



26 August 2019

Matthew E. Hill, P.E.
City of Sanford
156 School Street
Sanford, Maine 04073

Subject: Geotechnical Engineering Services
Riverside Avenue and William Oscar Emery Drive
Sanford, Maine
RWG&A Project No. 0266-021

Dear Mr. Hill:

R. W. Gillespie & Associates, Inc., (RWG&A) is pleased to present the results of the geotechnical engineering evaluation for the proposed reconstruction of Riverside Avenue and William Oscar Emery Drive in Sanford, Maine. The purpose of the services was to evaluate subsurface conditions and soil properties for the City's use in design of new pavement sections. The services were provided in general accordance with RWG&A Proposal No. P-10178.GI, dated 06 May 2019.

The following sections present the findings of the subsurface explorations, laboratory testing, engineering evaluations, and geotechnical design recommendations. Refer to Appendix A for limitations and use of this report.

INTRODUCTION

RWG&A's understanding of the proposed construction is based on communications with the City of Sanford. The project consists of reconstruction of Riverside Avenue from Washington Street to Pleasant Avenue, and at William Oscar Emery Drive from Pleasant Avenue to the roundabout and from its intersection with Riverside Avenue to River Street. The subject street sections are shown on Figure 1, *Locus Map*. The existing streets are bituminous concrete paved, two lanes wide, and have paved shoulders. The streets have curbs and sidewalks on one or both sides of the road.

SUBSURFACE EXPLORATION

The soil exploration program consisted of test borings B-1 through B-10 drilled on 02 July 2019 by Northern Test Boring Inc., of Gorham, Maine using a track-mounted drill rig. The borings

were drilled at locations requested by the City and shown in the figure titled, *Riverside Avenue: Geotechnical Roadway Explorations Locus Map* provided in the email dated 26 April 2019; 10:16AM. The approximate as-drilled boring locations are shown on Figure 2, *Exploration Location Plan*.

An RWG&A representative provided technical monitoring of the drilling activities, logged the boreholes, and obtained soil samples. In general, split-barrel sampling was performed at 2-foot intervals in the upper 4 feet, sampled with a 3-inch diameter split-barrel in accordance with *ASTM D3550, Standard Practice for Thick Wall, Ring Lined, Split Barrel, Drive Sampling of Soils*. Samples taken below 4 feet were obtained using split-barrel sampling with standard penetration testing (*ASTM D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*).

The soils encountered were described in the field in general accordance with *ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)* based on soil samples and drill cutting observations. Representative soil sample portions were transported to RWG&A's laboratory in sealed glass jars for further classification based on *ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)* and laboratory test results.

Logs of the explorations are included in Appendix B. Subsurface conditions described on the logs are based on RWG&A's field observations and the results of laboratory testing. Stratification lines shown on the exploration logs represent the estimated boundaries between the different soil types encountered and approximate refusal depths; the actual transitions will be more gradual and will vary over short distances. Subsurface information should only be considered representative of subsurface conditions encountered within the vertical reach of the explorations on the date the explorations were made.

LABORATORY TESTING

Laboratory testing was performed on soil samples to assist in description of the soils and estimation of engineering properties. The laboratory testing program included 17 grain-size analyses with water content determinations, two moisture-density relationship tests and two laboratory California Bearing Ratio tests (CBR). The tests were performed in general accordance with the following methods and procedures:

- *ASTM D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.*
- *ASTM D6913/6913M – 17, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis*
- *ASTM D1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils.*
- *ASTM D698 – 12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))*

The laboratory test results are presented in Appendix C, *Laboratory Test Results*, and moisture content determinations are also included on the boring logs. CBR test results are summarized in Table I, *Summary of Laboratory CBR Test Results*. The above tests were conducted at the RWG&A soil and materials testing laboratory in Biddeford, Maine, which is accredited by the American Association of State Highway and Transportation Officials (AASHTO) for the tests performed.

SUBSURFACE CONDITIONS

Subsurface conditions encountered varied with location. In general, asphaltic pavement ranged from 2 to 4 inches thick, and was underlain with about 3.1 to more than 5 feet of base/subbase fill material. Naturally deposited soils generally consisted of loose to dense silty sand. Refer to Table II, *Summary of Subsurface Conditions* for encountered material thicknesses.

Riverside Avenue – Washington Street to Winter Street: Subsurface conditions encountered in boring B-1 and B-2 consisted of about 2 to 4 inches of asphaltic pavement including a new layer of maintenance mix, over base and subbase aggregate materials underlain by naturally deposited silty sand.

The base aggregate material ranged from about 0.9 to 1.3 feet thick and generally consisted of gravelly sand with silt. The gravel fraction was coarse to fine and subrounded to subangular in shape. The subbase aggregate material ranged from about 3.3 to 4.7 feet thick and generally gravelly fine sand with silt. Gravel was coarse to fine, and round to sub-rounded in shape.

Riverside Avenue – Winter Street to Pleasant Avenue: Subsurface conditions consisted of about 2.5 to 4.5 inches of asphaltic pavement including a new layer of maintenance mix, over base and subbase aggregate materials underlain by naturally deposited silty sand. Trace amounts of organic material and debris were observed in boring B-5 about 2.5 feet below ground surface.

The base aggregate material ranged from about 0.7 to 1.7 feet thick and generally consisted of gravelly to silty sand. Gravel particle shape varied from sub-rounded to sub-angular gravel. The subbase aggregate material ranged from about 1.5 to 4.1 feet thick and generally consisted of sand with varying amounts of coarse to fine, round to sub-rounded gravel, and silt. A bulk sample was obtained at a depth of 2 to 4 feet below ground surface from boring B-6 for moisture-density relationship and CBR testing.

William Oscar Emery Drive – Pleasant Avenue to the Roundabout: Subsurface conditions encountered in borings B-7, B-8, and B-9 consisted of about 3 to 3.5 inches of asphaltic pavement with low severity transverse and alligator cracking, over base and subbase aggregate materials underlain by naturally deposited silty sand. A 3 to 4-inch thick layer of asphalt was encountered below the base aggregate at a depth of 2.5 feet and 1 foot in borings B-7 and B-8, respectively. The base aggregate material ranged from about 1.7 to 2.5 feet thick and generally consisted of sandy gravel to gravelly sand with varying amounts of silt. Gravel particles were generally sub-rounded to sub-angular. An approximately 5-foot thick layer of subbase aggregate material was encountered in boring B-8 and generally consisted of coarse to fine sand with silt and coarse to fine, round to subrounded gravel.

William Oscar Emery Drive – from the Roundabout to River Street: Subsurface conditions at borings B-9 and B-10 consisted of about 2 to 3.25 inches of asphaltic pavement over base and subbase aggregate materials underlain by naturally deposited silty sand. A refusal surface was encountered in boring B-9 about 4.5 feet below ground surface; the nature of the refusal surface is uncertain and might have been on a cobble, boulder, or manmade obstruction.

The base aggregate material ranged from about 1.3 to 1.7 feet thick and generally consisted of gravelly sand with silt. Gravel particles were subrounded to subangular. The subbase aggregate material was about 3 feet thick and generally consisted of gravelly sand with varying amounts of silt; Subbase gravel particles were round to subrounded. The naturally deposited soil encountered consisted of dense silty sand. A bulk sample was obtained from boring B-9 at a depth of 2 to 4 feet below ground surface for moisture-density relationship and perform a laboratory CBR testing.

Groundwater

Free water was observed in borings B-5 through B-8 at depths ranging from 5 to 7 feet below current ground surface at the time of drilling. Free water was not observed in the other borings. Groundwater levels at the site will fluctuate due to season, temperature, rainfall, nearby underground utilities, and construction activity in the area; therefore, water levels during and following construction will vary from those observed in the explorations.

ENGINEERING EVALUATIONS AND RECOMMENDATIONS

Engineering evaluations for this project are based on the subsurface explorations, laboratory testing, and planned construction information currently available to RWG&A. Should differing information become known prior to or during construction, these evaluations should be reviewed by RWG&A to confirm their continued applicability.

Evaluation of Existing Aggregate Base/Subbase Material and Subgrade Soils

Particle-size distributions tests were performed on samples of in-place aggregate base, subbase and subgrade materials recovered from 10 boreholes, and the test results were compared to (MaineDOT) *Standard Specifications, November 2014 Edition* Section 703.06 Aggregate for Base and Subbase. Refer to Table III, *Summary of Particle-Size Distribution Test Results* for comparison of particle-size distributions to applicable gradations in the Maine DOT standard specifications. In general, *in-situ* base and subbase materials do not appear to meet current Maine DOT grading requirements. Material proposed for reuse during construction should be stockpiled and tested for conformance to project particle-size distribution requirements.

Depth of freezing was calculated with the ModBerg Version 99.2.0 computer program. The design air freezing index is about 1123 Fahrenheit degree - days. The calculated depth of freezing for paved snow free condition is 50 inches. Particle-size distribution test results indicate existing aggregate base, subbase and subgrade materials are low to moderately frost-susceptible.

Full depth frost protection of pavements would require a total pavement section of about 50

inches, which would be cost prohibitive. Thinner pavement sections, including reinforced sections, are considered more frost-susceptible than thicker sections constructed of the same non-frost susceptible materials. It is typical practice in the New England region to provide partial depth frost protection for pavements with the expectation that some frost heaving will occur.

Subgrade CBR Values for Use in Pavement Section Design

RWG&A recommends the following CBR values be used for pavement section thickness design for *in-situ* subgrade soil.

Road Section	CBR Value
Riverside Avenue – Winter Street to Pleasant Avenue	68
William Oscar Emery Drive – Roundabout to River Street	68

As a minimum for full depth reconstruction, RWG&A recommends that as a minimum exposed subgrade be compacted to a minimum of 100 percent of the maximum dry density as determined by ASTM D1557, and proof rolled with a loaded tandem axle dump truck weighing not less than 15 tons to aid in identifying soft pockets and areas of excess yielding. Wet or saturated subgrades, soft spots, unsatisfactory soils, areas of excessive pumping, or rutting in excess of one inch in depth should be removed and replaced with suitable compacted common fill. Prior to the start of paving and as described above for pavement section subgrade, the surface of the pavement section base course material should be proof-rolled.

Geotechnical Observation

Geotechnical evaluations and recommendations provided for this project were developed based on currently available project design information and limited numbers of soil borings and tests. The City of Sanford Service should be sensitive to the potential need for adjustment during final design and construction.

As part of the project's construction phase, it is recommended that RWG&A be retained to observe and perform inspection of the geotechnical aspects of the project construction. These services should include observing general compliance with the design concepts, technical specifications and recommendations, and assisting in development of design changes should subsurface conditions differ from those anticipated prior to the start of construction. Observation improves the likelihood that the design intent will be carried out during construction. For this project, geotechnical observation and testing of the following aspects is recommended:

- Review geotechnical aspects of sitework submittals.
- Observe subgrade compaction and proof-rolling, and assess if the subgrade(s) are suitable for support of the proposed pavement sections.
- Observe placement and compaction of fill materials and asphalt pavement.
- Assist in technical reviews of the geotechnical aspects of the Contractors submittals.

In addition to geotechnical observation, RWG&A can provide construction inspection and materials testing services. Soil and materials testing would be performed at the RWG&A's soil testing laboratory which is accredited by the AASHTO for the testing of soils, concrete, and asphalt.

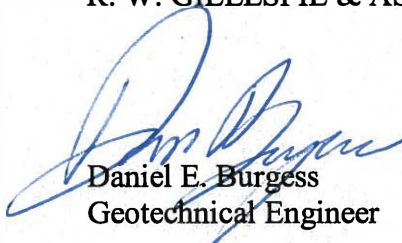
CLOSURE

This report has been prepared for specific application to the proposed Riverside Avenue and William Oscar Emery Drive Subsurface Information project in Sanford, Maine, and for the exclusive use of the City of Sanford. This work has been completed in accordance with generally accepted soil engineering practices. No other warranty, expressed or implied, is made. In the event any changes are made in the nature, design, or location of the proposed construction, the conclusions and recommendations of this report should be reviewed by RWG&A.

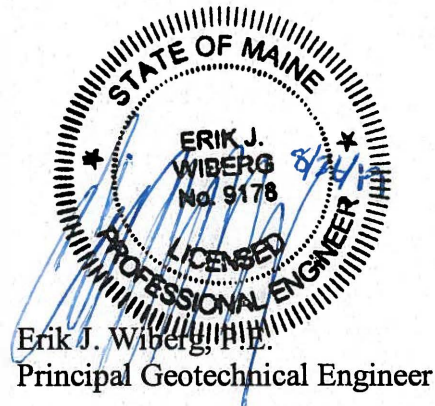
The recommendations presented are based on the results of widely spaced explorations. The nature of variations may not become evident until construction has begun. If variations are encountered, it will be necessary for RWG&A to re-evaluate the recommendations presented in this report. RWG&A requests an opportunity for a general review of the final design and specifications in order to determine that recommendations have been interpreted in the manner in which they were intended.

We have enjoyed working with you on this project. If you have any questions, or if we may be of further service, please contact us.

Sincerely,
R. W. GILLESPIE & ASSOCIATES, INC.



Daniel E. Burgess
Geotechnical Engineer



Erik J. Wiberg, P.E.
Principal Geotechnical Engineer

DEB/EJW:sf
In duplicate

Attachments

- Table I. Summary of Laboratory CBR Values
- Table II. Summary of Subsurface Conditions
- Table III. Summary of Particle Size Distribution Test Results
- Figure 1. Locus Map
- Figure 2. Exploration Location Plan
- Appendix A. Limitations
- Appendix B. Exploration Logs
- Appendix C. Laboratory Test Results



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TABLE I

Summary of Laboratory CBR Values

Project: Riverside Avenue and William Oscar Emery Drive

RWG&A Project No: 0266-021

Client: City of Sanford, Maine

Location: Sanford, Maine

Date: August 2019

Boring Location	Sample Depth (ft)	Percent Max. Dry Density/ CBR Value
Riverside Avenue		
B-6	3 to 5	99.6% / 67.8
William Oscar Emery Drive		
B-9	2 to 4.5	100.0 % / 67.8



TABLE II
Summary of Subsurface Conditions
Riverside Avenue - William Oscar Emery Drive
Sanford, Maine

Notes: 1. + indicates limit of thickness not encountered.
2. NA: Not apparent.

Boring ID	Offset from Centerline (ft)	Encountered Thickness				Free Water Depth (ft)	Exploration Depth (ft)
		Asphalt (in)	Base Fill Material (ft)	Subbase Fill Material (ft)	Silty Sand (ft)		
Riverside Avenue – Washington Street to Winter Street							
B-1	7.5 R	2.0	1.3	3.3	2.0+	NA	7.0
B-2	9.0 L	4.0	0.9	4.7	1.0+	NA	7.0
Riverside Avenue – Winter Street to Pleasant Avenue							
B-3	8.0 L	4.5	0.9	3.2	2.5+	NA	7.0
B-4	9.5 L	4.0	1.6	1.5	3.5+	NA	7.0
B-5	11.5 L	2.5	0.7	4.1	2.0+	6.5	7.0
B-6	11.0 L	3.0	1.7	3.0	2.0+	7.0	7.0
William Oscar Emery Drive – Pleasant Avenue to the Roundabout							
B-7	10.5 R	3.5	2.5	--	4.1+	6.5	7.0
B-8	11.0 R	3.0	1.7	5.0	--	5.0	6.3R
William Oscar Emery Drive – Roundabout to River Street							
B-9	5.0 R	2.0	1.3	3.0	--	NA	4.5R
B-10	7.5 L	3.25	1.7	3.0	2.0+	NA	7.0

3. R indicates refusal surface encountered.



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TABLE III
Summary of Particle-Size Distribution Test Results and
Comparison to MaineDOT Standard Specification
Riverside Avenue - William Oscar Emery Drive
Sanford, Maine

Boring Number	Sample Depth (ft)	MaineDOT Section 703.06 Aggregate for Base and Subbase Comparison				
		Type A	Type B	Type D	Type E	Comments
Riverside Avenue						
B-1	0.3 to 2.3	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-2	0.3 to 2.3	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-2	5.0 to 7.0	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-3	0.4 to 2.4	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-4	0.3 to 2.3	N	N	N	Y	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-4	5.0 to 7.0	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-5	0.2 to 2.2	N	Y	Y	Y	Misses on the ½ and ¼ inch sieve size
B-6	0.3 to 2.3	N	N	N	Y	Misses on the ½ , ¼ inch, and No. 40 sieve size
B-6	3.0 to 5.0	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-6	5.0 to 7.0	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
William Oscar Emery Drive						
B-7	0.3 to 2.3	Y	Y	Y	Y	
B-8	0.3 to 2.3	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-8	5.0 to 7.0	Y	Y	Y	Y	
B-9	0.2 to 2.2	N	N	N	N	Misses on the ½ , ¼ inch, and No. 200 sieve size
B-9	2.0 to 4.5	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-10	0.3 to 2.3	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size
B-10	5.0 to 7.0	N	N	N	N	Misses on the ½ , ¼ inch, No. 40 and 200 sieve size

