MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL GROUP
AUGUSTA, MAINE

SUBSURFACE INVESTIGATION FOR RECONSTRUCTION OF ROUTE 302 NAPLES, MAINE

Prepared by:

Kitty Breskin, P.E.
Geotechnical Design Engineer

Reviewed by:

Karen Gross
Geotechnical Design Engineer

Cumberland County
PIN 11060.00

Soils Report No. 2010-112

Federal BH-A1106(000)X
July 1, 2010

1.0 Introduction

1.1 Project Overview

Maine DOT proposes to rebuild the bridge and causeway between Long Pond and Brandy Pond on Route 302 in the Town of Naples. Pedestrian access will be enhanced and parking improved. The project scope includes substantial horizontal realignment and full depth construction. This report describes conditions of the existing roadway and the native soils under the new alignment. A separate report discusses conditions at the bridge and retaining wall to be built as part of this project.

2.0 Site and Subsurface Conditions

2.1 General Site Conditions

The existing roadway was designed in 1923 as a portion of State Highway "B". It appears that substantial fill has been constructed near the causeway since that time, and the roadway has been widened and paved. MaineDOT has no record of improvements since original construction.

Land use along the project consists of residential and commercial development. Near the causeway and bridge this use is quite dense, with substantial amounts of on-street parking. Additional pedestrian facilities are needed for the recreational uses in this area.

The existing pavement on the travel lanes is in fair to poor condition, with both longitudinal and transverse cracking. It appears to have been overlaid many times.

2.2 Mapped Data

Geologic mapping by the National Wetlands Inventory indicates there are no significant areas of wetland soils adjacent to the highway in the area covered by this project. The NWI map of this area is included in Appendix A.

NRCS mapping indicates Windsor loamy Sands on the east side of the causeway and Windsor, Hinckley and Hermon sands in the east. Windsor soils are classified as SM to SP in the Unified System and as A-2 or A-3 in AASHTO. Hinckley soils below the top 10 inches and Hinckley soils are classified as SM to GP and A-1 to A-2. NRCS maps consider only the upper 1.5 meters of soil. The NRCS map and soils data for the area of this project are included in Appendix A.

The Surficial Geology Map, Naples Quadrangle by Maine Geologic Survey, indicates artificial fill on the west side of the causeway and Till and Glacial Lake Sebago bottom deposits of massive to stratified sand and silt on the east side. A section of the Surficial Geology map is included in Appendix A.

2.3 Subsurface Investigation

The subsurface investigations for this highway project included 10 borings with Standard Penetration Tests and a set of five cores through the existing pavement. The borings were completed in February, 2010, in frozen ground. No Falling Weight Deflectometer testing was done as FWD testing is only used to determine the modulus of soils under existing Hot Mix Asphalt pavements and this project involves complete relocation of the roadway.

2.4 Native soils

The native soils are predominantly sand with varying amounts of silt and gravel, varying from loose to very dense. Borings were done in February, and density of the upper soil layers was affected by frost. Soils within the depth of frost are very likely to be looser during the construction season. Auger refusals were encountered in two borings, but these may be been boulders or blocks of stone from earlier construction. It appears that soils used in construction of the fills are very similar to the native soils in this area.

Table 1 Shows the boring locations and describes the soils encountered. Offsets are from existing Centerline. Boring logs are included in Appendix C and lab test data is in Appendix D.

Table 1 - Native Soils

Station	Offset	Soil Type
9+50	9.0 Rt	medium dense SAND, some silt, trace gravel
12+00	6.0 Lt	loose SAND, trace gravel, trace silt
15+00	2.8 Rt	dense SAND, some silt, little gravel
18+00	24.6 Lt	medium dense to loose SAND, some silt, little gravel
22+00	4.0 Lt	SAND, trace silt (fill)
25+00	12.7 Lt	SAND, little gravel, trace silt
28+25	27.8 Lt	loose SAND, little silt, trace gravel
29+00	26.0 Lt	medium dense SAND, some silt trace gravel
31+50	6.0 Lt	loose sandy SILT
62+00	0.6 Rt	loose SAND, trace silt

2.5 Existing Pavement

The existing highway was designed to have 9 foot wide travel lanes and 3 foot wide unbased shoulders. The original surface course included 2.5" of macadam over 3.5" of "broken stone base course" and 2" gravel base.

Pavement cores were taken at Stations 9+50, 15+00, 22+00, 29+00, and 62+00. These cores showed a pavement thickness of 3.5 to 4 inches and evidence of past overlays. Table 2 shows the Hot Mix Asphalt thickness encountered in cores. Photographs of the pavement cores are included in Appendix C.

Table 2 - Pavement Cores

Station	Offset (ft)	Thickness
9+50	9 Rt	4.4 inches
15+00	8 Rt	3.5 inches
22+00	35 Rt	4.1 inches
29+00	20 Lt	3.4 inches
62+00	5 Rt	4.5 inches

The soil materials under the pavement surface are generally sand and gravel. They are finer than gravels allowed under Standard Specification 703.06, aggregate for base and subbase. These sands could have been placed as embankment fill or could be native material; soils within the pavement structure are very similar to native soils in the area. Although soils encountered under the HMA pavement suface do not meet the Maine DOT standard specification for Type D or Type E subbase gravel, many samples meet standard criteria for well-graded sands.

2.6 Subsurface bedrock

Auger refusals were encountered in two borings along this project. At Station 22+00, the driller's log indicates that this may have been a boulder or a granite block. The refusal at Station 6+00 on the Left may indicate bedrock refusal, but it cannot be determined before construction. No bedrock outcrops are indicated on survey data and no shallow refusals were encountered in borings for the bridge and retaining wall. Subsurface boulders greater than 2 yards in size may be found during construction, and areas of bedrock may be encountered, but substantial amounts of bedrock excavation are not anticipated during reconstruction of this highway. As always, final bedrock quantities will be determined during construction.

3.0 Design Recommendations

3.1 Pavement Design

Very little of the new highway will be on the existing horizontal and vertical alignment, and complete reconstruction of the pavement structure is needed. A single pavement structure should be used throughout the project. A Soil Support Value on the order of 4.75 is appropriate for most of the native and fill soils on this project. A Resilient Modulus of 5600 psi should be used for design.

Pockets of loose, wet soils were encountered at or near the proposed subgrade elevation in the area between Station 10+00 and 14+00. These soils may be wet during construction, or it may be a seasonal subsurface drainage area. A non-woven geotextile meeting MaineDOT Standard Specification 722, Stabilization/Reinforcement geotextile may be needed to help support the subbase soils and construction traffic. This geotextile should be placed as shown in Standard Detail 620.03. A woven geotextile should not be used in this area.

3.2 Embankment fills

Fills of up to approximately 9 feet will be required. Fills adjacent to the bridge will be supported by retaining walls discussed in the report for the bridge structure. Embankment fills will be constructed on the west side of the bridge. Design side slopes of 2h:1v should be stable on the underlying silty sand soils. The 1:1 slopes on the Left in the area of Station 21+00 involve installing riprap over existing riprap to widen the embankment. A shear key for stability may be added during construction if very soft or loose materials are encountered at the toe of slope.

3.3 Soil Cut Slopes

A cut will be required from Station 8+00 to Station 16+00. Sideslopes on the Right will be graded at 3h:1v from Station 13+00 to Station 16+00. Long term stability is not a concern with these side slopes, however they will be erodible. Construction stabilization of these soils should be addressed in the Contractor's erosion and sedimentation control plan.

3.4 Frost Action

The design Freezing Index in Naples is 1370, corresponding to a depth of frost of approximately 5.5 feet for snow-free pavement and granular subgrade soils.

