MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE

GEOTECHNICAL DESIGN REPORT

For the Reconstruction of:

STATE ROUTE 2
MILFORD, MAINE

Prepared by:
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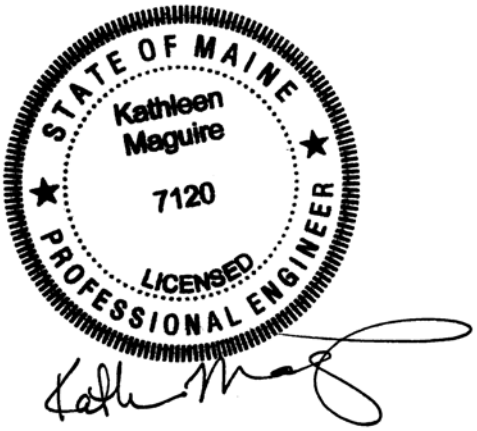

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Penobscot County Soils Report No. 2015-30

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GEOTECHNICAL DESIGN SUMMARY

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical recommendations for the design and reconstruction of approximately 1.69 miles of State Route 2 and a retaining wall in Milford, Maine. The project begins at Bradley Road and extends northeasterly to approximately 0.04 miles east of Grove Street. The following design recommendations are discussed in detail in Section 6 of this report.

Base and Subbase Soils - A resilient modulus of 5,200 psi can be used for the existing sand, silt, silty clay, and silty sand subgrade soils. The existing base and subbase materials do not meet the required MaineDOT Standard Specification gradations and are not recommended for reuse. Excavated subbase sand and gravel may be used as fill below subgrade level in fill areas provided all other requirements of MaineDOT Standard Specifications 203 and 703 are met.

Subgrade Soils - The native subgrade soils at the site will be susceptible to disturbance and rutting. All subgrade surfaces should be protected from any unnecessary construction traffic. If disturbance and rutting occur, remove and replace disturbed areas with compacted gravel borrow. Any cobbles or boulder encountered in excess of 6 inches shall be removed and replaced with compacted gravel borrow or ¾ inch stone. A non-woven stabilization geotextile can be used to minimize subgrade soil migration into the aggregate subbase material.

Surface Water and Groundwater - The Contractor shall control surface water and groundwater infiltration during construction using temporary ditches, sumps, granular drainage blankets, stone ditch protection or hand-laid riprap with geotextile underlayment to divert surface water and groundwater.

Bedrock Removal - Bedrock excavation for drainage may be necessary along the project. The nature, slope and degree of fracturing in the bedrock surface will not be evident until the excavations are made. Excavation of bedrock material may be done using conventional excavation methods, but may require drilling and blasting techniques. It is anticipated that there may be seepage of water from fractures and joints exposed in the bedrock surface.

Frost Protection - The approximate frost depth for the site considering the site soils and natural water contents determined in the laboratory ranges from approximately 4.0 to 6.5 feet. Any lenses of water trapped above these depths will freeze and potentially distort the pavement section.

Retaining Wall - A retaining wall will be necessary to accommodate the addition of a 5 foot sidewalk on the east side of US Route 2. The construction of a wet cast small landscape block wall is recommended. The proposed retaining wall shall be supplier designed. The factored bearing pressure for at the strength limit state for wall on native soils shall not exceed the calculated factored bearing resistance of 2.2 kips per square foot (ksf). A factored bearing resistance of 5 ksf shall be used to control settlement when analyzing the service limit state as allowed in LRFD C10.6.2.6.1. In no instance shall the bearing stress exceed the nominal resistance of the structural concrete which may be taken as 0.3f'c.

1.0 INTRODUCTION

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical recommendations for the design and reconstruction of approximately 1.69 miles of State Route 2 in Milford, Maine. The project begins at Bradley Road and extends northeasterly to approximately 0.04 miles east of Grove Street as shown on Sheet 1 – Location Map.

The project is located on the easterly side of the Penobscot River. In 1932 this portion of roadway was built over an approximately 20 foot wide Portland Cement Concrete (PCC) slab. The existing roadway deficiencies include poor drainage, poor intersection safety and operation, poor pavement condition, poor driveway definition and uncontrolled on-street parking. The project lies between two sections of recently reconstructed roadway.

The roadway will be reconstructed with 11 foot lanes and 6 foot shoulders. The existing turning lanes onto Old County Road and Bradley road will be evaluated and maintained in the reconstruction. The exiting PCC slab will be removed to allow for better storm water collection and to minimize reflective cracking and/or differential settlement at roadway edges. Storm water will be contained in a closed drainage system. Type 1 granite curbing will be used. A 5 foot sidewalk will be constructed. A precast concrete block retaining wall will be constructed from approximately Station 360+72 to approximately Station 360+18.

2.0 GEOLOGIC SETTING

According to the Surficial Geology Map entitled Old Town Quadrangle, Maine Open File 12-15 (2012) published by the Maine Geologic Survey, the surficial soils along the proposed project length consist of 3 types: Stream Alluvium, Presumpscot Formation and Till. Stream alluvium is present in the southern portion of the project limits and consists of sand, gravel and silt deposited on banks of modern streams. Presumpscot Formation soils are present in the northern portion of the project limits and consist of fine grained marine silts and clays. Till is present in the middle and northern most portions of the project limits and consists of loose to compact and well graded weakly stratified clay , silt, sand and gravel. Boulders may be present on the surface.

3.0 SUBSURFACE INVESTIGATION

Subsurface conditions at the site were explored by drilling twenty (20) test borings and five (5) pavement cores. All of the borings and pavement cores PC-1 through PC-4 were drilled between April 25 and 29, 2003 by the Maine Department of Transportation (MaineDOT) drill crew. Pavement core PC-5 was drilled on July 11, 2002 by the MaineDOT drill crew. No Standard Penetration Testing (SPT) was done in the test borings. All soils samples were taken from the drill auger flights for visual identification and laboratory testing. No falling weigh deflectometer (FWD) analysis was done at the site due to the presence of concrete pavement. The boring and pavement core locations are shown on Sheets 2 through 8 - Boring Location Plans. Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are presented in the boring logs provided in Appendix A - Boring Logs.

The MaineDOT Geotechnical Team member selected the boring locations and drilling methods, designated type and depth of samplings obtained, reviewed field logs for accuracy and identified laboratory testing requirements. A New England Transportation Technician Certification Program (NETTCP) Certified Subsurface Inspector logged the subsurface conditions encountered in the field. The borings were located in the field by taping to site features after completion of each boring.

4.0 LABORATORY TESTING

A laboratory testing program was conducted on selected soil samples obtained in the test borings to assist in soil classification, evaluation of engineering properties of the soils and geologic assessment of the project site. Laboratory testing consisted of eleven (11) standard grain size analyses with natural water content and nine (9) grain size analyses with hydrometer and natural water content. The results of laboratory tests are included as Appendix B - Laboratory Test Results. Laboratory test information is also shown on the boring logs provided in Appendix A – Boring Logs.

5.0 SUBSURFACE CONDITIONS

Subsurface conditions encountered under the pavement structure generally consisted of gravel, sand, silt, silty clay, and silty sand. The boring and pavement core locations are shown on Sheets 2 through 8 - Boring Location Plans. The boring logs are provided in Appendix A – Boring Logs.

5.1 Existing Pavement Section and Subbase

At the boring and pavement core locations the existing pavement section was found to be made up of approximately 1.2 to 7.2 inches of hot mix asphalt (HMA) and approximately 6.0 to 7.2 inches of PCC. Lesser thicknesses of HMA and PCC were encountered at locations outside the travel way (in roadway shoulders). Borings HB-MILF-112 and HB-MILF-119 encountered an approximately 2.4 to 4.8 inch thick gravel layer between the HMA and PCC.

Subbase gravel encountered beneath the PCC ranged from approximately 7.2 to 19.2 inches in thickness along the project length. Soils samples taken from the drill auger flights during drilling and tested in the laboratory were compared to MDOT Standard Specification 703.06, Aggregate for Base and Subbase Type D or E for possible material reuse.

Existing pavement layer and subbase thicknesses encountered at the boring and pavement core locations are summarized in Table 1 below.

Boring No.	Approximate Location		Pavement Section		
	Station	Offset (feet)	HMA (inches)	PCC (inches)	Subbase (inches)
HB-MILF-101	332+84	22.1 LT	7.2	6.0	16.8
HB-MILF-102	332+84	18.3 RT	0	0	26.4
HB-MILF-103	337+93	5.3 LT	6.0	6.0	14.4
PC-1	338+19	5.2 LT	6.6	7.0	--
HB-MILF-104	338+26	6.2 RT	4.8	6.0	19.2
HB-MILF-105	342+85	8.5 LT	6.0	6.0	12.0
HB-MILF-106	342+85	9.5 RT	7.2	6.0	10.8
HB-MILF-107	345+47	29.6 LT	0	--	--
HB-MILF-108	345+64	6.2 RT	7.2	7.2	15.6
PC-2	345+90	5.5 RT	5.4	6.2	--
HB-MILF-109	349+41	9.5 RT	6.0	0	19.2
HB-MILF-110	350+39	25.6 LT	2.4	0	12.0
PC-5	352+26	7.6 LT	5.4	7.1	--
HB-MILF-111	353+68	36.2 LT	0	0	7.2
PC-3	353+84	7.2 LT	4.8	7.2	--
HB-MILF-112	355+32	26.9 LT	2.4[a]	3.6	9.6
HB-MILF-113	355+32	6.9 RT	4.8	6.0	7.2
HB-MILF-114	360+24	5.6 RT	6.0	6.0	6.0
HB-MILF-115	360+40	14.4 LT	3.6	0	19.2
HB-MILF-116	365+16	11.6 LT	1.2	0	12.0
HB-MILF-117	365+16	14.4 RT	0	0	12.0
HB-MILF-118	370+08	4.9 LT	6.0	6.0	18.0
HB-MILF-119	370+08	9.9 RT	3.6[a]	6.0	15.6
PC-4	370+31	6.2 RT	6.2	6.1	--
HB-MILF-120	373+36	10.8 RT	3.6	0	16.8

HMA = Hot Mix Asphalt
-- = not applicable
PCC = Portland Cement Concrete
a = layer of gravel present between HMA and PCC

Table 1 - Existing Pavement Layer and Subbase Thicknesses

Grain size analyses conducted on eight (8) samples of the existing subbase material resulted in the soil being classified as an A-2-4, A-1-b or A-1-a under the AASHTO Soil Classification System and an SM, GM or GC-GM under the Unified Soil Classification System. The measured natural water contents of the existing subbase material samples tested ranged from approximately 4 to 13 percent.

5.2 Subgrade Soils

Subgrade soils encountered under the existing subbase material generally consisted of gravel, sand, silt, silty clay, and silty sand. Silt and clay soils were encountered in the vicinity of County Road (HB-MILF-103 and HB-MILF-104) and in the vicinity of Station 370+00 (HB-MILF-118 and HB-MILF-119). Subgrade soils over the remainder of the project length were found to be

granular (sands) although the fines content (material passing the #200 sieve) was found to be greater than 10% in all samples.

Existing subgrade soils encountered at the boring locations are summarized in Table 2 below.

Boring No.	Approximate Location		Subgrade Soils and Comments
	Station	Offset (feet)	
HB-MILF-101	332+84	22.1 LT	Silty fine to coarse sand, trace clay, some gravel.
HB-MILF-102	332+84	18.3 RT	Shoulder – Silty fine to coarse sand, trace clay, trace gravel.
HB-MILF-103	337+93	5.3 LT	Silt, some clay, some sand, trace gravel.
HB-MILF-104	338+26	6.2 RT	Silty clay, trace sand.
HB-MILF-105	342+85	8.5 LT	Silty fine to coarse sand, trace clay, trace gravel.
HB-MILF-106	342+85	9.5 RT	Silty fine to coarse sand, trace clay, trace gravel.
HB-MILF-107	345+47	29.6 LT	Shoulder – Fine to coarse sand, some silt, little gravel.
HB-MILF-108	345+64	6.2 RT	Fine to coarse sand, some silt.
HB-MILF-109	349+41	9.5 RT	Sand, some silt, little gravel.
HB-MILF-110	350+39	25.6 LT	Shoulder – Fine to coarse sand, some silt, little gravel.
HB-MILF-111	353+68	36.2 LT	Shoulder – Fine to coarse sand, some silt, little gravel.
HB-MILF-112	355+32	26.9 LT	Shoulder – Fine to coarse sand, some silt, little gravel.
HB-MILF-113	355+32	6.9 RT	Fine to coarse sand, some silt, little gravel.
HB-MILF-114	360+24	5.6 RT	Gravelly fine to coarse sand, little silt.
HB-MILF-115	360+40	14.4 LT	Shoulder – Gravelly fine to coarse sand, little silt.
HB-MILF-116	365+16	11.6 LT	Silty fine to coarse sand, trace gravel.
HB-MILF-117	365+16	14.4 RT	Shoulder – Silty fine to coarse sand, trace gravel.
HB-MILF-118	370+08	4.9 LT	Fine to coarse sand, some silt, little gravel, trace clay.
HB-MILF-119	370+08	9.9 RT	Sandy silt, trace gravel, trace clay.
HB-MILF-120	373+36	10.8 RT	Fine to coarse sand, some silt, little gravel.