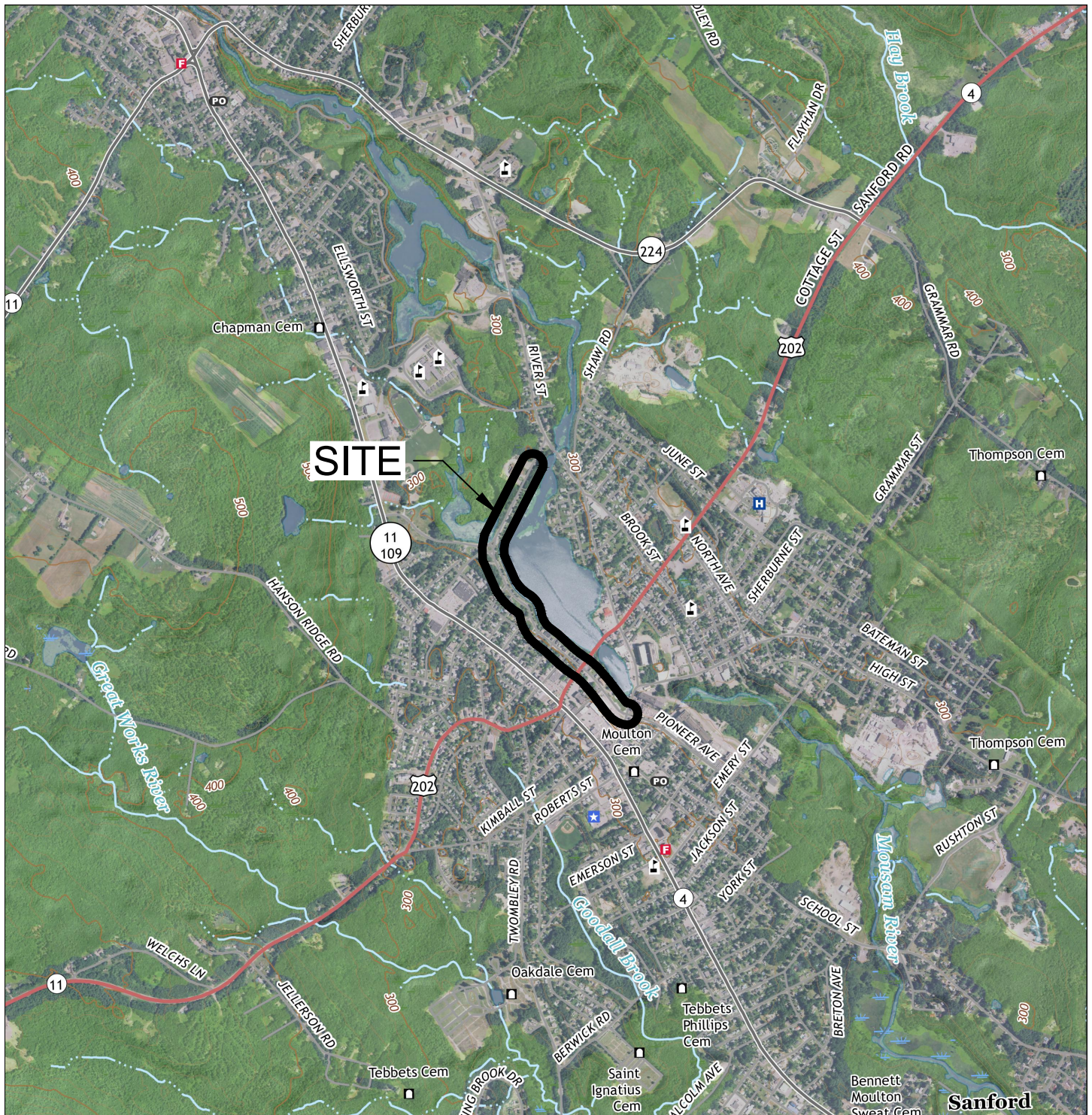


FIGURE 1
LOCUS MAP
GEOTECHNICAL ENGINEERING SERVICES
SUBSURFACE INFORMATION
SANFORD, MAINE

AUGUST 2019

PROJECT NO. 0266-021



SOURCE:
USGS 7.5-MINUTE TOPOGRAPHIC QUADRANGLE OF
SANFORD, ME, DATED 2018.

APPENDIX A
LIMITATIONS

Geotechnical Engineering Services
Riverside Avenue and William Oscar Emery Drive Subsurface Information
Sanford, Maine

LIMITATIONS

This evaluation has been limited to consideration of the geotechnical aspects of the proposed Reconstruction of Riverside Avenue and William Oscar Emery Drive in Sanford, Maine. The primary purpose of the evaluation was to obtain information regarding subsurface conditions on which to base recommendations about the geotechnical aspects of design of pavement sections. This report identifies construction considerations intended to solely assist engineers that will design the project and monitor its construction, and not to the benefit of others including but not limited to the Contractor. This report is not a technical specification nor is it intended to be used as a specification for bidding or building the project.

This geotechnical evaluation might also aid Contractors responsible for construction of the planned building. However, the recommendations and comments provided hereinafter are not intended to be instructions or directives to the project Contractors. The project Contractors must evaluate construction issues encountered in the work on the basis of their experience with similar projects taking in to account their own methods and procedures.

RWG&A has not considered the construction from a worker safety perspective. Construction safety is the responsibility of the project Contractor, who is also solely responsible for the means, methods, and sequencing of construction operations. RWG&A is providing this information as a service to the City of Sanford. Under no circumstances should this information be interpreted to mean that RWG&A and/or the City of Sanford are assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

RWG&A's services excluded: Any environmental site assessment relative to oil and hazardous materials or evidence of a potential release or threat of oil or hazardous materials on, below, or around the site. (Note: any statement in this report, or on the exploration logs, regarding odors or unusual or suspicious conditions is for informational purposes only and is not intended to constitute an environmental assessment.)

APPENDIX B
EXPLORATION LOGS

Geotechnical Engineering Services
Riverside Avenue and William Oscar Emery Drive Subsurface Information
Sanford, Maine

RWG&A, Inc. soil descriptions are based on the following criteria. Descriptive terminology is used to denote the grain size and percentage of each component. The soil descriptions are based on visual-manual classification procedures, Standard Penetration Test results, and the results of laboratory testing on selected soil samples, where available. The Unified Soil Classification Group Symbol will be indicated in capital letters.

COMPONENT DEFINITIONS BY GRADATION SIEVE LIMITS

Materials	Definitions	Fractions	Upper	Lower
Boulders	Material too large to pass through an opening 12 in. square.			
Cobbles	Material passing through a 12 in. opening and retained on the 3 in. sieve.			
Gravel	Material passing the 3 in. sieve and retained on 1/4" (No. 4 sieve).	Coarse Fine	3 in. 3/4 in.	3/4 in. 1/4 in.
Sand	Material passing the No. 4 sieve and retained on the No. 200 sieve.	Coarse Medium Fine	No. 4 (1/4") No. 10 (1/8") No. 40 (1/32")	No. 10 (1/8") No. 40 (1/32") No. 200
Silt	Material passing the No. 200 sieve which is usually non-plastic in character and exhibits little or no strength when air dried.		No. 200	
Clay	Material passing the No. 200 sieve which can also be made to exhibit plasticity within a certain range of moisture contents and which exhibits considerable strength when air dried.		No. 200	

SOIL DESCRIPTION

General

Soils are described as to the Unified Soil Classification Systems Group Symbol, density or consistency, color, grain size distribution and other pertinent properties such as plasticity and dry strength. The RWG&A order of descriptors is as follows:

1. USCS Group Name and Symbol, or Fill
2. Density or Consistency
3. Moisture
4. Grain Size & Constituent percentages
5. Other pertinent descriptors
6. Color

DESCRIPTIVE TERMINOLOGY DENOTING COMPONENT PROPORTIONS

<u>Descriptive Terms</u>	<u>Range of Proportions</u>
Noun (major component)	≥50%
Adjective (secondary component)	20 - 50%
Some (third component)	25 - 45%
Little (second or third component)	15 - 25%
Few (second or third component)	5 - 15%
Trace	0 - 5%
With	Amount of component not determined. Used as a conjunction only. Does not indicate component percentile

OTHER DESCRIPTIVE TERMS

Where appropriate, geological classifications are also used (Glacial Till, etc.)

TYPICAL DESCRIPTIONS

SAND WITH SILT (SP-SM): Medium dense, moist, coarse to medium sand, few silt, brown.
FILL; Loose, dry, fine sand, some gravel and silt, with brick and concrete fragments, dark brown.
SILTY CLAY (CL); Very stiff, moist, silty clay, olive-brown.

<u>DENSITY OR CONSISTENCY OF SOILS</u>		
<u>COHESIVE SOILS</u>		
<u>Consistency of Cohesive Soils</u>	<u>Standard Penetration Test (Blows Per Foot) (N)</u>	<u>Undrained Shear Strength (TSF)</u>
Very Soft	0 - 2	Below 0.13 (250 psf)
Soft	2 - 4	0.13 to 0.25 (to 500 psf)
Medium	4 - 8	0.25 to 0.5 (to 1,000 psf)
Stiff	8 - 15	0.5 to 1.0 (to 2,000 psf)
Very Stiff	15 - 30	1.0 to 2.0 (to 4,000 psf)
Hard	Over 30	over 2.0 (over 4,000 psf)
Consistency of cohesive soils is based upon field vane shear, torvane, or pocket penetrometer, or laboratory vane shear or Unconsolidated-Undrained Triaxial Compression tests. Consistency of cohesive soils is based upon the Standard Penetration test when no other data is available.		
<u>COHESIONLESS SOILS</u>		
<u>Density of Cohesionless Soils</u>	<u>Standard Penetration Test (Blows per Foot) (in)</u>	
Very Loose	0 - 4	
Loose	4 - 10	
Medium Dense	10 - 30	
Dense	30 - 50	
Very Dense	over 50	
<u>PENETRATION RESISTANCE</u>		
<u>STANDARD PENETRATION TEST (ASTM D1586)</u> - a 2.0-inch diameter, 1-3/8 inch inside diameter split barrel sample is driven into soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The total number of blows required for penetration from 6 to 18 inches is the Standard Penetration Resistance (N).		
<u>COBBLES AND BOULDERS</u>		
The percentage of cobbles and boulders is estimated visually where possible.		
<u>Descriptive Term</u>	<u>Estimated Percentage</u>	
Very Few	0 - 10%	
Few	10 - 25%	
Common	25 - 40%	
Numerous	40 - 50%	
If the percentage cannot be determined, as in a typical test boring, then use “with” to indicate the presence of cobbles and/or boulders. (i.e., gravelly sand with cobbles and boulders).		
<u>FILLS</u>		
The following terminology is used to denote size range of man-made materials within fill deposits:		
<u>Size Range</u>	<u>Comparative Soil Terms</u>	
<No. 200 Sieve	Silt - size	
No. 200 to 1/4 in.	Sand - size	
1/4 in. to 3 in.	Gravel - size	
3 in. to 12 in.	Cobble - size	
>12 in.	Boulder - size	
<u>SUPPLEMENTAL SOIL DESCRIPTION TERMINOLOGY</u>		
<u>Term</u>	<u>Example</u>	
Seam	Typically 1/16 to 1/2 inch thick	1/4 inch sand seams
Layer	Greater than 1/2 inch thick	2-inch sand layers
Occasional	One or less per foot of thickness	
Frequent	More than one per foot of thickness	
Interbedded	Alternating soil layers of different composition	
Varved	Alternating thin seams of silt and clay	
Mottled	Variations in color	



**R.W. Gillespie
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-1

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information
RWG&A Project No. 0266-021
Location: Sanford, Maine
Client: City of Sanford
RWG&A Representative: Dan Burgess
Boring Location: Riverside Ave.
Boring Abandonment Method: See Note.
Observed Water Depth: Not Obs.

Drilling Co.: Northern Test Boring
Drill Rig: Diedrich D-50
Driller Rep.: Mike Nadeau
Date Started: 07/02/2019
Date Completed: 07/02/2019
Surface Elevation:
Drilling Method: SSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPAHLTIC PAVEMENT (2 inches) RAP (2 inches).	20	19		8	MC
			S-2	FILL: Gravelly sand with silt and millings. Moist, coarse to fine sand, some coarse to fine angular gravel, few silt, black/brown.	12	17			GS
				FILL: Gravelly sand with silt. Moist, coarse to fine sand, some coarse to fine subround to round gravel, little silt, red/orange.		11			
5			S-3	SILTY SAND (SM); Moist, dense, coarse to fine sand, few fine gravel, little silt, light brown/orange.	12	8			
						4			
						10	34		
						5			
						15			
						19			
						14			
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.
2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.



**R.W. Gillespie
& Associates**

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-2

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information

RWG&A Project No. 0266-021

Location: Sanford, Maine

Client: City of Sanford

RWG&A Representative: Dan Burgess

Boring Location: Riverside Ave.

Boring Abandonment Method: See Note.

Observed Water Depth: Not Obs.

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50

Driller Rep.: Mike Nadeau

Date Started: 07/02/2019

Date Completed: 07/02/2019

Surface Elevation:

Drilling Method: SSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPAHLTIC PAVEMENT (4 inches).	18	22		4	MC
				FILL; Gravelly sand with silt. Moist, coarse to fine sand, some coarse to fine subround to subangular gravel, few silt, brown.		20			GS
			S-2	FILL: Gravel sand with silt. Moist, coarse to fine sand, little round to subround fine gravel, few to little silt, light brown.	15	16			
						15			
						20			
						13			
5			S-3	SILTY SAND (SM); Moist, medium dense to loose, coarse to fine sand, little silt, light brown.	10	20	12	6	MC
				Bottom of Exploration at 7'; Not refusal.		7			GS
						6			
						7			
						5			
						5			
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.

2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.



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Boring Log: B-3

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information

RWG&A Project No. 0266-021

Location: Sanford, Maine

Client: City of Sanford

RWG&A Representative: Dan Burgess

Boring Location: Riverside Ave.

Boring Abandonment Method: See Note.

Observed Water Depth: Not Obs.

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50

Driller Rep.: Mike Nadeau

Date Started: 07/02/2019

Date Completed: 07/02/2019

Surface Elevation:

Drilling Method: SSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPAHLTIC PAVEMENT (4.5 inches).	18	20		11	MC
				FILL; Silty sand with gravel. Moist, coarse to fine sand, little fine subangular to angular gravel, little silt, dark brown.		17			GS
			S-2	FILL: Sand with silt and gravel. Moist, coarse to fine sand, few coarse to fine subround to round gravel, little silt, brown.	15	13			
						10			
						10			
						15			
5			S-3	Large cobble encountered at approximately 3 feet, auger to 5 feet.	12	33		29	
				SILTY SAND (SM); Moist, medium dense, coarse to fine sand, little to some silt, light brown.		20			
						5			
						9			
						20			
						19			
				Bottom of Exploration at 7'; Not refusal.					
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.

2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.



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Boring Log: B-4

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information

RWG&A Project No. 0266-021

Location: Sanford, Maine

Client: City of Sanford

RWG&A Representative: Dan Burgess

Boring Location: Riverside Ave.

Boring Abandonment Method: See Note.

Observed Water Depth: Not Obs.

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50

Driller Rep.: Mike Nadeau

Date Started: 07/02/2019

Date Completed: 07/02/2019

Surface Elevation:

Drilling Method: SSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPAHLTIC PAVEMENT (4 inches).	5	20		4	MC
				FILL; Gravelly sand with silt. Moist, coarse to fine sand, little fine subround to subangular gravel, few silt, dark brown.		50/2"			GS
			S-2	Boulder encountered at approximately 0.9 feet, auger to 2 feet.	20	13			
				FILL: Sand with silt and gravel. Moist, coarse to fine sand, few coarse to fine subround to round gravel, little silt, brown.		20			
5			S-3	SILTY SAND (SM); Moist, dense, medium to fine sand, few fine gravel, some silt, light brown.	15	21	34	10	MC
						14			GS
						14			
						20			
						21			
				Bottom of Exploration at 7'; Not refusal.					
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.

2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.



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Boring Log: B-5

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information
RWG&A Project No. 0266-021
Location: Sanford, Maine
Client: City of Sanford
RWG&A Representative: Dan Burgess
Boring Location: Riverside Ave.
Boring Abandonment Method: See Note.
Observed Water Depth: 6.5 Feet

Drilling Co.: Northern Test Boring
Drill Rig: Diedrich D-50
Driller Rep.: Mike Nadeau
Date Started: 07/02/2019
Date Completed: 07/02/2019
Surface Elevation:
Drilling Method: SSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPAHLTIC PAVEMENT (2.5 inches).	15	9		1	MC
				FILL; Gravelly sand. Moist, medium to fine sand, some coarse to fine subround gravel, trace to few silt, brown.		5			GS
			S-2	FILL; Sand with silt and gravel, moist, medium to fine sand, little coarse to fine round to subround gravel, little silt, brown/black, trace organics and debris.	20	5			
						6			
						12			
						16			
5			S-3	SILTY SAND (SM); Dense, moist to wet, coarse to fine sand, trace coarse to fine subround to round gravel, little silt, light brown.	18	14	37		
						24			
						21			
						16			
				Bottom of Exploration at 7'; Not refusal.		15			
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.
2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.



