.5 to 24.3 feet. The glacial till soils encountered consisted of:

- Grey, wet gravelly, fine to coarse sand, some to trace silt;
- Grey, wet, fine to coarse sand, some gravel, some silt;
- Grey, moist fine to coarse sandy gravel, little silt;
- Grey, wet, silt, some fine to coarse sand, some to trace gravel; and
- Grey, wet, sandy silt, trace gravel.

Frequent cobbles were encountered in the glacial till deposit in borings BB-HMR-101 and BB-HMR-103.

SPT N-values in the granular till layers ranged from 25 to greater than 50 bpf indicating the consistency of those subunits is medium dense to very dense. SPT N-values in the silty till layers ranged from 12 to greater than 50 bpf indicating the consistency of those deposits is stiff to hard.

Three (3) grain size analyses resulted in the granular till samples being classified as A-1-A and A-2-4 under the AASHTO Soil Classification System and SW-SM, SM and GW-GM under the USCS. The natural water contents of the samples tested ranged from approximately 7 to 11 percent.

Five (5) grain size analyses resulted in the silty till being classified as A-4 under the AASHTO Soil Classification System and SM, CL and ML under the USCS. The natural water contents of the samples tested ranged from approximately 8 to 23 percent.

An Atterberg Limits test was conducted on one (1) sample of the fine grained glacial till subunit. Table 1 summarizes the results of Atterberg Limits tests conducted on the sample:

Boring No. and Sample No.	Soil Description	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BB-MUR-104, 10D	Silt	9.2	23	15	8	-0.73

Table 1 – Summary of Atterberg Limits Test Results

The plasticity index of the sample indicates that the soil has a low plasticity. The natural water content of the tested sample was approximately 9 percent and the plastic limit and liquid limit were 15 and 23, respectively. Interpretation of these results is that the soil is some- to heavily overconsolidated. The liquidity index is -0.73 which indicates that the soil is heavily preconsolidated.

5.5 Bedrock

Bedrock was encountered and cored in each of the four (4) of the explorations. The top of bedrock surface encountered ranged from El. 332.7 below the south bank of Mattawamkeag River to El. 326.9 below the north riverbank.

The bedrock at the site is identified as grey, fine grained, limey Slate, hard, very slightly weathered, no apparent jointing, cleavage along steeply dipping foliation, with occasional microfaults and calcite veins. One bedrock core contained a 2-foot intrusion of igneous rock. The RQD of the bedrock was determined to range from 0 to 77 percent, correlating to a rock mass quality of very poor to good.

Table 2 below summarizes approximate top of bedrock elevations at the test boring locations:

Boring	Station	Offset (feet)	Approx. Depth to Bedrock (feet)	Approx. Elevation of Bedrock Surface (feet)
BB-HMR-101	24+98.8	4.5 Lt.	53.8	332.7
BB-HMR-102	26+2.6	13.3 Lt	31.8	329.5
BB-HMR-103	26+93.7	6.3 Rt.	26.0	332.5
BB-HMR-104	27+95.2	12.3 Lt.	59.2	326.9

Table 2 – Summary of Approximate Bedrock Depths and Elevations

5.6 Groundwater

The groundwater levels observed in the two borings drilled in the bridge approach fills ranged from approximately 20 to 21 feet bgs. Groundwater levels will fluctuate with precipitation, seasonal changes, runoff, and adjacent construction activities.

6.0 FOUNDATION PILE EVALUATIONS

The bridge substructures are supported by treated timber piles. The historical bridge plans indicate that the timber piles had a 16 ton (32 kip) design load per pile at the abutments and a 20 tons (40 kips) design load per pile at the piers. The historical plans also provide pile cutoff elevations and design lengths equal to 35 feet for the abutments and 25 to 30 feet for the piers.

In order to assess the feasibility of re-using the existing timber pile foundations for the proposed superstructure replacement, timber pile integrity tests and pile load tests were conducted at the abutments, borings were conducted to determine subsurface conditions, and the theoretical capacity of the pier piles were calculated.

6.1 Pile Integrity Tests

The pile testing program was performed by GZA GeoEnvironmental on December 12 and December 19, 2013. The pile test program included an assessment of the condition and length of selected timber piles supporting Abutment No. 1 and Abutment No. 2.

The upper portion of a timber pile located under each abutment of the existing bridge was excavated and a Pile Integrity Test (PIT) was performed. Based on the wave speeds measured in the tests, the correlating test pile lengths for Abutment No. 1 and Abutment No. 2 were approximately 26 and 32 feet, respectively.

Details and results of the pile integrity tests are included as Appendix C – Pile Condition Assessment and Pile Load Test Results.

6.2 Pile Static Load Tests

The pile testing program performed by GZA GeoEnvironmental on December 12 and 19, 2013 included static load tests to evaluate the axial capacity of selected timber piles supporting Abutments No. 1 and No. 2.

Abutment No. 1 (South Abutment). A 19-inch pile section of the selected timber test pile was saw-cut and removed and a jack/load cell assembly installed on the lower pile section. The measured diameter of the pile was 12.6 inches. At a maximum test load of 138 kips, the gross displacement of the pile was less than the specified failure criteria of 0.47 inches at 138 kips. Therefore, the test results indicted a nominal geotechnical capacity of 138 kips for the Abutment No. 1 test pile.

Abutment No. 2 (North Abutment). A 19-inch pile section was saw-cut and removed from the timber test pile and a jack/load cell assembly installed on the pile. The measured diameter of the lower pile section was 10.875 inches. At a maximum test load of 120 kips, the gross displacement of the pile was less than the specified failure criteria of 0.55 inches at 120 kips. However, continuous jacking was needed to maintain the 120 kip load on the pile. The need for continuous jacking and ongoing displacement are indicative of a plunging failure. Therefore, the test results indicted a nominal geotechnical capacity of 120 kips for the Abutment No. 2 test pile.

Details and results of the static load tests are included as Appendix C – Pile Condition Assessment and Pile Load Test Results.

6.3 Estimated Nominal Geotechnical Pile Resistances

Design soil profiles were developed using the information obtained from the four test borings drilled by the MaineDOT in June 2014. The nominal geotechnical resistances of the piles at each abutment and pier were estimated by static calculation of the side friction and end bearing resistance. The static pile resistance calculations at the abutments were compared with the static load test results to validate the soil profile assumptions made at Piers No. 1 and No. 2.

The computed side resistance was based on the Nordland method. Tip resistance was based on the Thurman method with a limiting value based on the Meyerhof method. The estimated static nominal pile resistances for the piles at Piers No. 1 and 2 are provided in Table 3. A pile end-area of 50 square inches was assumed based on a minimum pile tip diameter of 8

inches. The nominal pile resistances as measured from static load tests at Abutments No. 1 and 2 are also shown in Table 3.

Structure	Side Resistance (kips)	Tip Resistance (kips)	Total Nominal Resistance (kips) φ=1.0	Estimate Pile Length below Pile Cap (feet)	Estimated Pile Tip Elev. (feet) (NGVD)
Abutment 1	-	-	138[1]	30[2]	345
Pier 1	24	73	98	14[3]	342
Pier 2	33	83	116	16[3]	338
Abutment 2	-	-	120[1]	34[2]	341

[1] Value based on static load test
[2] Abutment pile lengths from PIT test results
[3] Pier pile lengths are based on MaineDOT pile driving records from project field books.

Table 3 – Recommended Nominal Geotechnical Pile Resistances

Details and supporting calculations for recommended nominal geotechnical axial pile resistances are included as Appendix D – Geotechnical Pile Resistance Estimate.

6.4 Factored Geotechnical Pile Resistances for Strength Limit State

The AASHTO resistance factors for estimating pile side resistance based on the Nordland method and tip resistance based on Thurman are 0.45. The AASHTO resistance factor for estimating limiting tip resistance based on the Meyerhof method is 0.30. A resistance factor of 0.75 is recommended by AASHTO for estimation of pile resistance where the nominal resistance is measured from static load tests.

Based on interpretation of AASHTO Table 10.5.5.2.3-2, a resistance factor of 0.65 is recommended to calculate the geotechnical resistance of the pier piles for the strength limit state, considering the entire bridge a single site having completed two static load tests. Since the load tests were completed at each abutment, use of a higher resistance factor of 0.70 for the abutment piles is recommended.

The resulting recommended values for the factored geotechnical pile resistances for the strength limit state are provided in Table 4.

Substructure	Factored Geotechnical Pile Resistance (kips) φ = 0.65 to 0.70
Abutment 1	97
Pier 1	64
Pier 2	75
Abutment 2	84

Table 4 - Factored Geotechnical Pile Resistance for the Strength Limit State

Details and results of the estimated factored geotechnical axial pile resistances are included as Appendix C – Geotechnical Pile Resistance Estimate.

7.0 SEISMIC PARAMETERS

The United States Geological Survey Seismic Design CD (Version 2.1) provided with the LRFD Manual, and LRFD Articles 3.10.3.1 and 3.10.6 were used to develop parameters for seismic design. Based on site coordinates, the software provided the recommended AASHTO Response Spectra for a 7 percent probability of exceedance in 75 years. These results are summarized in Table 5 below:

Parameter	Design Value
Peak Ground Acceleration (PGA)	0.066g
S_{DS} (Period = 0.2 sec)	0.239g
S_{D1} (Period = 1.0 sec)	0.111g
Site Class	D
Seismic Zone	1

Table 5 - Seismic Design Parameters

In conformance with LRFD Table 4.7.4.3.1-1 seismic analysis is not required for multispan bridges in Seismic Zone 1. However, superstructure connections and minimum support length requirements shall be designed per LRFD Articles 3.10.9 and 4.7.4.4, respectively.

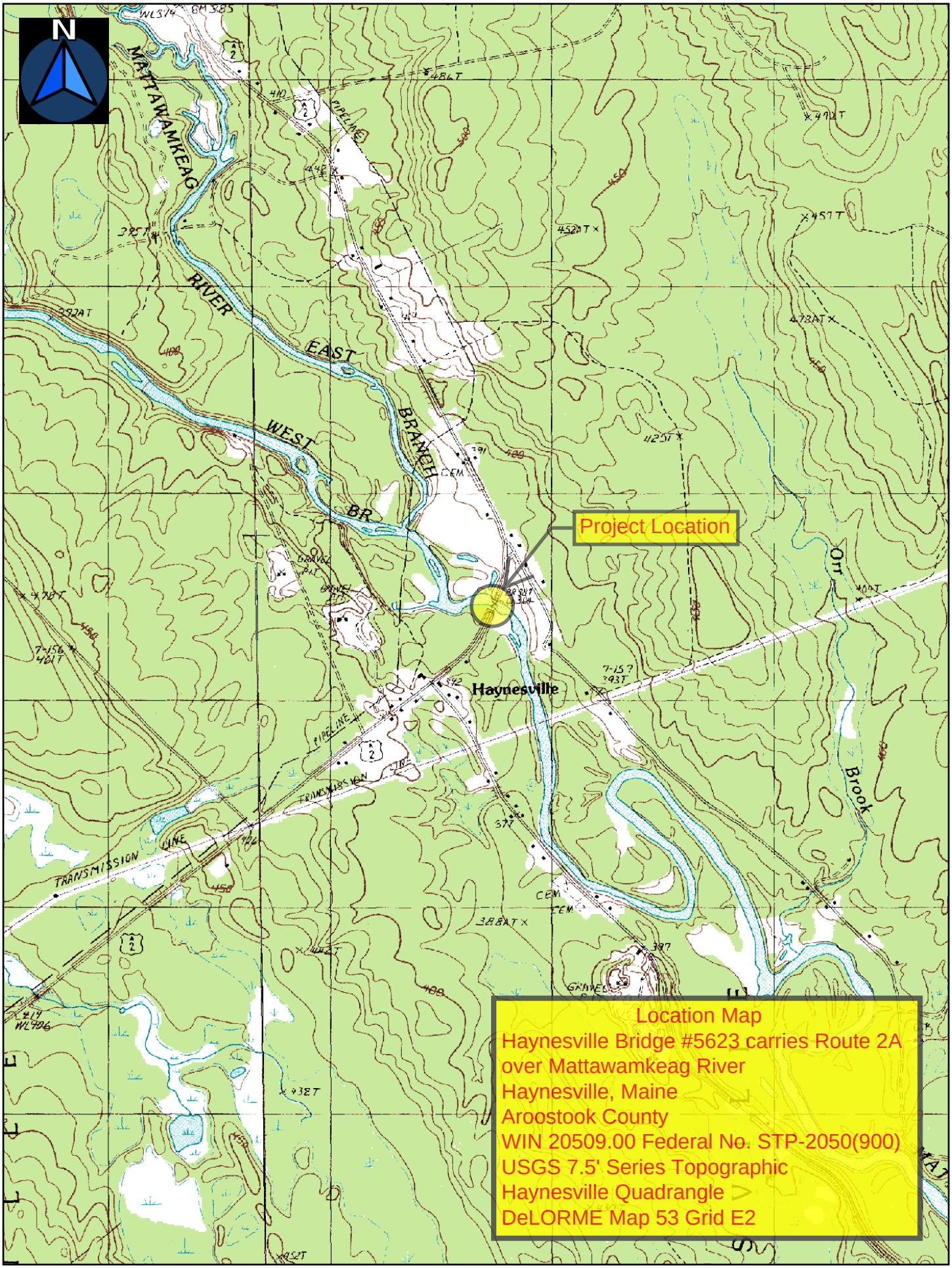
See Appendix E for supporting calculations.

8.0 CLOSURE

This Geotechnical Report has been prepared for the use of the MaineDOT Bridge Program for specific application to the proposed bridge superstructure replacement project at the Haynesville Bridge in Haynesville, Maine. The report was prepared in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

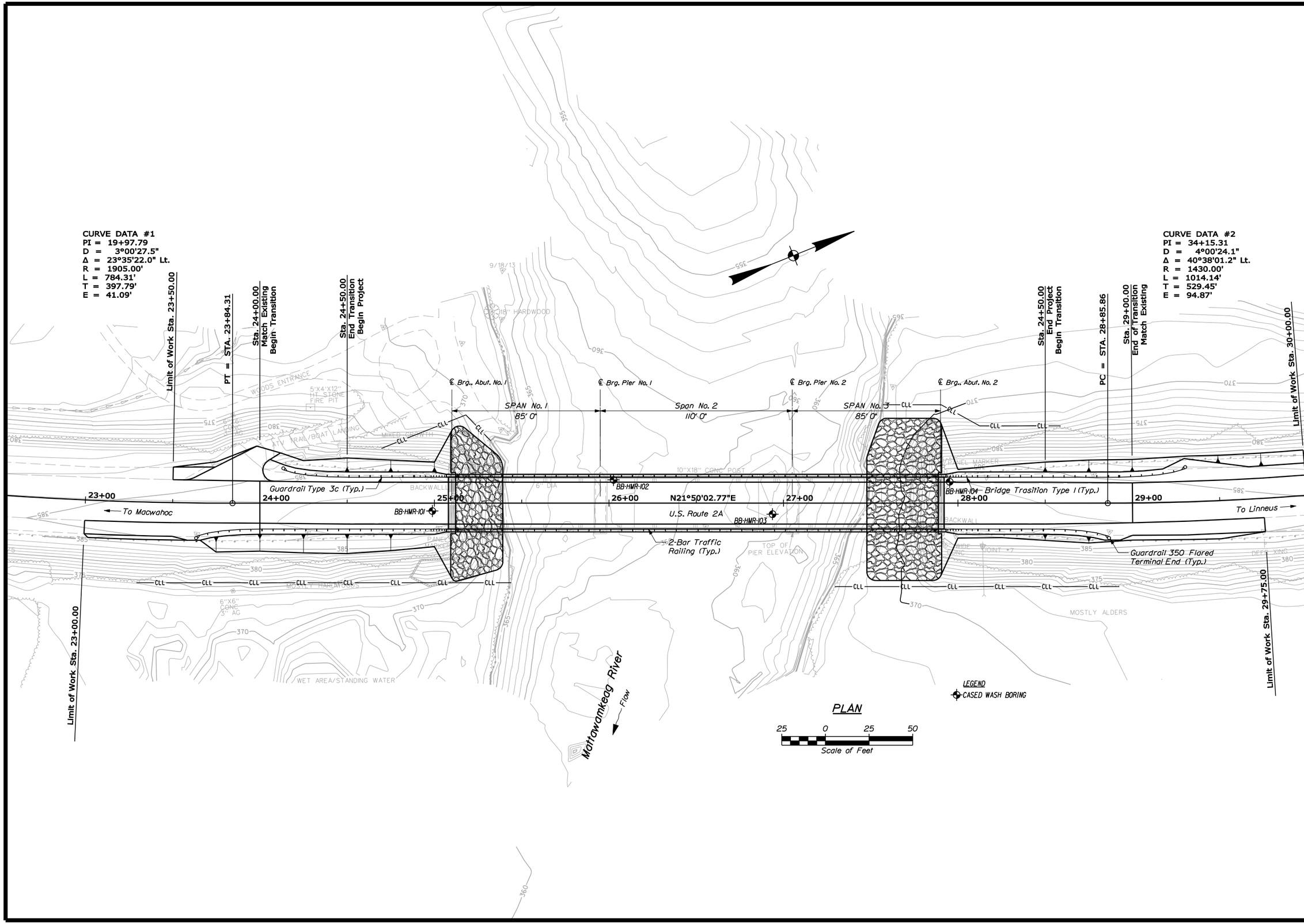
MaineDOT conducted a limited number of soil explorations at discrete locations near the existing bridge and a limited number of laboratory tests. MaineDOT shall not be responsible for the bidder's or contractor's interpretations of, estimates or conclusions derived from the geotechnical information. Data provided may not be representative of the subsurface conditions between boring locations.

Sheets



Map Scale 1:24000

The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch. Road names used on this map may not match official road names.



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

STP-2050(900)

WIN 20509.00

BRIDGE NO. 5623

BRIDGE PLANS

		BY	DATE
PROJ. MANAGER	S. BOOKE		
DESIGN-DETAILED	R. MYERS	G. LIBBY	
CHECKED-REVIEWED	R. MEYERS	-----	
DESIGN2-DETAILED2	L. KRUSINSKI	T. WHITE	JUN 2014
DESIGN3-DETAILED3	-----	-----	-----
REVISIONS 1	-----	-----	-----
REVISIONS 2	-----	-----	-----
REVISIONS 3	-----	-----	-----
REVISIONS 4	-----	-----	-----
FIELD CHANGES	-----	-----	-----

SIGNATURE

P.E. NUMBER

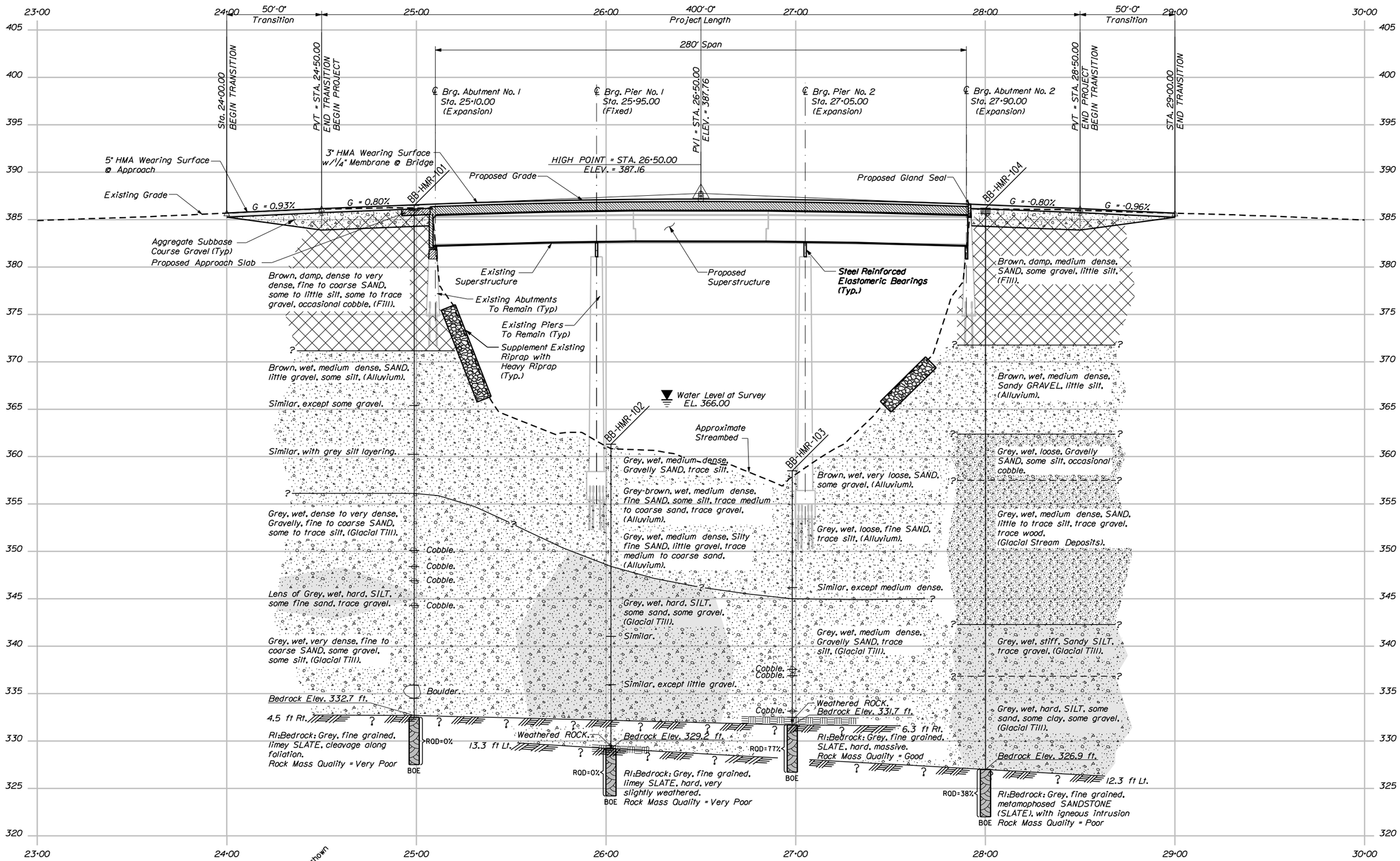
DATE

HAYNESVILLE BRIDGE
MATTAWAMKEAG RIVER
HAYNESVILLE AROOSTOOK COUNTY

BORING LOCATION PLAN

SHEET NUMBER
2
OF 4

Filename: ...\00\geotech\msto\006_BLP1.dgn Division: GEOTECH Username: terry.white Date:10/28/2015



LEGEND

Boring No. Offset, if shown

Weathered ROCK

Pavement Thickness if applicable

Strata Interface

Top of Intack Bedrock

ROD= Rock Quality Designation for Rock Core Sample

Boring

BOE= Bottom Of Exploration

PROFILE

HORIZ 25 0 25 50

VERT 5 0 5 10

SCALE

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 transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

STP-2050(900)

WIN 20509.00

BRIDGE NO. 5623

BRIDGE PLANS

	BY	DATE
PROJ. MANAGER	S. BODGE	
DESIGN-DETAILED	R. MYERS	G. LIBBY
CHECKED-REVIEWED	R. MEYERS	----
DESIGN2-DETAILED2	L.KRUSINSKI	T.WHITE
DESIGN3-DETAILED3	----	SEPT 2015
REVISIONS 1	----	----
REVISIONS 2	----	----
REVISIONS 3	----	----
REVISIONS 4	----	----
FIELD CHANGES	----	----

SIGNATURE

P.E. NUMBER

DATE

HAYNESVILLE BRIDGE
MATTAWAMKEAG RIVER
HAYNESVILLE AROOSTOOK COUNTY

INTERPRETIVE SUBSURFACE PROFILE

SHEET NUMBER

3

OF 4

Filename: ...\00\geotech\msta\007_ISP1.dgn Division: GEOTECH Username: terry.white Date:10/28/2015

Filename: ...\msta\008_BORING LOGS1.dgn   Division: GEOTECH   Username: terry.white   Date:11/2/2015

Maine Department of Transportation — Soil/Rock Exploration Log — US CUSTOMARY UNITS

Boring No.: BB-HMR-101   WIN: 20509.00

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag
Location: Haynesville, Maine

Driller:	MaineDOT	Elevation (ft.)	386.5	Auger ID/OD:	5" Solid Stem
Operator:	Giles/Daggett/Giles	Datum:	NAVD88	Sampler:	Standard Split Spoon
Logged By:	B. Wilder	Rig Type:	CME 45C	Hammer Wt./Fall:	140#/30"
Date Start/Finish:	6/11/2014-6/12/2014	Drilling Method:	Cased Wash Boring	Core Barrel:	NQ-2"
Boring Location:	24+98.8, 4.5 ft Rt.	Casing ID/OD:	NW	Water Level*:	20.0 ft bgs.
Hammer Efficiency Factor: 0.867		Hammer Type:	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows
0							SSA
1	1D	24/19	1.00 - 3.00	17/16/13/11	29	42	
5	2D/A	24/16	5.00 - 7.00	3/23/46/10	69	100	
10	3D	24/15	10.00 - 12.00	5/6/9/7	15	22	24
11							30
12							33
13							34
14							34
15	4D	24/14	15.00 - 17.00	9/9/9/10	18	26	21
16							37
17							61
18							53
19							27
20	5D	24/14	20.00 - 22.00	4/4/4/4	8	12	9
21							22
22							31
23							42
24							54
25	6D	24/13	25.00 - 27.00	9/9/10/15	19	27	23
26							57
27							53
28							52
29							92
30	7D	24/10	30.00 - 32.00	16/14/9/11	23	33	33
31							59
32							62
33							57
34							69
35	8D	12/4	35.00 - 36.00	20/60	---		46
36							333
37							177
38							140
39							191
40	9D	24/13	40.00 - 42.00	11/21/26/50	47	68	35
41							219
42							289
43							342
44							52
45	10D	24/14	45.00 - 47.00	6/17/28/2245	45	65	67
46							112
47							257
48							274
49							156
50	MD	1.2/0	50.50 - 50.60	50(1.2")	---		a70
54	R1	60/59	54.00 - 59.00	RQD = 0%			NQ-2

Visual Description and Remarks (Elevation (ft.) / Depth) and Laboratory Testing Results/AASHTO and Unified Class:

- 6.5" PAVEMENT. — 385.96 / 0.54
- Brown, damp, dense, gravelly, fine to coarse SAND, little silt, occasional cobbles, (Fill).
- 2D (5.0-6.5 ft bgs) Brown, damp, very dense, fine to coarse SAND, some gravel, little silt, occasional cobble, (Fill). — G#243186 A-1-b, SM WC=7.1% — 380.00 / 6.50
- 2D/A (6.5-7.0 ft bgs) Brown, moist, silty, fine to coarse SAND, some gravel, (Fill). — 379.50 / 7.00
- Brown, damp, medium dense, fine to coarse SAND, some gravel, some silt, occasional cobble, (Fill). — 371.50 / 15.00
- Brown, wet, medium dense, fine to coarse SAND, little gravel, some silt, (Alluvium).
- Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, (similar to 4D), (Alluvium). — G#243187 A-1-b, SM WC=17.1%
- Similar to above, with iron staining, some grey silt layering. — 357.00 / 29.50
- Grey, wet, dense, Gravelly, fine to coarse SAND, some silt, (Glacial Till).
- Grey, wet, very dense, Gravelly, fine to coarse SAND, trace silt, (Glacial Till).
- Roller Coned ahead to 40.0 ft bgs. Cobble from 36.0-36.7 ft bgs.
- Cobble from 38.0-38.2 ft bgs.
- Cobble from 39.5-39.8 ft bgs. — 346.50 / 40.00
- Grey, wet, hard, SILT, some fine sand, trace gravel. — G#243188 A-4, CL WC=15.4%
- Roller Coned ahead to 45.0 ft bgs.
- Cobble from 42.1-42.4 ft bgs.
- Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (Glacial Till). — G#243189 A-2-4, SM WC=9.3%
- Roller Coned ahead to 50.5 ft bgs.
- a70 blows for 0.5 ft.
- Boulder from 50.6-52.0 ft bgs. — 332.70 / 53.80
- Top of Bedrock at Elev. 332.7 ft. — 332.50 / 54.00
- R1:Bedrock: Grey, fine grained, limey SLATE, occassional calcite veins, microfaults evidence rock has be sheared, no apparent jointing; cleavage along foliation. Allsbury Formation. Rock Mass Quality = Very Poor.
- R1:Core Times (min:sec)
  - 54.0-55.0 ft (7:13)
  - 55.0-56.0 ft (4:35)
  - 56.0-57.0 ft (5:40)
  - 57.0-58.0 ft (9:17)
  - 58.0-59.0 ft (8:07) 98% Recovery — 327.50 / 59.00
- Bottom of Exploration at 59.00 feet below ground surface.

