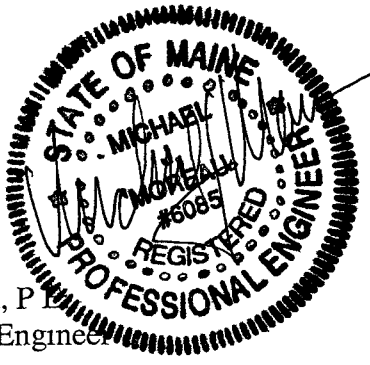
Maine Department of Transportation

Urban and Arterial Highway Geotechnical Section

Report of

GEOTECHNICAL ENGINEERING EVALUATION
for
ROUTE 1A RECONSTRUCTION
IN THE TOWN OF WINTERPORT, WALDO COUNTY

Prepared by



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Waldo County | PIN 2762 60 | Soils Report 2004-34
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1.0 GEOTECHNICAL DESIGN SUMMARY

This report summarizes our geotechnical engineering evaluations for the reconstruction of Route 1A in the Town of Winterport, Waldo County, Maine The design and construction recommendations below are discussed in greater detail in Section 4 0, Evaluation and Recommendations

Pavement Design Considerations

- Construct pavement structure with the following elements
  - 600 mm (24 in) of MaineDOT Specification 703 06 ASCG Type D or better in travel lanes and shoulders
  - 100 mm (4 in) PMRAP in one lift in travel lanes and 450 mm beyond shoulder break
  - 125 mm (4 in) new hot mix asphalt (HMA) over travel lanes
  - 75 mm (3 in) over shoulder areas

- Place and compact all the layers described above in accordance with project specifications

Highway Drainage

- Use full ditches or install Type B or C underdrains in curb or box sections as appropriate Connect underdrains to closed drainage systems, nearby culverts and/or daylight the outlets

Highway Construction Considerations

This is a Full Reconstruction project with the following requirements/recommendations-

- Excavation
  - Reclaim existing pavement for use as PMRAP Stockpiling of reclaimed asphalt will be necessary
  - Excavate existing subbase and subgrade soils to planned subgrade elevation MaineDOT Special Provisions may apply to treated base gravels
  - Remove cobbles and boulders larger than 150 mm (6 in) at subgrade level
  - Protect the exposed subgrade from softening due to contact with water and construction traffic Remove and replace disturbed or rutted materials with compacted sand and gravel
  - Proof-roll the subgrade surface to identify weak soil areas
  - Based on FWD testing, weak Subgrade soils are present in the following areas
    STA 1+100 to 1+160
    STA 1+740 to 1+820
    STA 2+100 to 2+180
    STA 2+290 to 2+310 (Project End)

Contractor may either place stabilization geotextile over weak subgrade soil beneath travel lane, or over-excavate and replace 300 mm (12 in) of the weak subgrade soil with ASCG compacted to specification
- Use approximately 10 m (30 ft) long subgrade excavation transition zones at the beginning and end of the full reconstruction sections
- Bedrock excavation may be needed between STA 1+480 and 1+520, STA 1+580 and 1+680 and between STA 1+840 and 2+000 for underdrain and/or pavement structure construction Use transition zones where the roadway subgrade changes from soil to bedrock and bedrock to soil

- Reuse of Excavated Soil
  - Do not use excavated existing subbase aggregate for pavement structure construction or to re-base shoulders Excavated subbase sand and gravel may be used as fill below subgrade elevation in fill embankment areas MaineDOT Special Provisions may apply to treated base gravels
  - Do not use excavated marine silty sands and/or clay-silt soils for fill anywhere beneath the pavement structure or dressing slopes Use these soils to dress slopes only below the bottom elevation of the shoulder subbase gravel

- Dewatering
  -Provide stone ditch protection or hand-laid riprap with geotextile underlayment if significant seepage is encountered during ditch excavation
  - Control groundwater and surface water infiltration to permit construction in-the-dry
  - Use French drains daylighted to nearby ditches if significant seepage is encountered in the subgrade along the full reconstruction sections

- Blasting
  - Bedrock excavation may be needed to achieve highway subgrade or for underdrain construction between STA 1+480 and 1+520, STA 1+580 and 1+680 and between STA 1+840 and 2+000 Rock excavation may also be needed for wall foundation excavation between STA 1+630 and 1+670 Conduct pre and post-blast condition surveys in accordance with industry standards if blasting is required

- Embankment Fill Areas
  - Bench existing fill slope soils in accordance with MaineDOT Standard Specification 203 09, Preparation of Embankment Area, where new fill slope extensions are constructed over existing slopes
  - Use 706 18 Common Borrow or similar material to construct fill embankment
  - Box culvert repair or replacement design at STA 1+223 must accommodate up to 2 inches of settlement as result of new fill embankment construction

Retaining Walls

- Provide supplier design Prefabricated Concrete Block Gravity Retaining Wall between STA 1+630 and 1+670 Use a maximum contact bearing pressure of 3 ksf for wall design considerations

- Design all project walls in accordance with AASHTO/MaineDOT specifications, Special Provisions

- Remove and replace weak or unsuitable soils from any wall subgrade with 2 feet of 703 20 Gravel Borrow compacted to 95 % T-180

Erosion Control Recommendations

- Use MaineDOT Best Management Practices to minimize erosion of fine-grained soils found along the project

2.0 INTRODUCTION

The Maine Department of Transportation is reconstructing approximately 1 28 km (0 80 mi) of Route 1A in Winterport, Waldo County, Maine (See Site Location Map in Appendix A, Figures) Current project plans show the entire alignment as a curbed section with sidewalks, and 3 6 m (12 ft) and 2 4 m (8 ft) travel lanes and shoulders, respectively

This reconstruction project will include pavement reclamation and reuse as PMRAP, full construction of the subbase and pavement for travel lanes and shoulders, installing pavement underdrains, and replacing or installing drainage systems as needed (replacing culverts, ditching, curb, underdrain and catch basins)

Horizontal and vertical sight distance corrections are necessary along two sections of the project A significant fill up to 5 m (16 ft) thick beneath the outboard slopes and 2 4 m (8 ft) deep over the existing highway embankment will be constructed between STA 1+180 and 1+320 A box culvert at the base of the fill area will be extended or replaced as part of the new fill embankment construction A low wall is planned between STA 1+630 and 1+670 LT which will help minimize Right-Of-Way (ROW) impacts and improve horizontal site distance

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Conditions

The project alignment crosses gently to moderately sloping ground Surficial drainage along this project is generally directed north and south to sag locations and thence towards the Penobscot River, or directly east over sloping ground to the river Land use within the corridor is primarily rural residential

The existing highway consists of two travel lanes (one in each direction) with gravel shoulders Along most of the alignment the road was constructed near the grade of the adjacent property There are minor cut and fill embankment sections along the alignment generally as follows

Fill Embankment Station
1+170 to 1+280 RT and LT
1+740 to 1+800 RT and LT
2+040 to 2+080 RT and LT
2+140 to 2+300 RT and LT

Cut Embankment Station
1+070 to 1+110 LT
1+320 to 1+360 LT
1+630 to 1+670 LT
1+900 to 1+940 LT

Surficial geology maps of the region indicate the predominant soils are glacial marine sediments consisting of silty sand, sandy silt, and clay-silt However, glacial stream deposits and glacial till may be inter-fingered or inter-bedded with the marine sediments The native marine sands and clay-silts within the project area are both poorly drained and highly frost susceptible The surficial geology map also shows the presence of end moraine deposits within the project area which consist of narrow ridges of till or sand and gravel partly or mostly buried by water-laid glacial sediment

3.2 Subsurface Conditions

Our field investigation included 14 Standard Penetration Testing (SPT) and power auger borings and 11 power auger bedrock probes conducted in November and December 2003 We show the boring locations on the project plan sheets in Appendix A, Figures In the borings, we found widely variable pavement depths typically ranging between 130 and 180 mm (5 and 7 in), but as thin as 100 mm (4in) and as thick as 240 mm (9 5 in) The subbase layer was also widely variable in thickness ranging from 0 to 890 mm (0 to 35 in) The subbase consisted primarily of fine to coarse sand or sandy gravel fill We typically encountered marine clay-silt or glacial till subgrade soils

We encountered ground water at 2 0 m and 2 9 m (6 6 and 9 5 ft) below ground surface in borings HB-WIN-101 and HB-WIN-102 respectively However, the groundwater level will fluctuate with seasonal changes, runoff, and adjacent construction activities

Several of the borings or probes encountered apparent bedrock refusal at depths ranging from 1 89 to 6 19 m (6 2 to 20 3 ft) below ground surface For a more detailed description of the subsurface conditions, please refer to the boring logs in Appendix B, Field Exploration and Test Data

3.3 Laboratory Testing

We conducted a laboratory soil testing program on selected samples recovered from the test borings to evaluate soil classification, material reuse, and subgrade soil properties Laboratory testing consisted of 18 grain-size analyses, 18 water content determinations, and 3 Atterberg

Limits tests Results of laboratory testing are presented in Appendix C, Laboratory Test Data The AASHTO and USCS soil classification and water content and Atterberg Limit data are also presented on the boring logs in Appendix B

4.0 EVALUATION and RECOMMENDATIONS

4.1 Pavement Design Considerations

4 1 1 Frost Penetration Estimates

The mean and design freezing indices are 1050 and 1570, respectively We have estimated the frost penetration depths based on these freezing index values and a 760 mm (30 in) pavement structure and present the estimates in the table below

	Total Frost Penetration (mm)		Frost Penetration into Subgrade (mm)	
Freezing Index (degree-F days)	Granular Subgrade	Non-granular Subgrade	Granular Subgrade	Non-granular Subgrade
Mean – 1050	1500	1070	740	310
Design – 1570	2060	1310	1300	550

4 1 2 Pavement Structure

Project plans call for construction of 3 6 m (12 ft) wide travel lanes and 2 4 m (8 ft) wide paved shoulders The explorations we conducted for this evaluation indicate that the pavement section along the project alignment is highly variable The typical existing pavement thickness ranges between 100 and 240 mm (4 to 9 5 in) The apparent total pavement structure thickness (asphalt paving and subbase) ranges from about 150 to 1070 mm (6 to 42 in)

Except in fill embankment areas, the native subgrade soils along the project are predominantly marine sediments consisting of clay-silts or glacial till Both of these soils are very frost susceptible and a deep pavement structural section is generally needed to minimize frost damage from heaving In addition, ground water levels will occur at or above the subgrade each spring season and will create weak conditions in these soils The fill embankment sections were constructed using a variety of soils including sandy gravel, sand, and silty sand The fill embankment soils we encountered are generally very loose to very dense (granular soils)

Based on grain size distribution tests of the existing subbase, the fines content ranges between 11 and 35 percent with three locations over 30 percent We also noted that the subbase material did not meet MaineDOT 703 06 ASCG Type D specifications in numerous locations and the depth of the subbase course was inadequate in 60 percent of the boring locations As a result of the

low quality and depth of the existing subbase, and the need for separation from the frost susceptible subgrade soils, we recommend full reconstruction

We considered several pavement recycling methods and determined that PMRAP is the best method for this project Because we recommend full reconstruction, the pavement must be removed After or during removal, the pavement may be ground to specification and stockpiled for use in PMRAP pavements

We have estimated a subgrade resilient modulus on the order of 33,000 kPa (4,790 psi) for this project This is consistent with the presence of stiff to hard glaciomarine silts and glacial till and we have used that value in our DARWin pavement design analysis We also used the current traffic data in our analysis (see Appendix D, Calculations)

Based on the results of the laboratory testing and DARWin analysis, a pavement structure that included 125 mm (5 in) of new HMA, 100 mm (4in) of PMRAP, and a minimum of 600 mm (24 in) of subbase gravel was required for a 20-year design life We recommend MaineDOT Specification 703 06 Aggregate Subbase Course Gravel (ASCG), Type D or better for the full subbase course depth We recommend placing and compacting all the layers described above in accordance with project specifications

4 1 3 Weak Subgrade Soil Areas

Based on the FWD results we have identified the following areas with low subgrade resilient modulus values

STA 1+100 to 1+160
STA 1+740 to 1+820
STA 2+100 to 2+180
STA 2+290 to 2+310 (Project End)

At the contractor's option, the weak subgrade soil areas may be improved by either placing stabilization geotextile over weak travel lane subgrade soil, or over-excavating 300 mm (12 in) of the weak subgrade soil and replacing it with ASCG compacted to specification

4.2 Highway Drainage Considerations

In general, highway drainage improvements should include culvert installation and replacement, installation of underdrains, curbing, and ditching Removing water from the pavement section will improve long-term design life and performance of the pavement section The ditches and underdrains are intended to prevent groundwater or trapped surface water from accumulating in the subbase course and on the subgrade The estimated seasonal frost penetration depth (1500 mm to 2060 mm, 59 in to 81 in) exceeds the anticipated thickness of the pavement section (825 mm, 32 in) Therefore, the entire pavement section and 310 to 550 mm (12 to 22 in) of the subgrade are expected to freeze The subgrade soils are considered to be frost susceptible

(heaving when freezing and loss of strength upon thawing) Keeping water out of the pavement structure will improve pavement performance against freeze/thaw action

In some locations, the project team may opt to use underdrains to minimize wetland or ROW impacts In other instances where appropriate, full ditches may be added or extended There are significant segments of the project site with inadequate ditching along both shoulders There also are a number of residential properties that would be significantly impacted with standard ditch construction

Consequently, given the nature of the of the Route 1A project and the need to provide adequate subbase drainage, we recommend improving pavement structure performance with underdrains in curbed and box sections and full ditches elsewhere The ditches and underdrains should be constructed so that the ditch or pipe inverts extend below the bottom of the pavement structure Standard ditches should be constructed with 3 1 (H V) fore slopes and 2 1 (H V) back slopes To minimize ROW impacts and facilitate pavement and subbase drainage, we also recommend bituminous curb sections with type B or C underdrain trenches adjacent to some residences and other improved properties We recommend that underdrains outlet into culverts or daylight into existing drain ways onto riprap aprons

4.3 Highway Construction Considerations

4 3 1 Excavation

The marine sediments and glacial till at the subgrade surface will be susceptible to disturbance and rutting as a result of exposure to water or construction traffic We recommend that the contractor protect the subgrade from exposure to water and any unnecessary construction traffic If disturbance and rutting occur, we recommend that the contractor remove and replace the disturbed materials with compacted sand and gravel The subgrade soil will also contain cobbles and possibly boulders We recommend that the contractor remove any cobbles and boulders larger than 150 mm (6 in) in diameter by raking the subgrade to a depth of 150 to 300 mm (6 to 12 in) After excavating to the subgrade level, the contractor should proof-roll the surface to identify weak soil areas

We recommend that the contractor use approximately 10 m (30 ft) long subgrade excavation transition zones at the beginning and end of the new construction We also recommend that the contractor use transition zones where the roadway subgrade changes from soil to bedrock and bedrock to soil We show the bedrock transition zone details in Appendix A, Figures

4 3 2 Dewatering

The native glacial-marine sands and silts and glacial till within the project area are both poorly drained and highly frost susceptible In some locations, these soil units may be saturated and significant water seepage may be encountered during excavation for ditches or the pavement structure, or during underdrain construction

We recommend that the contractor provide stone ditch protection or hand-laid riprap with geotextile underlayment if significant seepage is encountered during ditch excavation The contractor should control groundwater and surface water infiltration to permit construction in-the-dry We also recommend using French drains daylighted to nearby ditches if significant seepage is encountered in the subgrade along the full reconstruction sections

4 3 3 Reuse of Excavated Soils

The project plans call for full reconstruction To achieve planned grades, the contractor will excavate both existing subbase gravel and native marine sediments MaineDOT Special Provisions may apply to treated base gravels with regard to excavation and use as fill We do not recommend using the excavated subbase aggregate to re-base the shoulders Excavated subbase sand and gravel may be used as fill below subgrade elevation in fill embankment areas We do not recommend using marine sediments excavated from the subgrade level as fill beneath the pavement structure This soil may be used for dressing slopes, but only below the bottom elevation of the shoulder subbase gravel

4 3 4 Blasting

Bedrock excavation may be needed to achieve highway subgrade or for underdrain construction between approximate STA 1+480 and 1+520, STA 1+580 and 1+680 and between STA 1+840 and 2+000 Rock excavation may also be needed for wall foundation excavation between STA 1+630 and 1+670 The quantity of rock excavation will probably be small, but a pay item should be included in the estimate for rock excavation We recommend that the contractor conduct pre and post-blast surveys in accordance with industry standards if blasting is required for highway or drainage construction

4 3 5 Embankment Fill Area

Embankment filling will be necessary to widen the highway and correct a sight distance deficiency between approximate STA 1+180 and 1+320 Existing embankment fill in this area ranges from 0 5 to 2 5 m (1 6 to 8 2 ft) in depth We conducted explorations through the existing fill at STA 1+234 and found very loose to medium dense sands and gravels

The existing embankment slopes are covered with brush and other vegetation and were constructed at about 1 5 1 to 2 1 (H V) We did not observe any obvious evidence of slope instability or movement

These slopes as well as other embankment slopes that are created or extended as part of the reconstruction and widening effort should be designed as earth fill slopes no steeper than 2 1 (H V) We recommend that embankment fill below the pavement section consist of MaineDOT 703 18 common borrow We also recommend that all new embankment fill be thoroughly and systematically compacted to the full limit of the slope Where new fill slope extensions are constructed over existing slopes, we recommend benching the existing fill slope soils in

accordance with MaineDOT Standard Specification 203 09, Preparation of Embankment Area, to prevent creation of a preferential slip plane under the new embankment fill

The new embankment fill loads and densification of the fill materials during construction will result in ground surface settlement and consolidation of the underlying soils We have estimated that up to 50 mm (2 in) of settlement will occur as a result of embankment construction We expect that most of this settlement will occur during and immediately after construction of the embankment Nevertheless, the repair or replacement design for the box culvert at approximate STA 1+223 must accommodate the anticipated settlement Post-construction settlement is expected to be minimal

4 3 6 Cut Areas

We anticipate that soil backslope cuts may be required at several locations including approximate STA 1+630 and 1+670 and STA 1+920 which rise from behind the sidewalk into existing cut slopes We expect that cut slopes designed at 2 1 (H V) or flatter should be stable from a global stability standpoint However, since the anticipated slope soils are marine sand, sandy silt or clay-silt, surficial sloughing may occur on these slopes Consequently, we recommend that erosion control measures be taken to protect them

The length of the cut slope between STA 1+630 and 1+670 may be shortened to reduce ROW impacts by constructing an earth retaining structure General soil conditions and wall recommendations are discussed in Section 4 4, Retaining Wall Recommendations

4.4 Retaining Wall Recommendations

4 4 1 General

All retaining walls should be designed in accordance with the 2002 AASHTO Specifications for Highway Bridges, Section 5 Each wall must also satisfy internal stability Factor of Safety (FS) requirements for sliding, overturning, etc , as described in AASHTO and the Special Provisions in Appendix E We evaluated bearing capacity and potential settlement for the walls as appropriate and summarize the results below and in Appendix D, Calculations

After excavation for the wall foundation is complete, the contractor should recompact the subgrade If weak or unsuitable soils are present at the planned wall subgrade level, we recommend over-excavating 600 mm (2 ft) of the soil and replacing it with compacted 703 20 Gravel Borrow The gravel borrow should be compacted to 95 percent of the T-180 maximum dry density Specific recommendations for the wall systems are described below

4 4 2 Highway Retaining Wall

As a result of the widening project, a retaining wall will be constructed between STA 1+630 and 1+670 The retaining wall will provide grade separation between the highway and adjacent property, improve site distance, and minimize ROW impacts

Based on our analysis we predict that total settlement will be negligible and will, for the most part, occur as the walls are constructed A maximum contact bearing pressure of 3 ksf (144 kPa) over a properly prepared subgrade will satisfy bearing capacity requirements

We recommend that the contractor provide a supplier designed Prefabricated Concrete Block Gravity Retaining Wall that conforms to our recommendations, AASHTO specifications, and the Special Provisions in Appendix E

