Schonewald Engineering Associates, Inc.

GEOTECHNICAL DESIGN REPORT
HEAVY HAUL ROAD
INTERNATIONAL MARINE TERMINAL – PORTLAND, MAINE
MAINEDOT WIN 22809.50

PREPARED FOR:

HNTB Corporation
Westbrook, Maine

PREPARED BY:

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STATE OF MAINE
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3/8/23

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SchonewaldEA Project No. 19-004

GEOTECHNICAL DESIGN REPORT
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TABLE OF CONTENTS

NOTE 1: Report recompiled and the Table of Contents updated on March 8, 2023 at the request of HNTB to include the final version of Special Provision SP614 – Geocell Load Support System; no other changes made to the document.

INTRODUCTION

Schonewald Engineering Associates, Inc. (SchonewaldEA) has prepared this Geotechnical Design Report for HNTB Corporation (HNTB) to present subsurface information and provide final geotechnical design and construction recommendations for the heavy haul road for the International Marine Terminal located in Portland, Maine (MaineDOT WIN 22809.50).

SchonewaldEA's work on this project has been completed under a Subconsultant Task Order Agreement with HNTB that is dated October 8, 2019. This report is subject to the limitations contained in the Closure section of the report. A quality assurance review of the geotechnical analyses completed and recommendations developed by SchonewaldEA for this project was completed by Stephen J. Rabasca, P.E. of SoilMetrics, LLC located in Cape Elizabeth, Maine.

PROJECT DESCRIPTION

The location of the International Marine Terminal (IMT) located in Portland, Maine is depicted on attached Figure 1 – Locus Plan.

A heavy haul road will be constructed that will connect the IMT with Merrill's Terminal and will run immediately alongside an existing railroad track on property owned by MaineDOT. The haul road will be located between West Commercial Street and the tidal Fore River, and will extend from the westerly limits of the existing IMT rail loading slab to Cassidy Point Drive, located near the westerly terminus of the MaineDOT-owned property associated with the IMT. Merrill's Terminal will be used on a regular basis to assist the IMT with its transportation and storage needs.

The haul road will be approximately 2,700 feet long and will run parallel to and within the narrow MaineDOT-owned rail corridor; MaineDOT owns and PanAm operates this segment of rail line. Because of the existing railroad track and narrow nature of the proposed construction, the design calls for only limited cuts and fills; embankment slopes and grade separation structures, such as a retaining wall, are not necessary. The design calls for a 16-foot-wide single lane paved roadway, with a 125-foot-long, 24-foot-wide pull-out/ passing section to accommodate passing vehicles. Traffic analyses prepared by HNTB with input from IMT operations personnel call for designing the heavy haul road pavement section to accommodate 90-kip heavy haul trucks moving between the IMT and Merrill's Terminal. This operation is projected to result in the movement of 400 to 1,600 containers monthly in the future.

Ground surface elevations along the alignment range between 12 to 15 feet (NGVD 1929 vertical datum). Subsurface conditions underlying the heavy haul road/rail corridor consist of urban fills, including ash and debris from the historic Portland fire that were disposed of in this area of the city, and layered sandy, silty, and organic soils (recent alluvium) associated with the tidal river. Both are underlain by marine silt-clay of the Presumpscot Formation. Geotechnical and environmental issues include 1) potential pumping and weaving of weak near-surface soils under the repetitive action of the heavy haul trucks; 2) saturation and poor drainage of surficial soils due to high groundwater, low elevation, and proximity to the tidal Fore River that could exacerbate the pumping action; and 3) the environmental characteristics of the urban fill materials and, therefore, limiting required excavation to achieve the pavement section subgrade.

GEOLOGICAL SETTING

The surficial soils mapped in the vicinity of the site consist of a broad area of "artificial fill" associated with Portland's working waterfront and commercial areas, based on the map entitled "Surficial Geology of the Portland 1:100,000 Quadrangle, Maine" published by the Maine Geologic Survey.

SUBSURFACE INVESTIGATION PROGRAM

SchonewaldEA retained New England Boring Contractors of Hermon, Maine to provide drilling services for this project. Ten test borings were drilled along the proposed heavy haul road alignment to evaluate subsurface conditions. The test borings were designated MB-IMTHHR-101 through -110 and were spaced typically 275 to 300 feet apart. The test borings were drilled between October 30 and November 4, 2019 and were observed and logged by SchonewaldEA. The approximate locations of the test borings are depicted on Figure 2 – Boring Location Plan that is included with the Figures.

With one exception (MB-IMTHHR-104), the test borings were completed using standard hollow-stem auger drilling techniques that do not require the use of drilling fluid. Eight of the nine auger borings extended to 17 feet below the ground surface (BGS). The remaining auger boring (MB-IMTHHR-107) extended to 22 feet BGS and then a drill rod was hydraulically pushed as a rod probe to 50 feet BGS. This auger boring was extended an additional 5 feet and the rod probe was completed because organic silt had been encountered in the sample taken from 15 to 17 feet BGS and then soft marine silt-clay had been encountered at approximately 18.5 feet BGS. One test boring (MB-IMTHHR-104) was completed using standard cased wash boring techniques. This boring extended to 27 feet BGS. The cased wash boring was completed to allow vane shear testing of soft marine silt-clay if it was encountered near surface; soft marine silt-clay (Presumpscot Formation) was not encountered in MB-IMTHHR-104 or in any other boring above 18.5 feet BGS.

Standard Penetration Tests (SPTs) were completed and split-spoon soil samples obtained continuously from 1 to 7 feet BGS and then at five-foot intervals to the bottom of each boring. SPTs were performed using an auto hammer that had been calibrated in accordance with MaineDOT policy dated February 23, 2018. Groundwater levels observed within the borings were noted on the logs. The boreholes were backfilled using drill cuttings, supplemented by manufactured sand and gravel.

The logs of the subsurface explorations are included as Appendix A.

LABORATORY TESTING PROGRAM

Representative soil samples obtained in the test borings were submitted to the R.W. Gillespie & Associates, Inc. (RWGA) geotechnical laboratory located in Biddeford, Maine for gradation testing (wash sieves and hydrometer). The soil samples were selected from depths that were anticipated to correspond to the future pavement section subgrade elevation. The laboratory testing program is summarized in the following table.

Boring No.	Sample No.	Sample Depth (ft, BGS)	Sample Representative of:	Test Performed
MB-IMTHHR-101	1D-A	2-3	granular fill	grain size WITH hydrometer
MB-IMTHHR-102	1D	1-3	urban fill	wash sieve grain size
MB-IMTHHR-102	2D	3-5	urban fill	grain size WITH hydrometer
MB-IMTHHR-103	1D	1-3	urban fill	grain size WITH hydrometer
MB-IMTHHR-103	2D	3-5	silty fill	grain size WITH hydrometer
MB-IMTHHR-104	2D	3-5	urban fill	grain size WITH hydrometer
MB-IMTHHR-105	3D	5-7	sandy silt (alluvium)	grain size WITH hydrometer
MB-IMTHHR-106	3D	5-7	sandy silt (alluvium)	grain size WITH hydrometer
MB-IMTHHR-107	2D	3-5	urban fill	grain size WITH hydrometer

Boring No.	Sample No.	Sample Depth (ft, BGS)	Sample Representative of:	Test Performed
MB-IMTHHR-108	1D	1-3	silty fill	grain size WITH hydrometer
MB-IMTHHR-109	1D	1.7-3	silty granular fill	grain size WITH hydrometer
MB-IMTHHR-110	2D	3-5	fill	wash sieve grain size

Subsurface conditions, including the results of the laboratory testing program, are discussed in the following section. Laboratory test results are summarized on the test boring logs included in Appendix A and the laboratory test reports are included as Appendix B.

SUBSURFACE CONDITIONS

Subsurface conditions encountered in the test borings consisted of fill materials overlying tidal / alluvial deposits, both of varying compositions.

The fill material encountered was highly variable both with depth in a boring and between borings. In most of the borings, black ash was observed in the fill material, along with pieces of brick and granite; this material is referred to as urban fill. The borings also contained zones that appeared to be reworked / disturbed alluvial deposits, often with urban fill above and/or below these zones. The density of the fill materials, based on corrected N values from Standard Penetration Tests, was also highly variable and ranged from very loose to very dense.

The alluvial deposits were also highly variable, which is consistent with the depositional environment that would have experienced times of varying energy. For the purpose of classification, the alluvial deposits were broken into three types loosely based on silt content and, therefore, anticipated behavior:

1. Fine to coarse sand with gravel and lesser amounts of silt;
2. Fine to medium sand with silt and lesser amounts of gravel; and
3. Fine to medium sandy silt or silty fine to medium sand.

A summary of the laboratory test results is provided in the following table. Based on the laboratory tests, the fines content in the fill materials encountered in the test borings is highly variable, ranging from 10 to 47 percent.

Boring No.	Sample No.	Sample Depth (ft, BGS)	Sample Representative of:	Classification	% Fines (-#200 sieve)
MB-IMTHHR-101	1D-A	2-3	granular fill	A-1-a	10.0
MB-IMTHHR-102	1D	1-3	urban fill	A-1-a	13.0
MB-IMTHHR-102	2D	3-5	urban fill	A-1-b	23.0
MB-IMTHHR-103	1D	1-3	urban fill	A-2-4(0)	27.8
MB-IMTHHR-103	2D	3-5	silty fill	A-4(0)	46.9
MB-IMTHHR-104	2D	3-5	urban fill	A-2-4(0)	27.2
MB-IMTHHR-105	3D	5-7	sandy silt (alluvium)	A-4(0)	44.7
MB-IMTHHR-106	3D	5-7	sandy silt (alluvium)	A-4(0)	65.0
MB-IMTHHR-107	2D	3-5	urban fill	A-1-b	23.1

Boring No.	Sample No.	Sample Depth (ft, BGS)	Sample Representative of:	Classification	% Fines (-#200 sieve)
MB-IMTHHR-108	1D	1-3	silty fill	A-2-4(0)	30.3
MB-IMTHHR-109	1D	1.7-3	silty granular fill	A-2-4(0)	31.5
MB-IMTHHR-110	2D	3-5	fill	A-1-b	16.5

Two of the test borings encountered a fine sandy organic silt layer beneath the alluvial deposits (MB-IMTHHR-105 at 16 feet BGS and -107 at 13.5 feet BGS). Marine silt-clay of the Presumpscot Formation was encountered in test boring MB-IMTHHR-107 at 18.5 feet BGS beneath the organic silt layer.

Refusal was not encountered in any of the test borings.

Detailed descriptions of the soils encountered and groundwater levels observed in the test borings are provided on the logs included in Appendix A. Laboratory test results are provided in Appendix B.

GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

SchonewaldEA provides the following geotechnical recommendations for the design of the pavement section and construction of the heavy haul road. The calculations included as Appendix C provide specific references.

PAVEMENT SECTION SUBGRADE ELEVATION

Because the near surface soils consist predominately of urban fill that typically contains ash, the volume of soil that needs to be excavated to achieve pavement section subgrade should be limited to the extent practicable. Since the finished grade of the road is fixed by the elevation of the adjacent railroad track, limiting excavation can be achieved by thinning the pavement section. This is discussed in the following section. Material that is excavated to achieve pavement section subgrade should be assessed from an environmental perspective and disposed of accordingly.

PAVEMENT SECTION DESIGN

The pavement section was designed following procedures set forth in the AASHTO Interim Guide (1972) for flexible pavement design methodology and nomograph and corroborated using the methodology and nomograph presented in the AASHTO Guide for the Design of Pavement Structures (1993). The AASHTO methods are used to determine the required structural number based on equivalent 18-kip axle loads (traffic analysis) and site-specific freeze-thaw and subsurface soil and groundwater conditions. The required structural number must be less than or equal to the actual structural number provided by the pavement section. The actual structural number is determined from the thickness and material coefficients of each layer of the pavement section. The pavement section calculations are provided in Appendix C. The following provides a summary of the multi-step design process and basis for selecting the input variables.

- Step 1: Calculate the equivalent 18-kip single axle loads (ESALs) for the design period that was taken as 20 years. The ESALs was determined based on the traffic analysis developed by HNTB with input from IMT operations personnel. The traffic analysis calls for designing the pavement section to accommodate the unladen Kalmer reachstacker and HS25 modified trucks that will have a fully laden load of 90 kips. Based on the number of passes of the reachstacker and the heavy haul trucks set forth in the traffic analysis, the road was designed based on 7.5 million ESALs over the 20-year design life.

- Step 2: The terminal serviceability (Pt) after the 20-year design life was selected to be "fair condition" (Pt = 2.0).

- Step 3: The subgrade soil support value (S) was selected based on the gradation of the subgrade soils, specifically the fines content (S = 4.0). The subgrade soil support value was then used to determine the associated soil resilient modulus (Mr = 4.4 ksi).

- Step 4: The regional factor was selected for use on the AASHTO 1972 design nomograph. A regional factor of 4.0 was selected to account for the roadbed being subject to freeze-thaw and high groundwater conditions that could result in the roadbed potentially being wet and the subgrade potentially being saturated.

- Step 5: The variables noted above were used on the AASHTO 1972 design nomograph to determine the required structural number (SNreq'd = 5.4).

- Steps 6 and 7: Additional variables were determined for use on the AASHTO 1993 design nomograph to corroborate the results from the AASHTO 1972 nomograph. The additional variables replace the regional factor used in the 1972 methodology. Specifically, reliability (R) and its standard deviation (So) were selected and the design serviceability loss (ΔPSI) was determined.

- Step 8: The additional variables were used on the AASHTO 1993 design nomograph to corroborate the required structural number (SNreq'd = 5.4).

The heavy haul road pavement section was then developed to achieve the required structural number (SNreq'd) while limiting the overall thickness of the section. The actual structural number (SNactual) is determined by multiplying each layer thickness by the associated layer coefficient and summing the results. To reduce the overall pavement section thickness, a geocell was incorporated into the section. The geocell confines the granular (in)fill thereby resisting raveling and more efficiently supporting the vehicle loads. The result is a significant increase in the layer coefficient.

The design pavement section is depicted on the project drawings and consists of the following layers from the surface downward:

- 8 inches hot mix asphalt (HMA);
- 3 inches Aggregate for Base and Subbase, Type A (MaineDOT 703.06) as cover over the geocell;
- 6-inch deep geocell infilled with Type A base aggregate;
- 3 inches Type A base aggregate as bedding material; and
- Non-woven geotextile separation fabric placed over the prepared subgrade.

The overall thickness of the pavement section is 20 inches. Type A base aggregate was selected to limit the maximum particle size to no greater than 2/3 the layer thickness. The calculations that provide specific references are provided in Appendix C. Special Provision 614 was developed to set forth the specific construction requirements for the geocell load support system portion of the pavement section. A copy of Special Provision 614 is provided as Appendix D.

<u>SUBGRADE PREPARATION</u>

Subgrade should be prepared in accordance with Special Provision 203 included in the project documents. Specifically, all existing debris, vegetation, asphalt, topsoil and other organic or deleterious material should be removed from the roadway footprint to expose suitable subgrade soils consisting of inorganic soils.

Unsuitable subgrade soils observed in the earthwork area should be overexcavated and replaced using Granular Borrow for Underwater Backfill (MaineDOT 703.19) as directed by and/or with the prior authorization of the Resident. The subgrade soils should be proofrolled using a self-propelled static roller. Loose or yielding areas should be overexcavated and replaced using Granular Borrow for Underwater Backfill (MaineDOT 703.19). Fill material should be placed in loose lifts not to exceed 12 inches and compacted to 95 percent of the material's maximum dry density as determined by AASHTO T-180. Special placement and compaction methods may be warranted in wet areas. Crushed stone wrapped in geotextile fabric is typically used to fill depressions in wet areas.

Because of the potential for encountering pockets of unsuitable or only marginally suitable materials at the pavement section subgrade, it is recommended that a qualified geotechnical engineer be on site to observe subgrade preparation activities.

An 8-ounce non-woven separation geotextile should be placed over the prepared subgrade prior to placing the overlying layer of the pavement section.

SURFACE AND GROUNDWATER CONTROL

The heavy haul road is in a low-lying area adjacent to the tidal Fore River. For the road to function as intended, surface and groundwater should be managed such that the pavement section drains and does not become saturated. To meet this objective, the design incorporates an underdrain along the entire length of the road that extends deeper than the pavement section subgrade elevation.