Remarks:

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.

Page 1 of 1   Boring No.: BB-HMR-101

Boring No.: BB-HMR-102   WIN: 20509.00

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag
Location: Haynesville, Maine

Driller:	MaineDOT	Elevation (ft.)	361.3	Auger ID/OD:	N/A
Operator:	Giles/Daggett/Giles	Datum:	NAVD88	Sampler:	Standard Split Spoon
Logged By:	B. Wilder	Rig Type:	CME 45C	Hammer Wt./Fall:	140#/30"
Date Start/Finish:	6/4/2014-6/5/2014	Drilling Method:	Cased Wash Boring	Core Barrel:	NQ-2"
Boring Location:	26+02.6, 13.3 ft Lt.	Casing ID/OD:	NW	Water Level*:	River Boring
Hammer Efficiency Factor: 0.867		Hammer Type:	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions: D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample attempt; V = Insitu Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Insitu Vane Shear Test attempt; R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = weight of 140lb. hammer; WOR/C = weight of rods or casing; WO1P = Weight of one person; S_u = Insitu Field Vane Shear Strength (psf); T_v = Pocket Torvane Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw field SPT N-value; Hammer Efficiency Factor = Annual Calibration Value; N_{60} = SPT N-uncorrected corrected for hammer efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected; $S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows
0	1D	24/8	0.00 - 2.00	3/7/3/7	10	14	11
1							19
2							25
3							17
4	2D	24/16	4.00 - 6.00	4/4/4/5	8	12	6
5							14
6							22
7							15
8							31
9	3D	24/15	9.00 - 11.00	3/4/7/14	11	16	2
10							19
11							119
12							119
13							79
14	4D	24/14	14.00 - 16.00	23/16/13/13	29	42	49
15							75
16							83
17							179
18							103
19	5D	12/12	19.00 - 20.00	34/57	---		50
20							45
21							44
22							37
23							102
24	6D	12/11	24.00 - 25.00	45/70	---		80
25							39
26							53
27							54
28							104
29	7D	6/6	29.00 - 29.50	60	---		OPEN HOLE
32	R1	60/60	32.10 - 37.10	RQD = 0%			NQ-2

Visual Description and Remarks (Elevation (ft.) / Depth) and Laboratory Testing Results:

- Grey, wet, medium dense, gravelly, fine to coarse SAND, trace silt, (Alluvium). — 358.30 / 3.00
- Grey-brown, wet, medium dense, fine SAND, some silt, trace medium to coarse sand, trace gravel, (Alluvium). — G#243191 A-2-4, SM WC=27.7%
- Grey, wet, medium dense, Silty, fine SAND, little gravel, trace medium to coarse sand, (Alluvium). — G#242669 A-4, SM WC=16.6% — 348.30 / 13.00
- Grey, moist, dense, fine to coarse Sandy, GRAVEL, little silt, (Glacial Till). — G#245375 A-1-a, GW-GM WC=7.4% — 343.80 / 17.50
- Roller Coned ahead from 18.1-19.0 ft bgs.
- Grey, wet, hard, SILT, some fine to coarse sand, some gravel, (Glacial Till). Roller Coned ahead to 24.0 ft bgs. — G#243192 A-4, SM WC=7.9%
- Similar to above. Roller Coned ahead to 29.0 ft bgs.
- Grey, wet, hard, SILT, some sand, little gravel, (Glacial Till). Roller Coned ahead to 32.1 ft bgs. — G#243311 A-4, ML WC=9.1% — 329.50 / 31.80
- Weathered ROCK. — 329.20 / 32.10
- Top of Intack Bedrock at Elev. 329.2 ft.
- R1: Bedrock: Grey, fine grained, limey SLATE, hard, very slightly weathered, no apparent jointing, cleavage along steeply dipping foliation, occassion microfaults and calcite veins. Allsbury Formation. Rock Mass Quality = Very Poor.
- R1:Core Times (min:sec)
  - 32.1-33.1 ft (6:00)
  - 33.1-34.1 ft (4:31)
  - 34.1-35.1 ft (3:40)
  - 35.1-36.1 ft (3:40)
  - 36.1-37.1 ft (4:00) 100% Recovery — 324.20 / 37.10
- Bottom of Exploration at 37.10 feet below ground surface.

Remarks:

25.4 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.

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.

Page 1 of 1   Boring No.: BB-HMR-102

Boring No.: BB-HMR-103   WIN: 20509.00

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag
Location: Haynesville, Maine

Driller:	MaineDOT	Elevation (ft.)	358.5	Auger ID/OD:	N/A
Operator:	Giles/Daggett/Giles	Datum:	NAVD88	Sampler:	Standard Split Spoon
Logged By:	B. Wilder	Rig Type:	CME 45C	Hammer Wt./Fall:	140#/30"
Date Start/Finish:	6/12.16/2014	Drilling Method:	Cased Wash Boring	Core Barrel:	NQ-2"
Boring Location:	26+93.7, 6.3 ft Rt.	Casing ID/OD:	NW	Water Level*:	River Boring
Hammer Efficiency Factor: 0.867		Hammer Type:	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions: D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample attempt; V = Insitu Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Insitu Vane Shear Test attempt; R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = weight of 140lb. hammer; WOR/C = weight of rods or casing; WO1P = Weight of one person; S_u = Insitu Field Vane Shear Strength (psf); T_v = Pocket Torvane Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw field SPT N-value; Hammer Efficiency Factor = Annual Calibration Value; N_{60} = SPT N-uncorrected corrected for hammer efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected; $S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows
0	1D	24/12	0.00 - 2.00	1/1/1/1	2	3	1
1							2
2							5
3							4
4							9
5							13
6	2D	24/17	6.00 - 8.00	4/4/3/4	7	10	1
7							9
8							13
9							16
10							12
11	3D	24/14	11.00 - 13.00	4/4/5/16	9	13	4
12							26
13							64
14							62
15							42
16	4D	24/6	16.00 - 18.00	9/9/8/8	17	25	31
17							48
18							51
19							58
20							125
21	MD	1.2/0	21.30 - 21.40	50	---		74
22							111
23							96
24							83
25							a150
26	R1	60/60	26.80 - 31.80	RQD = 77%			NQ-2

Visual Description and Remarks (Elevation (ft.) / Depth) and Laboratory Testing Results:

- Brown, wet, very loose, fine to medium SAND, some silt, trace coarse sand, some gravel, (Alluvium). — G#243312 A-2-4, SM WC=27.7%
- Grey, wet, loose, fine SAND, trace silt, (Alluvium). — DS#302135 2D & 3D combined. c=0.81 psi Phi=30.5 degrees
- Similar to above, except medium dense. — 345.00 / 13.50
- Grey, wet, medium dense, gravelly, fine to coarse SAND, trace silt, (Glacial Till). — G#243313 A-1-a, SW-SM WC=10.6%
- Cobble from 20.8-21.3 ft bgs. Failed sample attempt. Cobble from 21.3-21.6 ft bgs. Roller Coned ahead to 25.0 ft bgs.
- a150 blows for 0.2 ft. Cobble from 25.2-25.6 ft bgs. Roller Coned ahead to 26.8 ft bgs. — 332.50 / 26.00
- Weathered ROCK. — 331.70 / 26.80
- Top of Intact Bedrock at Elev. 331.7 ft.
- R1:Bedrock: Grey, fine grained, SLATE, hard, massive, jointing widely spaced at 4 to 5 ft, cleavage along foliation. Allsbury Formation. Rock Mass Quality = Good.
- R1:Core Times (min:sec)
  - 26.8-27.8 ft (11:40)
  - 27.8-28.8 ft (6:16)
  - 28.8-29.8 ft (5:45)
  - 29.8-30.8 ft (5:32)
  - 30.8-31.8 ft (5:25) 100% Recovery — 326.70 / 31.80
- Bottom of Exploration at 31.80 feet below ground surface.

Remarks:

27.9 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.
DS=Direct Shear, C=Cohesion, FA=Friction Angle

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.

Page 1 of 1   Boring No.: BB-HMR-103

Boring No.: BB-HMR-104   WIN: 20509.00

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag
Location: Haynesville, Maine

Driller:	MaineDOT	Elevation (ft.)	386.1	Auger ID/OD:	N/A
Operator:	Giles/Daggett/Giles	Datum:	NAVD88	Sampler:	Standard Split Spoon
Logged By:	B. Wilder	Rig Type:	CME 45C	Hammer Wt./Fall:	140#/30"
Date Start/Finish:	6/16/2014-6/17/2014	Drilling Method:	Cased Wash Boring	Core Barrel:	NQ-2"
Boring Location:	27+95.2, 12.3 ft Lt.	Casing ID/OD:	NW	Water Level*:	21.0 ft bgs.
Hammer Efficiency Factor: 0.867		Hammer Type:	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions: D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample attempt; V = Insitu Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Insitu Vane Shear Test attempt; R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = weight of 140lb. hammer; WOR/C = weight of rods or casing; WO1P = Weight of one person; S_u = Insitu Field Vane Shear Strength (psf); T_v = Pocket Torvane Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw field SPT N-value; Hammer Efficiency Factor = Annual Calibration Value; N_{60} = SPT N-uncorrected corrected for hammer efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected; $S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows
0							SSA
5	1D	24/15	5.00 - 7.00	5/13/7/7	20	29	
10	2D	24/19	10.00 - 12.00	6/8/11/11	19	27	85
11							52
12							54
13							46
14							38
15	3D	24/13	15.00 - 17.00	6/7/6/9	13	19	22
16							26
17							31
18							35
19							37
20	4D	24/13	20.00 - 22.00	7/10/7/6	17	25	18
21							35
22							42
23							55
24							43
25	5D	24/12	25.00 - 27.00	9/3/2/7	5	7	16
26							58
27							91
28							65
29							38
30	6D	24/14	30.00 - 32.00	7/4/6/7	10	14	21
31							39
32							41
33							42
34							45
35	7D	24/15	35.00 - 37.00	4/4/5/6	9	13	20
36							29
37							40
38							43
39							58
40	8D	24/16	40.00 - 42.00	4/5/5/7	10	14	21
41							33
42							53
43							71
44							74
45	9D	24/18	45.00 - 47.00	3/3/5/6	8	12	29
46							39
47							45
48							167
49							396
50	10D	12/12	50.00 - 51.00	47/55	---		108
51							81
52							59
53							118
54							159
55	11D	24/20	55.00 - 57.00	32/48/45/60	93	134	RC
59	R1	60/60	59.20 - 64.20	RQD = 38%			NQ-2

Visual Description and Remarks (Elevation (ft.) / Depth) and Laboratory Testing Results:

- 7" PAVEMENT. — 385.52 / 0.58
- Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).
- Similar to above, (Fill). — G#243195 A-1-b, SM WC=4.8% — 372.10 / 14.00
- Brown, wet, medium dense, fine to coarse Sandy, GRAVEL, little silt, (Alluvium). — G#243314 combined w/ 4D A-1-a, GM WC=11.6%
- Similar to above. — G#243314 combined w/ 3D A-1-a, GM WC=11.6% — 362.10 / 24.00
- Grey, wet, loose, gravelly, fine to coarse SAND, some silt, occasional cobble, (Glacial Stream Deposits). — 357.60 / 28.50
- Grey, wet, medium dense, fine to medium SAND, little silt, trace coarse sand, trace gravel, trace wood, (Glacial Stream Deposits). — G#243196 A-2-4, SM WC=23.1%
- Grey, wet, medium dense, fine to medium SAND, trace coarse sand, trace gravel, trace silt, (Glacial Stream Deposits). — G#243197 A-3, SP-SM WC=20.8%
- Similar to above. — 343.10 / 43.00
- Grey, wet, stiff, Sandy SILT, trace gravel, (Glacial Till). — G#243198 A-4, ML WC=22.9%
- Grey, wet, hard, SILT, some sand, some clay, little gravel, (Glacial Till). Roller Coned ahead to 55.0 ft bgs. — G#243200 A-4, CL WC=9.2% LL=23 PL=15 PI=8
- Similar to above, (Glacial Till). — 326.90 / 59.20
- Top of Bedrock at Elev. 326.9 ft.
- R1:Bedrock: Upper 3 ft of core, grey, fine grained, SLATE, joint set at 1-2 ft, surfaces weathered, rust staining and pyrite veins, with igneous intrusion in lower 2-feet of core run. Allsbury Formation. Rock Mass Quality = Poor.
- R1:Core Times (min:sec)
  - 59.2-60.2 ft (5:27)
  - 60.2-61.2 ft (5:33)
  - 61.2-62.2 ft (5:33)
  - 62.2-63.2 ft (5:54)
  - 63.2-64.2 ft (5:45) 100% Recovery — 321.90 / 64.20
- Bottom of Exploration at 64.20 feet below ground surface.

Remarks:

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.

Page 1 of 1   Boring No.: BB-HMR-104

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

STP-2050(900)

BRIDGE PLANS
WIN 20509.00
BRIDGE NO. 5623

	BY	DATE
PROJ. MANAGER	S. BODGE	
DESIGN-DETAILED	R. MYERS	G. LIBBY
CHECKED-REVIEWED	R. MEYERS	-----
DESIGN2-DETAILED2	L.KRUSINSKI	T.WHITE	NOV 2015
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE
P.E. NUMBER
DATE

HAYNESVILLE BRIDGE
MATTAWAMKEAG RIVER
HAYNESVILLE AROOSTOOK COUNTY

BORING LOGS

SHEET NUMBER
4
OF 4

Appendix A

Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly-graded sands, gravelly sand, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Desired Soil Observations: (in this order)

Color (Munsell color chart)
Moisture (dry, damp, moist, wet, saturated)
Density/Consistency (from above right hand side)
Name (sand, silty sand, clay, etc., including portions - trace, little, etc.)
Gradation (well-graded, poorly-graded, uniform, etc.)
Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic)
Structure (layering, fractures, cracks, etc.)
Bonding (well, moderately, loosely, etc., if applicable)
Cementation (weak, moderate, or strong, if applicable, ASTM D 2488)
Geologic Origin (till, marine clay, alluvium, etc.)
Unified Soil Classification Designation
Groundwater level

TERMS DESCRIBING DENSITY/CONSISTENCY

Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) silty or clayey gravels; and (3) silty, clayey or gravelly sands. Consistency is rated according to standard penetration resistance.

Modified Burmister System

Descriptive Term	Portion of Total
trace	0% - 10%
little	11% - 20%
some	21% - 35%
adjective (e.g. sandy, clayey)	36% - 50%

Density of Cohesionless Soils	Standard Penetration Resistance N-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) gravelly, sandy or silty clays; and (3) clayey silts. Consistency is rated according to shear strength as indicated.

Consistency of Cohesive soils	SPT N-Value blows per foot	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	WOH, WOR, WOP, <2	0 - 250	Fist easily Penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnai
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$RQD = \frac{\text{sum of the lengths of intact pieces of core* > 100 mm}}{\text{length of core advance}}$$

*Minimum NQ rock core (1.88 in. OD of core)

Correlation of RQD to Rock Mass Quality

Rock Mass Quality	RQD
Very Poor	<25%
Poor	26% - 50%
Fair	51% - 75%
Good	76% - 90%
Excellent	91% - 100%

Desired Rock Observations: (in this order)

Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Lithology (igneous, sedimentary, metamorphic, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
- -dip (horiz - 0-5, low angle - 5-35, mod. dipping - 35-55, steep - 55-85, vertical - 85-90)
- -spacing (very close - <5 cm, close - 5-30 cm, mod. close 30-100 cm, wide - 1-3 m, very wide >3 m)
- -tightness (tight, open or healed)
- -infilling (grain size, color, etc.)

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock mass quality (very poor, poor, etc.)
ref: AASHTO Standard Specification for Highway Bridges 17th Ed. Table 4.4.8.1.2A
Recovery

Maine Department of Transportation
Geotechnical Section
Key to Soil and Rock Descriptions and Terms
Field Identification Information

Sample Container Labeling Requirements:

PIN	Blow Counts
Bridge Name / Town	Sample Recovery
Boring Number	Date
Sample Number	Personnel Initials
Sample Depth	

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-101
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/11/2014-6/12/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	24+98.8, 4.5 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	20.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	385.96	6½" PAVEMENT. 0.54	
	1D	24/19	1.00 - 3.00	17/16/13/11	29	42			Brown, damp, dense, gravelly, fine to coarse SAND, little silt, occasional cobbles, (Fill).	
5	2D/A	24/16	5.00 - 7.00	3/23/46/10	69	100			2D (5.0-6.5 ft bgs) Brown, damp, very dense, fine to coarse SAND, some gravel, little silt, occasional cobble, (Fill).	G#243186 A-1-b, SM WC=7.1%
								380.00	6.50 2D/A (6.5-7.0 ft bgs) Brown, moist, silty, fine to coarse SAND, some gravel, (Fill).	
10	3D	24/15	10.00 - 12.00	5/6/9/7	15	22	24		Brown, damp, medium dense, fine to coarse SAND, some gravel, some silt, occasional cobble, (Fill).	
							30			
							33			
							34			
							34			
15	4D	24/14	15.00 - 17.00	9/9/9/10	18	26	21	371.50	15.00 Brown, wet, medium dense, fine to coarse SAND, little gravel, some silt, (Alluvium).	
							37			
							61			
							53			
							27			
20	5D	24/14	20.00 - 22.00	4/4/4/4	8	12	9		Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt. (similar to 4D), (Alluvium).	G#243187 A-1-b, SM WC=17.1%
							22			
							31			
							42			
25							54			

Remarks:

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Boring No.: BB-HMR-101

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-101
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/11/2014-6/12/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	24+98.8, 4.5 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	20.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	6D	24/13	25.00 - 27.00	9/9/10/15	19	27	23			Similar to above, with iron staining, some grey silt layering.	
							57				
							53				
							52				
							92	357.00		29.50	
30	7D	24/10	30.00 - 32.00	16/14/9/11	23	33	33			Grey, wet, dense, Gravelly, fine to coarse SAND, some silt, (Glacial Till).	
							59				
							62				
							57				
							69				
35	8D	12/4	35.00 - 36.00	20/60	---		46			Grey, wet, very dense, Gravelly, fine to coarse SAND, trace silt, (Glacial Till).	
							333			Roller Coned ahead to 40.0 ft bgs. Cobble from 36.0-36.7 ft bgs.	
							177				
							140			Cobble from 38.0-38.2 ft bgs.	
							191			Cobble from 39.5-39.8 ft bgs.	
40	9D	24/13	40.00 - 42.00	11/21/26/50	47	68	35	346.50		40.00 Grey, wet, hard, SILT, some fine sand, trace gravel.	G#243188 A-4, CL WC=15.4%
							219			Roller Coned ahead to 45.0 ft bgs.	
							289			Cobble from 42.1-42.4 ft bgs.	
							342				
							52				
45	10D	24/14	45.00 - 47.00	6/17/28/2245	45	65	67			Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (Glacial Till). Roller Coned ahead to 50.5 ft bgs.	G#243189 A-2-4, SM WC=9.3%
							112				
							257				
							274				
50							156				

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-101
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/11/2014-6/12/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	24+98.8, 4.5 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	20.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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RC = Roller Cone
WOH = weight of 140lb. hammer
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WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
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N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
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-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50	MD	1.2/0	50.50 - 50.60	50(1.2")	---		[a]70			[a]70 blows for 0.5 ft. Boulder from 50.6-52.0 ft bgs.	
								332.70		53.80	
	R1	60/59	54.00 - 59.00	RQD = 0%			NQ-2	332.50		Top of Bedrock at Elev. 332.7 ft. 54.00 R1:Bedrock: Grey, fine grained, limey SLATE, occassional calcite veins, microfaults evidence rock has be sheared, no apparent jointing; cleavage along foliation. Allsbury Formation. Rock Mass Quality = Very Poor. R1:Core Times (min:sec) 54.0-55.0 ft (7:13) 55.0-56.0 ft (4:35) 56.0-57.0 ft (5:40) 57.0-58.0 ft (9:17) 58.0-59.0 ft (8:07) 98% Recovery	
55								327.50		59.00 **Bottom of Exploration at 59.00 feet below ground surface.**	
60											
65											
70											
75											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-102
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	361.3	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/4/2014-6/5/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	26+02.6, 13.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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WOH = weight of 140lb. hammer
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WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
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N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/8	0.00 - 2.00	3/7/3/7	10	14	11		Grey, wet, medium dense, gravelly, fine to coarse SAND, trace silt, (Alluvium).	
							19			
							25			
							17	358.30	3.00	
	2D	24/16	4.00 - 6.00	4/4/4/5	8	12	6		Grey-brown, wet, medium dense, fine SAND, some silt, trace medium to coarse sand, trace gravel, (Alluvium).	G#243191 A-2-4, SM WC=27.7%
5							14			
							22			
							15			
							31			
	3D	24/15	9.00 - 11.00	3/4/7/14	11	16	2		Grey, wet, medium dense, Silty, fine SAND, little gravel, trace medium to coarse sand, (Alluvium).	G#242669 A-4, SM WC=16.6%
10							19			
							119			
							119			
							79	348.30	13.00	
	4D	24/14	14.00 - 16.00	23/16/13/13	29	42	49		Grey, moist, dense, fine to coarse Sandy, GRAVEL, little silt, (Glacial Till).	G#245375 A-1-a, GW-GM WC=7.4%
15							75			
							83			
							179	343.80	17.50	
							103		Roller Coned ahead from 18.1-19.0 ft bgs.	
	5D	12/12	19.00 - 20.00	34/57	---		50		Grey, wet, hard, SILT, some fine to coarse sand, some gravel, (Glacial Till).	G#243192 A-4, SM WC=7.9%
20							45		Roller Coned ahead to 24.0 ft bgs.	
							44			
							37			
							102			
25	6D	12/11	24.00 - 25.00	45/70	---		80		Similar to above. Roller Coned ahead to 29.0 ft bgs.	

