Geotechnical Investigation Report

S. Edison Avenue
Roadway Improvements
City Of Tampa Florida

Prepared for: **Mr. Michael Miller**
City of Tampa DPW – Stormwater Engineering
306 E. Jackson St. ,6N
Tampa, Florida 33602

Prepared By:
MC Squared, Inc
5808 – A Breckenridge Parkway
Tampa, Florida 33610

Project No. T111413.258
January 2015

GEOTECHNICAL • ENVIRONMENTAL
MATERIALS TESTING

January 14, 2015

Mr. Michael Miller
City of Tampa DPW – Stormwater Engineering
306 E. Jackson st., 6N
Tampa, FL 33602

Additional Geotechnical Engineering Services
S. Edison Avenue Drainage Improvements
Phase 1
City of Tampa, Florida
MC^2 Project Number T111413.258

MC Squared, Inc. (MC^2) has performed additional geotechnical engineering services for the referenced project. The results of this exploration, together with our recommendations, are included in the accompanying report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **MC^2** will be pleased to continue our role as geotechnical consultants during the construction phase of this project.

We trust that this report will assist you in the design and construction of the proposed project. We appreciate the opportunity to be of service on this project. Should you have any questions, please do not hesitate to contact us.

Respectfully submitted,
MC^2

William P. Rovira IV, PE
Project Manager
Florida PE No. 74586

C. Rees Nickerson, PE
Senior Engineer
Florida PE No. 35792

5808-A Breckenridge Parkway, Tampa, Florida 33610
Phone (813) 623-3399, Fax (813) 623-6636
www.mc2engineers.com

TABLE OF CONTENTS

GEOTECHNICAL ENGINEERING SERVICES REPORT

INTRODUCTION

Authorization

This report presents the findings of our shallow subsurface investigation to provide underdrain design parameters for the City of Tampa, Florida. The services for this project were performed in general accordance with our Proposal T111413.258 dated December 4, 2014. Authorization to perform our services was in the form of acceptance of our proposal by Ms. Barbara Graves, **City of Tampa DPW –Stormwater Engineering**.

PROJECT INFORMATION

Project information has been provided by Ms. Barbara Graves and Mr. Michael Miller of the **City of Tampa Stormwater Division** through email and telephone. The main issue is the groundwater seepage that exits at the ground surface and pavement surface along the sidewalks and the street curbs. Arehna Engineers, Inc. addressed the seepage problems in a report dated December 30, 2013. In their report they recommended rebuilding the roadway and installing conventional roadside underdrains to intercept the groundwater seepage.

MC2 was requested to perform borings in the roadway to address rebuilding the roadway as recommended by Ahrena Engineers. MC2 completed that study and submitted a report dated May 12, 2014 in which we addressed pavement concerns and addressed the presence of buried organic soils to be dealt with during underdrain construction. The existing pavement is functional. Our previous asphaltic concrete cores indicate a substantial pavement thickness. In our opinion, when underdrains are installed to draw down the groundwater level below the pavement surface further pavement distress should be minimized. Therefore, this additional report addresses the possibility of moving the proposed underdrains to be constructed from under the curbs to beneath the sidewalks along each side of Edison Avenue and not rebuilding the roadway.

It was the intent of this investigation to perform subsurface borings and collect soil samples for testing to determine the composition of the existing shallow subsurface soils and estimate the soil permeability so that underdrains could be sized and located to intercept the groundwater flow along the sidewalks and roadway curbs

Scope of Services

The purpose of these services was to assess the existing shallow subsurface conditions along S. Edison Avenue extending south from W. Inman Avenue to Bayshore Blvd.

Specifically, the scope of the exploration and analysis included the following:

1. Drilled a total of ten (10) power auger borings to a depth of 10 feet. The borings were located in the grassed areas between the existing sidewalks and the curbs. Soil samples were obtained for each foot of soil penetrated.

2. Visually examined all recovered soil samples in the laboratory. Performed laboratory testing to classify the soils and determine the gradation of the soils retained on the 200 sieve. We completed 10 full gradation tests on samples retained from the power auger borings.

The information generated from the borings is presented this report. The information includes the encountered water table, the laboratory test results, the estimated permeability based on calculations from the gradation test results as well as a discussion of the design and installation of the underdrains and our estimates of the cone of influence for the underdrain system.

SUBSURFACE EXPLORATION

The auger boring soil profiles are included on the **Boring Location**/**Report of Core Borings, Sheet 1 in the Appendix of this report.**

Boring Locations

The locations of the 10 auger borings were selected by **MC^2** to evaluate the variation of soil conditions along the proposed underdrain alignment**.** The site plan indicating the approximate boring locations is presented in **Sheet 1** in the **Appendix** of this report.