CLOSURE

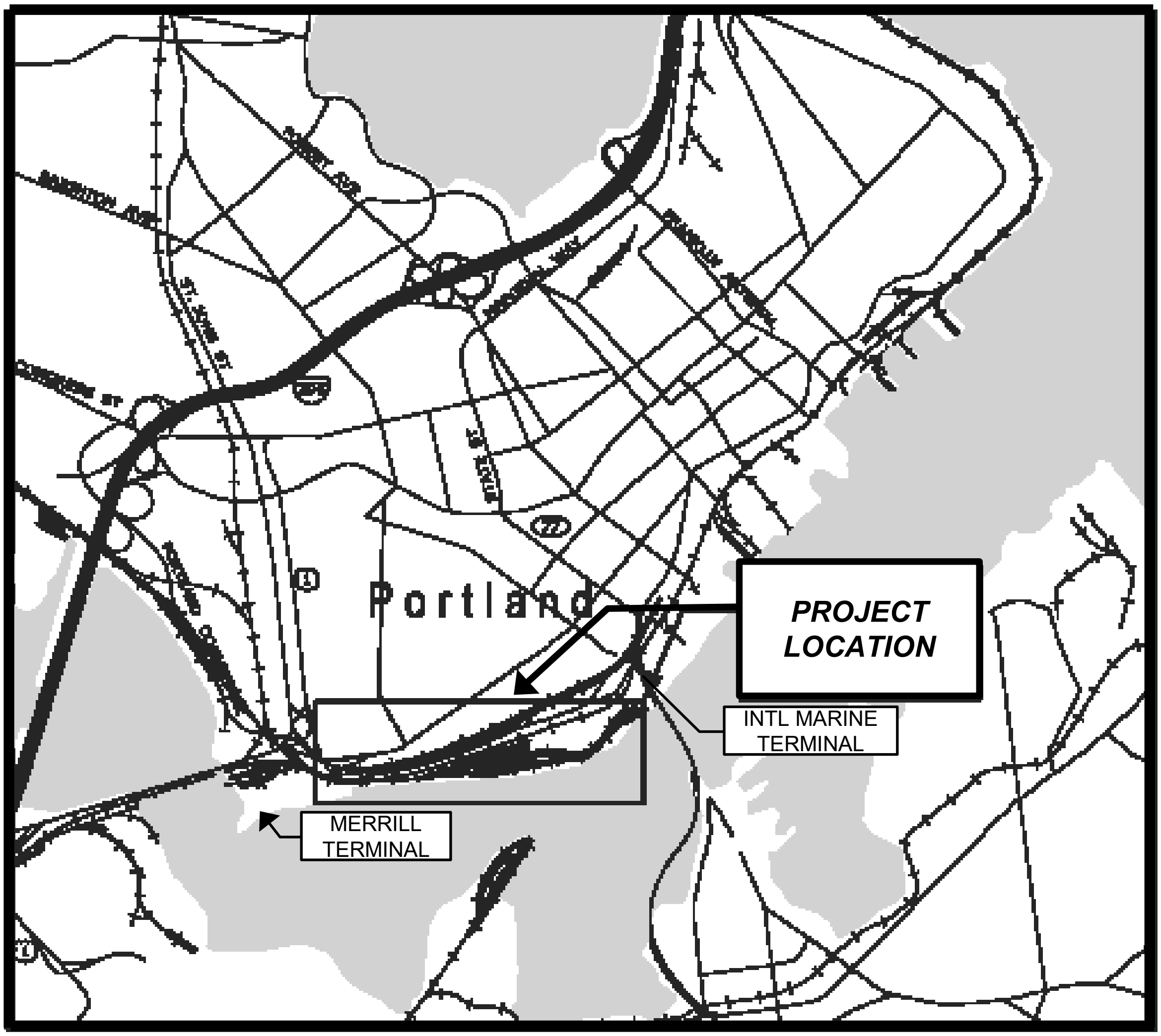
This report has been prepared for the use of HNTB Corporation for specific application to the heavy haul road to be constructed at the International Marine Terminal located in Portland, Maine in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use 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. These analyses and recommendations are based in part upon a limited subsurface investigation at discrete exploratory 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 recommended that a geotechnical engineer be provided the opportunity for a review of the design and specifications in order that the design recommendations and construction considerations presented in this report are properly interpreted and implemented in the design and specifications. It is also recommended that a geotechnical engineer be on site to observe subgrade preparation operations for the heavy haul road.

SCHONEWALD ENGINEERING ASSOCIATES, INC.

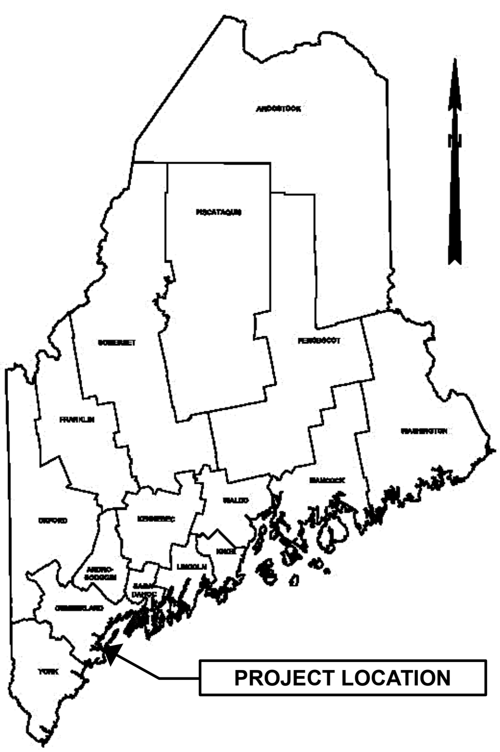
FIGURES



0 1/2 1

SCALE IN MILES

(BASE PLAN TAKEN FROM SHEET 1 OF PROJECT PLAN SET PREPARED BY HNTB)



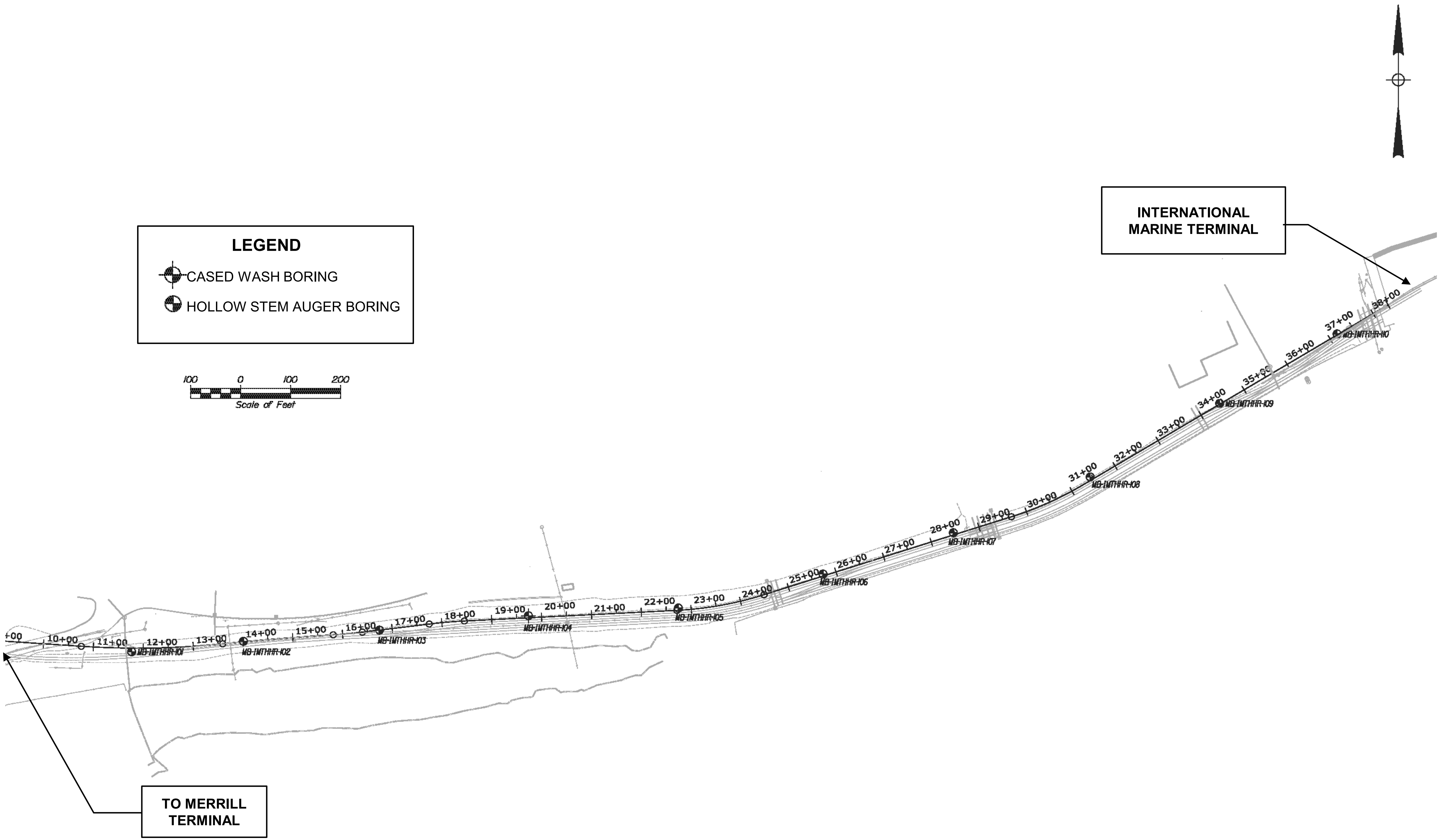
Schonewald Engineering Associates, Inc.

PROJECT NO.:	19-004
DATE:	AUGUST 2020
DRAWN BY:	IVS
APPROX. SCALE:	AS NOTED

LOCUS PLAN
HEAVY HAUL ROAD
INTERNATIONAL MARINE TERMINAL
PORTLAND, MAINE
MAINEDOT WIN 22809.50

Figure No.:

1



(BASE PLAN TAKEN FROM SHEET 5 OF PROJECT PLAN SET PREPARED BY HNTB)

SCHONEWALD ENGINEERING ASSOCIATES, INC.

PROJECT NO.: 19-004
DATE: AUGUST 2020
DRAWN BY: IVS
APPROX. SCALE: AS NOTED

BORING LOCATION PLAN
HEAVY HAUL ROAD
INTERNATIONAL MARINE TERMINAL
PORTLAND, MAINE
MAINEDOT WIN 22809.50

Figure No.:
2

APPENDIX A

SUBSURFACE EXPLORATION LOGS

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-101
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	15.7 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	11/4/19; 1355-1510	**Drilling Method:**	auger boring	**Core Barrel:**	N/A
Boring Location:	N295,067.9, E2,924,234.5	**Casing ID/OD:**		**Water Level*:**	10.6 ft (inside augers)
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			GRAVEL ACCESS ROAD	
								14.7		1.0	
	1D	24/13	1.0 - 3.0	5-18-15-11	33	39				1D: Dark brown, moist, fine to coarse SAND, some gravel, little to some silt. FILL	
	1D-A									Changing at 2 ft to 1D-A: Grey, damp, GRAVEL, some fine to coarse sand, little silt, with black ASH in tip of spoon. FILL	#15830-01 HYDROMTR A-1-a GP-GM -#200=10.0% WC=4.0%
								12.7		3.0	
	2D	24/6	3.0 - 5.0	5-14-12-10	26	31				2D: Dark brown grey, moist, medium dense, fine to coarse SAND, some gravel, some silt, with piece granite in tip of spoon; appears reworked. Strong petroleum odor.	
5	3D	24/15	5.0 - 7.0	5-10-4-3	14	16				Brown, moist, medium dense, fine to coarse SAND, some gravel, trace to little silt; possibly reworked.	
								9.4		6.3	
										Changing at 6.3 ft to 3D: Grey brown, moist to wet, fine Sandy SILT, trace medium to coarse sand; appears undisturbed (native).	
10	4D	24/17	10.0 - 12.0	4-8-6-9	14	16				4D: 8-inch thick olive brown, mottled, Clayey SILT, trace fine sand, with brown grey Silty fine SAND, trace fine gravel, trace medium to coarse sand layers above and below.	
								3.7		12.0	
15	5D	24/17	15.0 - 17.0	7-9-9-9	18	21				5D: Grey, wet, medium dense, fine to medium SAND, little to some silt, little gravel, trace coarse sand.	
								-1.3		17.0	
										Bottom of Exploration at 17.0 feet below ground surface. No refusal.	
20											
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-102
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	15.4 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	11/4/19; 1235-1345	**Drilling Method:**	auger boring	**Core Barrel:**	N/A
Boring Location:	N295,088.9, E2,924,458.1	**Casing ID/OD:**		**Water Level*:**	10.8 ft (inside augers)
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
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PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			GRAVEL ACCESS ROAD	#15830-02 WASH SIEVE A-1-a GM -#200=13.0% WC=2.1%
	1D	24/15	1.0 - 3.0	6-14-15-10	29	34		14.4		1.0 — 4 inches brown black ASH overlying 1D: Grey, dry, medium dense, GRAVEL, little to some fine to coarse sand, little silt. URBAN FILL	
	2D	24/13	3.0 - 5.0	5-3-4-4	7	8				2D: Dark brown grey, damp, loose, GRAVEL, some fine to coarse sand, some silt, with ASH. URBAN FILL	#15830-03 HYDROMTR A-1-b GM -#200=23.0% WC=4.2%
5	3D	24/10	5.0 - 7.0	4-7-2-3	9	11				3D: Moist, loose, layered dark grey, Gravelly fine to coarse SAND, little to some silt, with ASH; grey brown, fine Sandy SILT, little clay, little fine gravel, trace medium to coarse sand; and red brown, fine to coarse SAND, little silt. URBAN FILL	
								6.9		8.5	
10	4D	24/20	10.0 - 12.0	4-4-2-2	6	7				4D: Brown, wet, loose, fine to coarse SAND, trace to little gravel, trace to little silt; appears undisturbed (native).	
15	5D	24/10	15.0 - 17.0	3-1-7-12	8	9				5D: Grey, wet, loose, fine to coarse SAND, little gravel, trace silt, with one 1/8-inch layer black, oil-saturated material; appears undisturbed. Strong petroleum odor noted.	
								-1.6		17.0 — **Bottom of Exploration at 17.0 feet below ground surface.** No refusal.	
20											
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-103
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	14.3 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	11/4/19; 0915-1225	**Drilling Method:**	auger boring	**Core Barrel:**	N/A
Boring Location:	N295,111.3, E2,924,730.4	**Casing ID/OD:**		**Water Level*:**	10.9 ft (inside augers)
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			GRAVEL ACCESS ROAD	
								13.3		1.0	
	1D	24/12	1.0 - 3.0	6-8-29-14	37	44				5 inches black brown ASH overlying 1D: Grey brown, damp, dense, fine to coarse SAND, little to some silt, trace gravel, trace clay, with one piece granite in tip of spoon. URBAN FILL	#15830-04 HYDROMTR A-2-4(0) SM -#200=27.8% WC=10.2%
	2D	24/15	3.0 - 5.0	6-6-6-5	12	14				2D: Grey brown, damp to moist, medium dense, fine to medium SAND, some silt, little clay, trace to little gravel, trace coarse sand; appears reworked. FILL	#15830-05 HYDROMTR A-4(0) SM -#200=46.9% WC=18.3%
5	3D	24/24	5.0 - 7.0	3-3-4-4	7	8				3D: Grey brown, damp to moist, loose, fine to medium Sandy SILT, trace clay, trace gravel, trace coarse sand; possibly reworked. FILL	
10	4D	24/14	10.0 - 12.0	WOH-1-11-8	12	14				4D: Grey grading to red brown, moist to wet, (medium dense), Silty fine to medium SAND, trace gravel, trace coarse sand, with one 1-inch layer red-brown, fine to coarse SAND, trace to little silt, with one 3-inch layer dark grey black, Silty fine to medium SAND, trace coarse sand and pockets of Silty CLAY appears reworked. FILL	
								0.8		13.5	
15	5D	24/24	15.0 - 17.0	5-6-5-5	11	13				5D: Grey brown to red brown, wet, medium dense, predominantly fine Sandy SILT, little clay, trace gravel, trace coarse sand with one 8-inch layer fine to medium SAND, little silt grading to Silty fine SAND; appears undisturbed (native).	
								-2.7		17.0	
										Bottom of Exploration at 17.0 feet below ground surface. No refusal.	
20											
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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.: MB-IMTHHR-103