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Boring Log: B-6

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information
RWG&A Project No. 0266-021
Location: Sanford, Maine
Client: City of Sanford
RWG&A Representative: Dan Burgess
Boring Location: Riverside Ave.
Boring Abandonment Method: See Note.
Observed Water Depth: 7 Feet

Drilling Co.: Northern Test Boring
Drill Rig: Diedrich D-50
Driller Rep.: Mike Nadeau
Date Started: 07/02/2019
Date Completed: 07/02/2019
Surface Elevation:
Drilling Method: SSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPAHLTIC PAVEMENT (3 inches).	10	19		2	MC
				FILL; Gravelly sand with silt. Moist, coarse to fine sand, some coarse to fine subangular to angular gravel, few silt, brown.		29			GS
			S-2	FILL: Gravelly sand with silt. Moist, coarse to fine sand, some coarse to fine subround gravel, few silt, brown.	20	40		2	MC
						27			GS
						28			MD
5			S-3	SILTY SAND (SM); Moist to wet, loose, coarse to fine sand, trace fine gravel, little silt, brown.	10	26	8	26	CBR
				Becomes wet.		18			MC
				Bottom of Exploration at 7'; Not refusal.		15			GS
						2			
						3			
						5			
						5			
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.
2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.
3. Grab sample taken from 2 to 4 feet below ground surface for laboratory CBR test.



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Boring Log: B-7

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information
RWG&A Project No. 0266-021
Location: Sanford, Maine
Client: City of Sanford
RWG&A Representative: Dan Burgess
Boring Location: William Oscar Emery Drive
Boring Abandonment Method: See Note.
Observed Water Depth: 6.5 Feet

Drilling Co.: Northern Test Boring
Drill Rig: Diedrich D-50
Driller Rep.: Mike Nadeau
Date Started: 07/02/2019
Date Completed: 07/02/2019
Surface Elevation:
Drilling Method: SSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPAHLTIC PAVEMENT (3.5 inches).	11	15		4	MC
				FILL; Sandy gravel with silt. Moist, coarse to fine subround to angular gravel, some coarse to fine sand, few silt, brown.		23			GS
			S-2	Gravel to sand sized, fragmented bituminous concrete (4 inches).	15	25			
				SILTY SAND (SM); Moist to wet, loose, coarse to fine sand, few fine gravel, little silt, dark brown.		18			
5			S-3	Becomes medium dense to loose.	3	15			
						22	10		
						19			
						11			
						3			
						4			
						6			
						7			
				Bottom of Exploration at 7'; Not refusal.					
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.
2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.



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Boring Log: B-8

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information

RWG&A Project No. 0266-021

Location: Sanford, Maine

Client: City of Sanford

RWG&A Representative: Dan Burgess

Boring Location: William Oscar Emery Drive

Boring Abandonment Method: See Note.

Observed Water Depth: 5 Feet

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50

Driller Rep.: Mike Nadeau

Date Started: 07/02/2019

Date Completed: 07/02/2019

Surface Elevation:

Drilling Method: SSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPAHLTIC PAVEMENT (3 inches).	15	25		6	MC
				FILL; Gravelly sand with silt. Moist, coarse to fine sand, some coarse to fine subround to subangular gravel, few silt, brown.		27			GS
			S-2	ASPHALTIC PAVEMENT (3 inches).	18	32			
				FILL: Sandy gravel with silt. Moist, coarse to fine subround gravel, some coarse to fine sand, trace to few silt.		23			
5			S-3	Becomes wet.	6	25			
				Large cobble encountered at approximately 6 feet, Auger to 7 feet.		38			
				Bottom of Exploration at 7'; Not refusal.		34			
						17	100+	11	MC
						9			GS
						7			
						50/2"			
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.

2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.



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Boring Log: B-9

Total Depth (ft): 4.5

Sheet 1 of 1

Project Name: Subsurface Information
RWG&A Project No. 0266-021
Location: Sanford, Maine
Client: City of Sanford
RWG&A Representative: Dan Burgess
Boring Location: William Oscar Emery Drive
Boring Abandonment Method: See Note.
Observed Water Depth: Not Obs.

Drilling Co.: Northern Test Boring
Drill Rig: Diedrich D-50
Driller Rep.: Mike Nadeau
Date Started: 07/02/2019
Date Completed: 07/02/2019
Surface Elevation:
Drilling Method: SSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS	
0			S-1	ASPAHLTIC PAVEMENT (2 inches).	18	21	50/2"	4	MC	
					FILL; Gravelly sand with silt. Moist, coarse to fine sand, some coarse to fine subround to subangular gravel, few silt, brown.	15		34		GS
				S-2	FILL: Gravelly sand with silt. Moist, coarse to fine sand, little to some coarse to fine round to subround gravel, little silt, light brown.			35	2	MC
								23		GS
5				Bottom of Exploration at 4.5'; Auger refusal, possible boulder or bedrock.		27			MD	
						40			CBR	
10										
15										
20										
25										
30										

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.
2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.
3. Grab sample taken from 2 to 4 feet below ground surface for laboratory CBR test.



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Boring Log: B-10

Total Depth (ft): 7

Sheet 1 of 1

Project Name: Subsurface Information

RWG&A Project No. 0266-021

Location: Sanford, Maine

Client: City of Sanford

RWG&A Representative: Dan Burgess

Boring Location: William Oscar Emery Drive

Boring Abandonment Method: See Note.

Observed Water Depth: Not Obs.

Drilling Co.: Northern Test Boring

Drill Rig: Diedrich D-50

Driller Rep.: Mike Nadeau

Date Started: 07/02/2019

Date Completed: 07/02/2019

Surface Elevation:

Drilling Method: SSA

Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0			S-1	ASPHALTIC PAVEMENT (3.25 inches).	4	50/2"		4	MC GS
			S-2	FILL: Gravelly sand with silt. Moist, coarse to fine sand, some fine subround to subangular gravel, few silt, brown. Cobbles encountered at approximately 0.5 feet, auger to 2 feet.	18	29 35 31 23			
5			S-3	FILL: Sand with silt and gravel, moist, coarse to fine sand, some fine subround to subangular gravel, few silt, brown.	5	10 22 50/2"	100+	3	MC GS
				SILTY SAND (SM); Dense, moist, coarse to fine sand, little coarse to fine subround to round gravel, few to little silt, light brown.					
				Bottom of Exploration at 7'; Not refusal.					
10									
15									
20									
25									
30									

Notes: 1. Bore holes backfilled with cuttings and cold mix asphalt to match existing surface.

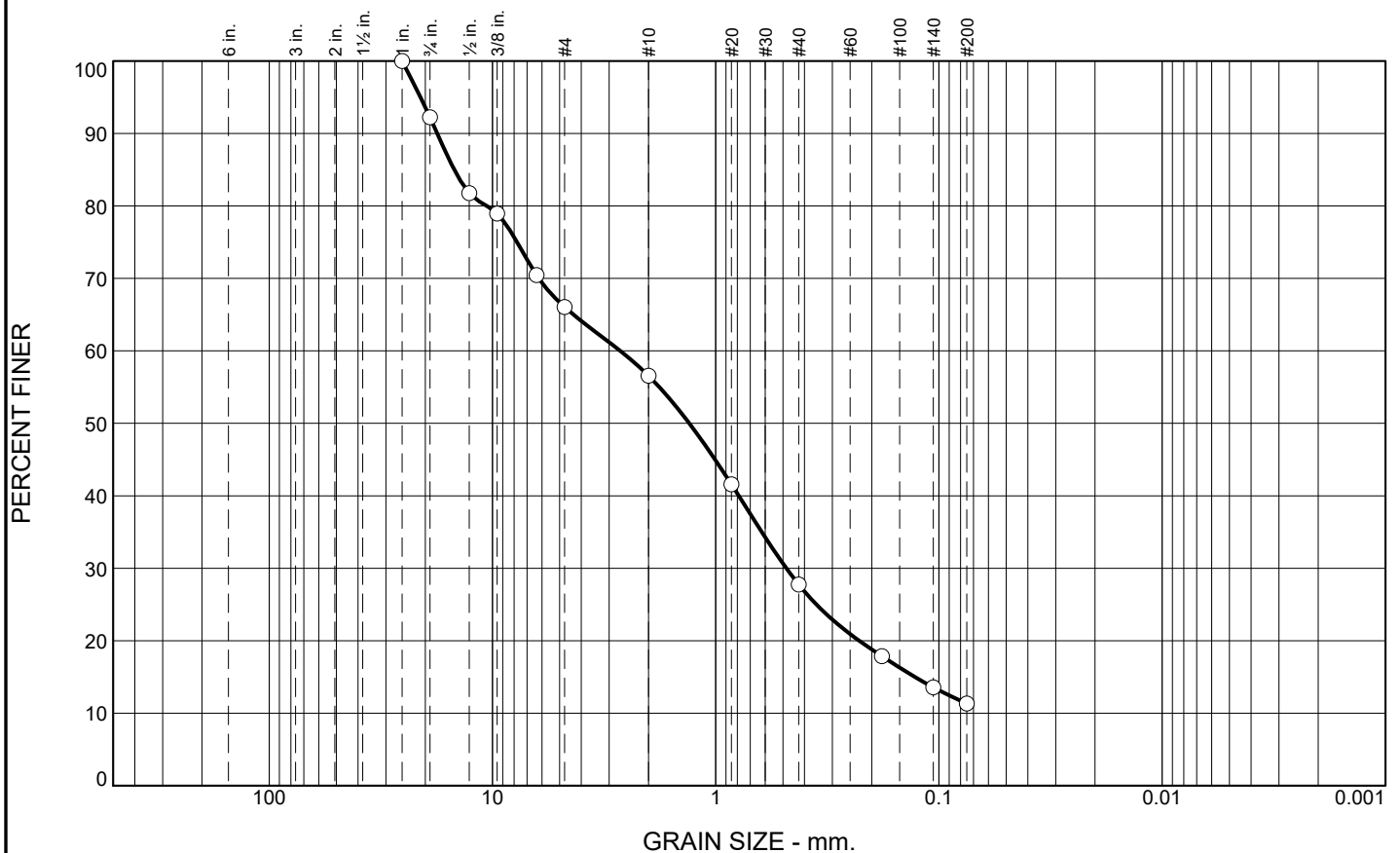
2. Samples were obtained with 3-inch diameter split-barrel sampler per ASTM D3550. N-Values reported are not standardized to a hammer energy and are not representative of standard penetration test (SPT) N-values.

APPENDIX C

LABORATORY TEST RESULTS

Geotechnical Engineering Services
Riverside Avenue and William Oscar Emery Drive Subsurface Information
Sanford, Maine

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.8	26.1	9.5	28.8	16.5	11.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	92.2		
1/2"	81.8		
3/8"	78.9		
1/4"	70.5		
#4	66.1		
#10	56.6		
#20	41.6		
#40	27.8		
#80	17.9		
#140	13.6		
#200	11.3		

* (no specification provided)

<u>Soil Description</u>		
Poorly graded sand with silt and gravel		
<u>Atterberg Limits</u>		
PL=	LL=	PI=
<u>Coefficients</u>		
D ₉₀ = 17.6587	D ₈₅ = 14.8219	D ₆₀ = 2.6788
D ₅₀ = 1.3124	D ₃₀ = 0.4830	D ₁₅ = 0.1283
D ₁₀ =	C _u =	C _c =
<u>Classification</u>		
USCS= SP-SM	AASHTO= A-1-b	
<u>Remarks</u>		
Moisture Content: 7.5%		

Location: Boring B-1
Sample Number: S-1

Depth: 0.3'-2.3'

Date: 7/17/2019

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

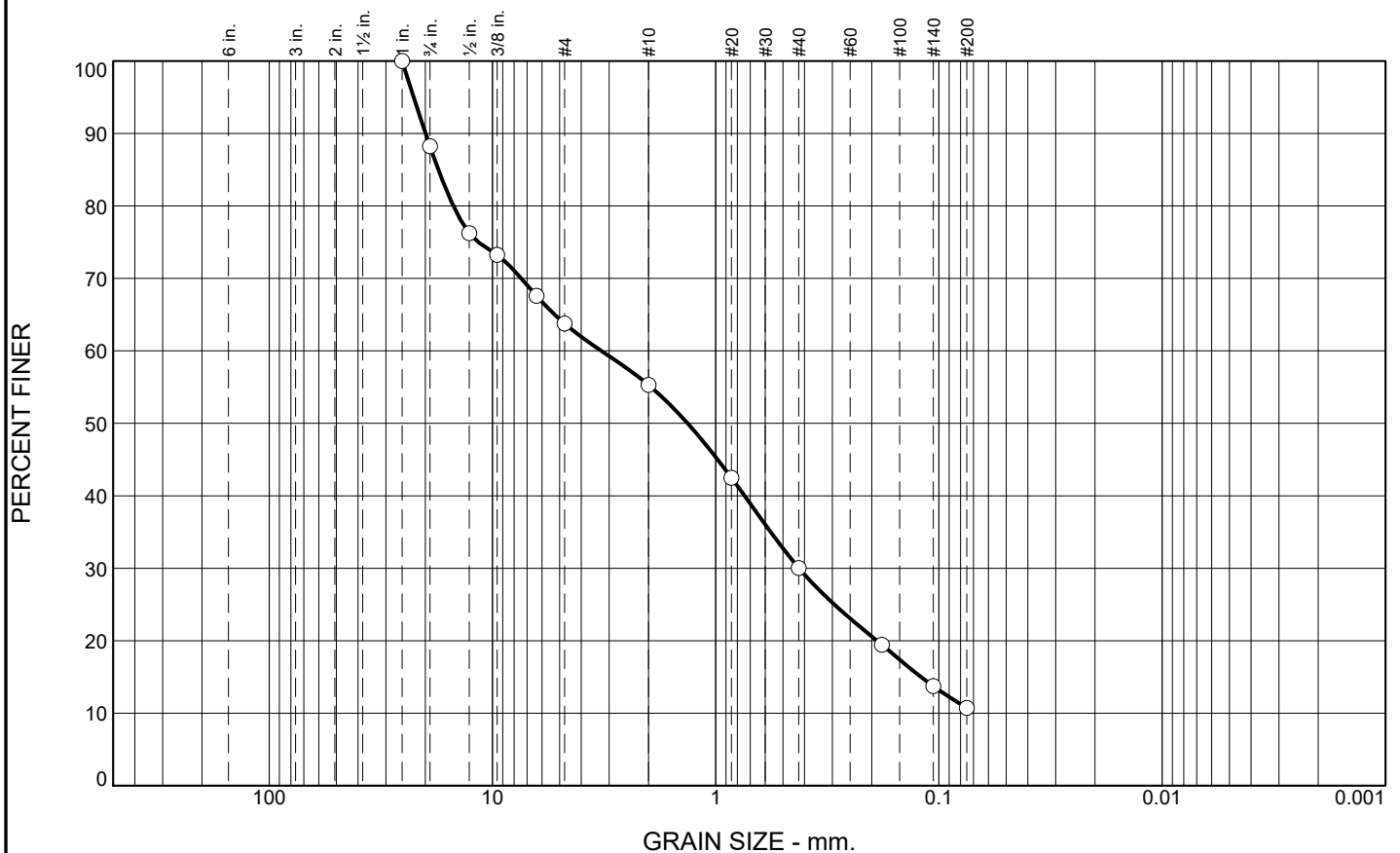
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-01

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.7	24.5	8.5	25.3	19.3	10.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	88.3		
1/2"	76.3		
3/8"	73.3		
1/4"	67.6		
#4	63.8		
#10	55.3		
#20	42.5		
#40	30.0		
#80	19.4		
#140	13.7		
#200	10.7		

* (no specification provided)

Soil Description

Poorly graded sand with silt and gravel

Atterberg Limits

PL=

LL=

PI=

Coefficients

D₉₀= 19.9232

D₈₅= 17.4581

D₆₀= 3.2571

D₅₀= 1.3356

D₃₀= 0.4239

D₁₅= 0.1204

D₁₀=

C_u=

C_c=

Classification

USCS= SP-SM

AASHTO= A-1-b

Remarks

Moisture Content: 4.3%

Location: Boring B-2
Sample Number: S-1

Depth: 0.3'-2.3'