4.5 Erosion Control Recommendations

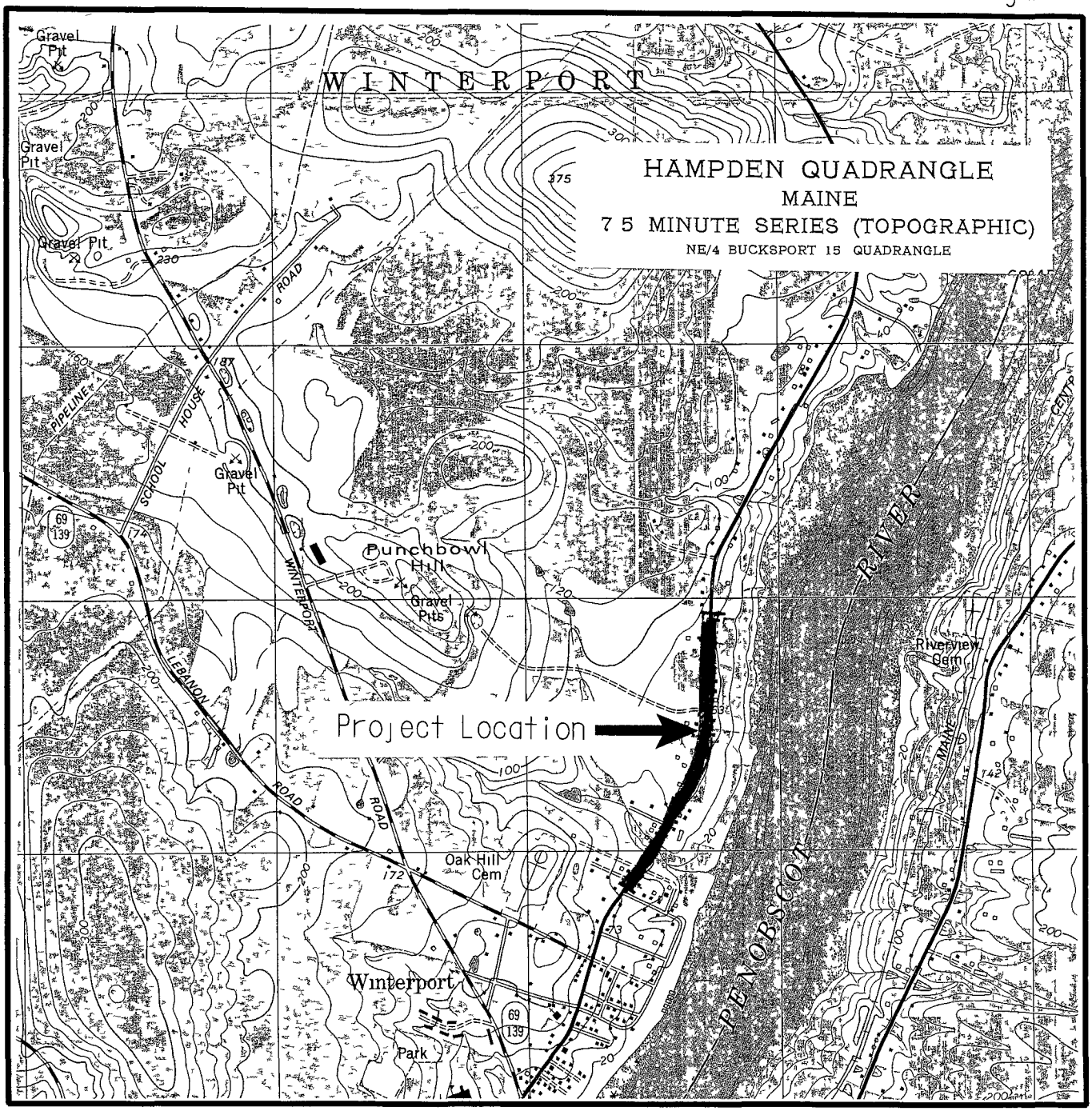
The fine-grained soils along the project are susceptible to erosion We recommend using appropriate erosion control measures during construction as described in the MaineDOT Best Management Practices guidelines

APPENDIX - A

Figures

Location Map

Figure 1



Winterport, Maine, Route 1A Reconstruction, PIN. 2762.60

1 5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

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1 24000, 1"= 2000', 1 cm = 240 m

METRIC
1 All dimensions are in millimeters unless otherwise noted
2 All elevations and stations are in meters

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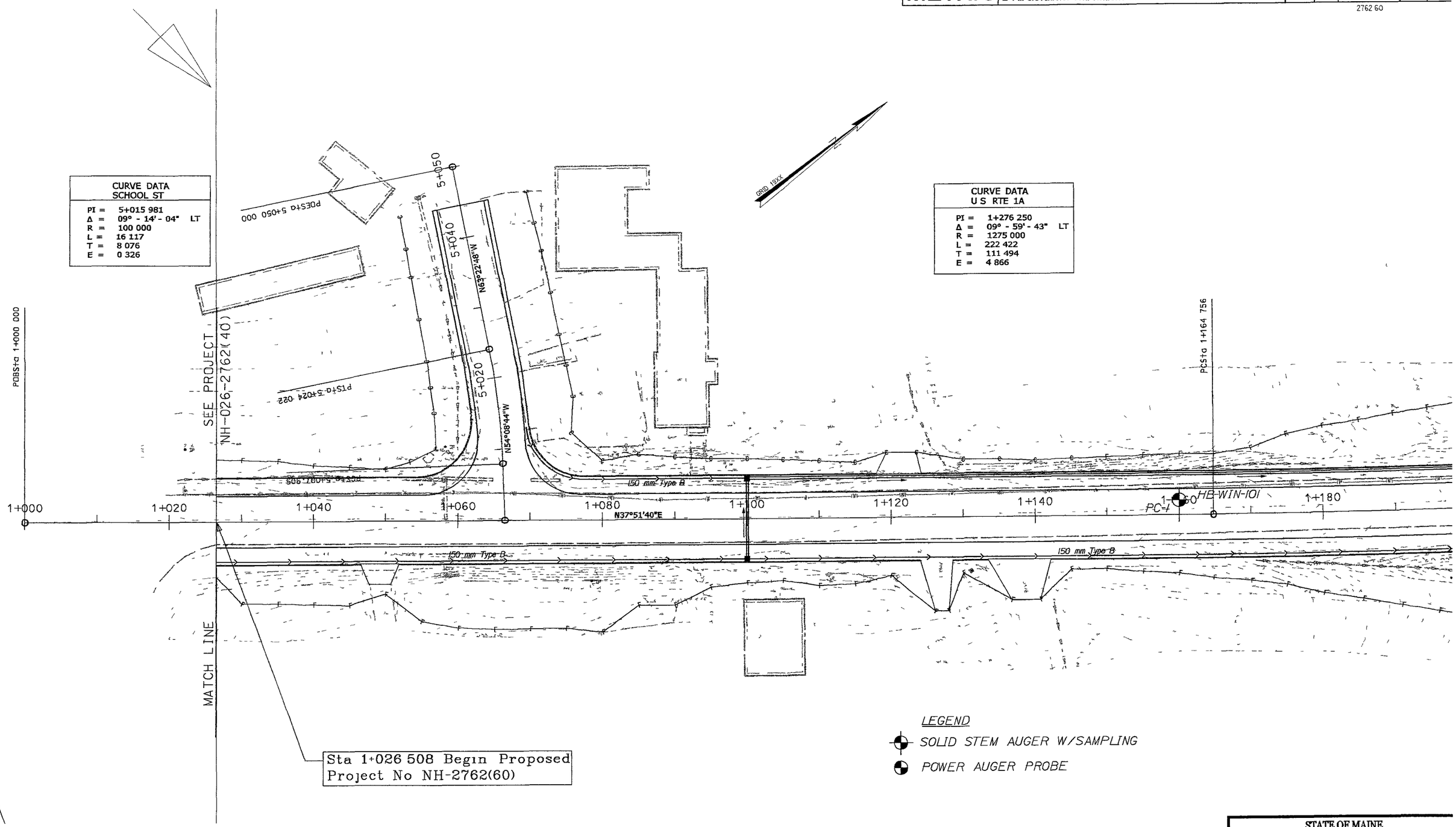
2762 60



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WINTERPORT

ROUTE 1A

SCALE

PLANS

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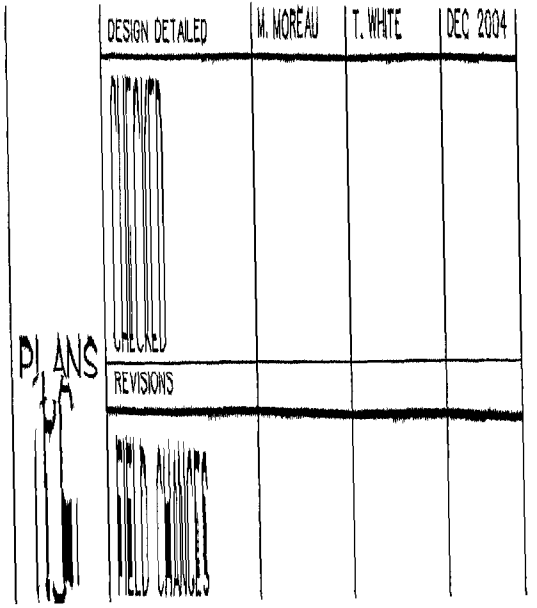
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L =	222 422
T =	111 494
E =	4 866

2762 500	
Δ =	
R =	1275 000
L =	222 422
T =	111 494
E =	4 866

GRID 19XX

PTSta 1+387 178

150 mm Type B

HB-WIN-103

HB-WIN-102

1+200 1+220 1+240 1+260 1+280 1+300 1+320 1+340 1+360 1+380

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WINTERPORT

ROUTE 1A

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METRIC 1 All dimensions are in millimeters unless otherwise noted
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2762 60

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L =	222 422
T =	111 494
E =	4 866

GRID 19XX

PTS±a 1+387 178

150 mm Type B

150 mm Type B

150 mm Type B

1+380 1+400 1+420 1+440 1+460 1+480 1+500 1+520 1+540 1+560

HB-WIN-104

HB-WIN-105

HB-WIN-106

N27°51'58"E

N27°51'58"E

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ROUTE 1A

METRIC 1 All dimensions are in millimeters unless otherwise noted
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FHWA REG. NO.	STATE	PROJECT NUMBER	SHEET NO	TOTAL SHEETS
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2762 60

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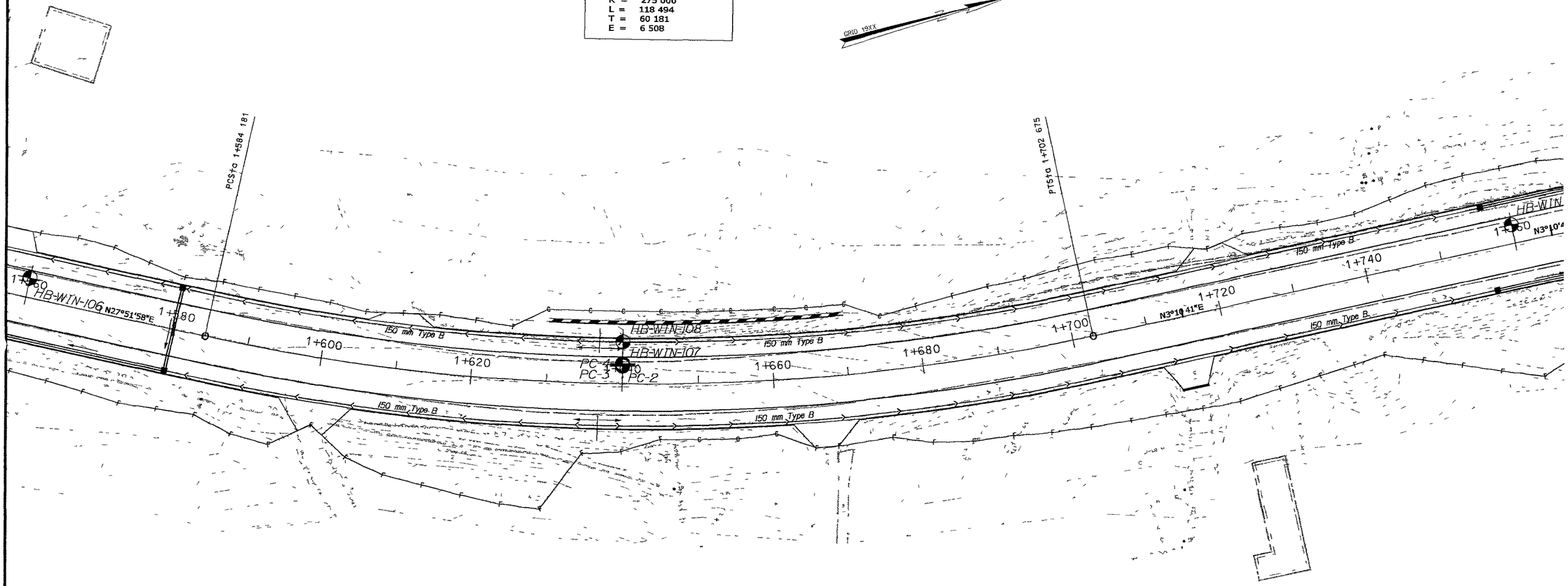

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ROUTE 1A

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METRIC

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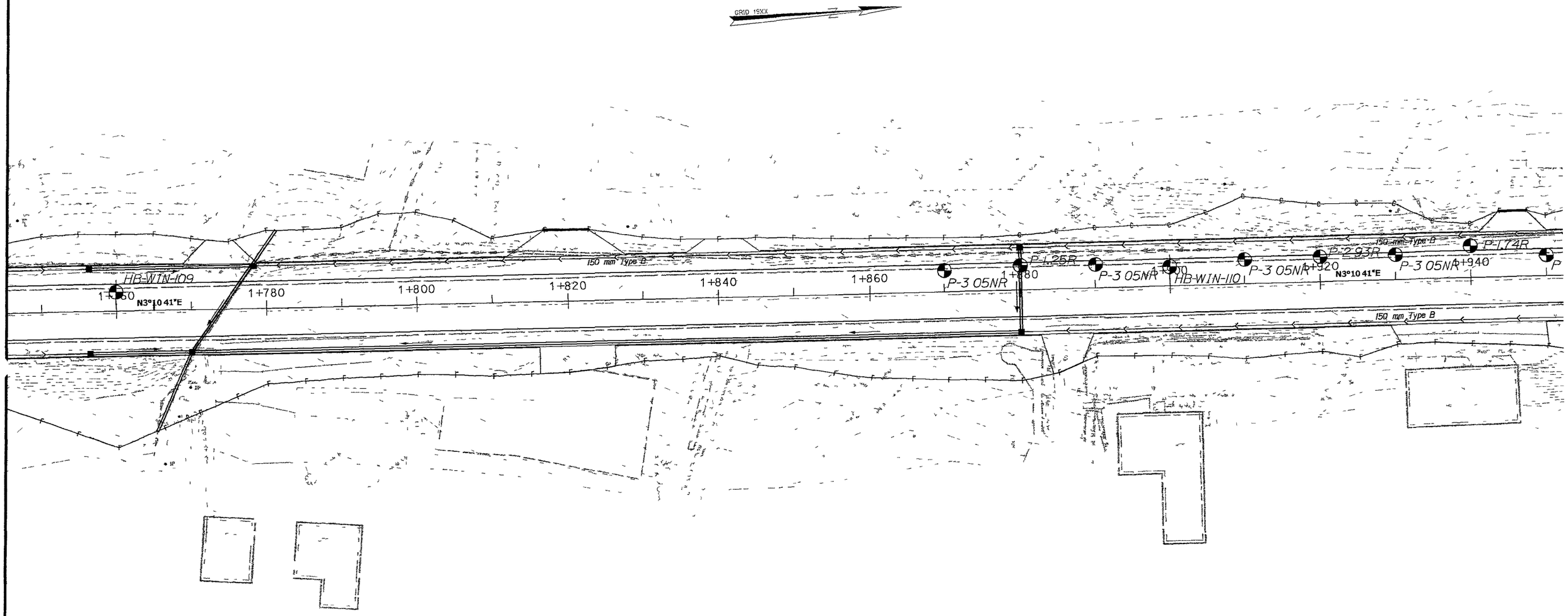

PLANS

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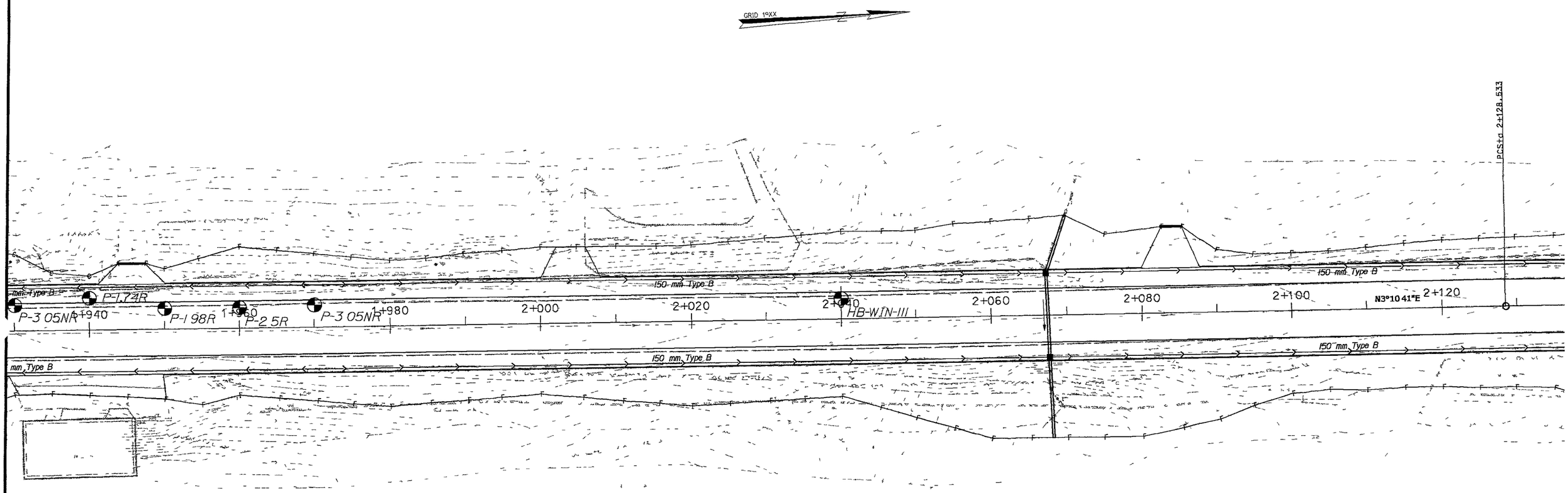

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PLANS

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

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WINTERPORT

ROUTE 1A

METRIC	1 All dimensions are in millimeters unless otherwise noted 2 All elevations and stations are in meters	F.H.W.A. REGN. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
		1	MAINE	NH-2762(60)	7	8

2762 60

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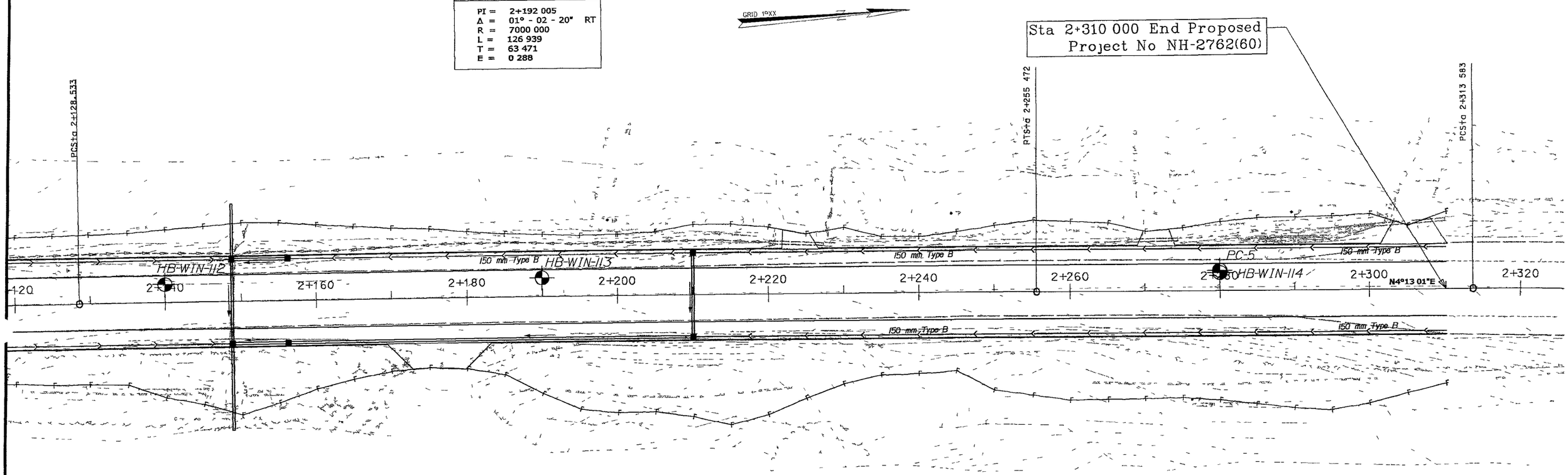
L =	126 939
T =	63 471
E =	0 288