Auger Borings

The auger borings were drilled by advancing a 4 inch diameter helical flight auger powered by a track mounted drill rig. The auger was advanced into the subsurface and after stopping rotation was vertically pulled up to above the ground surface where soil samples were collected from the auger flights for each foot of penetration.

LABORATORY TESTING

General

The soil samples were transported to our laboratory and were visually classified by a Geotechnical Engineer in general accordance with the American Society of Testing and Materials (ASTM) test designation D-2488, titled "Description and Identification of Soils (Visual-Manual Procedure)". The Unified Soil Classification was used for soil classification. The initial classification was based on visual observations and the laboratory tests were used to confirm the initial classification. A laboratory testing program was performed on selected representative samples. The laboratory testing was conducted in general conformance to ASTM standards and FDOT practices. Some procedural variations not considered material to the test data or to the conclusions reached herein may have been taken. The laboratory tests included moisture content tests, full gradation of the material retained on the 200 sieve and organic content tests. A summary of the laboratory results is included in **Table 1** in the **Appendix**.

Moisture Content

The laboratory moisture content test consists of the determination of the percentage of moisture contents in selected samples in general accordance with FDOT test designation FM 1-T265 (ASTM test designation D-2216). Briefly, natural moisture content is determined by weighing a sample of the selected material and then drying it in a warm oven. Care is taken to use a gentle heat so as not to destroy any organics. The sample is removed from the oven and reweighed. The difference between the two weights is the amount of moisture removed from the sample. The weight of the moisture divided by the weight of the dry soil sample is the percentage by weight of the moisture in the sample.

Percent passing the -200 Sieve and Full Gradation

The wash gradation test measures the percentage of a dry soil sample passing the No. 200 sieve. By definition in the Unified Soil Classification System, the percentage by weight passing the No. 200 sieve is the silt and clay content. The amount of silt and clay in a soil influences it properties, including permeability, workability and suitability as fill. This test was performed in general accordance with ASTM D-1140 (Standard Test Methods for Amount of Material Finer Than the No. 200 (75 μm) Sieve).

After washing the sample over the No. 200 sieve the residual soils retained are dried and passed through a series of varying sized screens to provide a breakdown of the soil grain sizes. The test was performed in general accordance with ASTM D-422 (Particle Size Analysis for Soils). Grain size graphs are presented in the **Appendix**.

Organic Content

The laboratory organic content test consists of drying the soil sample, then heating it in a small furnace to a minimum temperature of 400 degrees Centigrade for 6 hours. The high heat burns off all organic material, leaving only the soil minerals. The difference in the weight prior to and after the burning is the weight of the organics. The weight of the organics divided by the weight of the dried soil is the percentage of the organics within a sample. The organic content testing procedure were conducted in general accordance with the FDOT test designation 1-T267 (ASTM 2974 (Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils)).

SUBSURFACE CONDITIONS

Subsurface Conditions

The following subsurface description is of a generalized nature, provided to highlight the major soil strata encountered. The auger boring profiles included in our report should be reviewed for specific information at individual test locations. The stratifications shown on the boring profiles represent the conditions only at the actual test locations. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual. Variations may occur and should be expected between test locations.

In general, the subsurface conditions encountered below the grassed area between the curbs and the sidewalk consisted of an approximate 4 inch layer of grass sod and topsoil over slightly silty to silty fine sands (SP-SM, SM) to depths varying from 3.5 to 5 feet. The upper slightly silty to silty sand was underlain by relatively clean fine sands (SP, SP-SM) to the termination depth of the borings at 10 feet.

Groundwater Information

During the performance of our drilling on December 19, 2014, groundwater was encountered at a depth of 1.0 foot below the existing ground surface. The water table can be expected to vary at times and will fluctuate seasonally based on rainfall quantities, area geology, surface drainage conditions and other factors. At the time of drilling standing water was observed in many places along the roadway and curbs along S. Edison Avenue.

EVALUATION AND RECOMMENDATIONS

The borings indicated two predominant soil layers along the area drilled. Generally the upper layer is less permeable than the lower layer. Permeability calculations based on the gradation curves indicate estimated permeability rates in the range of 0.00121 to 0.00196 cm/sec. The soils at 5 feet and below have an estimated permeability of 0.00346 to 0.00676 cm/sec. Also, the upper soils encountered some slightly organic soil zones (up to 4% organics).

Based on the permeability estimates, the soil layering and cone of influence calculations we recommend the underdrain pipe centerline be installed a minimum of 6 feet below the existing sidewalk surface. By placing the drain into the more permeable layer the horizontal influence should be sufficient to draw the groundwater levels down to below the sidewalk and the roadway side of the curbs along Edison Avenue on each side. A typical underdrain cross section and details are presented on Sheet 3 in the Appendix.