Remarks:

25.4 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-102
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	361.3	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/4/2014-6/5/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	26+02.6, 13.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
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Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							39				
							53				
							54				
							104				
	7D	6/6	29.00 - 29.50	60	---		OPEN HOLE			Grey, wet, hard, SILT, some sand, little gravel, (Glacial Till). Roller Coned ahead to 32.1 ft bgs.	G#243311 A-4, ML WC=9.1%
30											
								329.50		31.80	
								329.20		Weathered ROCK. 32.10	
	R1	60/60	32.10 - 37.10	RQD = 0%			NQ-2			Top of Intack Bedrock at Elev. 329.2 ft. R1: Bedrock: Grey, fine grained, limey SLATE, hard, very slightly weathered, no apparent jointing, cleavage along steeply dipping foliation, occassion microfaults and calcite veins. Allsbury Formation. Rock Mass Quality = Very Poor. R1:Core Times (min:sec) 32.1-33.1 ft (6:00) 33.1-34.1 ft (4:31) 34.1-35.1 ft (3:40) 35.1-36.1 ft (3:40) 36.1-37.1 ft (4:00) 100% Recovery	
35								324.20		37.10	
40										**Bottom of Exploration at 37.10 feet below ground surface.**	
45											
50											

Remarks:

25.4 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-103
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	358.5	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/12,16/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	26+93.7, 6.3 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.00 - 2.00	1/1/1/1	2	3	1		Brown, wet, very loose, fine to medium SAND, some silt, trace coarse sand, some gravel, (Alluvium).	G#243312 A-2-4, SM WC=27.7%
							2			
							5			
							4			
							9			
5							13			
	2D	24/17	6.00 - 8.00	4/4/3/4	7	10	1		Grey, wet, loose, fine SAND, trace silt, (Alluvium).	DS#302135 2D & 3D combined. c=0.81 psi Phi=30.5 degrees
							9			
							13			
							16			
10							12			
	3D	24/14	11.00 - 13.00	4/4/5/16	9	13	4		Similar to above, except medium dense.	
							26			
							64	345.00	13.50	
							62			
15							42			
	4D	24/6	16.00 - 18.00	9/9/8/8	17	25	31		Grey, wet, medium dense, gravelly, fine to coarse SAND, trace silt, (Glacial Till).	G#243313 A-1-a, SW-SM WC=10.6%
							48			
							51			
							58			
20							125			
	MD	1.2/0	21.30 - 21.40	50	---		74		Cobble from 20.8-21.3 ft bgs. Failed sample attempt. Cobble from 21.3-21.6 ft bgs. Roller Coned ahead to 25.0 ft bgs.	
							111			
							96			
25							83			

Remarks:

27.9 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.
DS=Direct Shear, C=Cohesion, FA=Friction Angle

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-103
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	358.5	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/12,16/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	26+93.7, 6.3 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
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-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							[a]150			[a]150 blows for 0.2 ft. Cobble from 25.2-25.6 ft bgs.	
								332.50		Roller Coned ahead to 26.8 ft bgs.	
	R1	60/60	26.80 - 31.80	RQD = 77%			NQ-2				
								331.70		26.00 Weathered ROCK.	
										26.80 Top of Intact Bedrock at Elev. 331.7 ft. R1:Bedrock: Grey, fine grained, SLATE, hard, massive, jointing widely spaced at 4 to 5 ft, cleavage along foliation. Allsbury Formation. Rock Mass Quality = Good. R1:Core Times (min:sec) 26.8-27.8 ft (11:40) 27.8-28.8 ft (6:16) 28.8-29.8 ft (5:45) 29.8-30.8 ft (5:32) 30.8-31.8 ft (5:25) 100% Recovery	
30								326.70		31.80 **Bottom of Exploration at 31.80 feet below ground surface.**	
35											
40											
45											
50											

Remarks:

27.9 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.
DS=Direct Shear, C=Cohesion, FA=Friction Angle

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-104
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.1	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/16/2014-6/17/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	27+95.2, 12.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	21.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	385.52		7" PAVEMENT. 0.58	
5	1D	24/15	5.00 - 7.00	5/13/7/7	20	29				Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	
10	2D	24/19	10.00 - 12.00	6/8/11/11	19	27	85			Similar to above, (Fill).	G#243195 A-1-b, SM WC=4.8%
							52				
							54				
							46				
							38	372.10		14.00	
15	3D	24/13	15.00 - 17.00	6/7/6/9	13	19	22			Brown, wet, medium dense, fine to coarse Sandy, GRAVEL, little silt, (Alluvium).	G#243314 combined w/4D A-1-a, GM WC=11.6%
							26				
							31				
							35				
							37				
20	4D	24/13	20.00 - 22.00	7/10/7/6	17	25	18			Similar to above.	G#243314 combined w/3D A-1-a, GM WC=11.6%
							35				
							42				
							55				
25							43	362.10		24.00	

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-104
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.1	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/16/2014-6/17/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	27+95.2, 12.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	21.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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SSA = Solid Stem Auger
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S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
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-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	5D	24/12	25.00 - 27.00	9/3/2/7	5	7	16			Grey, wet, loose, gravelly, fine to coarse SAND, some silt, occasional cobble, (Glacial Stream Deposits).	
							58				
							91				
							65	357.60		28.50	
							38				
30	6D	24/14	30.00 - 32.00	7/4/6/7	10	14	21			Grey, wet, medium dense, fine to medium SAND, little silt, trace coarse sand, trace gravel, trace wood, (Glacial Stream Deposits).	G#243196 A-2-4, SM WC=23.1%
							39				
							41				
							42				
							45				
35	7D	24/15	35.00 - 37.00	4/4/5/6	9	13	20			Grey, wet, medium dense, fine to medium SAND, trace coarse sand, trace gravel, trace silt. (Glacial Stream Deposits).	G#243197 A-3, SP-SM WC=20.8%
							29				
							40				
							43				
							58				
40	8D	24/16	40.00 - 42.00	4/5/5/7	10	14	21			Similar to above.	
							33				
							53				
							71	343.10		43.00	
							74				
45	9D	24/18	45.00 - 47.00	3/3/5/6	8	12	29			Grey, wet, stiff, Sandy SILT, trace gravel. (Glacial Till).	G#243198 A-4, ML WC=22.9%
							39				
							45				
							167				
50							396				

Remarks:

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-104
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.1	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/16/2014-6/17/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	27+95.2, 12.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	21.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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SSA = Solid Stem Auger
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N-uncorrected = Raw field SPT N-value
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$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
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-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50	10D	12/12	50.00 - 51.00	47/55	---		108			Grey, wet, hard, SILT, some sand, some clay, little gravel, (Glacial Till).	G#243200 A-4, CL WC=9.2% LL=23 PL=15 PI=8
							81			Roller Coned ahead to 55.0 ft bgs.	
							59				
							118				
							159				
55	11D	24/20	55.00 - 57.00	32/48/45/60	93	134	RC			Similar to above, (Glacial Till).	
								326.90		59.20	
	R1	60/60	59.20 - 64.20	RQD = 38%			NQ-2			Top of Bedrock at Elev. 326.9 ft. R1:Bedrock: Upper 3 ft of core, grey, fine grained, SLATE, joint set at 1-2 ft, surfaces weathered, rust staining and pyrite veins, with igneous intrusion in lower 2-feet of core run. Allsbury Formation. Rock Mass Quality = Poor. R1:Core Times (min:sec) 59.2-60.2 ft (5:27) 60.2-61.2 ft (5:33) 61.2-62.2 ft (5:33) 62.2-63.2 ft (5:54) 63.2-64.2 ft (5:45) 100% Recovery	
60								321.90		64.20	
65										**Bottom of Exploration at 64.20 feet below ground surface.**	
70											
75											

Remarks:

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.

Appendix B

Laboratory Test Results

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Haynesville Work Number: 20509.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C. %	L.L.	P.I.	Classification Unified	Classification AASHTO	Classification Frost
BB-HMR-101, 2D	24+98.8	4.5 Rt.	5.0-6.5	243186	1	7.1			SM	A-1-b	II
BB-HMR-101, 5D	24+98.8	4.5 Rt.	20.0-22.0	243187	1	17.1			SM	A-1-b	II
BB-HMR-101, 9D	24+98.8	4.5 Rt.	40.0-42.0	243188	1	15.4			CL	A-4	IV
BB-HMR-101, 10D	24+98.8	4.5 Rt.	45.0-47.0	243189	1	9.3			SM	A-2-4	II
BB-HMR-102, 2D	26+02.6	13.3 Lt.	4.0-6.0	243191	2	27.7			SM	A-2-4	II
BB-HMR-102, 3D	26+02.6	13.3 Lt.	9.0-11.0	242669	2	16.6			SM	A-4	III
BB-HMR-102, 4D	26+02.6	13.3 Lt.	14.0-16.0	245375	2	7.4			GW-GM	A-1-a	0
BB-HMR-102, 5D	26+02.6	13.3 Lt.	19.0-20.0	243192	2	7.9			SM	A-4	III
BB-HMR-102, 7D	26+02.6	13.3 Lt.	29.0-29.5	243311	2	9.1			ML	A-4	IV
BB-HMR-103, 1D	26+93.7	6.3 Rt.	0.0-2.0	243312	3	27.7			SM	A-2-4	II
BB-HMR-103, 4D	26+93.7	6.3 Rt.	16.0-18.0	243313	3	10.6			SW-SM	A-1-a	0
BB-HMR-104, 2D	27+95.2	12.3 Lt.	10.0-12.0	243195	4	4.8			SM	A-1-b	II
BB-HMR-104, 3D/4D	27+95.2	12.3 Lt.	15.0-17.0	243314	4	11.6			GM	A-1-a	0
			20.0-22.0	---							
BB-HMR-104, 6D	27+95.2	12.3 Lt.	30.0-32.0	243196	4	23.1			SM	A-2-4	II
BB-HMR-104, 7D	27+95.2	12.3 Lt.	35.0-37.0	243197	4	20.8			SP-SM	A-3	0
BB-HMR-104, 9D	27+95.2	12.3 Lt.	45.0-47.0	243198	4	22.9			ML	A-4	IV
BB-HMR-104, 10D	27+95.2	12.3 Lt.	50.0-51.0	243200	4	9.2	23	8	CL	A-4	IV
						Direct Shear					
BB-HMR-103, 2D&3D	26+93.7	6.3 Rt.	6.0-8.0	302135	---	C=0.81 psi			FA=30.5 degrees		
			11.0-13.0								

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MaineDOT and Corps of Engineers Classification Systems.

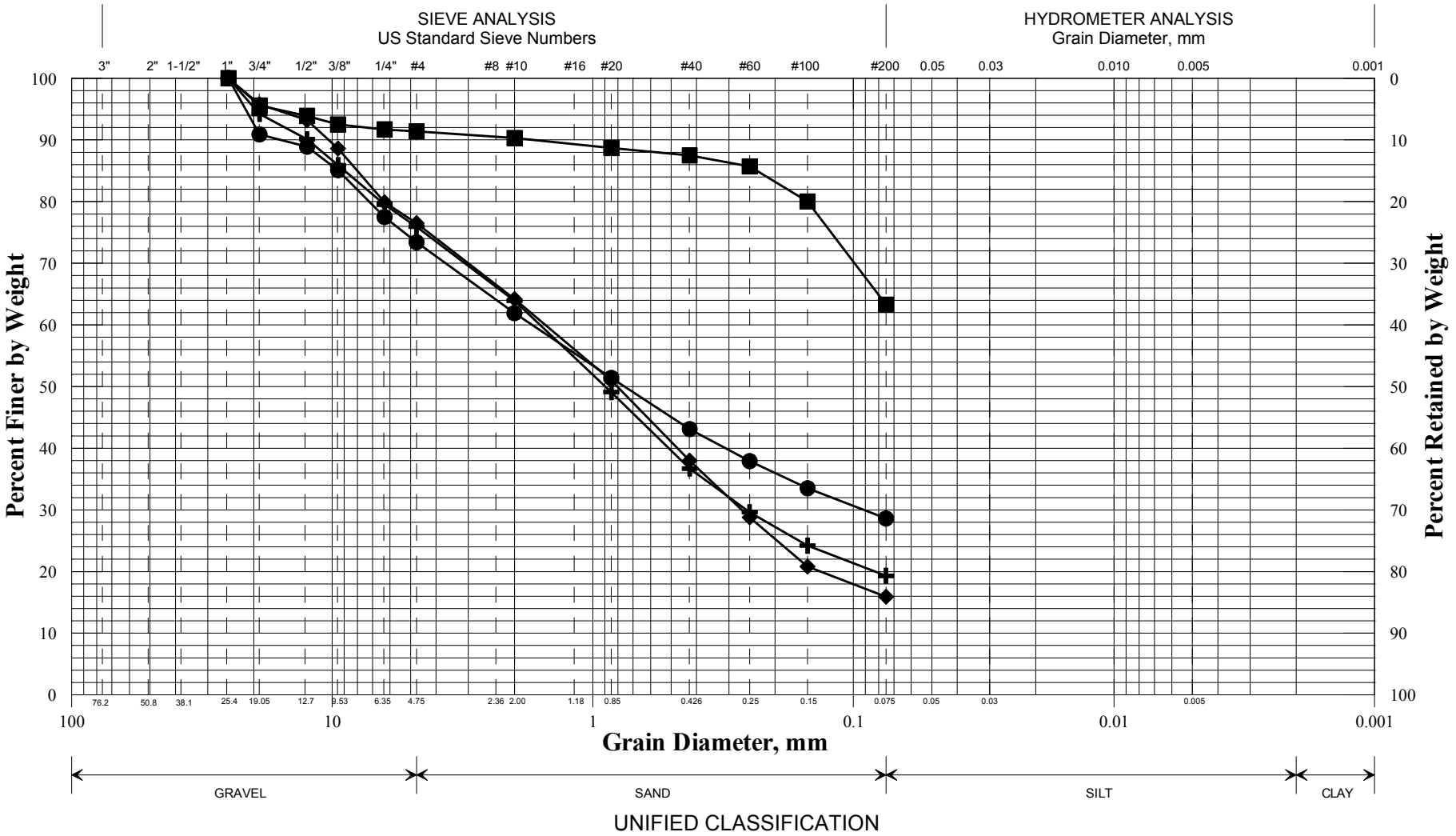
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-98 NP = Non Plastic

PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



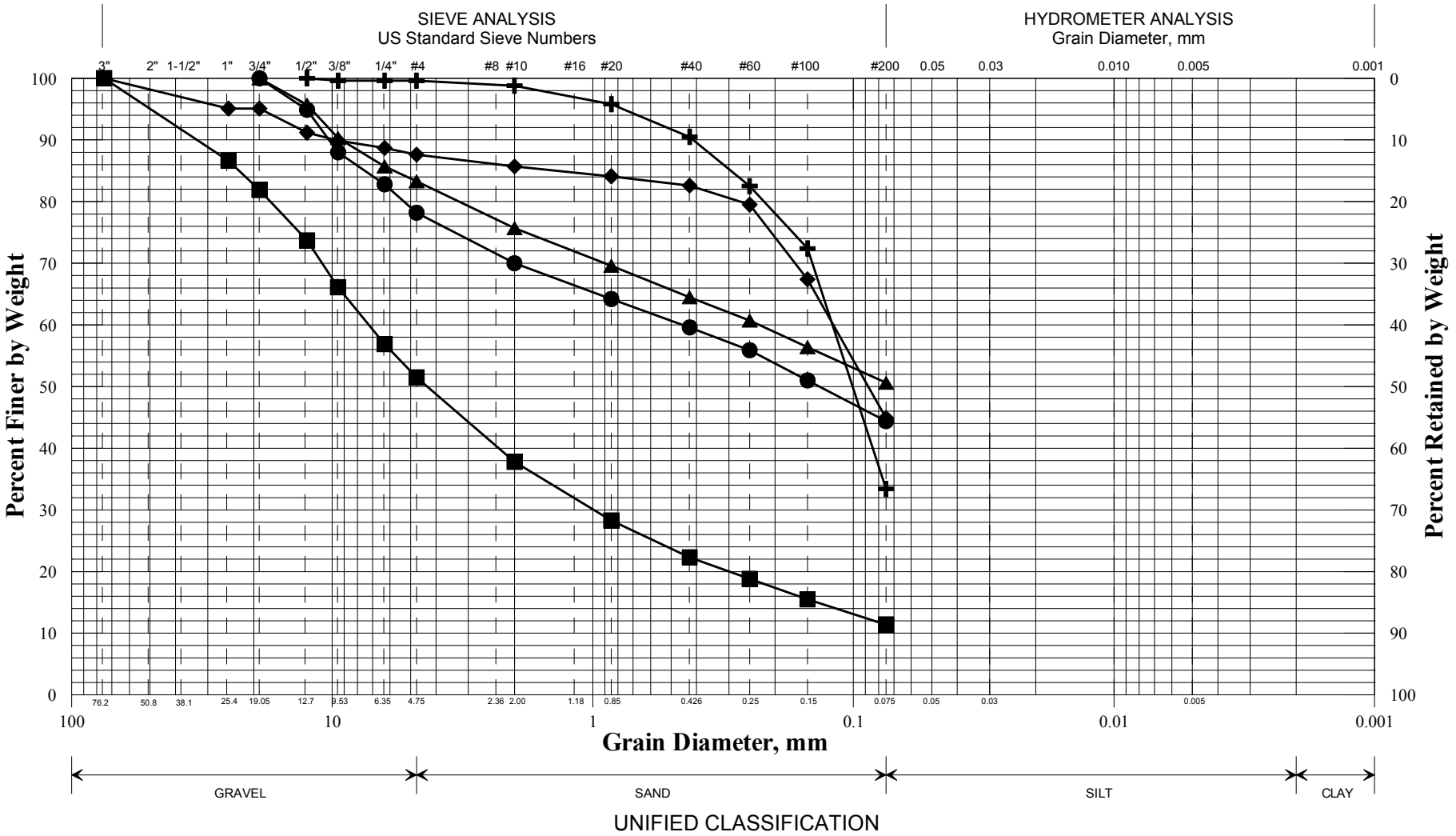
UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	BB-HMR-101/2D	24+98.8	4.5 RT	5.0-6.5	SAND, some gravel, little silt.	7.1			
◆	BB-HMR-101/5D	24+98.8	4.5 RT	20.0-22.0	SAND, some gravel, little silt.	17.1			
■	BB-HMR-101/9D	24+98.8	4.5 RT	40.0-42.0	SILT, some sand, trace gravel.	15.4			
●	BB-HMR-101/10D	24+98.8	4.5 RT	45.0-47.0	SAND, some silt, some gravel.	9.3			
▲									
✖									

WIN
020509.00
Town
Haynesville
Reported by/Date
WHITE, TERRY A 7/17/2014

SHEET 1

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	BB-HMR-102/2D	26+02.6	13.3 LT	4.0-6.0	SAND, some silt, trace gravel.	27.7			
◆	BB-HMR-102/3D	26+02.6	13.3 LT	9.0-11.0	Silty SAND, little gravel.	16.6			
■	BB-HMR-102/4D	26+02.6	13.3 LT	14.0-16.0	Sandy GRAVEL, little silt.	7.4			
●	BB-HMR-102/5D	26+02.6	13.3 LT	19.0-20.0	SILT, some sand, some gravel.	7.9			
▲	BB-HMR-102/7D	26+02.6	13.3 LT	29.0-29.5	SILT, some sand, little gravel.	9.1			
✖									

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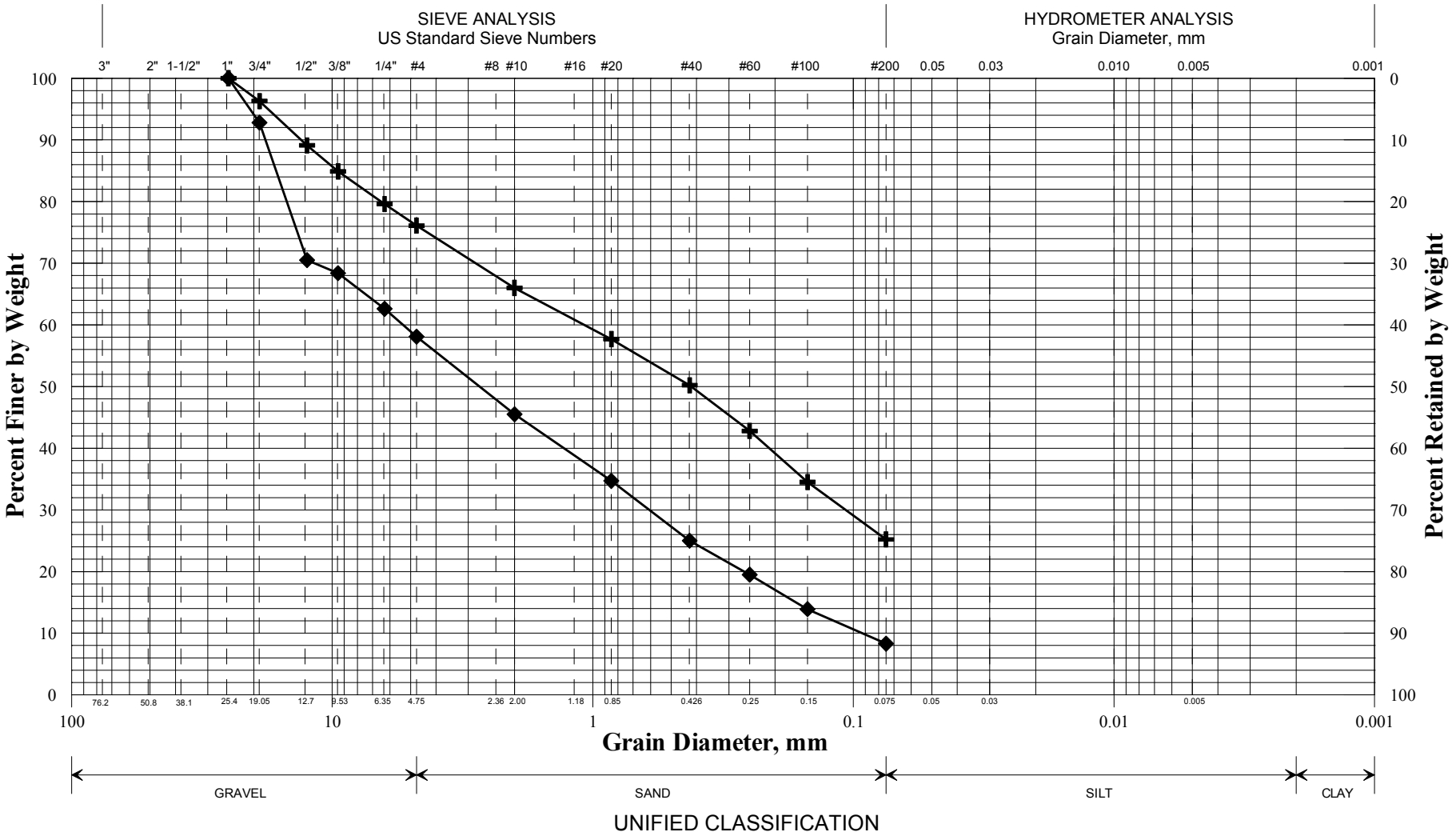
WHITE, TERRY A 7/17/2014

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	BB-HMR-103/1D	26+93.7	6.3 RT	0.0-2.0	SAND, some silt, some gravel.	27.7			
◆	BB-HMR-103/4D	26+93.7	6.3 RT	16.0-18.0	Gravelly SAND, trace silt.	10.6			
■									
●									
▲									
✖									

WIN
020509.00
Town
Haynesville
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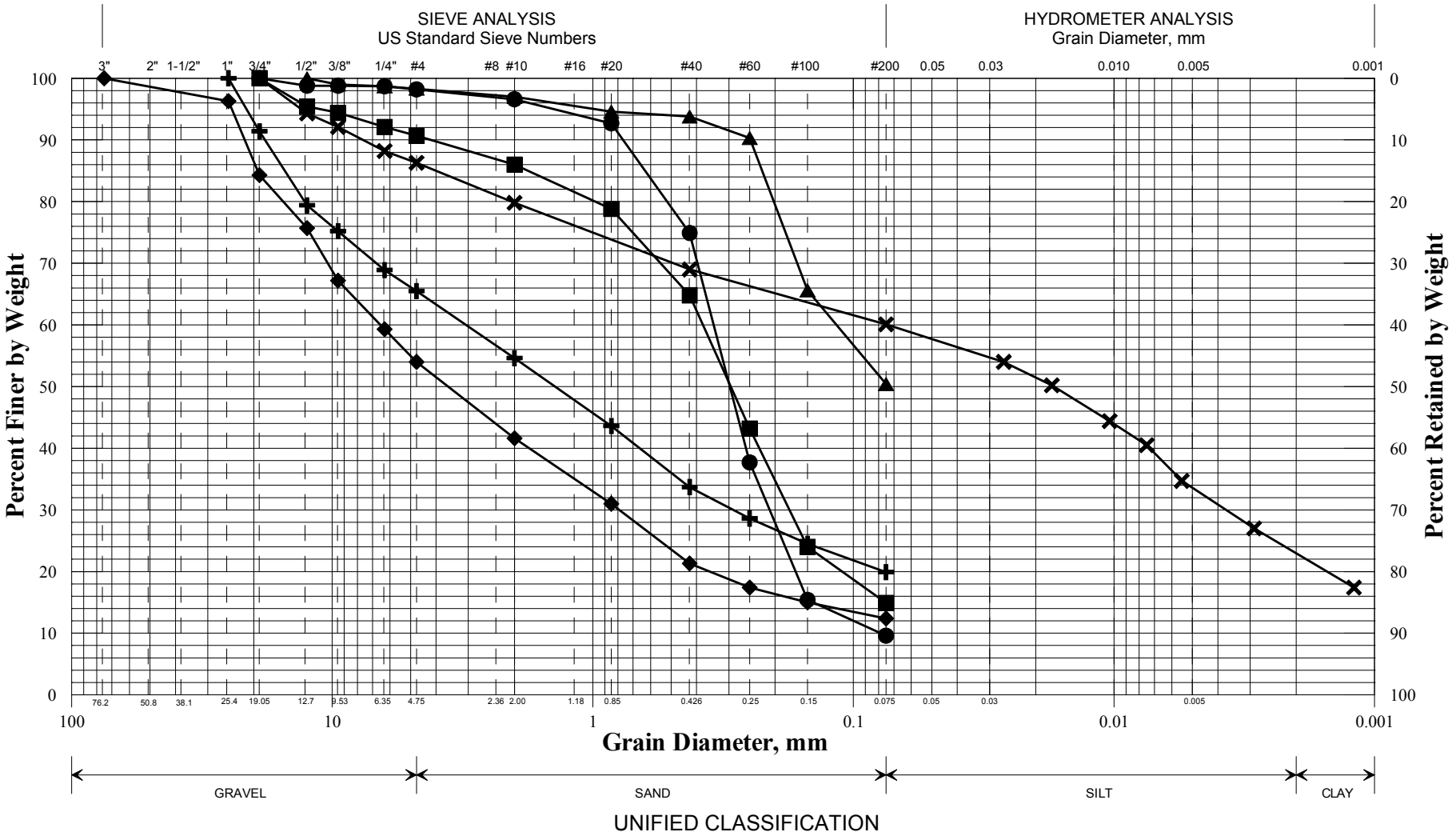
WHITE, TERRY A 7/17/2014