PLANS

CHECKED	
REVISIONS	
FIELD CHANGES	

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

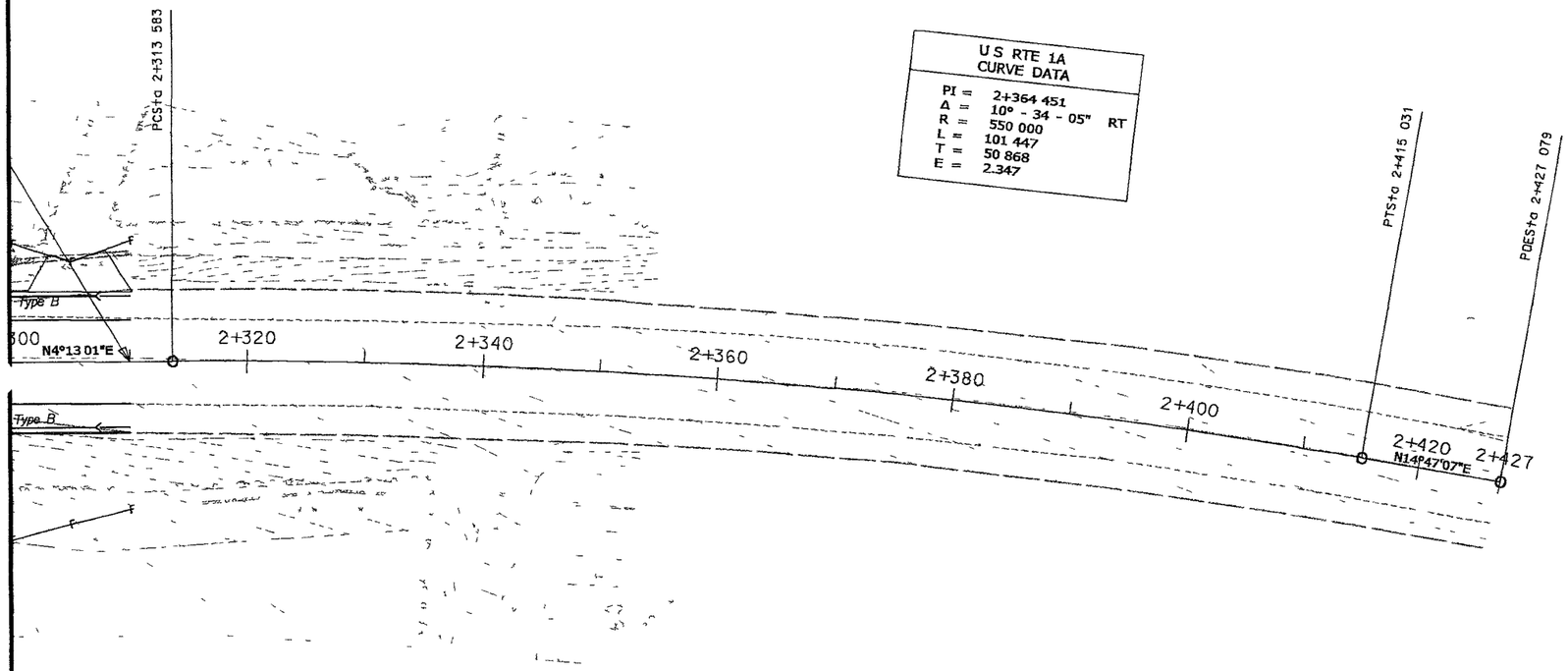
GEOPLANS

WINTERPORT

ROUTE 1A

METRIC	1 All dimensions are in millimeters unless otherwise noted 2 All elevations and stations are in meters	F.H.W.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO	TOTAL SHEETS
		1	MAINE	NH-2762(60) 2762 60	8	8

GRID 19XX



US RTE 1A CURVE DATA	
PI =	2+364 451
Δ =	10° - 34 - 05" RT
R =	550 000
L =	101 447
T =	50 868
E =	2.347

PLAN	DESIGN DETAILED	DEC 2004
	CHECKED	T WHITE
	REVISIONS	M MOREAU
	FIELD CHANGES	

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

GEOPLANS

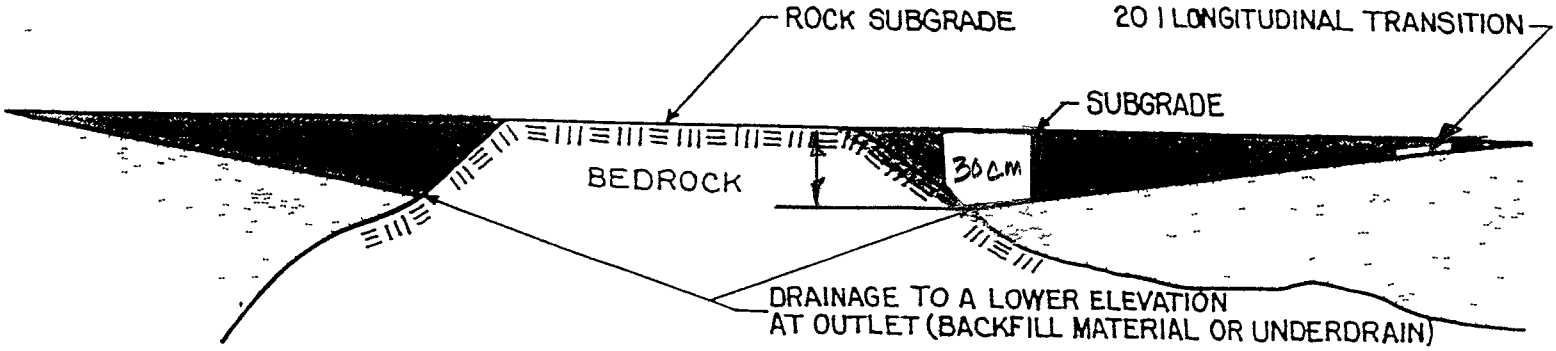
WINTERPORT

ROUTE 1A

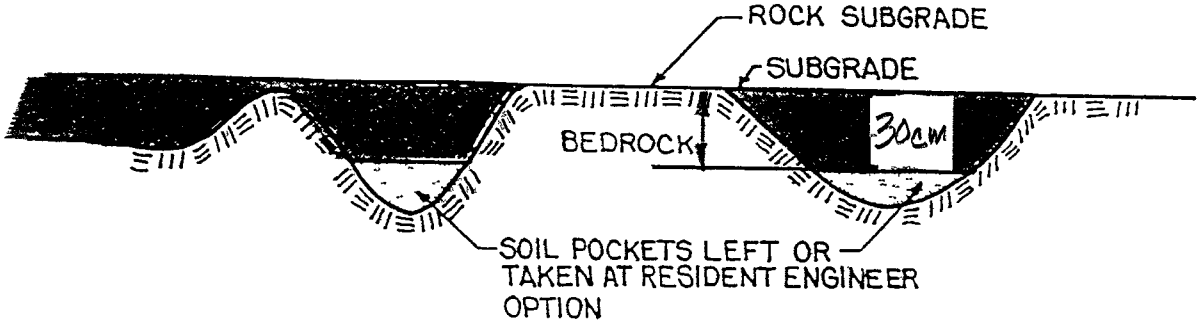
5 0 5 10

PROFILE OF UNDERCUT OF FROST SUSCEPTIBLE SOILS OVER LEDGE

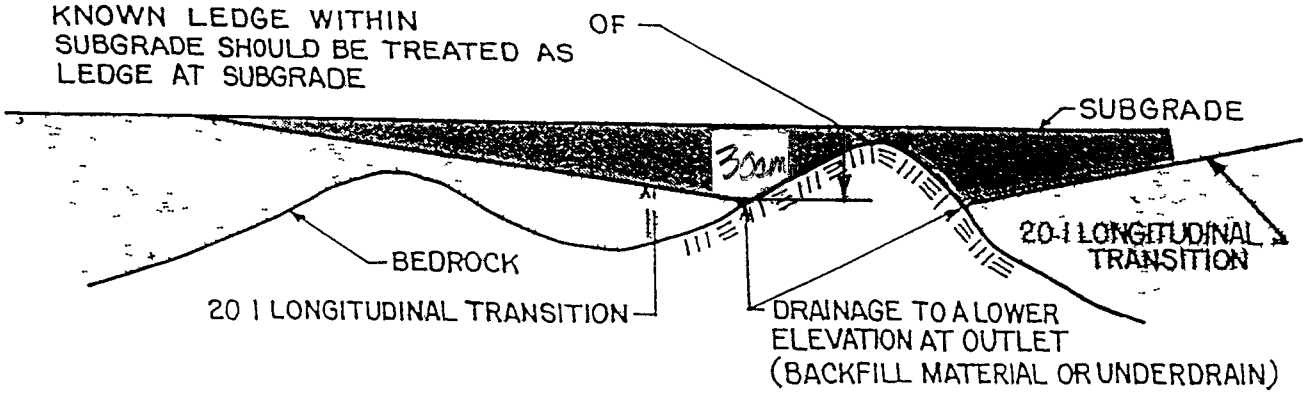
CONDITION 1



CONDITION 2



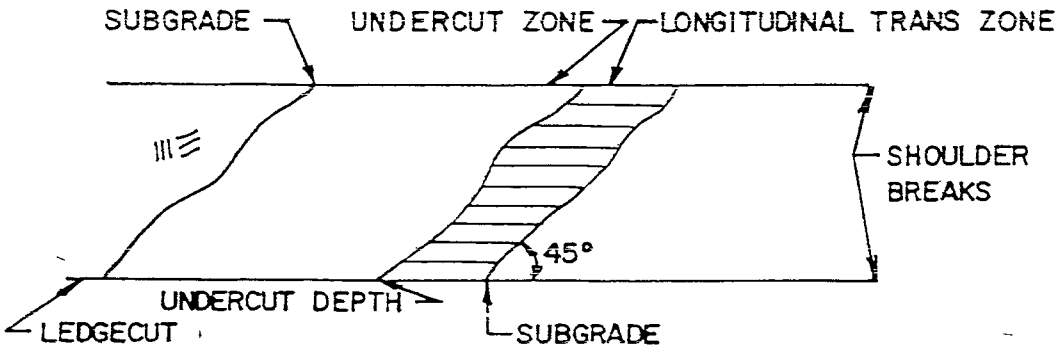
CONDITION 3

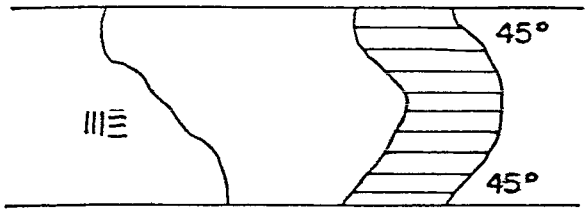


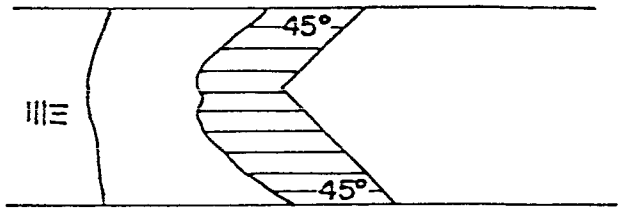
IF A SOIL SECTION BETWEEN LEDGE SUBGRADE IS OF SUCH LENGTH THAT THE TRANSITION FROM EACH EDGE WOULD MEET IT SHOULD BE TREATED AS AN EARTH POCKET

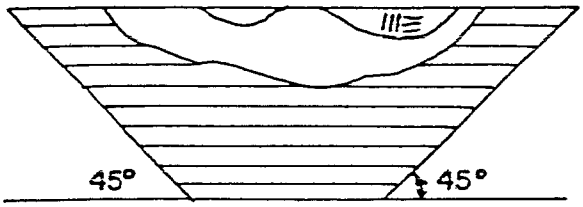
FROST SUSCEPTIBLE SOIL TO BE UNDERCUT AND REPLACED WITH NON FROST SUSCEPTIBLE MATERIAL

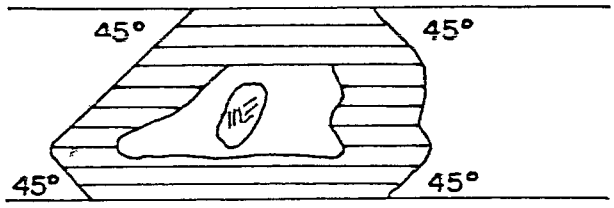
FROST SUSCEPTIBLE SOIL

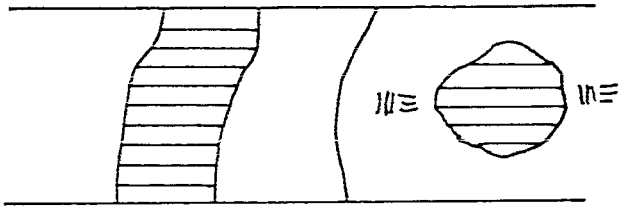












PLAN VIEW OF UNDERCUT OF FROST SUSCEPTIBLE SOILS OVER BEDROCK WITHIN THE FROST PENETRATION ZONE.

NOTE: THE UNDERCUT SHOULD BE FROM SHOULDER BREAK TO SHOULDER BREAK AND FROM THE LONGITUDINAL EXTREMETIES OF THE LEDGE AT THE UNDERCUT DEPTH, PARALLEL TO THIS LEDGE DEPTH AND/OR ON AN ANGLE OR ANGLES NOT LESS THAN 45° FROM ℄

APPENDIX - B

Field Exploration and Test Data

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project	Route 1A	**Boring No**	HB-WIN-101
Location	Winterport Maine	**PIN**	2762 60

Driller	MDOT	**Elevation (m)**	16 30	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	11/24/03-11/24/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+160 2 1 Lt	**Casing ID/OD**	N/A	**Water Level***	2 04 m bgs

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	16 19		PAVEMENT	
	1D	17 8/12 7	0 15 - 0 33	29/25(25)	- -		16 09		0 11	
							15 93		Brown damp sandy GRAVEL trace silt (Fill)	
									0 21	
							15 60		MACADAM	
									0 37	
	2D	61 0/43 2	0 91 1 52	5/6/8/11	14				Brown damp sandy GRAVEL trace silt (Fill)	G#176376 A 7 6 CL WC=28 8 LL=44 PL=23 PI=21
1 2									0 70	
									Brown moist stiff CLAY some silt trace sand (Glaciomarine)	
	3D/AB	61 0/53 3	1 52 2 13	4/5/8/10	13				(3D/A) 1 52 2 04 m bgs	
							14 26		2 04	
2 4							14 17		(3D/B) 2 04 2 13 m bgs Brown wet medium dense silty fine to coarse SAND little gravel (Moraine? Till?)	
									2 13	
3 6									**Bottom of Exploration at 2 13 m below ground surface** No Refusal	
4 8										
6										
7 2										
8 4										
9 6										

Remarks

See PC-1 Boring Log

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

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

Boring No HB-WIN-101

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-102
PIN 2762 60

Driller	MDOT	**Elevation (m)**	14 00	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	11/25/03-11/25/03	**Drilling Method**	Cased Washboring	**Core Barrel**	N/A
Boring Location	1+234 6 2 Rt	**Casing ID/OD**	HW	**Water Level***	2 89 m bgs

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0	1D	61 0/25 4	0 00 0 61	1/2/4/5	6	SSA			Brown moist loose fine to coarse SAND some gravel trace to little silt (Fill)	G#176378 A 1 b SW SM WC=8 5%
	2D	61 0/15 2	0 76 1 37	1/2/3/1	5					G#176377 A 1 b SW SM WC=7 9%
1 2										
	3D	61 0/7 6	1 52 2 13	1/1/1/5	2		12 48		1 52 Brown moist very loose silty fine to coarse SAND little gravel (Fill)	
2 4							11 56		2 44 Olive to grey wet loose silty fine to medium SAND trace gravel trace organics	
	4D/AB	61 0/30 5	3 05 3 66	2/3/2/4	5	15			(4D/A) 3 05 3 51 m bgs	
						16	10 49		3 51 (4D/B) 3 51 3 66 m bgs Grey wet loose medium to coarse SAND trace gravel	
3 6						21				
						27				
						22	9 43		4 57 Brown wet medium dense silty fine to medium SAND trace coarse sand little gravel (Till)	G#176382 A 4 SM WC=16 3%
	5D	61 0/22 9	4 57 5 18	7/16/7/4	23	18				
4 8						23				
						35				
						137				
6						110				
						WASH	7 87		Washed ahead from 6 13 6 19 m bgs	
							7 81		6 13 Weathered ROCK	
									6 19 **Bottom of Exploration at 6 19 m below ground surface** Refusal	
7 2										
8 4										
9 6										

Remarks

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

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

Boring No HB-WIN-102

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-103
PIN 2762 60

Driller	MDOT	**Elevation (m)**	19 30	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	11/24/03-11/24/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+360 2 5 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA				
	1D	61 0/25 4	0 21 0 82	17/9/5/5	14		19 12		PAVEMENT — 0 18 Dark brown medium dense treated sandy GRAVEL trace silt (Fill)	
	2D	61 0/48 3	0 91 1 52	5/11/13/17	24		18 23		— 1 07 Brown moist very stiff clay silt trace fine sand (Glaciomarine)	
1 2									(3D/A) 1 52 1 98 m bgs	
	3D/AB	61 0/55 9	1 52 2 13	5/9/12/17	21					
							17 32		— 1 98	
							17 17		(3D/B) 1 98 2 13 m bgs Brown damp medium dense silty fine to coarse SAND little gravel (Till? Moraine?)	
2 4									— 2 13 **Bottom of Exploration at 2 13 m below ground surface** No Refusal	
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No HB-WIN-103

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-104
PIN 2762 60

Driller	MDOT	**Elevation (m)**	19 40	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	11/24/03 11/24/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+400 2 6 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	19 23		PAVEMENT — 0 17	
	1D	17 8/12 7	0 21 0 39	35/25(25)	-		19 13		Dark brown sandy GRAVEL little silt (Fill) — 0 27	
							19 03		MACADAM — 0 37	
	2D	61 0/61 0	0 76 1 37	3/4/6/10	10		18 85		Brown damp sandy GRAVEL trace silt (Fill) — 0 55	G#176379 A 7 6 CL WC=28 8% LL=42 PL=26 PI=16
1 2									Brown moist stiff silty CLAY trace sand and gravel — 1 37	
	3D/AB	61 0/38 1	1 52 2 13	4/6/8/11	14		18 03		Brown moist stiff clay SILT (Glaciomarine) (3D/A) 1 52 1 98 m bgs — 1 98	
2 4							17 42		(3D/B) 1 98-2 13 m bgs	
							17 27		Brown moist silty fine to coarse SAND (Till? Moraine?) — 2 13	
3 6									**Bottom of Exploration at 2 13 m below ground surface**	
									No Refusal	
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No HB-WIN-104

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project	Route 1A	**Boring No.**	HB-WIN-105
Location	Winterport Maine	**PIN**	2762 60

Driller	MDOT	**Elevation (m)**	20 90	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	11/24/03-11/24/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+500 2 7 Rt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample Information: Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	20 72		PAVEMENT	
	1D	15 2/10 2	0 30 0 46	32/25(0)			20 53		Dark brown damp sandy GRAVEL little silt (Fill) — 0 18	
							20 44		MACADAM — 0 37	
									0 46	
12									**Bottom of Exploration at 0 46 m below ground surface**	
									Spoon and Auger Refusal	
24										
36										
48										
6										
72										
84										
96										

Remarks

Strong petroleum type odor in this boring

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

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

Boring No HB-WIN-105

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project	Route 1A	**Boring No ·**	HB-WIN-106
Location	Winterport Maine	**PIN**	2762 60

Driller	MDOT	**Elevation (m)**	21 50	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	11/24/03-11/24/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+560 2 6 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_V = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample Information: Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	21 30		PAVEMENT	
	1D	20 3/12 7	0 24 0 45	43/50(50)	-				0 20	
							21 26		Dark brown damp sandy GRAVEL little silt (Fill)	
							21 04		0 24	
							20 89		MACADAM	
	2D/AB	61 0/35 6	0 76 1 37	9/7/6/8	13				0 46	
1 2							20 59		COBBLES	
									0 61	
									Brown damp medium dense sandy GRAVEL trace silt (Fill)	
							20 13		(2D/A) 0 76 0 91 m bgs	
	3D/AB	61 0/40 6	1 52 2 13	7/16/21/23	37				0 91	
									(2D/B) 0 91 1 37 m bgs	
							19 61		Olive moist stiff SILT (Glaciomarine)	
									1 37	
2 4							19 37		Brown damp hard clay SILT (Glaciomarine)	
									(3D/A) 1 52 1 89 m bgs	
									1 89	
									(3D/B) 1 89 2 13 m bgs	
									Brown damp dense silty fine to coarse SAND trace gravel (Till)	
									2 13	
3 6									**Bottom of Exploration at 2 13 m below ground surface**	
									No Refusal	
4 8										
6										
7 2										
8 4										
9 6										