The minimum required perforated drainage pipe diameter should be 8 inches based on calculated flows using the highest estimated soil permeability and applying a minimum factor of safety of 2 to account for variations in the soil conditions.

An alternate to the trench installation would be to use horizontal drilling for installation of the underdrain pipe. In discussions with an experienced horizontal well contractor they indicated they could drill about 600 feet horizontally where a structure would be needed. The areas for the drilling pits would be approximately 5 feet square and to the depth of the pipe which in this case would be at 6 feet below the sidewalk surface. Based on the contractor's experience a 6 inch diameter pipe with number 10 slots can be installed. The development process involves introducing air into the pipe and surging the air in the pipe to force the groundwater back and forth so that the natural soils are graded to provide some filtering around the pipe to reduce infiltration of fines into the pipe. The contractor indicates that the process is "messy" and that drilling mud may "frac" out to the ground surface at some locations. A significant quantity of equipment is needed and the equipment will be large and noisy. The cost for installing the horizontally drilled underdrain is estimated to be in the range of $130 to $150 per lineal foot.

We have some concerns with the long term performance of a horizontally drilled underdrain due to the small slot size and the minimum soil filtering produced by the development process. In our opinion, a conventionally trenched underdrain will provide better long term performance than the horizontally drilled underdrain.

A conventional trenched underdrain will require well point dewatering to install the pipe, fabric and No. 57 stone. We recommend a dewatering contractor design, install and maintain the dewatering system for this project.

REPORT LIMITATIONS

The findings detailed herein are based on the available soil and pavement information obtained by **MC^2** and also the information provided by Ms. Barbara Graves, City of Tampa DPW – Stormwater Engineering for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **MC^2** should be notified immediately to determine if changes or other recommendations are required. In the event that **MC^2** is not retained to perform these functions, **MC^2** can not be responsible for the impact of those conditions on the performance of the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the geotechnical engineer should be provided the opportunity to review the final design plans and specifications to assess that our engineering findings have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of the City of Tampa, Florida.