Table 2 - Existing Subgrade Soils

Grain size analyses conducted on twelve (12) samples of the existing subgrade soils resulted in the soil being classified as an A-4, A-7, A-2-4 or A-1-b under the AASHTO Soil Classification System and an SC-SM, CL-ML, CL, or SM under the Unified Soil Classification System. The measured natural water contents of the existing subgrade soil samples tested ranged from approximately 8 to 23 percent.

5.3 Refusal Surface

Refusal of the drilling tools was encountered in borings HB-MILF-111 (Station 353+68), HB-MILF-114 (Station 360+24), HB-MILF-115 (Station 360+40), HB-MILF-116 (Station 365+16) and HB-MILF-117 (Station 365+16) at depths ranging from approximately 3.6 to 11.9 feet below ground surface (bgs). The remaining borings did not encounter a refusal surface. No rock cores were taken along the project and the nature of the refusal surface was not determined.

5.4 Groundwater

The measured groundwater level in the borings ranged from approximately 1.7 to 8.0 feet bgs. The groundwater levels measured during drilling activities are indicated on the boring logs in Appendix A. No water was introduced into the boreholes during the drilling operations. Groundwater levels along the project will fluctuate with seasonal changes, runoff and adjacent construction activities.

6.0 GEOTECHNICAL RECOMMENDATIONS

The following subsections discuss the geotechnical-related design features of this Milford Route 2 reconstruction project. Based on the findings along the project, full reconstruction of the roadway is recommended. A retaining wall will be necessary to accommodate the addition of a 5 foot sidewalk on the east side of US Route 2 in the area of Station 360+17 to 360+73.

6.1 Pavement and Subbase Soils

No falling weigh deflectometer (FWD) analysis was done at the site due to the presence of concrete pavement. A resilient modulus of 5,200 psi can be used for the existing sand, silt, silty clay, and silty sand subgrade soils. Pavement design for this project was done by the MaineDOT pavement group.

Soils samples of existing subbase materials taken from the drill auger flights during drilling and tested in the laboratory were compared to MaineDOT Standard Specification 703.06, Aggregate for Base and Subbase Type D or E for possible material reuse. None of the samples tested meet the material specification and reuse of the materials for base or subbase is not recommended. Excavated subbase sand and gravel may be used as fill below subgrade level in fill areas provided all other requirements of MaineDOT Standard Specifications 203 and 703 are met.

6.2 Subgrade Soils

Subgrade soils encountered under the existing subbase material generally consisted of gravel, sand, silt, silty clay, and silty sand. The native subgrade soils at the site will be susceptible to disturbance and rutting as a result of exposure to water and construction traffic. All subgrade surfaces should be protected from any unnecessary construction traffic. If disturbance and rutting occur, the Contractor shall remove and replace disturbed areas with compacted gravel borrow. Any cobbles or boulder encountered in excess of 6 inches shall be removed and replaced with compacted gravel borrow (MaineDOT Standard Specification 703.20, Item No. 203.26) or ¾ inch stone (MaineDOT Standard Specification 703.13, Item No. 203.35). A non-woven stabilization geotextile can be used to minimize subgrade soil migration into the aggregate subbase material.

6.3 Surface Water and Groundwater

Shallow groundwater was encountered in boring HB-MILF-119. Geotextile stabilization is not anticipated. If areas of geotextile stabilization are required for construction, non-woven fabric meeting the requirements of Standard Specification 722.01 shall be used.

The Contractor shall control surface water and groundwater infiltration during construction using temporary ditches, sumps, granular drainage blankets, stone ditch protection or hand-laid riprap with geotextile underlayment to divert surface water and groundwater.

6.4 Bedrock Removal

Refusal of the drilling tools was encountered in borings HB-MILF-111, HB-MILF-114, HB-MILF-115, HB-MILF-116 and HB-MILF-117 at depths ranging from approximately 3.6 to 11.9 bgs. Bedrock excavation for drainage may be necessary in the vicinity of these borings. Additional shallow bedrock may be encountered during construction of the underdrain system.

Construction activities should not be permitted to disturb the bedrock mass or to create any rock falls or any open fissures. The nature, slope and degree of fracturing in the bedrock surface will not be evident until the excavations are made. The final excavated bedrock surface shall be approved by the Resident.

Excavation of bedrock material may be done using conventional excavation methods, but may require drilling and blasting techniques. Blasting should be conducted in accordance with Section 105.2.6 of the MaineDOT Standard Specifications. It is also recommended that the contractor conduct pre-and post-blast surveys, as well as blast vibration monitoring at nearby structures in accordance with industry standards at the time of the blast.

It is anticipated that there may be seepage of water from fractures and joints exposed in the bedrock surface. Water should be controlled by pumping from sumps.

6.6 Frost Protection

The subgrade soils encountered in the borings are moderately to highly frost susceptible based on the amount of material passing the #200 sieve. Frost depth below a roadway depends on grain size distribution of the subgrade soils and the thickness of the pavement section. According to the Modberg Software by the US Army Cold Regions Research and Engineering Laboratory, the site has an air design-freezing index of approximately 1588 F-degree days. Table 3 below summarizes the approximate frost depth for the site considering the site soils and natural water contents determined in the laboratory.

Subgrade Soils	Approximate Laboratory Water Content	Approximate Frost Depth (feet)
Granular Soils	10%	5.5
Silt or Clay Soils	20%	4.3

Table 3 – Approximate Frost Depth

Any lenses of water trapped above these depths will freeze and potentially distort the pavement section. See Appendix C- Calculations for supporting documentation.

6.7 Retaining Wall

A retaining wall will be necessary to accommodate the addition of a 5 foot sidewalk on the east side of US Route 2 in the area of Station 360+17 to 360+73. The construction of a wet cast small landscape block wall is recommended. The proposed retaining wall shall be supplier designed by a Professional Engineer licensed in the State of Maine in accordance with AASHTO LRFD Bridge Design Specifications 7th Edition 2014 (LRFD) and Standard Specification 673. The proposed wall details are shown on Sheet 9 – Retaining Wall Details.

The factored bearing pressure for at the strength limit state for wall on native soils shall not exceed the calculated factored bearing resistance of 2.2 kips per square foot (ksf). A factored bearing resistance of 5 ksf shall be used to control settlement when analyzing the service limit state as allowed in LRFD C10.6.2.6.1. In no instance shall the bearing stress exceed the nominal resistance of the structural concrete which may be taken as $0.3f'_c$. See Appendix C - Calculations for supporting documentation.

7.0 CLOSURE

This report has been prepared for the use of the MaineDOT Highway Program for specific application to the proposed reconstruction of US Route 2 in Milford, Maine in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

In the event that any changes in the nature, design, or location of the proposed project are planned, this report should be reviewed by a geotechnical engineer to assess the appropriateness of the conclusions and recommendations and to modify the recommendations as appropriate to reflect the changes in design. Further, the analyses and recommendations are based in part upon limited soil explorations at discrete locations completed at the site. If variations from the conditions encountered during the investigation appear evident during construction, it may also become necessary to re-evaluate the recommendations made in this report.

It is also recommend that the geotechnical designer be provided the opportunity for a general review of the final design plans and specifications in order to verify that the earthwork and foundation recommendations have been properly interpreted and implemented in the design.

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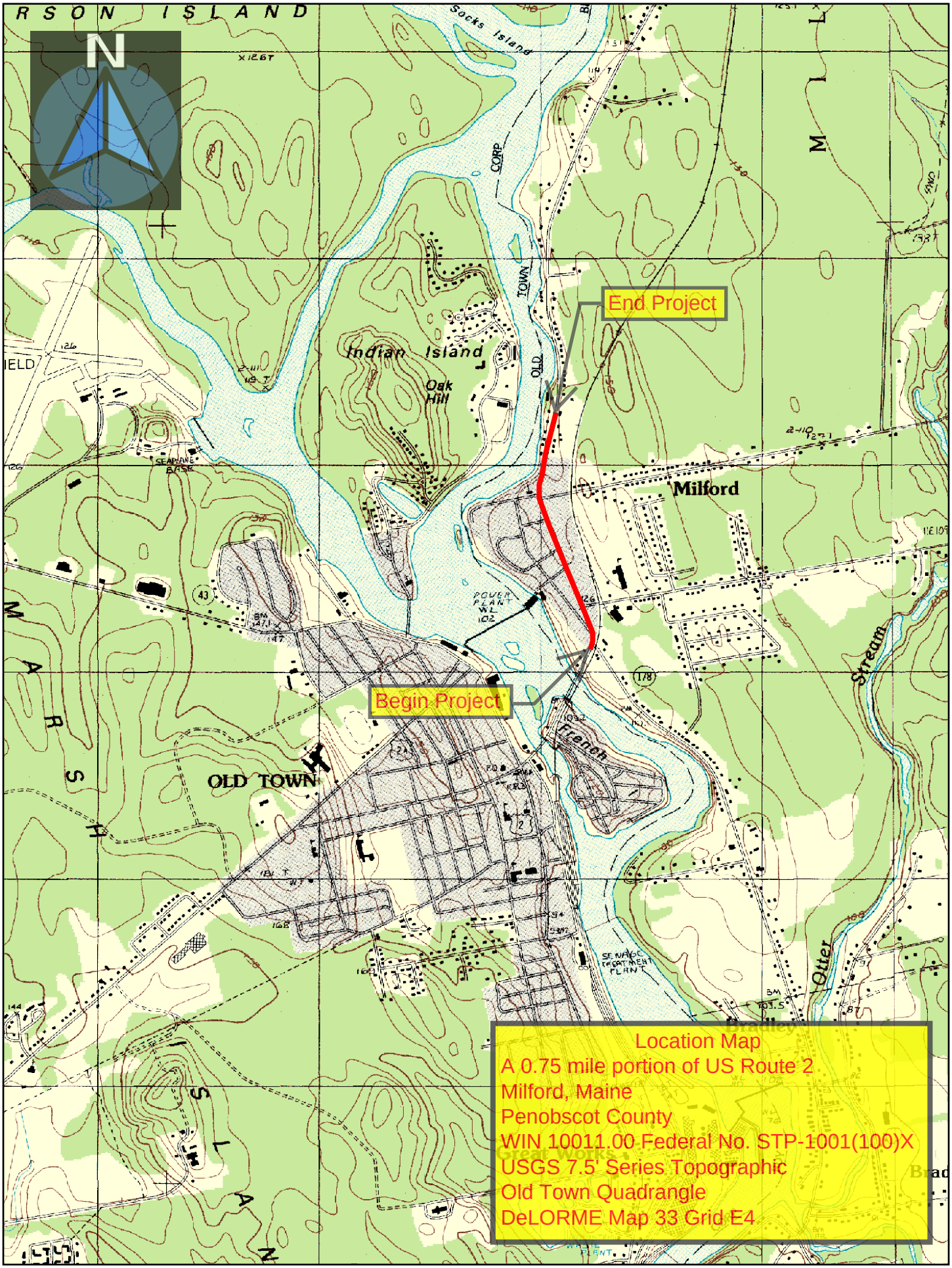
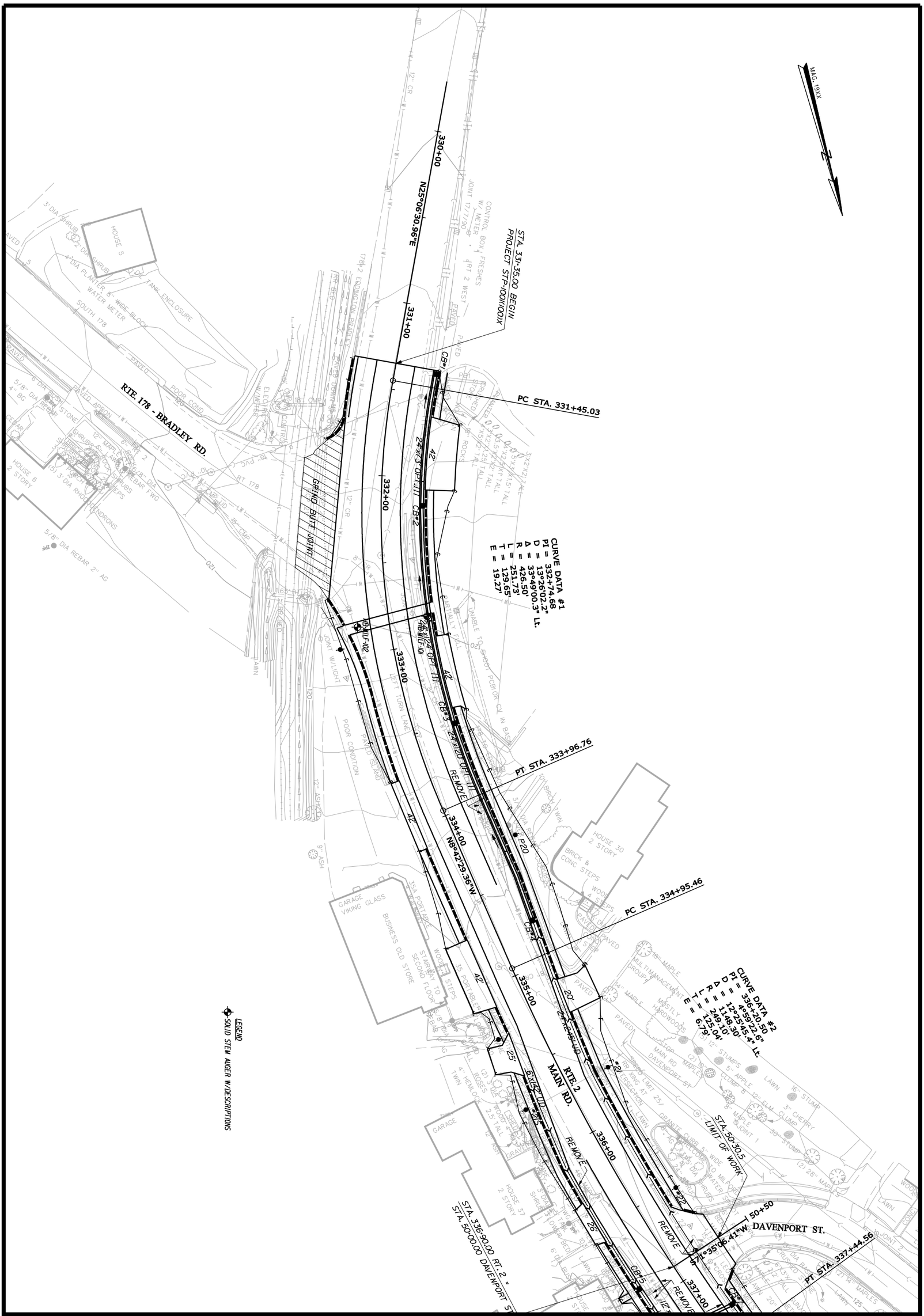