Remarks

Strong petroleum type odor in this boring

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

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

Boring No HB-WIN-106

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-107
PIN 2762 60

Driller	MDOT	**Elevation (m)**	22 00	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	11/24/03-11/24/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+640 2 7 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_V = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	21 83		PAVEMENT	
	1D/AB	61 0/33 0	0 18 0 79	13/7/8/9	15		21 76		0 17	
							21 60		MACADAM (1D/A) 0 18 0 40 m bgs	G#176381 A-2 4 SM WC=16 2%
	2D	61 0/45 7	0 79 1 40	3/2/2/7	4		21 24		0 24 Brown damp medium dense silty fine to coarse SAND little gravel (Fill)	G#176380 A 4 SM WC=20 9%
1 2									0 40 (1D/B) 0 40 0 79 m bgs Brown moist medium dense fine SAND trace medium to coarse sand and gravel some silt	
	3D/AB	34 0/25 4	1 52 1 86	4/19/25(25)			20 29		0 76	
2 4							20 14 20 11		Brown moist loose silty fine SAND tr ace medium to coarse sand and gravel (Till? Moraine?) (3D/A) 1 52 1 71 m bgs	
									1 71 (3D/B) 1 71 1 86 m bgs Brown damp silty fine to coarse SAND little gravel (Till? Moraine?)	
3 6									1 86 Weathered ROCK	
									1 89 **Bottom of Exploration at 1 89 m below ground surface** Refusal	
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No HB-WIN-107

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-108
PIN 2762 60

Driller	MDOT	**Elevation (m)**	22 40	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	12/2/03 12/2/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+640 5 6 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0	1D/AB	61 0/27 9	0 00 0 61	1/2/3/4	5	SSA	22 10		(1D/A) 0 0 0 30 m bgs Dark brown moist loose silty fine to coarse SAND little gravel and silt trace organics (Topsoil) 0 30	G#176384 A-1 b SP SM WC=17 3%
	2D	61 0/48 3	0 76 1 37	7/10/6/6	16		21 64		(1D/B) 0 30 0 61 m bgs Brown damp medium stiff sandy SILT little gravel (Till? Morune?) 0 76	G#176385 A 4 SM WC=15 0%
1 2	3D	25 4/20 3	1 52 1 78	9/50(100)	-		20 88		Brown wet, medium dense silty fine to medium SAND trace gravel (Till? Morune?) 1 52 Brown wet fine to coarse SAND some gravel and silt occasional cobbles (Till)	G#176383 A 2 4 SM WC=9 3%
2 4	4D	30 5/22 9	2 29 2 59	14/50			19 81		**Bottom of Exploration at 2 59 m below ground surface** Spoon and Auger Refusal 2 59	
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No HB-WIN-108

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project	Route 1A	**Boring No**	HB-WIN-109		
Location	Winterport Maine	**PIN**	2762 60		
Driller	MDOT	**Elevation (m)**	20 10	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	11/24/03 11/24/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+760 2 5 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_V = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	19 90		PAVEMENT	
		61 0/33 0	0 37 0 98	26/40/14/13	54		19 82		0 20 Dark brown very dense sandy GRAVEL little silt (Fill)	G#176387 A 1 a GW GM WC=3 4%
	1D/AB						19 73		0 27 MACADAM	
							19 49		0 37	
	2D	61 0/45 7	0 91 1 52	2/4/6/6	10		19 18		(1D/A) 0 30 0 61 m bgs Brown damp very dense sandy GRAVEL little silt (Fill)	G#176386 A 2 4 SM WC=9 0%
1 2									0 61 (1D/B) 0 61 0 91 m bgs Brown moist, very dense fine to coarse SAND, little gravel some silt	
	3D/AB	61 0/40 6	1 52 - 2 13	2/5/11/15	16		18 27		0 91	G#176389 A 4 CL WC=19 3% LL=25 PL=16 PI=9
2 4							17 96		Brown moist, stiff clayey SILT some sand trace gravel (Till? Moraine?) (3D/A) 1 52 1 83 m bgs 1 83 (3D/B) 1 83 2 13 m bgs Brown moist medium dense silty fine to coarse SAND little gravel (Till) 2 13	
3 6									**Bottom of Exploration at 2 13 m below ground surface** No Refusal	
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No HB-WIN-109

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-110
PIN 2762 60

Driller	MDOT	**Elevation (m)**	23 10	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	12/2/03 12/2/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	1+900 2 5 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	22 95		PAVEMENT	
	1D/AB	61 0/33 0	0 15 0 76	18/30/22/7	52		22 80		0 15 MACADAM Strong Odor (1D/A) 0 15 0 30 m bgs	G#176390 A 2 4 SM WC=11 9%
									0 30 (1D/B) 0 30 0 76 m bgs Brown moist, very dense to medium dense fine to coarse SAND some silt trace gravel (Till)	
1 2	2D	61 0/38 1	0 91 1 52	3/4/10/9	14					
	3D	61 0/55 9	1 52 2 13	8/8/16/17	24		21 58		1 52 Similar to above with occasional cobbles (Till)	
2 4										
3 6							20 05		3 05 **Bottom of Exploration at 3 05 m below ground surface** No Refusal	
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No. HB-WIN-110

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-111
PIN 2762 60

Driller	MDOT	**Elevation (m)**	22 90	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	12/2/03-12/2/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	2+040, 2 7 Rt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	22 77		PAVEMENT	
	1D/AB	43 2/35 6	0 15 0 58	35/32/50(100)			22 66		0 13	G#176388 A 1 a GW GM WC=4 9%
									MACADAM Strong Odor (1D/A) 0 15 0 24 m bgs	
							22 32		0 24	
	2D	61 0/50 8	0 76 1 37	10/12/9/9	21		22 17		(1D/B) 0 24 0 58 m bgs Brown damp sandy GRAVEL little silt (Fill)	
1 2									0 58	
									COBBLE	
	3D	61 0/40 6	1 52 2 13	6/8/17/29	25				0 73	
									Brown moist, very stiff sandy SILT little gravel occasional cobbles (Till)	
							20 77		2 13	
2 4									**Bottom of Exploration at 2 13 m below ground surface** No Refusal	
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-112
PIN 2762 60

Driller	MDOT	**Elevation (m)**	22 00	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	12/2/03-12/2/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	2+140 2 4 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	21 90		PAVEMENT	
	1D	30 5/17 8	0 15 0 46	27/52			21 82		0 10	
							21 70		Dark brown sandy GRAVEL trace silt	
									0 18	
							21 33		MACADAM	
	2D/AB	61 0/33 0	0 76 1 37	3/37/13/10	50				0 30	
1 2							21 09		Brown damp sandy GRAVEL cobbles trace silt	
									0 67	
									Brown moist hard SILT trace gravel trace clay (Till? Moraine?) (2D/A) 0 76 0 91 m bgs	
	MD	2 5/0 0	1 52 1 55	25(0)					0 91	
									(2D/B) 0 91 1 37 m bgs Brown moist dense silty fine to medium SAND cobbles little gravel (Till)	
2 4							19 87		2 13	
									Bottom of Exploration at 2 13 m below ground surface No Refusal	
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No. HB-WIN-113
PIN 2762 60

Driller	MDOT	**Elevation (m)**	22 30	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	12/2/03 12/2/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	2+190 2 5 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA	22 18		PAVEMENT 0 12	
	1D/AB	61 0/38 1	0 15 0 76	14/25/27/16	52		22 02		MACADAM 0 27	G#176392 A 1 a GW GM WC=5 8%
							21 69		(1D/A) 0 27 0 61 m bgs Brown moist sandy GRAVEL trace silt (Fill) 0 61	
	2D	61 0/25 4	0 76 1 37	5/6/6/8	12				(1D/B) 0 61 0 76 m bgs Brown moist medium dense fine to coarse SAND some gravel and silt (Till? Moraine?)	G#176391 A 2 4 SM WC=9 5%
1 2							20 78		1 52	
	3D	61 0/35 6	1 52 2 13	11/14/38/25	52				Brown damp very dense silty fine to medium SAND trace coarse sand little gravel (Till? Moraine?)	
							20 17		2 13	
2 4									**Bottom of Exploration at 2 13 m below ground surface** No Refusal	
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No HB-WIN-113

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No HB-WIN-114
PIN 2762 60

Driller	MDOT	**Elevation (m)**	23 90	**Auger ID/OD**	125 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Standard Split Spoon
Logged By	G Lidstone	**Rig Type**	CME 45C	**Hammer Wt /Fall**	63 5 kg/760 mm
Date Start/Finish	12/2/03 12/2/03	**Drilling Method**	Solid Stem Auger	**Core Barrel**	N/A
Boring Location	2+280 2 4 Lt	**Casing ID/OD**	N/A	**Water Level***	None Observed

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0						SSA				
	1D/AB	61 0/25 4	0 24 0 85	22/25/27/23	52		23 66		PAVEMENT 0 24	
							23 29		(1D/A) 0 24 0 61 m bgs Dark brown treated damp very dense sandy GRAVEL trace silt (Fill)	G#176393 A 2 4 SM WC=8 6%
							23 05		0 61	
	2D/AB	61 0/40 6	0 91 1 52	10/9/4/3	13		22 77		(1D/B) 0 61 0 85 m bgs Olive damp very dense fine to coarse sand some silt little gravel (Till? Moraine?)	
1 2									0 85	
	3D	61 0/40 6	1 52 2 13	8/10/11/13	21		22 38		Grey brown damp medium dense silty fine to coarse SAND little gravel (Till? Moraine?) (2D/A) 0 91 1 13 m bgs	
							21 77		1 13	
2 4									(2D/B) 1 13 1 52 m bgs Brown wet medium dense silty fine SAND trace medium sand (Till? Moraine?)	
									1 52	
3 6									Brown moist medium dense silty fine to medium SAND little gravel (Till)	
									2 13	
4 8									**Bottom of Exploration at 2 13 m below ground surface** No Refusal	
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No HB-WIN-114

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project	Route 1A	**Boring No**	PC-1
Location	Winterport Maine	**PIN**	2762 60

Driller	MDOT	**Elevation (m)**	16 30	**Auger ID/OD**	62 5 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Coring Machine
Logged By	G Lidstone	**Rig Type**	N/A	**Hammer Wt /Fall**	N/A
Date Start/Finish	11/25/03 11/25/03	**Drilling Method**	Coring Machine	**Core Barrel**	N/A
Boring Location	1+160 2 1 Lt	**Casing ID/OD**	N/A	**Water Level***	N/A

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 (kPa)
T_V = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample Information: Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0	PC1					CORE	16 19		PAVEMENT	
									0 11	
									Bottom of Exploration at 0 11 m below ground surface	
1 2										
2 4										
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project	Route 1A	**Boring No**	PC-2
Location	Winterport Maine	**PIN**	2762 60

Driller	MDOT	**Elevation (m)**	22 00	**Auger ID/OD**	62 5 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Coring Machine
Logged By	G Lidstone	**Rig Type**	N/A	**Hammer Wt /Fall**	N/A
Date Start/Finish	11/25/03-11/25/03	**Drilling Method**	Coring Machine	**Core Barrel**	N/A
Boring Location	1+640, 2 0 Lt	**Casing ID/OD**	N/A	**Water Level***	N/A

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 (kPa)
T_V = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample Information: Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0	PC1					CORE	21 83 21 76		PAVEMENT 0 17 MACADAM 0 24 **Bottom of Exploration at 0 24 m below ground surface**	
1 2										
2 4										
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

Only the top 50 mm in 3 attemps of pavement was recovered the rest was ground up and washed away

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
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No PC-3
PIN 2762 60

Driller	MDOT	**Elevation (m)**	22 00	**Auger ID/OD**	62 5 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Coring Machine
Logged By	G Lidstone	**Rig Type**	N/A	**Hammer Wt /Fall**	N/A
Date Start/Finish	11/25/03 11/25/03	**Drilling Method**	Coring Machine	**Core Barrel**	N/A
Boring Location	1+640 2 3 Lt	**Casing ID/OD**	N/A	**Water Level***	N/A

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample Information: Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0	PC1					CORE	21 83 21 76		PAVEMENT 0 17 MACADAM 0 24 **Bottom of Exploration at 0 24 m below ground surface**	
1 2										
2 4										
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No PC-3

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project	Route 1A	**Boring No**	PC-4
Location	Winterport Maine	**PIN**	2762 60

Driller	MDOT	**Elevation (m)**	22 00	**Auger ID/OD**	62 5 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Coring Machine
Logged By	G Lidstone	**Rig Type**	N/A	**Hammer Wt /Fall**	N/A
Date Start/Finish	11/25/03-11/25/03	**Drilling Method**	Coring Machine	**Core Barrel**	N/A
Boring Location	1+640 2 6 Lt	**Casing ID/OD**	N/A	**Water Level***	N/A

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample Information: Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0	PC1					CORE	21 83 21 76		PAVEMENT — 0 17 MACADAM — 0 24 **Bottom of Exploration at 0 24 m below ground surface**	
1 2										
2 4										
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

Boring No PC-4

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project Route 1A
Location Winterport Maine

Boring No PC-5
PIN 2762 60

Driller	MDOT	**Elevation (m)**	23 90	**Auger ID/OD**	62 5 mm
Operator	C Mann	**Datum**	NGVD	**Sampler**	Coring Machine
Logged By	G Lidstone	**Rig Type**	N/A	**Hammer Wt /Fall**	N/A
Date Start/Finish	11/25/03-11/25/03	**Drilling Method**	Coring Machine	**Core Barrel**	N/A
Boring Location	2+280 2 7 Lt	**Casing ID/OD**	N/A	**Water Level***	N/A

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 (kPa)
T_V = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

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

Depth (m)	Sample Information: Sample No	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
0	PC1					CORE	23 65		PAVEMENT 0 25	
									Bottom of Exploration at 0 25 m below ground surface	
1 2										
2 4										
3 6										
4 8										
6										
7 2										
8 4										
9 6										

Remarks

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

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

State of Maine - Department of Transportation

Power Auger Probe Summary Sheet

Town(s): Winterport Project Number: 2762.60

Station (Meter)	Offset (Meter)	Weathered Rock (Meter)	Refusal (Meter)	No Refusal (Meter)	Water Depth (m)	Comments / Date 12/1/2003
1+870	2 8 Lt			3 05		
1+880	3 2 Lt		1 25			0 21 m Pavement
1+890	3 1 Lt			3 05		0 152 m Pavement
1+900						Skipped
1+910	3 2 Lt			3 05		0 122 m Pavement
1+920	3 3 Lt		2 93			0 122 m Pavement
1+930	3 3 Lt			3 05		0 27 m Pavement
1+940	4 2 Lt		1 74			No Pavement
1+950	2 7 Lt		1 98		0 97	
1+960	2 7 Lt		2 5		0 85	
1+970	2 9 Lt			3 05	0 85	

APPENDIX - C

Laboratory Test Data

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Winterport Project Number: 2762.60

Boring & Sample Identification Number	Station (Meter)	Offset (Meter)	Depth (Meter)	Reference Number	G S D C Sheet	W C	L L	P I	Classification		
									Unified	AASHTO	Frost
HB-WIN-101, 2D	1+160	2 1 Lt	0 91-1 52	176376	1	28 8	44	21	CL	A-7-6	III
HB-WIN-102, 1D	1+234	6 2 Rt	0 0-0 61	176378	1	8 5			SW-SM	A-1-b	0
HB-WIN-102, 2D	1+234	6 2 Rt	0 76-1 37	176377	1	7 9			SW-SM	A-1-b	0
HB-WIN-102, 5D	1+234	6 2 Rt	4 57-5 18	176382	1	16 3			SM	A-4	III
HB-WIN-104, 2D	1+400	2 6 Lt	0 76-1 37	176379	1	28 8	42	16	CL	A-7-6	III
HB-WIN-108, 1D/A	1+640	5 6 Lt	0 0-0 30	176384	2	17 3			SP-SM	A-1-b	0
HB-WIN-108, 1D/B	1+640	5 6 Lt	0 30-0 61	176385	2	15 0			SM	A-4	III
HB-WIN-108, 3D	1+640	5 6 Lt	1 52-1 78	176383	2	9 3			SM	A-2-4	II
HB-WIN-107, 1D/B	1+640	2 7 Lt	0 40-0 79	176381	2	16 2			SM	A-2-4	III
HB-WIN-107, 2D	1+640	2 7 Lt	0 79-1 4	176380	2	20 9			SM	A-4	III
HB-WIN-109, 1D/A	1+760	2 5 Lt	0 30-0 61	176387	3	3 4			GW-GM	A-1-a	0
HB-WIN-109, 1D/B	1+760	2 5 Lt	0 61-0 91	176386	3	9 0			SM	A-2-4	II
HB-WIN-109, 2D	1+760	2 5 Lt	0 91-1 52	176389	3	19 3	25	9	CL	A-4	IV
HB-WIN-110, 1D/B	1+900	2 5 Lt	0 30-0 76	176390	3	11 9			SM	A-2-4	II
HB-WIN-111, 1D/B	2+040	2 7 Rt	0 24-0 58	176388	3	4 9			GW-GM	A-1-a	0
HB-WIN-113, 1D/A	2+190	2 5 Lt	0 27-0 61	176392	4	5 8			GW-GM	A-1-a	0
HB-WIN-113, 1D/B	2+190	2 5 Lt	0 61-0 76	176391	4	9 5			SM	A-2-4	II
HB-WIN-114, 1D/B	2+280	2 4 Lt	0 61-0 85	176393	4	8 6			SM	A-2-4	II

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 MDOT 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)

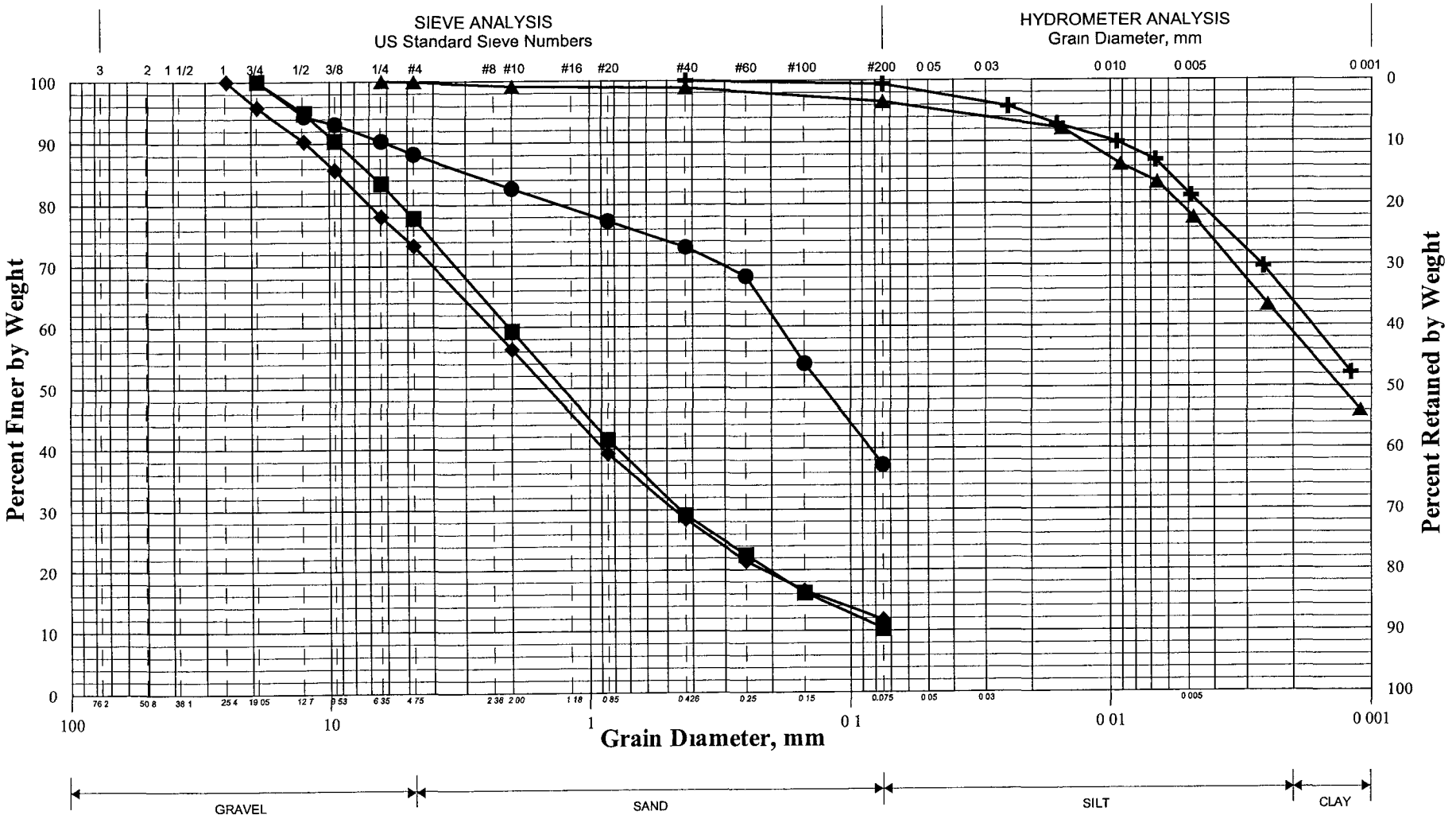
WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