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	BB-HMR-104/2D	27+95.2	12.3 LT	10.0-12.0	SAND, some gravel, little silt.	4.8			
◆	BB-HMR-104/3D & 4D	27+95.2	12.3 LT	15-17.0/20-22.0	Sandy GRAVEL, little silt.	11.6			
■	BB-HMR-104/6D	27+95.2	12.3 LT	30.0-32.0	SAND, little silt, trace gravel.	23.1			
●	BB-HMR-104/7D	27+95.2	12.3 LT	35.0-37.0	SAND, trace silt, trace gravel.	20.8			
▲	BB-HMR-104/9D	27+95.2	12.3 LT	45.0-47.0	Sandy SILT, trace gravel.	22.9			
✖	BB-HMR-104/10D	27+95.2	12.3 LT	50.0-51.0	SILT, some sand, some clay, little gravel.	9.2	23	15	8

WIN
020509.00
Town
Haynesville
Reported by/Date
WHITE, TERRY A 7/17/2014

MaineDOT

GEOTECHNICAL TEST REPORT
Central Laboratory

SAMPLE INFORMATION

Reference No.	Boring No./Sample No.	Sample Description	Sampled	Received
243200	BB-HMR-104/10D	GEOTECHNICAL (DISTURBED)	6/17/2014	6/30/2014

Sample Type: **GEOTECHNICAL** Location: **OTHER** Station: **27+95.2** Offset, ft: **12.3 LT** Dbfg, ft: **50.0-51.0**

WIN/Town **020509.00 - HAYNESVILLE** Sampler: **WILDER, BRUCE H**

TEST RESULTS

Sieve Analysis (T 88)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	100.0
½ in. [12.5 mm]	94.3
⅜ in. [9.5 mm]	92.1
¼ in. [6.3 mm]	88.2
No. 4 [4.75 mm]	86.3
No. 10 [2.00 mm]	79.8
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	69.0
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	60.1
[0.0265 mm]	54.0
[0.0173 mm]	50.2
[0.0104 mm]	44.4
[0.0075 mm]	40.5
[0.0055 mm]	34.7
[0.0029 mm]	27.0
[0.0012 mm]	17.4

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	23
Plastic Limit (T 90), %	15
Plasticity Index (T 90), %	8
Specific Gravity, Corrected to 20°C (T 100)	2.77
Loss on Ignition (T 267)	
Loss, %	
H2O, %	
Water Content (T 265), %	9.2

Consolidation (T 216)

Trimmings, Water Content, %	

	Initial	Final		Void Ratio	% Strain
Water Content, %			Pmin		
Dry Density, lbs/ft³			Pp		
Void Ratio			Pmax		
Saturation, %			Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear tons/ft²	Remold tons/ft²	U. Shear tons/ft²	Remold tons/ft²		

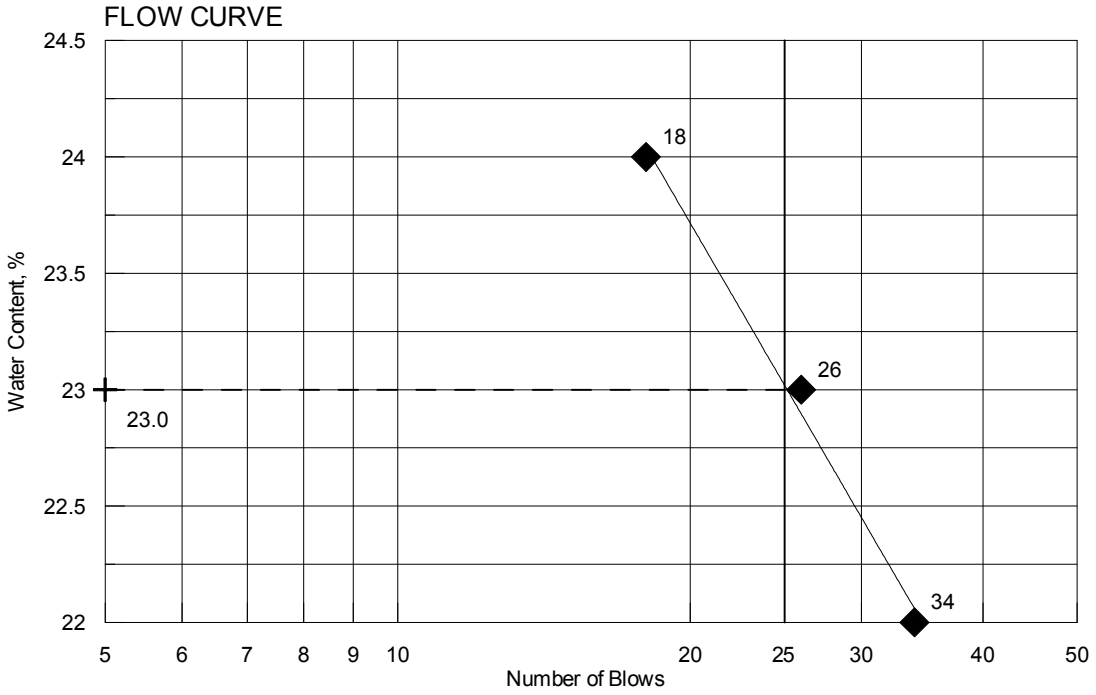
Comments:

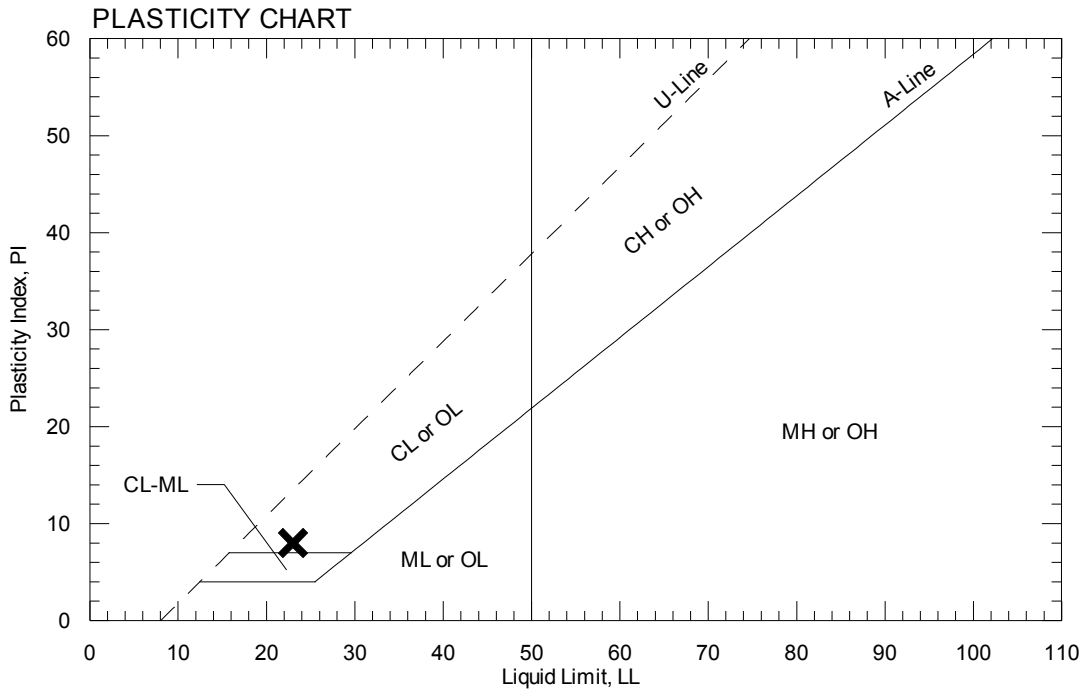
AUTHORIZATION AND DISTRIBUTION

Reported by: **FOGG, BRIAN** Date Reported: **7/11/2014**

Paper Copy: Lab File; Project File; Geotech File

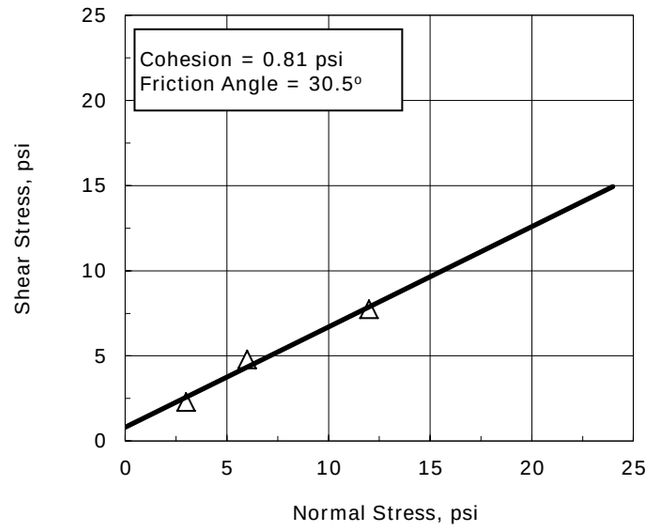
TOWN	Haynesville	Reference No.	243200
WIN	020509.00	Water Content, %	9.2
Sampled	6/17/2014	Liquid Limit @ 25 blows (T 89), %	23
Boring No./Sample No.	BB-HMR-104/10D	Plastic Limit (T 90), %	15
Station	27+95.2	Plasticity Index (T 90), %	8
Depth	50.0-51.0	Tested By	BBURR

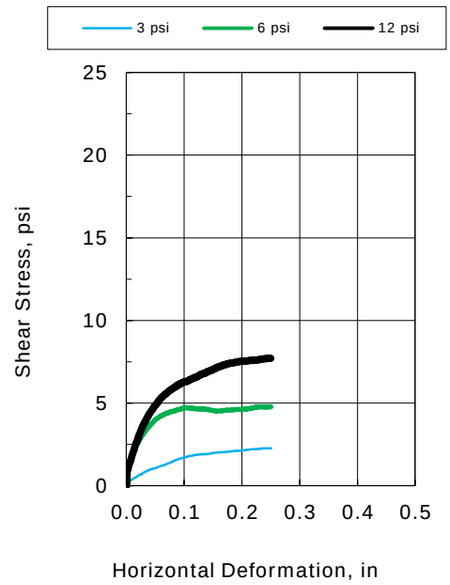




Client:	Maine DOT
Project Name:	Haynesville Mattawamkeag River
Project Location:	Haynesville, ME
GTX #:	302135
Test Date:	8/4/2014
Tested By:	md
Checked By:	jdt
Boring ID:	BB-HMR-103
Sample ID:	2D/3D
Depth, ft:	6-8/11-12
Visual Description:	Moist, gray silty clay and sand

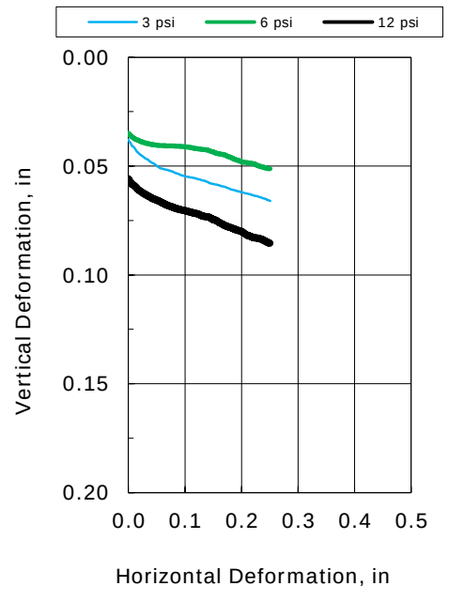
Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D3080





Test No.:	DS-1	DS-2	DS-3
Initial Diameter, in:	2.5	2.5	2.5
Initial Height, in:	1.0	1.0	1.0
Initial Mass, grams:	151	151	151
Initial Dry Density, pcf:	97.7	97.7	97.7
Initial Moisture Content, %:	19.8	19.8	19.8
Initial Bulk Density, pcf:	117	117	117
Initial Degree of Saturation:	75.7	75.6	75.7
Initial Void Ratio:	0.69	0.69	0.69
Final Dry Density, pcf:	105	103	107
Final Moisture Content, %:	20.2	19.1	20.6
Final Bulk Density, pcf:	126	123	129
Normal Stress, psi:	3.0	6.0	12
Maximum Shear Stress, psi:	2.3	4.8	7.7
Shear Rate, in/min:	0.001	0.001	0.001

Sample Type:	reconstituted
Estimated Specific Gravity:	2.65
Liquid Limit:	---
Plastic Limit:	---
Plasticity Index:	---
% Passing #200 sieve:	---
Soil Classification:	---
Group Symbol:	---



Notes: Material greater than #5 sieve screened out of sample prior to testing
Moisture content obtained before shear from sample trimmings
Moisture Content determined by ASTM D2216
Target Compaction: 117.0 pcf (wet) at 20% moisture content (values provided by client).
Values for cohesion and friction angle determined from best-fit straight line to the data for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site-specific conditions.
"---" indicates testing required to determine these values was not requested.

Appendix C

Pile Condition Assessment and Pile Load Test Results

GZA
GeoEnvironmental, Inc.

Engineers and Scientists

January 17, 2014 rev May 16, 2014
File No. 09.0025813.00

Ms. Laura Krusinski, P.E.
Maine Department of Transportation
State House Station 16, Transportation Building
Augusta, Maine 04333-0016

477 Congress Street
Suite 700
Portland, Maine
04101-3926
207-879-9190
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www.gza.com

Re: Pile Condition Assessment and Pile Load Test Results
Route 2A Bridge over Mattawamkeag River
Haynesville, Maine

Dear Ms. Krusinski:

This letter report summarizes the results of the pile testing program performed by GZA GeoEnvironmental, Inc. (GZA) at the above referenced project on December 12, 2013 and December 19, 2013. The purpose of the pile load test program is to assess the condition and evaluate the capacity of selected timber foundation piles supporting the existing north and south abutment structures of the above referenced bridge.

BACKGROUND

The Mattawamkeag River Bridge carries Route 2A over the Mattawamkeag River in Haynesville, Maine. The bridge runs roughly northeast-southwest, with Abutment 2 on the northeast side of the Mattawamkeag River and Abutment 1 on the southwest side of the Mattawamkeag River.

Based on the original design drawings provided to GZA by the Maine Department of Transportation (MaineDOT) dated February 1951, the generalized subsurface profile for Abutment 2 consists of about 7 feet of soft silty organics, overlaying by about 26 feet of medium dense sands overlaying 2 feet of very dense sands and gravels, overlaying a shale bedrock. The generalized subsurface profile for Abutment 1 consists of about 4 feet of soft brown silt overlaying by about 12 feet of dense sands overlaying 17 feet of very dense sands and gravels, overlaying a shale bedrock. The borings for Abutment 2 and Abutment 1 were reportedly taken at a subgrade elevation of +368.0 and +366.2, respectively.

The plans specify that the upper soft material was to be excavated and replaced with gravel borrow and built up to an elevation of +375.41 before piles were driven. Each abutment required 24 piles driven in two rows. The exterior row (i.e., riverside row) was to be installed at a 2H:12V batter and the interior row (i.e., land side row) was to be installed plumb. The piles are designated as treated wood with an estimated pile length of 35 feet with the upper 1.5 foot encased into the overlaying concrete abutment. The reported elevation of the bottom of concrete of each abutment is +375.4.

The drawings indicate that the piles had a 16-ton per pile design load. We understand that a deck replacement is proposed and that the future pile design load may be greater than 16 tons.

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PROGRAM OVERVIEW

The pile test program consisted of excavating the upper portion of an interior plumb timber pile located under the west side of each abutment of the existing bridge. The plumb timber piles were saw cut and an approximate 20-inch section was removed. For each pile a Pile Integrity Test (PIT) was performed on the lower pile section to evaluate pile integrity and provide an estimated pile length. A jacking assembly was then installed into each removed pile section and a compression load test was conducted on the lower pile section. The upper pile section embedded into the overlying 6-foot deep concrete slab abutment slab provided the reaction for the compression test loads. At the conclusion of the compression pile test loads, the test piles were repaired utilizing reinforcing bar and concrete. Each bridge abutment was then backfilled and the rip-rap restored.

PILE INTEGRITY TEST

The PIT test was performed on test piles in general accordance with standard practice for "Low-Strain Method of Dynamic Testing." The purpose of the PIT test was to evaluate the structural integrity and to estimate the length of the test pile. The PIT makes dynamic acceleration measurements as an acoustic wave propagates through a test pile. The acoustic wave is generated by a small impact at the pile surface. The impact is recorded as the beginning of the record and any variations in the shape (or cross sectional area) of the pile will produce reflections that are recorded as they return to the surface. The last reflection (i.e., deepest reflection) is generated by the pile toe. Each pile was impacted with four (4) different weight hammers (heaviest to lightest). The heavier hammer produce a lower frequency wider pulse signal (i.e., more energy) to distinguish the pile tip and the lighter hammer produce a higher frequency narrow pulse signal (i.e., lower energy) to provide more definition of the pile tip.

Dynamic measurements were made on the lower section of each test pile prior to the installation of the load test jacking assembly. It is our experience that typical wave speeds in creosote-treated timber pile range from approximately 10,000 to 12,500 feet per second, the variation based on moisture content, type of wood, etc. Based on evaluation of the acoustic wave traces and our review of the project documents, a wave speed of approximately 10,700 feet per second was established. Based on a wave speed of 10,700 feet per second, the corresponding test pile lengths for Abutment 2 and Abutment 1 are approximately 32 feet and 26 feet, respectively. The PIT test data for each test pile are provided in the attachments.

STATIC TEST SETUP

The compression load test was set up in general accordance with ASTM Method D1143 "Standard Test Method for Piles Under Static Axial Compressive Load." Photographs of the test setup are provided as Figure 2. GZA provided the hydraulic jack, load deflection monitoring equipment, and technical support to setup and execute the test in compliance with our Proposed Work Plan.

The deflection monitoring equipment used during testing included the following components: three electronic displacement gages (installed at the pile butt), a load cell and spherical bearing, a wire line system and optical survey.

The primary pile butt deflection monitoring equipment included three, four-inch travel, spring loaded electronic displacement gages with a resolution of 0.001 inch. The secondary system consisted of two scales each graduated to 0.02 inches (50 scale). One scale was mounted on a mirror secured to the jack and read with the wire line system, the second scale was mounted on

the jack and read with an optical level. All pile butt deflections, with the exception of the scale read through the optical level, were made relative to the reference beam. Note that the electronic displacement gages measuring pile butt deflections were mounted on the reference beam and measured deflections from the top of a 2-inch thick steel plate located between the pile butt and the hydraulic jack. The scales were secured to the jack, located above the pile and 2-inch steel load transfer plate.

An optical level was positioned adjacent to the pile load test structure to read scales mounted on the reference beam, reaction beam, and the jack. Given the elevation of the excavated test piles, and the tight excavated conditions, a benchmark scale could not be installed and read with survey level.

An electronic load cell was used to monitor the hydraulic jack/pressure gauge system used to load the pile. The calibration sheets for both the load cell and the jack are attached. A spherical bearing was used to provide a uniform jacking load.

STATIC TEST PROCEDURES

The compression pile load test was conducted in accordance with ASTM D1143 "Quick Load Test Method." The load sequence for the compression test followed the "Quick Load Test Method" with the load applied in increments equal to 5 percent of the design load (i.e., 6 kips). Each load increment was held for 5 minutes. The maximum test load was 120 kips or 2.0 times the assumed design load of 60 kips (i.e., 30 tons).

The maximum test load was held for 10 minutes. The load was removed in decrements of 25 percent of the applied load. Each decrement was held for 5 minutes until zero load was reached. Pile rebound was measured for a period of 10 minutes.

The data summary and load test plot from each test are provided in the attachments.

STATIC LOAD TEST RESULTS

North Abutment (Abutment2)

MaineDOT excavated the west side of the north abutment substructure to expose the exterior 2H:12V batter timber pile and the plumb timber interior pile. The excavation exposed the upper 4 feet of each pile underlying the existing abutment substructure. The exposed piles did not indicate any external rot or decay. The bottom of the pile cap was in intimate contact with the subgrade soil. The interior plumb pile was selected for the compression load test. Based on field measurements of the pile jacking assembly, a 19-inch pile section was saw-cut and removed from the timber test pile to prepare the pile for the compression load test. The upper cut was located approximately 6-inches below the existing abutment.

The chainsaw was easily removed from the saw cut, and the 19-inch section of pile was easily removed when it was cut, indicating that it was not in compression after cutting. Creosote "bled" from the cut surface of the pile. There was no indication of rot or decay in the cut pile section. The measured diameter of the lower pile section was 10.875 inches yielding a cross sectional area of 92.9 square inches.

A Pile Integrity Test (PIT) was performed on the lower pile section before setting up and conducting the compression load test. The PIT results indicated a length of approximately 32 feet.

The compression load test was set up and conducted in accordance with the schedule detailed above. The field test data obtained during the load test and the summary plot of load versus settlement for the average pile butt deflection are attached. In addition, the theoretical elastic compression, assuming a 32-foot long end bearing pile and a nominal elastic modulus of 1.6×10^6 psi, and the Davisson Failure Criteria are superimposed over the test results to display the theoretical pile butt deflection due to pile compression and the failure criteria at the applied pile load increment.

The compression pile load was taken to a maximum test load of 120 kips. The gross displacement of the pile butt at the first displacement reading, 0.28 inches, was less than the specified failure criterion [i.e., $S_f = S + (0.15 + D / 120)$] of 0.55 inches at 120 kips. Continuous jacking was required to maintain the 120-kip load on the pile and the average pile butt displacement during the 10 minute hold time requirement creeped to a pile displacement of 0.56-inches, slightly exceeding the calculated Davisson Criterion. The net set after unloading was 0.22 inches. The need for continuous jacking to maintain load and the ongoing displacement throughout the 120-kip load increment are indicative of a plunging failure. Therefore, the test results indicate a nominal geotechnical capacity of 120 kips for test pile NAB TP1.

Photographs of the pile cut cross-section, the compression load test setup, and subsequent pile repair of the north abutment test pile are included in the attachments.

South Abutment (Abutment1)

MaineDOT excavated the west side of the south abutment substructure to expose the exterior 2H:12V batter timber pile and the plumb timber interior pile. The excavation exposed the upper 4.5 feet of each pile underlying the existing abutment substructure. The exposed piles did not indicate any external rot or decay. However the interior (plumb) pile was installed at a batter of 2.5H:12V. Given the observed pile batter, the interior pile could not be compression load tested due to safety concerns associated with pile-jack assembly alignment issues.

The exterior pile, installed at an observed batter of 0.5H:12V, was selected for the compression load test. Based on field measurements of the pile jacking assembly, a 19-inch pile section was saw-cut and removed from the timber test pile to prepare the pile for the compression pile test. The upper cut was located approximately 29-inches below the existing abutment.

The chainsaw was pinched by the pile during the saw cut and required that wedges be driven into the saw cut to remove the chain saw. The 19-inch length of pile remained in compression and required removal in sections indicating that some displacement of the abutment had occurred as the pile was cut. The upper and lower pile surfaces were trimmed square to ensure proper alignment with the pile batter. Creosote "bled" from the cut surface of the pile. There was no indication of rot or decay in the cut pile section. The measured pile diameter of the lower pile section was 12.6-inches yielding a cross sectional area of 124.6 square inches.

A PIT was performed on the lower pile section before setting up and conducting the compression load test. The PIT results, detailed above, yielded a length of approximately 26 feet.

Once this test was set up and a seating load applied on December 13, 2013, it was determined that the jack could not develop any additional load. Discussions with the jack supplier indicated that a replacement pump was required. The test was then aborted until the replacement pump was procured. Given that the test was being conducted on the exterior pile and the pile indicated

potential load transfer during the pile cut, the jack assembly was left in the pile to support potential bridge abutment loadings and limit additional abutment deflection until the compression load test could be conducted.

The compression load test was set up and conducted on December 19, 2013 in accordance with the schedule detailed above. The field test data obtained during the load test and the summary plot of load versus settlement for the average pile butt deflection are attached. The theoretical elastic compression, assuming a 26-foot long end bearing pile and a nominal elastic modulus of 1.6×10^6 psi, and the Davisson Failure Criteria are superimposed over the test results to display the theoretical pile butt deflection due to pile compression and the failure criteria at the applied pile load increment.

The compression pile load test loading sequence was first taken to a test load of 120 kips. The gross displacement of the pile butt was 0.15, which is less than the specified failure criterion [i.e., $S_f = S + (0.15 + D / 120)$] of 0.44 inches at 120 kips.

During the pile loading increments, the jack pressure was significantly lower than the load calculated by the electronic load cell. The discrepancy was attributed to non-uniform load distribution on the jacking system. As a precaution and to assess creep, the 120 kip load increment was maintained for 15 minutes and then three (3) additional 6 kip load increments were applied to develop a maximum test load of 138 kips, as determined by the load cell. Two additional load increments were maintained for 10 minutes each, and the final 138 kip load increment was maintained for a period of 15 minutes.

