MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL GROUP
AUGUSTA, MAINE

SUBSURFACE INVESTIGATION FOR STABILIZATION OF SOUTH LUBEC ROAD LUBEC, MAINE

Prepared by:

Kitty Breskin, P.E.
Geotechnical Design Engineer

Reviewed by:

Karen Gross
Geotechnical Design Engineer

Washington County
PIN 18317.00

Soils Report No. 2011-120

December 28, 2011

MaineDOT

Highway Program

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

Memorandum

To: Shawn Davis, P. E., Project Manager
cc: David Gardner, Construction Resident
From: Kitty Breskin, P. E., Sr. Geotechnical Engineer
Date: December 16, 2011
Subject: South Lubec Road, PIN 18317.00

==========

The South Lubec Road serves Quoddy Head State Park, lighthouse, and several residences and small businesses. It is the only access to the peninsula, and three of the residences are occupied year-round. Traffic volumes in winter are very low, with higher volumes during the summer when the park and businesses are open.

The South Lubec Road is constructed on the north side of an isthmus of organic soils. These soils extend east from the sharp bend at Carrying Place Cove Road for approximately 1500 feet across Carrying Place Heath until firmer soils and shallow bedrock are reached. Although Lubec Embayment to the north is sheltered compared to conditions on the south side of the isthmus, there is enough fetch with a northeast wind to produce damaging waves. The peat has been eroding and breaking way in blocks for many years according to local residents, and in the area of concern the peat bluff has moved from 50 feet away to 25 feet or less from the edge of the roadway.

A 150 foot long portion of this roadway now has serious cracks in the pavement and a deep crack in the peat near the edge of the shoulder. The north edge of the pavement has dropped substantially below the centerline even in uncracked sections. The crack in the peat appears to extend to a depth of approximately 5 feet, and the face of the peat is undercut at the beach. In other sections, the roadway has settled and the outer edge of peat has raised up with a shallow vertical face that is likely to become a block failure in the future from breakage of the organic fibers that produce “apparent cohesion” in peat soils. This portion of the north lane of the South Lubec Road has been closed to reduce the load at the crack and to protect the public safety when this block breaks away.

No as-built records exist for this roadway. It appears from the vegetation and topography that gravel may extend out from the roadway for several feet on each side acting as a form of shoulder, however no explorations were done beyond the pavement. Our subsurface investigation included an auger boring at the east end of the severely cracked area, a washboring extended to bedrock at the west end, and a hand-dug test pit in the beach adjacent to the area of concern. The existing HMA pavement is 4.5” to 5” thick over 5.5 to 6 feet of gravelly sand. This is underlain by a peat layer measured as 10.5 feet thick. A sample off the auger flights showed a mixture of fibrous and amorphous peat. Below the peat, at beach level, we encountered a layer of sand underlain by soft plastic clay-silt with trace sand. The borings were stopped at or near bedrock, 28.5 to 35.5 feet down. The test pit in the beach showed 3” of brown stony gravel over 6” of gray fine sand. Below that we encountered 6” of gray, gravelly sand. The pit was not extended beyond this layer. Boring logs are attached to this report.

MaineDOT

Highway Program

In 2009 the Corps of Engineers provided MaineDOT with a set of plans and NEPA documentation for slope repair and stabilization of 500 feet of this roadway. The section covered by the ACOE plans is approximately 1000 feet northeast of the area of immediate concern, and Maine DOT did not conduct subsurface investigations in the area of the ACOE plans. Soils visible in the slope face appear to be primarily sand. That project was never built due to funding issues and confusion over responsibility for the South Lubec road. The plans show a bioengineering solution with a mix of treatments that were proposed to stabilize the slope and improve wildlife habitat. In one area of concern the peat was to be excavated to a 2h:1v slope and riprap placed on the lower portion of slope up to a foot above mean high water, elevation 10.5 feet on the datum in use for these plans. An area measuring 110' x 70' on the south side of the road was designated as a contractor staging area. A temporary ramp for beach access is shown on the plans and discussed in the NEPA documentation. This project is described as being some 500 feet east of Carrying Place Heath, but peat at the face of the slope is discussed. It is not known what subsurface investigations were done for the ACOE plans.

The NEPA documentation provided by the Corps discusses several alternatives. No Action was rejected because access to the Park, the Coast Guard station and the residences and business would be lost. A stone revetment was considered "cost-effective and physically viable" but rejected as detrimental to wildlife. An H-Pile wall was rejected as too expensive, and relocation of the roadway was rejected due to the cost of ROW and adverse environmental impacts to the bog.

During the first week of November, 2011, a CAT 312B excavator went off the pavement on the Carrying Place Cove Road just south of the intersection with South Lubec Road, and sank.

This is a small excavator, and the calculated stress under the shoes, unloaded, is on the order of 920 psf or 6.3 psi. The strength of the peat was not adequate to support this weight. No testing was done on our peat samples due to both technical difficulties in obtaining an undisturbed sample and questions about the meaning of tests on peat, but the difference in strength between the peat in this location and the material around the corner in the area of concern are likely to be small.

Average peat shear strengths reported in the literature are on the order of 350 psf. These materials have very low compressive and tensile strength and are very compressible.

I suggest that treatments described in the ACOE plans would create additional instability in the current area of concern. I anticipate significant difficulty in excavating the peat to a 2:1 slope; it seem unlikely that the area of peat on the south side of the road would support the loads required for this use, and riprap placed on the lower slope would sink, leading to another vertical face in peat soils closer to the road.

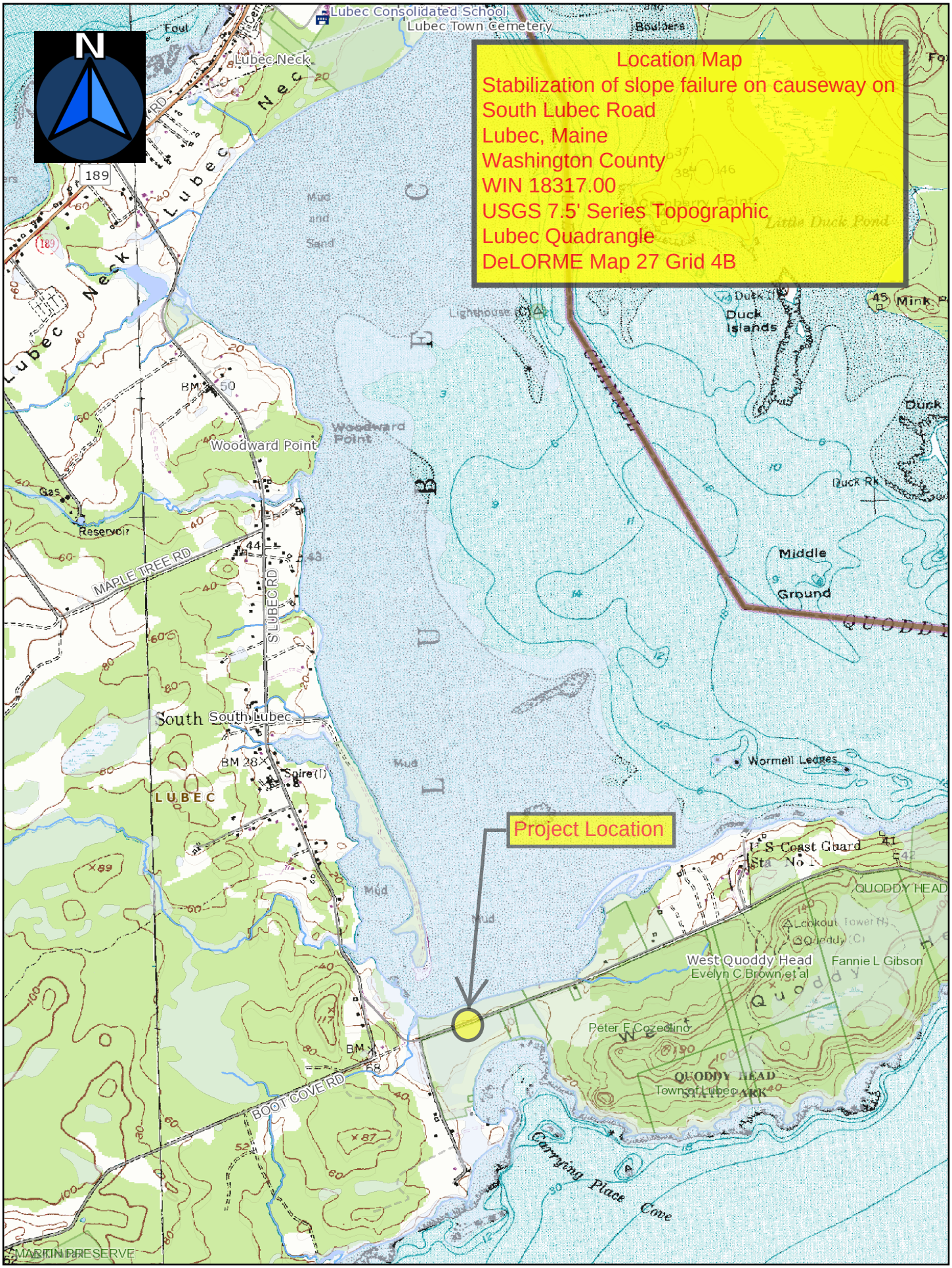
I agree with the Corps discussion that No Action is not a feasible alternative for this area. A sheetpile wall or a soldier pile and lagging solution is not possible with known bedrock depth of 28.5 feet below the roadway: this depth is inadequate to support a full cantilever wall 12.5 feet above the beach, and peat soils do not have adequate strength to use a tieback system.