Date: 7/17/2019

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

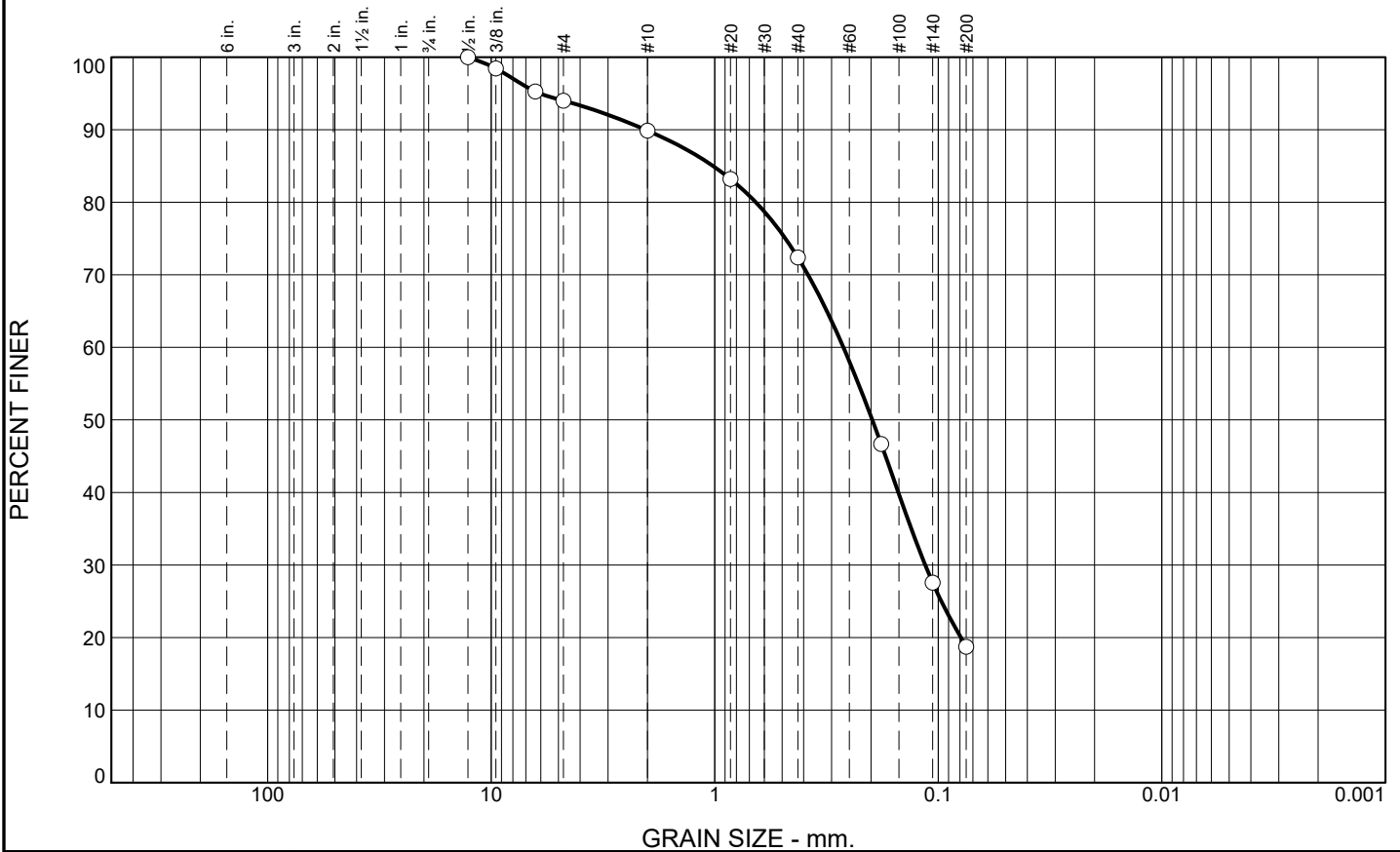
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-02

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.0	4.1	17.5	53.7	18.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	98.5		
1/4"	95.3		
#4	94.0		
#10	89.9		
#20	83.2		
#40	72.4		
#80	46.7		
#140	27.6		
#200	18.7		

* (no specification provided)

Soil Description		
Silty sand		
Atterberg Limits		
PL=	LL=	PI=
Coefficients		
D ₉₀ = 2.0394	D ₈₅ = 1.0163	D ₆₀ = 0.2659
D ₅₀ = 0.1972	D ₃₀ = 0.1145	D ₁₅ =
D ₁₀ =	C _u =	C _c =
Classification		
USCS= SM	AASHTO= A-2-4(0)	
Remarks		
Moisture Content: 5.6%		

Location: Boring B-2
Sample Number: S-3

Depth: 5'-7'

Date: 7/17/2019

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

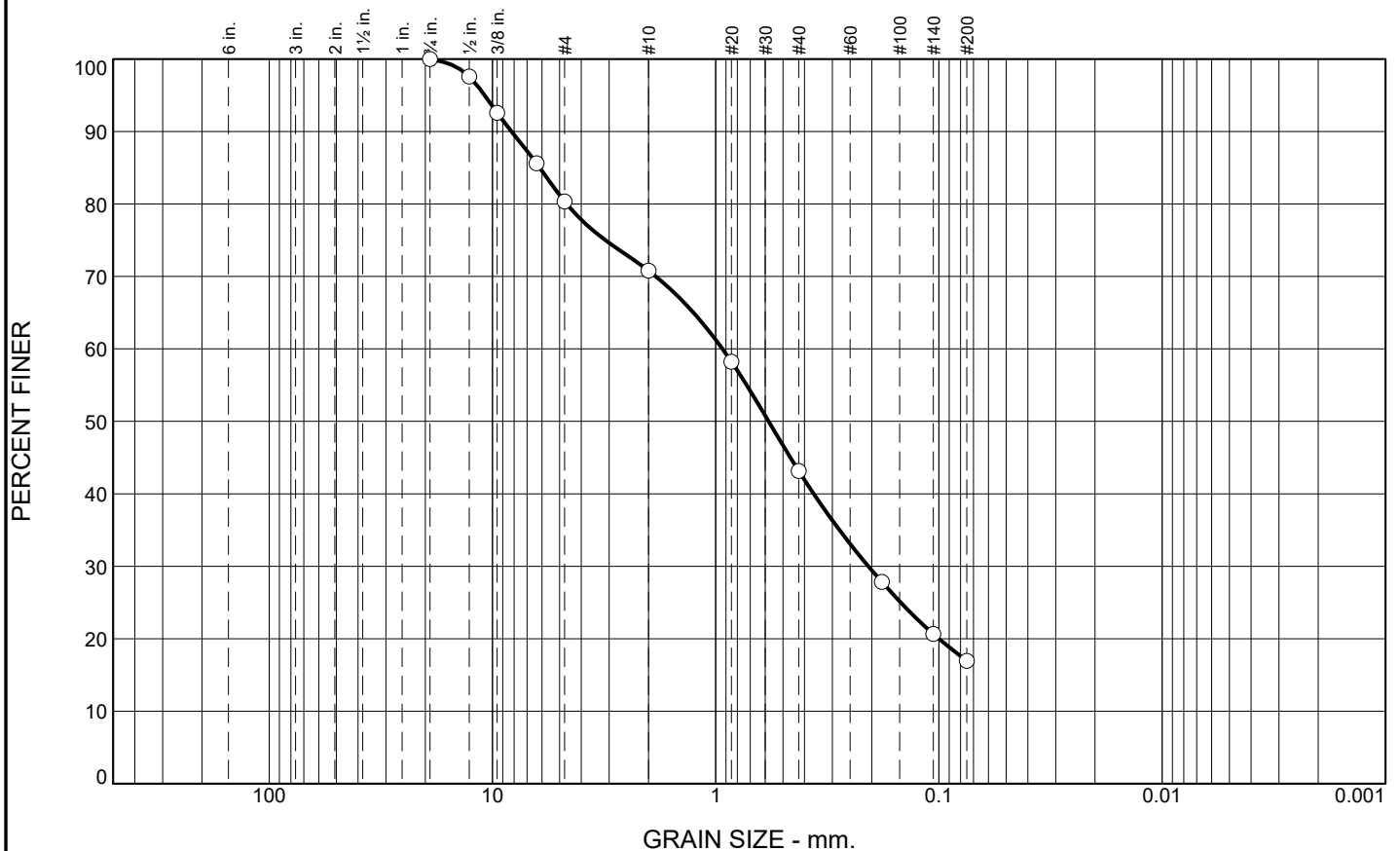
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-11

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	19.7	9.5	27.6	26.3	16.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	97.6		
3/8"	92.6		
1/4"	85.6		
#4	80.3		
#10	70.8		
#20	58.2		
#40	43.2		
#80	27.8		
#140	20.7		
#200	16.9		

* (no specification provided)

Soil Description
Silty sand with gravel

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= 8.2184 D₈₅= 6.1383 D₆₀= 0.9320
 D₅₀= 0.5796 D₃₀= 0.2071 D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= SM AASHTO= A-1-b

Remarks
 Moisture Content: 10.5%

Location: Boring B-3
Sample Number: S-1

Depth: 0.4'-2.4'

Date: 7/17/2019

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

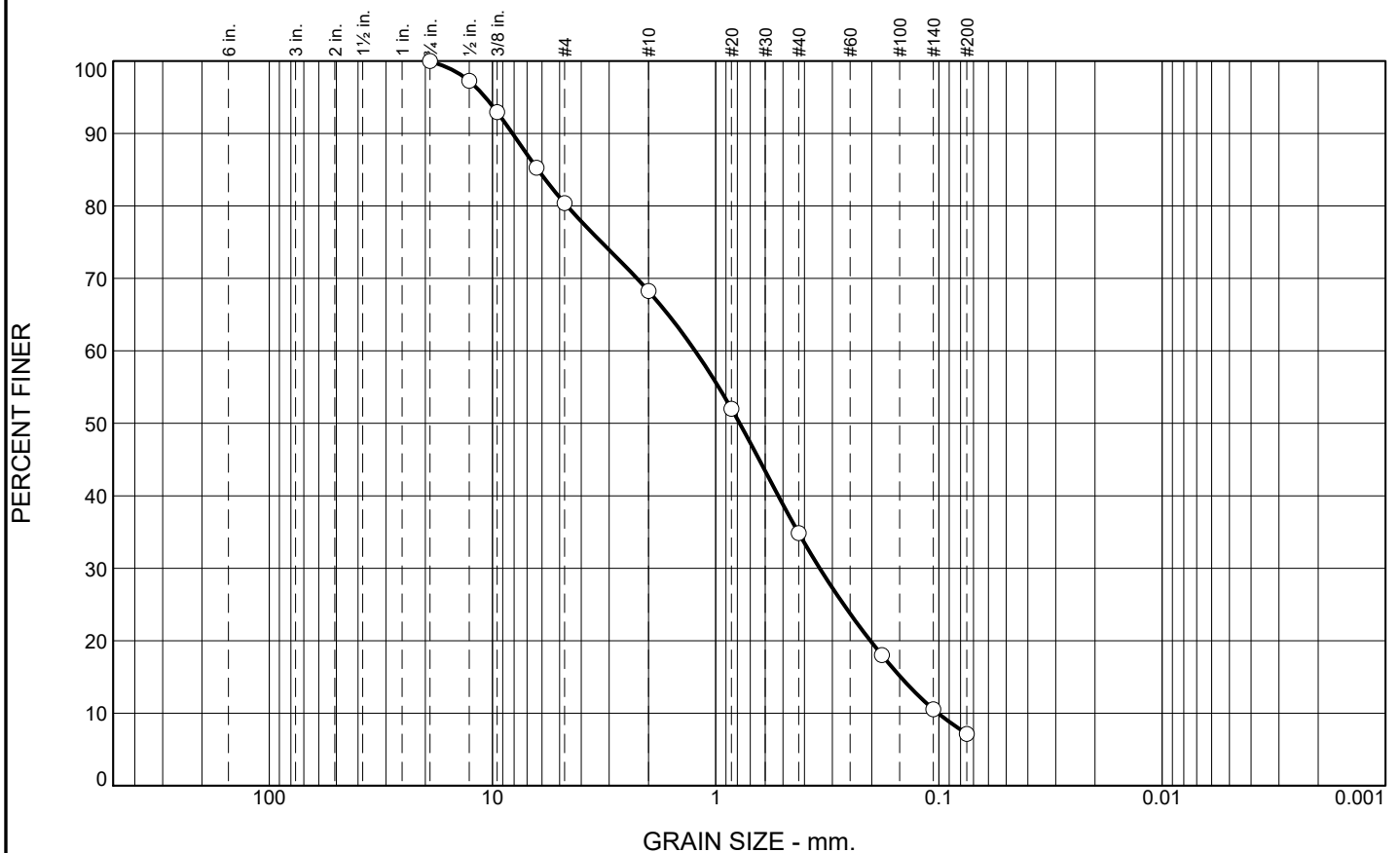
Client: City Of Sanford
Project: Subsurface Information
 Sanford, ME
Project No: 0266-021

Lab 15622-03

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	19.6	12.1	33.5	27.7	7.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	97.3		
3/8"	92.9		
1/4"	85.3		
#4	80.4		
#10	68.3		
#20	52.0		
#40	34.8		
#80	18.0		
#140	10.5		
#200	7.1		

* (no specification provided)

Soil Description

Poorly graded sand with silt and gravel

Atterberg Limits

PL=

LL=

PI=

Coefficients

D₉₀= 8.1328

D₈₅= 6.2521

D₆₀= 1.2356

D₅₀= 0.7811

D₃₀= 0.3424

D₁₅= 0.1485

D₁₀= 0.1010

C_u= 12.24

C_c= 0.94

Classification

USCS= SP-SM

AASHTO= A-1-b

Remarks

Moisture Content: 3.7%

Location: Boring B-4
Sample Number: S-1

Depth: 0.3'-2.3'

Date: 7/17/2019

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

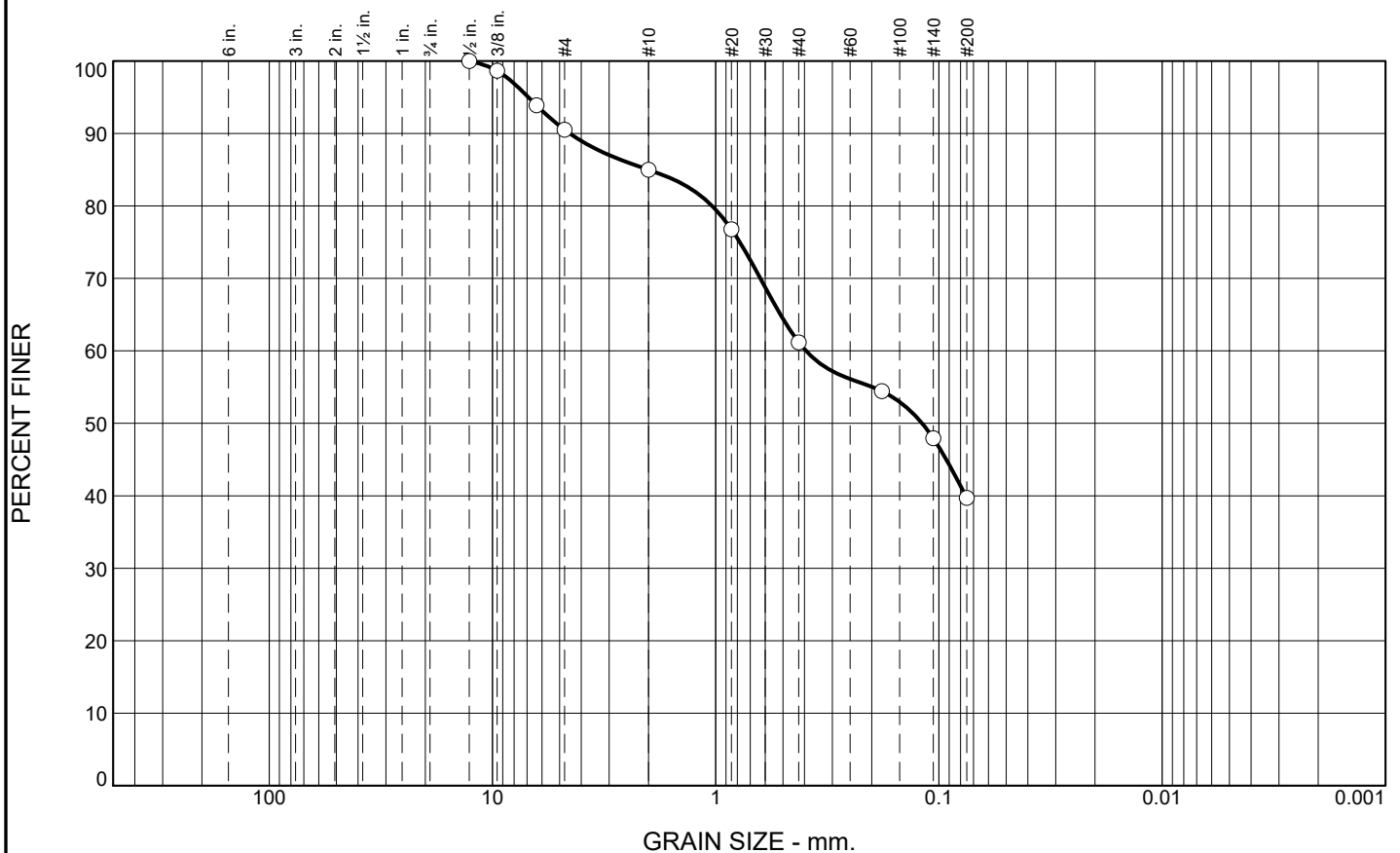
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-04

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.5	5.5	23.8	21.5	39.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	98.7		
1/4"	93.9		
#4	90.5		
#10	85.0		
#20	76.8		
#40	61.2		
#80	54.4		
#140	47.9		
#200	39.7		

* (no specification provided)

Soil Description		
Silty sand		
Atterberg Limits		
PL=	LL=	PI=
Coefficients		
D ₉₀ = 4.5016	D ₈₅ = 2.0021	D ₆₀ = 0.3942
D ₅₀ = 0.1189	D ₃₀ =	D ₁₅ =
D ₁₀ =	C _u =	C _c =
Classification		
USCS= SM	AASHTO= A-4(0)	
Remarks		
Moisture Content: 9.5%		

Location: Boring B-4
Sample Number: S-3

Depth: 5'-7'