At the maximum test load of 138 kips, the gross displacement of the pile butt, 0.20 inches, was significantly less than the specified failure criterion of 0.47 inches at 138 kips. The net set after unloading was 0.04 inches. Therefore, the test results indicate a nominal geotechnical capacity of 138 kips for test pile SAB TP2.

Photographs of the exposed timber piles, the pile cut cross-section, the compression load test setup, and subsequent pile repair of the south abutment test pile are included in the attachments.

It has been our pleasure serving the Department on this challenging assignment. Please feel free to call Chris Snow at (207) 358-5118 if you have any questions or comments.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

for Michael Deery
Project Engineer

STATE OF MAINE
CHRISTOPHER L. SNOW
No. 7275
LICENSED PROFESSIONAL ENGINEER
1-15-14

Bradford W. Roberts
Consultant/Reviewer

Christopher L. Snow, P.E.
Associate Principal

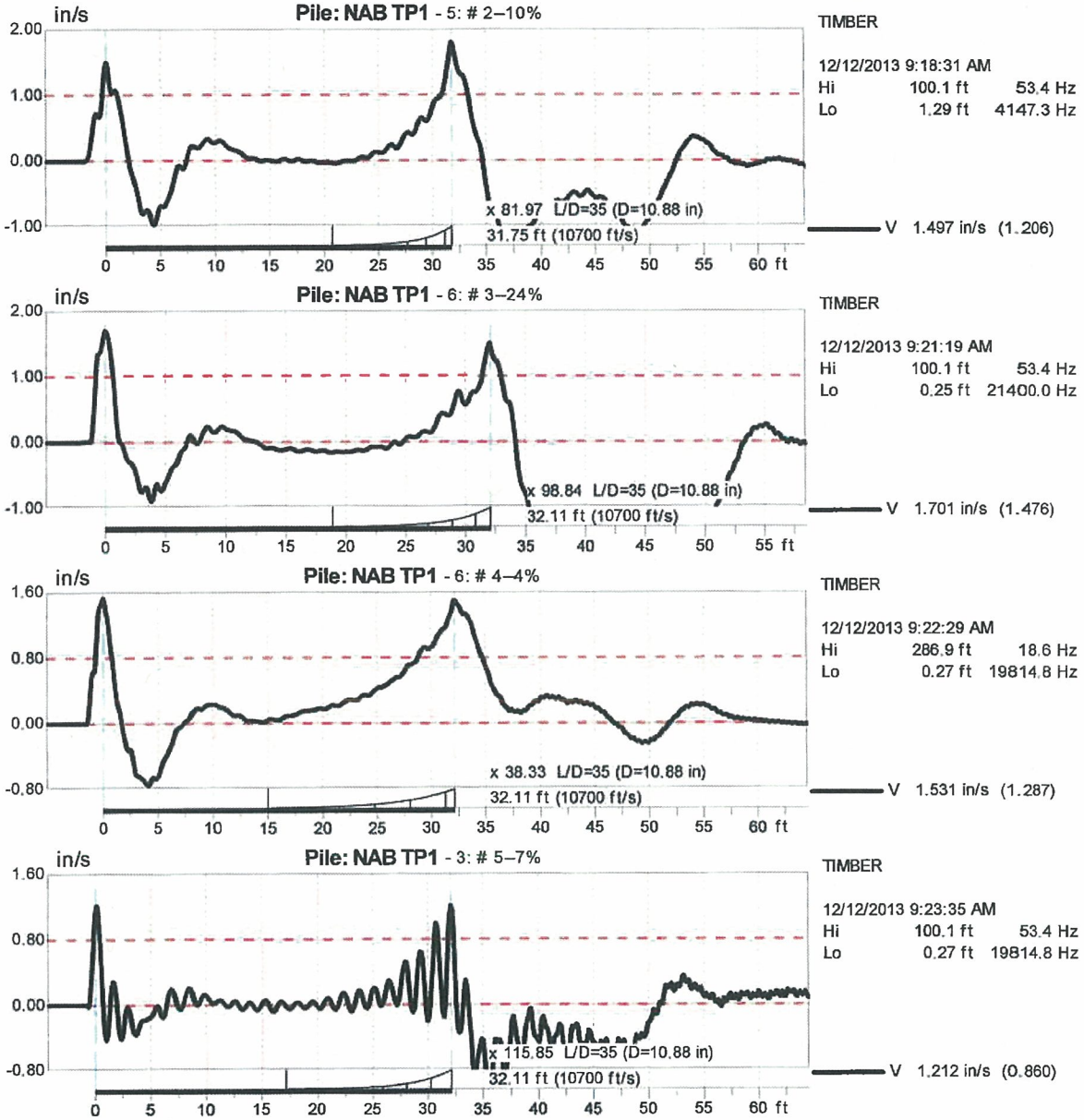
MD/BWR/CLS:erc
P:\09 Jobs\0025800s\09.0025813.00 Haynesville PLT\Report\PLT Submittal\25813 LoadTestletter 01 15 14.docx
Attachments: Field Data/Plots, Photos, and Calibrations

NORTH ABUTMENT TEST PILE

Pile Dynamics, Inc.
MATTAWAMKEAG RVR BR
E:\...\PIT\SAB TP 2.PIT

1/6/2014

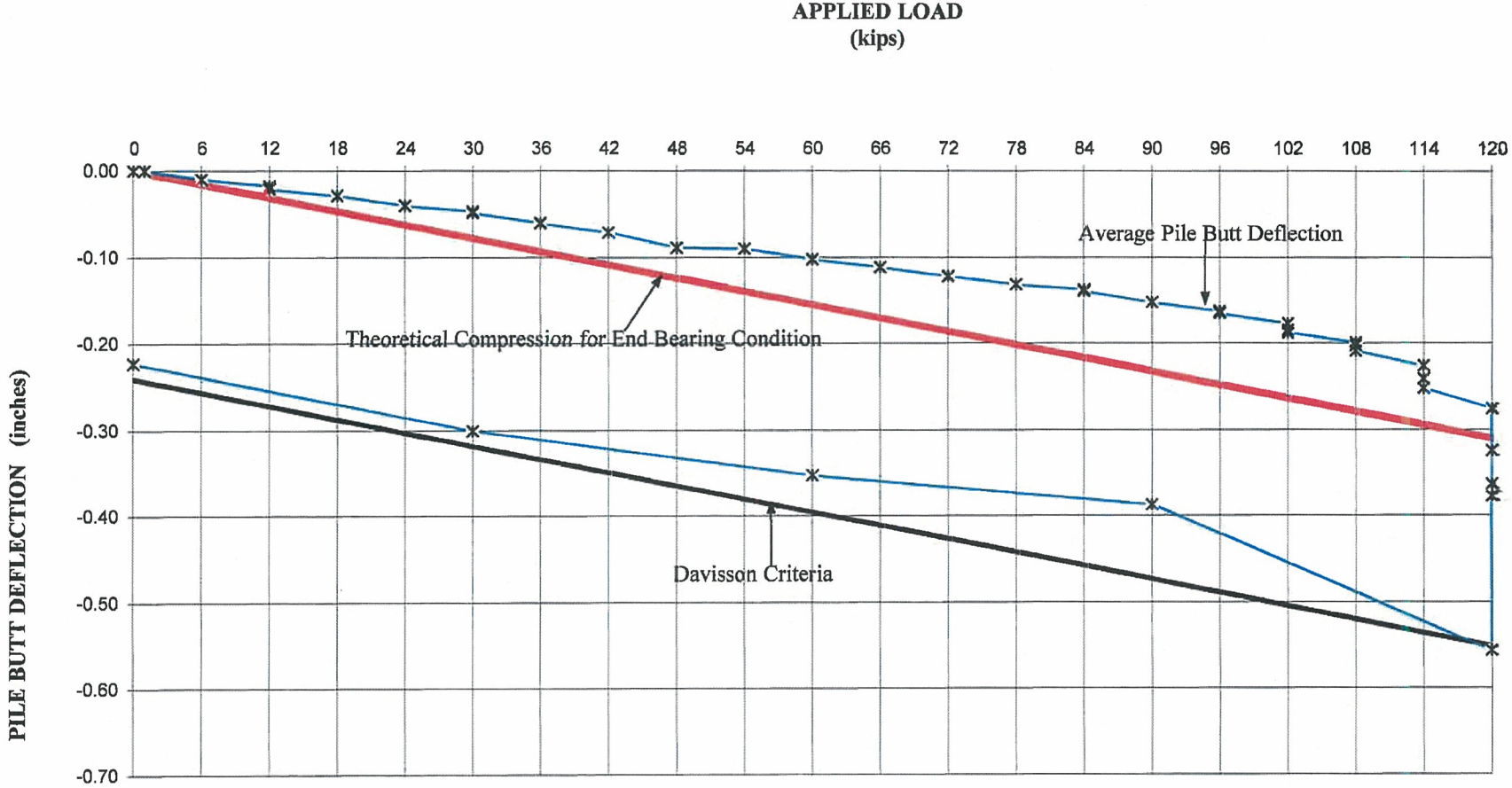
PIT-W 2009-2.DEMO



MATTAWAMKEAG RIVER BRIDGE - Pile No. NAB TP1

File No. 25813.00

Applied Load vs. Average Pile Butt Deflections



Test Date Dec 12 2013

Pile : 10.875-inch Diameter Timber

Length = 32.0 ft.

Area = 92.9 sq. in.

Modulus = 1.6E+06 psi

PILE BUTT DISPLACEMENT MEASUREMENTS

PILE NO.	NAB TP1	PROJECT	MATTAWAMKEAG RIVER BRIDGE
DATE	12/12/13	FILE NO.	25813.00
PILE	32.0 ft. 10.875-inch Diameter Timber	CONTRACTOR	MDOT/GZA

Load Cell Zero= 0 digits

Load Cell Calibration = 0.49 digits/kip

	LOAD	LOAD CELL	BUTT GAGES							WIRE LINE		OPTICAL LEVEL				COMMENTS
												Pile		Reference Beam		
TIME	KIPS	DIGITS	B1	B1 NET	B2	B2 NET	B3	B3 NET	AV. BUTT	W READ	W NET	P READ	P NET	R READ	R NET	
0	**0.0**	0	0.740	0.000	0.638	0.000	0.806	0.000	**0.000**	111	0.00	151	0.00	82	0.00	Initial zero Reading
0	**1.0**	0	0.740	0.000	0.638	0.000	0.806	0.000	**0.000**	111	0.00	151	0.00	82	0.00	Seating Load
1	**6.0**	3	0.748	-0.008	0.645	-0.007	0.820	-0.014	**-0.010**							Air Temp (-12 to +6 F) +Wind
2.5	**6.0**	3	0.748	-0.008	0.645	-0.007	0.820	-0.014	**-0.010**							
5	**6.0**	3	0.748	-0.008	0.645	-0.007	0.820	-0.014	**-0.010**	111	0.00	151	0.00	83	0.02	
1	**12.0**	6	0.757	-0.017	0.652	-0.014	0.827	-0.021	**-0.017**							
2.5	**12.0**	6	0.758	-0.018	0.654	-0.016	0.832	-0.026	**-0.020**							
5	**12.0**	6	0.759	-0.019	0.656	-0.018	0.832	-0.026	**-0.021**	112	-0.02	151	0.00	83	0.02	
1	**18.0**	9	0.770	-0.030	0.663	-0.025	0.837	-0.031	**-0.029**							
2.5	**18.0**	9	0.770	-0.030	0.663	-0.025	0.837	-0.031	**-0.029**							
5	**18.0**	9	0.770	-0.030	0.663	-0.025	0.837	-0.031	**-0.029**	112	-0.02	152	-0.02	82	0.00	
1	**24.0**	12	0.784	-0.044	0.673	-0.035	0.846	-0.040	**-0.040**							
2.5	**24.0**	12	0.785	-0.045	0.673	-0.035	0.846	-0.040	**-0.040**							
5	**24.0**	12	0.785	-0.045	0.673	-0.035	0.846	-0.040	**-0.040**	113	-0.04	153	-0.04	81	-0.02	
1	**30.0**	15	0.794	-0.054	0.678	-0.040	0.851	-0.045	**-0.046**							
2.5	**30.0**	15	0.795	-0.055	0.680	-0.042	0.853	-0.047	**-0.048**							
5	**30.0**	15	0.795	-0.055	0.680	-0.042	0.854	-0.048	**-0.048**	113	-0.04	153	-0.04	81	-0.02	
1	**36.0**	18	0.808	-0.068	0.693	-0.055	0.862	-0.056	**-0.060**							
2.5	**36.0**	18	0.809	-0.069	0.693	-0.055	0.862	-0.056	**-0.060**							
5	**36.0**	18	0.809	-0.069	0.694	-0.056	0.862	-0.056	**-0.060**	114	-0.06	154	-0.06	81	-0.02	
1	**42.0**	21	0.821	-0.081	0.705	-0.067	0.871	-0.065	**-0.071**							
2.5	**42.0**	21	0.821	-0.081	0.705	-0.067	0.871	-0.065	**-0.071**							
5	**42.0**	21	0.821	-0.081	0.705	-0.067	0.871	-0.065	**-0.071**	114	-0.06	154	-0.06	81	-0.02	
1	**48.0**	24	0.840	-0.100	0.722	-0.084	0.887	-0.081	**-0.088**							Over jack to 52 kips
2.5	**48.0**	24	0.840	-0.100	0.722	-0.084	0.888	-0.082	**-0.089**							
5	**48.0**	24	0.840	-0.100	0.722	-0.084	0.888	-0.082	**-0.089**	115	-0.08	154	-0.06	81	-0.02	
1	**54.0**	26	0.841	-0.101	0.723	-0.085	0.889	-0.083	**-0.090**							
2.5	**54.0**	26	0.842	-0.102	0.723	-0.085	0.889	-0.083	**-0.090**							
5	**54.0**	26	0.842	-0.102	0.723	-0.085	0.889	-0.083	**-0.090**	115	-0.08	155	-0.08	81	-0.02	
1	**60.0**	29	0.855	-0.115	0.735	-0.097	0.899	-0.093	**-0.102**							
2.5	**60.0**	29	0.856	-0.116	0.735	-0.097	0.900	-0.094	**-0.102**							
5	**60.0**	29	0.856	-0.116	0.735	-0.097	0.900	-0.094	**-0.102**	116	-0.10	155	-0.08	80	-0.04	Sun on Reference Beam
1	**66.0**	32	0.865	-0.125	0.745	-0.107	0.908	-0.102	**-0.111**							
2.5	**66.0**	32	0.866	-0.126	0.745	-0.107	0.908	-0.102	**-0.112**							
5	**66.0**	32	0.866	-0.126	0.745	-0.107	0.908	-0.102	**-0.112**	116	-0.10	155	-0.08	81	-0.02	
1	**72.0**	35	0.877	-0.137	0.755	-0.117	0.917	-0.111	**-0.122**							
2.5	**72.0**	35	0.877	-0.137	0.755	-0.117	0.917	-0.111	**-0.122**							
5	**72.0**	35	0.878	-0.138	0.755	-0.117	0.917	-0.111	**-0.122**	116	-0.10	156	-0.10	80	-0.04	

PILE BUTT DISPLACEMENT MEASUREMENTS

PILE NO.	NAB TP1	PROJECT	MATTAWAMKEAG RIVER BRIDGE
DATE	12/12/13	FILE NO.	25813.00
PILE	32.0 ft. 10.875-inch Diameter Timber	CONTRACTOR	MDOT/GZA

Load Cell Zero= 0 digits

Load Cell Calibration = 0.49 digits/kip

	LOAD	LOAD CELL	BUTT GAGES							WIRE LINE		OPTICAL LEVEL				COMMENTS
												Pile		Reference Beam		
TIME	KIPS	DIGITS	B1	B1 NET	B2	B2 NET	B3	B3 NET	AV. BUTT	W READ	W NET	P READ	P NET	R READ	R NET	
1	**78.0**	38	0.888	-0.148	0.765	-0.127	0.925	-0.119	**-0.131**							
2.5	**78.0**	38	0.888	-0.148	0.765	-0.127	0.925	-0.119	**-0.131**							
5	**78.0**	38	0.888	-0.148	0.765	-0.127	0.926	-0.120	**-0.132**	117	-0.12	157	-0.12	81	-0.02	
1	**84.0**	41	0.898	-0.158	0.768	-0.130	0.930	-0.124	**-0.137**							
2.5	**84.0**	41	0.898	-0.158	0.768	-0.130	0.931	-0.125	**-0.138**							Add Load
5	**84.0**	41	0.900	-0.160	0.770	-0.132	0.932	-0.126	**-0.139**	117	-0.12	157	-0.12	81	-0.02	
1	**90.0**	44	0.913	-0.173	0.784	-0.146	0.944	-0.138	**-0.152**							
2.5	**90.0**	44	0.914	-0.174	0.784	-0.146	0.944	-0.138	**-0.153**							Add Load
5	**90.0**	44	0.914	-0.174	0.784	-0.146	0.944	-0.138	**-0.153**	118	-0.14	158	-0.14	81	-0.02	
1	**96.0**	47	0.924	-0.184	0.794	-0.156	0.954	-0.148	**-0.163**							
2.5	**96.0**	47	0.926	-0.186	0.795	-0.157	0.956	-0.150	**-0.164**							Add Load
5	**96.0**	47	0.928	-0.188	0.796	-0.158	0.956	-0.150	**-0.165**	119	-0.16	159	-0.16	81	-0.02	
1	**102.0**	50	0.940	-0.200	0.808	-0.170	0.968	-0.162	**-0.177**							
2.5	**102.0**	50	0.947	-0.207	0.818	-0.180	0.974	-0.168	**-0.185**							Add Load (Multiple Jacks)
5	**102.0**	50	0.952	-0.212	0.819	-0.181	0.977	-0.171	**-0.188**	120	-0.18	160	-0.18	81	-0.02	
1	**108.0**	53	0.964	-0.224	0.830	-0.192	0.988	-0.182	**-0.199**							
2.5	**108.0**	53	0.968	-0.228	0.834	-0.196	0.990	-0.184	**-0.203**							Add Load (Multiple Jacks)
5	**108.0**	53	0.973	-0.233	0.842	-0.204	0.996	-0.190	**-0.209**	121	-0.20	161	-0.20	81	-0.02	
1	**114.0**	56	0.992	-0.252	0.859	-0.221	1.012	-0.206	**-0.226**							
2.5	**114.0**	56	1.007	-0.267	0.874	-0.236	1.026	-0.220	**-0.241**							Add Load (Multiple Jacks)
5	**114.0**	56	1.019	-0.279	0.884	-0.246	1.037	-0.231	**-0.252**	123	-0.24	164	-0.26	81	-0.02	
1	**120.0**	59	1.043	-0.303	0.909	-0.271	1.059	-0.253	**-0.276**	125	-0.28	165	-0.28	81	-0.02	Add Load (Continuous Jacking)
2.5	**120.0**	59	1.095	-0.355	0.957	-0.319	1.104	-0.298	**-0.324**							
5	**120.0**	59	1.137	-0.397	0.996	-0.358	1.140	-0.334	**-0.363**	130	-0.38					Survey Level Hit - No Readings
7.5	**120.0**	59	1.152	-0.412	1.011	-0.373	1.153	-0.347	**-0.377**							
10	**120.0**	59	1.168	-0.428	1.024	-0.386	1.660	-0.854	**-0.556**	132	-0.42					
5	**90.0**	44	1.160	-0.420	1.023	-0.385	1.162	-0.356	**-0.387**	130	-0.38					Unload to 50 kips - reload to 90
5	**60.0**	29	1.122	-0.382	0.992	-0.354	1.127	-0.321	**-0.352**	127	-0.32					
5	**30.0**	15	1.067	-0.327	0.940	-0.302	1.078	-0.272	**-0.300**	125	-0.28					
10	**0.0**	0	0.972	-0.232	0.861	-0.223	1.020	-0.214	**-0.223**	122	-0.22					

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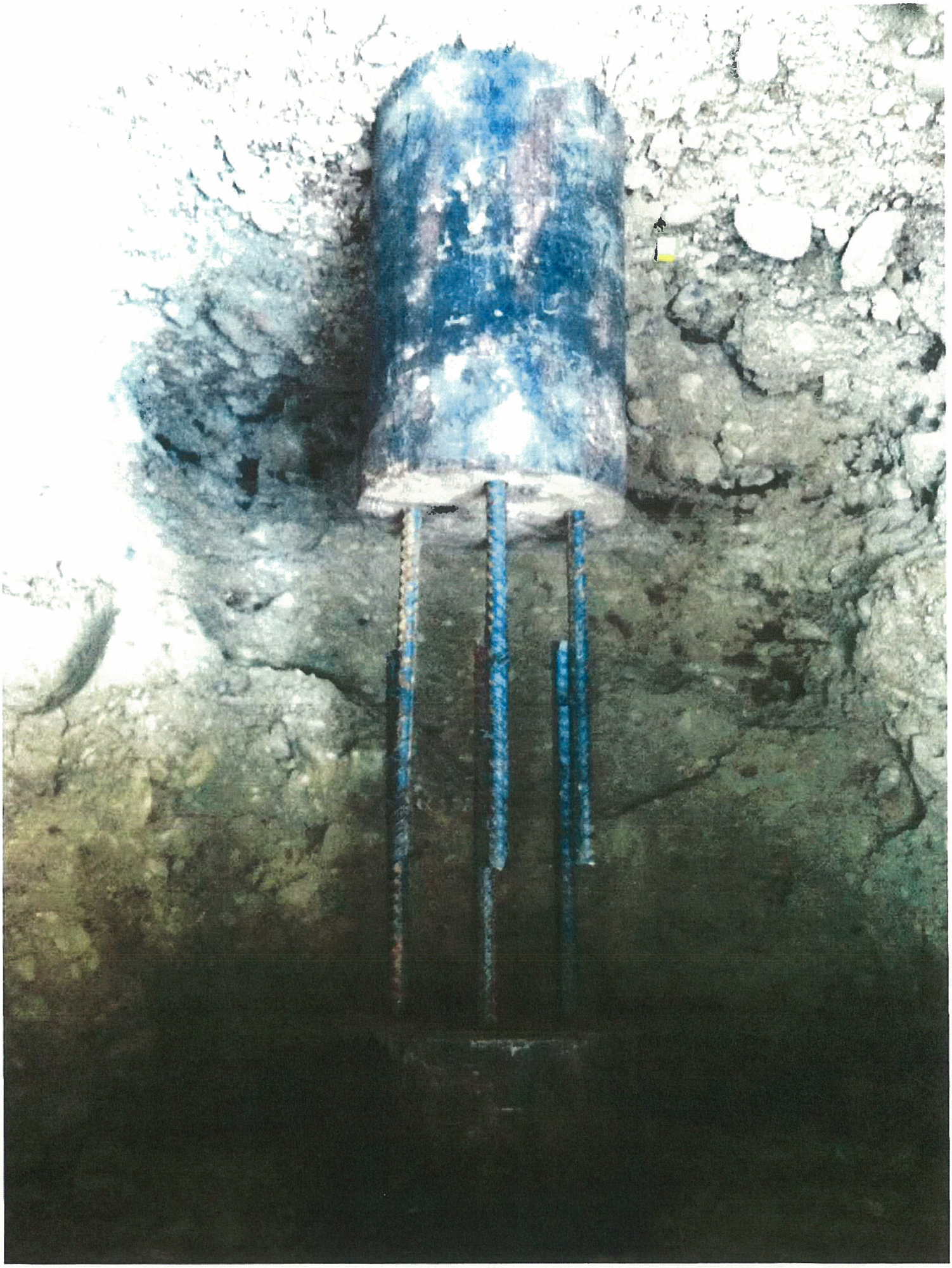
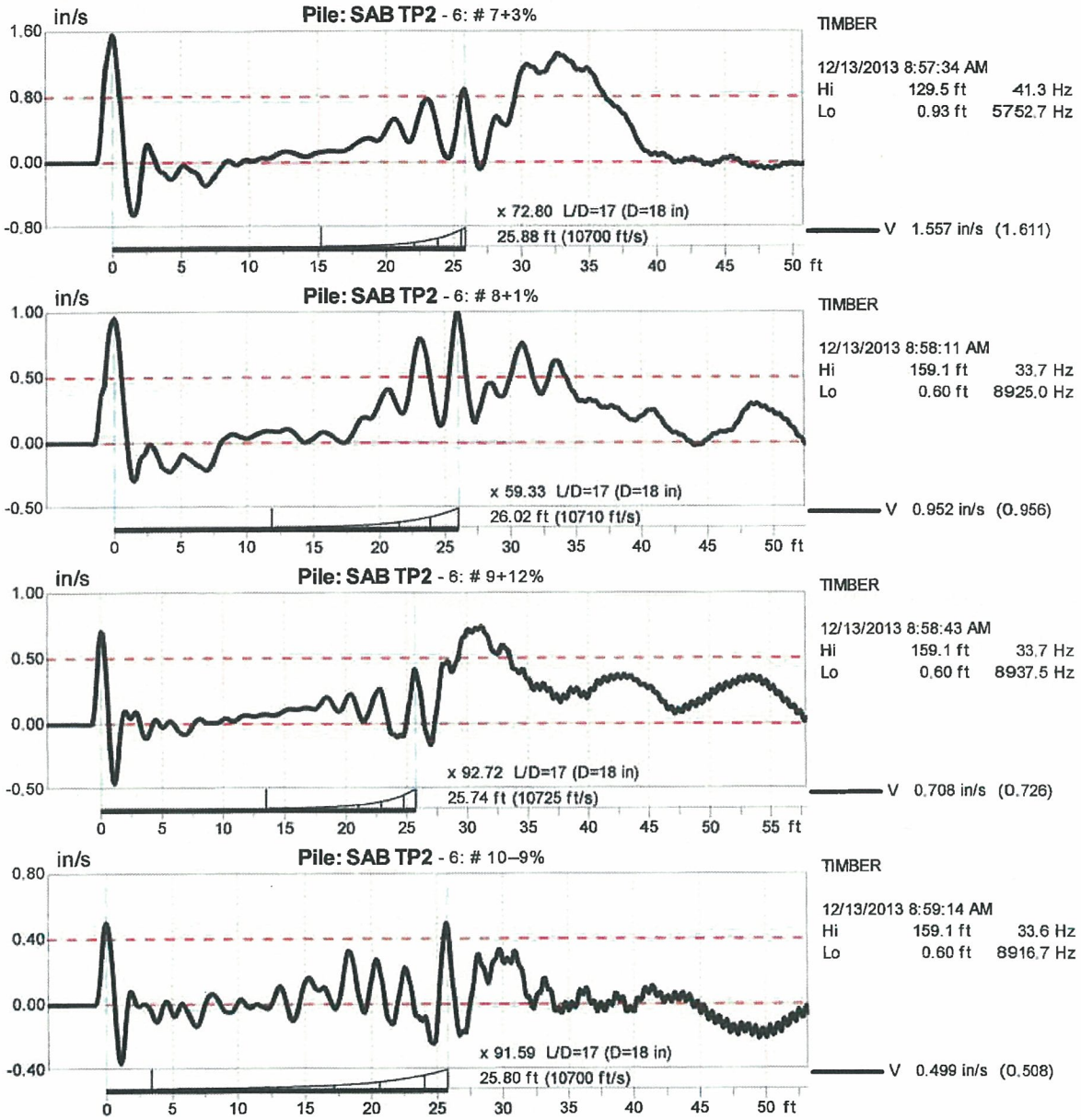