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	**Project:** International Marine Terminal - Heavy Haul Road **Location:** Portland, ME	**Boring No.:** MB-IMTHHR-104 **WIN:** 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	13.8 ft	**Auger ID/OD:**	4.5 inches (SSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	11/1/19; 1125-1410	**Drilling Method:**	cased wash boring	**Core Barrel:**	N/A
Boring Location:	N295,140.0, E2,925,028.7	**Casing ID/OD:**	4.0/4.5 inches	**Water Level*:**	>5.0 ft
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			GRAVEL ACCESS ROAD	
								12.8		1.0	
	1D	24/19	1.0 - 3.0	8-5-6-9	11	13				1D: Black, damp, ASH. URBAN FILL	
										Changing at 2.7 ft to Orange brown, damp, fine to coarse SAND, little gravel, trace silt. FILL	
	2D	24/15	3.0 - 5.0	7-5-4-8	9	11				2D: Grey brown with black, moist, loose, fine to medium SAND, little to some silt, trace fine gravel, trace clay, trace coarse sand, with ASH. URBAN FILL	#15830-06 HYDROMTR A-2-4(0) SM -#200=27.2% WC=11.4%
5	3D	24/16	5.0 - 7.0	9-6-7-7	13	15	32			3D: Grey brown, moist, medium dense, fine to medium SAND, little to some silt, little to some gravel, trace coarse sand; appears reworked. FILL	
							35				
							39				
							43	5.3		8.5	
							52				
10	4D	24/9	10.0 - 12.0	10-11-9-10	20	24	14			4D: Tan, medium dense, fine to coarse SAND, little to some gravel, little silt; appears undisturbed (native).	
							28				
							30				
							33				
							32				
15	5D	24/16	15.0 - 17.0	5-4-3-2	7	8	15			5D: Grey tan, loose, Silty fine to medium SAND, little fine gravel, trace coarse sand.	
							13				
							16			17 to 20 feet: material gravelly.	
							15				
							17				
20	6D	24/24	20.0 - 22.0	WOR-WOH-2-1	2	2	11			6D: Grey, very loose, Silty fine to coarse SAND, some gravel.	
							14				
							13			22 to 25 feet: material gravelly.	
							11				
							13				
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-104
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	13.8 ft	**Auger ID/OD:**	4.5 inches (SSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	11/1/19; 1125-1410	**Drilling Method:**	cased wash boring	**Core Barrel:**	N/A
Boring Location:	N295,140.0, E2,925,028.7	**Casing ID/OD:**	4.0/4.5 inches	**Water Level*:**	>5.0 ft
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	24/24	25.0 - 27.0	2-1-13-13	14	16				7D: Grey, medium dense, Silty fine to coarse SAND, some gravel.	
								-13.2		27.0	
										Bottom of Exploration at 27.0 feet below ground surface. No refusal.	
30											
35											
40											
45											
50											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-105
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	12.1 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	11/1/19; 0935-1115	**Drilling Method:**	auger boring	**Core Barrel:**	N/A
Boring Location:	N295,155.5, E2,925,328.8	**Casing ID/OD:**		**Water Level*:**	6.8 ft (open)
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			DIRT ACCESS ROAD	
								11.1		1.0	
	1D	24/18	1.0 - 3.0	3-6-8-9	14	16				1D: Black, damp, medium dense, ASH, little to some fine to coarse sand. URBAN FILL	
	2D	24/19	3.0 - 5.0	9-13-8-8	21	25				Black, damp, ASH; URBAN FILL Changing at 3.7 ft to: Orange tan, damp, fine to coarse SAND, trace to little silt; appears reworked. FILL	
								7.8		4.3	
5	3D	24/22	5.0 - 7.0	5-5-5-6	10	12				Changing at 4.3 ft to 2D: Tan, moist, Silty fine SAND, trace medium to coarse sand; appears undisturbed (native). 3D: Tan, moist, loose, fine Sandy SILT, little clay, trace medium to coarse sand.	#15830-07 HYDROMTR A-4(0) SM -#200=44.7% WC=22.3%
								3.6		8.5	
10	4D	24/12	10.0 - 12.0	2-10-9-11	19	22				4D: Brown grey, wet, medium dense, fine to coarse SAND, some gravel, trace to little silt.	
15	5D	24/24	15.0 - 17.0	2-3-4-2	7	8				5D: Grey brown, wet, loose, fine to medium SAND, some silt, little gravel.	
								-3.9		16.0	
										Grading to: Dark grey, fine Sandy ORGANIC SILT, trace medium to coarse sand.	
								-4.9		17.0	
										Bottom of Exploration at 17.0 feet below ground surface. No refusal.	
20											
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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Boring No.: MB-IMTHHR-105

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-106
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	12.3 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	11/1/19; 0805-0930	**Drilling Method:**	auger boring	**Core Barrel:**	N/A
Boring Location:	N295,223.5, E2,925,618.4	**Casing ID/OD:**		**Water Level*:**	8.9 ft (no stabilization)
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			DIRT ACCESS ROAD	
								11.3		1.0	
	1D	24/15	1.0 - 3.0	23-22-23-16	45	53				1D: Black brown, damp, dense, Gravelly fine to coarse SAND, little to some silt, with significant ASH. URBAN FILL	
	2D	24/15	3.0 - 5.0	5-7-7-5	14	16				Black, damp, medium dense, fine to coarse SAND, little to some silt, with significant ASH. URBAN FILL	
								7.9		4.4	
5	3D	24/18	5.0 - 7.0	4-3-5-11	8	9				Changing at 4.4 ft to 2D: Tan, moist, fine to medium SAND, some silt, trace coarse sand; appears undisturbed (native). 3D: Tan, moist, loose, fine Sandy SILT, little to some clay, trace medium to coarse sand, with clean fine to coarse sand and one piece of gravel in tip of spoon.	#15830-08 HYDROMTR A-4(0) ML -#200=65.0% WC=24.3%
								5.3		7.0	
10	4D	24/10	10.0 - 12.0	4-7-18-15	25	29				4D: Tan, wet, medium dense, fine to coarse SAND, some gravel, trace to little silt.	
15	5D	12/10	15.0 - 16.0	5-8 (blow sand)	--					5D: Grey tan, wet, fine to medium SAND, little gravel, trace coarse sand; blowing sand.	
								-3.7		16.0	
										Bottom of Exploration at 16.0 feet below ground surface. No refusal.	
20											
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-107
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	12.3 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	10/31/19; 1200-1405	**Drilling Method:**	auger boring w/ rod probe	**Core Barrel:**	N/A
Boring Location:	N295,306.3, E2,925,879.4	**Casing ID/OD:**		**Water Level*:**	10.3 ft
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			DIRT ACCESS ROAD	
								11.3		1.0	
	1D	24/12	1.0 - 3.0	11-7-4-7	11	13				1D: Dark brown black, damp, medium dense, silty sand with gravel URBAN FILL, predominantly ASH, with granite and brick fragments.	
	2D	24/14	3.0 - 5.0	3-3-2-5	5	6				2D: Dark brown black, damp to moist, loose, silty sand with gravel (fine to medium SAND, some silt, little fine gravel) URBAN FILL, predominantly ASH, with granite and brick fragments.	#15830-09 HYDROMTR A-1-b SM -#200=23.1% WC=20.5%
5	3D	24/13	5.0 - 7.0	4-6-4-2	10	12				3D: Dark brown black, moist, loose, silty sand with gravel URBAN FILL, predominantly ASH, with granite and brick fragments.	
10	4D	24/8	10.0 - 12.0	2-3-1-1	4	5				4D: Dark brown black, moist to wet, very loose, silty sand with gravel URBAN FILL, predominantly ASH, with granite and brick fragments.	
								-1.2		13.5	
15	5D	24/24	15.0 - 17.0	WOH/24"	--					5D: Dark grey, moist to wet, very loose, fine Sandy ORGANIC SILT.	
								-6.2		18.5	
20	6D	24/24	20.0 - 22.0	WOR/12"-WOH/12"	--		ROD PROBE			6D: Dark grey, saturated, very soft, Silty CLAY, little fine sand, with shell fragments.	
										Hydraulically push rod probe from 22 to 50 feet; minor resistance.	
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project:	International Marine Terminal - Heavy Haul Road	**Location:**	Portland, ME	**Boring No.:**	MB-IMTHHR-107
				WIN:	22809.50
Driller:	New England Boring Contractors	**Elevation (ft.)**	12.3 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	10/31/19; 1200-1405	**Drilling Method:**	auger boring w/ rod probe	**Core Barrel:**	N/A
Boring Location:	N295,306.3, E2,925,879.4	**Casing ID/OD:**		**Water Level*:**	10.3 ft
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25										Rod probe continued.	
30											
35											
40											
45											
50											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-107
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	12.3 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	10/31/19; 1200-1405	**Drilling Method:**	auger boring w/ rod probe	**Core Barrel:**	N/A
Boring Location:	N295,306.3, E2,925,879.4	**Casing ID/OD:**		**Water Level*:**	10.3 ft
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50								-37.7		50.0 **Bottom of Exploration at 50.0 feet below ground surface.** **Bottom of Exploration at 50.0 feet below ground surface.** No refusal.	
55											
60											
65											
70											
75											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-108
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	11.8 ft (est'd)	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	10/31/19; 1010-1150	**Drilling Method:**	auger boring	**Core Barrel:**	N/A
Boring Location:	N295,418.0, E2,926,153.2	**Casing ID/OD:**		**Water Level*:**	none observed (caved @ 6.3')
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			LOW GRASS AREA	
								10.8		1.0	
	1D	24/19	1.0 - 3.0	10-29-27-13	56	66				1D: Grey tan, damp, very dense, fine to medium SAND, little to some silt, little fine gravel, trace to little clay, trace coarse sand; appears reworked. MISC FILL	#15830-10 HYDROMTR A-2-4(0) SM -#200=30.3% WC=7.9%
	2D	24/10	3.0 - 5.0	3-3-5-12	8	9				2D: Tan, moist, loose, fine to medium SAND, trace to little silt, trace fine gravel, trace coarse sand; appears reworked. MISC FILL	
5	3D	24/16	5.0 - 7.0	3-9-5-4	14	16				3D: Eight-inch layer Grey brown, Silty MISC FILL overlying Brown, moist, fine to medium SAND, little to some silt, little fine gravel, trace coarse sand; appears reworked. FILL	
10	4D	24/9	10.0 - 12.0	15-10-1-1	11	13				Two-inch layer Orange tan, wet, fine to coarse SAND, little fine gravel, trace silt, with crushed brick. URBAN FILL	
								0.2		11.6	
										Changing at 11.6 ft to 4D: Grey, wet, fine Sandy SILT, trace medium to coarse sand, trace fine gravel; possibly undisturbed (native).	
15	5D	24/18	15.0 - 17.0	5-4-2-3	6	7				5D: Grey, wet, loose, fine to medium SAND, some organic silt, little gravel, trace coarse sand, with shells throughout; appears undisturbed (native) .	
								-5.2		17.0	
										Bottom of Exploration at 17.0 feet below ground surface. No refusal.	
20											
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-109
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	12.8 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	10/31/19; 0845-1005	**Drilling Method:**	auger boring	**Core Barrel:**	N/A
Boring Location:	N295,565.4, E2,926,412.5	**Casing ID/OD:**		**Water Level*:**	7.9 ft (open)
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			LOW GRASS AREA	
1.0	1D	24/18	1.0 - 3.0	4-8-8-6	16	19		11.8		Black, damp, fine to coarse SAND, some silt (ASH). URBAN FILL Changing at 1.7 ft to 1D: Brown, moist, fine to medium SAND, little to some silt, trace to little clay, trace coarse sand, with pockets of silt-clay. FILL	#15830-11 HYDROMTR A-2-4(0) SM -#200=31.5% WC=12.8%
	2D	24/20	3.0 - 5.0	3-2-3-3	5	6				2D: Tan, moist, loose, fine to medium SAND, some silt, trace coarse sand, with pockets of silt-clay. FILL	
5	3D	24/24	5.0 - 7.0	2-2-2-2	4	5				3D: Tan, wet, very loose, Silty fine to medium SAND, trace coarse sand; appears reworked. FILL	
10	4D	24/18	10.0 - 12.0	2-8-13-14	21	25				Tan, wet, Silty fine to medium SAND, trace coarse sand; appears reworked. FILL	
11.0								1.8		Changing at 11.0 ft to 4D: Orange tan, wet, fine to medium SAND, trace to little silt, trace coarse sand; appears undisturbed (native).	
15	5D	24/24	15.0 - 17.0	3-11-11-18	22	26				5D: Orange tan, wet, medium dense, fine to medium SAND, trace to little silt, trace coarse sand, with coarser-graded sand in tip of spoon; appears undisturbed (native).	
17.0								-4.2		**Bottom of Exploration at 17.0 feet below ground surface.** No refusal.	
20											
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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: International Marine Terminal - Heavy Haul Road
Location: Portland, ME

Boring No.: MB-IMTHHR-110
WIN: 22809.50

Driller:	New England Boring Contractors	**Elevation (ft.)**	14.0 ft	**Auger ID/OD:**	2.25/5.88 inches (HSA)
Operator:	Schaefer/ Titus	**Datum:**	NAVD88	**Sampler:**	standard split-spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 ATV (NEBC #D-19)	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	10/30/19; 1550-10/31/19; 0840	**Drilling Method:**	auger boring	**Core Barrel:**	N/A
Boring Location:	N295,704.4, E2,926,647.6	**Casing ID/OD:**		**Water Level*:**	7.4 ft (open)
Hammer Efficiency Factor:	0.707	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			LOW GRASS AREA	
								13.0		1.0	
	1D	24/17	1.0 - 3.0	4-7-9-15	16	19				1D: Dark brown black, moist, medium dense, fine to coarse SAND, some silt, little gravel (ASH) URBAN FILL	
	1D-A									Changing at 2.7 ft to 1D-A: Tan, moist, fine to medium SAND, little silt, trace coarse sand, trace gravel; appears reworked. FILL	
	2D	24/14	3.0 - 5.0	13-16-20-16	36	42				2D: Tan and light brown layers, moist, dense, fine to medium SAND, trace silt, trace gravel, trace coarse sand, with pockets of silt-clay. FILL	#15830-12 WASH SIEVE A-1-b SM -#200=16.5% WC=9.6%
5	3D	24/15	5.0 - 7.0	6-13-13-18	26	31				3D: Tan light brown, moist, medium dense, fine to medium SAND, trace silt, trace gravel, trace coarse sand, with pockets of silt-clay and pieces of brick. FILL	
								5.5		8.5	
10	4D	24/18	10.0 - 12.0	2-4-9-11	13	15				4D: Grey tan, wet, medium dense, fine to medium SAND, little silt, trace gravel, trace coarse sand, with rust-colored clean sand and dark grey brown silty fine sand layers; appears undisturbed (native).	
15	5D	24/16	15.0 - 17.0	1-2-2-3	4	5				5D: Grey tan, wet, very loose, fine to medium SAND, trace to little silt, trace fine gravel, trace coarse sand, with 4-inch layer ORGANIC SILT and wood at 16 feet and 6 inches of coarser clean sand material at bottom of sample.	
								-3.0		17.0	
										Bottom of Exploration at 17.0 feet below ground surface. No refusal.	
20											
25											

Remarks:

NEBC Rig #D-19 automatic hammer calibrated on 7/8/19.

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

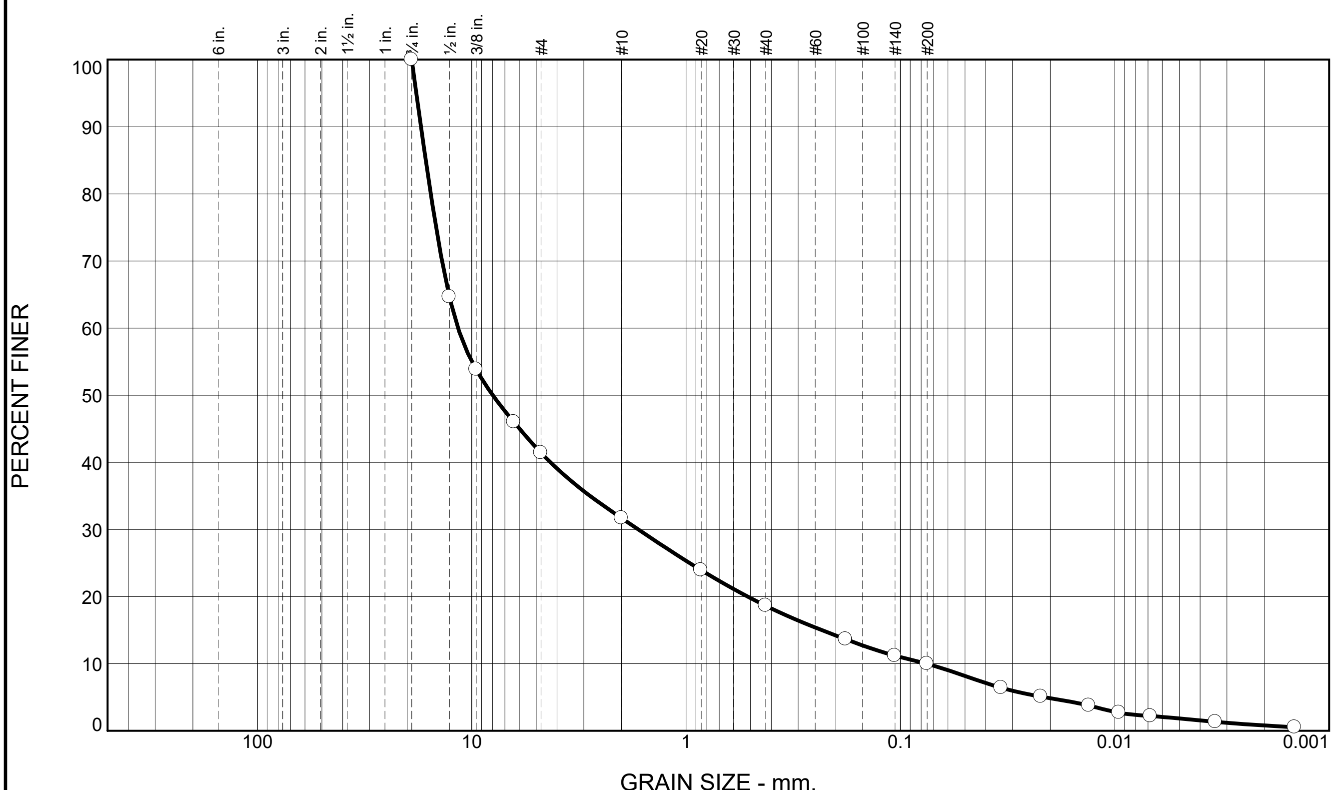
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

SCHONEWALD ENGINEERING ASSOCIATES, INC.