Map Scale 1:24000

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



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MILFORD
US ROUTE 2

BORING LOCATION PLANS

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

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HIGHWAY PLANS

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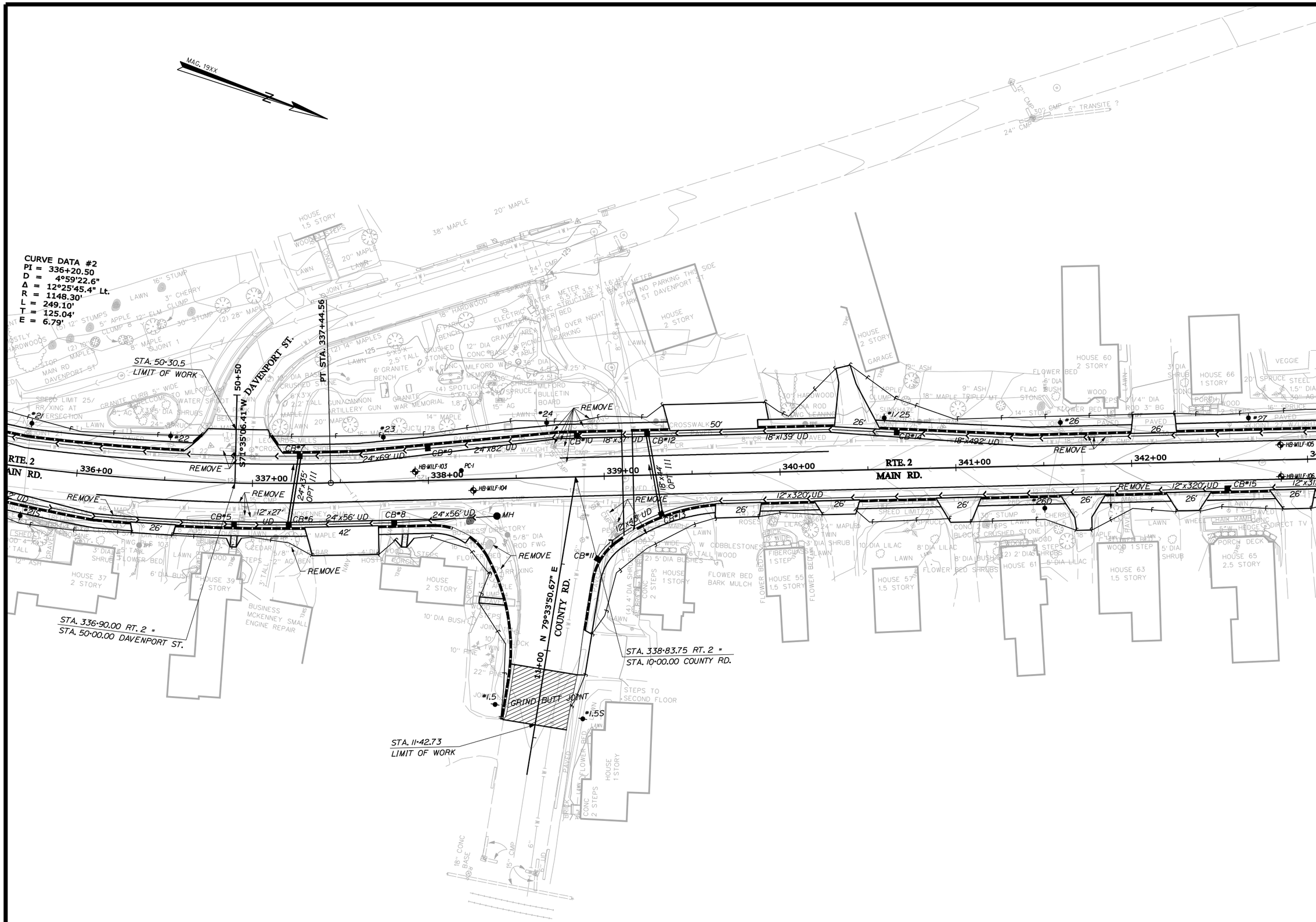

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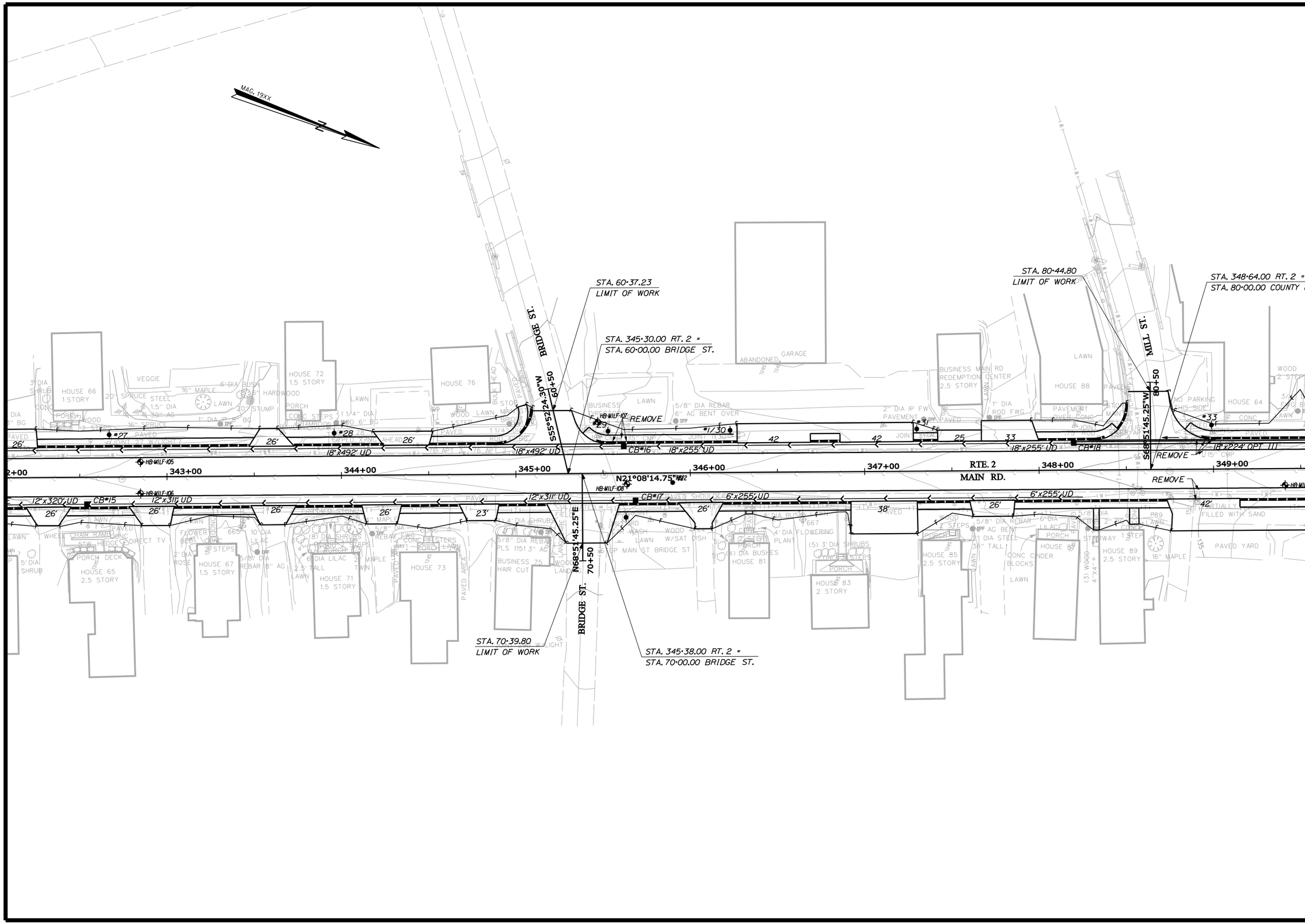

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US ROUTE 2

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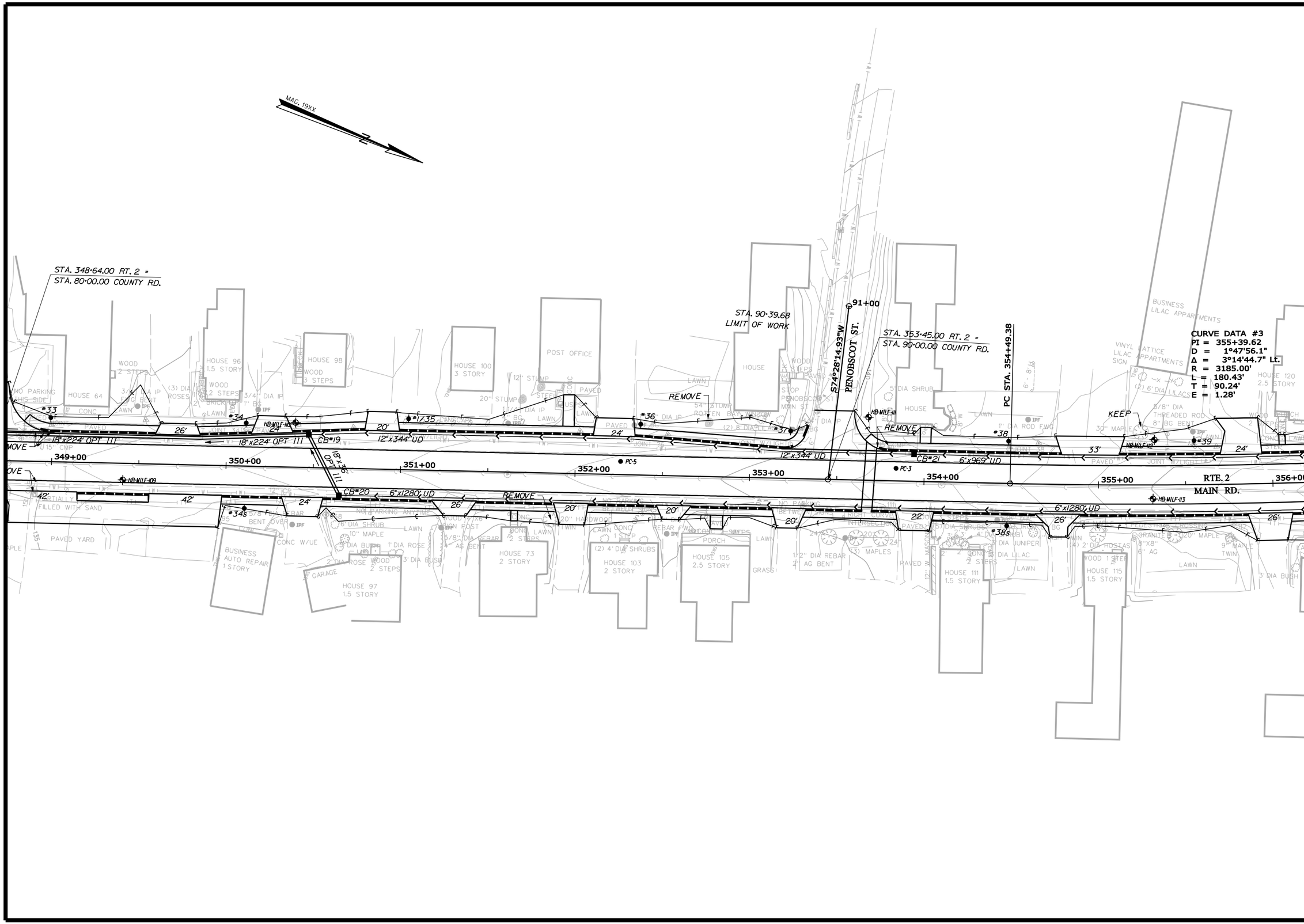