<u>APPENDIX</u>

Summary of Laboratory Test Results – Table 1

Boring Location Plan– Sheet 1

Report of Core Borings – Sheet 2

Underdrain Cross Section and Details – Sheet 3

Summary of Hydraulic Conductivity (K) Values - Table 2

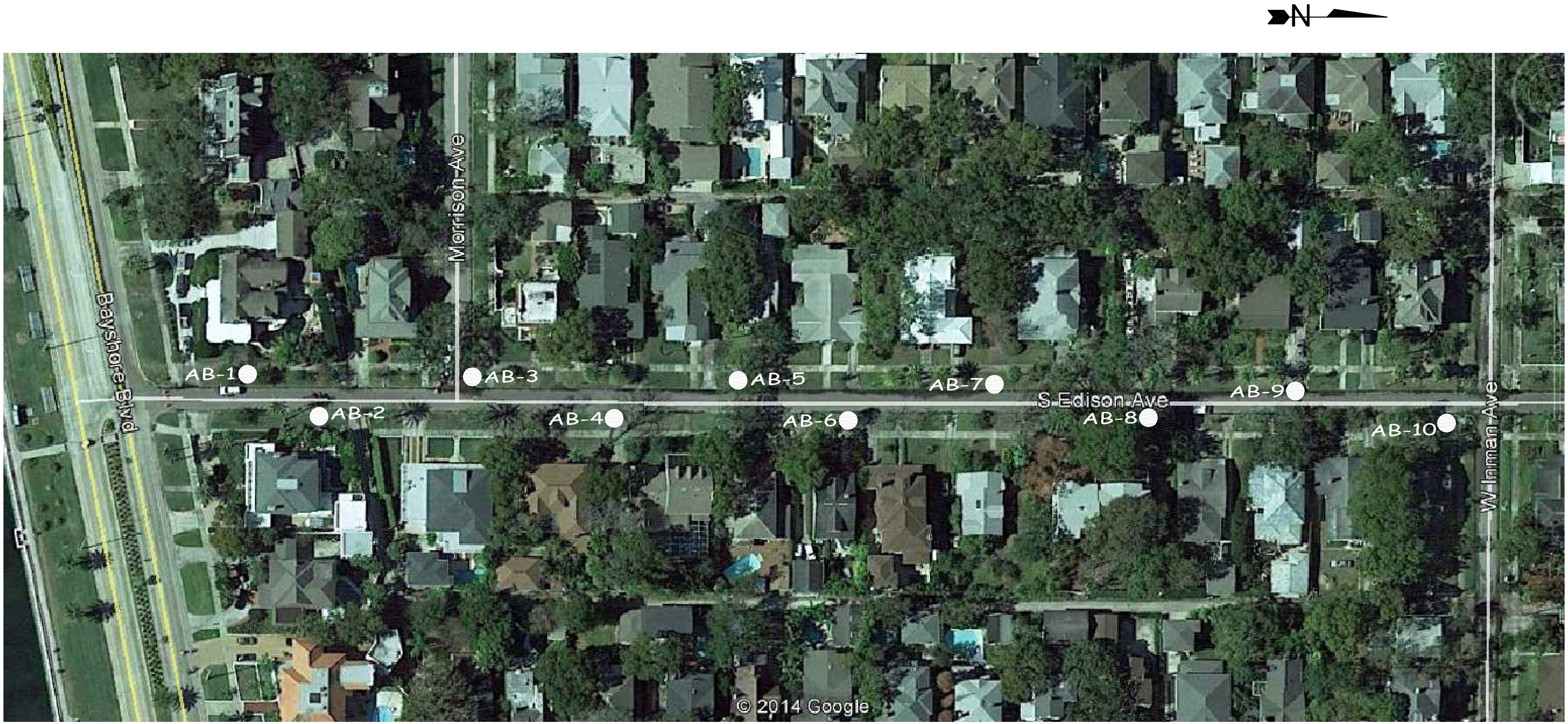
Grain Size Graphs

Test Procedures

Table 1
Summary of Laboratory Test Results
S. Edison Avenue Drainage Improvements
City of Tampa, Florida
MC² Inc. Project No. T111413.258

Boring No.	Depth (ft)	USCS Classi.	Sieve Analysis (% Passing)							Liquid Limit (%)	Plastic Index (%)	Organic Content (%)	Natural Moisture Content (%)
			#10	#20	#40	#60	#100	#140	#200				
S. Edison Avenue from Bayshore Blvd. to W. Inman Avenue													
AB-1	3.5 – 5.0	SM	99	98	97	93	80	44	31			3	54
AB-2	3.5 – 5.0	SM	100	100	99	93	68	25	16				26
AB-2	5.0 – 10.0	SP	100	100	98	92	57	11	3				31
AB-3	3.0 – 5.0	SM	100	99	99	95	73	33	21			3	38
AB-3	5.0 – 10.0	SP	100	100	99	92	59	12	4				22
AB-4	5.0 – 10.0	SP	100	98	92	60	15	7	5				29
AB-5	3.0 – 5.0	SP	100	100	99	92	61	15	4			1	29
AB-6	2.0 – 5.0	SM	99	98	97	90	63	28	15			4	41
AB-7	2.0 – 4.0	SM	100	99	99	93	64	27	14				37
AB-7	5.0 – 10.0	SP	100	100	99	92	59	15	4				30

Table 1 Summary of Laboratory Test Results S. Edison Avenue Drainage Improvements City of Tampa, Florida MC² Inc. Project No. T111413.258														
Boring No.	Depth (ft)	USCS Classi.	Sieve Analysis (% Passing)							Liquid Limit (%)	Plastic Index (%)	Organic Content (%)	Natural Moisture Content (%)
			#10	#20	#40	#60	#100	#140	#200				
AB-8	4.0 – 5.0	SM	100	100	99	94	69	27	15			2	35
AB-8	5.0 – 10.0	SP	100	100	99	92	60	16	4				26
AB-9	4.0 – 5.0	SP	99	99	97	89	58	15	4				25
AB-10	5.0 – 10.0	SP-SM	100	100	99	93	64	19	7				28