I recommend that a stone revetment be constructed on the beach at the edge the peat for a length of approximately 120 feet as an emergency stabilization. No treatment of other areas is required at this time, although further erosion of the peat face would make treatment of other areas necessary in the future. According to my computer modeling, a 1.5h:1v slope can be used on the beach with a vertical slope at the peat face for the height needed. A steeper face might be feasible, but it would be difficult to build and this slope repair will be built in challenging conditions. A mixture of stone sizes will be needed to form a compact, stable mass, with large stone armor at the face. The stones at the inner, vertical face of the revetment must carefully placed to be self-supporting to ensure that large stresses are not induced on the peat face. All stones used in this construction must meet the angularity requirements of the current revised specifications for large stone materials – rounded and sub-rounded pit tailings will not be allowed. A typical section is attached to this report. I anticipate that this revetment will extend to approximately 50 feet from the edge of pavement, to fill in the area where is appears that past block failures have occurred.

The work will be done from the beach during periods of low tide when the beach is dry. It is not feasible to construct beach access within the project limits. There is an area approximately 550 feet east of the area of immediate concern where beach access will be built. In this area, the ground slopes down very steeply from the paved roadway to a narrow shelf, and the drop from this shelf to the beach is shallow. Excavation of peat soils and replacement with granular material will be required. The soils at beach level are peat covered by a thin layer of stony gravel, so a geotextile below soils for this section of access road is recommended. This section of peat extends no more than 50 feet from the bank. The depth of overexcavation will be determined in the field.

Repair of the westbound lane of this road will require excavation of the existing HMA surface and placement of gravel to bring this lane up to an appropriate grade before the pavement is replaced. Lightweight fill is not recommended for this roadway due to difficulty of placement and high transportation costs. Some settlement in the peat is anticipated to occur as a result of this added weight, and HMA thickness should be reduced to minimize settlement. The most recent traffic count on this road showed an AADT of 460 based on summer traffic. Three inches of HMA should be adequate even with a substantial increase in traffic volumes. Traffic volumes are anticipated to be very light during the winter, and paving can be done during the 2012 construction season.

Attachments:
Location map
Plan
Section
MGS Surficial Materials map
NRCS Soils Map
Boring Logs
Lab Test Data



Map Scale 1:24000

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

PLAN LEGEND

Town, County, State		Centerline-Existing	
Property Lines		Centerline-Proposed	10+00
R/W Lines-Existing		Travelway-Existing	
R/W Lines-Proposed		Travelway-Proposed	
Culvert-Existing		Railroad	
Culvert Proposed		Catch Basins	Existing ■ Proposed
Curbing	Existing / Proposed	Manholes	Existing ● Proposed
Type 1		Proposed Underdrain	
Type 3		Proposed Ditch	
Type 5		Existing Ditch	
Outline of Bodies of Water		Utlity Poles	Existing ♦ Proposed
Ledge		Fire Hydrants	Existing ◆ Proposed
Buildings		Existing Water Line	
Trees	Conifer / Deciduous	Existing San. Sewer	
Tree Line		Existing San. Sewer Manhole	
Clearing Limit Line	CLL	Guardrail-Existing	
		Guardrail-Proposed	
		Guardrail-Cable, Other	

LUBEC

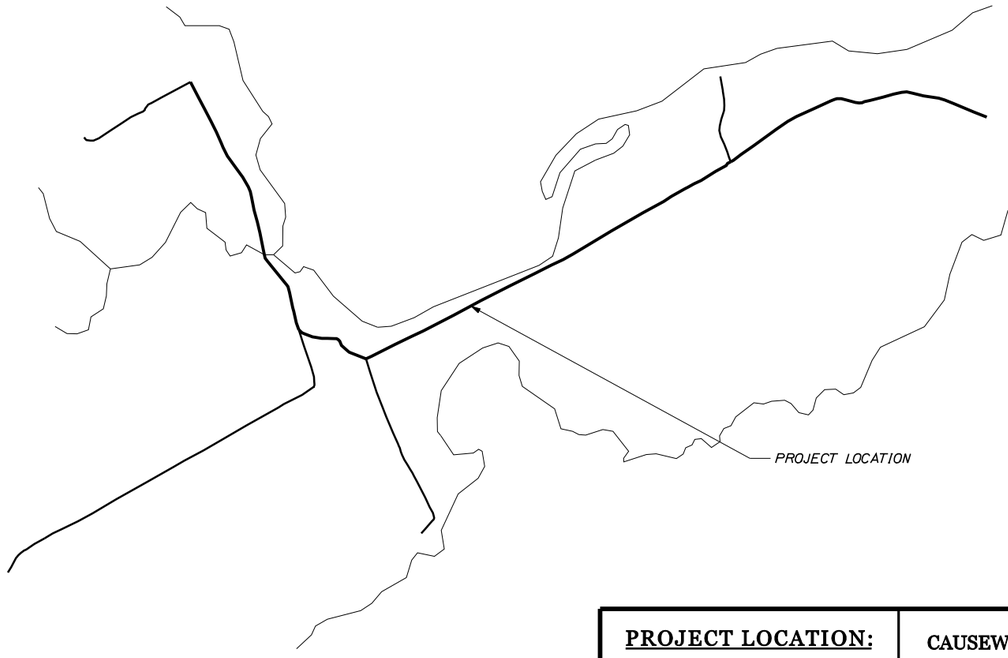
WASHINGTON COUNTY

SOUTH LUBEC ROAD

18317.00

PROJECT LENGTH : 0.04 MILES

INDEX OF SHEETS



NOT TO SCALE

TRAFFIC DATA

Current (2012) AADT	460
Future (20XX) AADT	X
DHV - % of AADT	X
Design Hour Volume	X
% Heavy Trucks (AADT)	X
% Heavy Trucks (DHV)	X
Directional Distribution (DHV)	X
18 kip Equivalent P 2.0	X
18 kip Equivalent P 2.5	X
Design Speed (mph)	X
Functional Class:	X

PROJECT LOCATION:	CAUSEWAY ON WEST QUODDY ROAD IN LUBEC
PROGRAM AREA:	HIGHWAY PROGRAM
SCOPE OF WORK:	Miscellaneous Safety Improvements

WIN 18317.00 01831700

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

DATE

APPROVED

COMMISSIONER:

CHIEF ENGINEER:

PROJECT INFORMATION

PROGRAM		SIGNATURE	
PROJECT MANAGER		P.E. NUMBER	
DESIGNER		DATE	
CONSULTANT			
PROJECT RESIDENT			
CONTRACTOR			
PROJECT COMPLETION DATE			

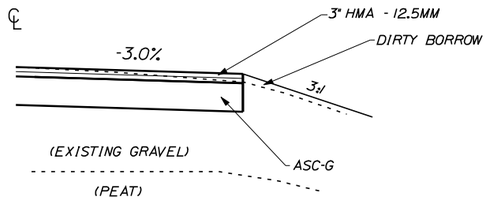
LUBEC
SOUTH LUBEC ROAD

TITLE SHEET

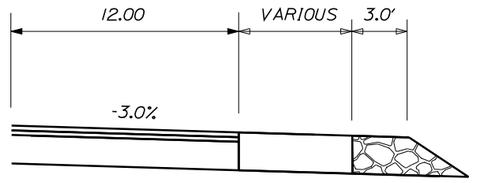
SHEET NUMBER

1

OF 9



12' Travelway



12' Travelway

NOTE:

1. THE PAVEMENT, BASE AND SUBBASE DEPTHS AS SHOWN ON THE PLANS ARE INTENDED TO BE NOMINAL.

2. WHEN SUPERELEVATION EXCEEDS THE SLOPE OF THE LOW SIDE SHOULDER, THE LOW SIDE SHOULDER SHALL HAVE THE SAME SLOPE AS THE TRAVELWAY.

3. CROWNS FOR BOTH NORMAL AND SUPERELEVATION SECTIONS FOR ALL COURSES OF SUBBASE AND PAVEMENT SHALL BE STRAIGHT.

4. THE GRAVEL QUANTITY CALCULATION IS BASED ON A 2" LOAM OR DIRTY BORROW DEPTH. THE ACTUAL DEPTH MAY VARY. SEE THE GENERAL NOTES.

5. THE ALGEBRAIC DIFFERENCE BETWEEN THE SHOULDER AND TRAVEWAY CROSS SLOPES "ROLLOVER" SHALL NOT EXCEED 8%.

6. THE STATIONING SHOWN UNDER EACH TYPICAL IS APPROXIMATE.

NOT TO SCALE

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

01831700

PIN
18317.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER		
DESIGN-DETAILED		
CHECKED-REVIEWED		
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

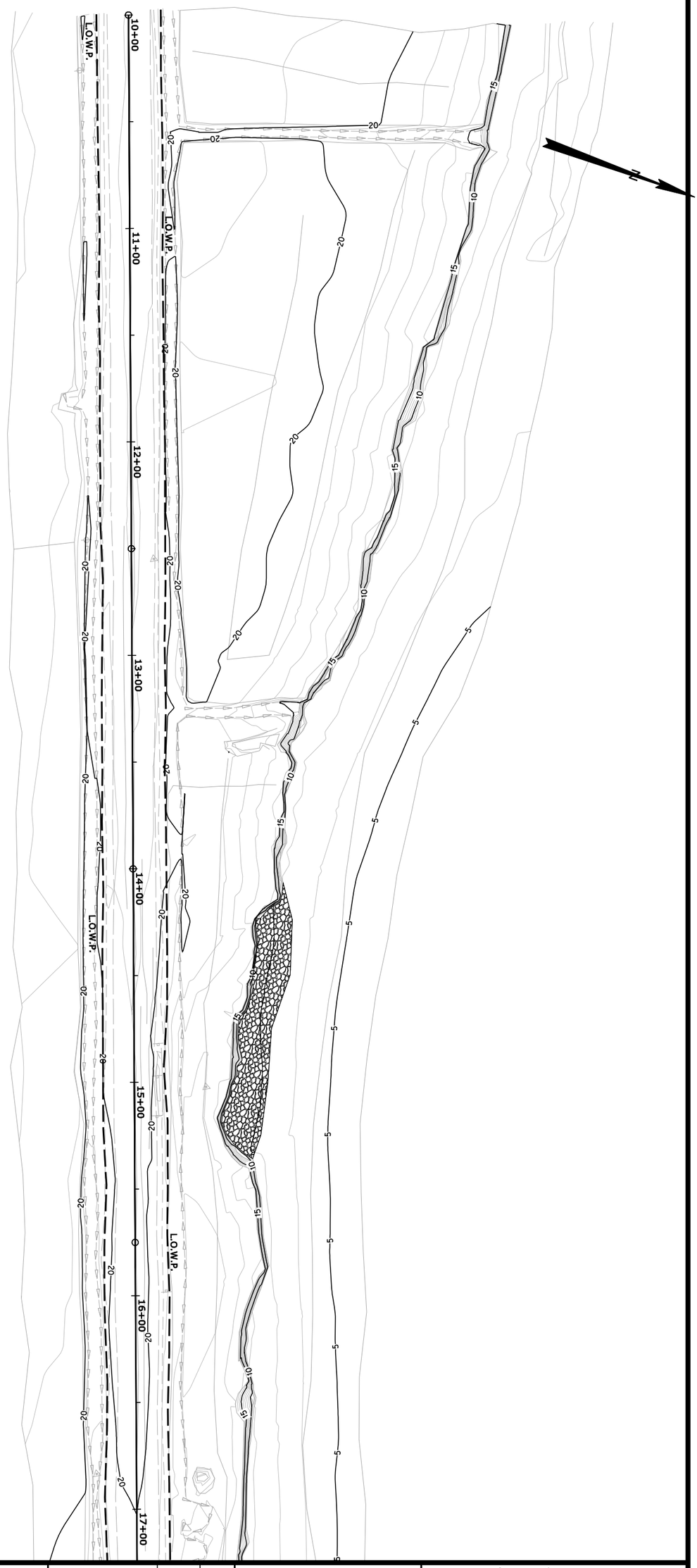
LUBEC
SOUTH LUBEC ROAD

TYPICAL SECTIONS

SHEET NUMBER

2

OF 9



STA. 10+00.00 TO STA. 17+00.00

LUBEC
SOUTH LUBEC ROAD

PLANS

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CHECKED-REVIEWED			
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DESIGN3-DETAILED3			
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REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

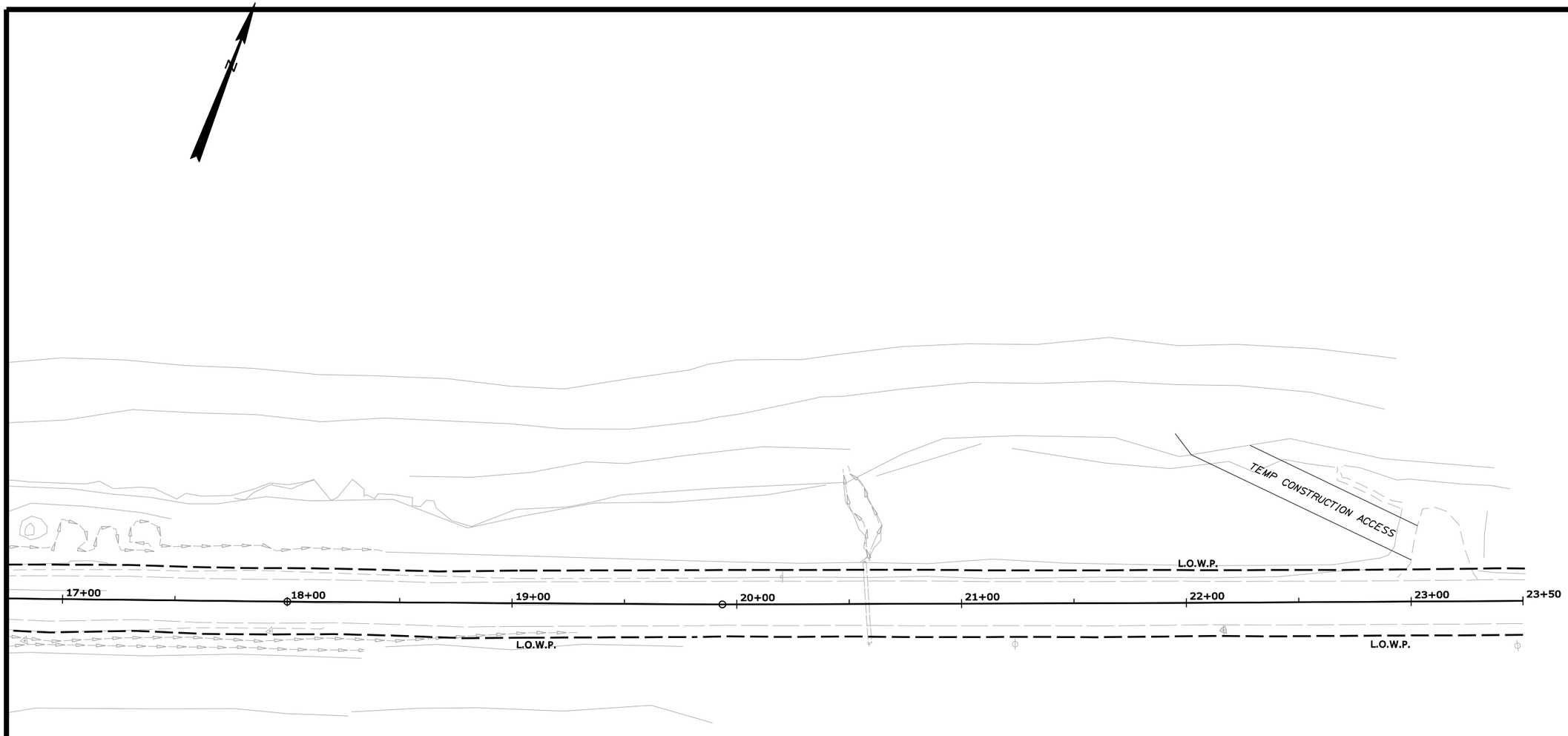
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