SOUTH ABUTMENT TEST PILE

Pile Dynamics, Inc.
MATTAWAMKEAG RVR BR
E:\...\PIT\NAB TP 1.PIT

1/6/2014

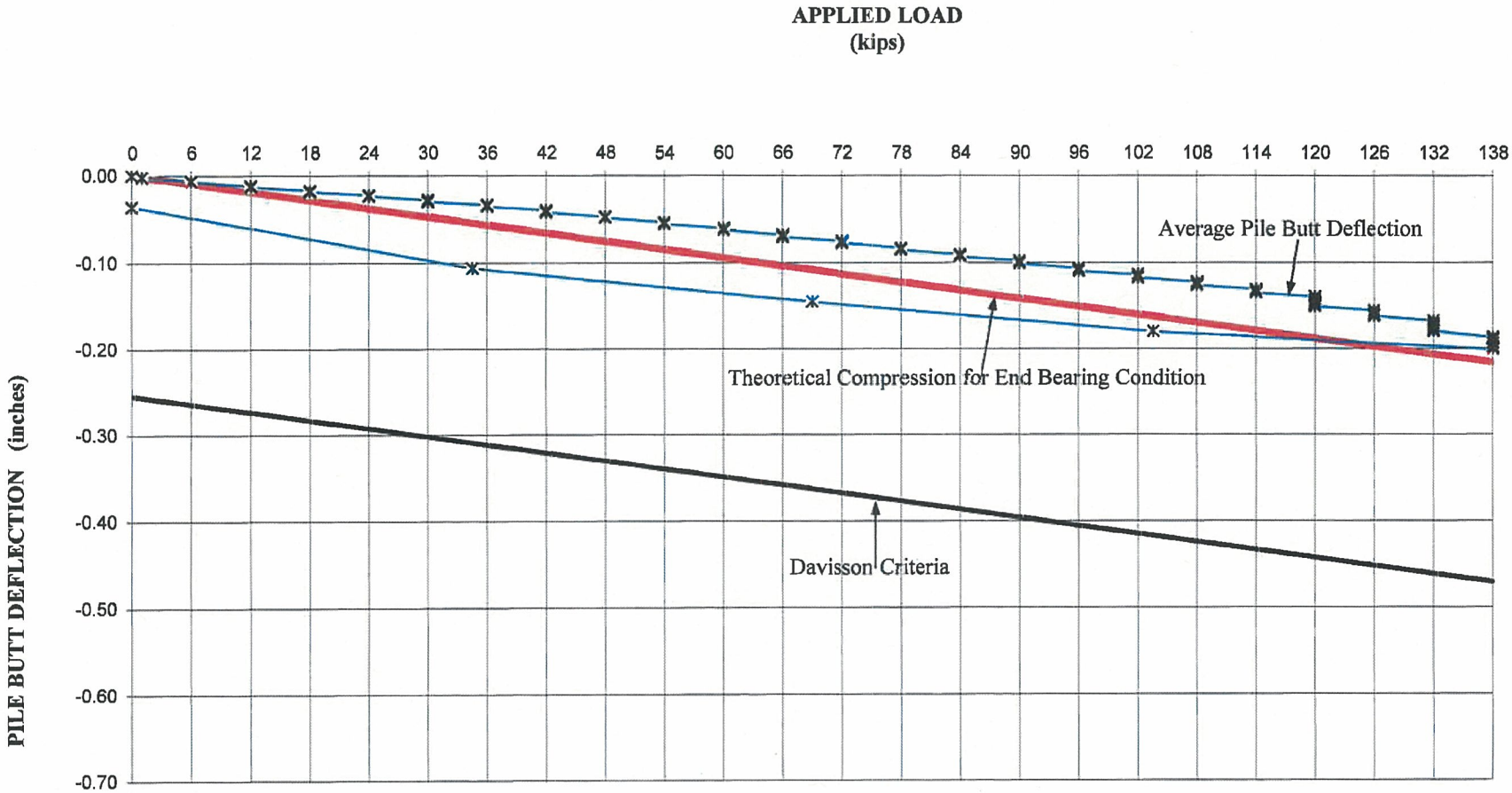
PIT-W 2009-2.DEMO



MATTAWAMKEAG RIVER BRIDGE - Pile No. SAB TP2

File No. 25813.00

Applied Load vs. Average Pile Butt Deflections



Test Date Dec 19 2013

Pile : 12.6-inch Diameter Timber

Length = 26.0 ft.
Area = 124.6 sq. in.
Modulus = 1.6E+06 psi

PILE BUTT DISPLACEMENT MEASUREMENTS

PILE NO.	SAB TP2	PROJECT	MATTAWAMKEAG RIVER BRIDGE
DATE	12/19/13	FILE NO.	25813.00
PILE	26.0 ft. 12.6-inch Diameter Timber	CONTRACTOR	MDOT/GZA

Load Cell Zero= 0 digits

Load Cell Calibration = 0.49 digits/kip

	LOAD	LOAD CELL	BUTT GAGES							WIRE LINE		OPTICAL LEVEL				COMMENTS
												Pile		Reference Beam		
TIME	KIPS	DIGITS	B1	B1 NET	B2	B2 NET	B3	B3 NET	AV. BUTT	W READ	W NET	P READ	P NET	R READ	R NET	
0	**0.0**	0	0.560	0.000	0.761	0.000	0.454	0.000	**0.000**	183	0.00	192	0.00	210	0.00	Initial zero Reading
0	**1.0**	0	0.563	-0.003	0.762	-0.001	0.456	-0.002	**-0.002**	183	0.00	192	0.00	210	0.00	Seating Load
1	**6.0**	3	0.567	-0.007	0.767	-0.006	0.459	-0.005	**-0.006**							
2.5	**6.0**	3	0.568	-0.008	0.768	-0.007	0.459	-0.005	**-0.007**							
5	**6.0**	3	0.568	-0.008	0.768	-0.007	0.459	-0.005	**-0.007**	183	0.00	192	0.00	210	0.00	
1	**12.0**	6	0.572	-0.012	0.773	-0.012	0.465	-0.011	**-0.012**							
2.5	**12.0**	6	0.573	-0.013	0.775	-0.014	0.466	-0.012	**-0.013**							
5	**12.0**	6	0.573	-0.013	0.775	-0.014	0.466	-0.012	**-0.013**	183	0.00	192	0.00	210	0.00	
1	**18.0**	9	0.576	-0.016	0.780	-0.019	0.470	-0.016	**-0.017**							
2.5	**18.0**	9	0.577	-0.017	0.781	-0.020	0.471	-0.017	**-0.018**							
5	**18.0**	9	0.577	-0.017	0.782	-0.021	0.472	-0.018	**-0.019**	184	-0.02	192	0.00	210	0.00	
1	**24.0**	12	0.580	-0.020	0.787	-0.026	0.475	-0.021	**-0.022**							
2.5	**24.0**	12	0.582	-0.022	0.787	-0.026	0.476	-0.022	**-0.023**							
5	**24.0**	12	0.582	-0.022	0.788	-0.027	0.476	-0.022	**-0.024**	184	-0.02	193	-0.02	210	0.00	
1	**30.0**	15	0.586	-0.026	0.792	-0.031	0.480	-0.026	**-0.028**							
2.5	**30.0**	15	0.587	-0.027	0.793	-0.032	0.481	-0.027	**-0.029**							
5	**30.0**	15	0.588	-0.028	0.795	-0.034	0.482	-0.028	**-0.030**	184	-0.02	193	-0.02	210	0.00	
1	**36.0**	18	0.592	-0.032	0.798	-0.037	0.485	-0.031	**-0.033**							
2.5	**36.0**	18	0.592	-0.032	0.799	-0.038	0.486	-0.032	**-0.034**							
5	**36.0**	18	0.593	-0.033	0.800	-0.039	0.487	-0.033	**-0.035**	184	-0.02	194	-0.04	210	0.00	
1	**42.0**	21	0.598	-0.038	0.805	-0.044	0.491	-0.037	**-0.040**							
2.5	**42.0**	21	0.600	-0.040	0.806	-0.045	0.492	-0.038	**-0.041**							
5	**42.0**	21	0.600	-0.040	0.808	-0.047	0.493	-0.039	**-0.042**	184	-0.02	194	-0.04	210	0.00	
1	**48.0**	24	0.605	-0.045	0.813	-0.052	0.498	-0.044	**-0.047**							
2.5	**48.0**	24	0.606	-0.046	0.813	-0.052	0.498	-0.044	**-0.047**							
5	**48.0**	24	0.607	-0.047	0.815	-0.054	0.498	-0.044	**-0.048**	185	-0.04	194	-0.04	211	0.02	
1	**54.0**	26	0.612	-0.052	0.820	-0.059	0.503	-0.049	**-0.053**							
2.5	**54.0**	26	0.614	-0.054	0.821	-0.060	0.503	-0.049	**-0.054**							
5	**54.0**	26	0.614	-0.054	0.822	-0.061	0.505	-0.051	**-0.055**	185	-0.04	194	-0.04	211	0.02	
1	**60.0**	29	0.619	-0.059	0.828	-0.067	0.509	-0.055	**-0.060**							
2.5	**60.0**	29	0.621	-0.061	0.830	-0.069	0.511	-0.057	**-0.062**							
5	**60.0**	29	0.621	-0.061	0.830	-0.069	0.511	-0.057	**-0.062**	185	-0.04	195	-0.06	211	0.02	
1	**66.0**	32	0.627	-0.067	0.836	-0.075	0.516	-0.062	**-0.068**							
2.5	**66.0**	32	0.629	-0.069	0.838	-0.077	0.517	-0.063	**-0.070**							Add Load
5	**66.0**	32	0.629	-0.069	0.839	-0.078	0.519	-0.065	**-0.071**	186	-0.06	195	-0.06	211	0.02	
1	**72.0**	35	0.633	-0.073	0.844	-0.083	0.523	-0.069	**-0.075**							
2.5	**72.0**	35	0.635	-0.075	0.845	-0.084	0.524	-0.070	**-0.076**							Add Load
5	**72.0**	35	0.636	-0.076	0.846	-0.085	0.525	-0.071	**-0.077**	186	-0.06	195	-0.06	211	0.02	

PILE BUTT DISPLACEMENT MEASUREMENTS

PILE NO.	SAB TP2	PROJECT	MATTAWAMKEAG RIVER BRIDGE
DATE	12/19/13	FILE NO.	25813.00
PILE	26.0 ft. 12.6-inch Diameter Timber	CONTRACTOR	MDOT/GZA

Load Cell Zero= 0 digits

Load Cell Calibration = 0.49 digits/kip

	LOAD	LOAD CELL	BUTT GAGES							WIRE LINE		OPTICAL LEVEL				COMMENTS
												Pile		Reference Beam		
TIME	KIPS	DIGITS	B1	B1 NET	B2	B2 NET	B3	B3 NET	AV. BUTT	W READ	W NET	P READ	P NET	R READ	R NET	
1	**78.0**	38	0.642	-0.082	0.852	-0.091	0.530	-0.076	**-0.083**							
2.5	**78.0**	38	0.644	-0.084	0.854	-0.093	0.530	-0.076	**-0.084**							Add Load
5	**78.0**	38	0.644	-0.084	0.855	-0.094	0.531	-0.077	**-0.085**	186	-0.06	196	-0.08	211	0.02	
1	**84.0**	41	0.649	-0.089	0.860	-0.099	0.537	-0.083	**-0.090**							
2.5	**84.0**	41	0.650	-0.090	0.862	-0.101	0.538	-0.084	**-0.092**							Add Load
5	**84.0**	41	0.652	-0.092	0.863	-0.102	0.538	-0.084	**-0.093**	187	-0.08	196	-0.08	211	0.02	
1	**90.0**	44	0.657	-0.097	0.868	-0.107	0.543	-0.089	**-0.098**							
2.5	**90.0**	44	0.659	-0.099	0.870	-0.109	0.544	-0.090	**-0.099**							Add Load
5	**90.0**	44	0.659	-0.099	0.872	-0.111	0.546	-0.092	**-0.101**	187	-0.08	197	-0.10	211	0.02	
1	**96.0**	47	0.665	-0.105	0.877	-0.116	0.551	-0.097	**-0.106**							
2.5	**96.0**	47	0.667	-0.107	0.879	-0.118	0.552	-0.098	**-0.108**							Add Load
5	**96.0**	47	0.669	-0.109	0.880	-0.119	0.554	-0.100	**-0.109**	187	-0.08	197	-0.10	211	0.02	
1	**102.0**	50	0.673	-0.113	0.885	-0.124	0.557	-0.103	**-0.113**							
2.5	**102.0**	50	0.675	-0.115	0.888	-0.127	0.560	-0.106	**-0.116**							Add Load - (2x)
5	**102.0**	50	0.676	-0.116	0.889	-0.128	0.561	-0.107	**-0.117**	188	-0.10	198	-0.12	211	0.02	
1	**108.0**	53	0.681	-0.121	0.895	-0.134	0.564	-0.110	**-0.122**							
2.5	**108.0**	53	0.683	-0.123	0.897	-0.136	0.568	-0.114	**-0.124**							Add Load - (2x)
5	**108.0**	53	0.685	-0.125	0.898	-0.137	0.569	-0.115	**-0.126**	188	-0.10	198	-0.12	211	0.02	
1	**114.0**	56	0.689	-0.129	0.904	-0.143	0.573	-0.119	**-0.130**							
2.5	**114.0**	56	0.692	-0.132	0.906	-0.145	0.575	-0.121	**-0.133**							Add Load - (2x)
5	**114.0**	56	0.693	-0.133	0.909	-0.148	0.576	-0.122	**-0.134**	189	-0.12	199	-0.14	211	0.02	
1	**120.0**	59	0.698	-0.138	0.913	-0.152	0.581	-0.127	**-0.139**							
2.5	**120.0**	59	0.702	-0.142	0.917	-0.156	0.584	-0.130	**-0.143**							Add Load
5	**120.0**	59	0.705	-0.145	0.920	-0.159	0.587	-0.133	**-0.146**							
7.5	**120.0**	59	0.707	-0.147	0.922	-0.161	0.589	-0.135	**-0.148**							
10	**120.0**	59	0.708	-0.148	0.924	-0.163	0.590	-0.136	**-0.149**							Add Load
15	**120.0**	59	0.710	-0.150	0.926	-0.165	0.591	-0.137	**-0.151**	189	-0.12	200	-0.16	211	0.02	
1	**126.0**	62	0.714	-0.154	0.930	-0.169	0.596	-0.142	**-0.155**							
2.5	**126.0**	62	0.718	-0.158	0.934	-0.173	0.599	-0.145	**-0.159**							Add Load
5	**126.0**	62	0.719	-0.159	0.936	-0.175	0.600	-0.146	**-0.160**							
7.5	**126.0**	62	0.720	-0.160	0.936	-0.175	0.600	-0.146	**-0.160**							Add Load
10	**126.0**	62	0.722	-0.162	0.937	-0.176	0.601	-0.147	**-0.162**	190	-0.14	201	-0.18	211	0.02	
1	**132.0**	65	0.727	-0.167	0.943	-0.182	0.607	-0.153	**-0.167**							
2.5	**132.0**	65	0.730	-0.170	0.947	-0.186	0.610	-0.156	**-0.171**							Add Load
5	**132.0**	65	0.734	-0.174	0.950	-0.189	0.613	-0.159	**-0.174**							
7.5	**132.0**	65	0.738	-0.178	0.953	-0.192	0.615	-0.161	**-0.177**							Add Load
10	**132.0**	65	0.740	-0.180	0.956	-0.195	0.617	-0.163	**-0.179**	191	-0.16	201	-0.18	211	0.02	

PILE BUTT DISPLACEMENT MEASUREMENTS

PILE NO.	SAB TP2	PROJECT	MATTAWAMKEAG RIVER BRIDGE
DATE	12/19/13	FILE NO.	25813.00
PILE	26.0 ft. 12.6-inch Diameter Timber	CONTRACTOR	MDOT/GZA

Load Cell Zero= 0 digits

Load Cell Calibration = 0.49 digits/kip

	LOAD	LOAD CELL	BUTT GAGES							WIRE LINE		OPTICAL LEVEL				COMMENTS
												Pile		Reference Beam		
TIME	KIPS	DIGITS	B1	B1 NET	B2	B2 NET	B3	B3 NET	AV. BUTT	W READ	W NET	P READ	P NET	R READ	R NET	
1	**138.0**	68	0.748	-0.188	0.962	-0.201	0.624	-0.170	**-0.186**							
2.5	**138.0**	68	0.748	-0.188	0.966	-0.205	0.626	-0.172	**-0.188**							Add Load
5	**138.0**	68	0.749	-0.189	0.967	-0.206	0.626	-0.172	**-0.189**							
7.5	**138.0**	68	0.754	-0.194	0.971	-0.210	0.630	-0.176	**-0.193**							Add Load
10	**138.0**	68	0.758	-0.198	0.975	-0.214	0.634	-0.180	**-0.197**							Add Load
12.5	**138.0**	68	0.760	-0.200	0.978	-0.217	0.636	-0.182	**-0.200**							Add Load
15	**138.0**	68	0.761	-0.201	0.978	-0.217	0.637	-0.183	**-0.200**	192	-0.18	202	-0.20	211	0.02	
5	**103.5**	51	0.740	-0.180	0.955	-0.194	0.619	-0.165	**-0.180**	191	-0.16	201	-0.18	211	0.02	
5	**69.0**	34	0.700	-0.140	0.925	-0.164	0.584	-0.130	**-0.145**	189	-0.12	199	-0.14	211	0.02	
5	**34.5**	17	0.659	-0.099	0.887	-0.126	0.546	-0.092	**-0.106**	187	-0.08	198	-0.12	211	0.02	
10	**0.0**	0	0.586	-0.026	0.814	-0.053	0.483	-0.029	**-0.036**	184	-0.02	194	-0.04	211	0.02	

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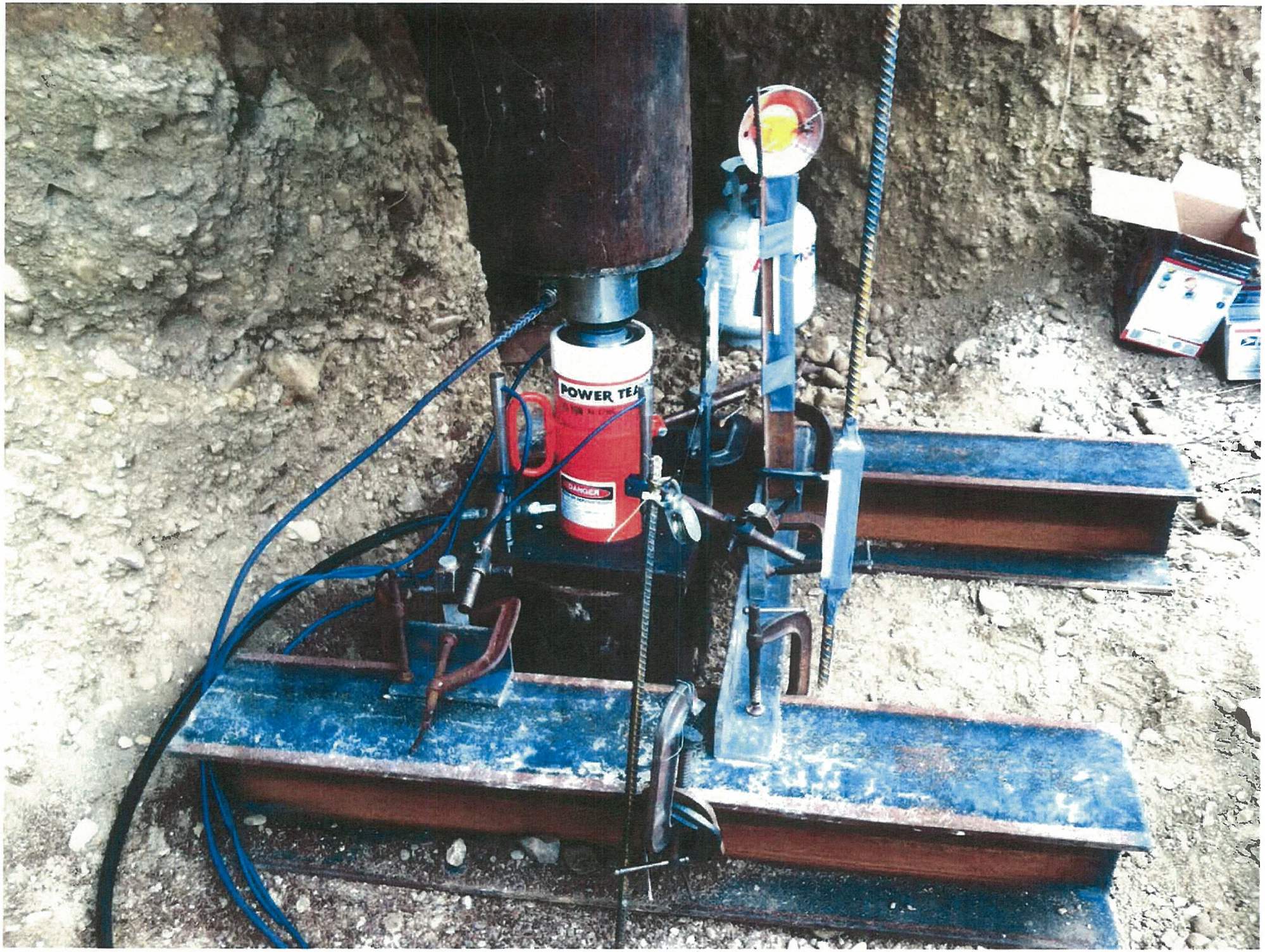
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LOADCELL AND JACK CALIBRATION REPORTS

Richard Dudgeon, Inc.
100 HICKS STREET Bridgeport, CT 06608
Tel (203) 336-4459 Fax (203) 333-8417

LOADCELL CALIBRATION REPORT

LOADCELL 200 TONS CAPACITY, _____ SERIAL No. 2535
STRAIN INDICATOR INSTRUMENT: MODEL P3 SERIAL No. 199528
LOAD CELL TEST No. 2.900 (GAUGE FACTOR), ZERO SET No. +00.00

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Dudgeon Order No. L17532 Order Date 11/25/13 Test Date 11/26/13
Customer GZA GEO ENVIRONMENTAL Purchase Order No. CHRIS SNOW
Test Performed By W. Nold In 50 Ton Tinius Olsen Test Machine, Universal Test Machine Serial Number 19249.

Test Method: Cylinder pressure increased in even increments at slow rate by hydraulic pump. Output force of loadcell measured by Test Machine (within a tolerance of one percent) between 1/2 and 50 tons traceable to the Nat'l Institute of Standards and Technology (formerly the Nat'l Bureau of Standards).

STANDARD FORCE	LOADCELL READINGS			AVERAGE
(~~KIPS~~/TONS)	RUN 1	RUN 2	RUN 3	READING
0	+00.00	+00.00	+00.00	+00.00
5	05.82	05.76	05.76	05.78
10	10.99	10.98	11.01	10.99
15	15.95	15.98	15.99	15.97
20	20.75	20.76	20.78	20.76
25	25.49	25.50	25.54	25.51
30	30.27	30.22	30.29	30.26
35	34.86	34.92	35.09	34.96
40	39.49	39.53	39.60	39.54
45	44.26	44.20	44.29	44.25
50	48.93	49.08	49.11	49.01

File:LDCELTO3COL.FRM, 10/14/04 Temperature at time of test 70 Deg. F

RICHARD DUDGEON, INC.
1565 RAILROAD AVE. BRIDGEPORT, CT. 06605 TEL:203-336-4459 FAX:203-333-8417

PRESSURE GAUGE CERTIFICATION

CUSTOMER: **GZA-GEO ENVIRONMENTAL INC**

CUSTOMER'S ORDER NO	DUDGEON ORDER NO.	ORDER DATE
CHRIS SNOW	**L17532**	11/25/13

GAUGE SERIAL NO.	CAPACITY
2416-1983	10,000 PSI 6" ϕ

WE HEREBY CERTIFY THE ABOVE HYDRAULIC GAUGE HAVE BEEN TESTED AGAINST OUR HEISE DIGITAL PRESSURE INDICATOR, SERIAL NO. S7-9400 AND FOUND TO BE WITHIN A STANDARD ACCURACY (PLUS OR MINUS 1/2%) OF FULL SCALE. OUR TEST EQUIPMENT IS TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS.