NOT TO SCALE

LEGEND

● POWER AUGER BORING

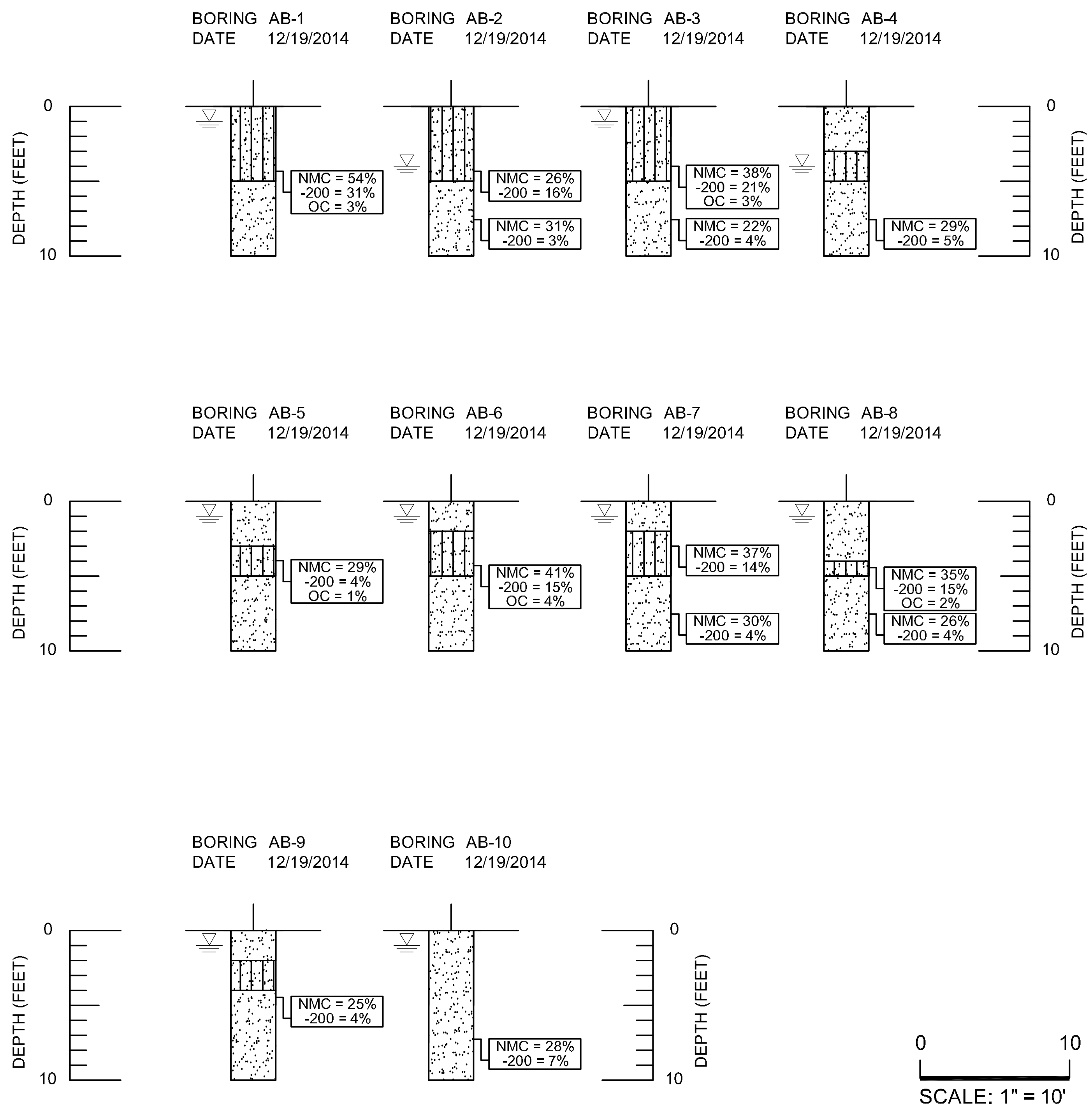
DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
5808 Breckenridge Parkway, Suite-A
Tampa, Florida 33610
Ph:813-623-3399 Fax:813-623-6636
GEOTECHNICAL • ENVIRONMENTAL MATERIALS TESTING

FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 9191
WILLIAM P. ROVIRA IV, P.E.
FLORIDA LICENSE No. 74586

	NAME	DATE
DESIGNED BY:	IR	01/15
DRAWN BY:	IR	01/15
CHECKED BY:	RN	01/15
SUPERVISED BY:		

BORING LOCATION PLAN	PROJECT NO.	SHEET NO.
S. Edison Avenue (Phase 1) Roadway Improvements City Of Tampa, Florida	T111413.258	1



GRANULAR MATERIALS- RELATIVE DENSITY	SPT (BLOWS/FT)
VERY LOOSE	LESS THAN 4
LOOSE	5-10
MEDIUM	11-30
DENSE	31-50
VERY DENSE	GREATER THAN 50

SILTS AND CLAYS CONSISTENCY	SPT (BLOWS/FT)
VERY SOFT	LESS THAN 2
SOFT	3-4
FIRM	5-8
STIFF	9-15
VERY STIFF	16-30
HARD	30-50
VERY HARD	GREATER THAN 50

LEGEND

ASPHALT AND/OR BASE MATERIAL.

(SP/SP-SM) BROWN OR GRAY FINE SAND TO SLIGHTLY SILTY FINE SAND.

(SM) DARK GRAY SLIGHTLY ORGANIC SILTY FINE SAND.