APPENDIX B

LABORATORY TEST REPORTS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	58.6	9.7	13.1	8.6	9.2	0.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	64.6		
3/8"	53.8		
1/4"	46.0		
#4	41.4		
#10	31.7		
#20	23.9		
#40	18.6		
#80	13.6		
#140	11.2		
#200	10.0		
0.0338 mm.	6.4		
0.0221 mm.	5.1		
0.0132 mm.	3.8		
0.0096 mm.	2.7		
0.0068 mm.	2.2		
0.0034 mm.	1.3		
0.0014 mm.	0.5		

* (no specification provided)

Soil Description

Poorly graded gravel with silt and sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 17.2440 D_{85}= 16.3791 D_{60}= 11.5859
D_{50}= 7.9748 D_{30}= 1.6710 D_{15}= 0.2327
D_{10}= 0.0756 C_u= 153.29 C_c= 3.19

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Moisture Content: 4.0%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-101
Sample Number: 1D-A **Depth:** 2'-3' **Date:** 12/10/2019

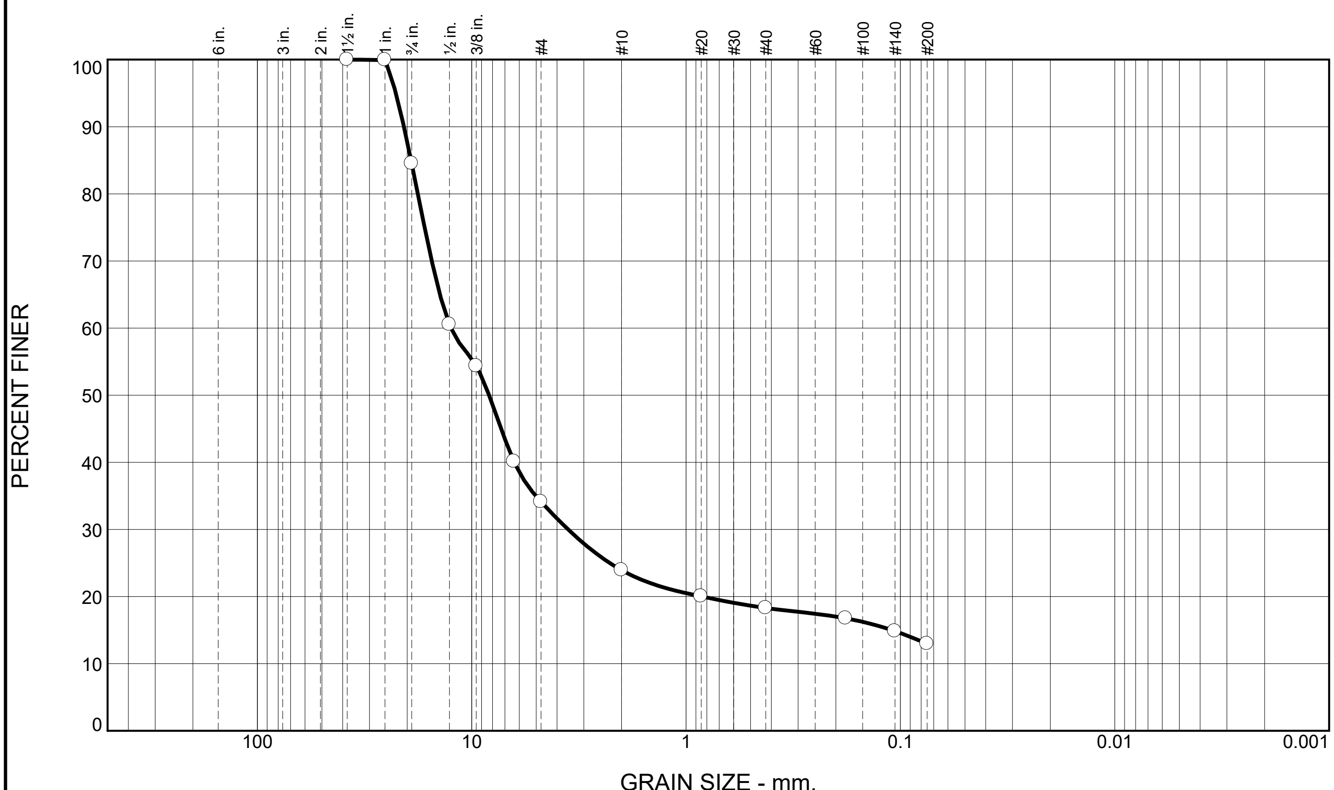
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-01

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.5	50.4	10.2	5.6	5.3	13.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100.0		
1"	99.9		
3/4"	84.5		
1/2"	60.5		
3/8"	54.4		
1/4"	40.1		
#4	34.1		
#10	23.9		
#20	20.0		
#40	18.3		
#80	16.8		
#140	14.8		
#200	13.0		

* (no specification provided)

Soil Description

silty gravel with sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 20.7142 D_{85}= 19.1886 D_{60}= 12.4975
D_{50}= 8.2931 D_{30}= 3.5519 D_{15}= 0.1097
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-1-a

Remarks

Moisture Content: 2.1%

Location: MB-IMTHRR-102
Sample Number: 1D **Depth:** 1'-3' **Date:** 12-06-2019

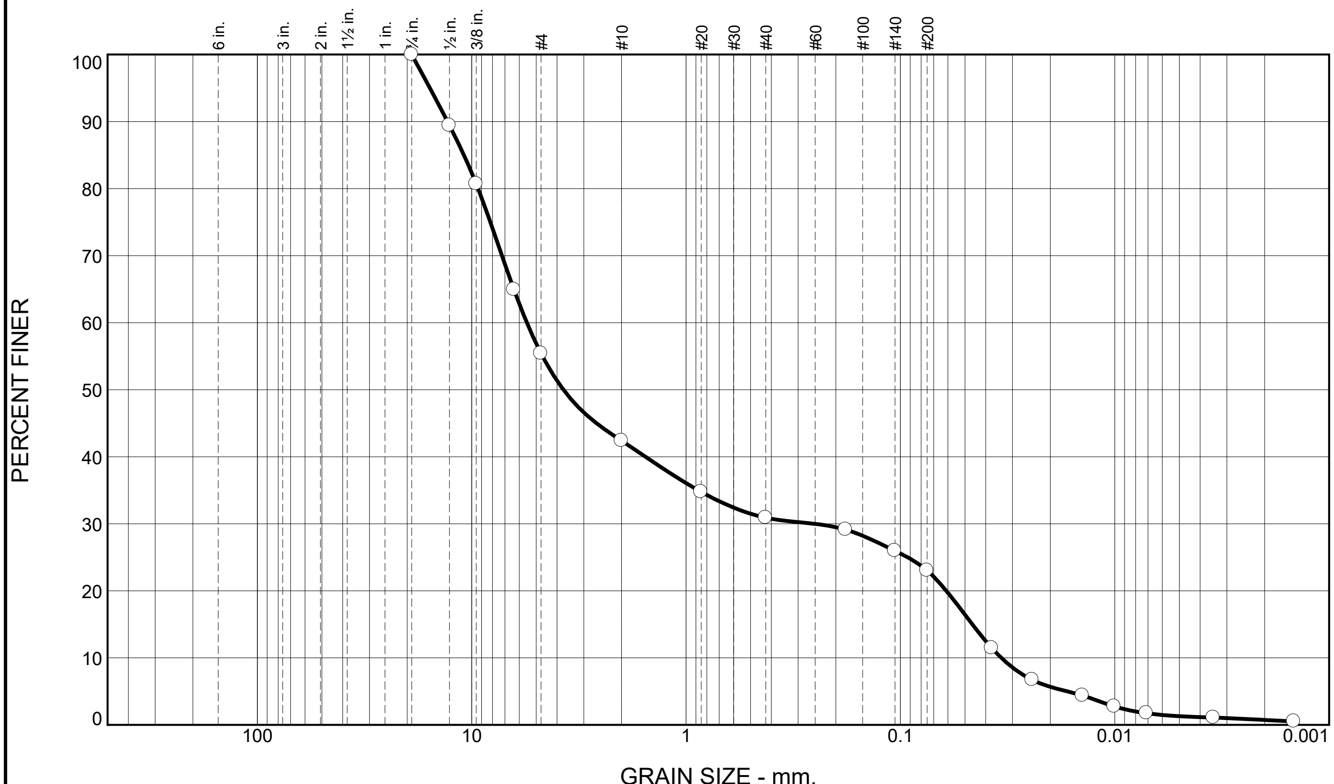
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-02

Tested By: JJB/NRP **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	44.6	13.0	11.5	7.9	22.3	0.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	89.4		
3/8"	80.7		
1/4"	64.9		
#4	55.4		
#10	42.4		
#20	34.8		
#40	30.9		
#80	29.1		
#140	25.9		
#200	23.0		
0.0375 mm.	11.5		
0.0243 mm.	6.7		
0.0141 mm.	4.4		
0.0100 mm.	2.7		
0.0071 mm.	1.7		
0.0035 mm.	1.1		
0.0015 mm.	0.5		

* (no specification provided)

Soil Description

Silty gravel with sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 12.9687 D_{85}= 10.8700 D_{60}= 5.5294
D_{50}= 3.7383 D_{30}= 0.2527 D_{15}= 0.0462
D_{10}= 0.0338 C_u= 163.46 C_c= 0.34

Classification

USCS= GM AASHTO= A-1-b

Remarks

Moisture Content: 4.2%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-102
Sample Number: 2D **Depth:** 3'-5' **Date:** 12/10/2019

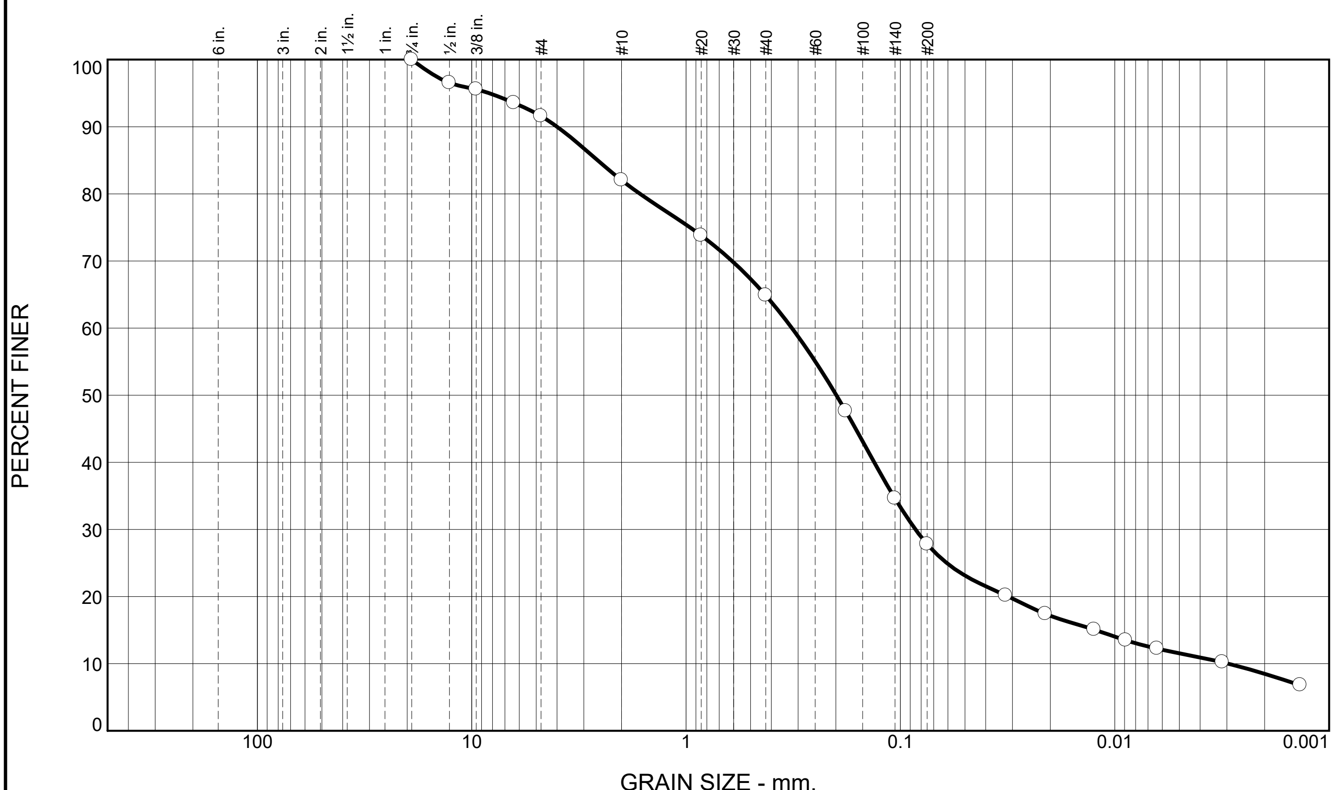
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-03

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.4	9.6	17.1	37.1	19.3	8.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	96.5		
3/8"	95.6		
1/4"	93.5		
#4	91.6		
#10	82.0		
#20	73.8		
#40	64.9		
#80	47.6		
#140	34.6		
#200	27.8		
0.0323 mm.	20.2		
0.0211 mm.	17.4		
0.0125 mm.	15.1		
0.0089 mm.	13.5		
0.0063 mm.	12.2		
0.0031 mm.	10.2		
0.0014 mm.	6.8		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 4.0006 D_{85}= 2.5843 D_{60}= 0.3206
D_{50}= 0.1989 D_{30}= 0.0851 D_{15}= 0.0123
D_{10}= 0.0030 C_u= 108.28 C_c= 7.63

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content: 10.2%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-103
Sample Number: 1D **Depth:** 1'-3' **Date:** 12/10/2019

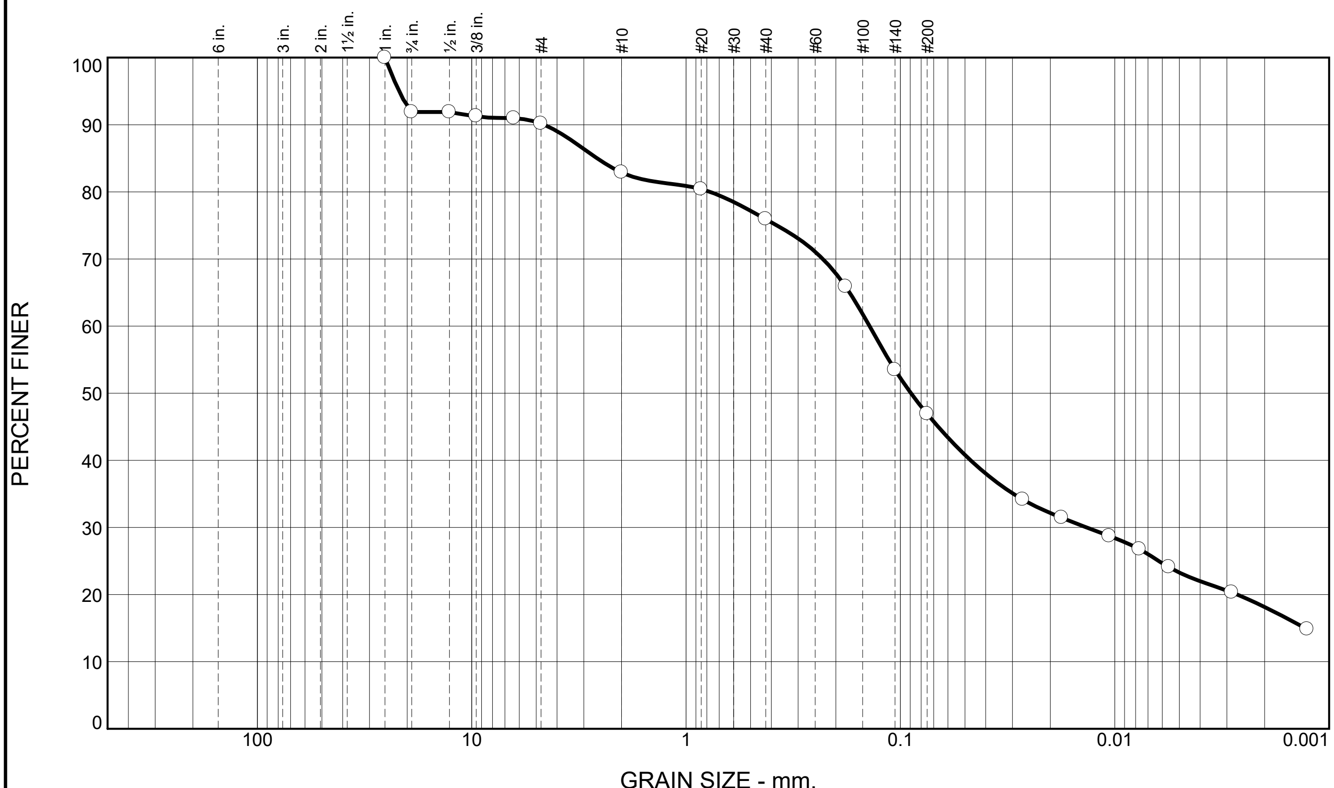
R.W. Gillespie & Associates, Inc.
Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-04