01831700

PIN
18317.00

HIGHWAY PLANS

SHEET NUMBER 3 OF 9



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

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PIN
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HIGHWAY PLANS

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DESIGN3-DETAILED3		
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REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

LUBEC
SOUTH LUBEC ROAD

PLANS

SHEET NUMBER

4

OF 9

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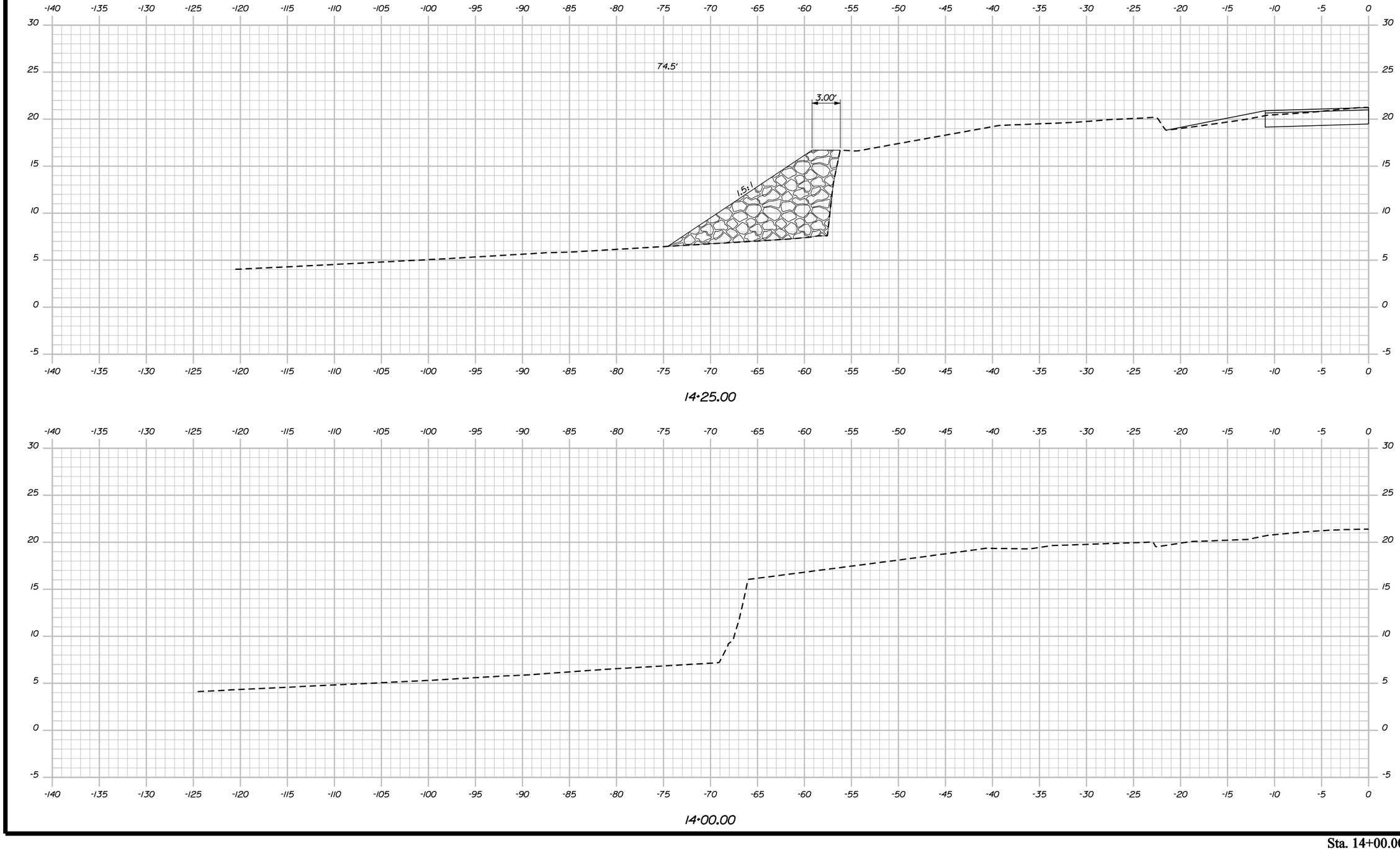

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

01831700

PIN
18317.00

HIGHWAY PLANS

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CHECKED-REVIEWED		
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