NOTES:

A WITH TRACES OF SHELL

WATER TABLE

N SPT N VALUE

-200 FINES PASSING NO. 200 SIEVE (%)

NMC NATURAL MOISTURE CONTENT (%)

OC ORGANIC CONTENT (%)

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
5808 Breckenridge Parkway, Suite-A
Tampa, Florida 33610
Ph:813-623-3399 Fax:813-623-6636
GEOTECHNICAL • ENVIRONMENTAL MATERIALS TESTING

FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 9191
WILLIAM P. ROVIRA IV, P.E.
FLORIDA LICENSE No. 74586

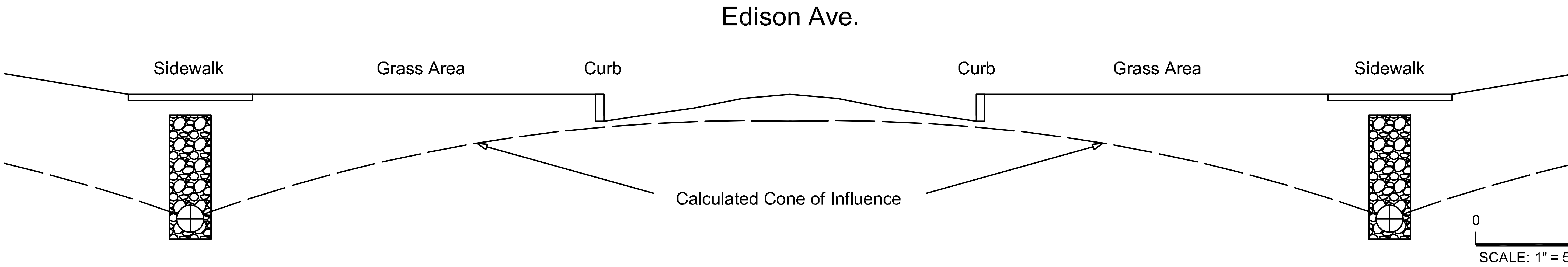
	NAME	DATE
DESIGNED BY:	IR	01/15
DRAWN BY:	IR	01/15
CHECKED BY:	RN	01/15
SUPERVISED BY:		

REPORT OF CORE BORINGS

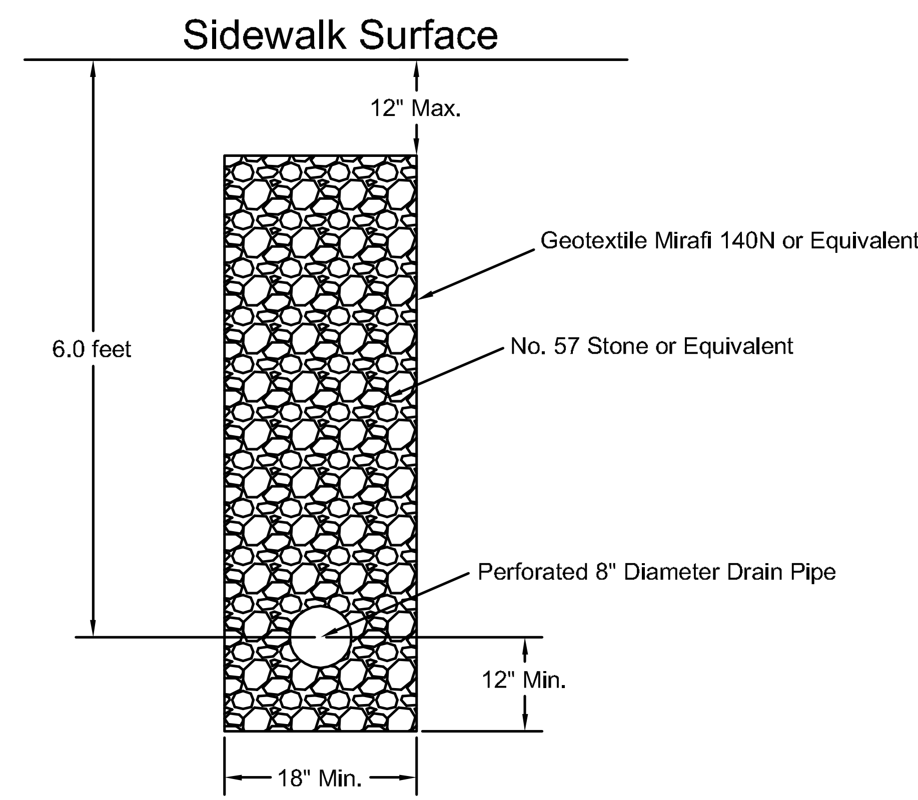
S. Edison Avenue (Phase 1)
Roadway Improvements
City Of Tampa, Florida