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.1	1.7	7.3	7.0	29.0	28.8	18.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	91.9		
1/2"	91.9		
3/8"	91.3		
1/4"	91.0		
#4	90.2		
#10	82.9		
#20	80.4		
#40	75.9		
#80	65.9		
#140	53.5		
#200	46.9		
0.0268 mm.	34.1		
0.0177 mm.	31.4		
0.0106 mm.	28.7		
0.0077 mm.	26.8		
0.0056 mm.	24.1		
0.0028 mm.	20.3		
0.0013 mm.	14.8		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 4.5927 D_{85}= 2.5988 D_{60}= 0.1393
D_{50}= 0.0893 D_{30}= 0.0135 D_{15}= 0.0013
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Moisture Content: 18.3%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-103
Sample Number: 2D **Depth:** 3'-5' **Date:** 12/10/2019

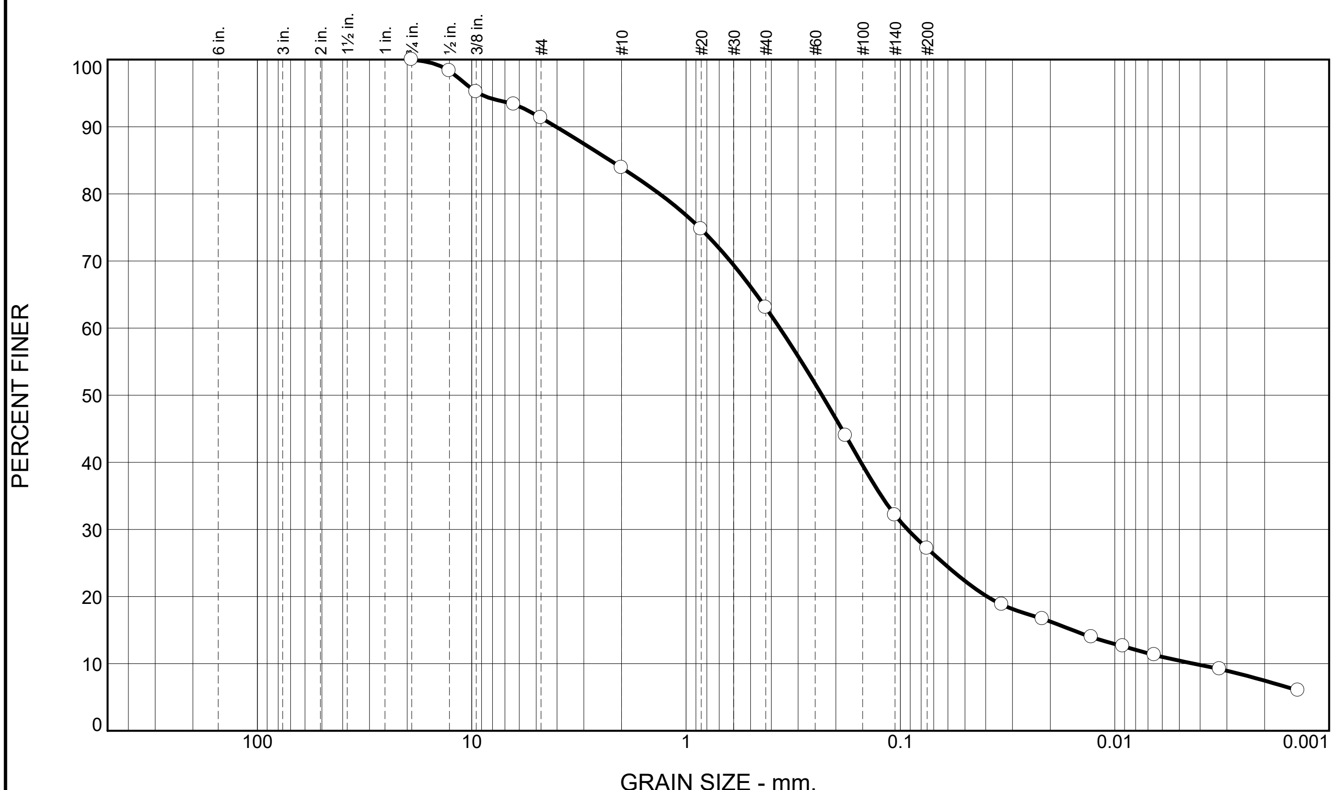
R.W. Gillespie & Associates, Inc.
Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-05

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.7	7.4	20.8	35.9	19.7	7.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	98.3		
3/8"	95.2		
1/4"	93.3		
#4	91.3		
#10	83.9		
#20	74.7		
#40	63.1		
#80	44.0		
#140	32.1		
#200	27.2		
0.0336 mm.	18.8		
0.0217 mm.	16.7		
0.0128 mm.	14.0		
0.0092 mm.	12.6		
0.0065 mm.	11.3		
0.0032 mm.	9.2		
0.0014 mm.	6.0		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 4.0457 D_{85}= 2.2633 D_{60}= 0.3652
D_{50}= 0.2322 D_{30}= 0.0928 D_{15}= 0.0157
D_{10}= 0.0043 C_u= 85.38 C_c= 5.51

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content: 11.4%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-104
Sample Number: 2D **Depth:** 3'-5' **Date:** 12/10/2019

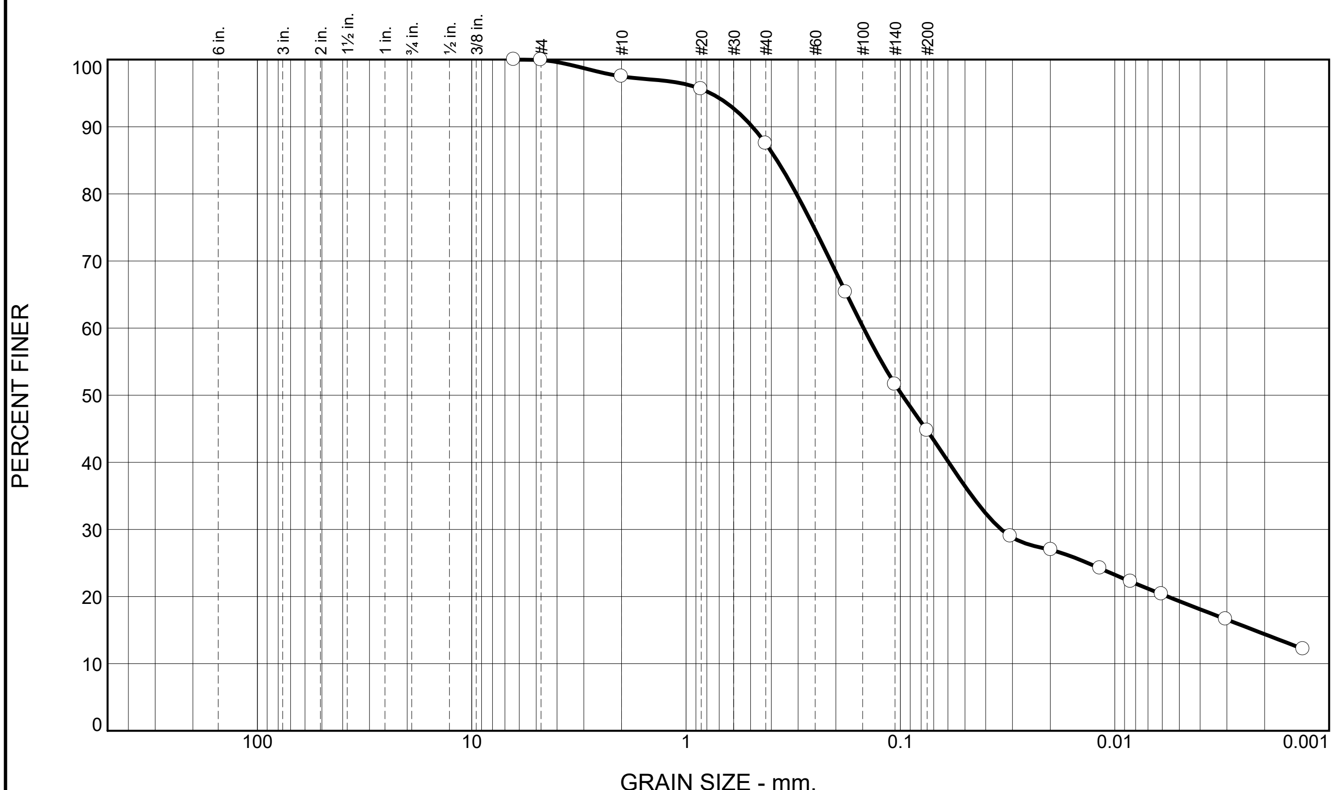
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-06

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	2.4	10.0	42.8	30.3	14.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.9		
#10	97.5		
#20	95.6		
#40	87.5		
#80	65.3		
#140	51.6		
#200	44.7		
0.0307 mm.	29.0		
0.0198 mm.	26.9		
0.0117 mm.	24.2		
0.0084 mm.	22.2		
0.0060 mm.	20.3		
0.0030 mm.	16.6		
0.0013 mm.	12.2		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4903 D_{85}= 0.3763 D_{60}= 0.1486
D_{50}= 0.0982 D_{30}= 0.0338 D_{15}= 0.0022
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Moisture Content: 22.3%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-105
Sample Number: 3D **Depth:** 5'-7' **Date:** 12/10/2019

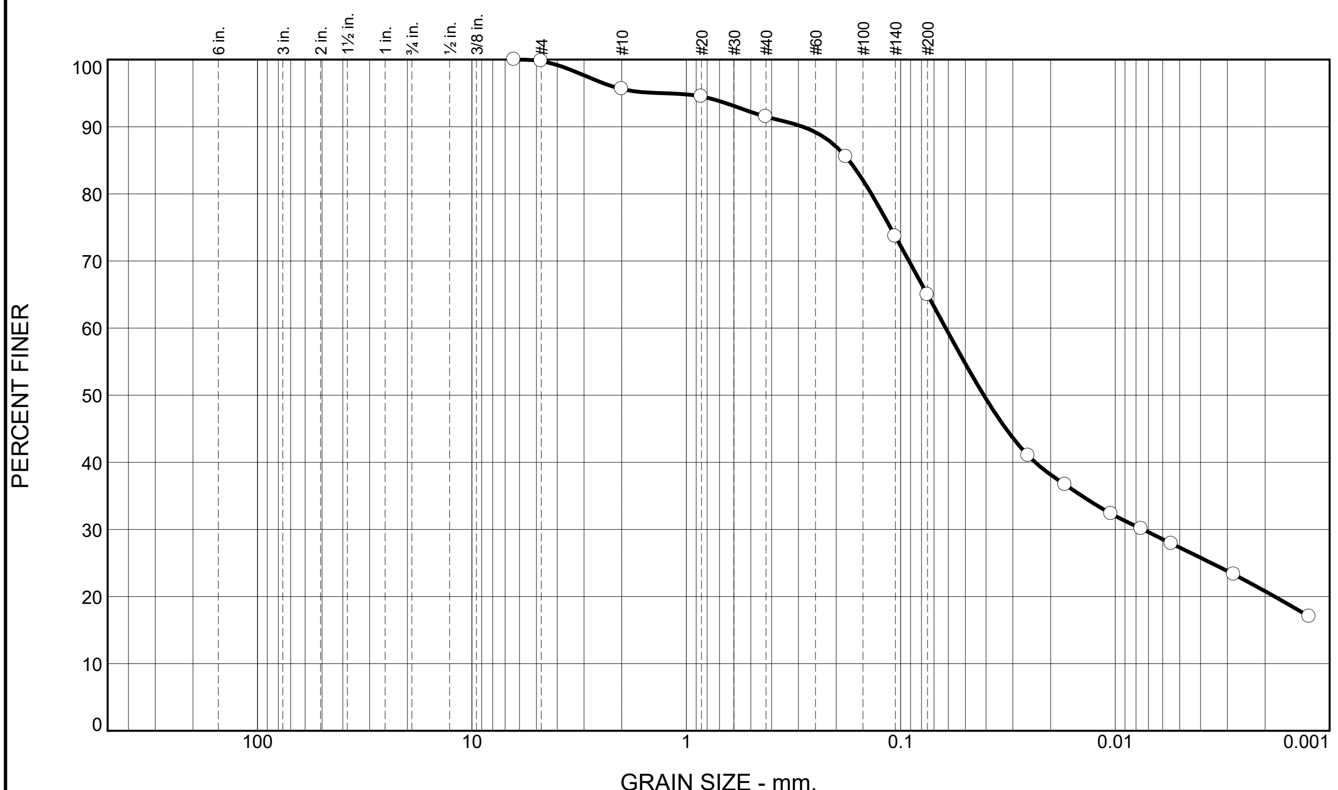
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-07

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	4.2	4.1	26.5	44.2	20.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.8		
#10	95.6		
#20	94.5		
#40	91.5		
#80	85.5		
#140	73.7		
#200	65.0		
0.0254 mm.	41.0		
0.0171 mm.	36.7		
0.0104 mm.	32.3		
0.0075 mm.	30.1		
0.0055 mm.	27.9		
0.0028 mm.	23.3		
0.0012 mm.	17.0		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2861 D_{85}= 0.1745 D_{60}= 0.0617
D_{50}= 0.0410 D_{30}= 0.0074 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Moisture Content: 24.3%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-106
Sample Number: 3D **Depth:** 5'-7' **Date:** 12/10/2019

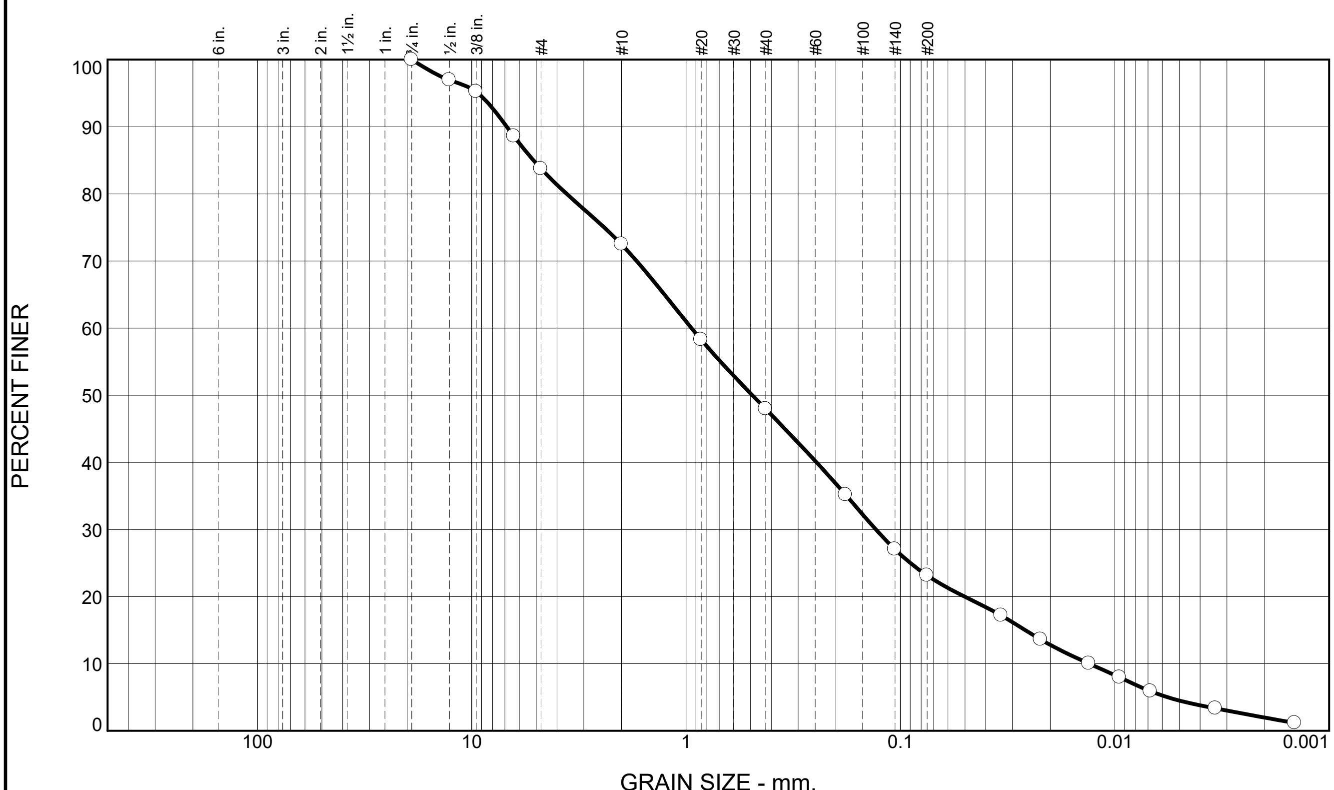
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-08