Soils in this area are granular materials with low to moderate fines content, and are slightly frost susceptible, however pockets of soils with higher fines may be encountered

during construction. Any water trapped in the upper subgrade will freeze, and ice lenses could cause damage to the pavement.

3.5 Surface Water

Shallow groundwater was encountered at a depth of 5.8 feet below existing grade at Station 12+00 and at Station 31+50 at a depth of 6.0 feet. It is not known if these are areas of groundwater that persist during the summer. The lake levels are dropped during the winter months to provide storage space for winter storms. The new drainage system includes catchbasins that will have sumps at or below normal summer water elevations in the lake.

Appendix A
Resource Maps

NRCS Soils Survey
Surficial Geology
National Wetlands Inventory

Soil Map—Cumberland County and Part of Oxford County, Maine
(Naples PIN 11060.00)

70° 36' 52"
70° 35' 5"
43° 58' 30"
43° 58' 32"

43° 57' 38"
43° 57' 40"
70° 36' 51"
70° 35' 3"

Map Scale: 1:11,500 if printed on A size (8.5" x 11") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1,000 2,000 3,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:11,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 19N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cumberland County and Part of Oxford County, Maine
Survey Area Data: Version 7, Jan 8, 2009

Date(s) aerial images were photographed: 4/29/1998

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Cumberland County and Part of Oxford County, Maine (ME005)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CeC	Canaan very rocky sandy loam, 8 to 20 percent slopes	2.0	0.4%
Cu	Cut and fill land	2.6	0.5%
DeA	Deerfield loamy sand, 0 to 3 percent slopes	15.0	3.1%
DeB	Deerfield loamy sand, 3 to 8 percent slopes	44.6	9.2%
HgB	Hermon sandy loam, 3 to 8 percent slopes	32.8	6.8%
HgC	Hermon sandy loam, 8 to 15 percent slopes	2.0	0.4%
HhB	Hermon very stony sandy loam, 3 to 8 percent slopes	2.0	0.4%
HhC	Hermon very stony sandy loam, 8 to 15 percent slopes	26.8	5.5%
HhD	Hermon very stony sandy loam, 15 to 35 percent slopes	21.5	4.4%
HlB	Hinckley gravelly sandy loam, 3 to 8 percent slopes	41.3	8.5%
HlC	Hinckley gravelly sandy loam, 8 to 15 percent slopes	3.3	0.7%
Sn	Scantic silt loam	15.3	3.2%
So	Scarboro sandy loam	7.5	1.5%
Sz	Swanton fine sandy loam	16.5	3.4%
W	Water	119.1	24.6%
Wa	Walpole fine sandy loam	10.0	2.1%
WmB	Windsor loamy sand, 0 to 8 percent slopes	107.1	22.1%
WmC	Windsor loamy sand, 8 to 15 percent slopes	15.2	3.1%
Totals for Area of Interest		**484.5**	**100.0%**

Naples Quadrangle, Maine

Surficial geologic mapping by
Carol T. Hildreth

Digital cartography by:
Michael E. Foley

Robert G. Marvinney
State Geologist

Cartographic design and editing by:
Robert D. Tucker

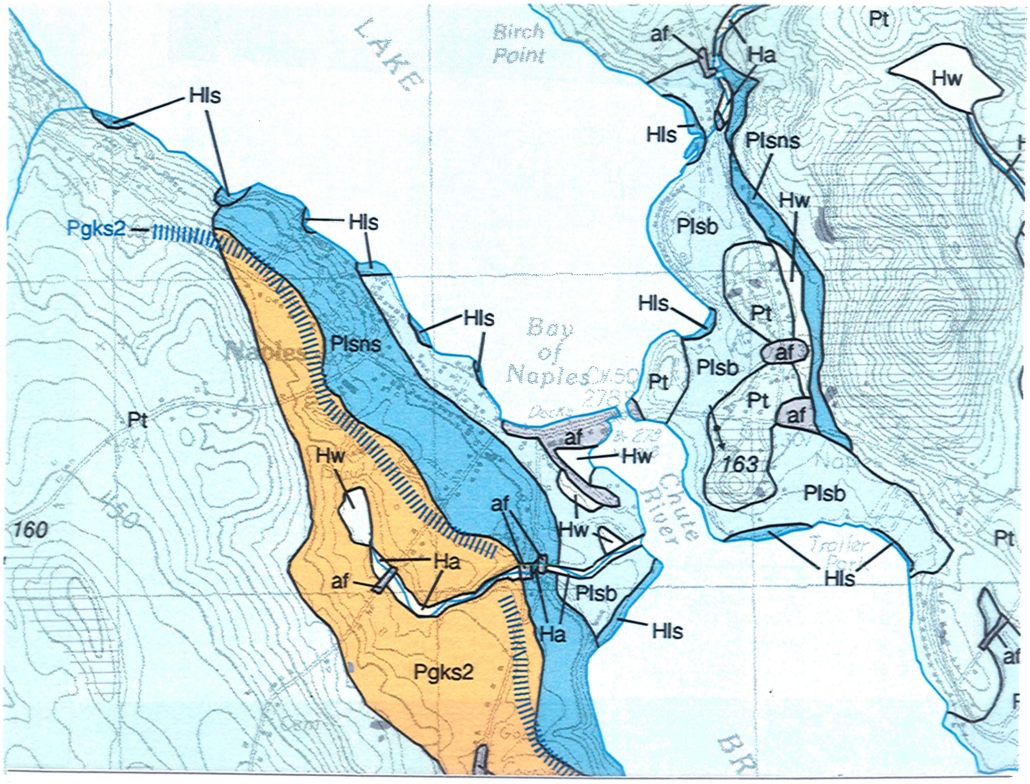
Funding for the preparation of this map was provided in part by the U.S. Geological Survey STATEMAP Program, Cooperative Agreement No. 1434-95-A-01364.

Maine Geological Survey

Address: 22 State House Station, Augusta, Maine 04333
Telephone: 207-287-2801 **E-mail:** mgs@maine.gov
Home page: http://www.maine.gov/doc/nrimc/nrimc.htm

Open-File No. 97-50
1997

For additional information, see Open-File Report 97-65.