PROJECT NO. T111413.258

SHEET NO. 2



Underdrain Cross Section



Underdrain Details

Notes:

1. Underdrain Clean Outs should be located no further than 10 feet apart

0 2
SCALE: 1" = 2'

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
5808 Breckenridge Parkway, Suite-A
Tampa, Florida 33610
Ph:813-623-3399 Fax:813-623-6636
GEOTECHNICAL • ENVIRONMENTAL MATERIALS TESTING

FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 9191
WILLIAM P. ROVIRA IV, P.E.
FLORIDA LICENSE No. 74586

	NAME	DATE
DESIGNED BY:	IR	01/15
DRAWN BY:	IR	01/15
CHECKED BY:	RN	01/15
SUPERVISED BY:		

Underdrain Cross Section and Details	PROJECT NO.	SHEET NO.
S. Edison Avenue (Phase 1) Roadway Improvements City Of Tampa, Florida	T111413.258	3

Table 2
Summary of Hydraulic Conductivity (K) Values
S. Edison Avenue Drainage Improvements
City of Tampa, Florida
MC2 Inc. Project No. T111413.258

Boring Number	Depth (ft)	K (cm/s)
AB-2	3.5 – 5	1.21e-3
AB-2	5 – 10	6.76e-3
AB-3	5 – 10	4.84e-3
AB-4	5 – 10	7.84e-3
AB-5	3 – 5	4.00e-3
AB-6	2 – 5	1.48e-3
AB-7	2 – 4	1.96e-3
AB-7	5 – 10	4.00e-3
AB-8	4 – 5	1.53e-3
AB-8	5 – 10	3.46e-3
AB-9	4 – 5	4.00e-3
AB-10	5 – 10	2.89e-3

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

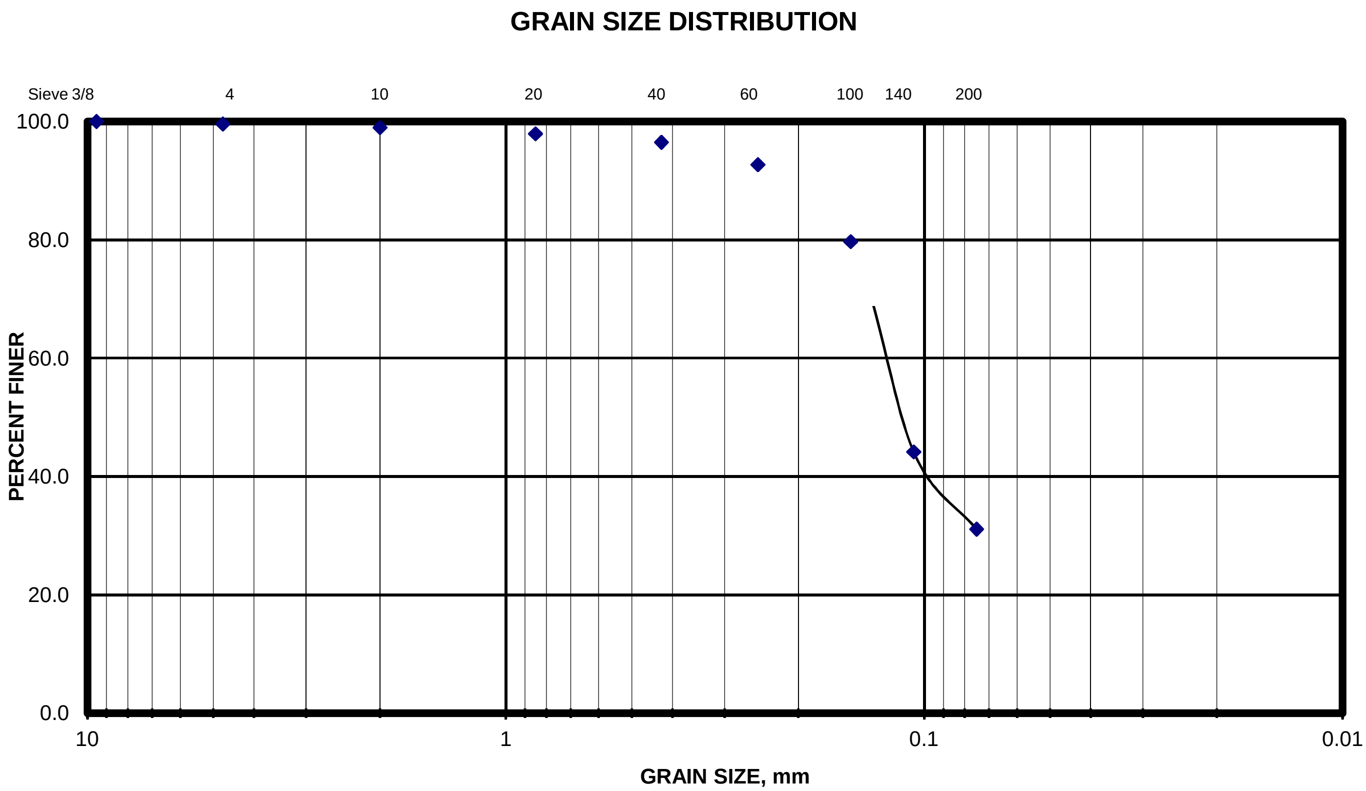
Project: Edison Ave.