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DATE

LUBEC
SOUTH LUBEC ROAD

CROSS SECTIONS

SHEET NUMBER

5

OF 9

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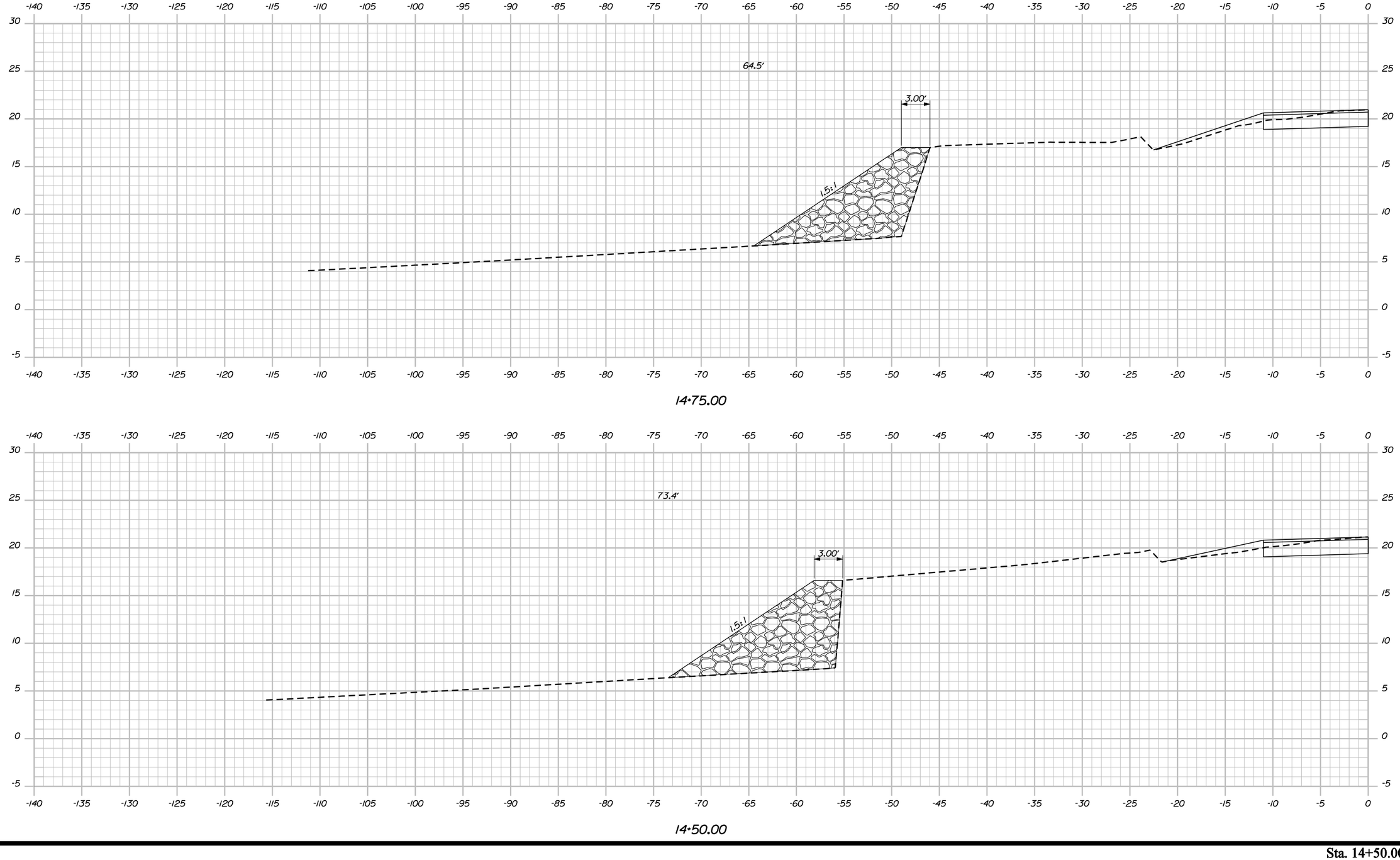

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

01831700

PIN
18317.00

HIGHWAY PLANS

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CHECKED-REVIEWED		
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

LUBEC
SOUTH LUBEC ROAD

CROSS SECTIONS

SHEET NUMBER

6

OF 9

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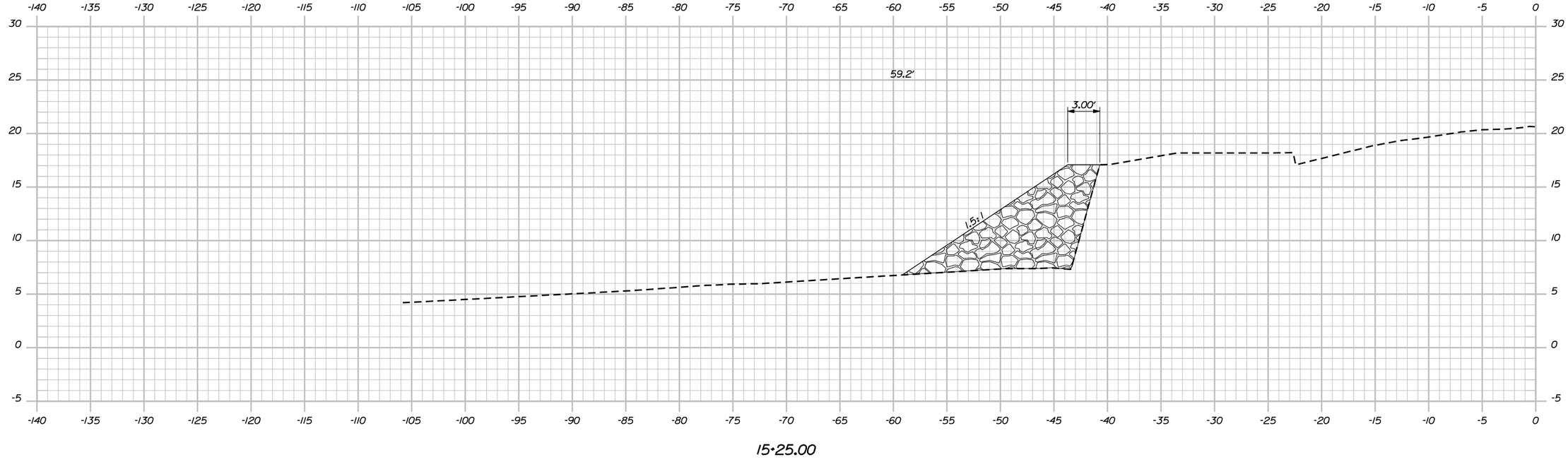

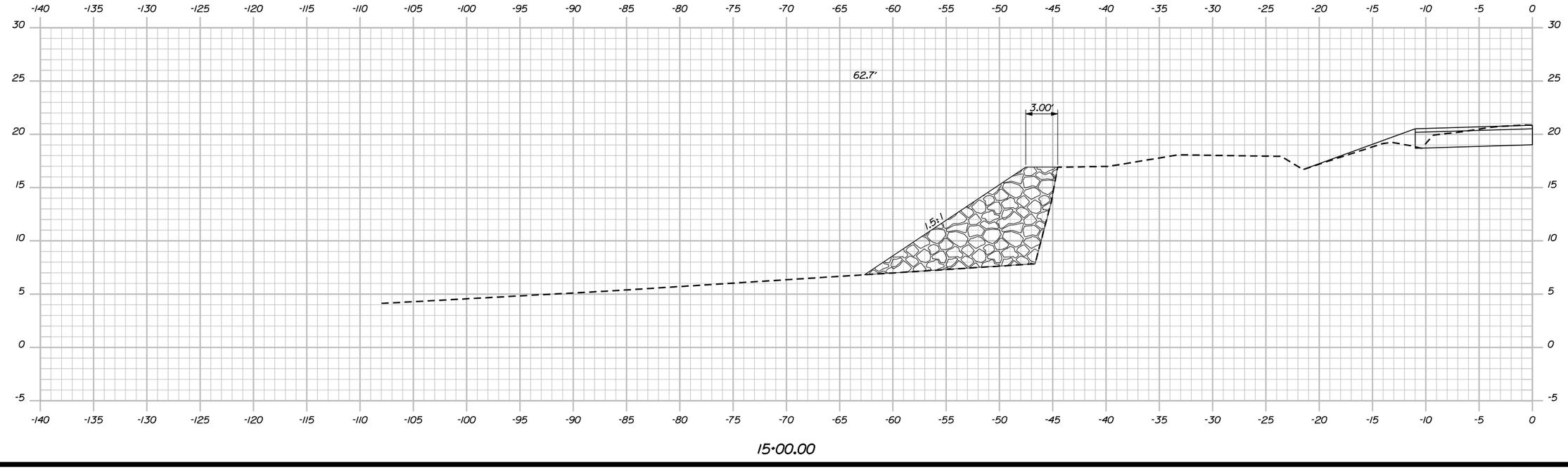

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

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HIGHWAY PLANS

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DESIGN3-DETAILED3		
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REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
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LUBEC
SOUTH LUBEC ROAD