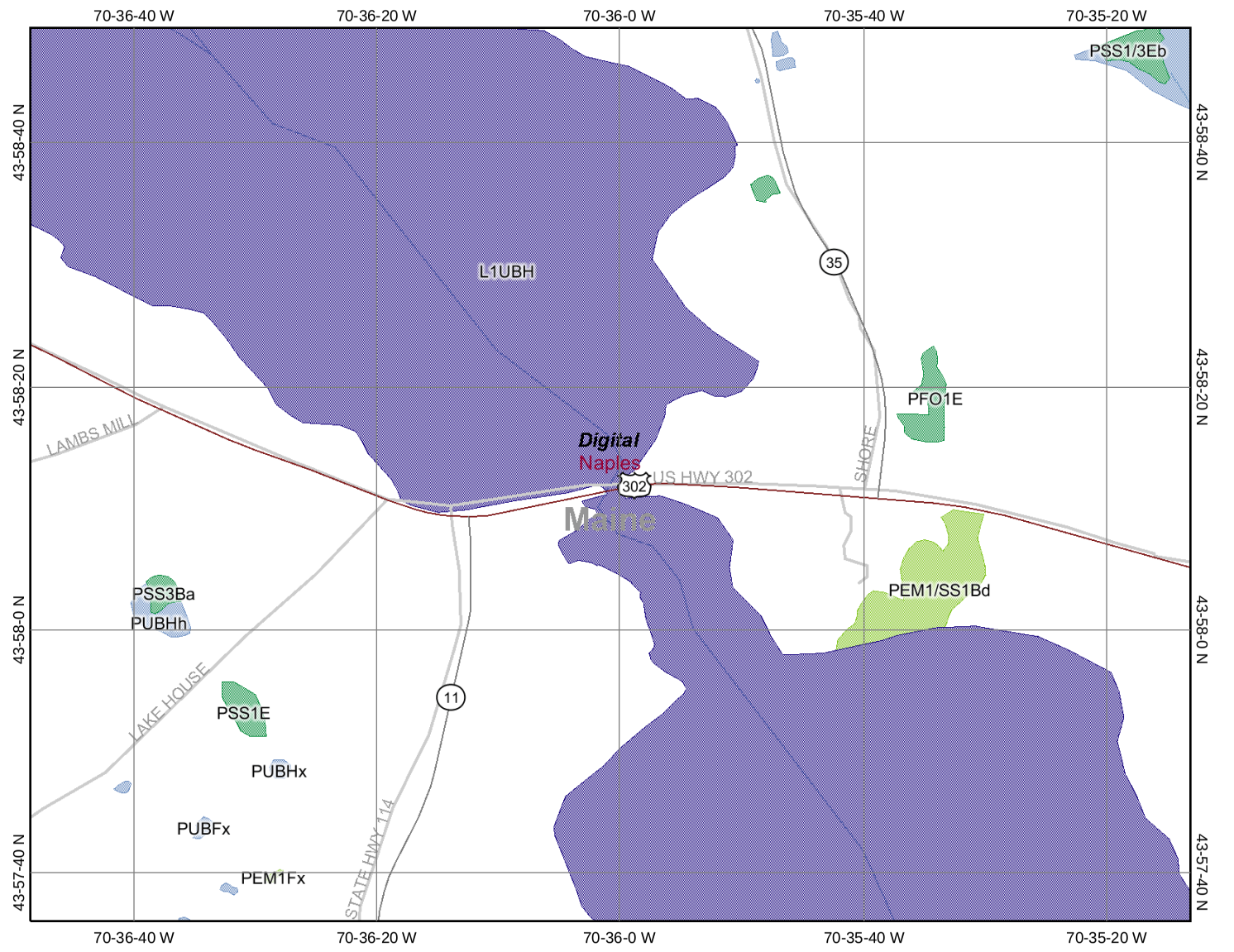
Surficial Geology

af — **Artificial fill** - Man-made. Material varies from natural sand and gravel to quarry waste to sanitary landfill; includes highway and railroad embankments and dredge spoil areas. This material is mapped only where it can be identified using the topographic contour lines. Minor artificial fill is present in virtually all developed areas of the quadrangle. Thickness of fill varies.

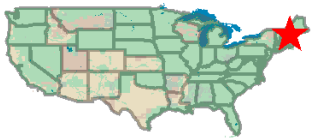
Pt — **Till** (Pleistocene) - Light- to dark-gray, nonsorted to poorly sorted mixture of clay, silt, sand, pebbles, cobbles, and boulders; a predominantly sandy diamicton containing some gravel. Thickness varies and generally is less than 6 m (20 ft), but is probably more than 24 m (80 ft) under the crest of most drumlins. See Site 11 on materials map for detailed description of one exposure.

Plsb — **Glacial Lake Sebago bottom deposit** (Pleistocene) - Massive to stratified and cross-stratified sand (generally fine- to medium-grained) and massive to laminated silt and silty clay. May contain boulders and gravel. Found as a blanket deposit over bedrock and older glacial sediments. Deposited at bottom of glacial Lake Sebago during late-glacial time. Variable thickness, generally 0.5-18 m (1-60 ft). A monitoring well in this unit along Thompson Point Road has 7 m (23 ft) of sand deposited over 9 m (28 ft) of sand and clay over 4 m (12 ft) of sand, clay, and gravel. A nearby seismic line shows 40.5 m (133 ft) to bedrock. This unit occupies the lowest elevations in the quadrangle, extending under the large lakes. Includes silt-clay varves. Worm tracks occur on the surfaces of some of the varve beds.

Naples, PIN 11060.00



Map center: 43° 58' 13" N, 70° 36' 1" W



Legend

Ohio_wet_scan
- 0
- 1
- Out of range

Interstate

Major Roads
- Other Road
- Interstate
- State highway
- US highway

Roads

Cities

USGS Quad Index 24K

Lower 48 Wetland Polygons
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

Lower 48 Available Wetland Data
- Non-Digital
- Digital
- No Data
- Scan

NHD Streams

Counties 100K

States 100K

South America

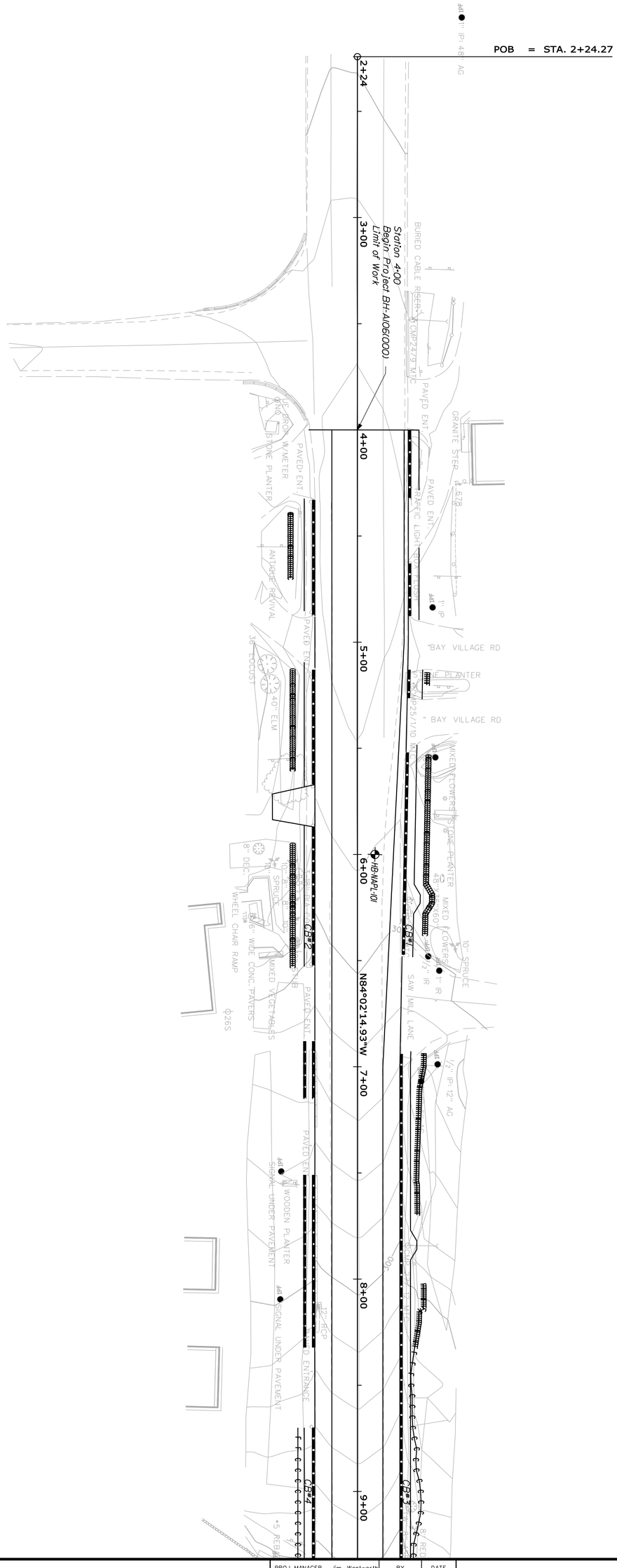
North America

N

Scale: 1:15,867

Appendix B
Geoplans

Filename: ...\geotech\msta\001_Geoplan1.dgn Division: GEOTECH Username: Terry.White Date:6/3/2010