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	16.3	11.2	24.6	24.8	21.1	2.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	96.9		
3/8"	95.2		
1/4"	88.6		
#4	83.7		
#10	72.5		
#20	58.3		
#40	47.9		
#80	35.2		
#140	27.0		
#200	23.1		
0.0338 mm.	17.2		
0.0221 mm.	13.6		
0.0132 mm.	10.0		
0.0095 mm.	8.0		
0.0068 mm.	5.9		
0.0034 mm.	3.3		
0.0014 mm.	1.2		

* (no specification provided)

Soil Description

Silty sand with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 6.8593 D_{85}= 5.1540 D_{60}= 0.9437
D_{50}= 0.4909 D_{30}= 0.1302 D_{15}= 0.0262
D_{10}= 0.0132 C_u= 71.62 C_c= 1.36

Classification

USCS= SM AASHTO= A-1-b

Remarks

Moisture Content: 20.5% The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-107
Sample Number: 2D **Depth:** 3'-5' **Date:** 12/10/2019

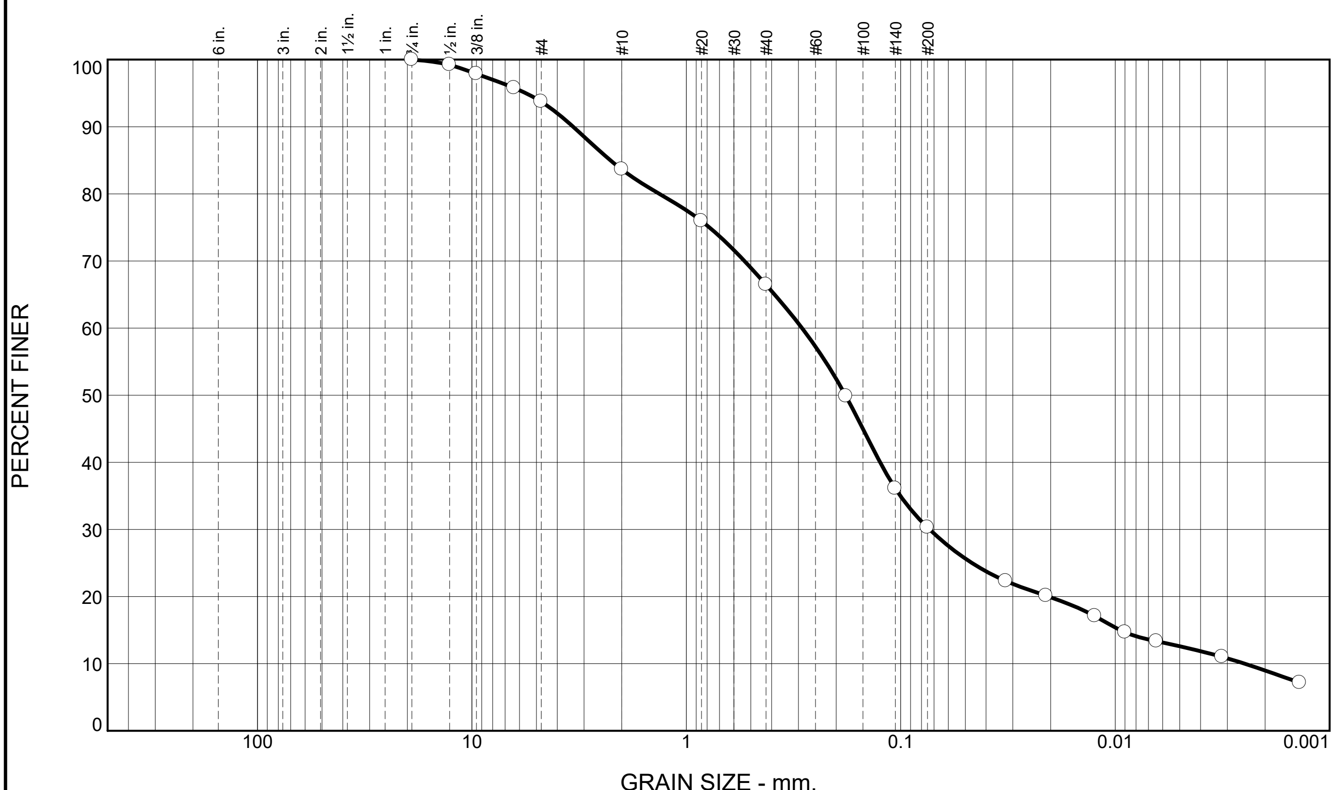
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-09

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.3	10.1	17.1	36.2	21.3	9.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	99.2		
3/8"	97.9		
1/4"	95.8		
#4	93.7		
#10	83.6		
#20	76.0		
#40	66.5		
#80	49.8		
#140	36.1		
#200	30.3		
0.0323 mm.	22.3		
0.0210 mm.	20.1		
0.0124 mm.	17.1		
0.0090 mm.	14.7		
0.0064 mm.	13.3		
0.0032 mm.	11.0		
0.0014 mm.	7.1		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 3.3725 D_{85}= 2.2585 D_{60}= 0.2886
D_{50}= 0.1811 D_{30}= 0.0734 D_{15}= 0.0095
D_{10}= 0.0025 C_u= 115.73 C_c= 7.48

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content: 7.9%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-108
Sample Number: 1D **Depth:** 1'-3' **Date:** 12/10/2019

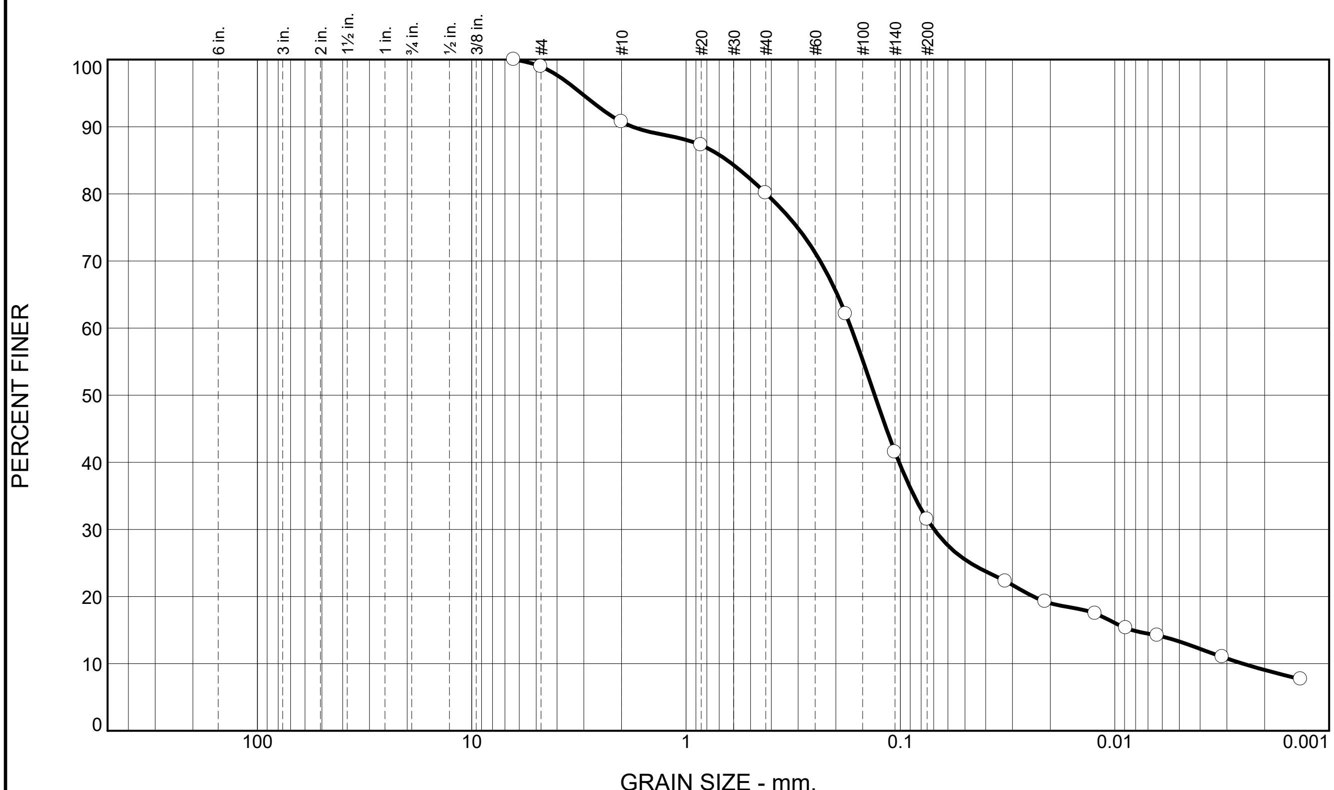
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-10

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	8.3	10.6	48.6	22.4	9.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4"	100.0		
#4	99.0		
#10	90.7		
#20	87.3		
#40	80.1		
#80	62.1		
#140	41.5		
#200	31.5		
0.0323 mm.	22.3		
0.0211 mm.	19.2		
0.0123 mm.	17.5		
0.0089 mm.	15.3		
0.0063 mm.	14.2		
0.0031 mm.	11.0		
0.0014 mm.	7.7		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= LL= NV PI=

Coefficients

D_{90}= 1.7777 D_{85}= 0.6424 D_{60}= 0.1697
D_{50}= 0.1318 D_{30}= 0.0697 D_{15}= 0.0083
D_{10}= 0.0025 C_u= 67.23 C_c= 11.32

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content: 12.8%
The Specific Gravity value used in this test is an assumed value.

Location: MB-IMTHRR-109
Sample Number: 1D **Depth:** 1.7'-3' **Date:** 12/10/2019

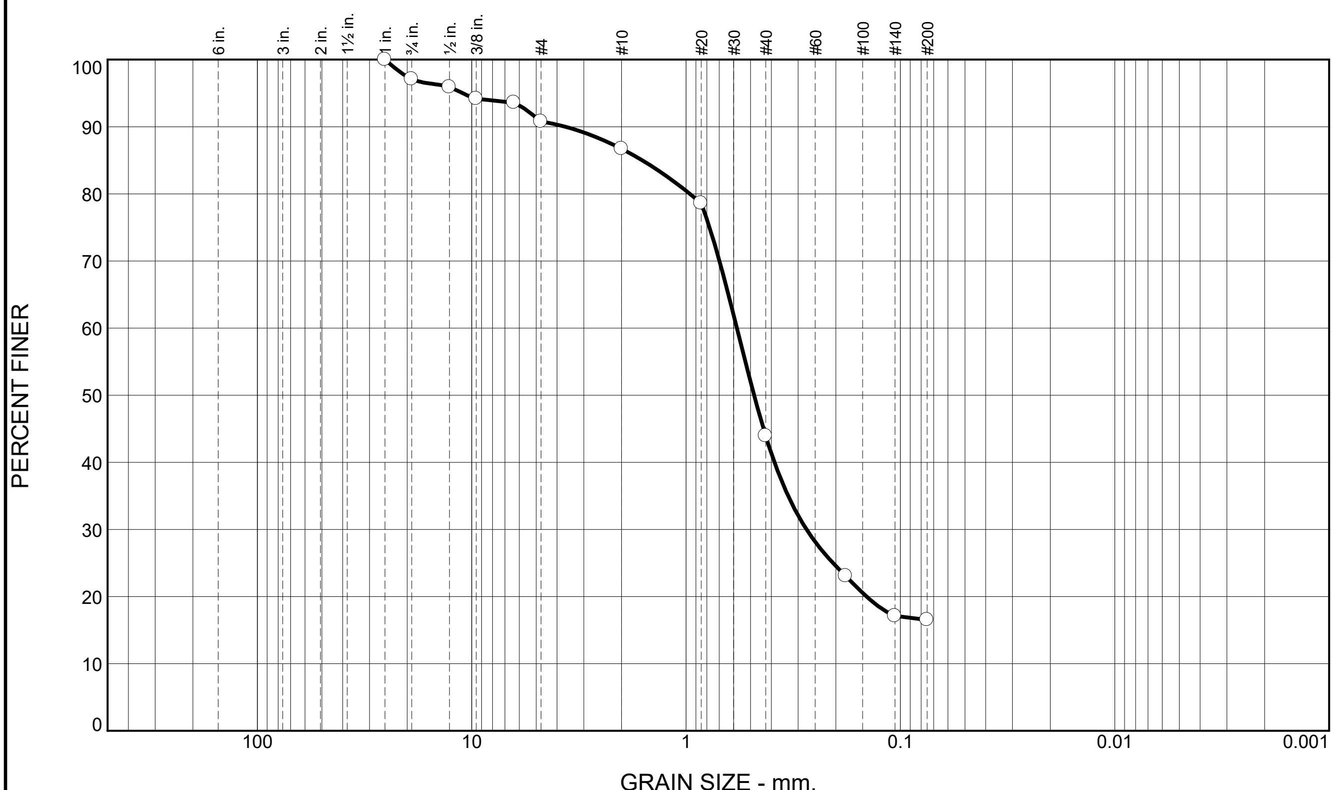
R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-11

Tested By: AGS **Checked By:** MTG

MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.9	6.3	4.1	42.8	27.4	16.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	97.1		
1/2"	95.9		
3/8"	94.2		
1/4"	93.6		
#4	90.8		
#10	86.7		
#20	78.6		
#40	43.9		
#80	23.0		
#140	17.1		
#200	16.5		

* (no specification provided)

Soil Description

silty sand

Atterberg Limits

PL= NP LL= NP PI= NV

Coefficients

D_{90}= 3.6606 D_{85}= 1.6003 D_{60}= 0.5791
D_{50}= 0.4816 D_{30}= 0.2742 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Moisture Content: 9.6%

Location: MB-IMTHRR-110
Sample Number: 2D **Depth:** 3'-5' **Date:** 12-06-2019

R.W. Gillespie & Associates, Inc. Biddeford, Maine

Client: Schonewald Engineering Associates, Inc
Project: ME DOT IMT Heavy Haul Road (#19-004)
Portland, ME
Project No: 1368-019 **Lab No.** 15830-12

Tested By: JJB/NRP **Checked By:** MTG

MTG

Schonewald Engineering Associates, Inc.

APPENDIX C

CALCULATIONS

Project:	MaineDOT Intl Marine Terminal Heavy Haul Road	**Proj. No.**	19-004
Location	Portland, ME	**MaineDOT WIN**	22809.50
Subject:	Pavement Design Calculations	**Last updated:**	5/25/20; IVS
	Overview of design process	**Checked:**	

Objective:
Determine required structural number based on equivalent 18-kip axle loads (traffic analysis) and site-specific freeze-thaw and subsurface soil and groundwater conditions. Use required structural number and material layer coefficients to develop pavement section.

References:
* Civil Engineering Reference Manual (PE Review Manual), 4th Edition, 1986, Section 16 - Traffic Analysis, Transportation, and Highway Design, Section 21 - AASHTO Method of Flexible Pavement Design
* Yoder and Witczak, Principles of Pavement Design, 2nd Edition, 1975
* AASHTO Interim Guide (1972) flexible pavement design methodology and nomograph
* AASHTO Guide for Design of Pavement Structures, 1993, Part II - Pavement Design Procedures for New Construction or Reconstruction

Analysis:

Step 1: Calculate Equivalent 18-kip Single Axle Loads for 20-year design period.
ESALs = 7,490,654 = 7.5M (Pages 2 and 3 attached)

Step 2: Select terminal serviceability (Pt) after 20-year design life
Pt = 2.0 (fair condition)

Step 3: Select (subgrade) soil support value (S) and associated Soil Resilient Modulus (Mr)
S = 4.0 — based on MaineDOT chart (Page 4 attached)
S is a function of percent passing #200 standard sieve:
use boring log descriptions, as well as lab test data
Mr = 4.4 ksi — chart relating S to Mr (Page 5 attached)

Step 4: Select regional factor for use on AASHTO 1972 design nomograph
R = 4.0 — (roadbed potentially wet; subject to freeze-thaw; high water table; subgrade potentially saturated)

Step 5: Determine required structural number ($SN_{req'd}$)
$SN_{req'd}$ = 5.4
from 1972 AASHTO flexible pavement nomograph (Page 6 attached)

Step 6: Select reliability (R) and (reliability) standard deviation (So) for use on AASHTO 1993 design nomograph
R = 78% — based on functional class, AASHTO 1993 Part II, Table 2.2 on Page II-9
So = 0.45 — for flexible pavements, AASHTO 1993 Part II, 2.1.3 on Pages II-9 and 10

Step 7: Determine design serviceability loss (ΔPSI) for use on AASHTO 1993 design nomograph
ΔPSI = Po - Pt - Pfrost(20 yrs)
Po = 4.2 — for flexible pavements, AASHTO 1993 Part II, 2.2.1 on Page II-10
Pt = 2.0 — consistent with AASHTO 1972
Pfrost(20 yrs) = 0.5 — regional/environmental serviceability loss due to frost action, AASHTO 1993, Part II, Fig 2.2 on Page II-11
ΔPSI = 1.7

Step 8: Check required structural number using 1993 AASHTO methodology
$SN_{req'd}$ = 5.4 ✓
from 1993 AASHTO flexible pavement nomograph (Page 7 attached)

Step 9: Develop pavement design such that actual structural number (SN_{actual}) exceeds $SN_{req'd}$
Page 8 attached

Project:	MaineDOT Intl Marine Terminal Heavy Haul Road	**Proj. No.**	19-004
Location	Portland, ME	**MaineDOT WIN**	22809.50
Subject:	Pavement Design Calculations	**Last updated:**	5/25/20; IVS
	Traffic Analysis	**Checked:**	

Objective:
Develop equivalent number of 18-kip axle loads to use for designing the pavement section for the IMT heavy haul road.