Date: 7/17/2019

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

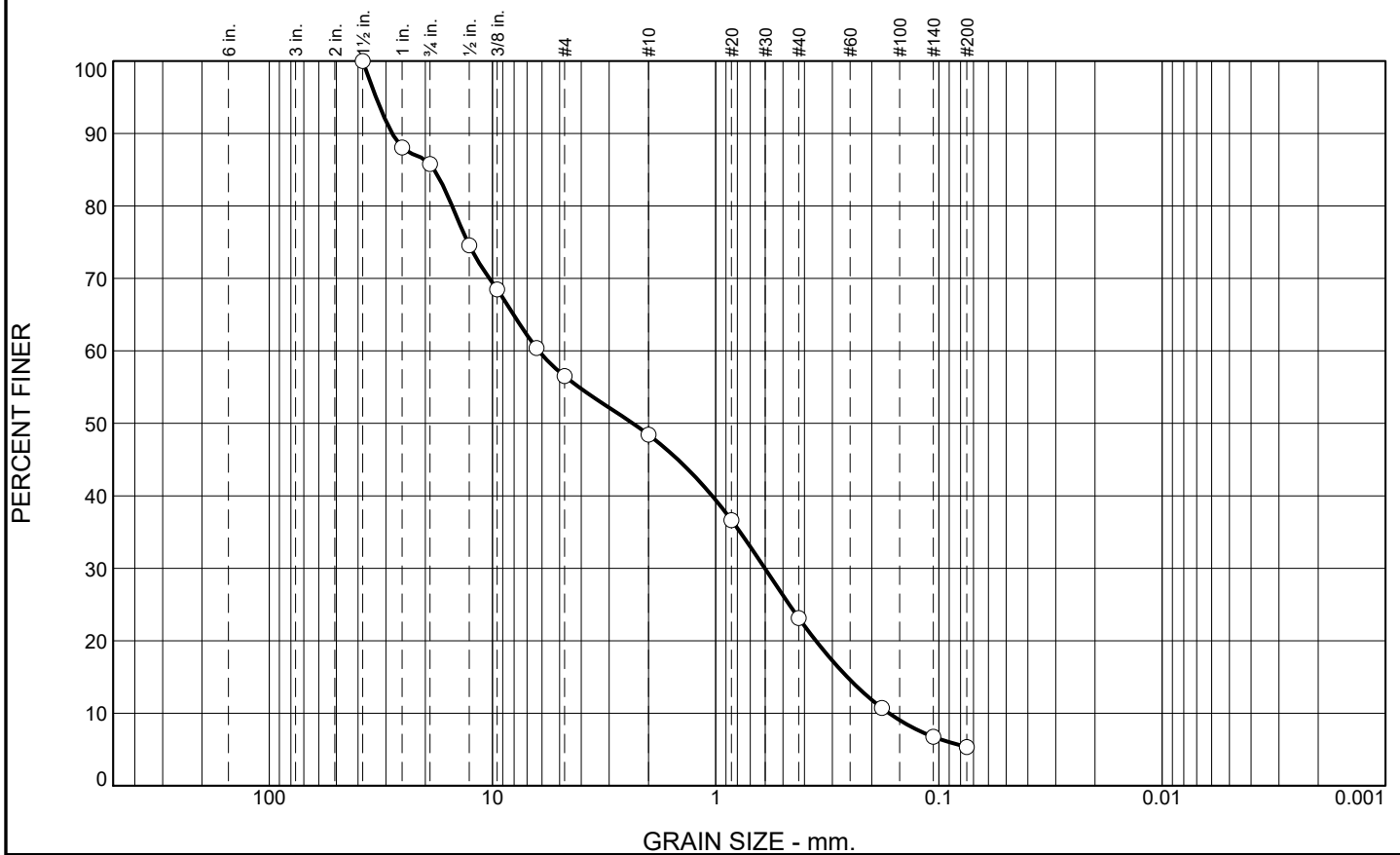
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-12

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.2	29.3	8.1	25.3	17.8	5.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100.0		
1"	88.1		
3/4"	85.8		
1/2"	74.6		
3/8"	68.5		
1/4"	60.4		
#4	56.5		
#10	48.4		
#20	36.6		
#40	23.1		
#80	10.7		
#140	6.7		
#200	5.3		

* (no specification provided)

<u>Soil Description</u>		
Poorly graded sand with silt and gravel		
<u>Atterberg Limits</u>		
PL=	LL=	PI=
<u>Coefficients</u>		
D ₉₀ = 28.1405	D ₈₅ = 18.2087	D ₆₀ = 6.2028
D ₅₀ = 2.3526	D ₃₀ = 0.6026	D ₁₅ = 0.2574
D ₁₀ = 0.1672	C _u = 37.09	C _c = 0.35
<u>Classification</u>		
USCS= SP-SM	AASHTO= A-1-a	
<u>Remarks</u>		
Moisture Content: 1.2%		

Location: Boring B-5
Sample Number: S-1

Depth: 0.2'-2.2'

Date: 7/17/2019

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

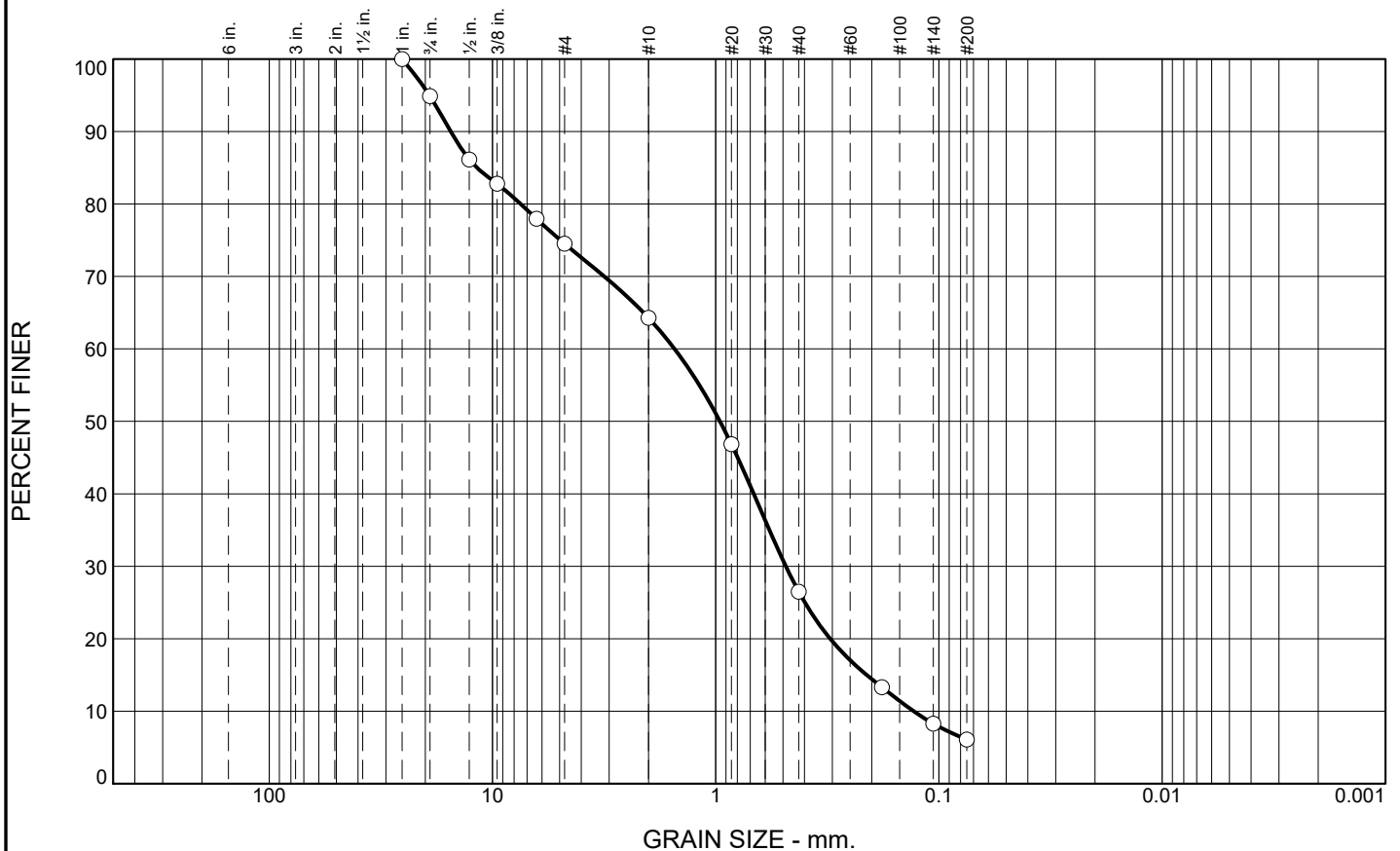
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-05

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.1	20.4	10.2	37.8	20.4	6.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	94.9		
1/2"	86.1		
3/8"	82.8		
1/4"	78.0		
#4	74.5		
#10	64.3		
#20	46.8		
#40	26.5		
#80	13.3		
#140	8.3		
#200	6.1		

* (no specification provided)

Soil Description Well-graded sand with silt and gravel		
Atterberg Limits PL= LL= PI=		
Coefficients D ₉₀ = 15.3603 D ₈₅ = 11.7269 D ₆₀ = 1.5276 D ₅₀ = 0.9563 D ₃₀ = 0.4854 D ₁₅ = 0.2106 D ₁₀ = 0.1299 C _u = 11.76 C _c = 1.19		
Classification USCS= SW-SM AASHTO= A-1-b		
Remarks Moisture Content: 1.9%		

Location: Boring B-6
Sample Number: S-1

Depth: 0.3'-2.3'

Date: 7/17/2019

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

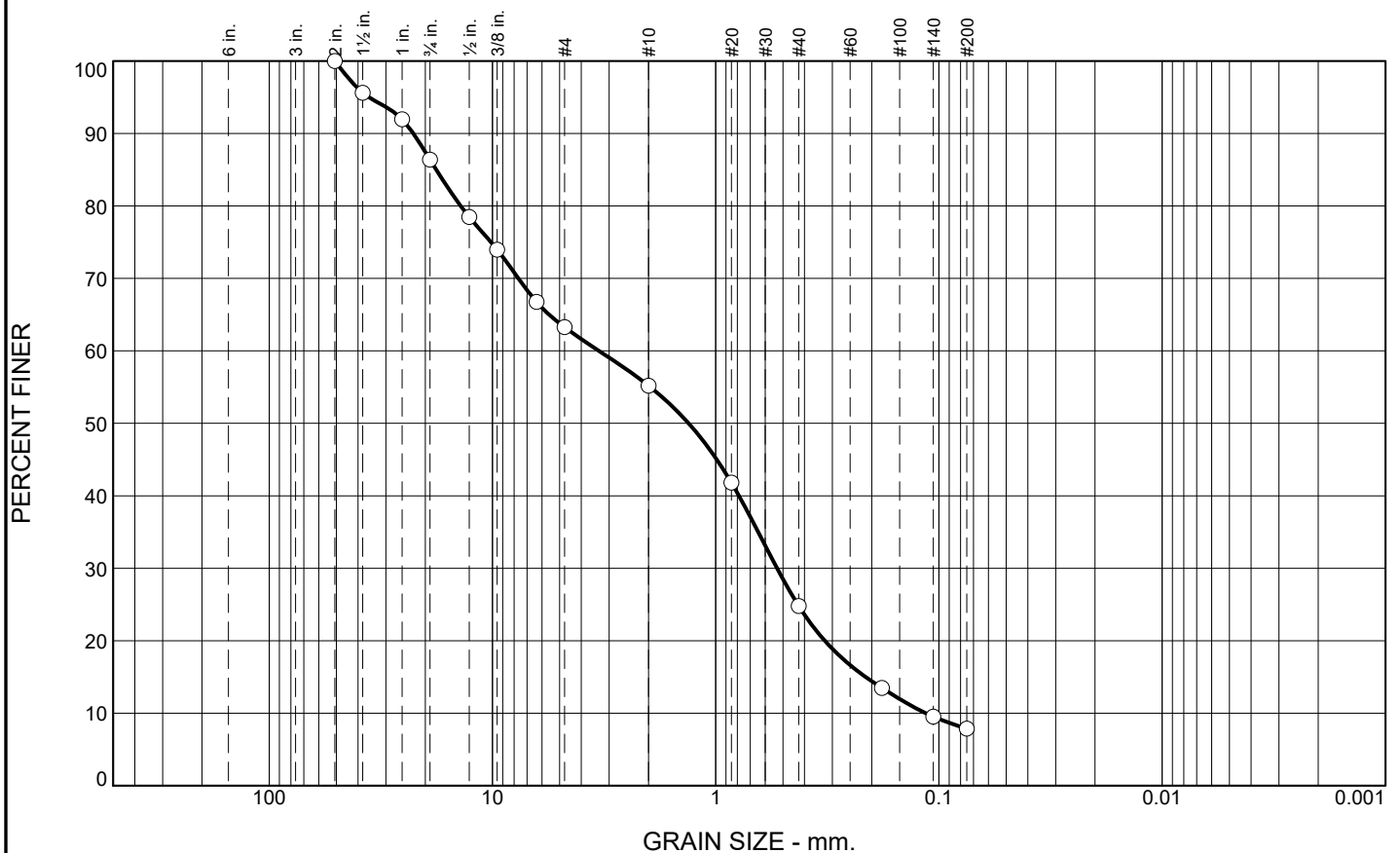
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-06

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.6	23.1	8.1	30.4	16.9	7.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100.0		
1 1/2"	95.6		
1"	92.0		
3/4"	86.4		
1/2"	78.5		
3/8"	74.0		
1/4"	66.8		
#4	63.3		
#10	55.2		
#20	41.8		
#40	24.8		
#80	13.5		
#140	9.5		
#200	7.9		

* (no specification provided)

Soil Description

poorly graded sand with silt and gravel

Atterberg Limits

PL=

LL=

PI=

Coefficients

D₉₀= 22.6185

D₈₅= 17.8472

D₆₀= 3.3355

D₅₀= 1.3207

D₃₀= 0.5314

D₁₅= 0.2131

D₁₀= 0.1146

C_u= 29.11

C_c= 0.74

Classification

USCS= SP-SM

AASHTO= A-1-b

Remarks

Moisture Content: 1.5%

Location: B-6 Riverside Avenue and William Oscar Emery Drive
Sample Number: 15617-01 Depth: 2.25'-4.25'

Date: 7-11-2019

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

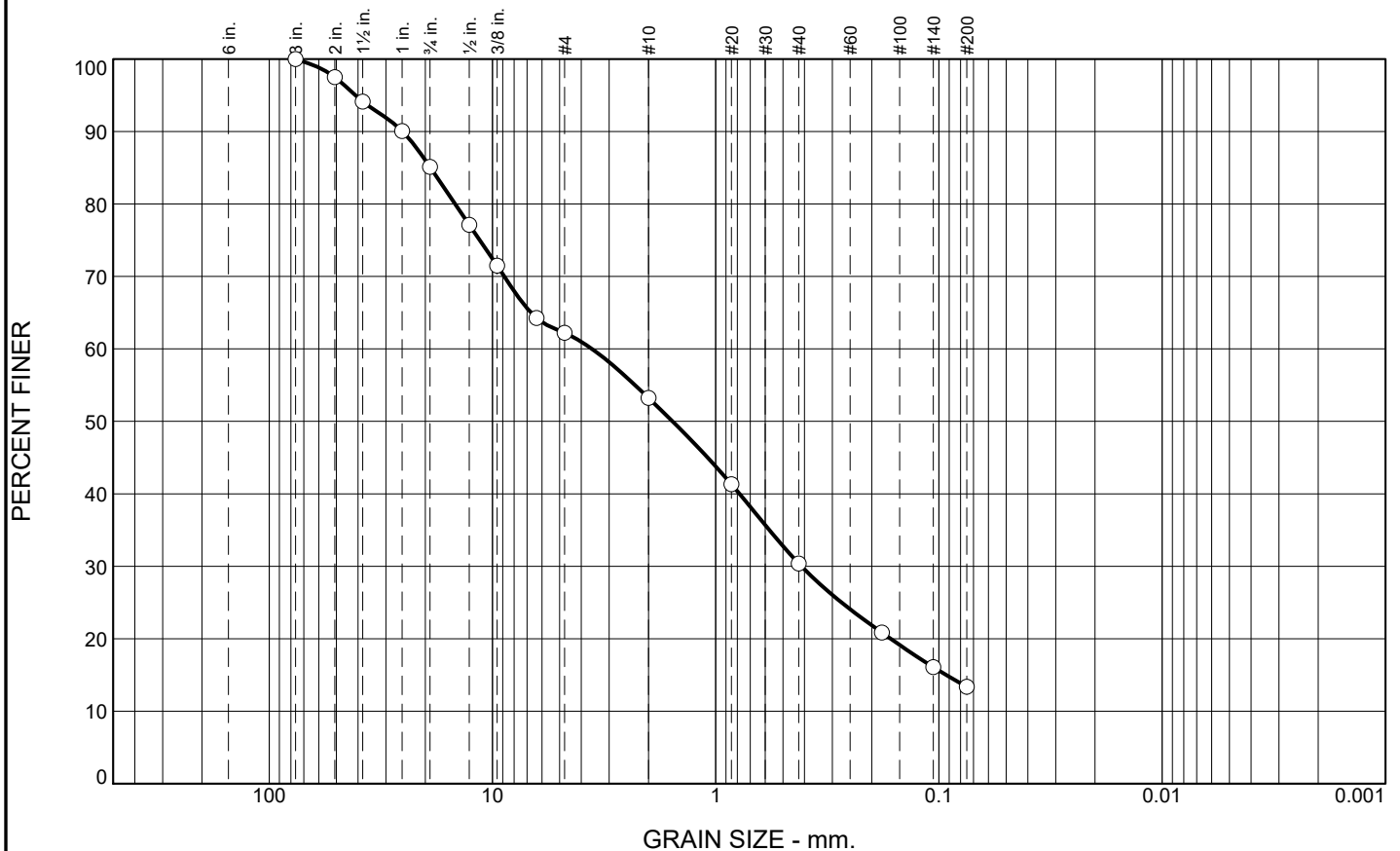
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15617-01