PROJ. MANAGER	Jim Wentworth	BY	DATE
DESIGN-DETAILED	K.BRESKIN	T.WHITE	JUN 2010
CHECKED-REVIEWED	_____	_____	_____
DESIGN2-DETAILED2	_____	__	_____
DESIGN3-DETAILED3	_____	_____	_____
REVISIONS 1	_____		_____
REVISIONS 2	_____		_____
REVISIONS 3	_____		_____
REVISIONS 4	_____		_____
FIELD CHANGES	_____		_____

SIGNATURE

P.E. NUMBER

DATE

SHEET NUMBER 1 OF 6

NAPLES
ROUTES 11/302

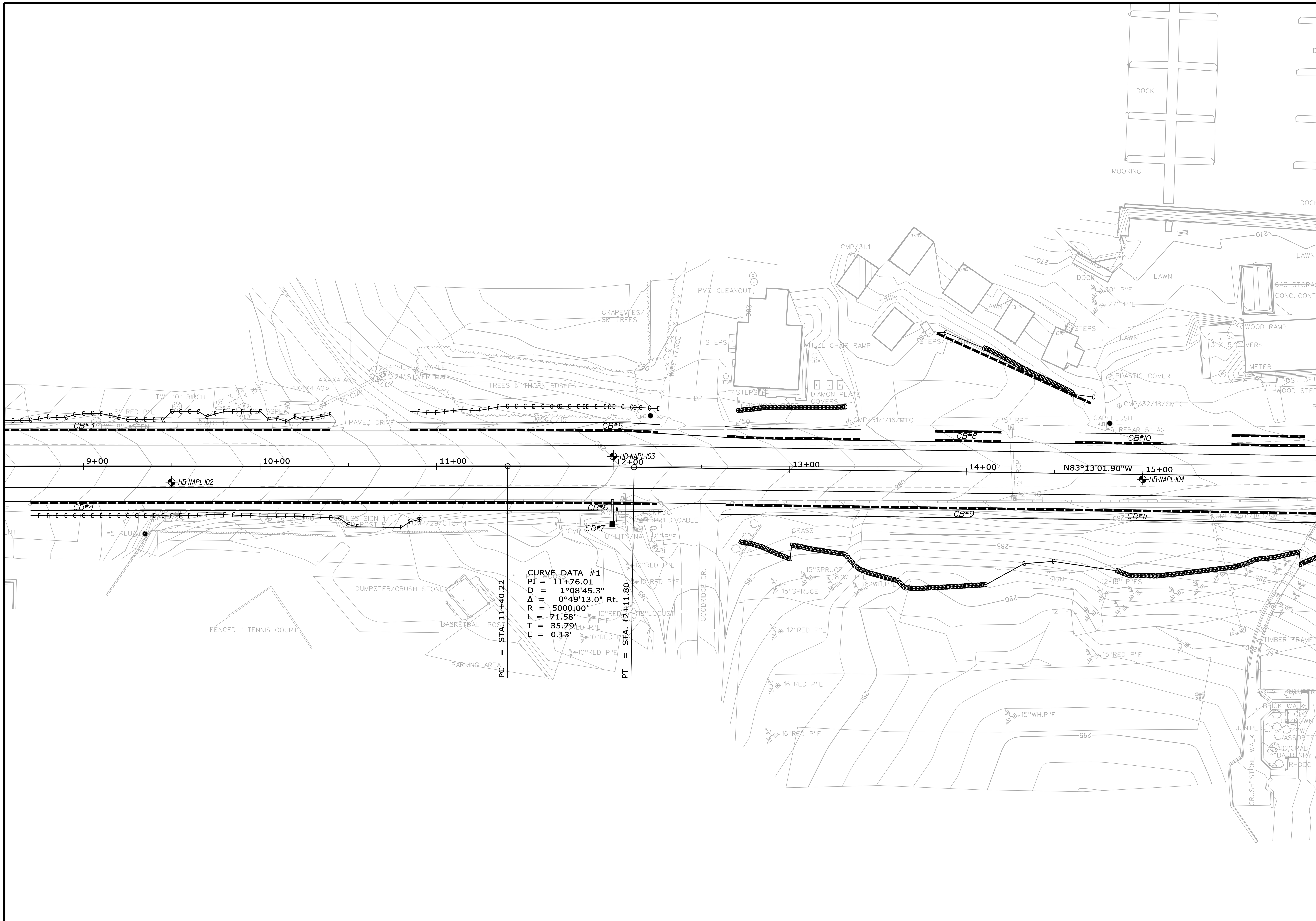
GEOPLANS

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BH-A106(000)

PIN 11060.00 HIGHWAY PLANS

Filename: ...\geotech\msta\002_Geoplan2.dgn   Division: GEOTECH   Username: Terry.White   Date:6/3/2010



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BH-A106(000)

PIN 11060.00

HIGHWAY PLANS

		BY	DATE
PROJ. MANAGER	Jim Wentworth		
DESIGN-DETAILED	K.BRESKIN	T.WHITE	JUN 2010
CHECKED-REVIEWED			
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

NAPLES
ROUTES 11/302

GEOPLANS

SHEET NUMBER

2

OF 6

Filename: ...\geotech\mst0\003_Geoplan3.dgn Division: GEOTECH Username: Terry.White Date:6/3/2010

MAG. 19kX

CURVE DATA #2
PI = 18+73.62
D = 7°09'43.1"
Δ = 27°17'27.2" Lt.
R = 800.00'
L = 381.05'
T = 194.21'
E = 23.24'

PC = STA. 16+79.41
PT = STA. 20+60.46

25'-0" | 30'-0" Navigation Channel
63'-6" Clear
80'-0" Bridge Span

PLAN
25 0 25 50
Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BH-A106(000)

PIN
11060.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	Jim Wentworth	
DESIGN-DETAILED	K.BRESKIN	JUN. 2010
CHECKED-REVIEWED	-----	-----
DESIGN2-DETAILED2	-----	-----
DESIGN3-DETAILED3	-----	-----
REVISIONS 1	-----	-----
REVISIONS 2	-----	-----
REVISIONS 3	-----	-----
REVISIONS 4	-----	-----
FIELD CHANGES	-----	-----