References:
Civil Engineering Reference Manual (PE Review Manual, 1991), Section 16 - Traffic Analysis, Transportation, and Highway Design, Section 20 - Pavement Design Parameters

Data Sources:
Refer to attached vehicle frequency and load information provided by HNTB with vehicle frequency last updated on 5/15/20.

Analysis:

VEHICLE	NO. OF AXLES	AXLE No.	AXLE LOAD (kips)	PASSES (1) (per year)	EQUIV. 18-kip PASSES (per year)	EQUIV. 18-kip PASSES IN 20 YEARS
REACH STACKER	2	1	77.2	24	8,121	162,413
(UNLADEN)		2	74.9	24	7,195	143,906
HEAVY HAUL TRUCK	4	1	10.0	13,000	1,238	24,768
(UNLADEN)		2	5.0	13,000	77	1,548
		3	2.5	13,000	5	97
		4	2.5	13,000	5	97
HEAVY HAUL TRUCK	4	1	10.0	13,000	1,238	24,768
(LADEN)		2	40.0	13,000	317,025	6,340,497
		3	20.0	13,000	19,814	396,281
		4	20.0	13,000	19,814	396,281
		TOTAL 18-KIP EQUIVALENT AXLE LOADS IN 20 YEARS:				7,490,654

Step 1: convert the number of axle loads to the number of equivalent 18-kip axle loads

EAL18-kip = EAL n-kip (n Load-kip/18)^4

Step 2: convert the axle loads in 1 year to axle loads in 20 years

EAL 20 yrs = EAL 1 yr * 20

(1) Average number of passes per year for heavy haul trucks:

= [(100 trucks/week *52 wks/yr *5 yrs)+(200*52*5)+(300*52*5)+(400*52*5)] / 20 yrs

= 13,000 passes/year

PORTLAND IMT

VEHICLE FREQUENCY ALONG HEAVY HAUL ROAD

Last Updated: 5/15/2020

Design Criteria

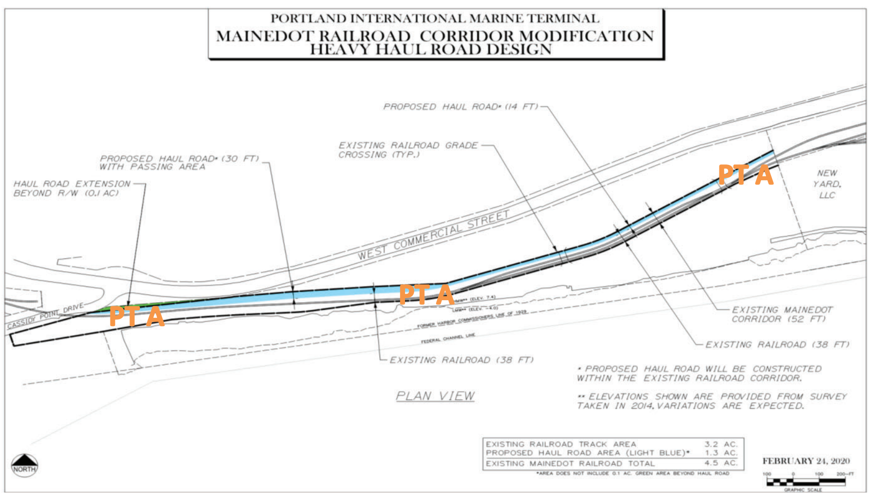
Mode of Operation

1. Merrill's Terminal will be used on a regular basis to assist the Maine Port Authority (MPA) with its transportation and storage needs. This operation could result in the movement of 400 to 1,600 containers monthly in the future. Use a 20-year design life.
2. The Kalmar reach stacker would be sent to Merrill's Terminal once per month. The number of yearly round-way trips would be 1x12=12. The number of passes would be 2x12=24.
3. The HS25 Modified Truck would be fully loaded at 90,000 lbs (axle loads are 10,000 lbs, 40,000 lbs, and 40,000 lbs).
4. The unloaded HS25 Modified Truck might use Commercial Street, but assume it returns on the Heavy Haul Road (HHR).
5. For year 1 to 5, the number of round-trips for HS25 Modified truck is assumed to be 400x12= 4,800.
6. For year 6 to 10, the number of round-trips for HS25 Modified truck is assumed to be 900x12= 10,800.
7. For year 11 to 15, the number of round-trips for HS25 Modified truck is assumed to be 1,400x12= 16,800.
8. For year 16 to 20, the number of round-trips for HS25 Modified truck is assumed to be 1,600x12= 19,200.

PT A: Along Heavy Haul Road

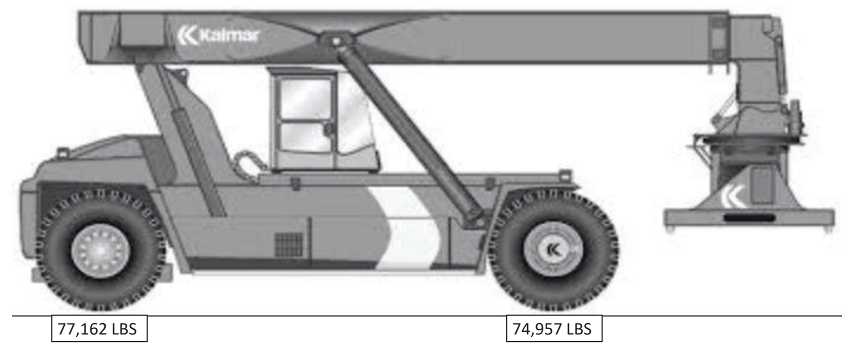
Vehicle Type	Average Passes (per year)	
Kalmar Reachstacker (empty)	*24*	*Kalmar will not travel on HHR while carrying a container. Axle loads are 74,957 and 77,162 lbs.*
HS25 Modofied Truck (loaded)	*13000*	*Heavy trucks will be the primary use of the HHR.**
HS25 Modified Truck (unloaded)	*13000*	*The unloaded truck would comprise the cab and chassis.***

**Maximum container weight is 67,200 lbs, use a modified HS25 as design truck.*
***Assume unloaded HS25 Modified Truck weight is approximately 20,000 lbs.*