CROSS SECTIONS

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7

OF 9

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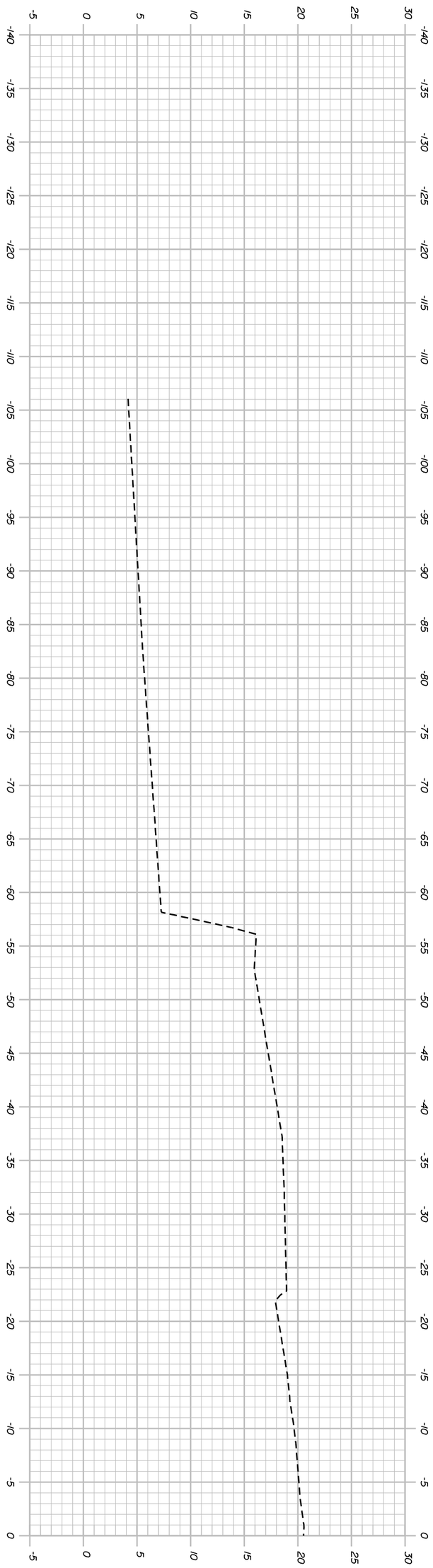

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SHEET NUMBER 8 OF 9

LUBEC
SOUTH LUBEC ROAD

CROSS SECTIONS

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DESIGN3-DETAILED3			
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REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