SIGNATURE

P.E. NUMBER

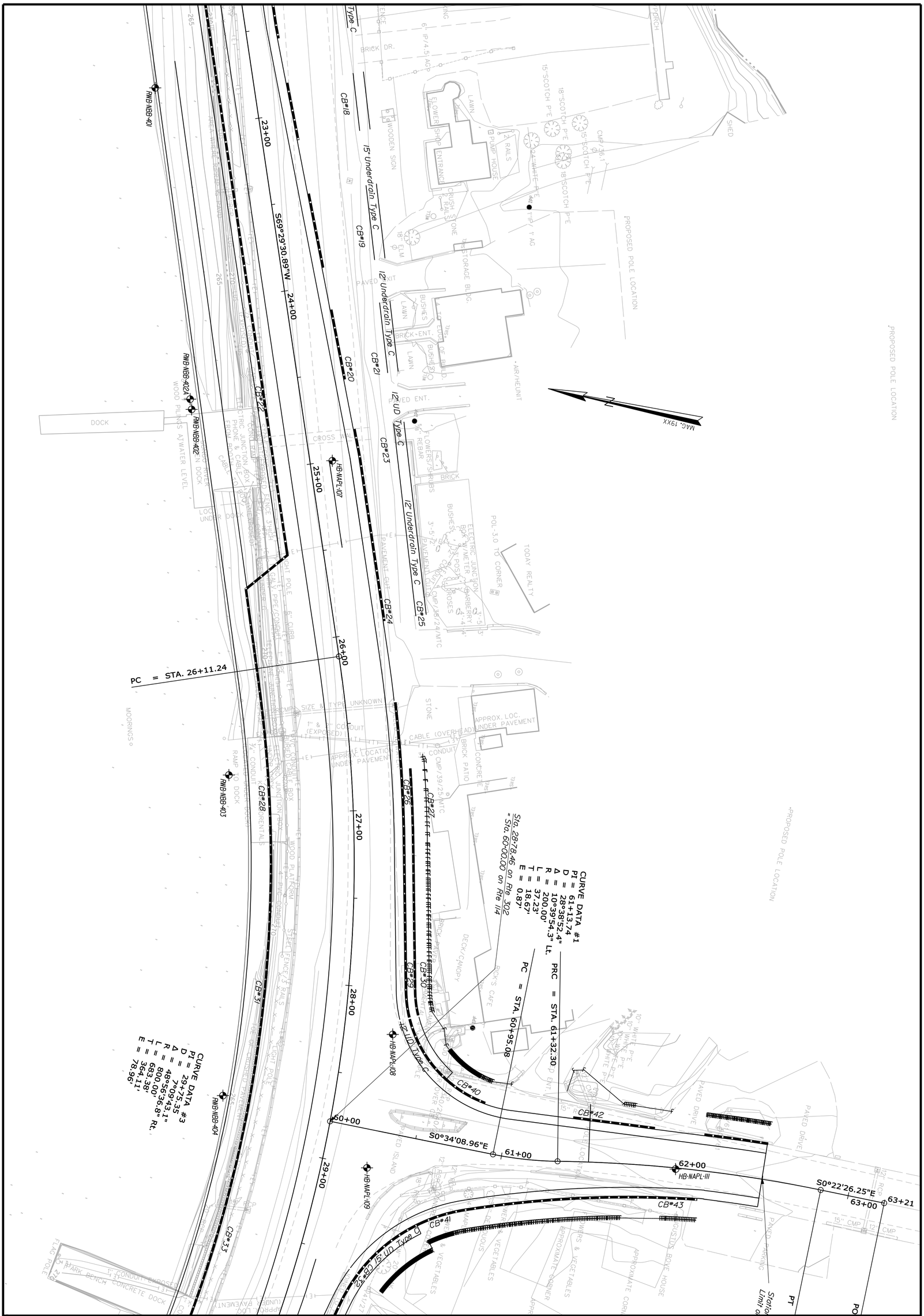
DATE

NAPLES
ROUTES 11/302

GEOPLANS

SHEET NUMBER
3
OF 6

Filename: ...\geotech\msta\004_Geoplan4.dgn Division: GEOTECH Username: Terry.White Date:6/3/2010

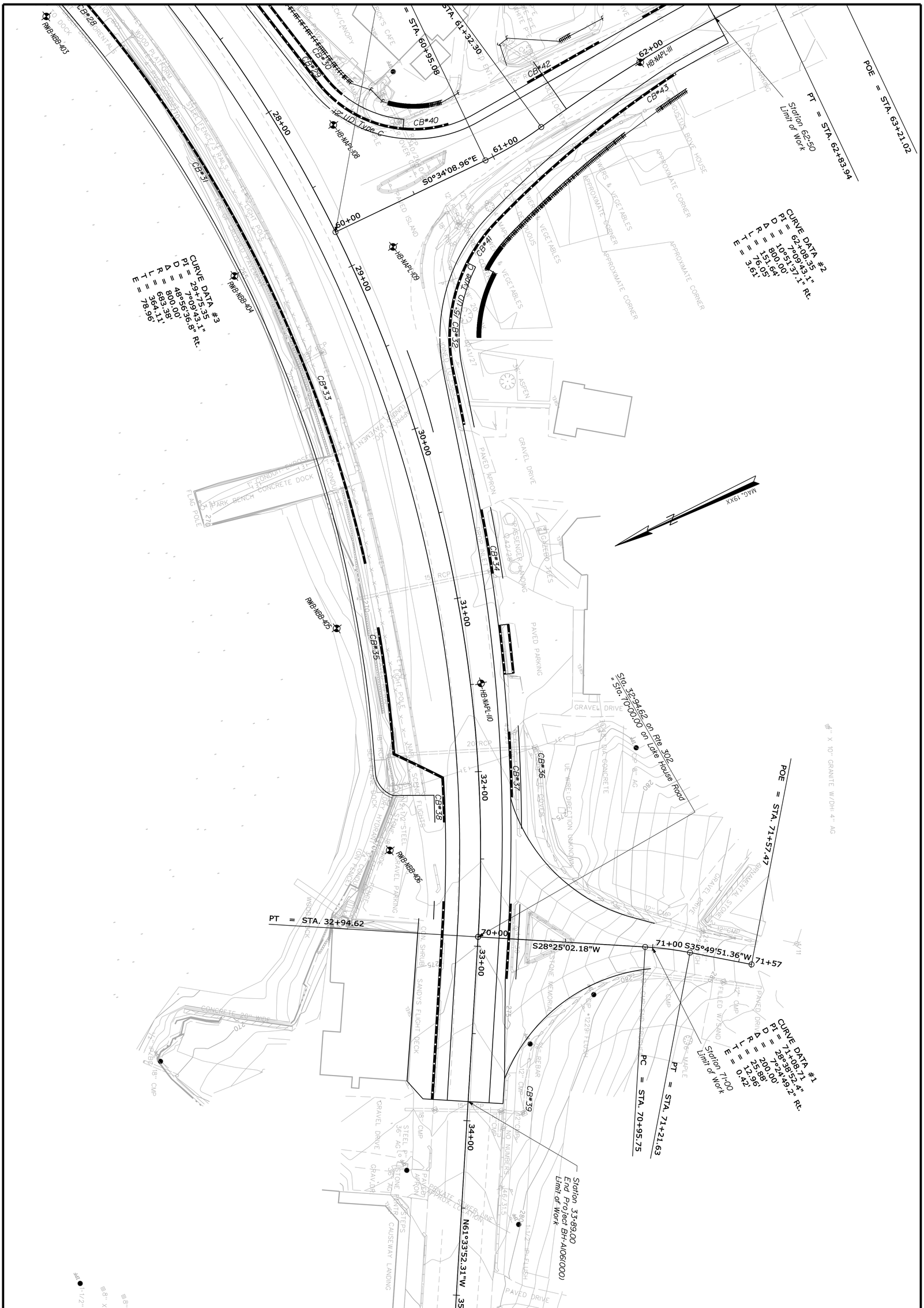


SHEET NUMBER 4 OF 6	NAPLES ROUTES 11/302	PROJ. MANAGER Jim Wentworth	BY / DATE
		DESIGN-DETAILED K.BRESKIN	T.WHITE JUN 2010
		CHECKED-REVIEWED	SIGNATURE
		DESIGN2-DETAILED2	
		DESIGN3-DETAILED3	P.E. NUMBER
		REVISIONS 1	
		REVISIONS 2	
		REVISIONS 3	DATE
		REVISIONS 4	
		FIELD CHANGES	
	GEOPLANS		

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BH-A106(000)