REFERENCE PRESSURE (PSI)	GAUGE READING (PSI)
0	50
1000	1050
2000	2025
3000	3025
4000	4000
5000	5000
6000	6000
7000	6975
8000	7975
9000	8975
10000	Ø

RICHARD DUDGEON, INC.

W. Neel

DATE: 11/26/13

Richard Dudgeon, Inc.
100 HICKS STREET, Bridgeport, CT 06608
Tel (203) 336-4459 Fax (203) 333-8417

Louis

JACK CALIBRATION REPORT

Cylinder 75 Tons Capacity, 6 " Stroke, Serial No. RJ 43608
Gauge 10,000 PSI Rating, 6 " Dial Dia., Serial No. 2467983

Notice: Calibration reports prepared by Richard Dudgeon, Inc. are submitted on a confidential basis and the data contained therein is our customer's proprietary information. Such reports may or may not be used by others without the express written consent of Richard Dudgeon, Inc. and it's customers.

Dudgeon Order No. L17532 Order Date 11/25/13 Test Date 11/26/13
Customer LOZA-LEO ENVIRONMENTAL Purchase Order No CHRIS SNOW
Test Performed By W. Nold In 50 Ton Tinius Olsen Test Machine Co., Universal Test Machine Serial Number 19249.

Test Method: Cylinder pressure increased in even increments at slow rate by hydraulic pump. Output force of cylinder measured by Test Machine calibrated (within a tolerance of one percent) between 1/2 and 50 tons traceable to the Nat'l Institute of Standards and Technology (formerly the Nat'l Bureau of Standards.

	LOAD ON CYLINDER TONS/~~KIPS~~	GAUGE READING IN PSI AT RAM EXTENSIONS OF 1 INCHES	3 INCHES	5 INCHES	AVERAGE PRESSURE PSI	
10	5	750	725	750	750	150
20	10	1350	1375	1350	1350	135
30	15	1950	1975	2000	1975	132
40	20	2600	2600	2600	2600	130
50	25	3225	3250	3250	3250	130
60	30	3875	3875	3875	3875	129
70	35	4500	4525	4550	4525	129
80	40	5150	5150	5175	5150	129
90	45	5825	5825	5825	5825	129
100	50	6475	6500	6525	6500	130

Temperature at time of test 70 Deg. F

Appendix D

Geotechnical Pile Resistance Estimate

GZA
GeoEnvironmental, Inc.

Engineers and Scientists

MEMORANDUM

TO: Laura Krusinski, P.E.
Maine Department of Transportation

FROM: Christopher L. Snow, P.E.
Russell J. Morgan

DATE: August 27, 2014

FILE NO.: 09.0025813.00

SUBJECT: Revised Geotechnical Pile Resistance Estimate
Piers 1 and 2
Route 2A Bridge over Mattawamkeag River
Haynesville, Maine

STATE OF MAINE
CHRISTOPHER L. SNOW
No. 7275
LICENSED
PROFESSIONAL ENGINEER
8/27/14

477 Congress Street
Suite 700
Portland, Maine
04101-3926
207-879-9190
FAX 879-0099
www.gza.com

This memorandum provides the results of GZA GeoEnvironmental, Inc.'s (GZA's) revised evaluation of geotechnical pile resistance for the Route 2A Bridge over Mattawamkeag River in Haynesville, Maine. It was revised based on the results of recent MaineDOT test borings, and supersedes our preliminary evaluation as described in our May 9, 2014 memorandum. The work was completed in accordance with GZA's General Consultant Agreement (GCA CT #20110613000000006485) with Maine Department of Transportation (MaineDOT), the MaineDOT Project Contract dated July 28, 2011, and the attached Limitations.

BACKGROUND

The Mattawamkeag River Bridge consists of a 280-foot long, three-span, steel-girder, concrete-deck bridge carrying Route 2A over the Mattawamkeag River. Timber pile foundations support the bridge's two river piers and two stub abutments. The plans show a design capacity of 16 tons per pile for abutment piles and 20 tons per pile for pier piles. GZA understands that MaineDOT wishes to reuse the pile foundations and possibly the abutment and pier substructures to support a replacement bridge deck and other loads associated with the proposed improvements.

GZA completed preliminary estimates of the nominal geotechnical static resistance of the piles based on the circa-1950 borings, as presented in our memorandum entitled "Preliminary Geotechnical Pile Resistance, Piers 1 and 2, Route 2A Bridge over Mattawamkeag River, Haynesville, Maine," dated May 9, 2014. Due to the age of the borings and the historic differences in test boring equipment, it was necessary to make significant adjustments in developing the standard penetration N-values that formed the basis of the in-situ soils testing data.

MaineDOT has since drilled additional test borings and completed laboratory testing for the project. This memorandum presents the results of GZA's reevaluation of the project given the new data and supersedes recommendations presented in the May 9, 2014 document.

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SUBSURFACE EXPLORATION

Four test borings were drilled by MaineDOT along the project alignment between June 4, 2014 and June 17, 2014. A test boring was completed adjacent to each abutment and pier structure. Test borings were drilled to total depths ranging from approximately 32 to 64 feet below ground surface (bgs). Bedrock was cored in each of the test borings. Subsurface conditions at the site include granular embankment fill (at the abutments); overlying silty sand (alluvium) and silty sand and gravel (glacial till); and slate bedrock. A boring location plan and logs of the test borings were prepared by MaineDOT and are attached for reference.

Conditions encountered during the recent MaineDOT test borings indicate that the alluvial material, previously assumed to be loose to very loose, is more medium dense in nature and the glacial till material is consistently very dense. The depth to bedrock documented in the 2014 MaineDOT test borings was relatively consistent with the depth to bedrock shown in interpretive subsurface profile presented in the original design drawings dated February 1951, and is approximately 30 feet below the stream bed.

UPDATED DESIGN SOIL PROFILES

Three soil units: Fill, Silty Sand (alluvial) and Silty Sand and Gravel (Glacial Till), were encountered in the test borings near the abutments. The thicknesses and generalized description are presented for each of the two abutment locations in the following tables.

ABUTMENT PROFILE (ABUTMENT 1) (based on BB-HMR-101)					
Strata Designation	**Approx. Base El. (ft-NGVD 29)**	**Depth Below Pile Cap (ft)**	**Unit Weight (pcf)**	**Representative N60 for layer**	**Description**
Pile Cap	375	0			
Fill	372	3	120	30	Brown, Gravelly Sand w/ Silt
Silty Sand	357	18	120	15	Brown Silty Sand w/ Gravel
Glacial Till	333	42	130	50	Grey Sand w/ Sand and Gravel
Bedrock	--		--	--	Slate

ABUTMENT PROFILE (ABUTMENT 2) (based on BB-HMR-104)					
Strata Designation	**Approx. Base El. (ft-NGVD 29)**	**Depth Below Pile Cap (ft)**	**Unit Weight (pcf)**	**Representative N60 for layer**	**Description**
Pile Cap	375	0			
Fill	372	3	120	30	Brown, Gravelly Sand w/ Silt
Silty Sand	338	37	120	15	Gray-brown Silty Sand w/ Gravel
Glacial Till	327	48	130	50	Gray Silt w/ Sand and Gravel
Bedrock	--		--	--	Slate

Two soil units: Silty Sand (alluvial) and Silty Sand and Gravel (Glacial Till), were encountered in the test borings near the piers. The thicknesses and generalized description are presented for each of the two pier locations in the following tables.

PIER PROFILE (PIER 1) (based on BB-HMR-102)					
Strata Designation	**Approx. Base El. (ft-NGVD 29)**	**Depth Below Pile Cap (ft)**	**Unit Weight (pcf)**	**Representative N60 for layer**	**Description**
Pile Cap	356	0			
Silty Sand	348	8	120	14	Gray-brown Silty Sand w/ Gravel
Glacial Till	333	23	130	50	Gray Silt w/ Sand and Gravel
Bedrock	--		--	--	Slate

PIER PROFILE (PIER 2) (based on BB-HMR-103)					
Strata Designation	**Approx. Base El. (ft-NGVD 29)**	**Depth Below Pile Cap (ft)**	**Unit Weight (pcf)**	**Representative N60 for layer**	**Description**
Pile Cap	354	0			
Silty Sand	345	9	120	12	Brown-gray Sand w/ Silt
Glacial Till	333	21	130	50	Gray Sand w/ Silt and Gravel
Bedrock	--		--	--	Slate

PILE DESIGN CONSIDERATIONS

The nominal geotechnical resistance of the piles at each foundation location was estimated by static calculation of the side friction and point components of the resistance. Static calculations of the side friction and point components of the geotechnical resistance were also completed at each of the abutments and compared with the static load test results to validate the profile assumptions made at each pier.

The program SPILE (FHWA, 1993) was used to estimate the pile resistances. In SPILE, the side resistance is based on the Nordlund method, and the tip resistance is based on the Thurman method, with a limiting value based on the Meyerhof method. The AASHTO resistance factors for these methods for the strength limit state are summarized in the table below.

RESISTANCE FACTORS – STRENGTH LIMIT STATE (AASHTO TABLE 10.5.5.2.3-1)		
Driven Pile Resistance Component	**Method**	**Resistance Factor (ϕ)**
Side	Nordlund / Thurman	0.45
Tip	Nordlund / Thurman	0.45
Tip	Meyerhof SPT	0.30
Side + Tip	Static Load Test of Pile without dynamic testing	0.75

The AASHTO resistance factor for piles in uplift for the extreme limit state should be taken as 0.8.

Piles at each pier were judged to have developed resistance in the glacial till above the bedrock. The glacial till was modelled as very dense granular soil with an N60 of 50. Pile end-area was assumed to be 50 in^2 (i.e., minimum timber pile tip diameter of 8 inches, as specified in the State of Maine State Highway Commission Standard Specifications, Revision of 1945).

CONCLUSIONS/RECOMMENDATIONS

1. The nominal geotechnical resistance of the abutment piles, estimated by static calculation, was found to correlate well with the static load test results at each respective abutment. Therefore, the subsurface profile developed from the recent test borings was judged to be appropriate for static analysis.

2. We recommend using a resistance factor of 0.65 to calculate the geotechnical resistance of the pier piles for the strength limit state. This is based on our interpretation of AASHTO Table 10.5.5.2.3-2 that the entire bridge may be considered a single site with large variability and having completed the two static load tests at the abutments. Since load tests were completed locally at each abutment, we recommend using the higher resistance factor of 0.7 at the abutments.

3. The recommended values for nominal geotechnical resistance are summarized in the following table.

NOMINAL PILE RESISTANCE					
Substructure	**Side Resistance (kips)**	**Tip Resistance (kips)**	**Total Qs + Qp (kips)**	**Estimated Length (below Pile Cap) (ft)**	**Estimated Tip El. (ft - NGVD)**
Abutment 1	82[2]	119[2]	**138**[1] 201[2]	30[3]	345
Pier 1 (bearing in till)	24	73	98	14[4]	342
Pier 2 (bearing in till)	33	83	116	16[4]	338
Abutment 2	67[2]	7[2]	**120**[5] 74[2]	34[3]	341

Notes:
1. Abutment 1 resistance from static load test **(in bold)** is the recommended nominal resistance.
2. Values based on static calculations.
3. Abutment pile lengths as estimated from Pile Integrity Test (PIT) results.
4. Pier pile lengths are based on a MaineDOT pile driving records for the project.
5. Abutment 2 resistance from static load test **(in bold)** is the recommended nominal resistance.

The nominal pile resistance values should also be used as the factored geotechnical resistance for the extreme and service limit states.

4. The calculated values for factored geotechnical resistance for the strength limit state are summarized in the following table.

FACTORED PILE RESISTANCE FOR STRENGTH LIMIT STATE				
Substructure	**Side Resistance (kips)**	**Tip Resistance (kips)**	**ϕ (Qs + Qp) (kips) Bold = static calc, ϕ = 0.65 *(italic = static calc, ϕ = 0.45)***	**Total (kips) (Load Test, ϕ = 0.70)**
Abutment 1	**53** *(37)*	**77** *(54)*	**130** *(91)*	97
Pier 1 (bearing in till)	**16** *(11)*	**48** *(33)*	**64** *(44)*	-
Pier 2 (bearing in till)	**21** *(15)*	**54** *(37)*	**75** *(52)*	-
Abutment 2	**44** *(30)*	**4** *(3)*	**48** *(33)*	84

5. The recommended values for factored geotechnical resistance for the strength limit state are summarized in the following table.

RECOMMENDED FACTORED GEOTECHNICAL PILE RESISTANCE FOR STRENGTH LIMIT STATE	
Substructure	**Total (kips) (ϕ = 0.65 to 0.70)**
Abutment 1	97
Pier 1 (bearing in till)	64
Pier 2 (bearing in till)	75
Abutment 2	84

6. The recommended values for factored geotechnical tensile resistance for the strength and service limit states are summarized in the following table.

RECOMMENDED FACTORED GEOTECHNICAL TENSILE PILE RESISTANCE		
Substructure	**Strength Limit State Bold = ϕ = 0.80 x 0.65 *(italic = ϕ = 0.80 x 0.45)* (kips)**	**Service Limit State (ϕ = 0.80 x 1.0) (kips)**
Abutment 1	**42** *(30)*	66
Pier 1 (bearing in till)	**13** *(9)*	19
Pier 2 (bearing in till)	**17** *(12)*	26
Abutment 2	**35** *(24)*	54

CLOSURE

We trust this information meets current project needs. Please feel free to call Chris Snow at (207) 879-9190.

CLS/RJM:erc
P:\09 Jobs\0025800s\09.0025813.00 Haynesville PLT\Report\revised static resist report 08 - 14\FINAL 25813 StaticPileMemo REVISED 08-26-14.docx

Attachments: Limitations
Boring Location Plan, Sheet 2 of 4, Haynesville Bridge, Mattawamkeag River Bridge, Haynesville, Maine, June 2014
Interpretative Subsurface Profile, Sheet 3 of 4, Haynesville Bridge, Mattawamkeag River Bridge, Haynesville, Maine, June 2014 (with GZA markups)
Boring Logs, Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River, MaineDOT, June 2014
Spile Results (HAYPR1GT.OUT, HAYPR2GT.OUT, ABUT1.OUT, ABUT2.OUT)

LIMITATIONS

Explorations

1. The analyses and recommendations in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text 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 transitions are probably more erratic. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors occurring since the time measurements were made.

Review

4. In the event that any changes in the nature, design, or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by GZA GeoEnvironmental, Inc. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

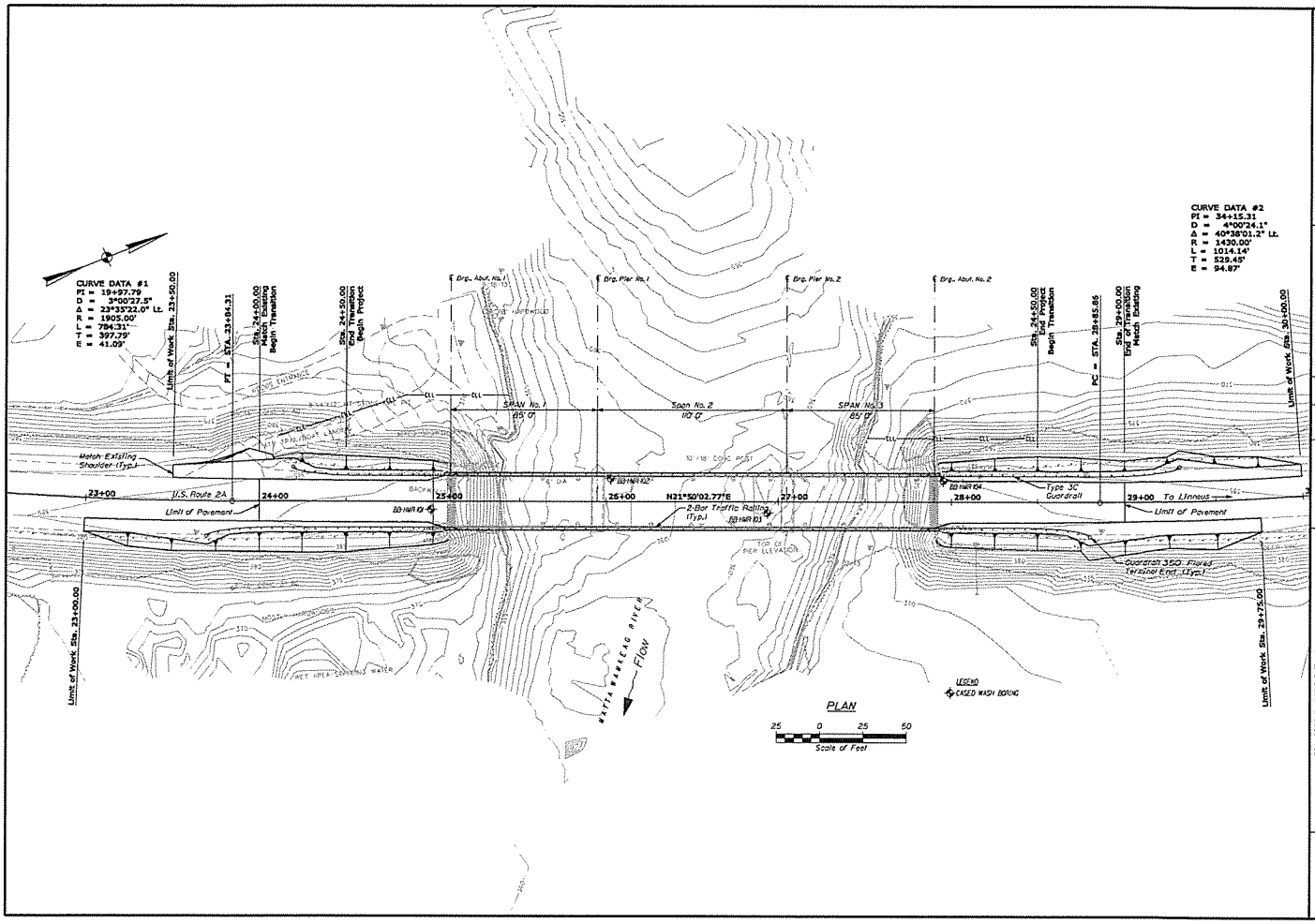
Construction

5. It is recommended that this firm be retained to provide soil engineering services during construction of the foundation phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

Use of Report

6. This design basis report has been prepared for this project by GZA GeoEnvironmental, Inc. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.

7. This report has been prepared for this project by GZA GeoEnvironmental, Inc. for the exclusive use of MaineDOT for specific application to the reconstruction of the Mattawamkeag River bridge in Haynesville, Maine in accordance with generally accepted soil and foundation engineering practices. No Warranty, express or implied, is made.



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
STP-2050(900)
WIN 20509.00
BRIDGE PLANS
BRIDGE NO. 5523

DESIGN DETAILED	K. BITTS	C.LIBBY	01/11
CHECKED DETAILED	K. M. HICKS		
DESIGN ESTIMATE			
CHECKED ESTIMATE			
REVISION 1			
REVISION 2			
REVISION 3			
FIELD CHANGES			

SIGNATURES
P.E. ROGER
DATE

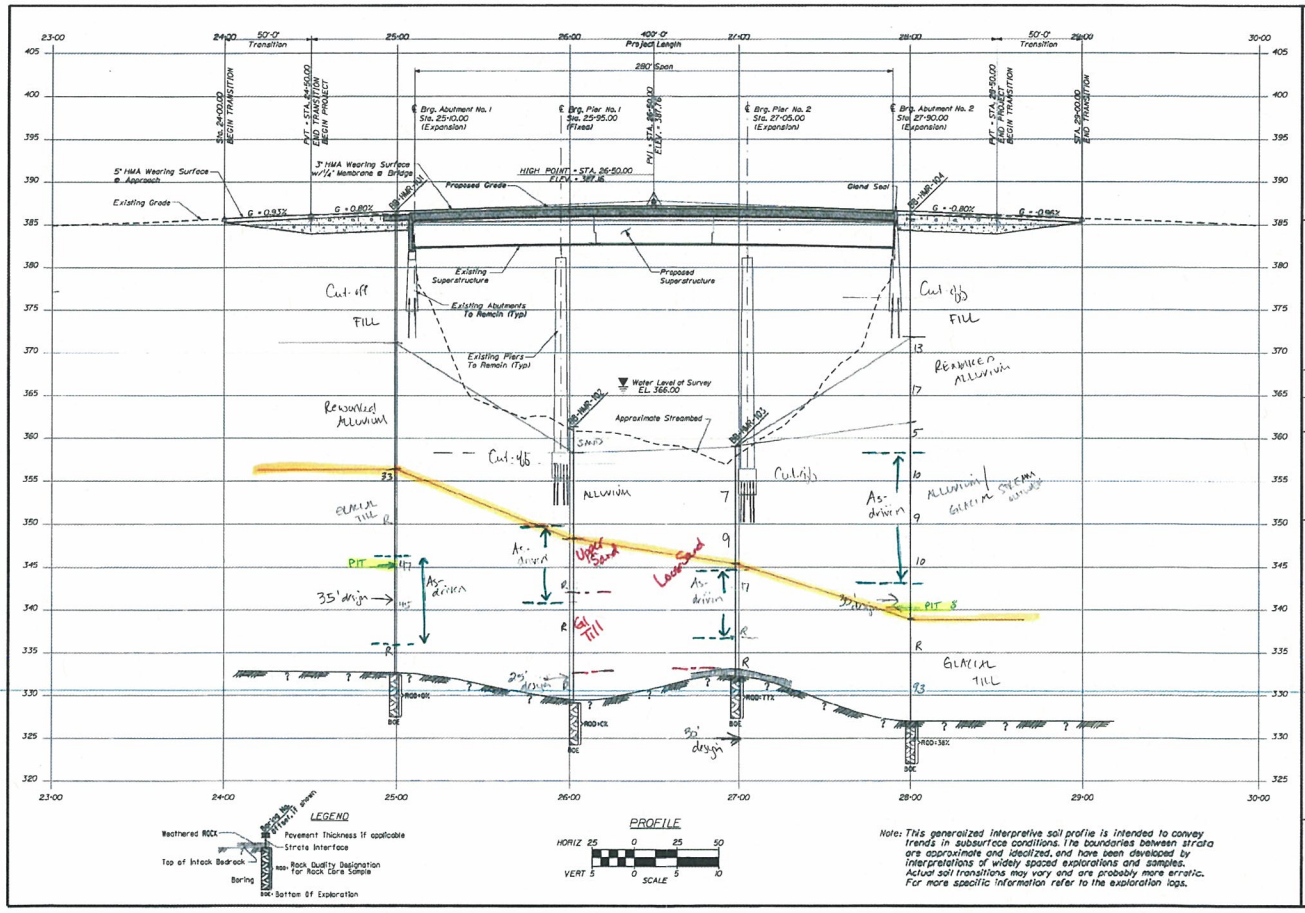
HAYNESVILLE BRIDGE
MATTAWAMKEAG RIVER
HAYNESVILLE AROOSTOOK COUNTY

BORING LOCATION PLAN

SHEET NUMBER
2
OF 4

Filename: ...\00VEGETE\NMSTA\006_BLP1.dgn Division: HIGHWAY Username: common Date: 7/21/2014

23 = 10'
2.8 in = 1'



LEGEND

Weathered ROCK — Pavement Thickness if applicable
Strata Interface
Top of Intact Bedrock — Rock Quality Designation for Rock Core Sample
Boring
BOC - Bottom Of Exploration

PROFILE

HORIZ 25 0 25 50
VERT 5 0 5 10
SCALE

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 transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

STP-2056(900)

WIN 23609.00

BRIDGE PLANS

BRIDGE NO. 5823

PROJ MANAGER	S. BRIDGE	BY	DATE
CONSTR. ENGINEER	R. BENNETT		
DESIGN ENGINEER	C.E. CARLSON	J. LUBBI	JUL 2014
REVISION 1			
REVISION 2			
REVISION 3			
REVISION 4			
FIELD ENGINEER			

SIGNATURE

P.E. STAMPER

DATE

HAYNESVILLE BRIDGE
MATTAWAMKEAG RIVER
HAYNESVILLE AROOSTOOK COUNTY

INTERPRETIVE SUBSURFACE PROFILE

SHEET NUMBER
3
OF 4

Filename: ...\DOT\GEOTECH\NSTA\007_ISP1.dgn Division: HIGHWAY Username: common Date: 7/21/2014

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-101
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/11/2014-6/12/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	24+98.8, 4.5 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	20.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	385.96	6½" PAVEMENT. 0.54	
	1D	24/19	1.00 - 3.00	17/16/13/11	29	42			Brown, damp, medium dense, gravelly, fine to coarse SAND, little silt, occasional cobbles, (Fill).	
5	2D/A	24/16	5.00 - 7.00	3/23/46/10	69	100			2D (5.0-6.5 ft bgs) Brown, damp, very dense, fine to coarse SAND, some gravel, some silt, occasional cobble, (Fill).	G#243186 A-1-b, SM WC=7.1%
								380.00	6.50	
									2D/A (6.5-7.0 ft bgs) Brown, moist, silty, fine to coarse SAND, some gravel, (Fill).	
10	3D	24/15	10.00 - 12.00	5/6/9/7	15	22	24		Brown, damp, medium dense, fine to coarse SAND, some gravel, some silt, occasional cobble, (Fill).	
							30			
							33			
							34			
							34			
15								371.50	15.00	
	4D	24/14	15.00 - 17.00	9/9/9/10	18	26	21		Brown, wet, medium dense, fine to coarse SAND, little gravel, some silt, (Reworked Alluvium).	
							37			
							61			
							53			
							27			
20	5D	24/14	20.00 - 22.00	4/4/4/4	8	12	9		Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt. (similar to 4D) (Reworked Alluvium)	G#243187 A-1-b, SM WC=17.1%
							22			
							31			
							42			
25							54			

Remarks:

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.