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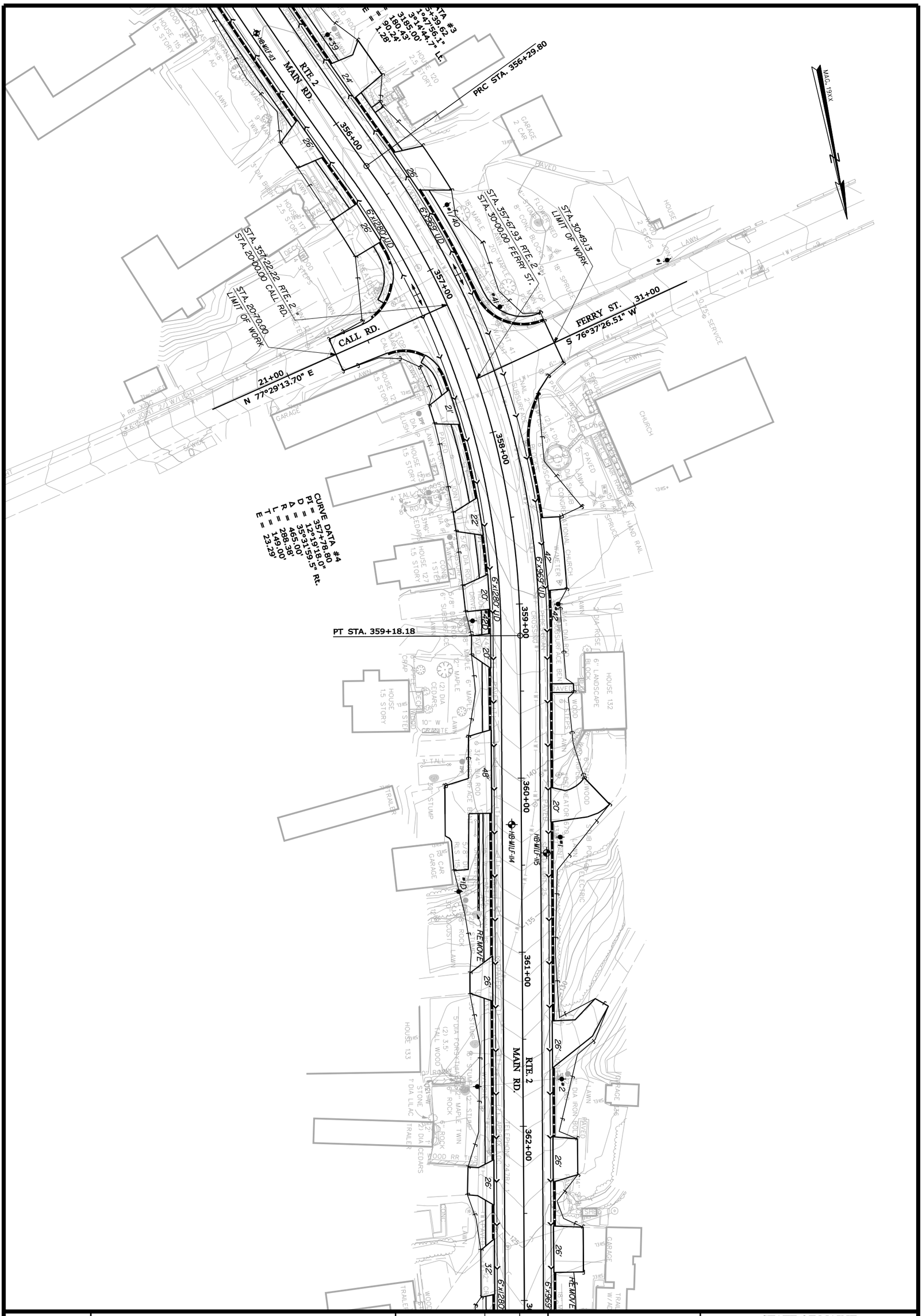

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DESIGN2-DETAILED2	S. Paul	------	------
DESIGN3-DETAILED3	K.MAGUIRE	T.WHITE	NOV 2015
REVISIONS 1	------		------
REVISIONS 2	------		------
REVISIONS 3	------		------
REVISIONS 4	------		------
FIELD CHANGES	------		------

SIGNATURE

P.E. NUMBER

DATE

MILFORD
US ROUTE 2

BORING LOCATION PLANS

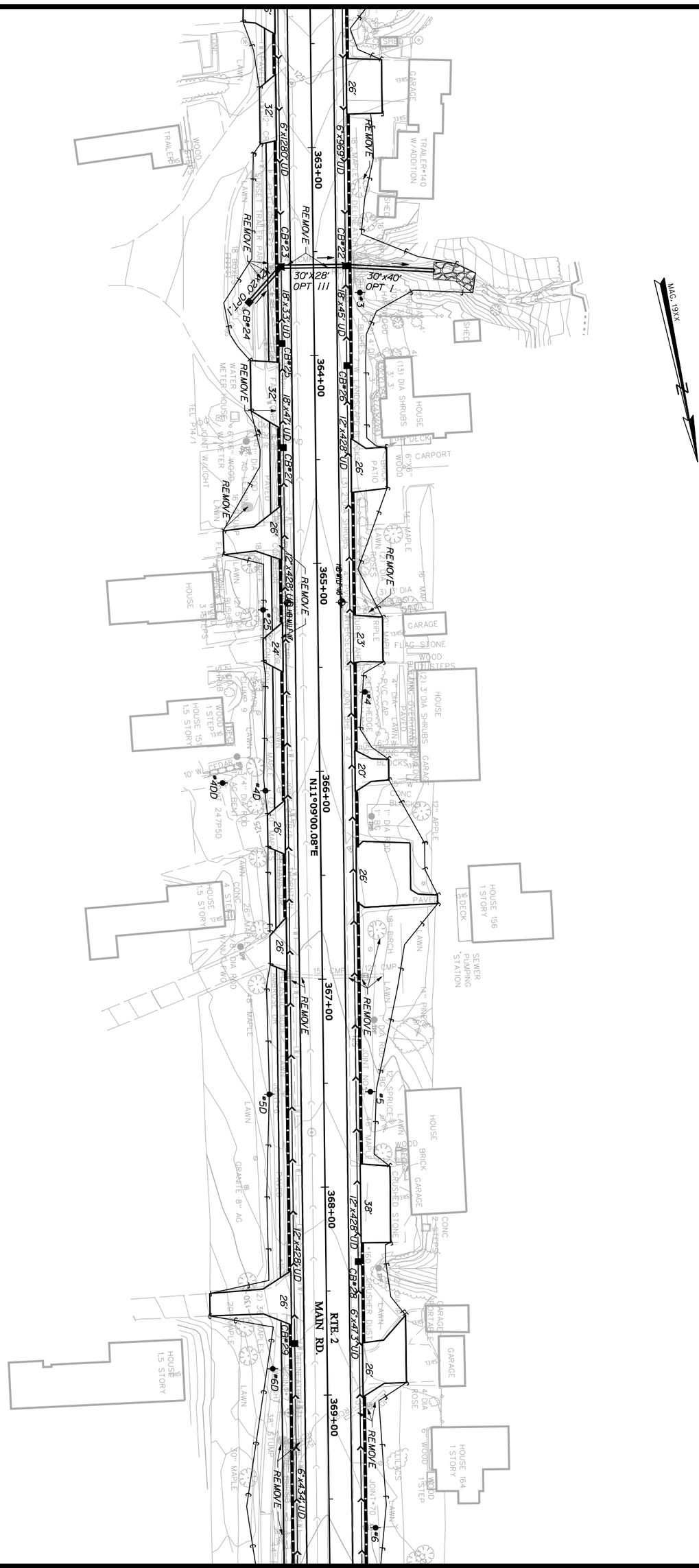
SHEET NUMBER 6 OF 9

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

STP-1001(100)X

WIN
W.I.N. 010011.00

HIGHWAY PLANS



PROJ. MANAGER	P. MacDonald	BY	DATE
DESIGN-DETAILED	HNTB	BT Tran	
CHECKED-REVIEWED	-----	-----	-----
DESIGN2-DETAILED2	S. Paul	-------	------
DESIGN3-DETAILED3	K.MAGUIRE	T.WHITE	NOV 2015
REVISIONS 1	------		------
REVISIONS 2	------		------
REVISIONS 3	------		------
REVISIONS 4	------		------
FIELD CHANGES	------		------

SIGNATURE

P.E. NUMBER

DATE

MILFORD
US ROUTE 2

BORING LOCATION PLANS

SHEET NUMBER 7 OF 9

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

STP-1001(100)X

WIN
W.I.N. 010011.00

HIGHWAY PLANS

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

STP-1001(100)X

WIN
W.I.N. 010011.00

HIGHWAY PLANS

PROJ. MANAGER	P. MacDonald	BY	DATE	
DESIGN-DETAILED	HNTB	BT Tran		SIGNATURE
CHECKED-REVIEWED	-----	-----	-----	
DESIGN2-DETAILED2	S. Poul	-----	-----	
DESIGN3-DETAILED3	K.MAGUIRE	T.WHITE	NOV 2015	P.E. NUMBER
REVISIONS 1	-----	-----	-----	
REVISIONS 2	-----	-----	-----	
REVISIONS 3	-----	-----	-----	DATE
REVISIONS 4	-----	-----	-----	
FIELD CHANGES	-----	-----	-----	

MILFORD
US ROUTE 2

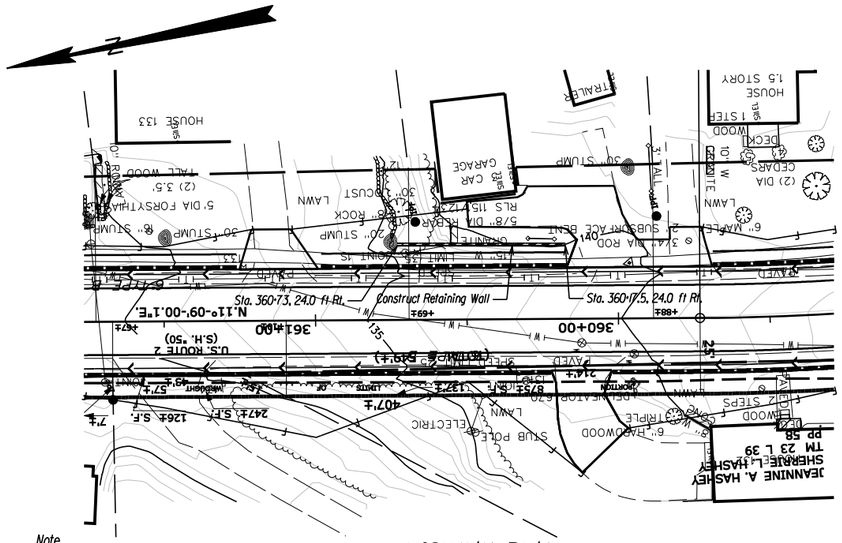
BORING LOCATION PLANS

SHEET NUMBER

8

OF 9

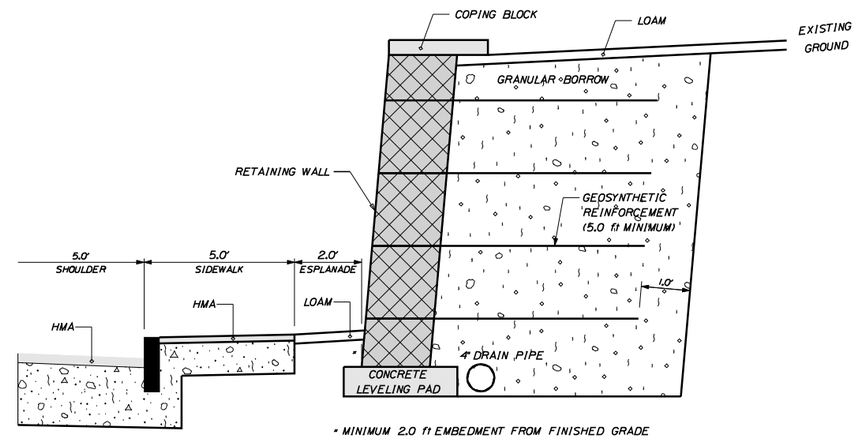
Filename: ...\00\geotech\msto\008_BLP7.dgn Division: GEOTECH Username: terry.white Date:11/17/2015



Note.
1. Highway Plan has bee rotated 180 degrees to align Station direction with Retaining Wall Plan and Retaining Wall Elevation.