PIN 11060.00 HIGHWAY PLANS

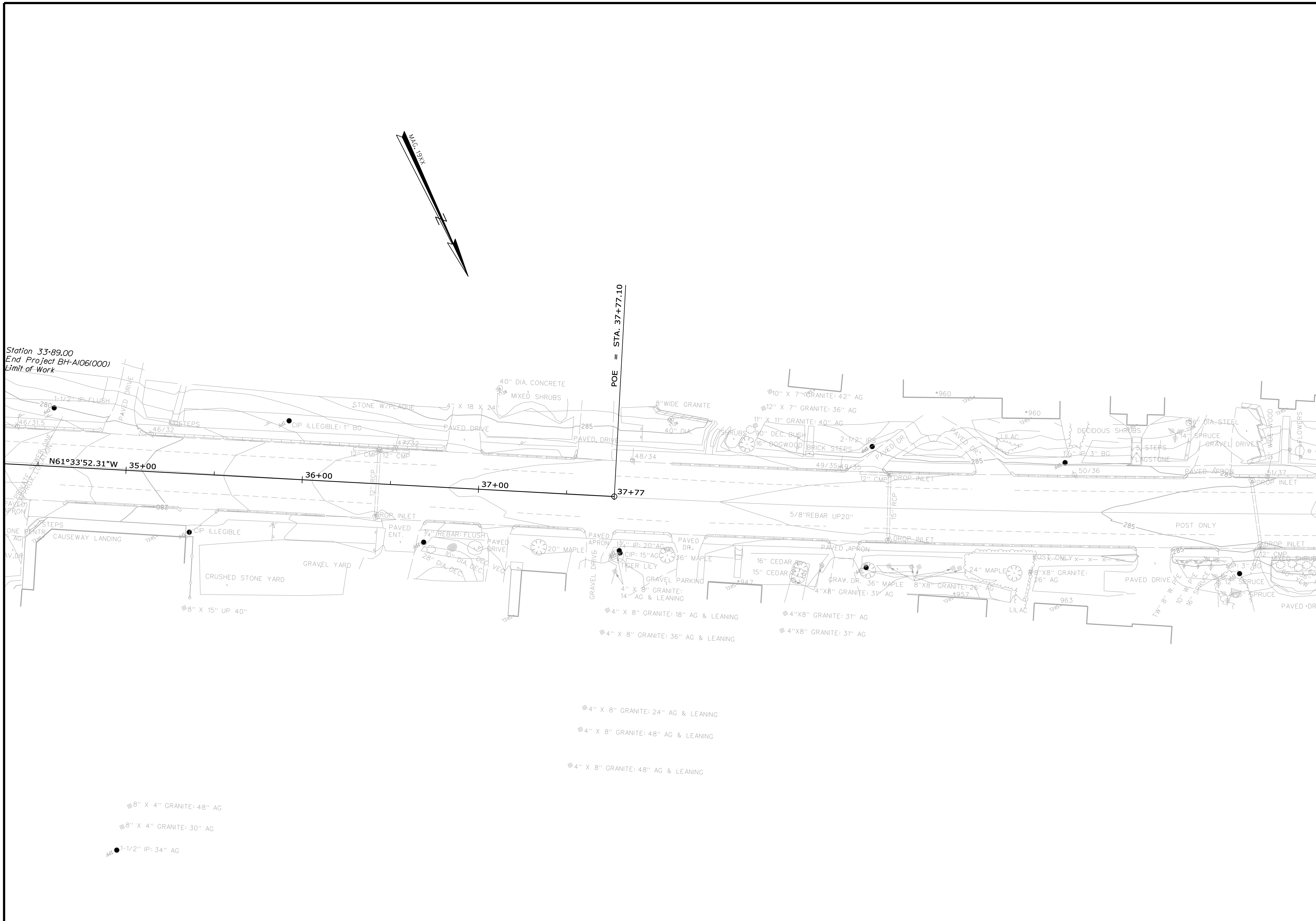


SHEET NUMBER 5 OF 6	NAPLES ROUTES 11/302	PROJ. MANAGER Jim Wentworth	BY / DATE
		DESIGN-DETAILED K.BRESKIN	T.WHITE / JUN 2010
		CHECKED-REVIEWED _____	_____ / _____
		DESIGN2-DETAILED2 _____	__ / _____
		DESIGN3-DETAILED3 _____	_____ / _____
		REVISIONS 1 _____	_____
		REVISIONS 2 _____	_____
		REVISIONS 3 _____	_____
		REVISIONS 4 _____	_____
		FIELD CHANGES _____	_____
	GEOPLANS	SIGNATURE	
		P.E. NUMBER	
		DATE	

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BH-A106(000)

PIN 11060.00 HIGHWAY PLANS



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BH-A106(000)

PIN
11060.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	Jim Wentworth	
DESIGN-DETAILED	K.BRESKIN	
CHECKED-REVIEWED	T. WHITE	JUN 2010
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

NAPLES
ROUTES 11/302

GEOPLANS

SHEET NUMBER
6
OF 6

Filename: ...\geotech\msta\006_Geoplan6.dgn
Division: GEOTECH
Username: Terry.White
Date:6/3/2010

Appendix C
Field Exploration Data

Soils Descriptions
Boring Logs
Core Photographs

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

Sample Container Labeling Requirements:

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

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

January 2008

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-101
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	305.9	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	6+00, 8.0 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	305.55		PAVEMENT. 0.35	
	1D	16.8/16	1.00 - 2.40	18/37/50(4.8")	---					Brown, dry, very dense, gravelly, fine to coarse SAND.	
								303.30		2.60	
										Bottom of Exploration at 2.60 feet below ground surface. AUGER REFUSAL	
5											
10											
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-102
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	294.4	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	9+50, 9.0 Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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	294.00		PAVEMENT. 0.40	
	1D	24/18	1.00 - 3.00	28/28/31/32	59	83				Brown, damp, very dense fine to coarse SAND, some gravel, little silt.	G#238179 A-1-b, SM WC=3.7%
								290.90		3.50	
5	2D	24/20	5.00 - 7.00	9/8/11/12	19	27				Light brown, damp, medium dense, fine to medium SAND, some silt, trace gravel.	G#238178 A-2-4, SM WC=9.4%
								287.40		7.00	
										Bottom of Exploration at 7.00 feet below ground surface. NO REFUSAL	
10											
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-103
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	284.9	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	12+00, 6.0 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	5.8' bgs.
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	284.50		PAVEMENT. 0.40	
	1D	24/19	1.00 - 3.00	32/41/28/16	69	97				Light brown, damp, very dense, gravelly, fine to coarse SAND, trace silt.	
								281.40		3.50	
5	2D	24/16	5.00 - 7.00	1/2/2/5	4	6				Brown, wet, loose, fine to coarse SAND, trace gravel, trace silt.	G#238181 A-1-b, SP WC=23.1%
								277.90		7.00	
10										**Bottom of Exploration at 7.00 feet below ground surface.** NO REFUSAL	
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-104
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	277.4	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	15+00, 2.8 Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	277.05		PAVEMENT. 0.35	
	1D	24/20	1.00 - 3.00	30/32/15/24	47	66				Brown, damp, dense, gravelly, fine to coarse SAND, trace silt.	
								274.40		3.00	
5	2D	24/18	5.00 - 7.00	30/18/13/37	31	43				Light brown, moist, dense, fine to coarse SAND, some silt, little gravel.	G#238176 A-1-b, SM WC=8.8%
								270.40		7.00	
10										**Bottom of Exploration at 7.00 feet below ground surface.** NO REFUSAL	
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-105
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	277.1	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	18+00, 24.6 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	276.70		PAVEMENT. 0.40	
	1D	4.8/4.8	1.00 - 1.40	50(4.8")	---					Brown, damp, very dense, (FROST) gravelly, fine to coarse SAND, trace silt.	
								273.60		3.50	
5	2D	24/19	5.00 - 7.00	8/8/5/2	13	18				Brown, moist, medium dense, fine to coarse silty SAND, trace gravel.	G#238174 A-4, SM WC=16.3%
10	3D	24/16	10.00 - 12.00	3/4/2/4	6	8				Similar to above, except loose.	
								265.10		12.00	
										Bottom of Exploration at 12.00 feet below ground surface. NO REFUSAL	
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-106
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	272.0	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	22+00, 4.0 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	271.60		PAVEMENT. 0.40	
	1D	12/12	1.00 - 2.00	23/60	---					Brown, damp, very dense, (FROST) gravelly, fine to coarse SAND, trace silt, (Fill).	
5	2D	24/14	5.00 - 7.00	16/22/28/28	50	70				Similar to above, (Fill).	
								263.80		8.20	
										Bottom of Exploration at 8.20 feet below ground surface. AUGER REFUSAL, Boulder or Granite Block	
10											
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.
Bridge Boring 50-80' south went to 80' before hitting Bedrock.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-107
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	272.2	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	25+00, 12.7 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	271.80		PAVEMENT. 0.40	
	1D	6/6	1.00 - 1.50	50	---					Brown, damp, very dense, (FROST) gravelly, fine to coarse SAND, little gravel, trace silt.	
5	2D	18/13	5.00 - 6.50	14/10/50	60	84				Similar to above.	G#238173 A-1-b, SW-SM WC=11.0%
								265.70		6.50 **Bottom of Exploration at 6.50 feet below ground surface.** AUGER REFUSAL, Boulder ?	
10											
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-108
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	272.2	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	28+25, 27.8 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	271.80		PAVEMENT. 0.40	
										Brown, damp, gravelly, fine to coarse SAND, little silt, trace gravel.	
								268.70		3.50	
5	1D	24/18	5.00 - 7.00	2/2/3/4	5	7				Grey-brown, wet, loose, fine to medium SAND, little silt, trace gravel.	G#238182 A-1-b, SM WC=20.1%
								265.20		7.00	
										Bottom of Exploration at 7.00 feet below ground surface. NO REFUSAL	
10											
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-109
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	272.2	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	29+00, 26.0 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	271.90		PAVEMENT. 0.30	
	1D	24/16	1.00 - 3.00	10/21/14/18	35	49				Brown, damp, dense, gravelly, fine to coarse SAND, trace silt.	
								268.70		3.50	
5	2D	24/17	5.00 - 7.00	5/7/7/8	14	20				Light brown, wet, medium dense, fine to medium SAND, some silt, trace gravel.	G#238180 A-2-4, SM WC=18.2%
								265.20		7.00	
10										**Bottom of Exploration at 7.00 feet below ground surface.** NO REFUSAL	
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-110
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	272.5	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	31+50, 6.0 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	6.0' bgs.
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	272.10		PAVEMENT. 0.40	
	1D	18/15	1.00 - 2.50	20/42/50	92	129				Brown, damp, very dense, (FROST) gravelly, fine to coarse SAND, little gravel, little silt.	G#238177 A-1-b, SM WC=7.0%
								268.90		3.60	
5	2D	24/16	5.00 - 7.00	2/3/4/4	7	10				Grey, wet, loose, sandy SILT.	G#238175 A-4, ML WC=22.6%
								265.50		7.00	
										Bottom of Exploration at 7.00 feet below ground surface. NO REFUSAL	
10											
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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: Approaches to Naples Bay Bridge Routes 11 & 302
Location: Naples, Maine