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



UNIFIED CLASSIFICATION

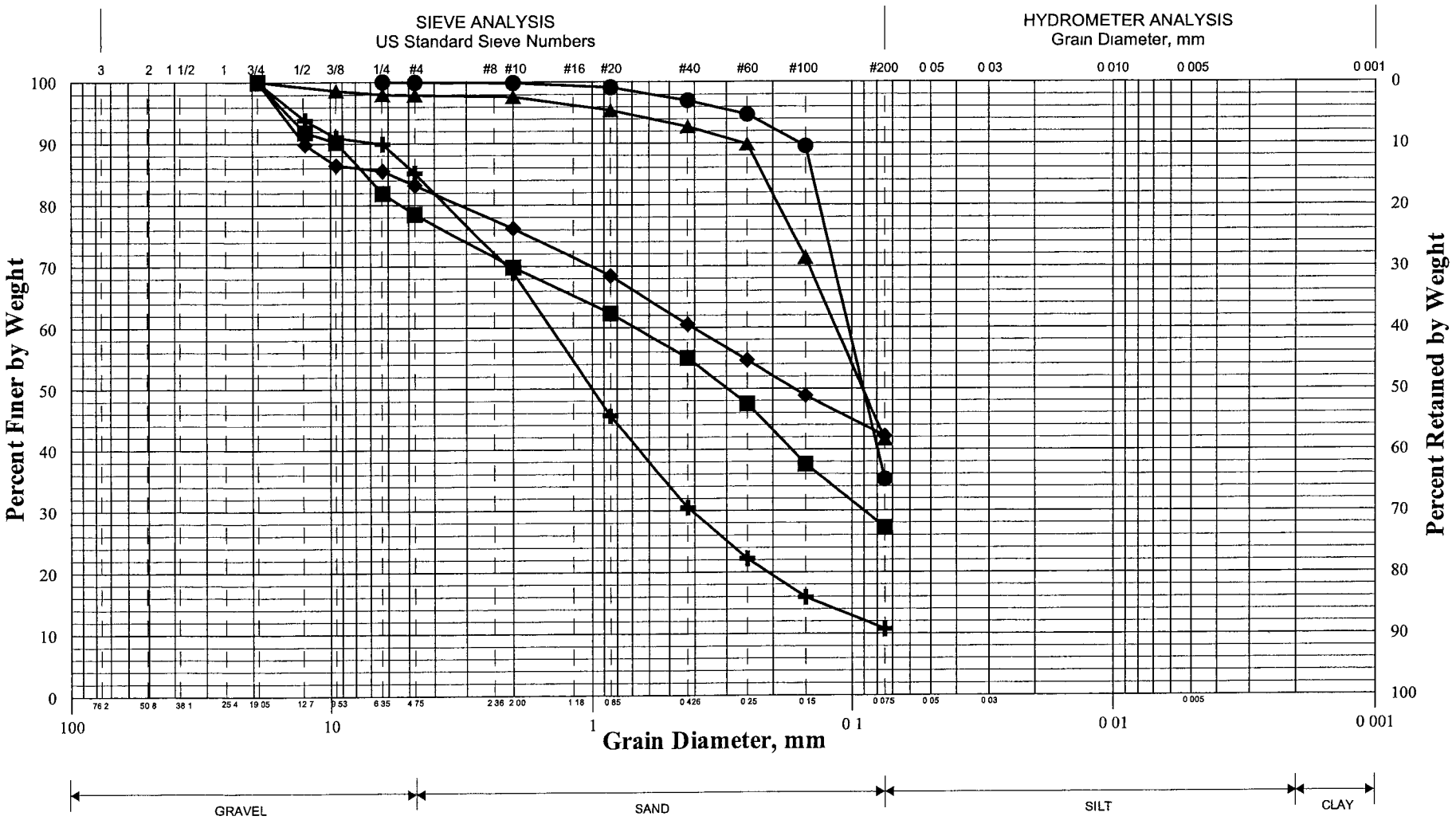
	Boring No	Sample No	Depth (m)	Description	w%	LL	PL	PI
+	HB-WIN-101	2D	0 91-1 52	CLAY, some silt, trace sand	28 8	44	23	21
◆	HB-WIN-102	1D	0 0-0 61	SAND, some gravel, little silt	8 5			
■	HB-WIN-102	2D	0 76-1 37	SAND, some gravel trace silt	7 9			
●	HB-WIN-102	5D	4 57-5 18	Silty SAND, little gravel	16 3			
▲	HB-WIN-104	2D	0 76-1 37	Silty CLAY trace sand, trace gravel	28 8	42	26	16
×								

PIN	2762 60
Town	Winterport
Reported by	T White
Date	1/23/04

SHEET NO. 1

State of Maine Department of Transportation

GRAIN SIZE DISTRIBUTION CURVE



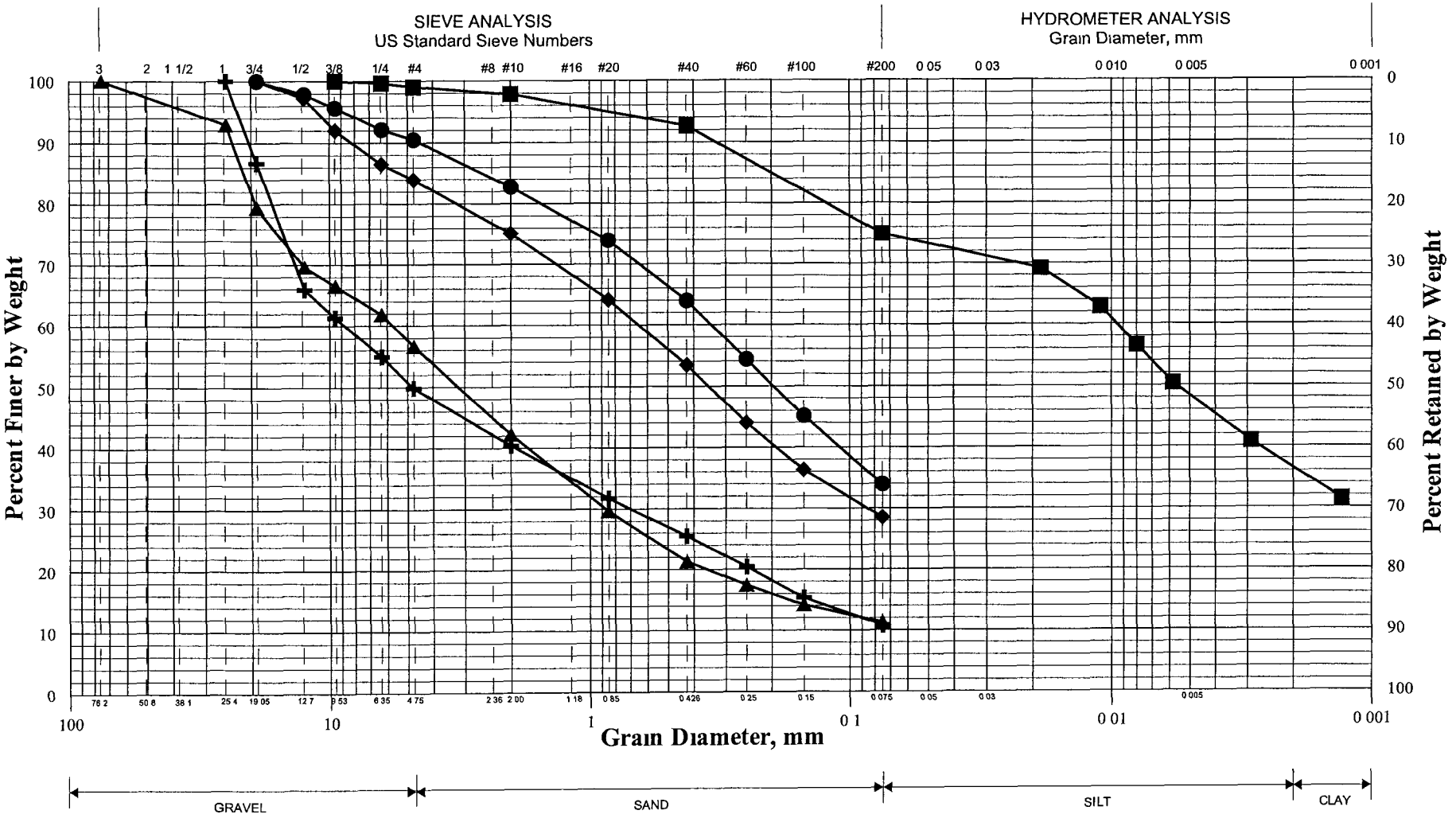
	Boring No	Sample No	Depth (m)	Description	w%	LL	PL	PI
+	HB-WIN-108	1D/A	0 0-0 30	SAND, little gravel, little silt	17 3			
◆	HB-WIN-108	1D/B	0 30-0 61	Sandy SILT, little gravel	15 0			
■	HB-WIN-108	3D	1 52-1 78	SAND, some silt, some gravel	9 3			
●	HB-WIN-107	1D/B	0 40-0 79	SAND, some silt, trace gravel	16 2			
▲	HB-WIN-107	2D	0 79-1 4	Silty SAND, trace gravel	20 9			
×								

PIN	2762 60
Town	Winterport
Reported by	T White
Date	1/23/04

SHEET NO 2

State of Maine Department of Transportation

GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

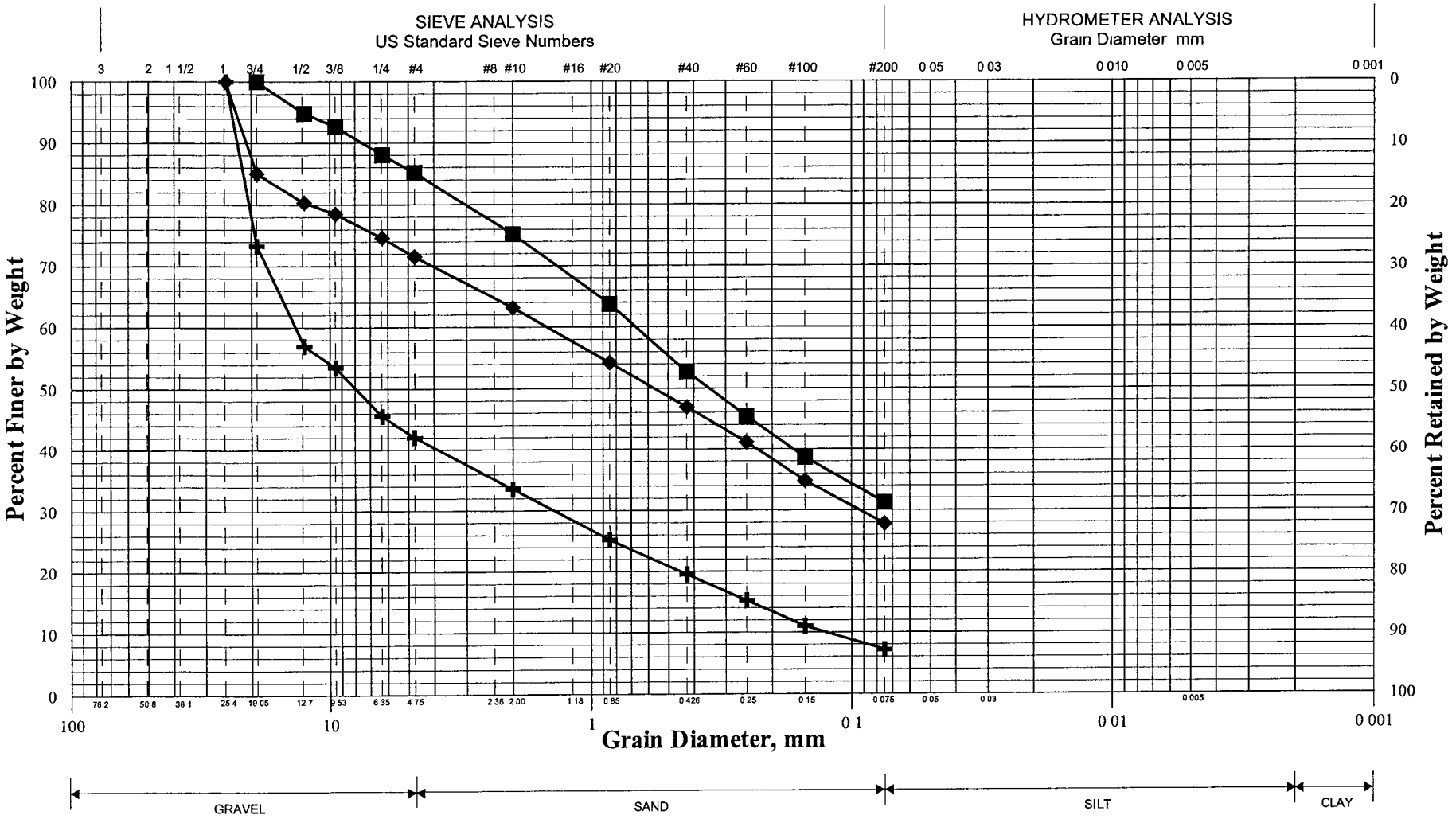
	Boring No	Sample No	Depth (m)	Description	w%	LL	PL	PI
+	HB-WIN-109	1D/A	0 30-0 61	Sandy GRAVEL, little silt	3 4			
◆	HB-WIN-109	1D/B	0 61-0 91	SAND, some silt, little gravel	9 0			
■	HB-WIN-109	2D	0 91-1 52	Clayey SILT, some sand, trace gravel	19 3	25	16	9
●	HB-WIN-110	1D/B	0 30-0 76	SAND, some silt, trace gravel	11 9			
▲	HB-WIN-111	1D/B	0 24-0 58	Sandy GRAVEL, little silt	4 9			
×								

PIN 2762 60
Town Winterport
Reported by T White
Date 1/23/04

SHEET NO 3

State of Maine Department of Transportation

GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

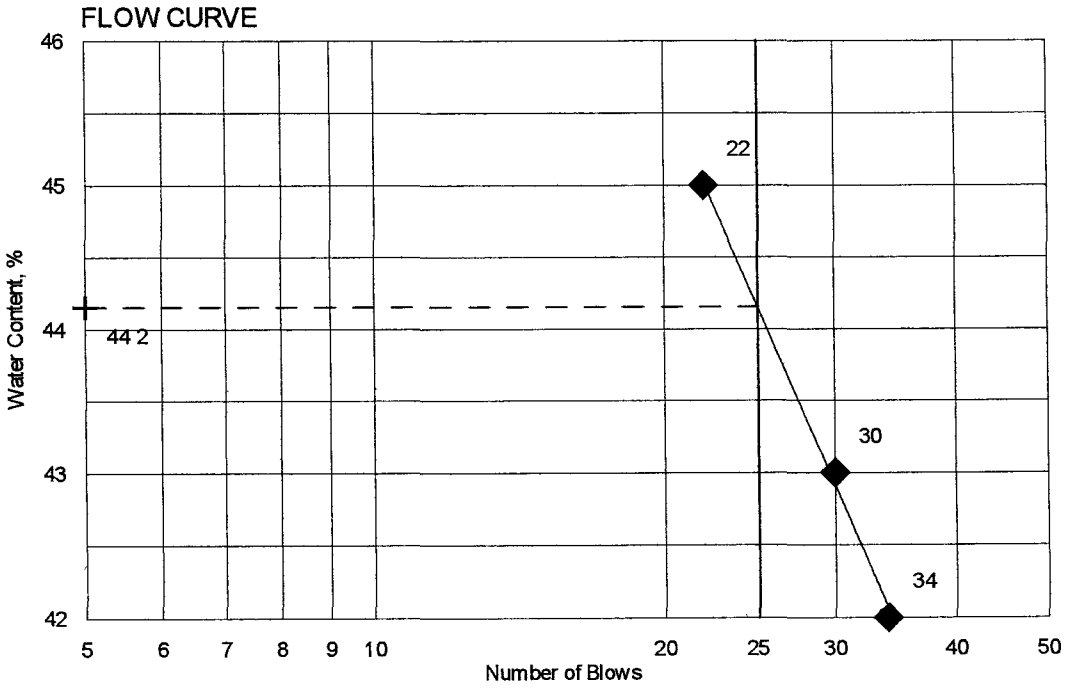
	Boring No	Sample No	Depth (m)	Description	w%	LL	PL	PI
+	HB-WIN-113	1D/A	0 27-0 61	GRAVEL, some sand, trace silt	5 8			
◆	HB-WIN-113	1D/B	0 61-0 76	SAND some gravel some silt	9 5			
■	HB-WIN-114	1D/B	0 61-0 85	SAND, some silt, little gravel	8 6			
●								
▲								
×								

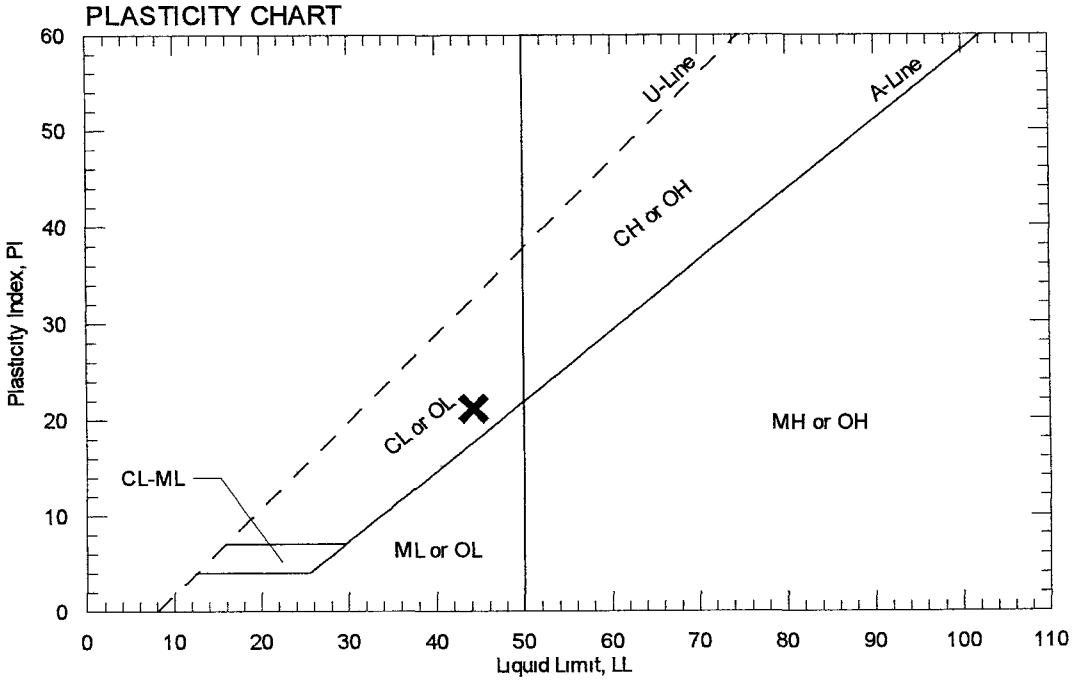
PIN 2762 60
Town Winterport
Reported by T White
Date 1/23/04

SHEET NO 4

State of Maine-Department of Transportation
Atterberg Limits Test Summary Sheet

TOWN	Winterport	Reference No	176376
PIN	2762	Natural water content (%)	28 8
Date	1/22/2004	Plastic limit	23
Boring No	HB-WIN-101	Liquid limit	44
Station		Plasticity index	21
Depth/Sample No	0 91-1 52m/2D	Reported by	B D Fogg