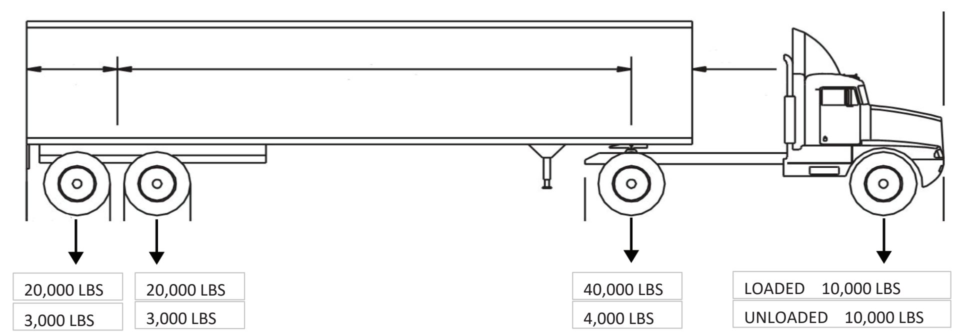


HNTB

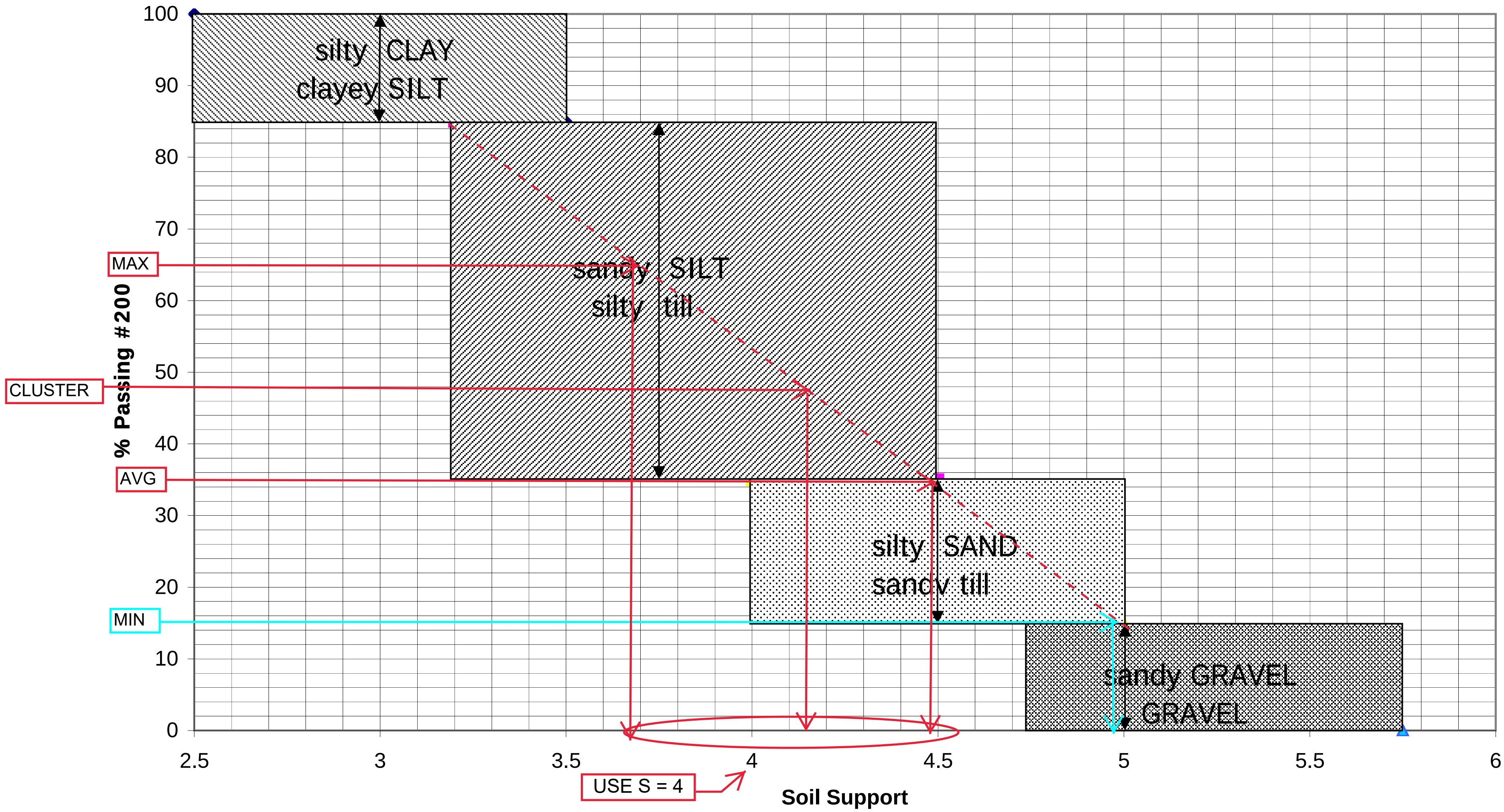
Kalmar Reachstacker



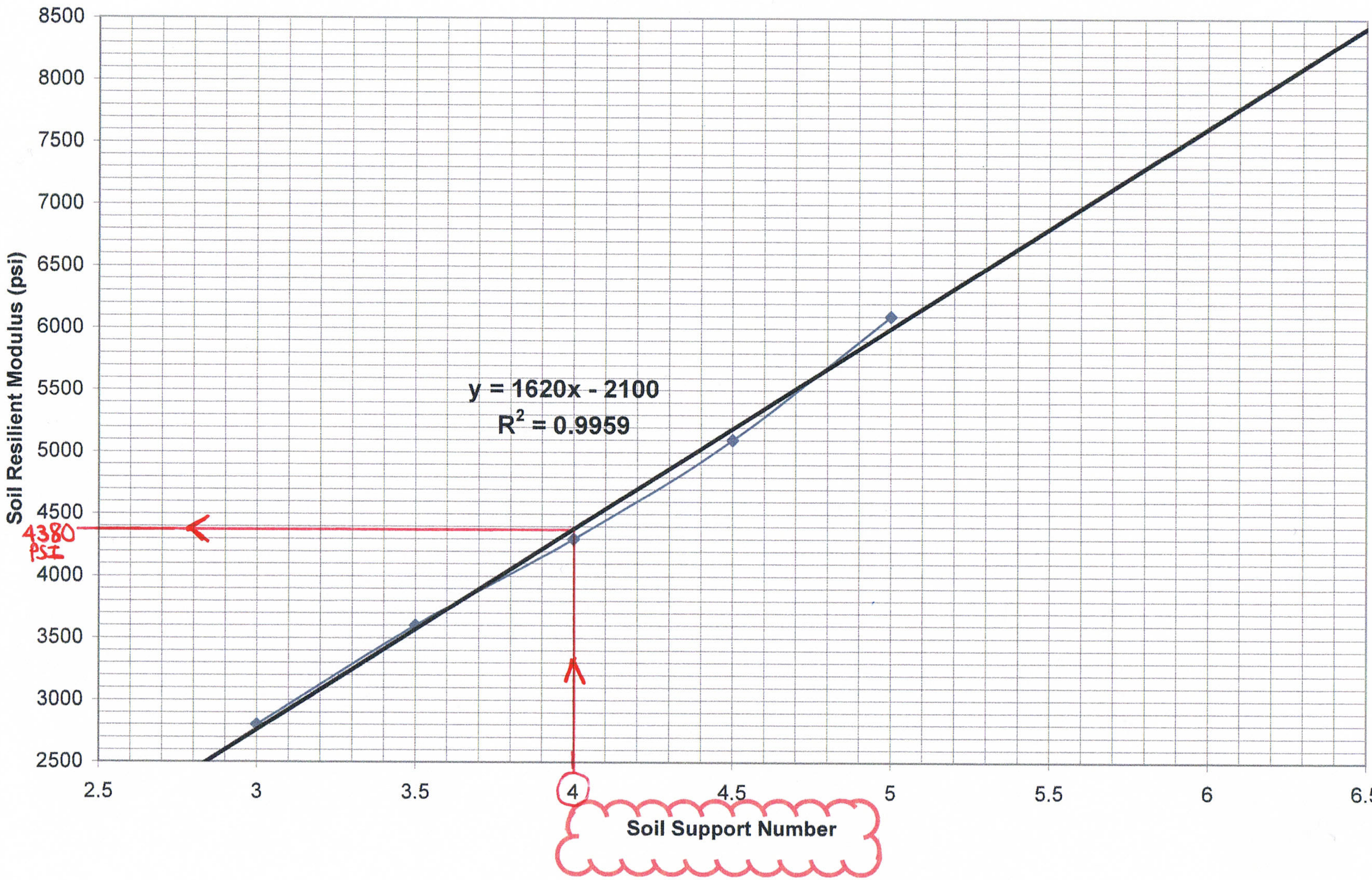
HS25 Modified



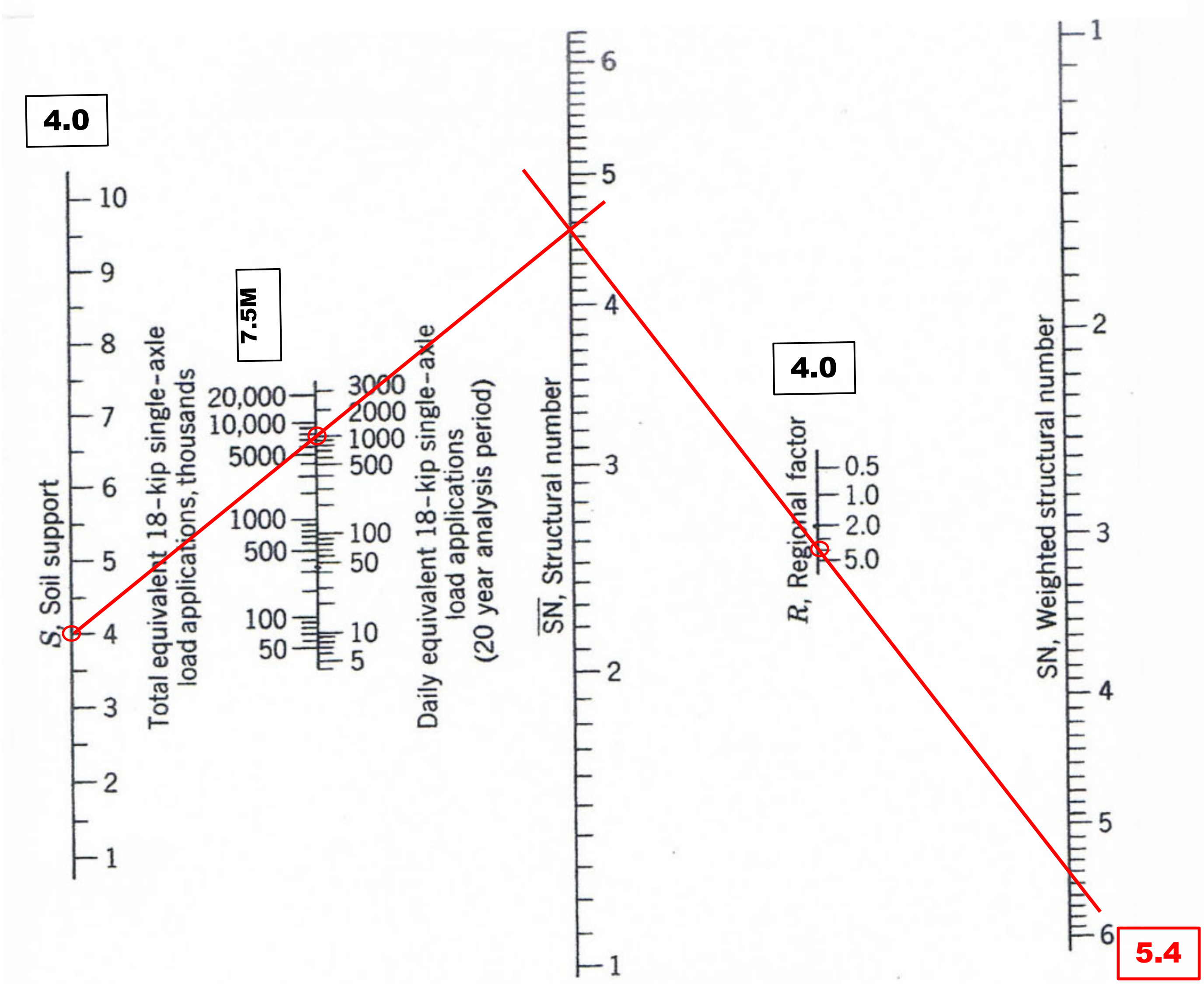
Guidelines for Selection of Soil Support Values for Pavement Design



Soil Resilient Modulus = Mr chart



Heavy Haul Truck:
90 K, 4-axle, 13000 passes per year



Design chart for flexible payments, $p_t = 2.0$

AASHO flexible-pavement design nomographs. (From AASHO Interim Guide, 1972.)

PRINCIPLES OF PAVEMENT DESIGN

SECOND EDITION

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Heavy Haul Truck:
90 K, 4-axle, 13000 passes per year

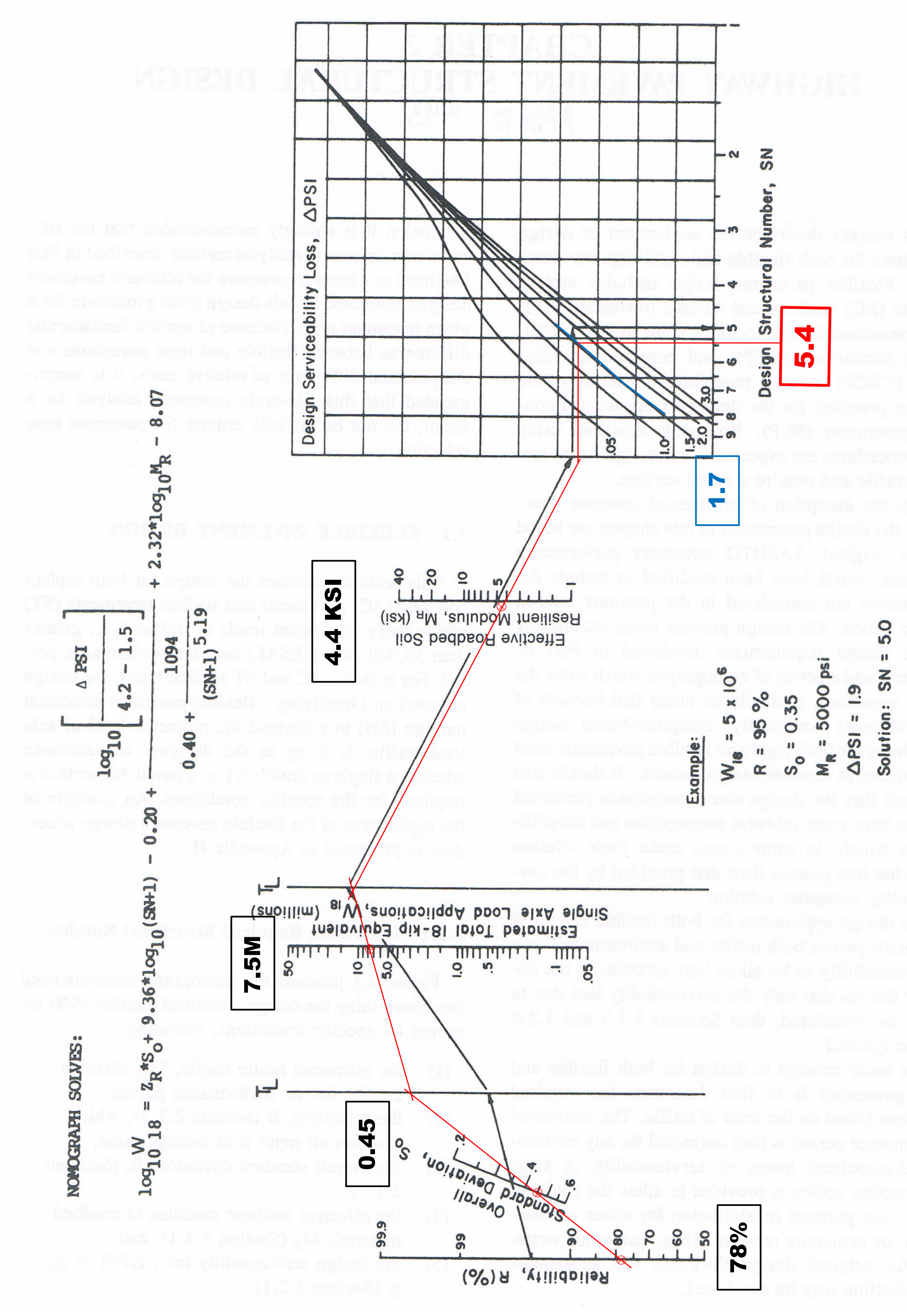

Figure 3.1. Design Chart for Flexible Pavements Based on Using Mean Values for Each Input

Project:	MaineDOT Intl Marine Terminal Heavy Haul Road	**Proj. No.**	19-004
Location	Portland, ME	**MaineDOT WIN**	22809.50
Subject:	Pavement Design Calculations	**Last updated:**	5/25/20; IVS
	Determine SN_{actual} for Design Pavement Section	**Checked:**	

Objective:
Determine the actual structural number (SN_{actual}) of the proposed pavement section for the IMT heavy haul road.

References:
* Civil Engineering Reference Manual (PE Review Manual), 4th Edition, 1986, Section 16 - Traffic Analysis, Transportation, and Highway Design, Section 21 - AASHTO [1972] Method of Flexible Pavement Design
* AASHTO Guide for Design of Pavement Structures, 1993, Part II - Pavement Design Procedures for New Construction or Reconstruction

Data Sources:
Layer coefficients provided via email from HNTB dated 5/22/20 based on their conversation with MaineDOT pavement designer.

Analysis:

LAYER	LAYER THICKNESS (inches)	LAYER COEFFICIENT	LAYER SN
HMA	4	0.44	1.76
	4	0.34	1.36
base	3	0.12	0.36
base in geocell	6	0.27 (1)	1.62
base	3	0.12	0.36
TOTAL THICKNESS (in) =	20	**SN actual =**	5.46
		SN req'd =	5.4
			✓ $SN_{actual} \geq SN_{req'd}$

(1) layer coefficient of geocell in-fill (base material) = 2.25 * layer coefficient of in-fill material alone, based on research conducted by geocell manufacturer

SCHONEWALD ENGINEERING ASSOCIATES, INC.

APPENDIX D

SPECIAL PROVISION

SPECIAL PROVISION
SECTION 614
GEOCELL SLOPE PROTECTION
(Geocell Load Support System)

All work and materials shall conform to the Contract Drawings and the provisions of the State of Maine Department of Transportation Standard Specifications, March 2020 Edition, SECTION 614 – Geocell Slope Protection, with the following modifications:

614.01 Description

Replace Subsection 614.01 with the following:

This work shall consist of furnishing and installing a Geocell Load Support System as part of the Pavement Section in reasonably close conformity with the lines and grades shown on the Plans, as specified herein, and as directed by the Resident. The Geocell Load Support System consists of non-woven separation geotextile placement over prepared subgrade; bedding material placement; geocell deployment and installation, including anchors and connectors; infill material placement; and cover material placement, grading, and compaction in preparation for HMA placement. Subgrade preparation and placing and compacting Granular Borrow to the required Geocell Load Support System subgrade elevation as needed shall be in accordance with Special Provision 203 – Excavation and Embankment.

614.02 Submittals

Replace Subsection 614.02.A – Product Data with the following:

Submit manufacturer’s product data for the separation geotextile, geocell, and geocell accessories including, but not limited to anchors and connectors.

Replace Subsection 614.02.B – Supplier Design with the following:

Submit manufacturer's project-specific design recommendations or engineering design for panel layout, type and layout for connectors for adjacent panels, anchor type, anchor length, and anchor spacing. The project-specific design shall be prepared, checked, and sealed by a Professional Engineer licensed in the State of Maine.

Replace Subsection 614.02.E – Material Certification with the following:

Manufacturer shall supply certificate of analysis containing the following test results for the geocell material used for project: base resin lot number(s), resin density per ASTM-1505, production lot number(s), material thickness, short term seam peel strength, percentage of carbon black, and environmental stress crack resistance.

Add Subsection 614.02.F – Manufacturer’s Field Representative as follows:

Submit qualifications of manufacturer's field representative certifying the field representative is experienced in the installation of the specified products for the intended application, specifically to support heavy haul loads in a pavement application.

614.031 Geocell Sections

Replace the first paragraph with the following:

The geocell sections shall be a high-density polyethylene sheet strip assembly connected by a series of offset, full depth, ultrasonic welded seams aligned perpendicular to the longitudinal axis of the strips, which, when expanded, form walls of a flexible 3-dimensional, cellular engineered soil confinement system. When expanded, the cell walls shall be of adequate height to retain a minimum 6-inch depth of infill material. The geocell material shall be manufactured by Presto Products Company, Appleton, Wisconsin (Geoweb GW30V); Hanes Geo Components, Winston Salem, North Carolina (TerraCell 140); or an approved equal. Sections shall be in conformance with manufacturers design recommendations or engineering design for this project.

Modify the following four sections as follows:

1. Geocell base material
    a. Density, ASTM D 1505: 58-60.5 pcf
    b. Environmental stress crack resistance (ESCR) ASTM D 1693: 5,000 hours
2. Geocell strip properties and assembly
    a. Perforated Strip/Geocell:
        ii. Textured sheet thickness: 60 mil +/- 6 mil
3. Geocell properties
    b. Individual cell dimensions (+/- 10%):
        i. Length: 11.3 inches
        ii. Width: 12.6 inches
        iii. Nominal area: 71.3 in^2
        iv. Nominal depth: 6 inches
4. Geocell Seam Strength Tests
    b. Short term seam peel strength test:
        ii. 480 lbf (for 6-inch depth)

614.032 Integral Components

Modify this section with the following:

Adjacent sheets (edge to edge and end to end) shall be connected using high-strength polyethylene ATRA, or an approved equal, connector. Connectors shall be used to connect sections together at each interleaf or end-to-end connection. Metal staples or zip ties shall not be allowed. Location and connection detail shall be in accordance with the geocell manufacturer's recommendations and the project-specific design.

The anchoring system shall consist of straight No. 4 steel reinforcing rods with an ATRA clip, or an approved equal, as end cap. Length shall be as specified in the manufacturer's recommendations or the project-specific design.

614.033 Granular Borrow

Delete this section.

614.034 Geocell Bedding, Infill, and Cover Material

Replace this section with the following:

Geocell bedding, infill, and cover material shall be as shown on the Plans and shall meet the requirements of MaineDOT Section 703.06 – Aggregate for Base and Subbase, Type A.

614.035 Surface Treatment

Replace this section with the following:

The HMA section specified on the Plans shall be placed over the untreated aggregate surface course material that covers the in-filled geocell material.

614.036 Separation Geotextile

Add the following to this section:

The separation geotextile placed over the prepared subgrade shall be a Class 1, nonwoven geotextile that meets the requirements of MaineDOT Section 722.04 and has a minimum (MARV) weight greater than or equal to 6 oz/sy.

614.04 Construction Requirements

Replace Subsection 614.04 in its entirety with the following:

Geocell Load Support System shall be constructed as part of the pavement section to the full limits depicted on the Plans. The Geocell Load Support System shall have the following construction requirements:

1. General
    a. Prepare subgrade and install load support system in accordance with manufacturer's instructions.
    b. On-site time for installation assistance by the manufacturer's field representative shall be 1 day with one trip. All labor and expense costs for the geocell manufacturer's field representative installation assistance shall be incidental to the contract price
2. Subgrade Preparation
    a. Subgrade preparation and placing and compacting Granular Borrow to the required Geocell Load Support System subgrade elevation as needed shall be in accordance with Special Provision 203 – Excavation and Embankment.
    b. Install separation geotextile over prepared surfaces ensuring required overlaps are maintained and outer edges of the geotextile are buried a minimum of 6 in. below subgrade.
3. Bedding Layer Placement
    a. Place Bedding Material over the Separation Geotextile to the depth and grades depicted on the Plans. Use care not to damage or otherwise wrinkle or displace the Separation Geotextile.
    b. Grade using low ground pressure equipment and lightly compact Bedding Material using a static roller to provide a firm and stable surface upon which to deploy the geocell.
4. Placing, Anchoring, and Connecting Geocell Sections
    a. Anchor and connect geocell sections per the project-specific design, shop drawings and manufacturer's recommendations. Use types and frequency of connectors and anchors as indicated on the shop drawings.
    b. Expand geocell sections in the work direction. Confirm each geocell section is expanded uniformly to the required dimensions and the outer cells of each section are correctly aligned.
    c. Interleaf edges of adjacent sections. Ensure that the upper surface of adjoining geocell sections are flush at the joint and adjoining cells are fully aligned at the cell wall slot.
    d. Anchor with specified anchors in prescribed pattern throughout the road surface.
    e. Connect the sections with connectors manufactured by the geocell manufacturer. Connectors shall be placed at each interleaf and end to end connection. Insert the connectors in accordance with the manufacturer's recommendations.

5. Placing Infill and Cover Material
    a. Place infill and cover material in the expanded cells with suitable material handling equipment, such as a backhoe or front-end loader. A bulldozer or grader shall not be used. Limit drop height to a maximum of 3 feet. Avoid displacement of the geocell sections by infilling in the direction of work. Spotters shall be used whenever infill and cover material is being placed and spread.
    b. Infill and cover material shall be free-flowing and not frozen when placed and spread.
    c. Evenly spread infill and cover material to ensure the infill fills and is flush against the cell walls.
    d. Overfill and compact material to infill the geocells and achieve the required depth of cover over the top of the geocells in one operation. Lightly compact the cover material surface with a static roller.
    e. Compaction is complete when the geocells are full and no longer accept infill material when traversed by a static roller.
    f. Use plastic shovels to spot check that the cells are adequately filled and that the integrity of the geocell was maintained. This shall be done at locations selected by the Resident and in the presence of the Resident or Inspector.
    g. Limit grading of the cover material surface prior to HMA placement. Place the HMA wearing course as soon as possible after the placement of the geocell infill and cover material is complete.

<u>614.06 Method of Measurement</u>

Add the following:

The Geocell Load Support System measurement will be by the square foot of material installed.

<u>614.07 Basis of Payment</u>

Add the following:

Geocell Load Support System will be paid for at the contract unit price per square foot which shall be full compensation for design; all labor and materials to furnish and install the separation geotextile, geocell material and accessories, including connectors and anchors, bedding, infill, and cover material, and preparation of the cover material surface for HMA placement. Compensation for subgrade preparation and placing and compacting granular borrow to achieve subgrade shall be under Special Provision 203 – Excavation and Embankment. All labor and expense costs for the geocell manufacturer's field representative installation assistance shall be incidental to the contract price.

Payment will be made under the following Pay Items:

Pay Item		Pay Unit
614.301	Geocell Load Support System	Square Foot