Boring No.: HB-NAPL-111
PIN: 11060.00

Driller:	MaineDOT	**Elevation (ft.)**	273.2	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/11/10-2/11/10	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	62+00, 0.6 Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	6.0' bgs.
Hammer Efficiency Factor:	0.84	**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
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 = weight of rods
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 Information: 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	272.65		PAVEMENT.	
										0.55	
	1D	12/12	1.00 - 2.00	23/60	---					Brown, damp, very dense, (FROST) gravelly, fine to coarse SAND, trace silt.	
								270.20		3.00	
5	2D	24/24	5.00 - 7.00	4/4/4/6	8	11				Light brown, wet, loose, fine to medium SAND, trace silt.	
								266.20		7.00	
										Bottom of Exploration at 7.00 feet below ground surface. NO REFUSAL	
10											
15											
20											
25											

Remarks:

All offsets are from Proposed Alignment.

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.


Naples 11060.00
15700 8" RA
.35 Pavement
2-11-10
10THS & .1 100THS FT. .2 PAT.NO. .3 2,713,208 .4 .5 .6 .7 .8 .9
13 3:05PM


Naples
11060.00
22+00
35 RT
10THS & .1
100THS FT. .2
PAT.NO. .3 2,713,208
.4
.5
.6
.7
.8
13 3:05PM


Maples
11060.00
2-11-10
29400 20' Lt
10THS & 1 100THS FT.
13 3:06PM


Naples 11060100
9450 9' RT
10THS & .1
100THS FT.
.2
PAT.NO.
.3
2,713,208
.4
.5
.6
.7
.8
13 3:06PM


Napk 180000
62700 5R+
2-11-10
INCHES
Lufkin
RUGGED
ENGINEERS
OIL
JOINTS
P.R. APP'D.
13 3:07PM

Appendix D
Lab Test Data
Lab Testing Summary Sheet
Grain Size Curves

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Naples Project Number: 11060.00

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	AASHTO	Frost
HB-NAPL-102, 1D	9+50	9.0 Rt.	1.0-3.0	238179	1	3.7			SM	A-1-b	II
HB-NAPL-102, 2D	9+50	9.0 Rt.	5.0-7.0	238178	1	9.4			SM	A-2-4	II
HB-NAPL-103, 2D	12+00	6.0 Lt.	5.0-7.0	238181	1	23.1			SP	A-1-b	0
HB-NAPL-104, 2D	15+00	2.8 Rt.	5.0-7.0	238176	1	8.8			SM	A-1-b	II
HB-NAPL-105, 2D	18+00	24.6 Lt.	5.0-7.0	238174	1	16.3			SM	A-4	III
HB-NAPL-107, 2D	25+00	12.7 Lt.	5.0-6.5	238173	2	11.0			SW-SM	A-1-b	0
HB-NAPL-108, 1D	28+25	27.8 Lt.	5.0-7.0	238182	2	20.1			SM	A-1-b	II
HB-NAPL-109, 2D	29+00	26.0 Lt.	5.0-7.0	238180	2	18.2			SM	A-2-4	II
HB-NAPL-110, 1D	31+50	6.0 Lt.	1.0-2.5	238177	2	7.0			SM	A-1-b	II
HB-NAPL-110, 2D	31+50	6.0 Lt.	5.0-7.0	238175	2	22.6			ML	A-4	IV

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)