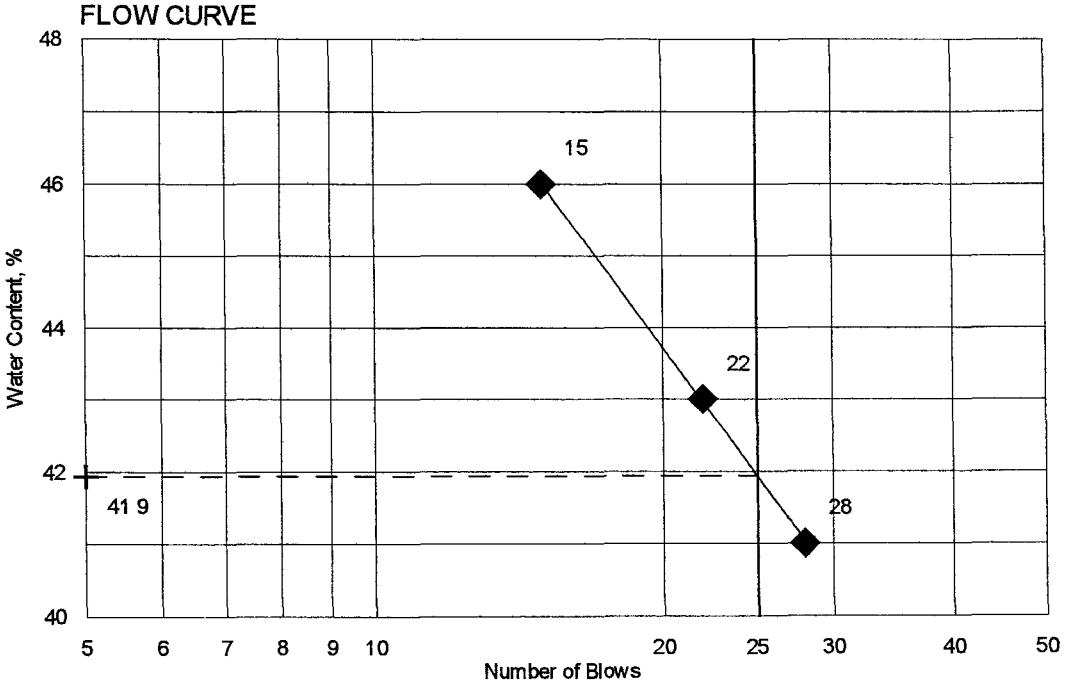


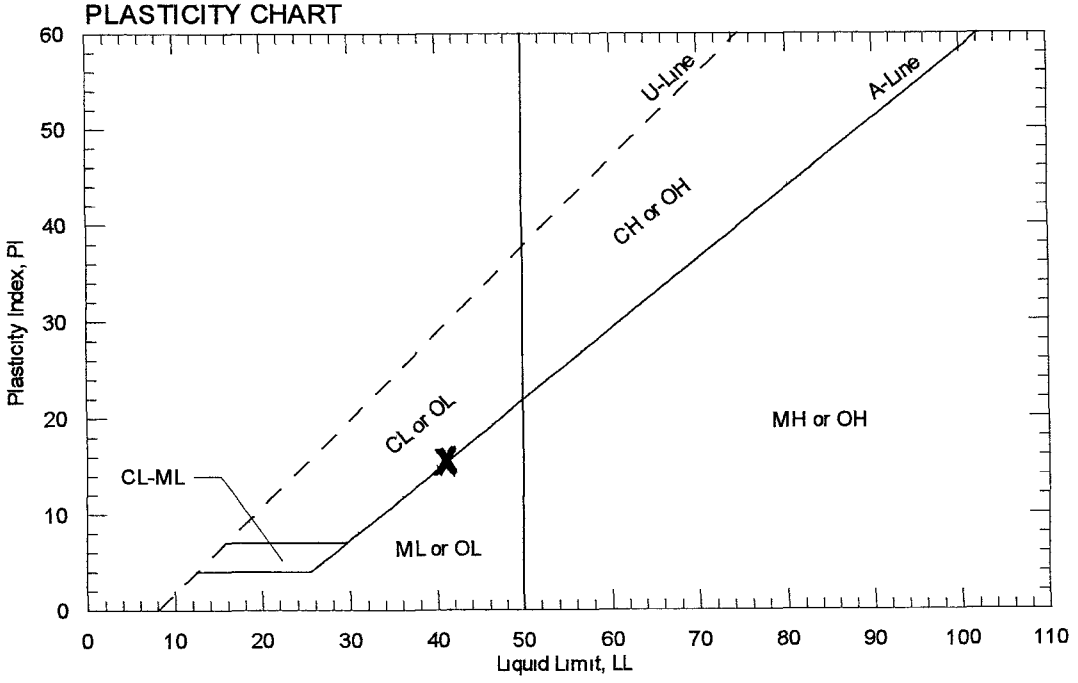


State of Maine-Department of Transportation

Atterberg Limits Test Summary Sheet

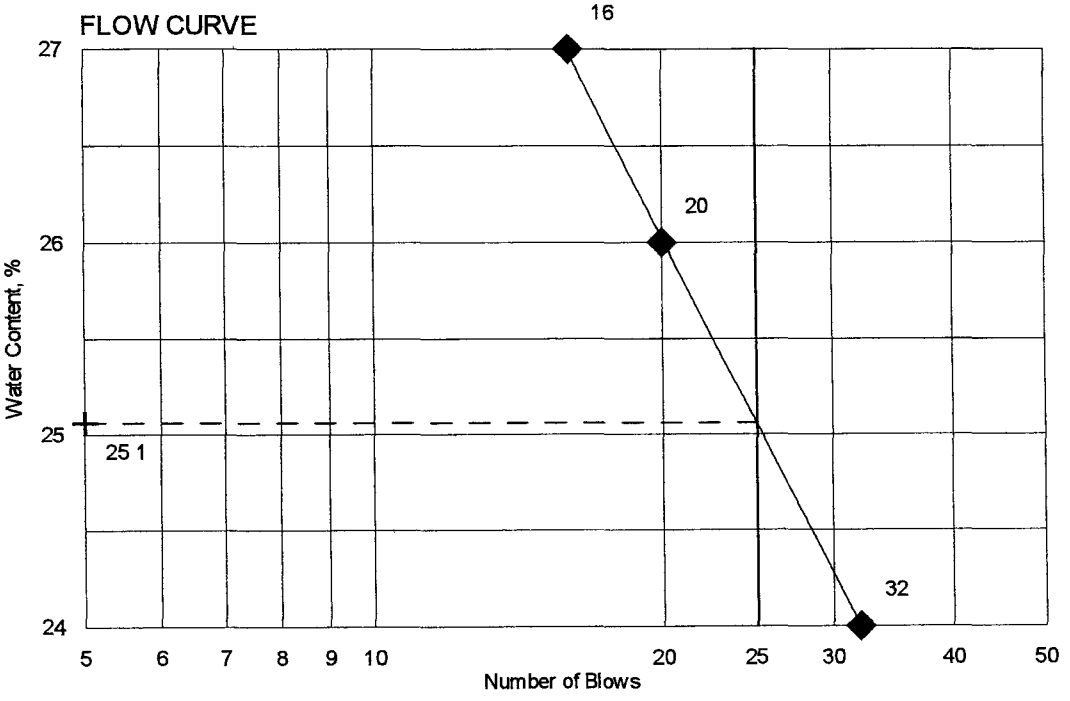
TOWN	Winterport	Reference No	176379
PIN	2762	Natural water content (%)	28 8
Date	1/22/2004	Plastic limit	26
Boring No	HB-WIN-104	Liquid limit	42
Station		Plasticity index	16
Depth/Sample No	0 76-1 37m/2D	Reported by	B D Fogg

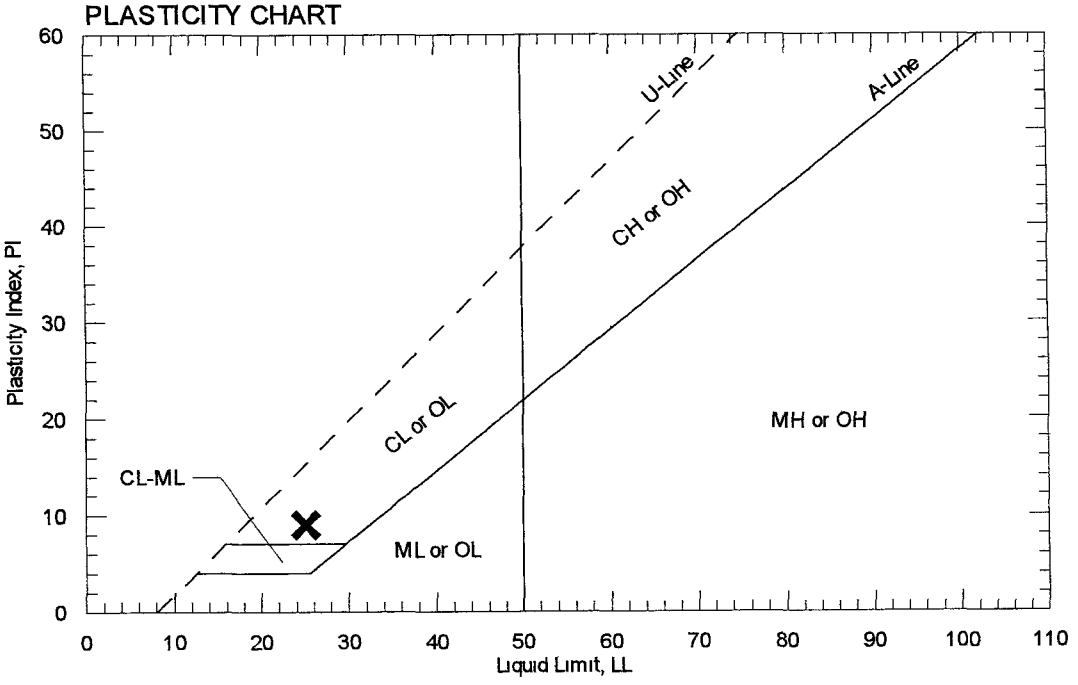




State of Maine-Department of Transportation
Atterberg Limits Test Summary Sheet

TOWN	WINTERPORT	Reference No	176389
PIN	2762	Natural water content (%)	19 3
Date	1/21/2004	Plastic limit	16
Boring No	HB-WIN-109	Liquid limit	25
Station		Plasticity index	9
Depth/Sample No	0 91-1 52m/2D	Reported by	B D Fogg





APPENDIX - D

Calculations

Pavement Design

10/26/04

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

State Of Maine

Flexible Structural Design Module

Winterport, Route 1A
PIN 2762 60

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	4,350,800
Initial Serviceability	4 5
Terminal Serviceability	2 5
Reliability Level	95 %
Overall Standard Deviation	0 45
Roadbed Soil Resilient Modulus	33,000 kPa
Stage Construction	1
Calculated Design Structural Number	130 mm

Specified Layer Design

Layer	Material Description	Struct Coef (A1)	Drain Coef (M1)	Thickness (D1)(mm)	Width (m)	Calculated SN (mm)
1	New HMA	0 44	1	100	-	44
2	New HMA	0 34	1	25	-	9
3	FA or PMRAP	0 26	1	100	-	26
4	ASCG	0 09	1	600	-	54
Total	-	-	-	825	-	133

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef (A1)	Drain Coef (M1)	Spec Thickness (D1)(mm)	Min Thickness (D1)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note This value is not represented by the inputs or an error occurred in calculation

3-11/04

REQUEST FOR TRAFFIC DATA

48C

Mike, please update & Return to Mike Moreau, Highway
Thanx
Mike Moreau

✓ ok
File: Rte 1A

To: ~~Ed Henscom, [illegible]~~
~~[illegible]~~ Mike Davies

Date of Request: 3-19-02

Town(s): Winterport

Date of Return: _____

Pin: 2762.60

Project Manager: _____

Route Rt 1A

County: _____

Location/Description: Rt 1A N/b Merrill to Memorial

☐ Existing Location ☐ Relocation (Attach Sketch) ☐ Route Review
☐ Hazard Justification ☐ Turning Movement ☐ Other _____

Desc of Sections	Sec 1	Sec. 2	Sec 3	Sec.4	Sec 5
Prep By: DMC	US 1A @ Cul	US 1A @ Cul			
Current ~~(03)~~ 06 AADT	6450 (06)	5370			
~~Future (_) AADT~~					
Future ~~(23)~~ 26 AADT	8380 (26)	6980			
DHV-% of AADT	9%	9			
Design Hourly Vol	754	628			
% Heavy Tks. (AADT)	18	16			
% Heavy Tks. (DHV)	14	12			
Direct.Dist. (DHV)	55	55			
18-Kip Equiv P2 0	490	625			
18-Kip Equiv P2.5	483	596			

ESALS = 4,350,800

Fax Note 7671
Date 4-9
# of pages ▶ 1
From Roy Lord
Co MDOT
Phone #
Fax #

Notes or Remarks: 18-Kip ESALS are based on 20 year life

*** Please attach location map with project location highlighted ***
*** Remember to provide current and future years for project study***

Comments: Have 2000 Counts.

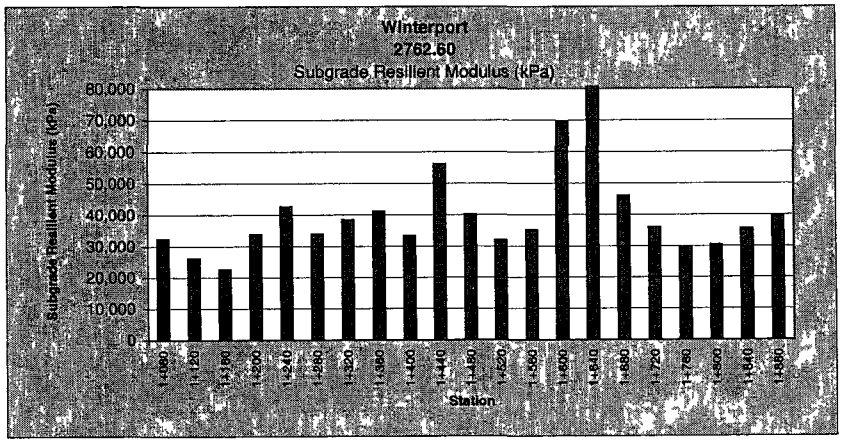
2002 AADT - 5070

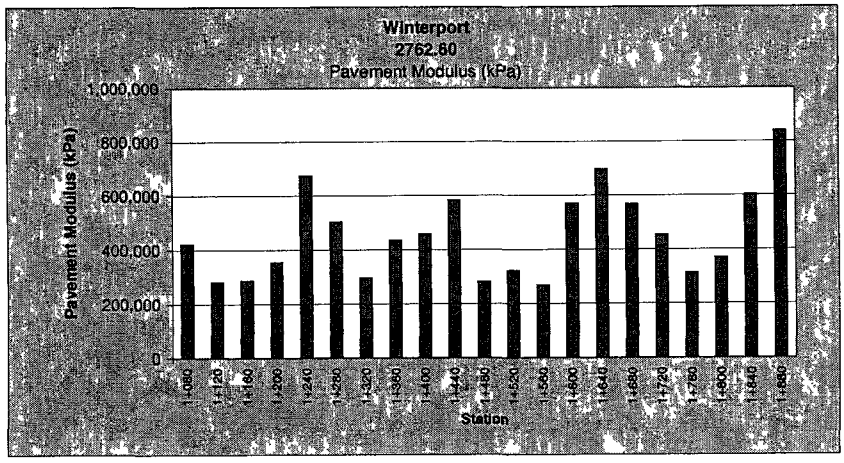
February 6, 2004

Winterport
2762.60
Route #1A

Station (Meters)	Existing Pavement Modulus (kPa)	Subgrade Resilient Modulus (kPa)	Pavement Depth (mm)	* Combined Pavement/Gravel Depth Used for Calculation (mm)
1+080	421 205	32 497	110	700
1+120	280 307	26 152	110	700
1+160	285,580	22 613	110	700
1+200	352 559	33 926	110	700
1+240	673,708	42 663	180	760
1+280	502 507	34 027	180	760
1+320	295 607	38,508	180	760
1+360	434 286	41 200	180	760
1+400	457 316	33 420	170	550
1+440	582 825	56 172	170	550
1+480	279 262	40,196	200	760
1+520	321 243	32,046	200	760
1+560	267,689	35,267	200	760
1+600	569,681	69 601	170	580
1+640	696 330	80 912	170	580
1+680	566 877	46 152	200	685
1+720	452,689	36 027	200	685
1+760	312 904	29,803	200	685
1+800	368,699	30 538	200	685
1+840	601 266	35 648	150	**300**
1+880	839 507	39 805	150	**300**

*** For actual Gravel Depths, see attached logdraft forms**



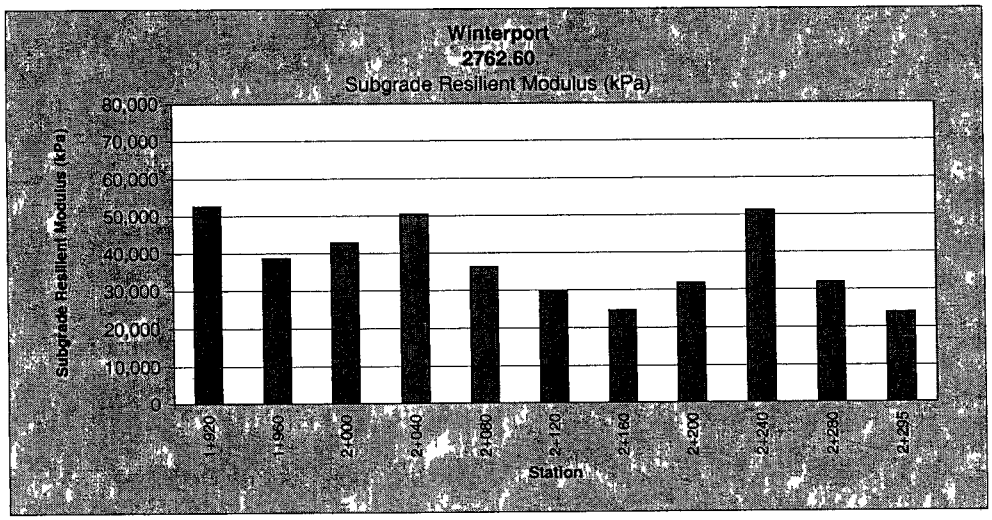


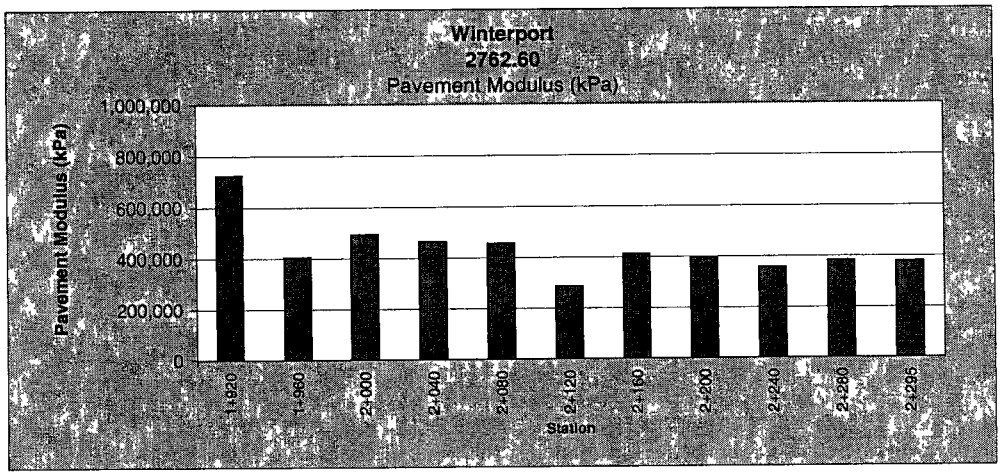
February 6, 2004

Winterport
2762.60
Route #1A

Station (Meters)	Existing Pavement Modulus (kPa)	Subgrade Resilient Modulus (kPa)	Pavement Depth (mm)	* Combined Pavement/Gravel Depth Used for Calculation (mm)
1+920	725,052	52,566	150	**300**
1+960	405,526	38,738	130	730
2+000	494,395	42,854	130	730
2+040	466,081	50,409	130	730
2+080	456,494	36,365	130	730
2+120	287,539	29,973	100	670
2+160	412,790	24,598	100	670
2+200	396,850	31,849	120	610
2+240	358,451	51,143	240	610
2+280	384,358	31,869	240	610
2+295	380,281	23,913	240	610

*** For actual Gravel Depths, see attached logdraft forms**





Bearing Capacity and Settlement

Definition of Units

$psf = \frac{lbf}{ft^2}$ $pcf = \frac{lbf}{ft^3}$ $Mg = 1000\ kg$ $kN = 1000\ newton$ $kPa = \frac{kN}{m^2}$ $tsf = g\left(\frac{ton}{ft^2}\right)$ $kip = 1000\ lbf$