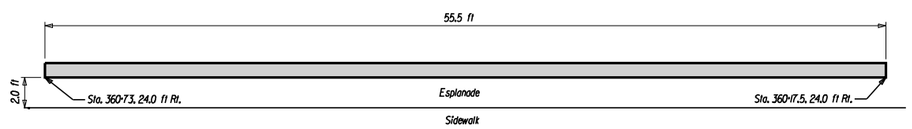
HIGHWAY PLAN

25 0 25 50
Scale in Feet



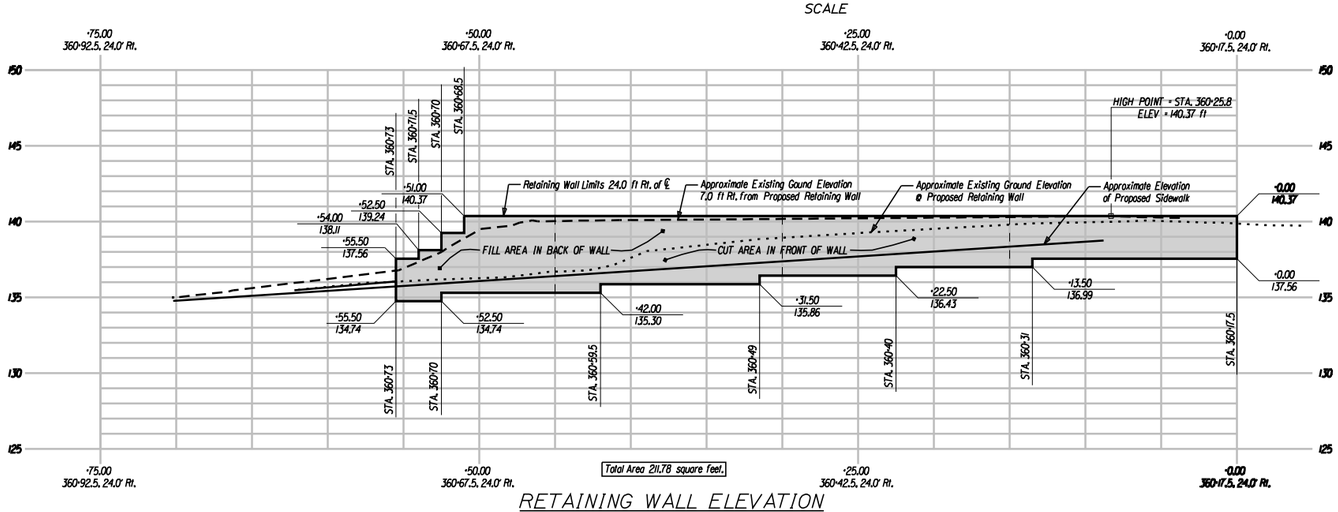
* MINIMUM 2.0 ft EMBEDMENT FROM FINISHED GRADE OF SIDEWALK TO BOTTOM OF CONCRETE LEVELING PAD.

TYPICAL SECTION



RETAINING WALL PLAN

5 0 5 10
SCALE



RETAINING WALL ELEVATION

HORIZ 5 0 5 10
VERT 5 0 5 10
SCALE

LEGEND

+22.50 = Total Feet From +0.00 Point
136.99 = Elevation of Block in Feet

1.
THE CONTRACTOR SHALL PROVIDE A WET CAST SMALL LANDSCAPE BLOCK WALL IN ACCORDANCE WITH SPECIAL PROVISION 673. REQUIRED DESIGN SHALL BE STAMPED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF MAINE AND THE DESIGN AND SHOP DRAWINGS SHALL BE SUBMITTED TO THE RESIDENT FOR REVIEW.
PLAN DETAILS ARE SHOWN FOR ESTIMATING PURPOSES ONLY.
2.
BACKFILL AND FOUNDATION SOIL PARAMETERS FOR USE IN THE SUBMITTED DESIGN SHALL BE IN ACCORDANCE WITH SPECIAL PROVISION 673.
3.
THE PRECAST CONCRETE BLOCK GRAVITY WALLS SHALL BE DESIGNED IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 7TH EDITION, 2014, AND SPECIAL PROVISION 673.
NO TRAFFIC LOADING WILL BE REQUIRED IN THE DESIGN OF WALL.
4.
FOR THE STRENGTH LIMIT STATE THE APPLIED FACTORED BEARING PRESSURE FOR THE WETCAST SMALL LANDSCAPE BLOCK WALL SHALL NOT EXCEED A FACTORED BEARING RESISTANCE OF 2.2 KSF.
5.
PIPED DRAINAGE SHALL BE INCLUDED IN THE DESIGN OF THE WALL. WALL DRAINAGE WILL BE INCIDENTAL TO CONSTRUCTION OF THE WALL.
6.
A MINIMUM EMBEDMENT DEPTH OF 2.0 FEET IS REQUIRED FOR CONSTRUCTION OF THE WET CAST SMALL LANDSCAPE CONCRETE BLOCK WALL.
7.
RETAINING WALL ELEVATION DRAWN FACING RIGHT OF CENTRAL LINE. DOWN STATION TO RIGHT AND UP STATION TO LEFT.
8.
END AND STANDARD COPING NOT SHOWN ON PLAN AND ELEVATION VIEWS.
9.
PLAN VIEW WALL BATTER NOT SHOWN.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

STP-1001(100)X

WIN
W.I.N. 010011.00

HIGHWAY PLANS

		BY	DATE
PROJ. MANAGER	P. MacDonald		
DESIGN-DETAILED	HNTB	BT Tran	
CHECKED-REVIEWED	-----	-----	-----
DESIGN2-DETAILED2	S. Paul	-----	-----
DESIGN3-DETAILED3	K.MAGUIRE	T.WHITE	NOV 2015
REVISIONS 1	-----	-----	-----
REVISIONS 2	-----	-----	-----
REVISIONS 3	-----	-----	-----
REVISIONS 4	-----	-----	-----
FIELD CHANGES	-----	-----	-----

SIGNATURE
P.E. NUMBER
DATE

MILFORD
US ROUTE 2

RETAINING WALL DETAILS

SHEET NUMBER
9
OF 9

Filename: ...\009_RETAINING WALL DETAILS1.dgn Division: GEOTECH Username: terry.white Date:11/17/2015

Appendix A

Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

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

Desired Soil Observations: (in this order)

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

TERMS DESCRIBING DENSITY/CONSISTENCY

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

Modified Burmister System

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

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

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

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

Rock Quality Designation (RQD):

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

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

Correlation of RQD to Rock Mass Quality

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

Desired Rock Observations: (in this order)

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

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

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

Sample Container Labeling Requirements:

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-101
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	119.75	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	332+84, 22.1 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	119.15	PAVEMENT -HMA 0.60	
							118.65	CONCRETE - PCC 1.10	
	S3	16.8/16.8	1.10 - 2.50					Brown, moist, fine to coarse SAND, some silt, some gravel.	G#128473 A-2-4, SM WC=11.1%
							117.25	2.50 Brown, moist, Silty fine to coarse SAND, trace clay, trace gravel.	
5									
10									
15							104.75	15.00 **Bottom of Exploration at 15.00 feet below ground surface.** No Refusal	
20									
25									

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-102
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	119.75	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	332+84, 18.3 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	6.5 ft bgs.

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S1	26.4/26.4	0.00 - 2.20			SSA		Brown, damp, fine to coarse SAND, some gravel, some silt.	G#128474 A-1-b, SM WC=9.1%
	S2	51.6/51.6	2.20 - 6.50				117.55 (2.20)	Brown, moist, Silty fine to coarse SAND, trace clay, trace gravel.	G#100576 A-4, SC-SM WC=13.1%
5							113.25 (6.50)	Similar to above but, wet with occasional cobbles.	
10									
15							104.75 (15.00)	**Bottom of Exploration at 15.00 feet below ground surface.** No Refusal	
20									
25									

Remarks:

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-103
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	124.67	**Auger ID/OD:**	5" Dia
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/29/03-4/29/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	337+93, 5.3 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	124.17		PAVEMENT - HMA 0.50	
							123.67		CONCRETE - PCC 1.00	
	S18	14.4/14.4	1.00 - 2.20						Brown, damp, Sandy GRAVEL, little silt. 2.20	G#100577 A-1-a, GM WC=4.2%
	S19	93.6/93.6	2.20 - 10.00				122.47		Brown, damp, SILT, some clay, some sand, trace gravel.	G#100578 A-4, CL-ML WC=18.1%
5										
10							114.67		10.00	
15										
20										
25										

Bottom of Exploration at 10.00 feet below ground surface.
No Refusal

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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-MILF-103

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-104
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	124.67	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	338+26, 6.2 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	8.0 ft bgs.

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S4	19.2/19.2	0.90 - 2.50			SSA	124.27	PAVEMENT - HMA (0.40)	
							123.77	CONCRETE - PCC (0.90)	
								Brown, damp, Sandy GRAVEL, little silt.	G#100579 A-1-a, GM WC=3.7%
	S5	66/66	2.50 - 8.00				122.17	Brown, damp, Silty CLAY, trace sand. (2.50)	G#100580 A-7, CL WC=22.8%
5									
							116.67	Brown, wet, fine to coarse SAND, some silt, little gravel, trace clay. (8.00)	
	S6	84/84	8.00 - 15.00						G#100581 A-4, SC-SM WC=13.1%
10									
15							109.67	**Bottom of Exploration at 15.00 feet below ground surface.** No Refusal (15.00)	
20									
25									

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-105
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	130.91	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	342+85, 8.5 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	130.41		PAVEMENT - HMA (0.50)	
							129.91		CONCRETE - PCC (1.00)	
							128.91		Brown, damp, Sandy GRAVEL, little silt. (2.00)	
									Brown, damp, Silty fine to coarse SAND, trace clay, trace gravel.	
5										
10							120.91		(10.00) **Bottom of Exploration at 10.00 feet below ground surface.** No Refusal	
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-106
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	130.91	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	342+85, 9.5 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	130.31		PAVEMENT - HMA (0.60)	
							129.81		CONCRETE - PCC (1.10)	
							128.91		Brown, damp, Sandy GRAVEL, little silt. (2.00)	
									Brown, damp, Silty fine to coarse SAND, trace clay, trace gravel.	
5										
10							120.91		(10.00) **Bottom of Exploration at 10.00 feet below ground surface.** No Refusal	
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-107
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	131.56	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	345+47, 29.6 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S7	68.4/68.4	0.30 - 6.00			SSA	131.26		Brown, damp, Sandy SILT, with organics. 0.30	G#100582 A-2-4, SM WC=13.2%
									Brown, damp, fine to coarse SAND, some silt, little gravel.	
5							125.56		6.00	
	S8	108/108	6.00 - 15.00						Brown, wet, Silty fine to coarse SAND, trace gravel.	G#100583 A-4, SM WC=11.6%
10										
15							116.56		15.00	
									Bottom of Exploration at 15.00 feet below ground surface. No Refusal	
20										
25										

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-108
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	131.89	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/29/03-4/29/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	345+64, 6.2 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	131.29	PAVEMENT - HMA 0.60	
							130.69	CONCRETE - PCC 1.20	
								Brown, damp, Sandy GRAVEL, trace silt.	
							129.39	2.50	
								Brown, damp, fine to coarse SAND, some silt.	
5									
							123.89	8.00	
	S20	84/32.44	8.00 - 15.00					Brown, damp, Silty fine to coarse SAND, little clay, trace gravel, (Till).	G#100584 A-4, SC-SM WC=9.7%
10									
15							116.89	15.00	
								Bottom of Exploration at 15.00 feet below ground surface. No Refusal	
20									
25									