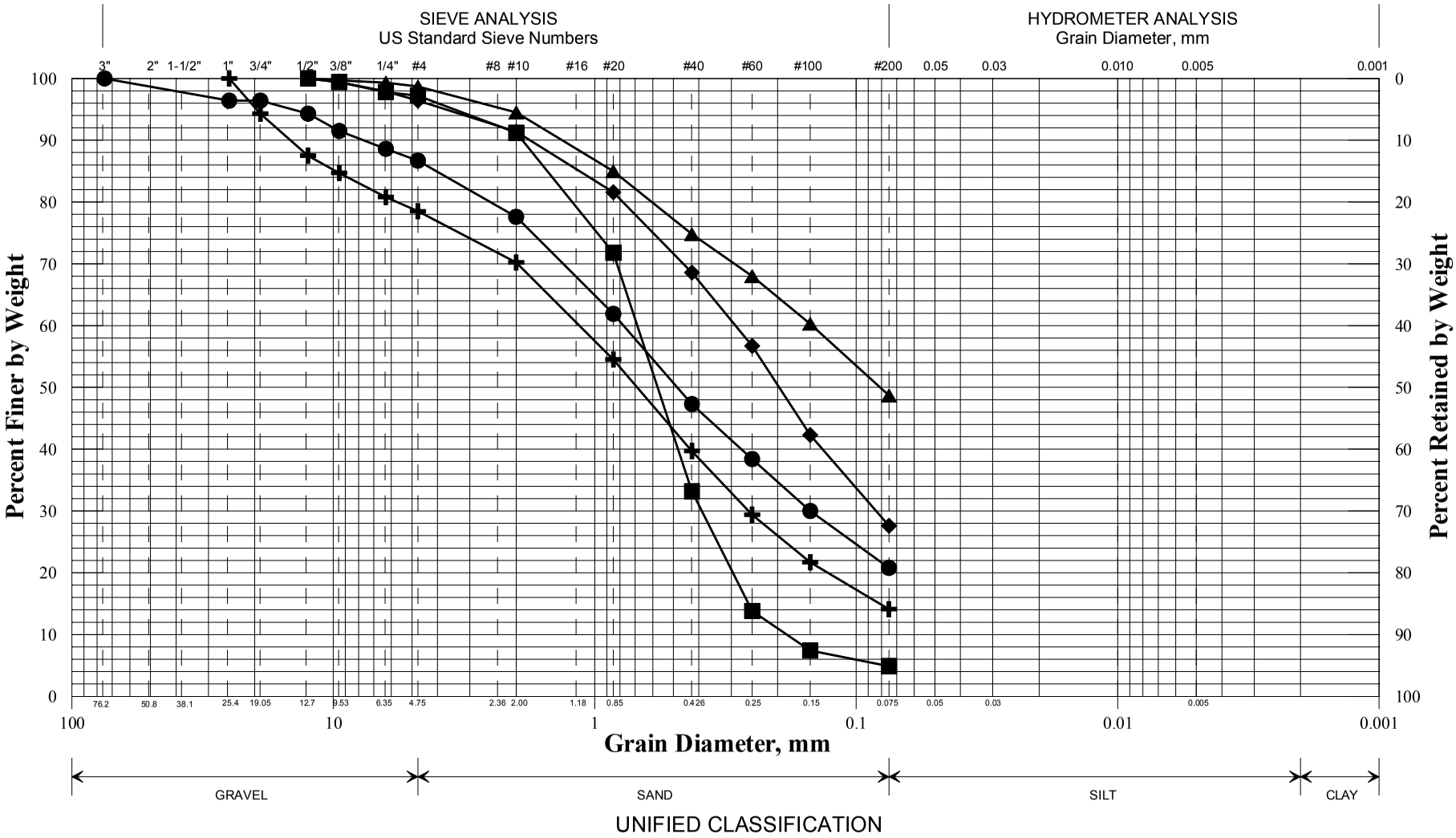
WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

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

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

State of Maine Department of Transportation

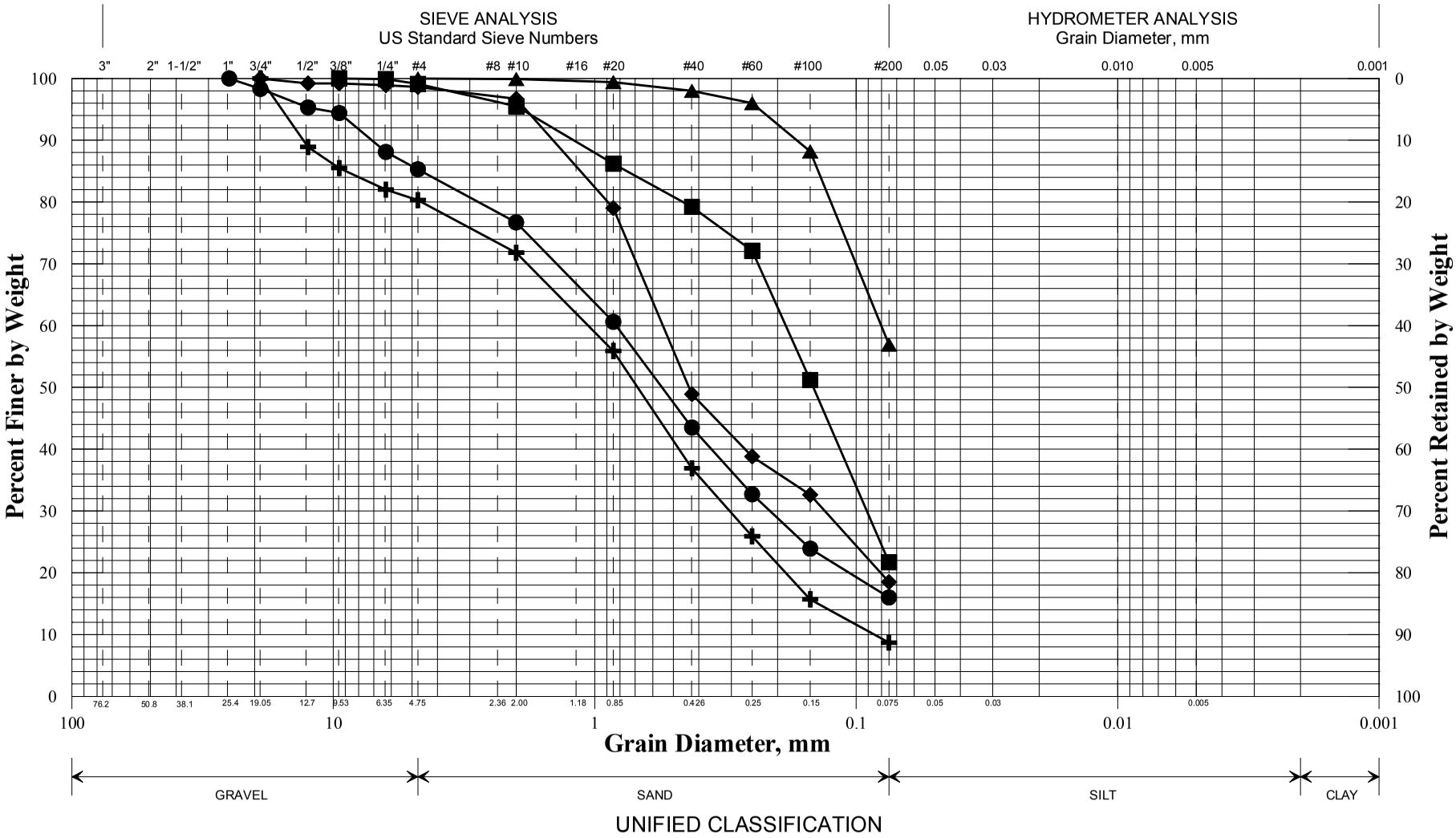
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-NAPL-102/1D	9+50	9.0 RT	1.0-3.0	SAND, some gravel, little silt.	3.7			
◆	HB-NAPL-102/2D	9+50	9.0 RT	5.0-7.0	SAND, some silt, trace gravel.	9.4			
■	HB-NAPL-103/2D	12+00	6.0 LT	5.0-7.0	SAND, trace silt, trace gravel.	23.1			
●	HB-NAPL-104/2D	15+00	2.8 RT	5.0-7.0	SAND, some silt, little gravel.	8.8			
▲	HB-NAPL-105/2D	18+00	24.6 LT	5.0-7.0	Silty SAND, trace gravel.	16.3			
✖									

PIN
011060.00
Town
Naples
Reported by/Date
WHITE, TERRY A 5/4/2010

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-NAPL-107/2D	25+00	12.7 LT	5.0-6.5	SAND, little gravel, trace silt.	11.0			
◆	HB-NAPL-108/1D	28+25	27.8 LT	5.0-7.0	SAND, little silt, trace gravel.	20.1			
■	HB-NAPL-109/2D	29+00	26.0 LT	5.0-7.0	SAND, some silt, trace gravel.	18.2			
●	HB-NAPL-110/1D	31+50	6.0 LT	1.0-2.5	SAND, little silt, little gravel.	7.0			
▲	HB-NAPL-110/2D	31+50	6.0 LT	5.0-7.0	Sandy SILT.	22.6			
✖									

PIN
011060.00
Town
Naples
Reported by/Date
WHITE, TERRY A 5/4/2010