$ksf = \frac{kip}{ft^2}$ $ft = 0.305\,m$ $in = 0.025\,m$ $MPa = 1000\ kPa$ $1ft = 12in$

Wall Location Bearing Capacity, c = 0 Case:

$q_{ult} = c\ N_c + q\ N_q + 0.5\ \gamma\ B\ N_\gamma$ Bowles p 134

$c = 0psf$

From field data, $N_{des} = 16$, $\phi = 30°$ Sowers p 318

$\phi = 30$ $N_c = 37.2$ $N_q = 22.5$ $N_\gamma = 19.7$ Bowles p 134

$q = 2ft\ 120pcf$ $q = 240\ psf$

$\gamma = 120pcf$

$B = 3.5ft$

$q_{ult} = c\ N_c + q\ N_q + 0.5\ \gamma\ B\ N_\gamma$

$q_{ult} = 9.537 \times 10^3\ psf$

$q_{allow} = \frac{q_{ult}}{3}$ $q_{allow} = 3.179 \times 10^3\ psf$

c = 0 Case Controls
Recommend 3 ksf

Wall Location Elastic Settlement

$$\Delta H = q\ B \left[\frac{\left(1 - \mu^2\right)}{E_s\ 1000 \frac{lbf}{kip}} \right] I_w\ 12 \frac{in}{ft}$$

Bowles p 184

$q = 5ft\ 150pcf$

$B = 3\ 5ft$

$\mu = 0\ 3$ Bowles p 67

$E_s = 3000ksf$ Bowles p 67

$I_w = 2\ 53$ Bowles p 184

$$\Delta H = q\ B \left[\frac{\left(1 - \mu^2\right)}{E_s\ 1000 \frac{lbf}{kip}} \right] I_w\ 12 \frac{in}{ft} \qquad \Delta H = 0\ 024\ in$$

Winterport, Route 1A

PROJECT IDENTIFICATION

Title	Winterport, Route 1A
Project Number	PIN 2762 60 -
Client	
Designer	Mike Moreau, PE
Station Number	
Description	Winterport Embankment, STA 1+220

Company's information

Name	MaineDOT
Street	16 State House Station Augusta, ME 04333-0016
Telephone #	
Fax #	
E-Mail	

Original file path and name C \FoSSA\Winterport PIN 2762 60 F2S
Original date and time of creating this file Mon Nov 01 09 36 19 2004

GEOMETRY Analysis of a 2D geometry

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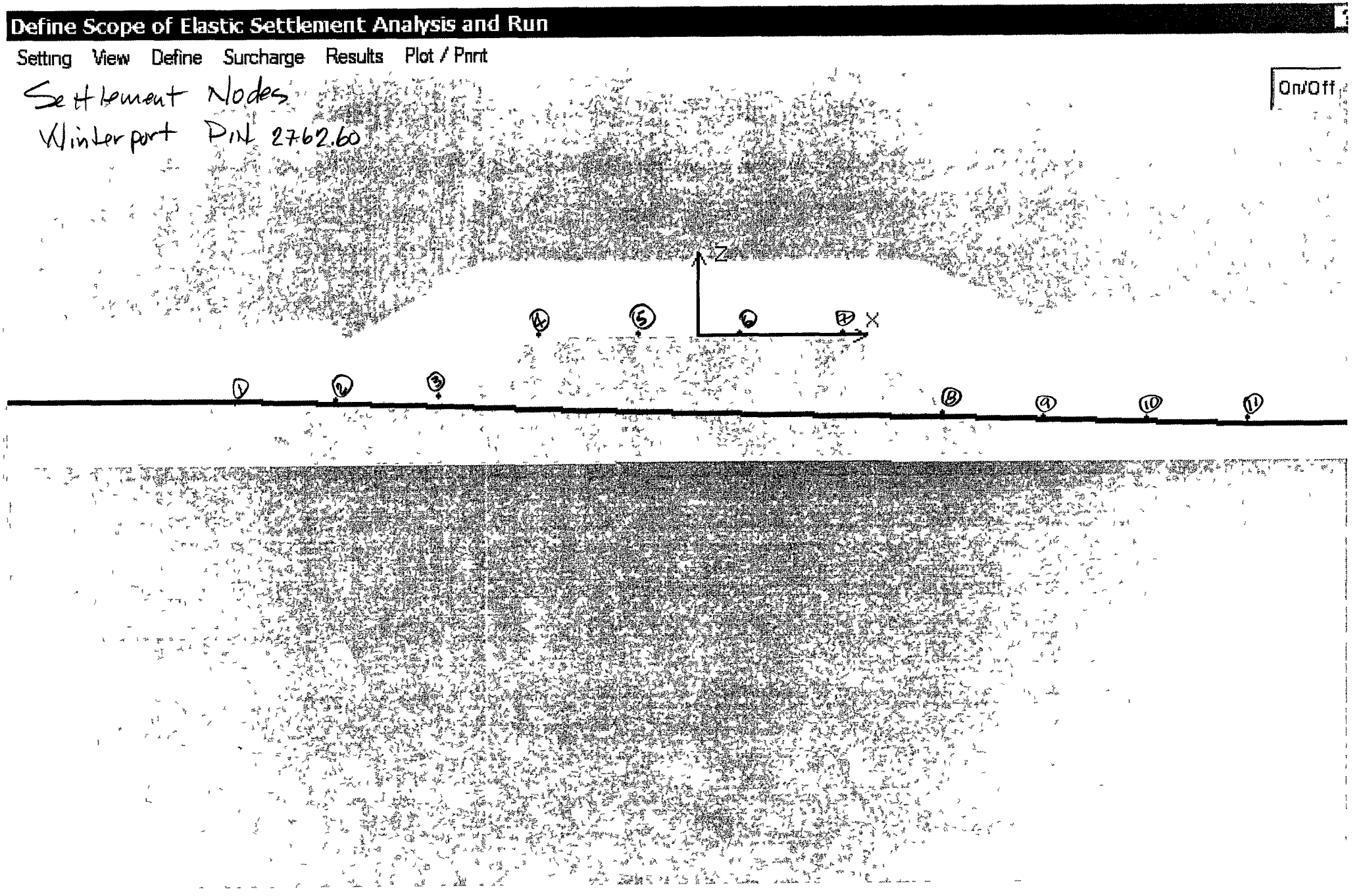
Define Scope of Elastic Settlement Analysis and Run
Setting View Define Surcharge Results Plot / Prnt
Settlement Nodes
Winterport PIN 2762.60
On/Off
Z
X
1
2
3
4
5
6
7
8
9
10
11

IMMEDIATE SETTLEMENT, S_I

Node #	Settlement along section X [m]	Y [m]	Layer #	Young's Modulus, E [kN/m²]	Poisson's Ratio, μ	$S_I(k)$ [m.]	Z initial [m]	Z final [m]
1	100 00	0 00	1	5000	0 2500	-0 0006	11 90	11 90
			2	5000	0 3000	-0 0004		
2	103 70	0 00	1	5000	0 2500	0 0115	11 99	11 97
			2	5000	0 3000	0 0070		
3	107 40	0 00	1	5000	0 2500	0 0254	12 08	12 04
			2	5000	0 3000	0 0155		
4	111 10	0 00	1	5000	0 2500	0 0290	12 07	12 02
			2	5000	0 3000	0 0185		
5	114 80	0 00	1	5000	0 2500	0 0275	12 02	11 98
			2	5000	0 3000	0 0182		
6	118 50	0 00	1	5000	0 2500	0 0276	12 00	11 95
			2	5000	0 3000	0 0182		
7	122 20	0 00	1	5000	0 2500	0 0278	12 00	11 95
			2	5000	0 3000	0 0187		
8	125 90	0 00	1	5000	0 2500	0 0229	11 36	11 32
			2	5000	0 3000	0 0194		
9	129 60	0 00	1	5000	0 2500	0 0143	11 17	11 14
			2	5000	0 3000	0 0140		
10	133 30	0 00	1	5000	0 2500	0 0065	11 13	11 12
			2	5000	0 3000	0 0060		
11	137 00	0 00	1	5000	0 2500	-0 0004	11 10	11 10
			2	5000	0 3000	-0 0005		

Soil # 1 Under Existing Embank # 1 Run 1

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IMMEDIATE SETTLEMENT, S_I

Node #	Settlement along section X [m]	Y [m]	Layer #	Young's Modulus, E [kN/m²]	Poisson's Ratio, μ	$S_I(k)$ [m]	Z initial [m]	Z final [m]	
1	100 00	0 00	1	5000	0 2500	-0 0004	11 90	11 90	
			2	5000	0 3000	0 0001			
2	103 70	0 00	1	5000	0 2500	0 0119	11 99	11 97	
			2	5000	0 3000	0 0076			
3	107 40	0 00	1	5000	0 2500	0 0257	12 08	12 04	
			2	5000	0 3000	0 0151			
4	111 10	0 00	1	5000	0 2500	0 0335	14 30	14 25	1 8 in
			2	5000	0 3000	0 0121			
5	114 80	0 00	1	5000	0 2500	0 0313	14 30	14 26	
			2	5000	0 3000	0 0101			
6	118 50	0 00	1	5000	0 2500	0 0312	14 30	14 26	
			2	5000	0 3000	0 0099			
7	122 20	0 00	1	5000	0 2500	0 0323	14 30	14 26	
			2	5000	0 3000	0 0119			
8	125 90	0 00	1	5000	0 2500	0 0230	11 36	11 32	
			2	5000	0 3000	0 0188			
9	129 60	0 00	1	5000	0 2500	0 0147	11 17	11 14	
			2	5000	0 3000	0 0146			
10	133 30	0 00	1	5000	0 2500	0 0068	11 13	11 12	
			2	5000	0 3000	0 0065			
11	137 00	0 00	1	5000	0 2500	-0 0003	11 10	11 10	
			2	5000	0 3000	-0 0002			

Soil # 1 Coincident w/Embank # 1 Run 2

Say Up To 2" Settlement

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TABULTAED GEOMETRY INPUT OF FOUNDATION SOILS

Found Soil #	Point #	Coordinates (X, Z) (X) [m]	(Z) [m]	DESCRIPTION
1	1	100 00	11 90	
	2	108 00	12 10	Run 1
	3	117 00	12 00	
	4	125 50	12 00	
	5	126 00	11 20	
	6	137 00	11 10	
2	1	100 00	9 70	
	2	117 22	9 74	
	3	137 00	9 70	

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TABULTAED GEOMETRY INPUT OF FOUNDATION SOILS

Found Soil #	Point #	Coordinates (X, Z) (X) [m]	(Z) [m]	DESCRIPTION
1	1	100 00	11 90	
	2	108 00	12 10	
	3	111 00	14 30	Run 2
	4	117 00	14 30	
	5	122 50	14 30	
	6	125 50	12 00	
	7	126 00	11 20	
	8	137 00	11 10	
2	1	100 00	9 70	
	2	117 22	9 74	
	3	137 00	9 70	

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TABULTAED GEOMETRY INPUT OF EMBANKMENT SOILS

Embank. Soil #	Point #	Coordinates (X, Z) (X) [m]	(Z) [m]	DESCRIPTION
1	1	122 50	14 30	
	2	1142 50	14 30	
2	1	125 00	17 00	
	2	1145 00	17 00	

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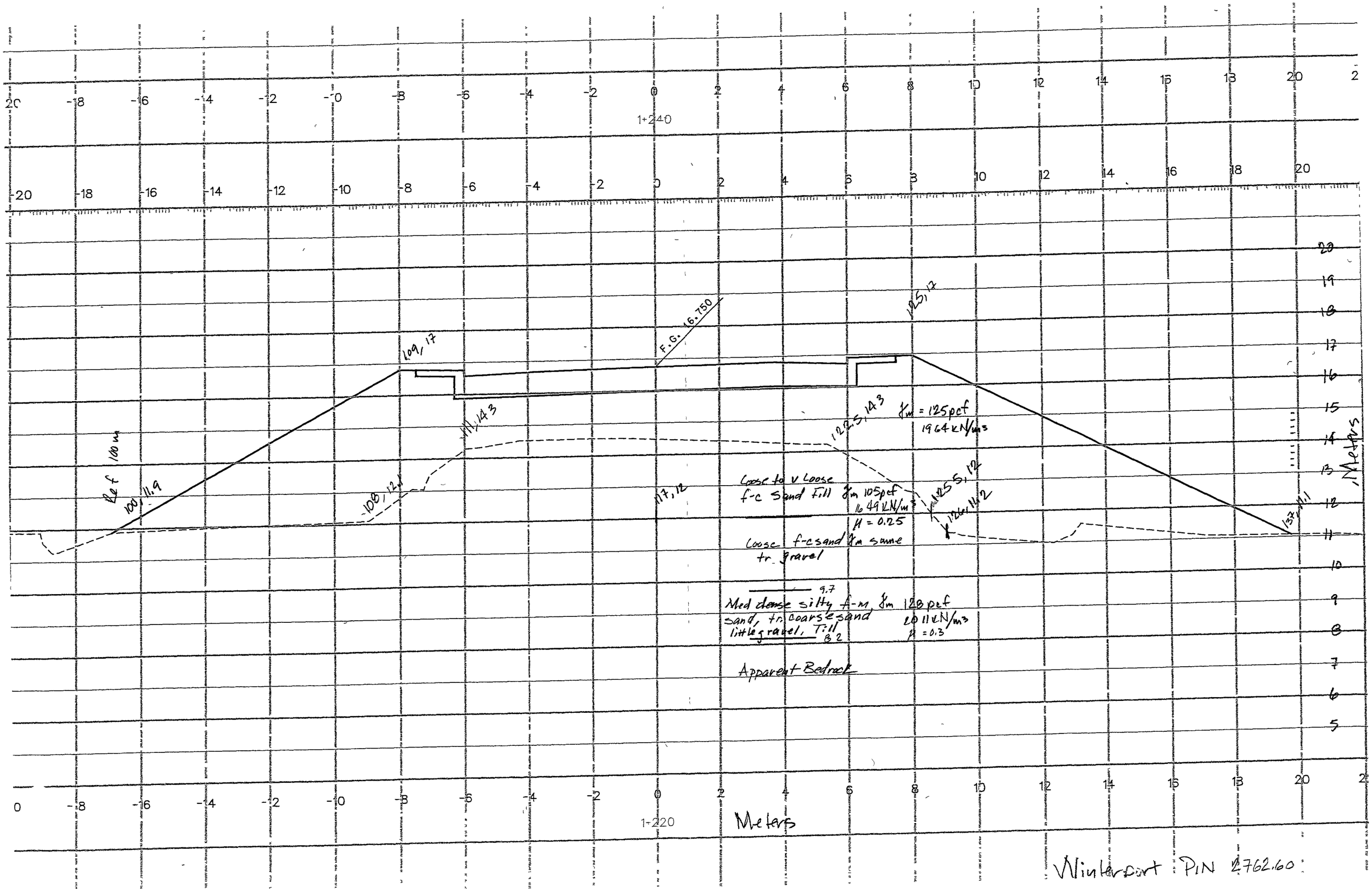


1+240
1+220
Meters
Ref 100 m
100, 11.9
108, 12.1
109, 17
111, 14.3
117, 12
F.G. 16.750
122.5, 14.3
125, 17
125.5, 12
126, 11.2
137, 11.1
γm = 125 pcf
1964 kN/m³
Loose to v Loose
f-c Sand Fill γm 105 pcf
1649 kN/m³
μ = 0.25
Loose f-c sand γm same
tr. gravel
9.7
Med dense silty f-m, γm 128 pcf
sand, tr. coarse sand
little gravel, Till
8.2
2011 kN/m³
μ = 0.3
Apparent Bedrock
Winterport PIN 2762.60

Frost Penetration

PRELIM BY M. Moreau DATE 11/04 PROJ NO 2762.60 FILE NO ____ OF ____
FINAL CHK BY ____ DATE ____ LOCATION Winterport SH NO ____ OF ____
ITEM NO ____ SUBJECT RTE 1A Reconstruction

Frost Penetration

Ref. • Maine DOT mean & design freezing indices
• Army Corps Engineers freeze index vs depth for granular & fine-grained soils

Mean Freeze Index - 1050

Design Freeze Index - 1570

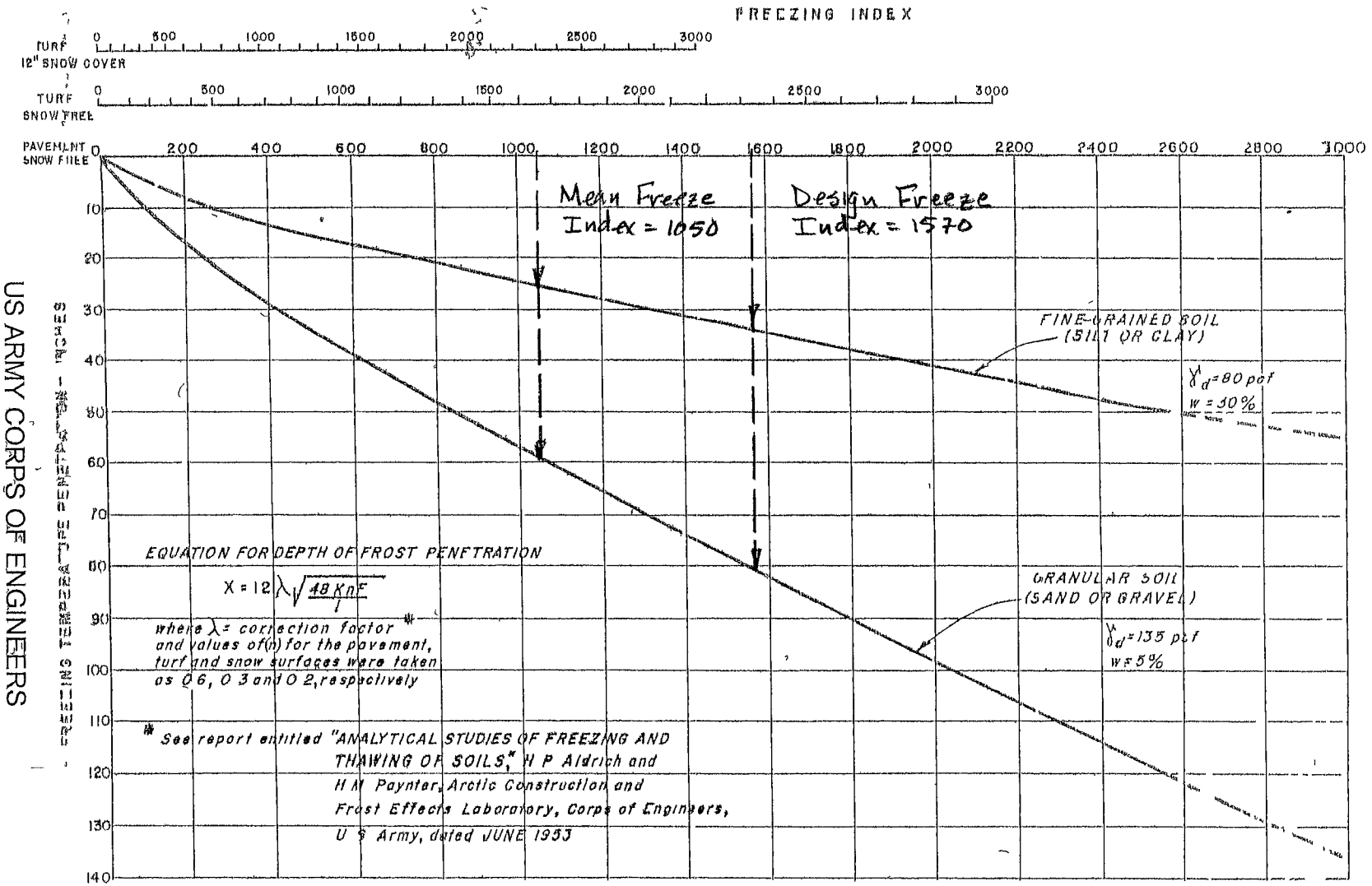
	Total Frost Pen. *			Frost Pen Into Subgrade	
FI	Granular Sub	% **	Non-Gran	Gran. Subgrade	Non-Granular
1050	59" 1500 mm	.42	760 + 310 = 1070	1500 - 760 = 740 x .42	310
1570	81" 2060 mm	42	760 + 550 = 1310	2060 - 760 = 1300 x .42	550