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-109
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	136.15	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	D. Ross	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/25/03-4/25/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	349+41, 9.5 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	135.65		PAVEMENT - HMA (0.50)	
									Yellow-brown, dry, GRAVEL, some sand, little to some silt. (2.10)	
							134.05		Grey, moist, SAND, some silt, little gravel, (Till).	
5										
							126.65		(9.50)	
10									**Bottom of Exploration at 9.50 feet below ground surface.** No Refusal	
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-110
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	137.14	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	350+39, 25.6 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	136.94	PAVEMENT - HMA (0.20)	
							135.94	Brown, damp, Sandy GRAVEL, little silt. (1.20)	
								Brown, damp, fine to coarse SAND, some silt, little gravel.	
5	S9	60/60	5.00 - 10.00				132.14	(5.00) Brown, moist, Silty fine to coarse SAND, trace gravel.	G#100585 A-4, SM WC=15.3%
10							127.14	(10.00) **Bottom of Exploration at 10.00 feet below ground surface.** No Refusal	
15									
20									
25									

Remarks:

HMA = Hot Mix Asphalt

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-111
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	140.42	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	353+68, 36.2 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	139.82		Brown, damp, Sandy GRAVEL, little silt. 0.60	
									Brown, damp, fine to coarse SAND, some silt, little gravel.	
5										
10										
							128.52		11.90	
							128.22		Possible weathered BEDROCK? 12.20	
									Bottom of Exploration at 12.20 feet below ground surface. Refusal	
15										
20										
25										

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-112
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	144.69	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	355+32, 26.9 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	144.49		PAVEMENT - HMA 0.20	
							144.29		Brown, dry, Sandy GRAVEL, little silt. 0.40	
							143.99		CONCRETE - PCC 0.70	
							143.19		Brown, damp, Sandy GRAVEL, little silt. 1.50	
									Brown, damp, fine to coarse SAND, some silt, little gravel.	
5										
10							134.69		10.00	
									Bottom of Exploration at 10.00 feet below ground surface. No Refusal	
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-113
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	144.69	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	355+32, 6.9 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	144.29		PAVEMENT - HMA 0.40	
							143.79		CONCRETE - PCC 0.90	
	S10	102/102	1.50 - 10.00				143.19		Brown, damp, Sandy GRAVEL, little silt. 1.50	G#100586 A-2-4, SM WC=8.4%
									Brown, damp, fine to coarse SAND, some silt, little gravel.	
5										
10							134.69		10.00	
15										
20										
25										

Bottom of Exploration at 10.00 feet below ground surface.
No Refusal

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-114
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	138.12	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	360+24, 5.6 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	137.62	PAVEMENT - HMA (0.50)	
							137.12	CONCRETE - PCC (1.00)	
	S11	30/30	1.50 - 4.00				136.62	Brown, damp, Sandy GRAVEL, little silt. (1.50)	G#100587 A-1-b, SM WC=6.2%
								Brown, damp, Gravelly fine to coarse SAND, little silt.	
	S12	36/36	4.00 - 7.00				134.12	Brown, moist, fine to coarse SAND, some gravel, some silt, occasional cobbles. (4.00)	G#100588 A-1-b, SM WC=8.1%
5									
	S13	32.4/32.4	7.00 - 9.70				131.12	Brown, moist, Silty fine to coarse SAND, trace gravel. (7.00)	G#100589 A-4, SM WC=12.5%
							128.42	(9.70)	
10							127.92	Possible weathered BEDROCK? (10.20)	
								Bottom of Exploration at 10.20 feet below ground surface. Refusal	
15									
20									
25									

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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Boring No.: HB-MILF-114

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-115
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	136.81	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	360+40, 14.4 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	136.51		PAVEMENT - HMA (0.30)	
									Brown, damp, Sandy GRAVEL, little silt.	
							134.91		(1.90) Brown, damp, Gravelly fine to coarse SAND, little silt.	
5							130.81		(6.00) Brown, moist, Silty fine to coarse SAND, trace gravel.	
							127.31		(9.50)	
10							126.91		Possible weathered BEDROCK? (9.90)	
									Bottom of Exploration at 9.90 feet below ground surface. Refusal	
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-116
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	122.7	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	365+16, 11.6 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	122.60		PAVEMENT - HMA (0.10)	
							121.60		Brown, damp, Sandy GRAVEL, little silt. (1.10)	
									Brown, moist, Silty fine to coarse SAND, trace gravel.	
							119.10		(3.60)	
							118.20		Possible weathered BEDROCK? (4.50)	
5									**Bottom of Exploration at 4.50 feet below ground surface.** Refusal	
10										
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-117
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	123.03	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	365+16, 14.4 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	122.03		Brown, damp, Sandy GRAVEL, little silt. (1.00)	
									Brown, moist, Silty fine to coarse SAND, trace gravel. (4.60)	
5							118.43		Possible weathered BEDROCK? (4.70)	
							118.33		**Bottom of Exploration at 4.70 feet below ground surface.** Refusal	
10										
15										
20										
25										

Remarks:

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-118
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	130.58	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	370+08, 4.9 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	130.08		PAVEMENT - HMA (0.50)	
							129.58		CONCRETE - PCC (1.00)	
	S15	18/18	1.00 - 2.50						Brown, damp, Gravelly fine to coarse SAND, little silt.	G#100590 A-1-a, SM WC=5.2%
	S16	90/90	2.50 - 10.00				128.08		Brown, moist, fine to coarse SAND, some silt, little gravel, trace clay. (2.50)	G#100591 A-4, SC-SM WC=11.3%
5										
10							120.58		(10.00) **Bottom of Exploration at 10.00 feet below ground surface.** No Refusal	
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-119
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	130.91	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	370+08, 9.9 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	1.7 ft bgs.

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	130.61		PAVEMENT - HMA (0.30)	
							130.21		Brown, dry, Sandy GRAVEL, little silt. (0.70)	
							129.71		CONCRETE - PCC (1.20)	
	S14	90/90	2.50 - 10.00				128.41		Brown, damp to wet, fine to coarse SAND, some silt, little gravel, trace clay. (2.50)	G#100592 A-4, SC-SM WC=14.6%
									Brown, moist, Sandy SILT, trace gravel, trace clay.	
5										
10							120.91		(10.00)	
15										
20										
25										

Bottom of Exploration at 10.00 feet below ground surface.
No Refusal

Remarks:

Surface water in ditch near by.
HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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Boring No.: HB-MILF-119

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: HB-MILF-120
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	131.89	**Auger ID/OD:**	5" Dia.
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	G. Lidstone	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/28/03-4/28/03	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	373+36, 10.8 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

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

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

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S17	16.8/16.8	0.30 - 1.70			SSA	131.59	PAVEMENT - HMA 0.30	G#100593 A-1-a, GC-GM WC=4.9%
							130.19	Brown, damp, Sandy GRAVEL, little silt, trace clay. 1.70	
								Brown, moist, fine to coarse SAND some silt, little gravel.	
5									
10							121.89	10.00	
								Bottom of Exploration at 10.00 feet below ground surface. No Refusal	
15									
20									
25									

Remarks:

Edge of concrete at 10.5 ft right of existing CL.
HMA = Hot Mix Asphalt

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: PC-1
WIN: 10011.00

Driller:	MDOT	**Elevation (ft.)**	124.67	**Auger ID/OD:**	N/A
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	N/A
Logged By:	G. Lidstone	**Rig Type:**	N/A	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/29/03-4/29/03	**Drilling Method:**	Hand Held Core Machine	**Core Barrel:**	50 mm
Boring Location:	338+19, 5.2 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	N/A

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0		6.6/6.6	0.00 - 0.55			CORE	124.12		PAVEMENT - HMA 0.55	
		6.96/6.96	0.55 - 1.13				123.54		CONCRETE - PCC 1.13	
									Bottom of Exploration at 1.13 feet below ground surface.	
5										
10										
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Conc

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: PC-2
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	132.22	**Auger ID/OD:**	N/A
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	N/A
Logged By:	G. Lidstone	**Rig Type:**	N/A	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/29/03-4/29/03	**Drilling Method:**	Hand Held Core Machine	**Core Barrel:**	50 mm
Boring Location:	345+90, 5.5 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	N/A

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0		5.4/5.4	0.00 - 0.45			CORE	131.77		PAVEMENT - HMA 0.45	
		6.24/6.24	0.45 - 0.97				131.25		CONCRETE - PCC 0.97	
									Bottom of Exploration at 0.97 feet below ground surface.	
5										
10										
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: PC-3
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	141.08	**Auger ID/OD:**	N/A
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	N/A
Logged By:	G. Lidstone	**Rig Type:**	N/A	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/29/03-4/29/03	**Drilling Method:**	Hand Held Core Machine	**Core Barrel:**	50 mm
Boring Location:	353+84, 7.2 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	N/A

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0		4.8/4.8	0.00 - 0.40			CORE	140.68		PAVEMENT - HMA (0.40)	
		7.2/7.2	0.40 - 1.00				140.08		CONCRETE - PCC (1.00)	
									Bottom of Exploration at 1.00 feet below ground surface.	
5										
10										
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: PC-4
WIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	131.56	**Auger ID/OD:**	N/A
Operator:	C. Mann	**Datum:**	NAVD 88	**Sampler:**	N/A
Logged By:	G. Lidstone	**Rig Type:**	N/A	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	4/29/03-4/29/03	**Drilling Method:**	Hand Held Core Machine	**Core Barrel:**	50 mm
Boring Location:	370+31, 6.2 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	N/A

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

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

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0		6.24/6.24	0.00 - 0.52			CORE	131.04		PAVEMENT - HMA 0.52	
		6.12/6.12	0.52 - 1.03				130.53		CONCRETE -PCC 1.03	
									Bottom of Exploration at 1.03 feet below ground surface.	
5										
10										
15										
20										
25										

Remarks:

HMA = Hot Mix Asphalt
PCC = Portland Cement Concrete

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 2
Location: Milford, Maine

Boring No.: PC-5
PIN: 10011.00

Driller:	MaineDOT	**Elevation (ft.)**	139.11	**Auger ID/OD:**	N/A
Operator:	G.Lidstone	**Datum:**	NAVD 88	**Sampler:**	Pavement Core
Logged By:	B.Wilder	**Rig Type:**	N/A	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	7/11/02-7/11/02	**Drilling Method:**	CORE	**Core Barrel:**	500 mm
Boring Location:	10+737, 2.3 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 (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WOH = weight of 140lb. hammer
WOR = weight of rods WOC = weight of casing

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						PC	138.66		PAVEMENT. 0.450	
							138.07		CONCRETE. 1.040	
									Bottom of Exploration at 1.04 feet below ground surface.	
6										
12										
18										
24										
30										

Remarks:

From Route 178 just past Milford Post Office.

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

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

Appendix B

Laboratory Test Results

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Milford Project Number: 10011.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C.	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
HB-MILF-101, S3	322+84	22.1 Lt.	1.1-2.5	128473	1	11.1			SM	A-2-4	II
HB-MILF-102, S1	332+84	18.3 Rt.	0.0-2.2	128474	1	9.1			SM	A-1-b	II
HB-MILF-102, S2	332+84	18.3 Rt.	2.2-6.5	100576	1	13.1			SC-SM	A-4	III
HB-MILF-103, S18	337+93	5.3 Lt.	1.0-2.2	100577	1	4.2			GM	A-1-a	0
HB-MILF-103, S19	337+93	5.3 Lt.	2.2-10.0	100578	1	18.1			CL-ML	A-4	IV
HB-MILF-104, S4	338+26	6.2 Rt.	0.9-2.5	100579	2	3.7			GM	A-1-a	0
HB-MILF-104, S5	338+26	6.2 Rt.	2.5-8.0	100580	2	22.8			CL	A-7	IV
HB-MILF-104, S6	338+26	6.2 Rt.	8.0-15.0	100581	2	13.1			SC-SM	A-4	III
HB-MILF-107, S7	345+47	29.6 Lt.	0.3-6.0	100582	2	13.2			SM	A-2-4	II
HB-MILF-107, S8	345+47	29.6 Lt.	6.0-15.0	100583	2	11.6			SM	A-4	III
HB-MILF-108, S20	345+64	6.2 Rt.	8.0-15.0	100584	2	9.7			SC-SM	A-4	III
HB-MILF-110, S9	350+39	25.6 Lt.	5.0-10.0	100585	3	15.3			SM	A-4	III
HB-MILF-113, S10	355+32	6.9 Rt.	1.5-10.0	100586	3	8.4			SM	A-2-4	II
HB-MILF-114, S11	360+24	5.6 Rt.	1.5-4.0	100587	3	6.2			SM	A-1-b	II
HB-MILF-114, S12	360+24	5.6 Rt.	4.0-7.0	100588	3	8.1			SM	A-1-b	II
HB-MILF-114, S13	360+24	5.6 Rt.	7.0-9.7	100589	3	12.5			SM	A-4	III
HB-MILF-118, S15	370+08	4.9 Lt.	1.0-2.5	100590	4	5.2			SM	A-1-a	0
HB-MILF-118, S16	370+08	4.9 Lt.	2.5-10.0	100591	4	11.3			SC-SM	A-4	III
HB-MILF-119, S14	370+08	9.9 Rt.	2.5-10.0	100592	4	14.6			SC-SM	A-4	III
HB-MILF-120, S17	373+36	10.8 Rt.	0.3-1.7	100593	4	4.9			GC-GM	A-1-a	I

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.