Tested By: MSM/JJB

Checked By: DEB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.9	22.9	9.0	22.8	17.0	13.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	97.5		
1 1/2"	94.1		
1"	90.1		
3/4"	85.1		
1/2"	77.1		
3/8"	71.5		
1/4"	64.3		
#4	62.2		
#10	53.2		
#20	41.3		
#40	30.4		
#80	20.9		
#140	16.1		
#200	13.4		

* (no specification provided)

Soil Description

silty sand with gravel

Atterberg Limits

PL=

LL=

PI=

Coefficients

D₉₀= 25.2441

D₈₅= 18.9278

D₆₀= 3.5837

D₅₀= 1.5599

D₃₀= 0.4133

D₁₅= 0.0928

D₁₀=

C_u=

C_c=

Classification

USCS= SM

AASHTO= A-1-b

Remarks

Mopisture Content: 2.02%

Location: B-9- Riverside Avenue and William Oscar Emery Drive
Sample Number: 15617-02 Depth: 2'-4.5'

Date: 7-9-2019

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

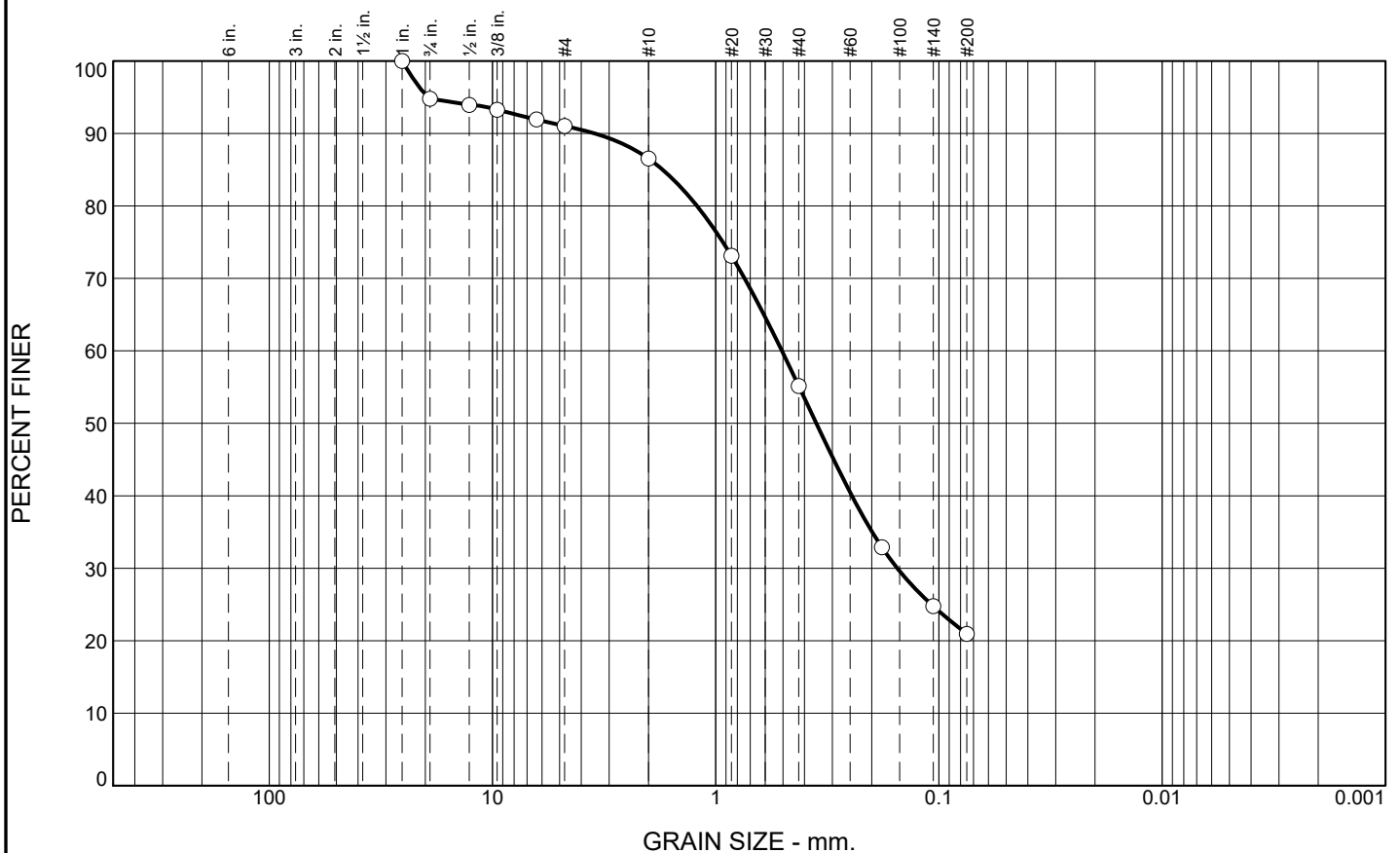
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15617-02

Tested By: JJB/MCM

Checked By: DEB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.2	3.7	4.6	31.3	34.3	20.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	94.8		
1/2"	93.9		
3/8"	93.3		
1/4"	91.9		
#4	91.1		
#10	86.5		
#20	73.1		
#40	55.2		
#80	32.9		
#140	24.8		
#200	20.9		

* (no specification provided)

<u>Soil Description</u>		
Silty sand		
<u>Atterberg Limits</u>		
PL=	LL=	PI=
<u>Coefficients</u>		
D ₉₀ = 3.4732	D ₈₅ = 1.7259	D ₆₀ = 0.5052
D ₅₀ = 0.3544	D ₃₀ = 0.1537	D ₁₅ =
D ₁₀ =	C _u =	C _c =
<u>Classification</u>		
USCS= SM	AASHTO= A-2-4(0)	
<u>Remarks</u>		
Moisture Content: 25.7%		

Location: Boring B-6
Sample Number: S-3

Depth: 5'-7'

Date: 7/17/2019

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

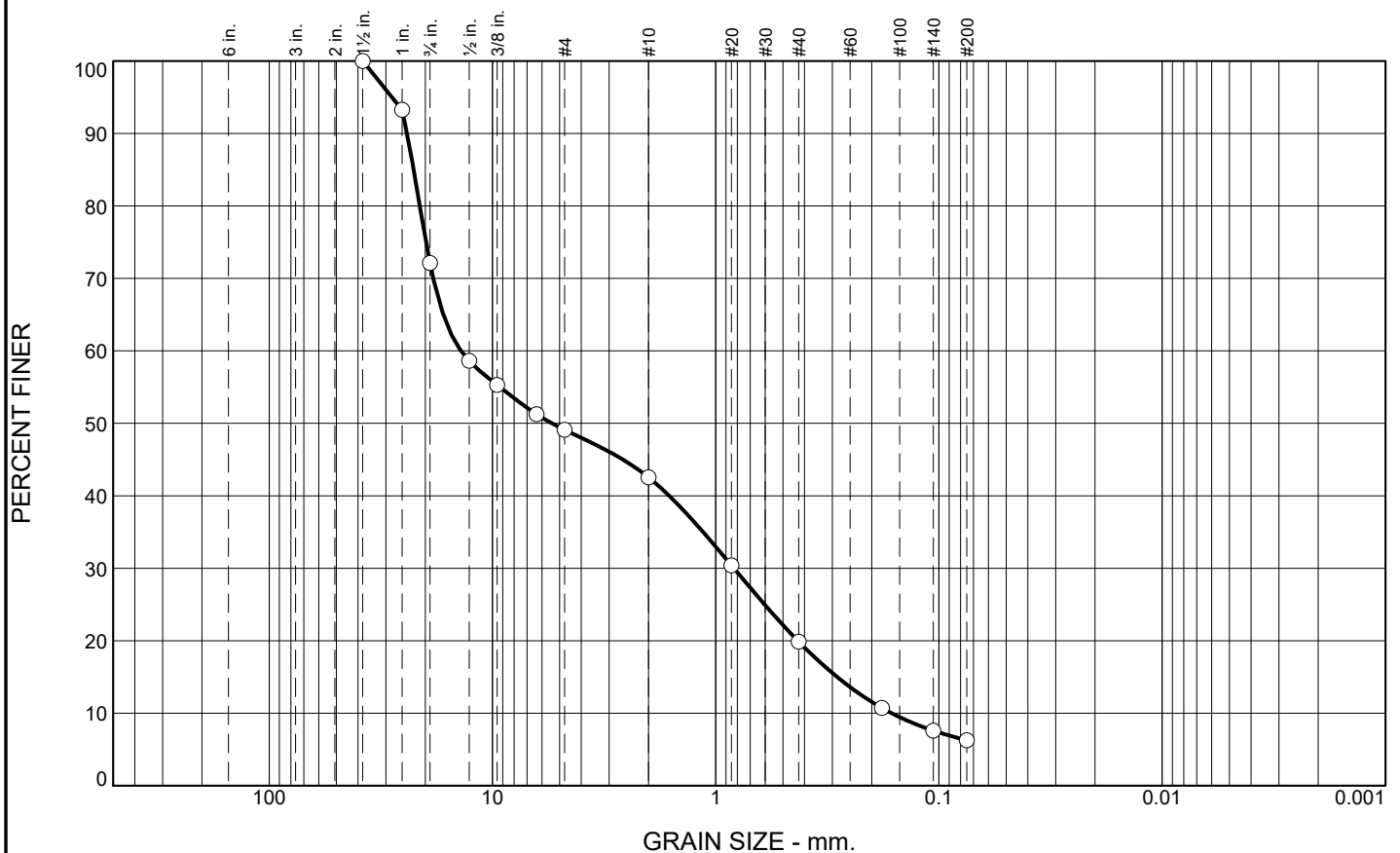
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-13

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	27.9	23.0	6.6	22.6	13.6	6.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100.0		
1"	93.3		
3/4"	72.1		
1/2"	58.6		
3/8"	55.3		
1/4"	51.3		
#4	49.1		
#10	42.5		
#20	30.4		
#40	19.9		
#80	10.7		
#140	7.6		
#200	6.3		

* (no specification provided)

Soil Description

Poorly graded gravel with silt and sand

Atterberg Limits

PL=

LL=

PI=

Coefficients

D₉₀= 24.1147

D₈₅= 22.5455

D₆₀= 13.8290

D₅₀= 5.4128

D₃₀= 0.8290

D₁₅= 0.2861

D₁₀= 0.1631

C_u= 84.78

C_c= 0.30

Classification

USCS= GP-GM

AASHTO= A-1-a

Remarks

Moisture Content: 3.7%

Location: Boring B-7
Sample Number: S-1

Depth: 0.3'-2.3'

Date: 7/17/2019

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

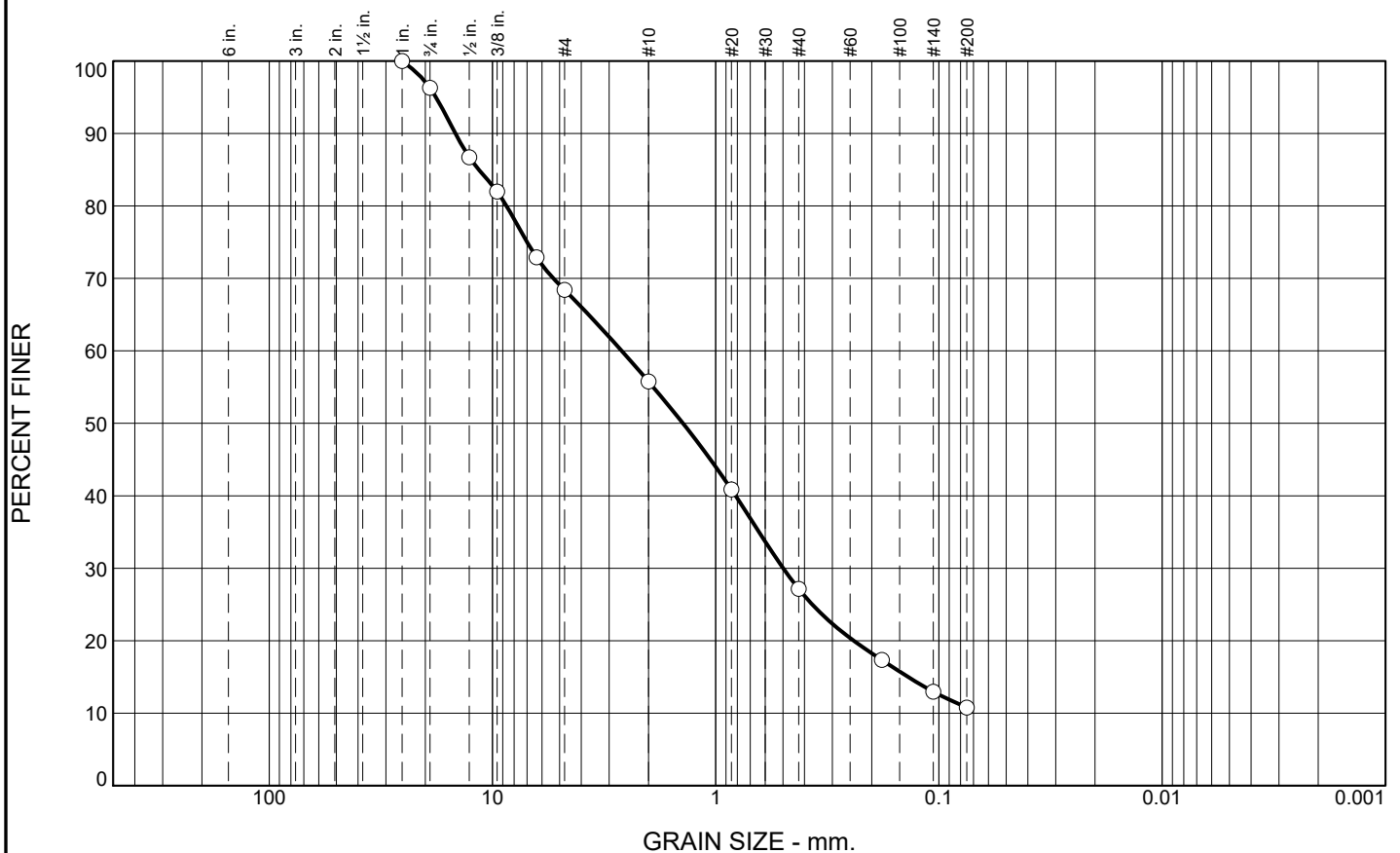
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-07

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.7	27.9	12.6	28.7	16.3	10.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	96.3		
1/2"	86.7		
3/8"	82.0		
1/4"	72.9		
#4	68.4		
#10	55.8		
#20	40.9		
#40	27.1		
#80	17.3		
#140	13.0		
#200	10.8		

* (no specification provided)

<u>Soil Description</u>		
Poorly graded sand with silt and gravel		
<u>Atterberg Limits</u>		
PL=	LL=	PI=
<u>Coefficients</u>		
D ₉₀ = 14.6392	D ₈₅ = 11.5063	D ₆₀ = 2.6362
D ₅₀ = 1.4004	D ₃₀ = 0.4988	D ₁₅ = 0.1375
D ₁₀ =	C _u =	C _c =
<u>Classification</u>		
USCS= SP-SM	AASHTO=	A-1-b
<u>Remarks</u>		
Moisture Content: 5.5%		

Location: Boring B-8
Sample Number: S-1

Depth: 0.3'-2.3'

Date: 7/17/2019

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

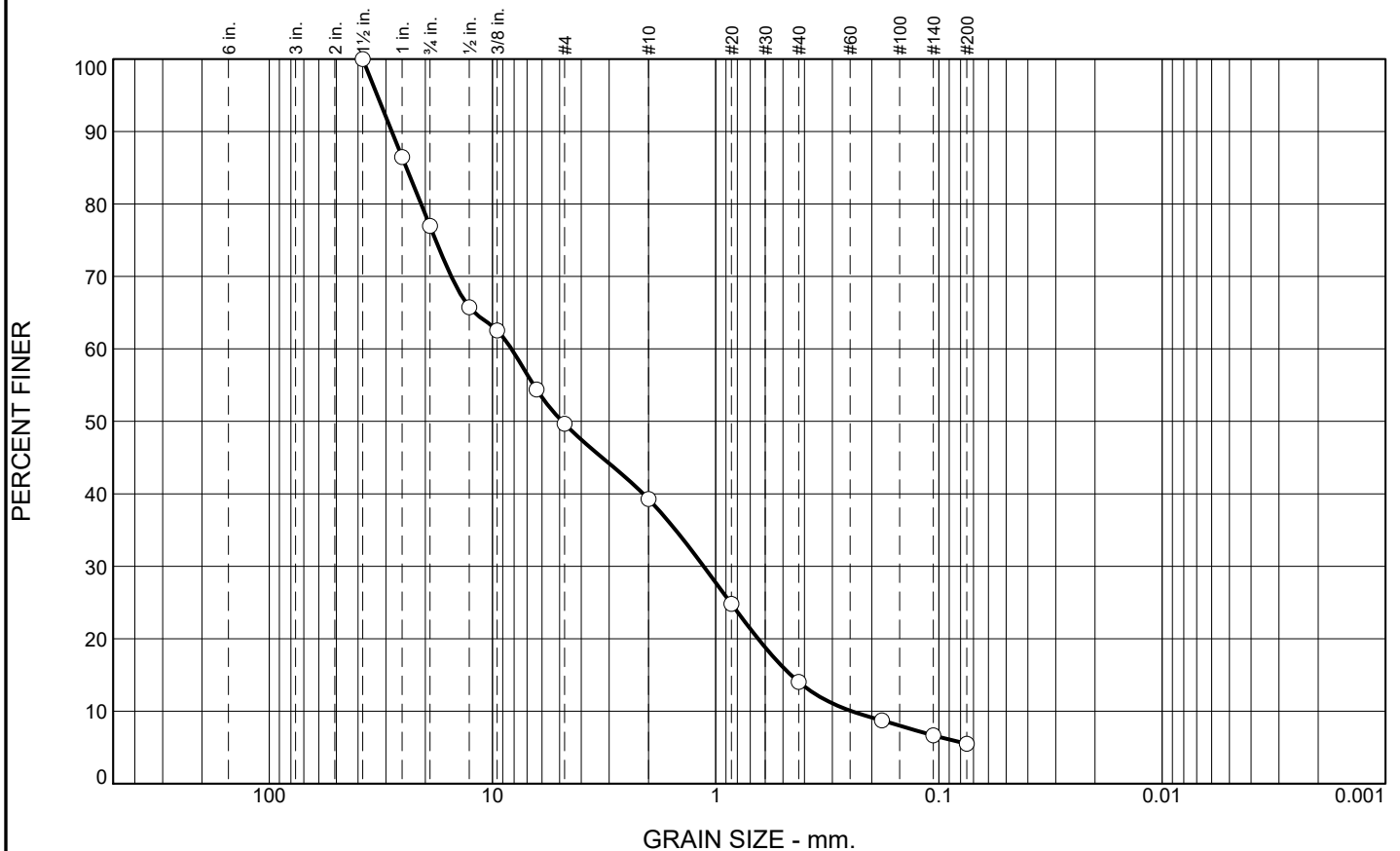
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-08