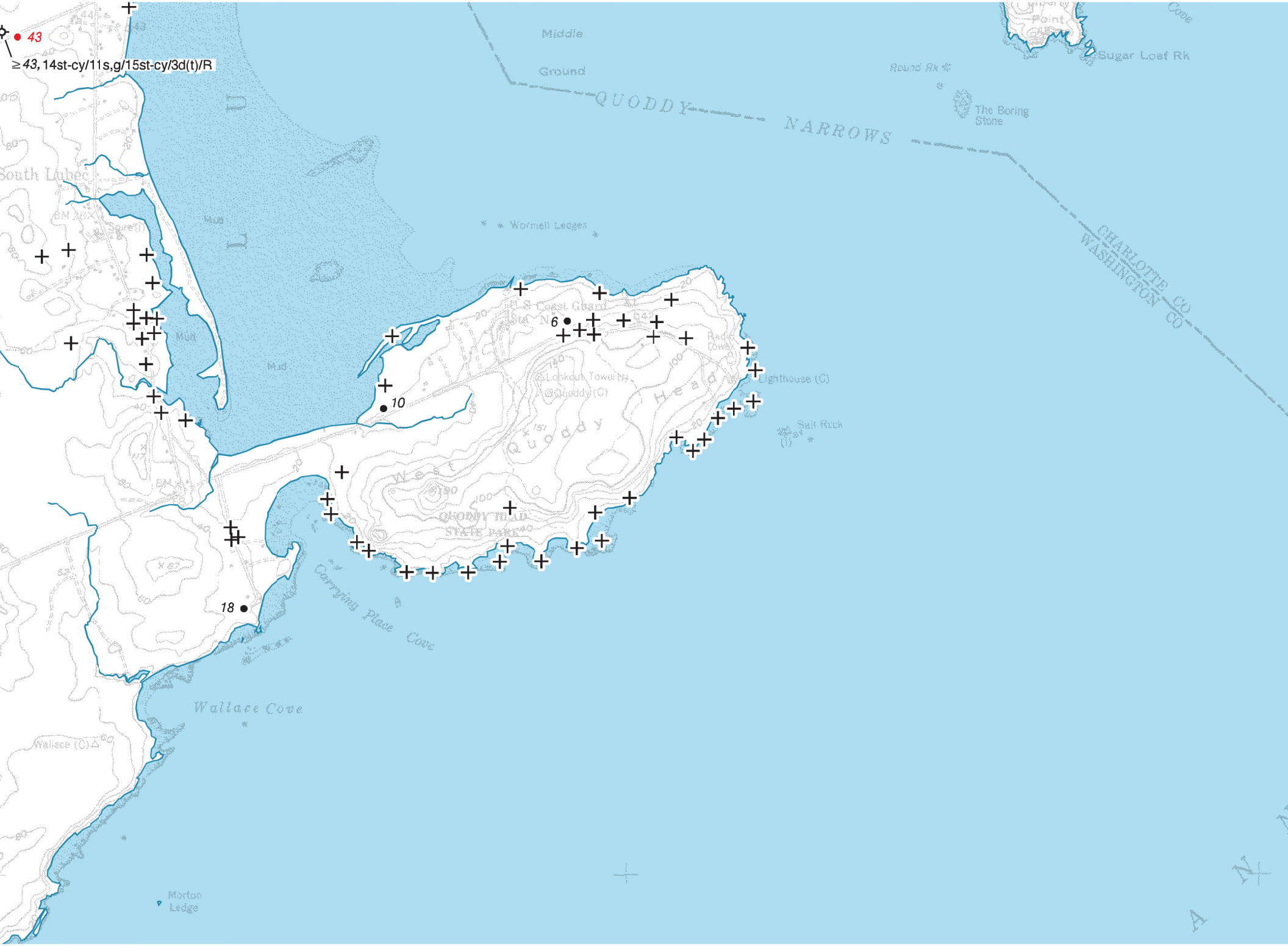
P.E. NUMBER

DATE

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

01831700

PIN 18317.00 HIGHWAY PLANS

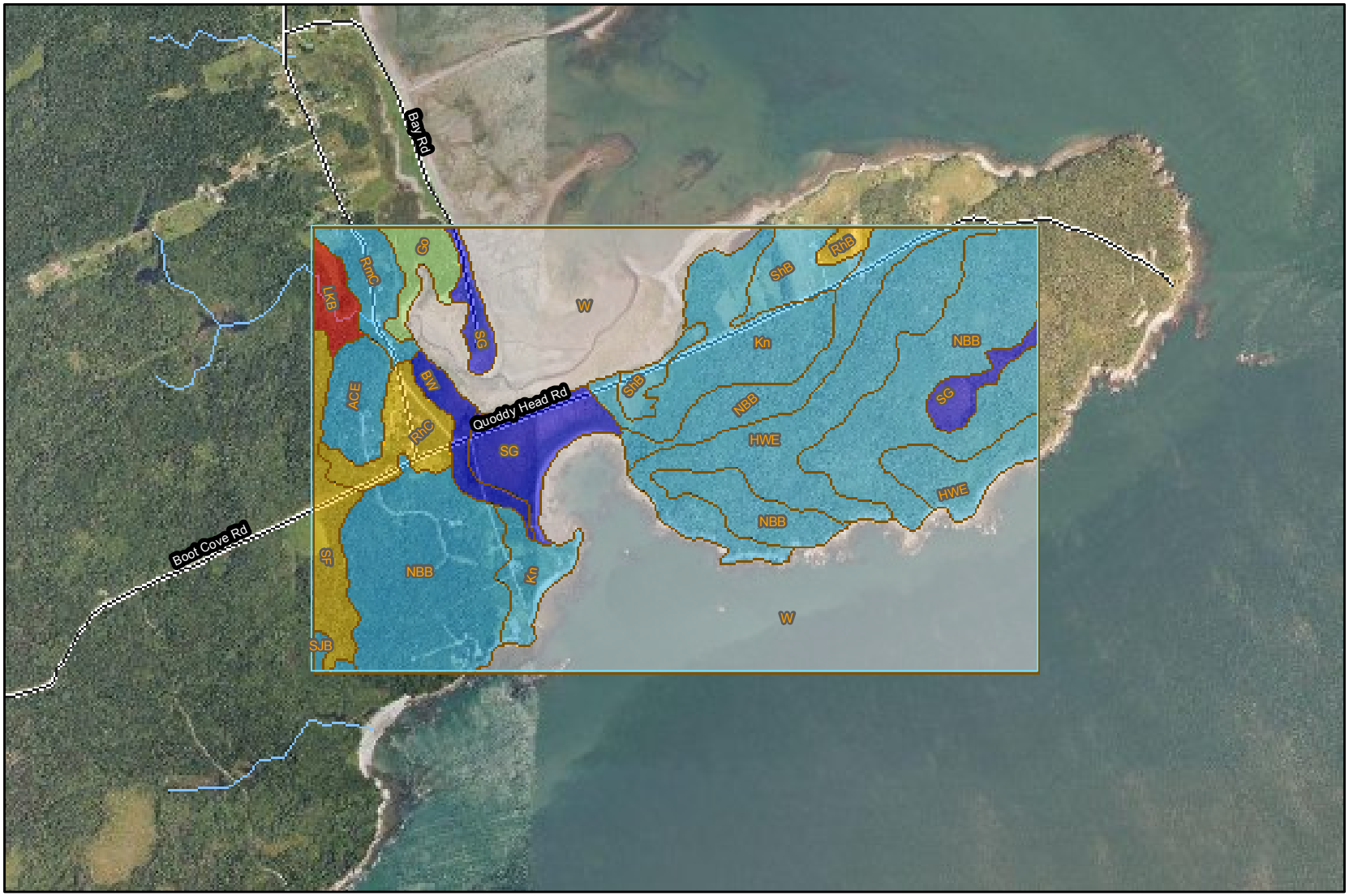

43
≥43, 14st-cy/11s,g/15st-cy/3d(t)/R
Middle
Ground
QUODDY
NARROWS
Round Rk
The Boring
Stone
Sugar Loaf Rk
Point
Cove
South Lubec
Mud
Wormell Ledges
CHARLOTTE CO
WASHINGTON CO
6
10
18
Lighthouse (C)
Salt Rock
Quoddy
Head
Carrying Place Cove
Wallace Cove
Wallace (C)
Morton
Ledge

67° 0' 21"

66° 56' 32"

44° 49' 32"

44° 49' 28"



44° 47' 43"

44° 47' 39"

67° 0' 25"

66° 56' 36"

Map Scale: 1:24,000 if printed on A size (8.5" x 11") sheet.

N

Meters
0 300 600 1,200 1,800

Feet
0 1,000 2,000 4,000 6,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- <= 5.5
- > 5.5 AND <= 6
- > 6 AND <= 12.5
- > 12.5 AND <= 63
- > 63 AND <= 89.5
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

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

MAP INFORMATION

Map Scale: 1:24,000 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: Washington County Area, Maine
Survey Area Data: Version 13, Oct 2, 2009

Date(s) aerial images were photographed: Data not available.

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.

Organic Matter

Organic Matter— Summary by Map Unit — Washington County Area, Maine (ME617)				
Map unit symbol	**Map unit name**	**Rating (percent)**	**Acres in AOI**	**Percent of AOI**
ACE	Abram-Rock outcrop-Ricker complex, 15 to 80 percent slopes	63.00	23.7	2.1%
BW	Bucksport and Wonsqueak soils	89.50	15.8	1.4%
Go	Gouldsboro silt loam	12.50	16.1	1.4%
HWE	Hogback-Abram-Rawsonville complex, 15 to 60 percent slopes, very stony	63.00	120.8	10.6%
Kn	Kinsman sand	53.00	84.9	7.5%
LKB	Lamoine-Rawsonville-Scantic complex, 0 to 8 percent slopes, very stony	5.50	13.0	1.1%
NBB	Naskeag-Rawsonville-Hogback complex, 0 to 8 percent slopes, very stony	63.00	268.5	23.6%
RhB	Rawsonville-Hogback complex, 3 to 8 percent slopes	6.00	4.9	0.4%
RhC	Rawsonville-Hogback complex, 8 to 15 percent slopes	6.00	25.8	2.3%
RmC	Rawsonville-Hogback-Abram complex, 3 to 15 percent slopes, very stony	63.00	22.4	2.0%
SF	Scantic-Biddeford association, 0 to 3 percent slopes	6.00	29.2	2.6%
SG	Sebago and Moosabec soils	89.50	57.0	5.0%
ShB	Sheepscot fine sandy loam, 0 to 8 percent slopes	63.00	30.7	2.7%
SJB	Sheepscot-Croghan-Kinsman complex, 0 to 8 percent slopes	63.00	2.9	0.3%
W	Water		423.1	37.2%
Totals for Area of Interest			**1,138.7**	**100.0%**

Description

Organic matter is the plant and animal residue in the soil at various stages of decomposition. The estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained by returning crop residue to the soil. Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms. An irregular distribution of organic carbon with depth may indicate different episodes of soil deposition or soil formation. Soils that are very high in organic matter have poor engineering properties and subside upon drying.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options: Surface Layer

Maine Department of Transportation

Test Pit Log

US CUSTOMARY UNITS

Project: Slope failure West Quoddy Road causeway

Location: Lubec, Maine

Test Pit No.: 1

PIN: 18317.00

Contractor:	MaineDOT	**Equipment Type:**	Shovel	**Elevation (ft.)**	
Operator:	Daggett	**Sampling Method:**	No samples taken	**Datum:**	NAVD88
Logged By:	K. Breskin	**Test Pit Dimensions (ft):**			
Date Start/Finish:	11/7/11	**Total Depth (ft):**	15"		
Location:		**Water Level* (ft):**			

Definitions:
S = Grab Sample
V = Insitu Vane Shear Test
U = Thin Wall Tube Sample

Definitions:
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis

Depth (ft.)	Sample Information: Sample No.	Sample Depth (ft.)	Shear Strength (psf)	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0				-0.25		2-3" Brown, stony GRAVEL.	
				-0.75		6" Grey, fine SAND. 0.3	G#176412 A-2-4, SM WC=22.5%
				-1.25		6" Grey, gravelly SAND. 0.8	
						1.3	
5						**Bottom of Test Pit at 1.3 feet below ground surface.**	
10							
15							
20							
25							

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Slope failure West Quoddy Road causeway
Location: Lubec, Maine

Boring No.: HB-WQH-101
WIN: 18317.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Wilder/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	N/A
Logged By:	K. Breskin	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	11/7/11-11/7/11	**Drilling Method:**	Solis Stem Auger	**Core Barrel:**	N/A
Boring Location:	58 ft East of Pole 90-110	**Casing ID/OD:**	N/A	**Water Level*:**	3.0 ft ±

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

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

Definitions:
WC = water content, percent
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-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	-0.37		4½" HMA.	
									0.37	
							-1.60		Grey-brown, moist, sandy GRAVEL.	
									1.60	
									changed to wet and silty at 1.6 ft bgs.	
5										
							-6.00		6.00	
									Brown, PEAT.	
10										
15							-16.50		16.50	
									Blue-grey, wet, silty SAND.	
20										
25										

Remarks:

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Maine Department of Transportation

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Location: Lubec, Maine

Boring No.: HB-WQH-101
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Operator:	Wilder/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	N/A
Logged By:	K. Breskin	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	11/7/11-11/7/11	**Drilling Method:**	Solis Stem Auger	**Core Barrel:**	N/A
Boring Location:	58 ft East of Pole 90-110	**Casing ID/OD:**	N/A	**Water Level*:**	3.0 ft ±

Definitions:
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Definitions:
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$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
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Definitions:
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Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25										
30										
35							-35.40		firm hard -35.40 **Bottom of Exploration at 35.40 feet below ground surface.** Ran out of auger.	
40										
45										
50										

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Slope failure West Quoddy Road causeway
Location: Lubec, Maine