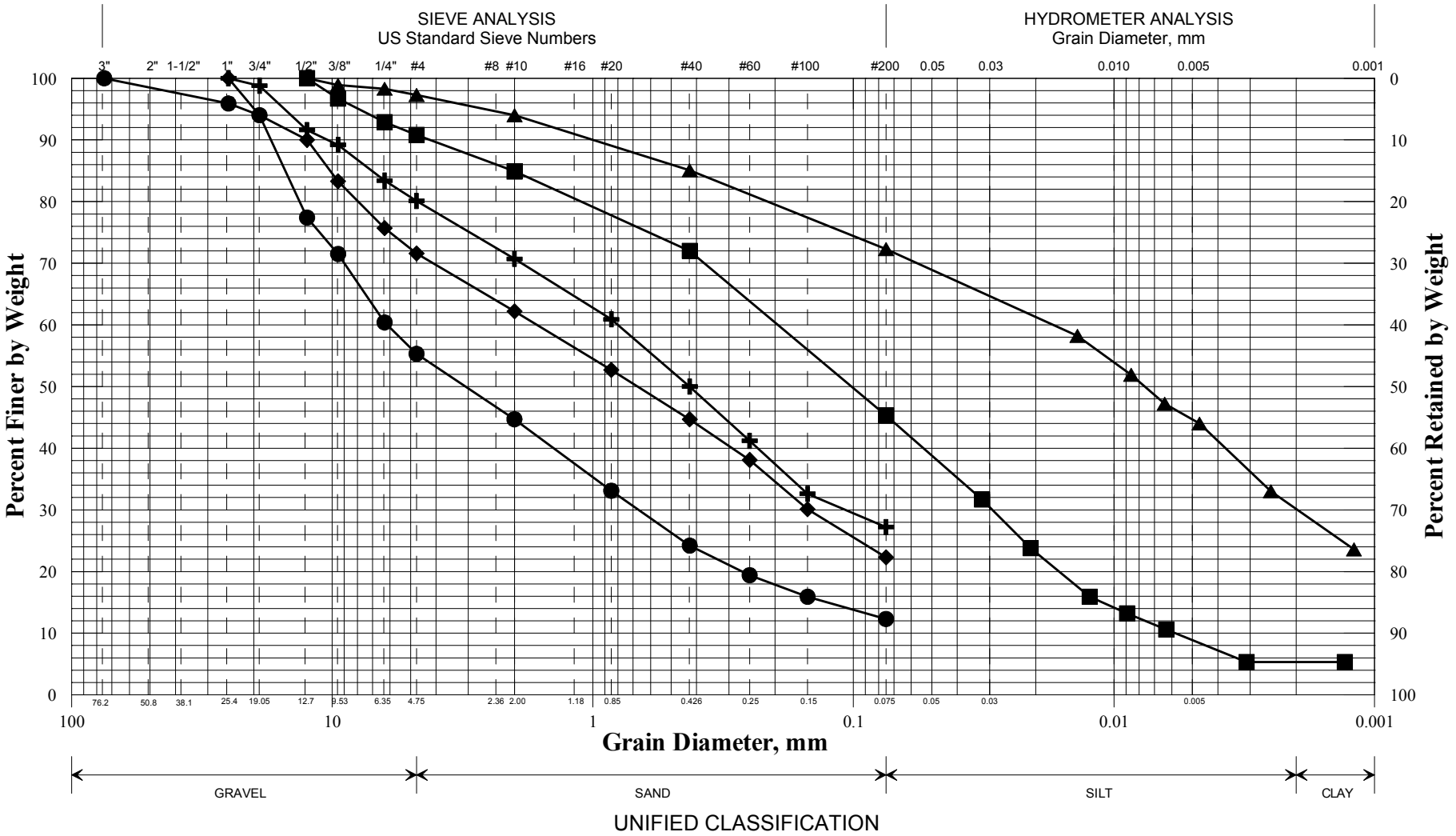
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

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/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-MILF-101/S3	322+84	22.1 LT	1.1-2.5	SAND, some silt, some gravel.	11.1			
◆	HB-MILF-102/S1	332+84	18.3 RT	0.0-2.2	SAND, some gravel, some silt.	9.1			
■	HB-MILF-102/S2	332+84	18.3 RT	2.2-6.5	Silty SAND, trace clay, trace gravel.	13.1			
●	HB-MILF-103/S18	337+93	5.3 LT	1.0-2.2	Sandy GRAVEL, little silt.	4.2			
▲	HB-MILF-103/S19	337+93	5.3 LT	2.2-10.0	SILT, some clay, some sand, trace gravel.	18.1			
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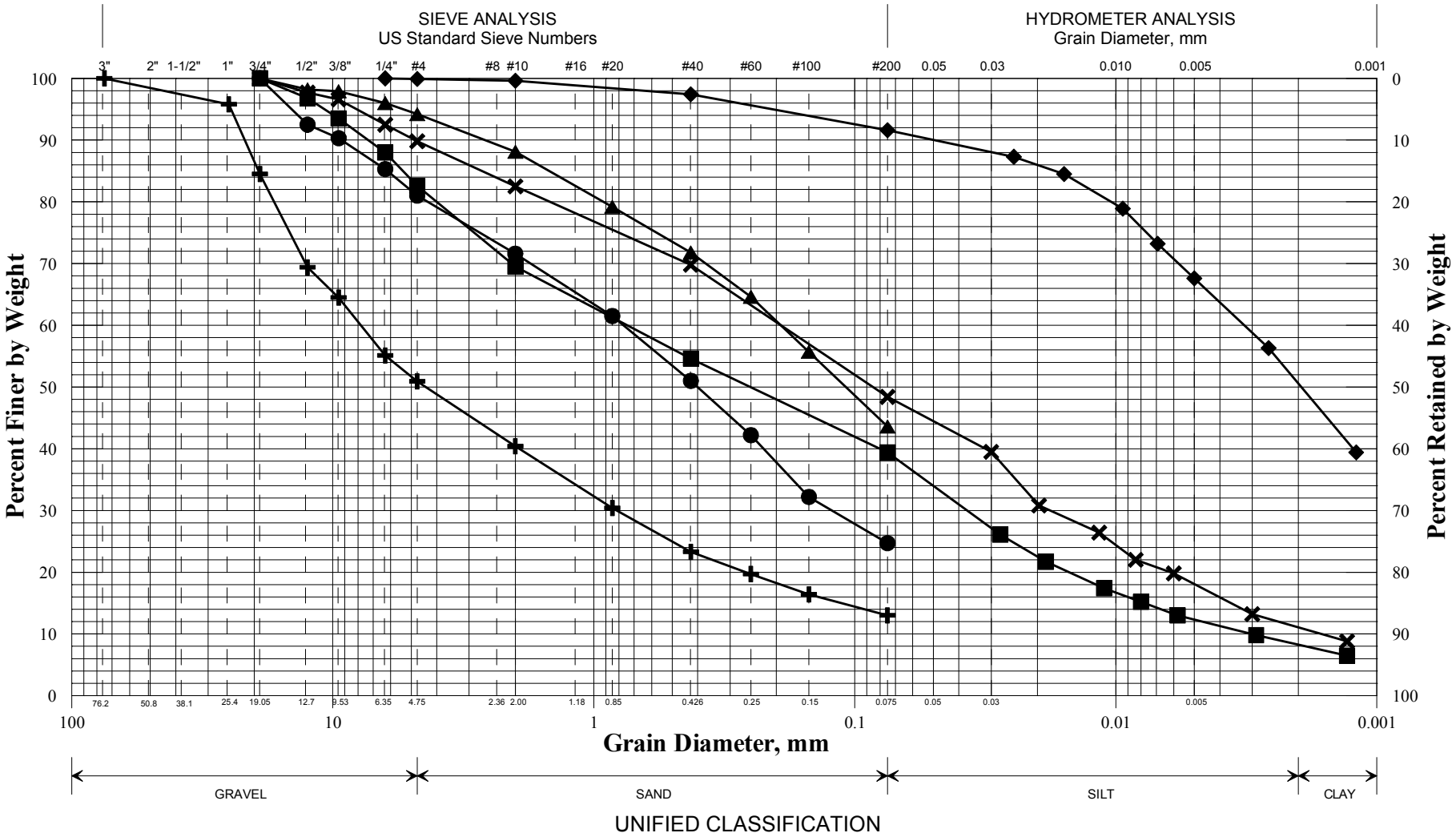
GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-MILF-104/S4	338+26	6.2 RT	0.9-2.5	Sandy GRAVEL, little silt.	3.7			
◆	HB-MILF-104/S5	338+26	6.2 RT	2.5-8.0	Silty CLAY, trace sand.	22.8			
■	HB-MILF-104/S6	338+26	6.2 RT	8.0-15.0	SAND, some silt, little gravel, trace clay.	13.1			
●	HB-MILF-107/S7	345+47	29.6 LT	0.3-6.0	SAND, some silt, little gravel.	13.2			
▲	HB-MILF-107/S8	345+47	29.6 LT	6.0-15.0	Silty SAND, trace gravel.	11.6			
✕	HB-MILF-108/S20	345+64	6.2 RT	8.0-15.0	Silty SAND, little clay, trace gravel.	9.7			

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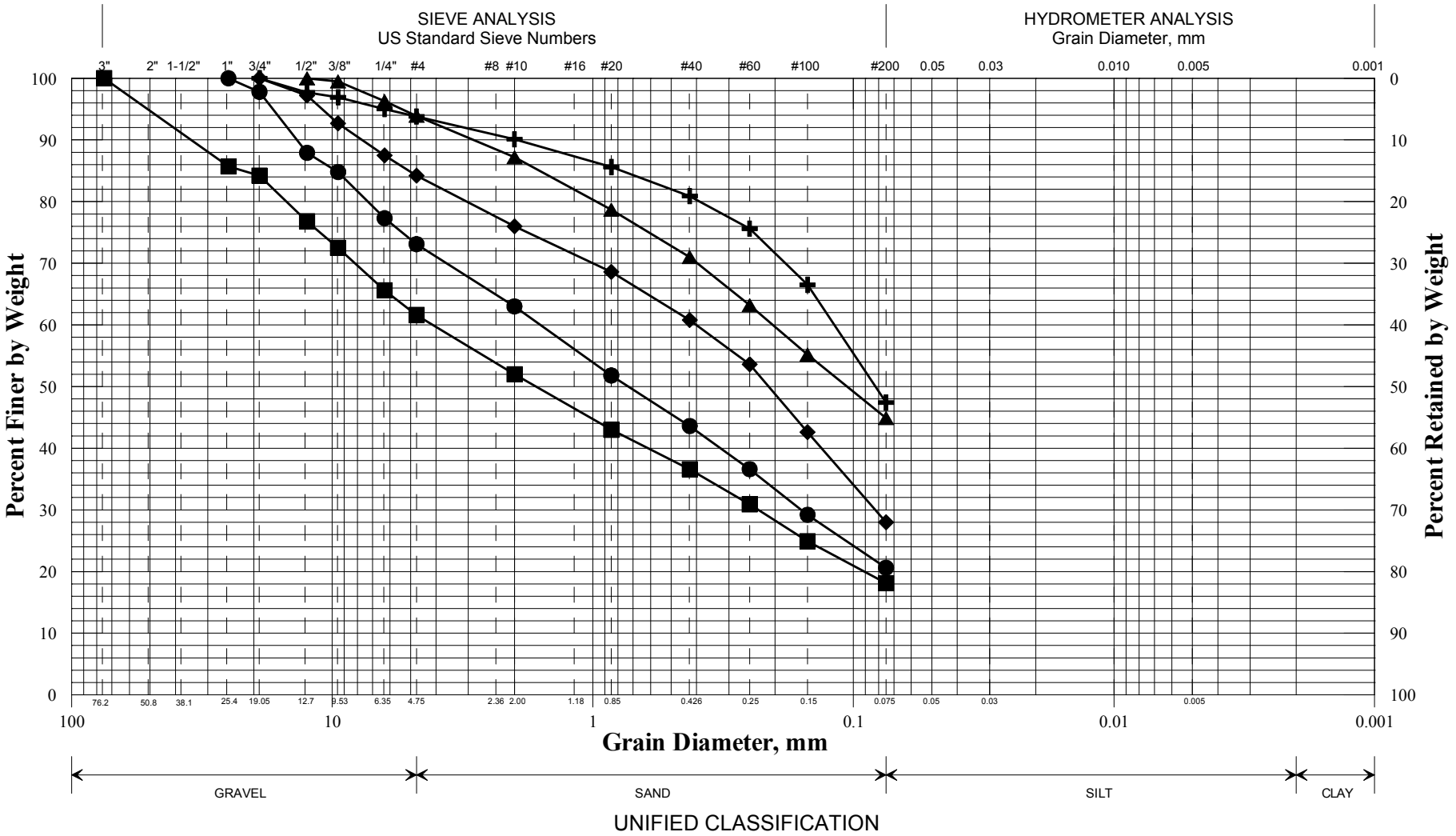
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-MILF-110/S9	350+39	25.6 LT	5.0-10.0	Silty SAND, trace gravel.	15.3			
◆	HB-MILF-113/S10	355+32	6.9 RT	1.5-10.0	SAND, some silt, little gravel.	8.4			
■	HB-MILF-114/S11	360+24	5.6 RT	1.5-4.0	Gravelly SAND, little silt.	6.2			
●	HB-MILF-114/S12	360+24	5.6 RT	4.0-7.0	SAND, some gravel, some silt.	8.1			
▲	HB-MILF-114/S13	360+24	5.6 RT	7.0-9.7	Silty SAND, trace gravel.	12.5			
✖									