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	23.0	27.3	10.4	25.3	8.5	5.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100.0		
1"	86.5		
3/4"	77.0		
1/2"	65.8		
3/8"	62.6		
1/4"	54.4		
#4	49.7		
#10	39.3		
#20	24.8		
#40	14.0		
#80	8.7		
#140	6.7		
#200	5.5		

* (no specification provided)

Soil Description

Poorly graded gravel with silt and sand

Atterberg Limits

PL=

LL=

PI=

Coefficients

D₉₀= 28.2464

D₈₅= 24.2913

D₆₀= 8.2211

D₅₀= 4.8676

D₃₀= 1.1324

D₁₅= 0.4613

D₁₀= 0.2460

C_u= 33.42

C_c= 0.63

Classification

USCS= GP-GM

AASHTO= A-1-a

Remarks

Moisture Content: 11.3%

Location: Boring B-8
Sample Number: S-3

Depth: 5'-7'

Date: 7/17/2019

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

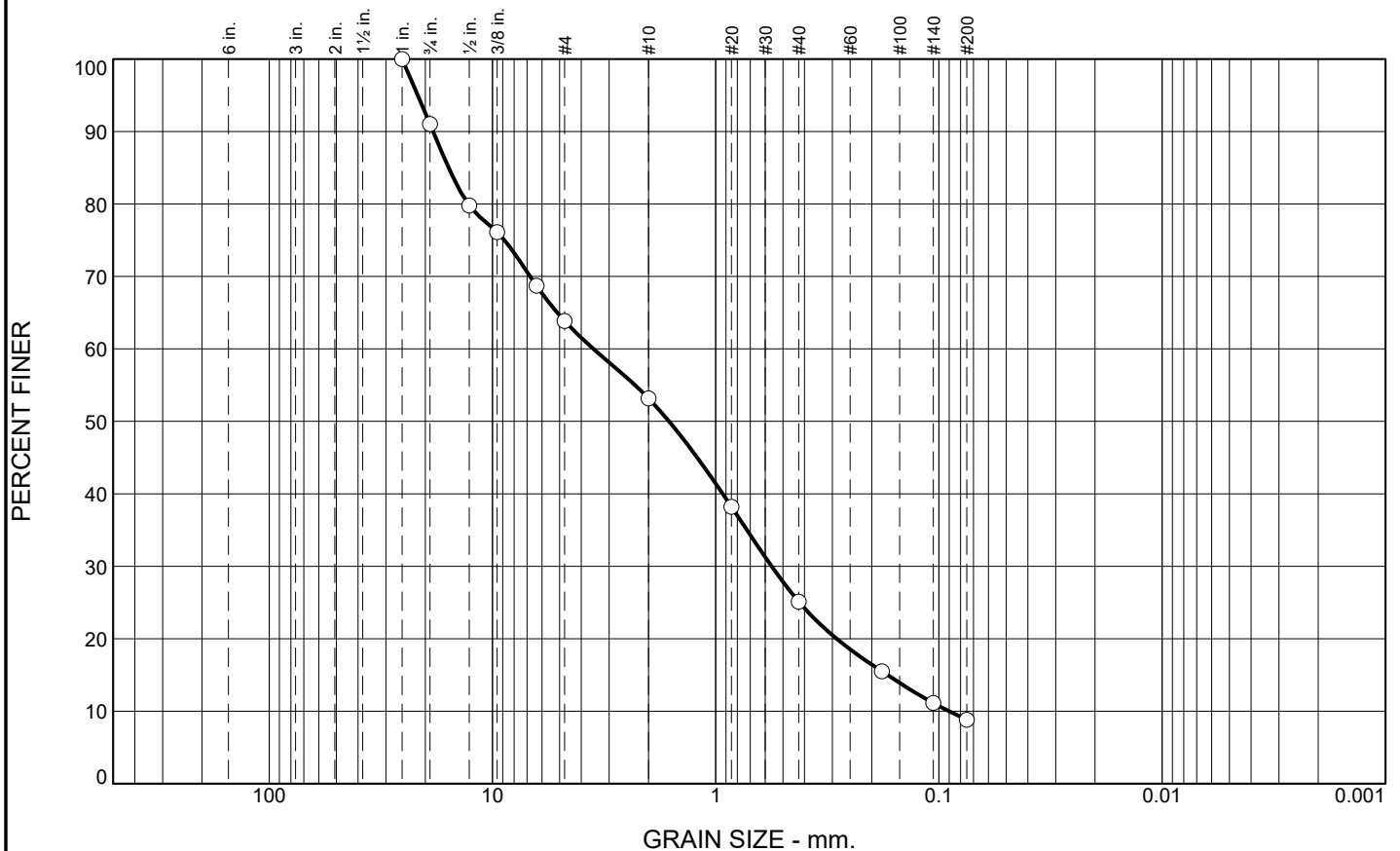
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-14

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.0	27.1	10.7	28.1	16.3	8.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	91.0		
1/2"	79.8		
3/8"	76.1		
1/4"	68.7		
#4	63.9		
#10	53.2		
#20	38.2		
#40	25.1		
#80	15.5		
#140	11.1		
#200	8.8		

* (no specification provided)

Soil Description

Poorly graded sand with silt and gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 18.4386 D₈₅= 15.7045 D₆₀= 3.5282
D₅₀= 1.6165 D₃₀= 0.5620 D₁₅= 0.1701
D₁₀= 0.0901 C_u= 39.15 C_c= 0.99

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Moisture Content: 3.6%

Location: Boring B-9
Sample Number: S-1

Depth: 0.2'-2.2'

Date: 7/17/2019

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

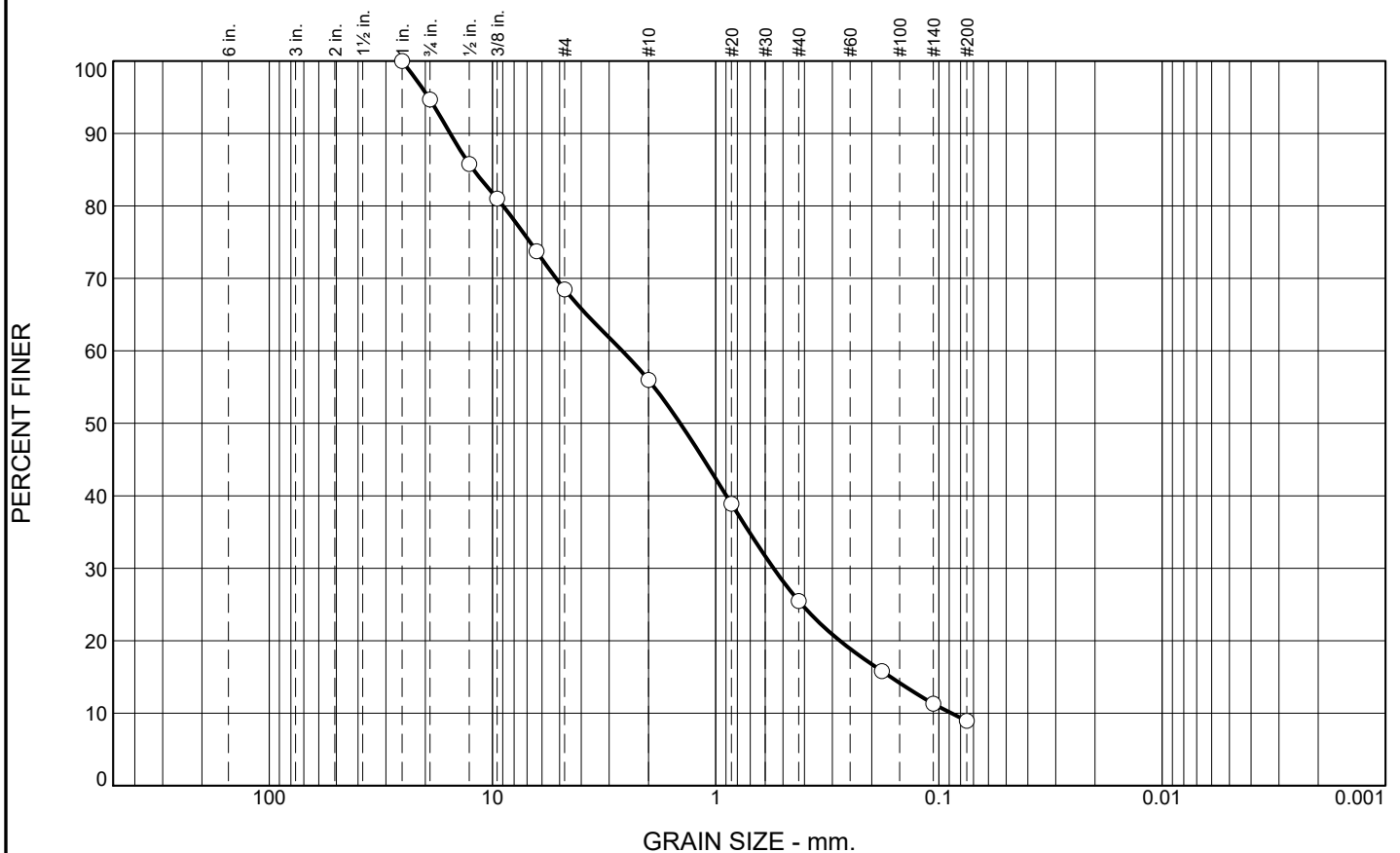
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-09

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.3	26.2	12.5	30.5	16.6	8.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	94.7		
1/2"	85.8		
3/8"	81.0		
1/4"	73.7		
#4	68.5		
#10	56.0		
#20	38.9		
#40	25.5		
#80	15.8		
#140	11.3		
#200	8.9		

* (no specification provided)

<u>Soil Description</u>		
Well-graded sand with silt and gravel		
<u>Atterberg Limits</u>		
PL=	LL=	PI=
<u>Coefficients</u>		
D ₉₀ = 15.4441	D ₈₅ = 12.1641	D ₆₀ = 2.6219
D ₅₀ = 1.4405	D ₃₀ = 0.5511	D ₁₅ = 0.1646
D ₁₀ = 0.0881	C _u = 29.78	C _c = 1.32
<u>Classification</u>		
USCS= SW-SM	AASHTO= A-1-b	
<u>Remarks</u>		
Moisture Content: 4.1%		

Location: Boring B-10
Sample Number: S-1

Depth: 0.3'-0.5'

Date: 7/17/2019

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

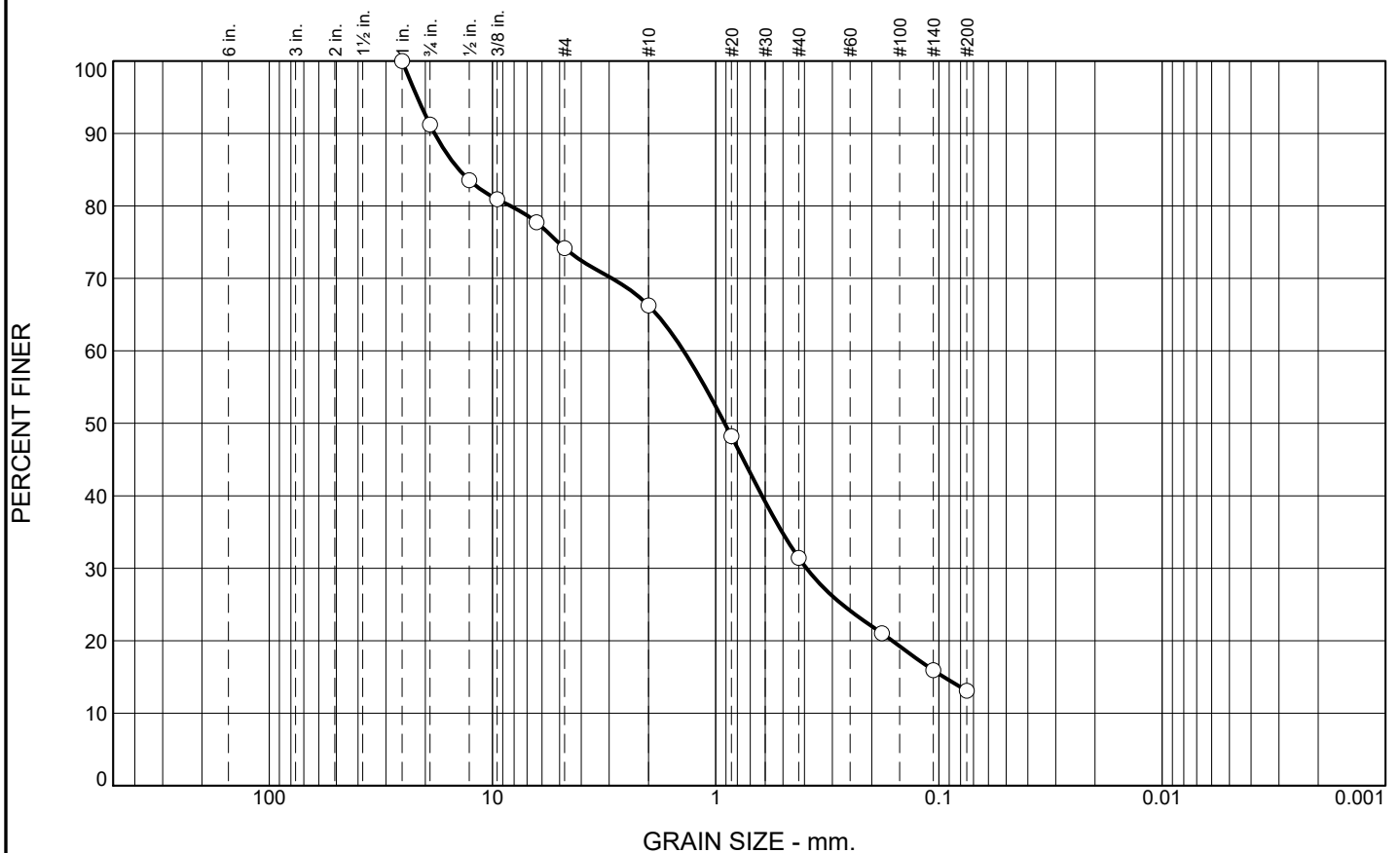
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME
Project No: 0266-021

Lab 15622-10

Tested By: MSM

Checked By: MTG

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.8	17.0	7.9	34.9	18.3	13.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	91.2		
1/2"	83.6		
3/8"	80.9		
1/4"	77.8		
#4	74.2		
#10	66.3		
#20	48.2		
#40	31.4		
#80	21.0		
#140	15.9		
#200	13.1		

* (no specification provided)

Soil Description

Silty sand with gravel

Atterberg Limits

PL=

LL=

PI=

Coefficients

D₉₀= 18.1512

D₈₅= 14.0939

D₆₀= 1.3918

D₅₀= 0.9107

D₃₀= 0.3926

D₁₅= 0.0952

D₁₀=

C_u=

C_c=

Classification

USCS= SM

AASHTO= A-1-b

Remarks

Moisture Content: 2.9%

Location: Boring B-10

Sample Number: S-3

Depth: 5'-6.2'