Boring No.: HB-WQH-102
WIN: 18317.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Solid Stem
Operator:	Wilder/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	K. Breskin	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	11/7/11-11/7/11	**Drilling Method:**	Solis Stem Auger	**Core Barrel:**	N/A
Boring Location:	19 ft West of Pole 90-110	**Casing ID/OD:**	HW	**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, 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	-0.37		4½" HMA.	
										0.37	
	1D	24/9	1.00 - 3.00	8/8/7/7	15	21				Grey-brown, moist, medium dense, Gravelly SAND, trace silt.	G#176413 A-1-a, SW-SM WC=6.9%
							17				
5	MD	24/1	5.00 - 7.00	4/4/3/2	7	10	17			1" of grey, wet, loose, SAND, some silt.	
							3	-6.00		6.00	
							4				
							5				
							WOH				
10	MD	24/0	10.00 - 12.00	5/6/4/4	10	14	WOH			PEAT.	
							20				
							18				
							36	-13.00		13.00	
	4D/A	24/18	14.00 - 16.00	7/3/2/1	5	7	30			Top 3" Brown, SAND. then Grey, loose, saturated, Sandy SILT, trace gravel.	G#176414 A-4, ML WC=21.6%
15	4D/B						22				G#176415 A-4, ML WC=23.7%
							24				
							22				
							28				
	5D/MV	24/18	19.00 - 21.00	2/2/3/2	5	7	42	-19.00		19.00	
20							43			Grey, wet, soft, Silty CLAY, trace sand, trace gravel. Failed 55x110 mm vane attempt, would not push.	G#176416 A-6, CL WC=25.4%
							57				
							61				
							66				
25	6D/MV	24/10	24.00 - 26.00	WOH/WOH/WOH/ WOH	---		65			Grey, saturated, very soft, Clayey SILT, trace sand, trace gravel. Failed 55x110 mm vane attempt, would not push.	G#176417 A-4, CL-ML

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Slope failure West Quoddy Road causeway
Location: Lubec, Maine

Boring No.: HB-WQH-102
WIN: 18317.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Solid Stem
Operator:	Wilder/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	K. Breskin	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	11/7/11-11/7/11	**Drilling Method:**	Solis Stem Auger	**Core Barrel:**	N/A
Boring Location:	19 ft West of Pole 90-110	**Casing ID/OD:**	HW	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MD = Unsuccessful Split Spoon Sample attempt
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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
WQ1P = 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.
25							63				WC=10.0% LL=25 PL=19 PI=6
							63				
							63				
							40	-28.50		28.50	
										Bottom of Exploration at 28.50 feet below ground surface. REFUSAL	
30											
35											
40											
45											
50											

Remarks:

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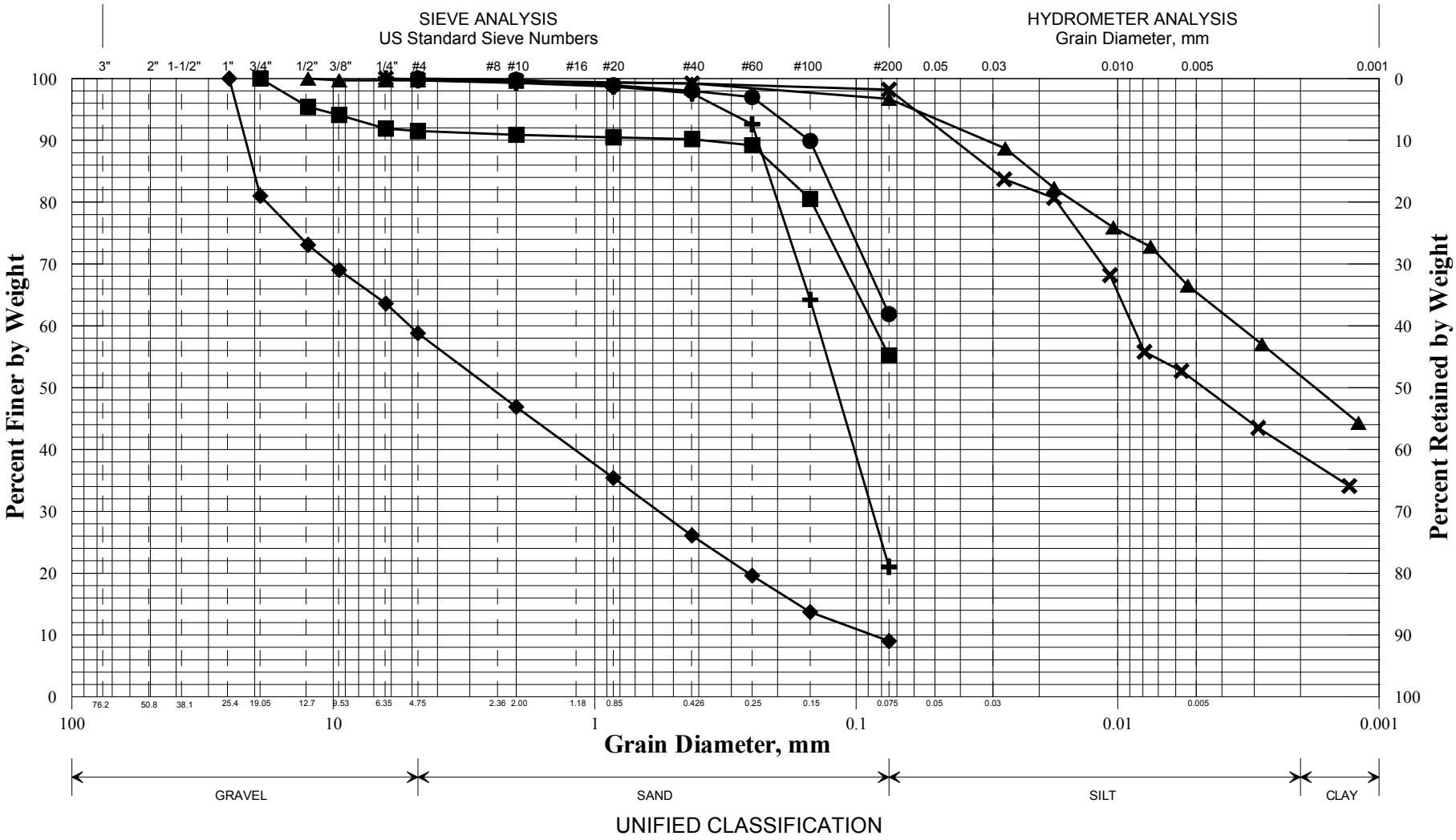
Boring No.: HB-WQH-102

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	TEST PIT 1	BEACH		1	SAND, some silt, trace gravel.	22.5			
◆	HB-WQH-102/1D	P90-110	19.0 WE	1.0-3.0	Gravelly SAND, trace silt.	6.9			
■	HB-WQH-102/4D-A	P90-110	19.0 WE	14.0-15.0	Sandy SILT, trace gravel.	21.6			
●	HB-WQH-102/4D-B	P90-110	19.0 WE	15.0-16.0	Sandy SILT.	23.7			
▲	HB-WQH-102/5D	P90-110	19.0 WE	19.0-21.0	Silty CLAY, trace sand, trace gravel.	25.4			
✖	HB-WQH-102/6D	P90-110	19.0 WE	24.0-26.0	Clayey SILT, trace sand, trace gravel.	10.0	25	19	6

WIN
018317.00
Town
Lubec
Reported by/Date
WHITE, TERRY A 12/2/2011

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Lubec Work Number: 18317.00

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
TEST PIT 1	BEACH		1.0	176412	1	22.5			SM	A-2-4	II
HB-WQH-102, 1D	P90-110	19.0 WE	1.0-3.0	176413	1	6.9			SW-SM	A-1-a	0
HB-WQH-102, 4D-A	P90-110	19.0 WE	14.0-15.0	176414	1	21.6			ML	A-4	IV
HB-WQH-102, 4D-B	P90-110	19.0 WE	15.0-16.0	176415	1	23.7			ML	A-4	IV
HB-WQH-102, 5D	P90-110	19.0 WE	19.0-21.0	176416	1	25.4			CL	A-6	IV
HB-WQH-102, 6D	P90-110	19.0 WE	24.0-26.0	176417	1	10.0	25	6	CL-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