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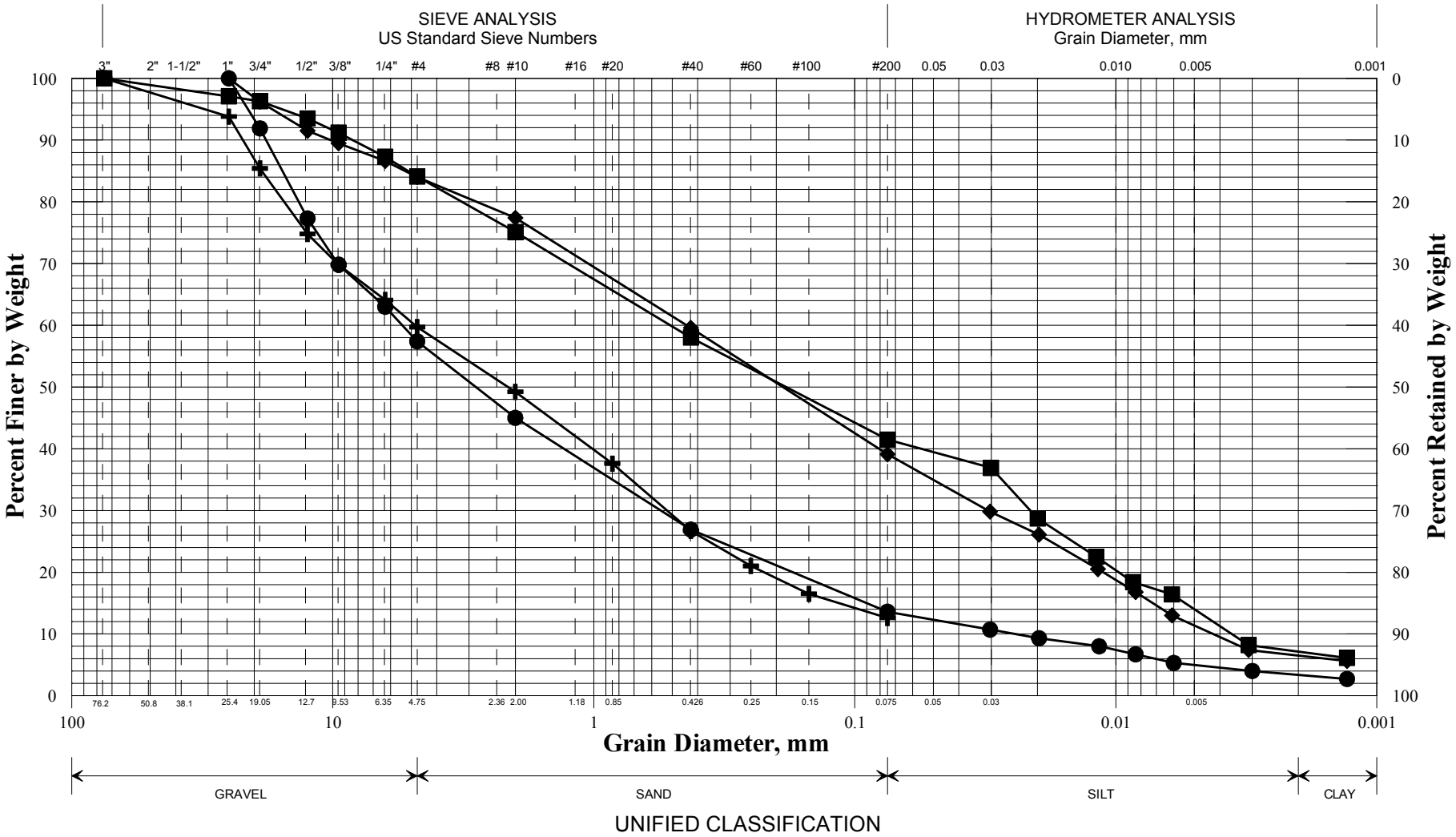
SHEET 3

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-MILF-118/S15	370+08	4.9 LT	1.0-2.5	Gravelly SAND, little silt.	5.2			
◆	HB-MILF-118/S16	370+08	4.9 LT	2.5-10.0	SAND, some silt, little gravel, trace clay.	11.3			
■	HB-MILF-119/S14	370+08	9.9 RT	2.5-10.0	SAND, some silt, little gravel, trace clay.	14.6			
●	HB-MILF-120/S17	373+36	10.8 RT	0.3-1.7	Sandy GRAVEL, little silt, trace clay.	4.9			
▲									
✖									

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Appendix C

Calculations

Frost Protection:

Evaluate Approximate Frost Depth using USACRREL Modberg Software Closest Station is Orono

For coarse grained soils (sands) with average water content of 10%

ModBerg Results - Project Location: Orono, Maine

Air Design Freezing Index	=	1588 F-days
N-Factor	=	0.70
Surface Design Freezing Index	=	1112 F-days
Mean Annual Temperature	=	43.5 deg F
Design Length of Freezing Season	=	132 days

Layer #:Type	t	w%	d	Cf	Cu	Kf	Ku	L
1-Asphalt	4.0	10.0	140.0	28	28	0.9	0.9	0
2-Coarse	62.5	10.0	125.0	28	34	2.0	1.6	1,800

t = Layer thickness, in inches.
w% = Moisture content, in percentage of dry density.
d = Dry density, in lbs/cubic ft.
Cf = Heat Capacity of frozen phase, in BTU/(cubic ft degree F).
Cu = Heat Capacity of thawed phase, in BTU/(cubic ft degree F).
Kf = Thermal conductivity in frozen phase, in BTU/(ft hr degree).
Ku = Thermal conductivity in thawed phase, in BTU/(ft hr degree).
L = Latent heat of fusion, in BTU / cubic ft.

Total Depth of Frost Penetration = 5.54 ft = 66.5 in.

Approximate Frost Depth for coarse grained soils = 5.5 feet

For fine grained soils (silt and clay) with avarage water content of 20%

ModBerg Results - Project Location: Orono, Maine

Air Design Freezing Index	=	1588 F-days
N-Factor	=	0.75
Surface Design Freezing Index	=	1191 F-days
Mean Annual Temperature	=	43.5 deg F
Design Length of Freezing Season	=	132 days

Layer #:Type	t	w%	d	Cf	Cu	Kf	Ku	L
1-Portland	4.0	10.0	140.0	30	30	1.0	1.0	0
2-Coarse	18.0	10.0	125.0	28	34	2.0	1.6	1,800
3-Fine	29.8	20.0	115.0	31	43	1.5	1.2	3,312

t = Layer thickness, in inches.
w% = Moisture content, in percentage of dry density.
d = Dry density, in lbs/cubic ft.
Cf = Heat Capacity of frozen phase, in BTU/(cubic ft degree F).
Cu = Heat Capacity of thawed phase, in BTU/(cubic ft degree F).
Kf = Thermal conductivity in frozen phase, in BTU/(ft hr degree).
Ku = Thermal conductivity in thawed phase, in BTU/(ft hr degree).
L = Latent heat of fusion, in BTU / cubic ft.

Total Depth of Frost Penetration = 4.31 ft = 51.8 in.

Approximate Frost Depth for fine grained soils = 4.3 feet

Bearing Resistance - Native Granular Soils:

Part 1 - Service Limit State

Nominal and factored Bearing Resistance - block wall on sand

Presumptive Bearing Resistance for Service Limit State ONLY

Reference: AASHTO LRFD Bridge Design Specifications 7th Edition 2014
Table C10.6.2.6.1-1 Presumptive Bearing Resistances for Spread Footings at the Service Limit State Modified after US Department of Navy (1982)

Type of Bearing Material: Fine to coarse sand (SM)

Assume soils are medium dense at bearing elevation - no N-values available

Consistency In Place: medium dense

Bearing Resistance: Ordinary Range (ksf) 4 to 8

Recommended Nominal Value: $q_{nom} := 5 \cdot ksf$

Resistance factor at the **service limit state** = 1.0 (LRFD Article 10.5.5.1) $\phi_{service_bc} := 1.0$

$q_{factored_service_bc} := q_{nom} \cdot \phi_{service_bc}$ $q_{factored_service_bc} = 5 \cdot ksf$

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

Part 2 - Strength Limit State

Nominal and factored Bearing Resistance - block wall on sand

Reference: Foundation Engineering and Design by JE Bowles Fifth Edition

Assumptions:

1. The wall will be founded at ~ Elev range 135-139 feet

   Bottom of Construction will be 1 foot below grade $D_{footing} := 1.0 \cdot ft$

2. Assumed parameters for fill soils: (Ref: Bowles 5th Ed Table 3-4)

   Saturated unit weight: $\gamma_s := 125 \cdot pcf$

   Dry unit weight: $\gamma_d := 120 \cdot pcf$

   Internal friction angle: $\phi_{ns} := 32 \cdot deg$

   Undrained shear strength: $c_{ns} := 0 \cdot psf$

3. Use Terzaghi strip equations as L>B
4. Effective stress analysis footing on ϕ-c soil (Bowles 5th Ed. Example 4-1 pg 231)
5. Water table is well below bearing elevation

Effective stress at box bearing level:

$q_{eff} := D_{footing} \cdot \gamma_s$ $q_{eff} = 0.125 \cdot ksf$

Blocks are 18 inches wide: $B := 18 \cdot in$

Terzaghi Shape factors from Table 4-1 For a strip footing: $s_c := 1.0$ $s_\gamma := 1.0$

Meyerhof Bearing Capacity Factors - Bowles 5th Ed. table 4-4 pg 223

For ϕ=32 deg $N_c := 35.47$ $N_q := 23.2$ $N_\gamma := 22$

Nominal Bearing Resistance per Terzaghi equation (Bowles 5th Ed. Table 4-1 pg 220)

$$q_{nominal} := c_{ns} \cdot N_c \cdot s_c + q_{eff} \cdot N_q + 0.5(\gamma_s)B \cdot N_\gamma \cdot s_\gamma$$

$$q_{nominal} = 5 \cdot ksf$$

Factored Bearing Resistance for Strength Limit State

Resistance Factor: $\phi_b := 0.45$ AASHTO LRFD Table 10.5.5.2.2-1

$$q_{factored} := q_{nominal} \cdot \phi_b$$

$q_{factored} = 2.2 \cdot ksf$ $B = 18 \cdot in$

Recommend a limiting factored bearing resistance of 2.2 ksf for the Strength Limit State

Factored Bearing Resistance for Service and Extreme Limit States

Resistance Factor: $\phi_b := 1.0$ AASHTO LRFD Article 11.5.8

$$q_{factored} := q_{nominal} \cdot \phi_b$$

$q_{factored} = 5 \cdot ksf$ $B = 18 \cdot in$

Recommend a limiting factored bearing resistance of 5.0 ksf for the Service Limit State

These values are for a wall with only 1.0 foot of embedment.
Recommend a minimum embedment of 2.0 feet.
These bearing resistances are conservative for 2.0 feet of embedment.