* based on 760 mm (30in) pavement structure

** percentage = fine-grained ÷ granular penetration depths

@ 1050 = 25/59 = .42

@ 1570 = 34/81 = .42

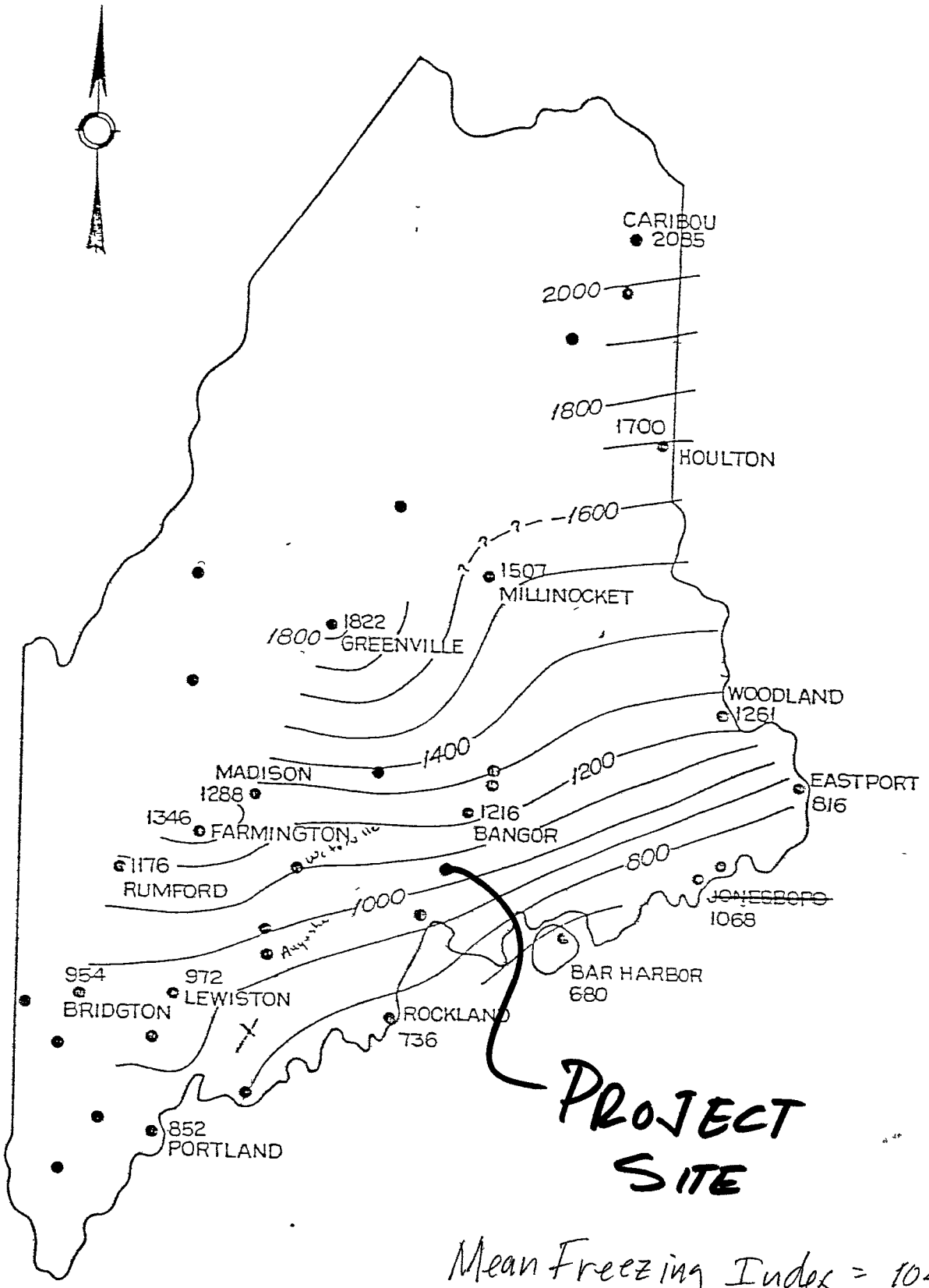


RELATIONSHIP BETWEEN FREEZING INDEX AND FREEZING TEMPERATURE PENETRATION FOR VARIOUS SURFACE CONDITIONS FOR GRANULAR AND FINE-GRAINED SOILS

US ARMY CORPS OF ENGINEERS
Frost Investigations, Prediction of Freezing Temperature Penetration in New England
Miscellaneous Paper No 11
June 1955

FIG 12

Winterport, Route 1 PIN 2762.00



Mean Freezing Index = 1050

Figure 4

MAINE

MEAN FREEZING INDEX
FOR 30 YRS.

HO 8

OUTLINE MAP OF MAINE

PUBLISHED BY
THE NATIONAL SURVEY CO
CHESTER VT

SCALE OF MILES
0 5 10 20 30

2500
2600
2600
2680
2400
2212
2200
2013
2351
1800
1882
1651
1760
1400
1250
Design Freezing Index = 1570

PROJECT SITE

EXTRAPOLATIONS BASED ON
1. COLDEST YEAR IN 10, 1958-67 FIG 7
2. FORT KENT, DATA, COLDEST YEAR IN 21
3. PLANT HARDINESS ZONE MAP, USDA MISCELLANEOUS PUBLICATION NO 814

MAINE
DESIGN FREEZING INDEX

APPENDIX - E

Special Provisions

SPECIAL PROVISION
SECTION 635
PREFABRICATED GRAVITY RETAINING WALL
(Prefabricated Concrete Block Gravity Wall)

The following replaces Section 635 in the Standard Specifications

Description This work shall consist of the design and construction of a prefabricated concrete block gravity wall in accordance with these specifications and in reasonably close conformance with the lines and grades shown on the plans, or established by the Engineer Blocks shall be made of wet cast concrete made from Portland cement, water, chemical admixtures, and aggregates

Included in the scope of the prefabricated gravity wall construction are: geotechnical design of any wall with a maximum height greater than 1 37 meters (4 5 feet) or as specified on the wall detail sheet, all grading necessary for wall construction, compaction of the wall foundation, backfill, piped drainage, construction of leveling pads, and block wall installation

The prefabricated gravity wall design shall follow the general dimensions of the wall envelope shown in the contract plans The minimum wall embedment shall be at or below the elevation shown on the plans or as specified by the designer The top of the upper row of blocks shall be at or above the top of the face elevation shown on the plans

The Contractor shall require the design-supplier to supply an on-site, qualified experienced technical representative to advise the Contractor concerning proper installation procedures The technical representative shall be on-site during initial stages of installation and thereafter shall remain available for consultation as necessary for the Contractor or as required by the Engineer The work done by this representative is incidental to the construction of the wall

MATERIALS

Materials Materials shall meet the requirements of the following subsections of Division 700 - Materials

Aggregate for crushed stone surface	703 12
Gravel Borrow	703 20
Underdrain Pipe	706 06 or 706 09
Reinforcing Steel	709 01

The Contractor is cautioned that all of the materials listed are not required for every prefabricated concrete block gravity wall The Contractor shall furnish the Engineer a Certificate of Compliance certifying that the applicable materials comply with this section of the specifications Materials shall meet the following additional requirements

Concrete Units Materials shall conform to the requirements of Supplemental Specification Section 502 Structural Concrete Class A except that the requirements for Chloride Permeability shall not apply

A The minimum 28 day compressive strength requirement shall be 30 MPa (4350 psi) for any individual unit and 31 7 MPa (4600 psi) for the average of 3 units

B Unit Depth - 1040 mm (41 inches), minimum for an unreinforced wall, or 710 mm (28 inches) minimum for a geogrid reinforced wall

C Unit Width - 1160 mm (46 inches), minimum at the face

D Unit Height - 450 mm (18 inches), minimum at the face for a standard block

E Tolerances - formed dimensions shall not vary more than 2 mm (1/16") from the Manufacturer's published tolerances

F Face Texture - formed finish on all exposed surfaces

G Color - pigment shall be added during the casting process of the concrete unit to achieve a consistent shade of gray or other color as determined by the Engineer

H Imperfections - All units shall be sound and free of cracks or other defects that would interfere with the proper placing of each unit or significantly impair the strength or performance of the construction Minor cracks (e g no greater than 0 5 mm (0 02 inches) in width and no longer than 25% of the unit height) incidental to the method of manufacture or minor chipping resultant from shipment and delivery, are not grounds for rejection

Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 3 meters (10 feet) under diffused lighting

I Other Constituents – air entraining agents, coloring pigments, integral water repellents, pozzolans, and other constituents shall be previously established as suitable for use in Class A concrete and shall conform to applicable AASHTO standards or, shall be shown by test or experience to be not detrimental to the appearance or durability of the concrete units or any material customarily used in retaining wall construction

J Other Units – end blocks, steps, caps and other wall units shall be supplied by the same supplier as the block units and cast in strict accordance with manufacturer's requirements and with Sections A through I above

Geogrid Reinforcing The structural geogrid reinforcing shall meet the following requirements

A The geogrids shall be a regular polymeric grid structure of select high density polyethylene (HDPE), polypropylene (PP), or polyester (PET) resin manufactured by Tensar, Huesker, Strata Systems, Mirafi, or approved equal

B The geogrid shall conform to the following criteria

B1 PP and HDPE Minimum retained strength of 70 % after 150 hours, per ASTM D-4355

B2 HDPE Grade = E-4, E-5, E-8, E-9, E-10, E-11, J-3, J-4, J-5, P-24, or P-34, per ASTM D-1248

B3 PET Molecular weight (Mn) > 25,000 g/mole, Inherent Viscosity Method per ASTM D-4603, with Correlation or Determined Directly Using Gel Permeation Chromatography

B4 PET Carboxyl end group (CEG) < 30 meg/kg, GRI GG7

B5 All polymers Minimum Weight per Unit Area of 270 g/m^2, per ASTM D-5261

B6 A default total reduction factor for creep, durability, and installation damage of 7 may be used in design, provided the criteria of B2 through B5 are satisfied and B1 is adjusted to 70% after 500 hours is satisfied

C The Long Term Tensile Strength (T_{al}) of the geogrid shall be determined by reducing the Ultimate Strength (T_u), as determined using ASTM 4595 or GRI GG1, by the product of the reduction factors for durability, installation damage, and creep, denoted RF_D, RF_{ID}, and, RF_{CR}, respectively The required tests used to determine the reduction factors, minimum value to be used in design if test value is less than minimum, and maximum value to be used in design in the absence of test data are summarized below

Reduction Factor	Test	Minimum/Maximum
Durability (RF_D)	HDPE and PP ASTM D4355 PET GRI GG7	1 1/2 0
Installation Damage(RF_{ID})	Site installation damaged tests, similar to ASTM D-5818	1 1/3 0
Creep(RF_{CR})	ASTM D-5262	HDPE = 2 5/5 0 PP = 4 0/5 0 PET = 2 0/2 5

D The pullout resistance factors, F* and α, used in pullout design, shall be determined for the proposed reinforcement and wall system, with soil similar to the specified backfill material of this Section The pullout resistance factors shall be determined in accordance with Appendix A of FHWA SA-96-071

"Mechanical Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines " In the absence of test data, empirical relationships may be used to determine the pullout resistance factors, any empirical relationships used in design shall be referenced in the design calculations

E Long-term connection strength between the geogrid reinforcement and the modular blocks shall be checked, per AASHTO-Standard Specifications for Highway Bridges, Section 5 8

F The Contractor shall submit a Manufacturer's Certificate, which shall state that the furnished geogrid(s) meets the requirements of this Section, as evaluated by the manufacturer's quality control program Included with the certificates, shall be the design parameters and required properties referenced in this Section The certificates shall be attested to by a person having legal authority to bond the manufacturer In case of dispute over validity of values, the Engineer can require the Contractor to supply test data from a Department approved laboratory to support the certified values submitted

Geogrid Connection Reinforcing bar used in the geogrid connection shall ba ½" diameter epoxy coated reinforcing bar, coated on the ends and meeting the requirements of Section 503, Reinforcing Steel Installation shall be in accordance with manufacturer's recommendations

Concrete Leveling Pad Concrete shall be Class A conforming to the requirements of Section 502 Structural Concrete Unless otherwise specified, concrete for leveling pads shall be accepted under Method "C" requirements, except that the requirements for Chloride Permeability shall not apply

Reinforced and Select Backfill Material Reinforced and select backfill material placed behind the concrete units shall be Gravel Borrow conforming to the requirements of Subsection 703 20 Material between blocks must be gravel borrow as above or crushed stone meeting the requirements of Subsection 703 12 If Gravel Borrow is used between blocks, geotextile shall be placed behind vertical joints to prevent loss of granular material between blocks Compliance with the gradation requirements shall be the responsibility of the Contractor, who shall furnish a copy of the backfill test results prior to construction If crushed stone is used between blocks no geotextile is required behind vertical joints

Materials Certificate Letter The Contractor, or the supplier as his agent, shall furnish the Engineer a Materials Certificate Letter for the above materials, including the backfill material, in accordance with Section 700 of the Standard Specifications A copy of all test results performed by the Contractor or his supplier necessary to assure contract compliance shall also be furnished to the Engineer The Engineer will base acceptance upon the materials Certificate Letter, accompanying test reports, and visual inspection

DESIGN REQUIREMENTS

Design Requirements The Prefabricated Concrete Block Gravity Wall shall be designed by a Professional Engineer registered in the State of Maine The design to be performed by the wall system supplier shall be in accordance with AASHTO Standard Specifications for Highway Bridges, current edition, except as required herein Thirty days prior to beginning construction of the wall, the design computations shall be submitted to the Engineer for review by the Department The design by the wall system supplier shall consider the stability of the wall as outlined below

(a) Safety Factors The minimum factors of safety shall be as follows

1	Overturning	2 0
2	Sliding	1 5
3	Stability of temporary construction slope	1 2
4	Ultimate bearing capacity	2 0
5	Reinforcement pullout	1 5
6	Reinforcement rupture	1 5
7	Reinforcement connection failure	2 0

(b) Backfill Soil Parameters For overturning and sliding stability calculations, earth pressure shall be assumed acting on a vertical plane dropping from the back of the highest block or geogrid Stability shall also be calculated at each level within the wall

These unit weights and friction angles are based on a backfill meeting the requirements for select backfill in this specification Backfill behind the concrete units and reinforced fill zone shall be assumed to have a unit weight of 1922 kg/m^3 [120 pcf] and a friction angle of 30 degrees The friction angle of the foundation soils shall be assumed to be 30 degrees unless otherwise noted on the plans The friction angle of the select backfill used in the reinforced fill zone for internal stability design of the wall shall be assumed to be 34° unless noted otherwise on the plans

(d) External loads which affect the internal stability such as those applied through traffic, slope surcharge, hydrostatic and seismic loads shall be accounted for in the design

(e) The actual applied bearing pressures under the prefabricated concrete block gravity wall shall be clearly indicated on the design drawings

(f) Stability during Construction The factors of safety to be used for stability during construction stages shall be the same factors used for the design of the wall

(g) Hydrostatic forces Unless specified otherwise, when a design high water surface is shown on the plans at the face of the wall, the design stresses calculated from that elevation to the bottom of wall must include a 0 9 meter [3 foot] minimum differential head of saturated backfill

(h) Design Life Design life shall be in accordance with AASHTO requirements

(i) Depth of embedment Depth of embedment required for frost protection and stability shall be shown on the plans supplied by the designer Minimum embedment depth shall be 300 mm for a non-critical wall

(j) Drainage system Piped drainage shall be designed to collect and dispose of water from the base of the reinforced soil zone and the backfill This shall outlet into surrounding drainage systems or ditches

(k) The design shall provide for end blocks, cap blocks, or other concrete units necessary to give the wall a finished appearance

Submittals The Contractor shall supply wall design computations, wall details, dimensions, quantities, and cross sections necessary to construct the wall Thirty days prior to beginning construction of the wall, the design computations and wall details shall be submitted to the Engineer for review Mix design information shall be submitted including aggregate source, current gradation, aggregate quality information and concrete unit weight If geotechnical design is required, the fully detailed plans shall be prepared in conformance with Subsection 105 7 of the Standard Specifications and shall include, but not be limited to the following items

I A plan and elevation sheet or sheets for each wall, containing the following elevations at the top of leveling pads, the distance along the face of the wall to all steps in the leveling pads, the location of the original and final ground line
II All details for foundations and leveling pads, including details for steps in the leveling pads, as well as allowable and actual maximum bearing pressures shall be provided
III The wall plans shall be prepared and stamped by a Professional Engineer Four sets of design drawings and detail design computations shall be submitted to the Engineer
IV Prior to the beginning of construction, the contractor shall supply the Engineer with two copies of the design-supplier's Installation Manual In addition, the Contractor shall have two copies of the Installation Manual on the project site

CONSTRUCTION REQUIREMENTS

Excavation The excavation and use as fill disposal of all excavated material shall meet the requirements of Section 203 -- Excavation and Embankment, except as modified herein

Foundation The area upon which the prefabricated block gravity wall structure is to rest, and within the limits shown on the submitted plans, shall be graded for a width equal to, or exceeding, the length of the blocks Prior to wall and leveling pad construction, this foundation material shall be compacted to at least 95 percent of maximum laboratory dry density Frozen and unsuitable soil shall be removed and replaced with gravel borrow compacted to 95% of T-180

A concrete leveling pad shall be constructed as indicated on the plans Dimensions may be modified per the wall supplier's recommendations, with written approval of the Resident Engineer The leveling pad shall be cast to the design elevations as shown on the plans, or as required by the wall supplier upon written approval of the Resident Engineer Allowable elevation tolerances are +3 mm [+0 01 foot] and -6 mm [-0 02 foot] from the design elevations Leveling pads which do not meet this requirement shall be repaired or replaced as directed by the Engineer at no additional cost to the Department Placement of wall units may begin after the strength of the concrete leveling pad reaches 6900 kPa (1000 psi) or is adequate to support the proposed loads Contractor may begin placement of concrete block units after 12 hours at his own risk

Method and Equipment Prior to erection of the prefabricated concrete block wall, the Contractor shall furnish the Engineer with detailed information concerning the proposed construction method and equipment to be used The erection procedure shall be in accordance with the manufacturer's instructions Any units that are damaged due to handling will be replaced at the Contractor's expense

Installation of Wall Units A field representative from the wall system being used shall be available, as needed, during the erection of the wall The services of the representative shall be at no additional cost to the project Horizontal joint fillers shall be installed as needed

The maximum offset in any unit horizontal joint shall be 6 5 mm [1/4 inch] The prefabricated wall blocks shall be installed to a tolerance of plus or minus 20 mm in 3 m [3/4 inch in 10 feet] in vertical alignment and horizontal alignment

Select Backfill Placement Backfill placement shall closely follow the erection of each row of prefabricated wall units The Contractor shall decrease the lift thickness if necessary to obtain the specified density The maximum lift thickness shall be 200 mm [8 inches] (loose) Gravel borrow backfill shall be compacted in accordance with Subsection 203 12 except that the minimum required compaction shall be 95 percent of maximum density as determined by AASHTO T99 Method C or D Backfill compaction shall be accomplished without disturbance or displacement of the wall blocks Sheepsfoot rollers will not be allowed Whenever a compaction test fails, no additional backfill shall be placed over the area until the lift is recompacted and a passing test achieved

The moisture content of the backfill material prior to and during compaction shall be uniform throughout each layer Backfill material shall have a placement moisture content less than or equal to the optimum moisture content Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniform and acceptable throughout the entire lift The optimum moisture content shall be determined in accordance with AASHTO T99, Method C or D At the end of the day's operations, the Contractor shall shape the last level of backfill so as to direct runoff of rain water away from the wall face

Method of Measurement Prefabricated Modular Gravity Wall will be measured by the square meter of front surface not to exceed the dimensions shown on the contract plans unless authorized by the Resident Engineer Vertical and horizontal dimensions will be from the edges of the blocks No field measurements for computations will be made unless the Resident Engineer specifies, in writing, a change in the limits indicated on the plans

Basis of Payment The accepted quantity of Prefabricated Modular Gravity Retaining Wall will be paid for at the contract unit price per square meter complete in place Payment shall be full compensation for furnishing geotechnical design as required, all labor, equipment and materials including all precast concrete units, hardware, joint fillers, woven geotextile, geogrid and steel, drainage pipe, and technical field representative

Cost of cast-in-place concrete for leveling pad will not be paid for separately, but will be considered incidental to the Prefabricated Modular Gravity Wall Excavation, foundation material and backfill material will all be incidental to the Prefabricated Modular Gravity Wall

There will be no allowance for excavating and backfilling for the Prefabricated Modular Gravity Wall beyond the limits shown on the approved submitted plans, except for excavation required to remove unsuitable subsoil in preparation for the foundation Payment for excavating unsuitable subsoil shall be full compensation for all costs of pumping, drainage, sheeting, bracing and incidentals for proper execution of the work

Payment will be made under

Pay Item	Pay Unit
635 31 Prefabricated Concrete Block Gravity Wall	Square Meter(square foot)