Boring No.: BB-HMR-101

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-101
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/11/2014-6/12/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	24+98.8, 4.5 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	20.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	6D	24/13	25.00 - 27.00	9/9/10/15	19	27	23		Similar to above, with iron staining, some grey silt layering.	
							57			
							53			
							52			
							92	357.00	29.50	
30	7D	24/10	30.00 - 32.00	16/14/9/11	23	33	33		Grey, wet, dense, gravelly, fine to coarse SAND, some silt, (Glacial Till)	
							59			
							62			
							57			
							69			
35	8D	12/4	35.00 - 36.00	20/60	---		46		Grey, wet, very dense, gravelly, fine to coarse SAND, trace silt, (Glacial Till).	
							333		Roller Coned ahead to 40.0 ft bgs. Cobble from 36.0-36.7 ft bgs.	
							177			
							140		Cobble from 38.0-38.2 ft bgs.	
							191		Cobble from 39.5-39.8 ft bgs.	
40	9D	24/13	40.00 - 42.00	11/21/26/50	47	68	35	346.50	40.00 Grey, wet, hard, SILT, some fine sand, trace gravel.	G#243188 A-4, CL WC=15.4%
							219		Roller Coned ahead to 45.0 ft bgs.	
							289		Cobble from 42.1-42.4 ft bgs.	
							342			
							52			
45	10D	24/14	45.00 - 47.00	6/17/28/2245	45	65	67		Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (Glaical Till). Roller Coned ahead to 50.5 ft bgs.	G#243189 A-2-4, SM WC=9.3%
							112			
							257			
							274			
50							156			

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-101
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/11/2014-6/12/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	24+98.8, 4.5 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	20.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50	MD	1.2/0	50.50 - 50.60	50(1.2")	---		a70			a70 blows for 0.5 ft. Boulder from 50.6-52.0 ft bgs.	
								332.70		53.80	
	R1	60/59	54.00 - 59.00	RQD = 0%			NQ-2	332.50		Top of Bedrock at Elev. 332.7 ft. 54.00 R1:Bedrock: Grey, fine grained, limey SLATE, occassional calcite veins, microfaults evidence rock has be sheared, no apparent jointing; cleavage along foliation. Rock Mass Quality = Very Poor. R1:Core Times (min:sec) 54.0-55.0 ft (7:13) 55.0-56.0 ft (4:35) 56.0-57.0 ft (5:40) 57.0-58.0 ft (9:17) 58.0-59.0 ft (8:07) 98% Recovery	
55								327.50		59.00 **Bottom of Exploration at 59.00 feet below ground surface.**	
60											
65											
70											
75											

Remarks:

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Boring No.: BB-HMR-101

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-102
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	361.3	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/4/2014-6/5/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	26+02.6, 13.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/8	0.00 - 2.00	3/7/3/7	10	14	11		Grey, wet, medium dense, gravelly, fine to coarse SAND, trace silt.	
							19			
							25			
							17	358.30	3.00	
	2D	24/16	4.00 - 6.00	4/4/4/5	8	12	6		Grey-brown, wet, medium dense, fine SAND, some silt, trace medium to coarse sand, trace gravel, (Alluvium).	G#243191 A-2-4, SM WC=27.7%
5							14			
							22			
							15			
							31			
	3D	24/15	9.00 - 11.00	3/4/7/14	11	16	2		Grey, wet, medium dense, silty, fine SAND, little gravel, trace medium to coarse sand, (Alluvium).	G#242669 A-4, SM WC=16.6%
10							19			
							119			
							119			
							79	348.30	13.00	
	4D	24/14	14.00 - 16.00	23/16/13/13	29	42	49		Grey, moist, dense, fine to coarse sandy, GRAVEL, little silt.	G#245375 A-1-a, GW-GM WC=7.4%
15							75			
							83			
							179	343.80	17.50	
							103		Roller Coned ahead from 18.1-19.0 ft bgs.	
	5D	12/12	19.00 - 20.00	34/57	---		50		Grey, wet, hard, SILT, some fine to coarse sand, some gravel, (Glacial Till).	G#243192 A-4, SM WC=7.9%
20							45		Roller Coned ahead to 24.0 ft bgs.	
							44			
							37			
							102			
25	6D	12/11	24.00 - 25.00	45/70	---		80		Similar to above. Roller Coned ahead to 29.0 ft bgs.	

Remarks:

25.4 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-102
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	361.3	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/4/2014-6/5/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	26+02.6, 13.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							39			
							53			
							54			
							104			
	7D	6/6	29.00 - 29.50	60	---		OPEN HOLE		Grey, wet, hard, SILT, some sand, little gravel. Roller Coned ahead to 32.1 ft bgs.	G#243311 A-4, ML WC=9.1%
30										
								329.50	31.80	
	R1	60/60	32.10 - 37.10	RQD = 0%			NQ-2	329.20	Weathered ROCK. 32.10	
									Top of Intack Bedrock at Elev. 329.2 ft. R1: Bedrock: Grey, fine grained, limey SLATE, hard, very slightly weathered, no apparent jointing, cleavage along steeply dipping foliation, occassion microfaults and calcite veins. Rock Mass Quality = Very Poor. R1:Core Times (min:sec) 32.1-33.1 ft (6:00) 33.1-34.1 ft (4:31) 34.1-35.1 ft (3:40) 35.1-36.1 ft (3:40) 36.1-37.1 ft (4:00) 100% Recovery	
35										
								324.20	37.10	
									Bottom of Exploration at 37.10 feet below ground surface.	
40										
45										
50										

Remarks:

25.4 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.

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Boring No.: BB-HMR-102

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-103
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	358.5	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/12,16/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	26+93.7, 6.3 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.00 - 2.00	1/1/1/1	2	3	1		Brown, wet, very loose, fine to medium SAND, some silt, trace coarse sand, trace gravel, (Alluvium).	G#243312 A-2-4, SM WC=27.7%
							2			
							5			
							4			
							9			
5							13			
	2D	24/17	6.00 - 8.00	4/4/3/4	7	10	1		Grey, wet, loose, fine SAND, trace silt, (Alluvium).	DS#302135 2D & 3D combined. c=0.81 psi Phi=30.5 degrees
							9			
							13			
							16			
10							12			
	3D	24/14	11.00 - 13.00	4/4/5/16	9	13	4		Similar to above, except medium dense.	
							26			
							64	345.00	13.50	
							62			
15							42			
	4D	24/6	16.00 - 18.00	9/9/8/8	17	25	31		Grey, wet, medium dense, gravelly, fine to coarse SAND, trace silt, (Glacial Outwash or Glacial Till).	G#243313 A-1-a, SW-SM WC=10.6%
							48			
							51			
							58			
20							125			
	MD	1.2/0	21.30 - 21.40	50	---		74		Cobble from 20.8-21.3 ft bgs. Failed sample attempt. Cobble from 21.3-21.6 ft bgs. Roller Coned ahead to 25.0 ft bgs.	
							111			
							96			
25							83			

Remarks:

27.9 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.
DS=Direct Shear, C=Cohesion, FA=Friction Angle

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-103
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	358.5	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/12,16/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	26+93.7, 6.3 ft Rt.	**Casing ID/OD:**	NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							a150			a150 blows for 0.2 ft. Cobble from 25.2-25.6 ft bgs.	
								332.50		Roller Coned ahead to 26.8 ft bgs.	
	R1	60/60	26.80 - 31.80	RQD = 77%			NQ-2			26.00	
								331.70		Weathered ROCK.	
										26.80	
										Top of Intact Bedrock at Elev. 331.7 ft. R1:Bedrock: Grey, fine grained, SLATE, hard, massive, jointing widely spaced at 4 to 5 ft, cleavage along foliation. Rock Mass Quality = Good. R1:Core Times (min:sec) 26.8-27.8 ft (11:40) 27.8-28.8 ft (6:16) 28.8-29.8 ft (5:45) 29.8-30.8 ft (5:32) 30.8-31.8 ft (5:25) 100% Recovery	
30								326.70		31.80	
										Bottom of Exploration at 31.80 feet below ground surface.	
35											
40											
45											
50											

Remarks:

27.9 ft from Bridge Deck to Ground.
8" Concrete Bridge Deck.
DS=Direct Shear, C=Cohesion, FA=Friction Angle

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Boring No.: BB-HMR-103

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-104
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.1	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/16/2014-6/17/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	27+95.2, 12.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	21.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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WOR/C = weight of rods or casing
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S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	385.52	7" PAVEMENT. 0.58	
5	1D	24/15	5.00 - 7.00	5/13/7/7	20	29			Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	
10	2D	24/19	10.00 - 12.00	6/8/11/11	19	27	85		Similar to above, (Fill).	G#243195 A-1-b, SM WC=4.8%
							52			
							54			
							46			
							38	372.10	14.00	
15	3D	24/13	15.00 - 17.00	6/7/6/9	13	19	22		Brown, wet, medium dense, fine to coarse sandy, GRAVEL, little silt, (Native soils, alluvium reworked?)	G#243314 combined w/4D A-1-a, GM WC=11.6%
							26			
							31			
							35			
							37			
20	4D	24/13	20.00 - 22.00	7/10/7/6	17	25	18		Similar to above.	G#243314 combined w/3D A-1-a, GM WC=11.6%
							35			
							42			
							55	362.10	24.00	
25							43			

Remarks:

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Boring No.: BB-HMR-104

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-104
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.1	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/16/2014-6/17/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	27+95.2, 12.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	21.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	5D	24/12	25.00 - 27.00	9/3/2/7	5	7	16		Grey, wet, loose, gravelly, fine to coarse SAND, some silt, occasional cobble.	
							58			
							91			
							65	357.60	28.50	
							38			
30	6D	24/14	30.00 - 32.00	7/4/6/7	10	14	21		Grey, wet, medium dense, fine to medium SAND, little silt, trace coarse sand, trace gravel, trace wood, (Alluvium or Glacial Outwash).	G#243196 A-2-4, SM WC=23.1%
							39			
							41			
							42			
							45			
35	7D	24/15	35.00 - 37.00	4/4/5/6	9	13	20		Grey, wet, medium dense, fine to medium SAND, trace coarse sand, trace gravel, trace silt. (Sand layer; Glacial Stream Deposits).	G#243197 A-3, SP-SM WC=20.8%
							29			
							40			
							43			
							58			
40	8D	24/16	40.00 - 42.00	4/5/5/7	10	14	21		Similar to above.	
							33			
							53			
							71			
							74			
45	9D	24/18	45.00 - 47.00	3/3/5/6	8	12	29		Grey, wet, stiff, sandy SILT, trace gravel. (Glacial stream deposits?).	G#243198 A-4, ML WC=22.9%
							39			
							45			
							167	337.60	48.50	
50							396			

Remarks:

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Haynesville Bridge #5623 carries US Route 2A over Mattawamkeag River
Location: Haynesville, Maine

Boring No.: BB-HMR-104
PIN: 20509.00

Driller:	MaineDOT	**Elevation (ft.)**	386.1	**Auger ID/OD:**	N/A
Operator:	Giles/Daggett/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	6/16/2014-6/17/2014	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	27+95.2, 12.3 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	21.0 ft bgs.
Hammer Efficiency Factor:	0.867	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50	10D	12/12	50.00 - 51.00	47/55	---		108		Grey, wet, hard, SILT, some sand, some clay, little gravel, (Glacial Till).	G#243200 A-4, CL WC=9.2% LL=23% PL=15% PI=8%
							81		Roller Coned ahead to 55.0 ft bgs.	
							59			
							118			
							159			
55	11D	24/20	55.00 - 57.00	32/48/45/60	93	134	RC		Similar to above, (Glacial Till).	
								326.90	59.20	
	R1	60/60	59.20 - 64.20	RQD = 38%			NQ-2		Top of Bedrock at Elev. 326.9 ft. R1:Bedrock: Upper 3 ft of core, grey, fine grained, metamorphosed SANDSTONE, joint set at 1-2 ft, surfaces weathered, rust staining and pyrite veins, with igneous intrusion in lower 2-feet of core run. Rock Mass Quality = Poor. R1:Core Times (min:sec) 59.2-60.2 ft (5:27) 60.2-61.2 ft (5:33) 61.2-62.2 ft (5:33) 62.2-63.2 ft (5:54) 63.2-64.2 ft (5:45) 100% Recovery	
60								321.90		
65									64.20 **Bottom of Exploration at 64.20 feet below ground surface.**	
70										
75										

Remarks:

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.

Boring No.: BB-HMR-104

ÚÄÄÄÄÄÄÄÄ ULTIMATE STATIC PILE CAPACITY/Federal Highway Administration ÄÄÄÄÄÄÄÄ¿

Nordlund (1963, 1979) and Tomlinson (1979, 1980) methods

Project Name : Haynesville
File Name : Pier 1 GT
Date : 08/11/14

Client : MaineDOT
Project Manager : CLS ck: 8-18-14
Computed by : JRB

Depth of Top of Pile = 0.00 ft.
Depth to Water Table = 0.00 ft.
Diameter of pile tip = 8.00 in.
Type of Pile = Timber Pile
Taper of Pile = 0.32

Pile length = 14.00 ft.

SKIN FRICTION CONTRIBUTION

Layer	Soil Type	Thickness (ft)	Effective Stress (psf)	Internal Friction Angle	N-SPT	Pile Perimeter (ft)
1	Cohesionless	8.00	230.40	33.13*	20.44*	2.45
2	Cohesionless	6.00	663.60	43.00*	70.91*	2.20

Layer	Soil Type	Undrained Shear Strength (psf)	Adhesion	Pile Taper	Sliding Friction Angle	Skin Resistance (Kips)
1	Cohesionless	--	--------	0.32	16.77	2.81
2	Cohesionless	--	--------	0.32	19.64	21.84

Total Side Friction : 24.65

POINT RESISTANCE CONTRIBUTION

Effective Stress at pile Tip (psf)	Internal Friction Angle	SPT Value	Pile End Area (ft*ft)	Bearing Capacity Factor Nq	End Bearing Resistance (Kips)
866.40	43.00*	63.61	0.35	307.00	72.79

Limiting End Bearing Resistance : 236.53

Ultimate Static Pile Capacity : 97.44

ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ

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ÚÄÄÄÄÄÄÄÄ ULTIMATE STATIC PILE CAPACITY/Federal Highway Administration ÄÄÄÄÄÄÄÄ¿
³           Nordlund (1963, 1979) and Tomlinson (1979, 1980) methods          ³
³                                                                             ³
³ Project Name   : Haynesville          Client          : MaineDOT            ³
³ File Name      : Pier 2 GT            Project Manager : CLS  ck: 8-18-14    ³
³ Date           : 08/11/14             Computed by     : JRB                 ³
³                                                                             ³
³ Depth of Top of Pile =   0.00 ft.         Pile length          =  16.00 ft. ³
³ Depth to Water Table =   0.00 ft.                                           ³
³ Diameter of pile tip =   8.00 in.                                           ³
³ Type of Pile         = Timber Pile                                          ³
³ Taper of Pile        =     0.32                                             ³
³                                                                             ³
³                                                                             ³
³                            SKIN FRICTION CONTRIBUTION                       ³
³                                                                             ³
³ Layer    Soil        Thickness    Effective   Internal   N-SPT      Pile   ³
³          Type                       Stress    Friction             Perimeter ³
³                         (ft)        (psf)      Angle                 (ft)   ³
³                                                                             ³
³   1   Cohesionless      9.00        259.20     32.26*   17.52*      2.50    ³
³   2   Cohesionless      7.00        755.00     43.00*   60.23*      2.22    ³
³                                                                             ³
³                                                                             ³
³ Layer    Soil       Undrained Shear  Adhesion  Pile    Sliding      Skin    ³
³          Type          Strength                Taper   Friction   Resistance ³
³                         (psf)                            Angle      (Kips)   ³
³                                                                             ³
³   1   Cohesionless        --        --------   0.32    16.68        3.36    ³
³   2   Cohesionless        --        --------   0.32    19.80       29.65    ³
³                                                                             ³
³                                                                             ³
³                                          Total Side Friction  :     33.01   ³
³                                                                             ³
³                          POINT RESISTANCE CONTRIBUTION                      ³
³                                                                             ³
³ Effective     Internal      SPT      Pile End     Bearing        End Bearing ³
³ Stress at     Friction     Value       Area       Capacity       Resistance  ³
³ pile Tip       Angle                              Factor                     ³
³   (psf)                              (ft*ft)        Nq             (Kips)    ³
³                                                                             ³
³   991.60       43.00*     60.23       0.35       307.00           83.31     ³
³                                                                             ³
³                                 Limiting End Bearing Resistance :   236.53  ³
³                                                                             ³
³                                                                             ³
³                                 Ultimate Static Pile Capacity   :   116.32  ³
³                                                                             ³
ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
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ABUT1.OUT

ÚÄÄÄÄÄÄÄÄ ULTIMATE STATIC PILE CAPACITY/Federal Highway Administration ÄÄÄÄÄÄÄÄ¿

Nordlund (1963, 1979) and Tomlinson (1979, 1980) methods

Project Name	: Haynesville	Client	: MaineDOT
File Name	: abut1	Project Manager	: CLS ck: 8-18-14
Date	: 08/14/14	Computed by	: JRB

Depth of Top of Pile = 0.00 ft. Pile length = 31.50 ft.
Depth to Water Table = 20.00 ft.
Diameter of pile tip = 8.00 in.
Type of Pile = Timber Pile
Taper of Pile = 0.32

SKIN FRICTION CONTRIBUTION

Layer	Soil Type	Thickness (ft)	Effective Stress (psf)	Internal Friction Angle	N-SPT	Pile Perimeter (ft)
1	Cohesionless	3.00	180.00	41.47*	52.37*	3.15
2	Cohesionless	15.00	1260.00	32.18*	17.28*	2.83
3	Cohesionless	13.50	2741.10	40.06*	45.32*	2.33

Layer	Soil Type	Undrained Shear Strength (psf)	Adhesion	Pile Taper	Sliding Friction Angle	Skin Resistance (Kips)
1	Cohesionless	--	--------	0.32	26.25	7.49
2	Cohesionless	--	--------	0.32	18.58	~~36.49~~ 31 kips
3	Cohesionless	--	--------	0.32	19.36	~~241.86~~ 51 kips

Layer 2: Top 10 feet; Qs = 10/15x 36.5 kips = 24.4 kips
Bottom 5 feet Qs = N/25 x pi x d x L = 17/25 x pi x 8/12 x 5 = 7.1 kips
Total = 31 kips

Total Side Friction : ~~285.84~~ 82 kips

POINT RESISTANCE CONTRIBUTION

Effective Stress at pile Tip (psf)	Internal Friction Angle	SPT Value	Pile End Area (ft*ft)	Bearing Capacity Factor Nq	End Bearing Resistance (Kips)
3197.40	39.34*	42.27	0.35	143.75	118.86

Limiting End Bearing Resistance : 127.73

Ultimate Static Pile Capacity : ~~404.70~~ 201 kips

ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ

The SPT Method was used for sands at greater depths (> 20B) considering tendency for Nordlund to overestimate the friction resistance at greater depths (cased by unlimited effective stress method).
Assuming a minimum B = 8 in. 20B = 13 feet.
For SPT Method, Qs = N/25 in kips per square foot, where N is the average SPT blow count for the layer.
Layer 3: Qs (till) = N/25 x pi x d x L = 45/24 x pi x 8/12 x 13.5 = 51 kips.
Assume area based on 8-in diameter pile.
Check Nominal structural capacity Rn (struct) = Fco x 2 (typ ASD FS) x Ap = 1.2 ksi x 2 x 50 sq-in = 120 kips
Note: Nominal geotechnical capacity exceeds nominal structural capacity and the maximum load of the static test. Use the latter as the nominal geotechnical resistance.

ABUT2.OUT

```
ÚÄÄÄÄÄÄÄÄ ULTIMATE STATIC PILE CAPACITY/Federal Highway Administration ÄÄÄÄÄÄÄÄ¿
³           Nordlund (1963, 1979) and Tomlinson (1979, 1980) methods          ³
³                                                                             ³
³ Project Name    : Haynesville          Client          : MaineDOT          ³
³ File Name       : abut2                Project Manager : CLS  ck: 8-18-14  ³
³ Date            : 08/14/14             Computed by     : JRB               ³
³                                                                             ³
³ Depth of Top of Pile =   0.00 ft.        Pile length          =  35.00 ft. ³
³ Depth to Water Table =  20.00 ft.                                           ³
³ Diameter of pile tip =   8.00 in.                                           ³
³ Type of Pile         = Timber Pile                                          ³
³ Taper of Pile        =     0.32                                             ³
³                                                                             ³
³                                                                             ³
³                            SKIN FRICTION CONTRIBUTION                       ³
³                                                                             ³
³ Layer    Soil        Thickness    Effective   Internal   N-SPT      Pile   ³
³          Type                       Stress    Friction              Perimeter ³
³                         (ft)        (psf)      Angle                 (ft)   ³
³                                                                             ³
³   1   Cohesionless      3.00       180.00     41.47*    52.37*      3.27   ³
³   2   Cohesionless     32.00      2280.00     31.28*    14.28*      2.66   ³
³                                                                             ³
³                                                                             ³
³ Layer    Soil       Undrained Shear  Adhesion  Pile    Sliding      Skin   ³
³          Type          Strength                Taper   Friction   Resistance ³
³                         (psf)                           Angle      (Kips)   ³
³                                                                             ³
³   1   Cohesionless        --        --------   0.32    27.01        8.21   ³
³   2   Cohesionless        --        --------   0.32    17.06      105.76   ³
³                                                                             ³
³                                                Total Side Friction  :  113.97 ³
³                                                                             ³
³                           POINT RESISTANCE CONTRIBUTION                     ³
³                                                                             ³
³ Effective     Internal      SPT      Pile End     Bearing        End Bearing ³
³ Stress at     Friction     Value       Area       Capacity       Resistance  ³
³ pile Tip       Angle                             Factor                     ³
³   (psf)                              (ft*ft)       Nq            (Kips)     ³
³                                                                             ³
³  3264.00       30.76*     12.53       0.35        33.95          19.99     ³
³                                                                             ³
³                                Limiting End Bearing Resistance :    6.60    ³
³                                                                             ³
³                                Ultimate Static Pile Capacity   :  120.56    ³
³                                                                             ³
ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ
```

Layer 2: Top 10 feet; Qs = 10/32x 105.8 kips = 33.1 kips
. Bottom 22 feet Qs = N/25 x pi x d x L = 14/25 x pi x 8/12 x 22 = 25.8 kips
. Total = 59 kips

59 kips

67 kips

74 kips

The SPT Method was used for sands at greater depths (> 20B) considering tendency for Nordlund to overestimate the friction resistance at greater depths (cased by unlimited effective stress method).
Assuming a minimum B = 8 in. 20B = 13 feet.
For SPT Method, Qs = N/25 in kips per square foot, where N is the average SPT blow count for the layer.

Assume area based on 8-in diameter pile.
Check Nominal structural capacity Rn (struct) = Fco x 2 (typ ASD FS) x Ap = 1.2 ksi x 2 x 50 sq-in = 120 kips
Note: Nominal geotechnical capacity exceeds nominal structural capacity and the maximum load of the static test. Use the latter as the nominal geotechnical resistance.

Appendix E

Seismic Parameters

Haynesville
20509.00

Seismic Site Classification Determination
AASHTO LRFD Table C3.10.3.1.1

By: Laura Krusinski
Date: January 2014
Check: BS 9/2015

BB-HMR-101				BB-HMR-102				BB-HMR-103				BB-HMR-104			
SPT N		**di**	**di/N**	**SPT N**		**di**	**di/N**	**SPT N**		**di**	**di/N**	**SPT N**		**di**	**di/N**
42		3	0.07	14		3	0.21	3		5	1.67	29		6	0.21
100		3	0.03	12		5	0.42	10		5	0.50	27		8	0.30
32		9	0.28	16		5	0.31	13		3.5	0.27	19		5	0.26
26		5	0.19	42		4.5	0.11	25		6.5	0.26	25		5	0.20
12		5	0.42	50		6.6	0.13	50		6	0.12	7		3.5	0.50
27		5	0.19	50		7.8	0.16					14		5.5	0.39
33		5	0.15	14			0.00					13		5	0.38
50		5	0.10									14		5	0.36
68		5	0.07									12		7	0.58
65		5	0.08									50		5	0.10
70		3.8	0.05									93		4.2	0.05
100	bedrock	46.2	0.46												
				100	**Bedrock**	68.1	2.13	100	**Bedrock**	74		100	**Bedrock**	40.8	
					31.9				26				59.2		
SUM		**100**	**2.10**			**100**	**3.47**			**100**	**2.82**			**100**	**3.33**
		di/di/N	**47.73**			**di/di/N**	**28.79**			**di/di/N**	**35.51**			**di/di/N**	**30.03**

SUM	Nav.	35.52

Conclusion: Site Class D

Site Classification per LRFD Table C310.3.1-1 - Method B

Haynesville
20509.00

L. Krusinski
January 2014
Check: BS 9/2015

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years
State - Maine
Zip Code - 04497
Zip Code Latitude = 45.724300
Zip Code Longitude = -068.072900
Site Class B
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.066	PGA - Site Class B
0.2	0.149	Ss - Site Class B
1.0	0.046	S1 - Site Class B

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
Spectral Response Accelerations SDs and SD1
State - Maine
Zip Code - 04497
Zip Code Latitude = 45.724300
Zip Code Longitude = -068.072900
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class D - Fpga = 1.60, Fa = 1.60, Fv = 2.40
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.106	As - Site Class D
0.2	0.239	SDs - Site Class D
1.0	0.111	SD1 - Site Class D