Date: 7/17/2019

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

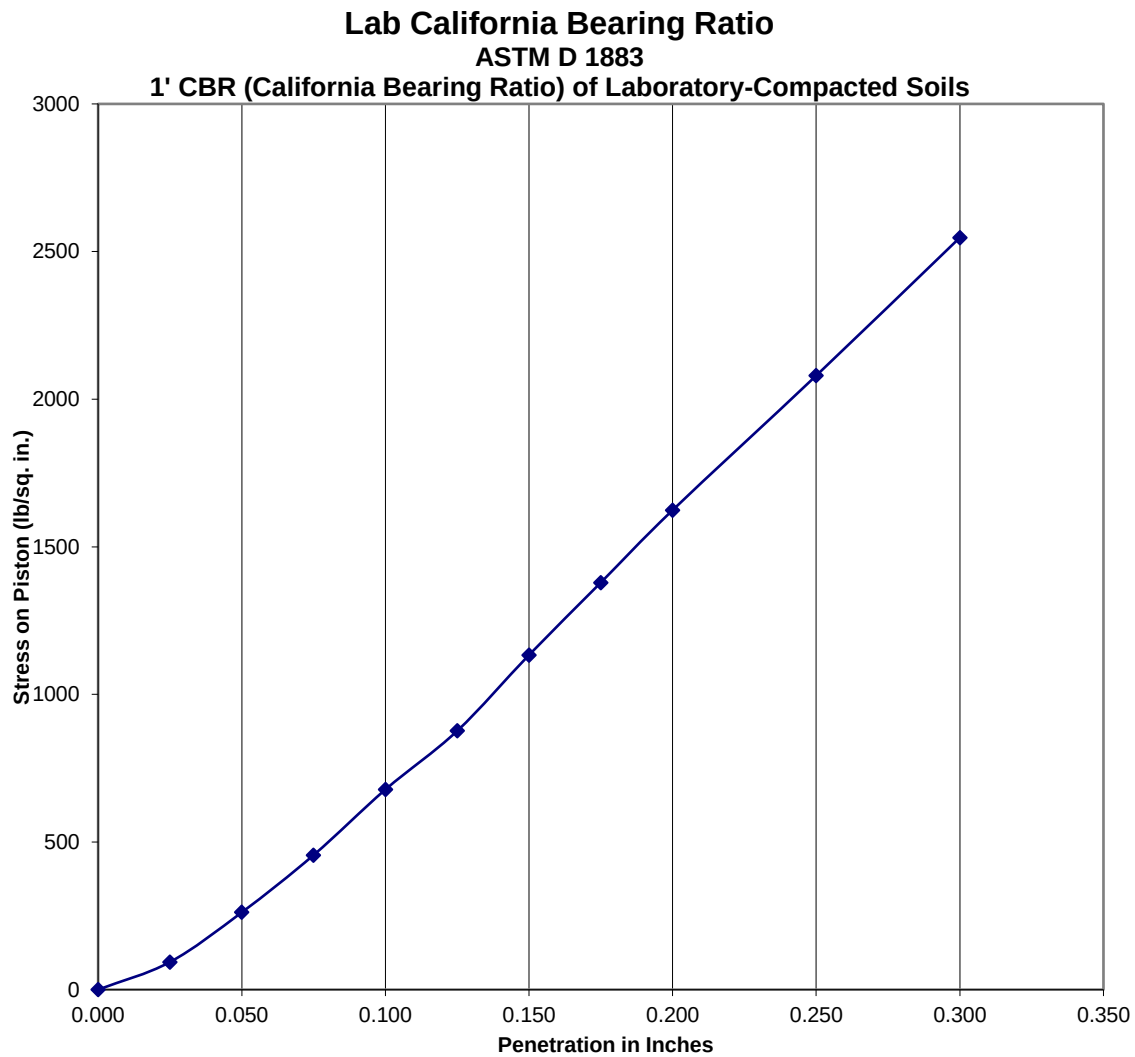
Client: City Of Sanford
Project: Subsurface Information
Sanford, ME

Project No: 0266-021

Lab 15622-15

Tested By: MSM

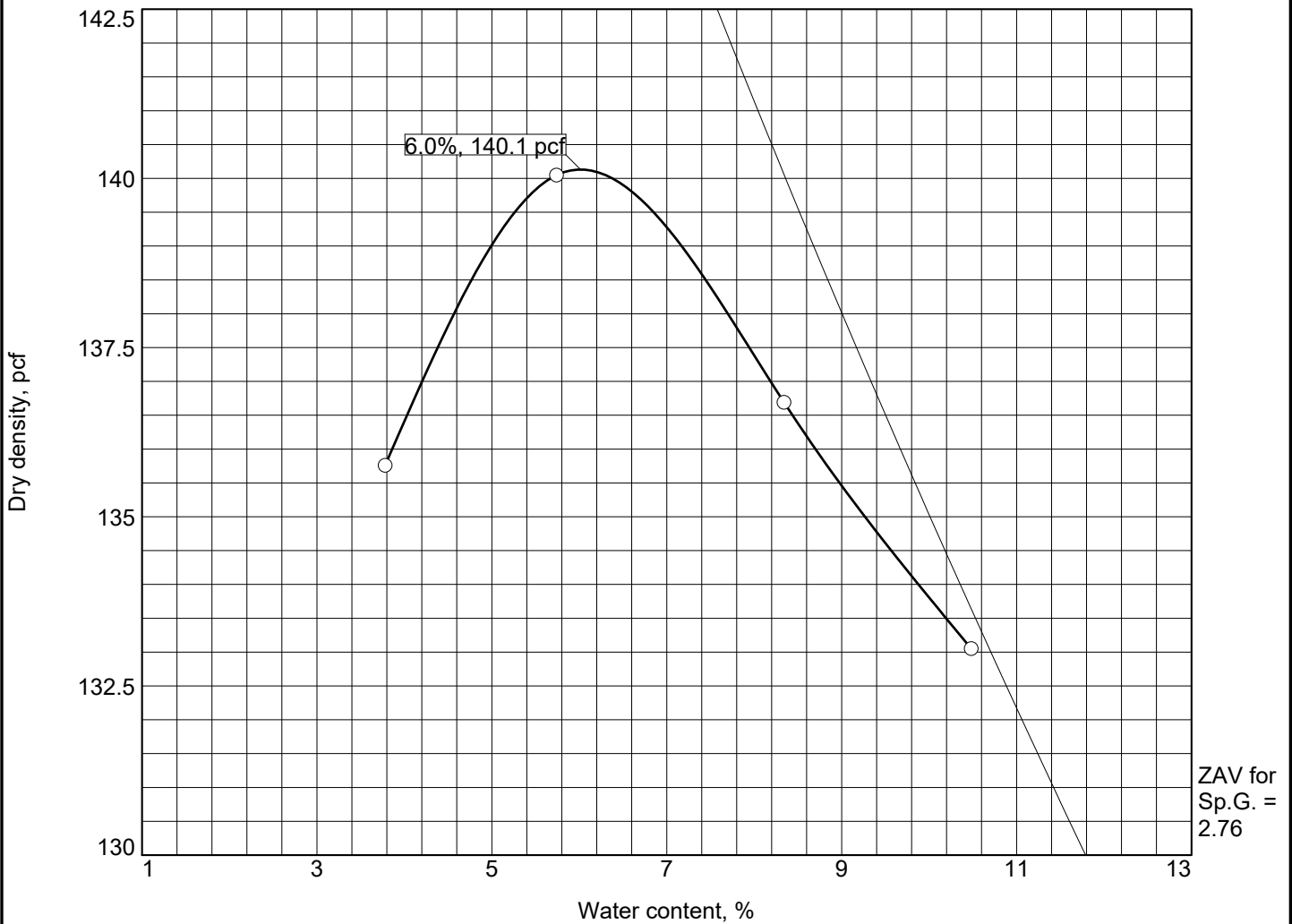
Checked By: MTG



Bearing Ratio at 0.1 inch penetration = 67.8 at 100.3% Compaction

Test Location: B-9		Sample #/Test Depth: 2'-4.5'	
Prep Method:	D1557	As Compacted Moisture Content:	7.9%
Curing Conditions:	Soaked	Top 1" of Test Sample Moisture Content:	7.2%
Tested Dry Density:	140.5	Sample Swell:	0%
Surcharge Weight:	10 lbs	% Retained on 19mm Sieve:	14.9%
Special Sample Testing Procedures or Comments from Above			
None			
Project: SubSurface Information		Client: City of Sanford	
Project #: 0266-021		Date: 7/17/2019	
Location: Sanford, ME		Sample #: 15617-02	
R. W. Gillespie & Associates			
20 Pomerleau St. Suite 100 Biddeford, ME 04005		177 Shattuck Way, Suite 1 West Newington, NH 03801	

MOISTURE-DENSITY REPORT



Test specification: ASTM D 1557-12 Method C Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
2'-4.5'	SM						14.9	13.4

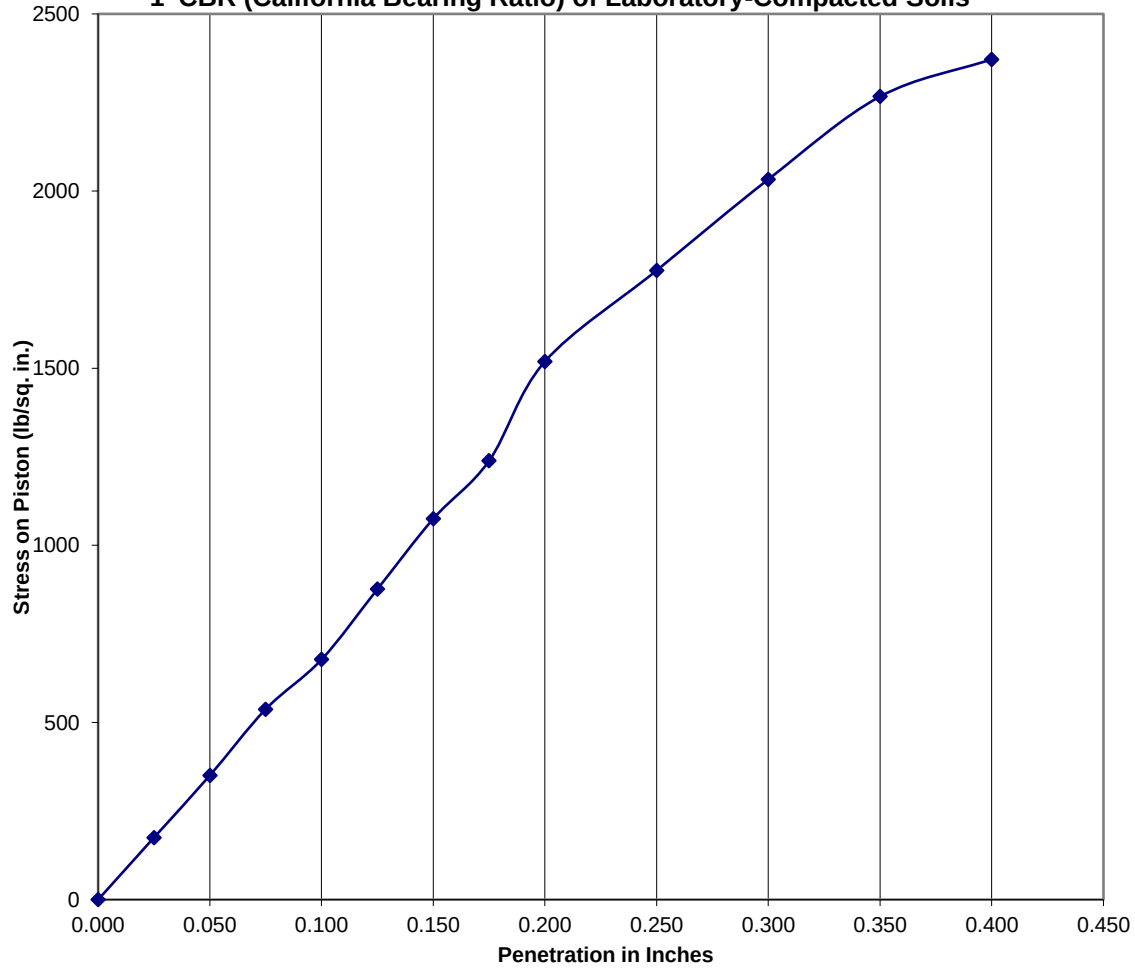
ROCK CORRECTED TEST RESULTS		MATERIAL DESCRIPTION	
Maximum dry density = 140.1 pcf		silty sand with gravel	
Optimum moisture = 6.0 %			
Project No. 0266-021 Client: City Of Sanford Project: Subsurface Information Sanford, ME ○ Loc.: B-9- Riverside Avenue and William Oscar Emery Drive		Remarks:	
R.W. Gillespie & Associates, Inc. Biddeford, Maine			
		Lab 15617-02	

Tested By: JJB Checked By: DEB

Lab California Bearing Ratio

ASTM D 1883

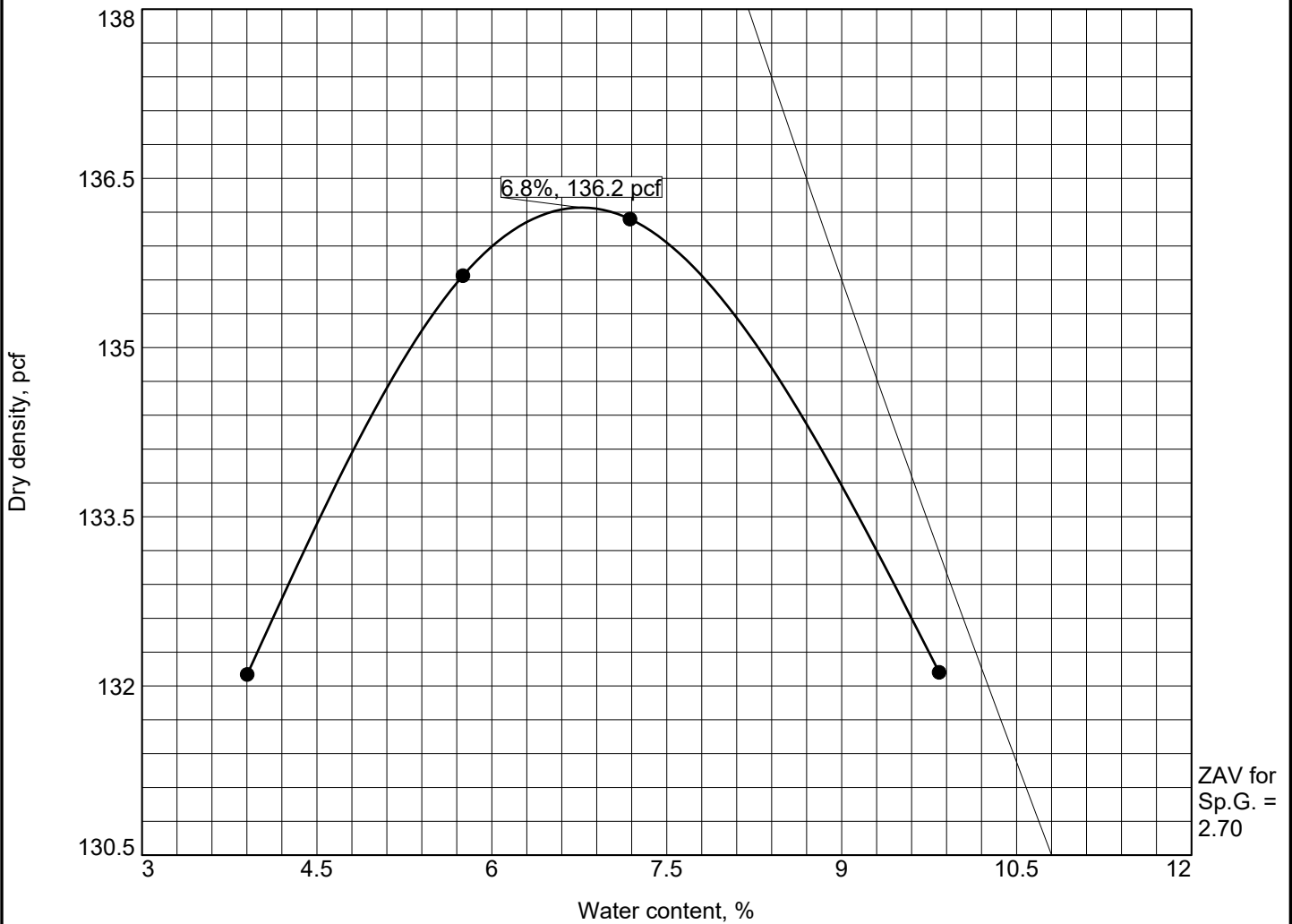
1' CBR (California Bearing Ratio) of Laboratory-Compacted Soils



Bearing Ratio at 0.1 inch penetration = 67.8 at 99.6% Compaction

Test Location: B-6		Sample #/Test Depth: 3'-5'	
Prep Method:	D1557	As Compacted Moisture Content:	6.8%
Curing Conditions:	Soaked	Top 1" of Test Sample Moisture Content:	6.8%
Tested Dry Density:	135.7	Sample Swell:	0%
Surcharge Weight:	10 lbs	% Retained on 19mm Sieve:	13.6%
Special Sample Testing Procedures or Comments from Above			
None			
Project: SubSurface Information		Client: City of Sanford	
Project #: 0266-021		Date: 7/17/2019	
Location: Sanford, ME		Sample #: 15617-01	
R. W. Gillespie & Associates			
20 Pomerleau St. Suite 100 Biddeford, ME 04005		177 Shattuck Way, Suite 1 West Newington, NH 03801	

MOISTURE-DENSITY REPORT



Test specification: ASTM D 1557-12 Method C Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
2.25'-4.25'	SP-SM	A-1-b					13.6	7.9

ROCK CORRECTED TEST RESULTS		MATERIAL DESCRIPTION	
Maximum dry density = 136.2 pcf		poorly graded sand with silt and gravel	
Optimum moisture = 6.8 %			
Project No. 0266-021 Client: City Of Sanford Project: Subsurface Information Sanford, ME ○ Loc.: B-6 Riverside Avenue and William Oscar Emery Drive		Remarks:	
R.W. Gillespie & Associates, Inc. Biddeford, Maine			
		Lab 15617-01	

Tested By: JJB Checked By: DEB