Sample Location: AB-1, 3.5'-5'

Soil Description: 0

Soil Classification: SM LL PI

NMC % 53.9 Organic Content % 3.3



% Gravel	% Sand	%-200
0.4	68.5	31.1

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

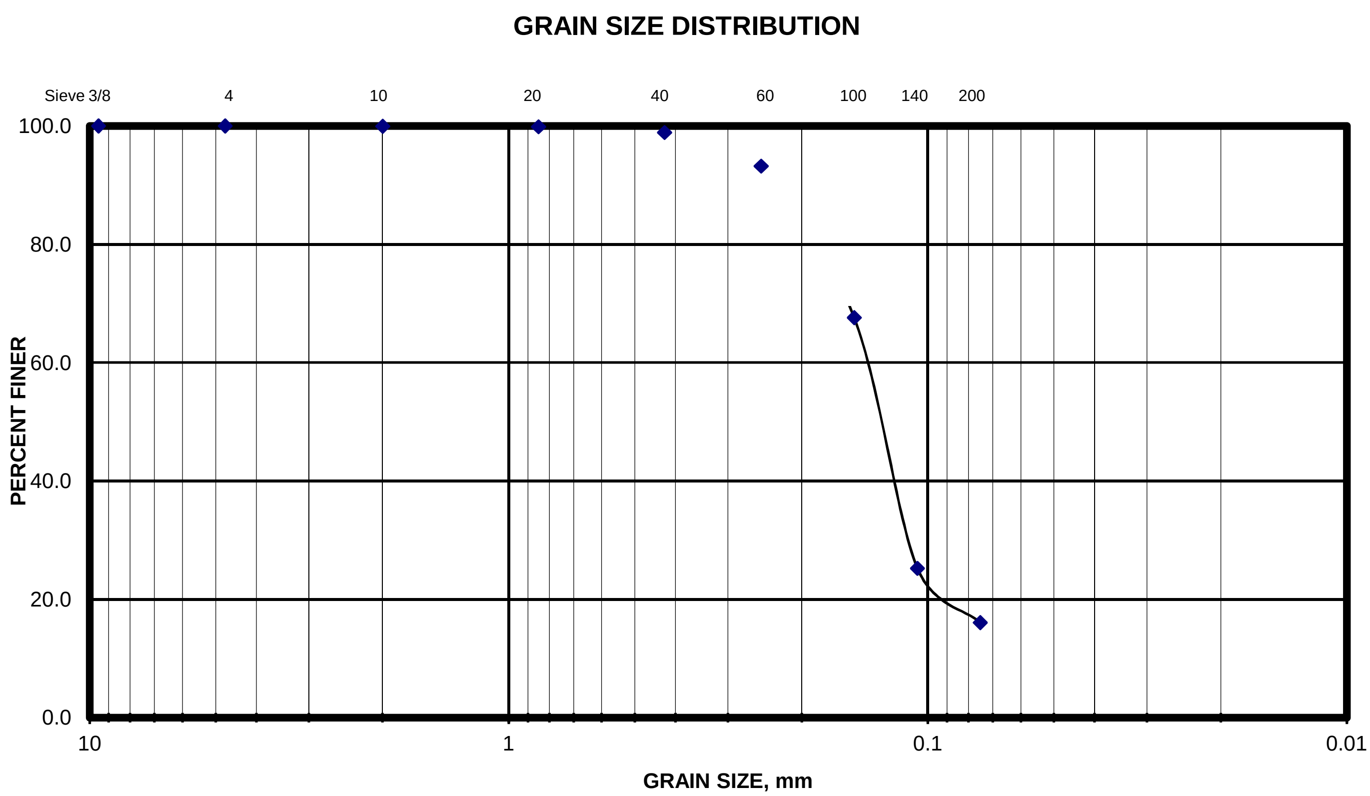
Project: Edison Ave.

Sample Location: AB-2, 3.5'-5'

Soil Description:

Soil Classification: SM LL PI

NMC % 25.8



% Gravel	% Sand	%-200
0.0	83.9	16.1

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

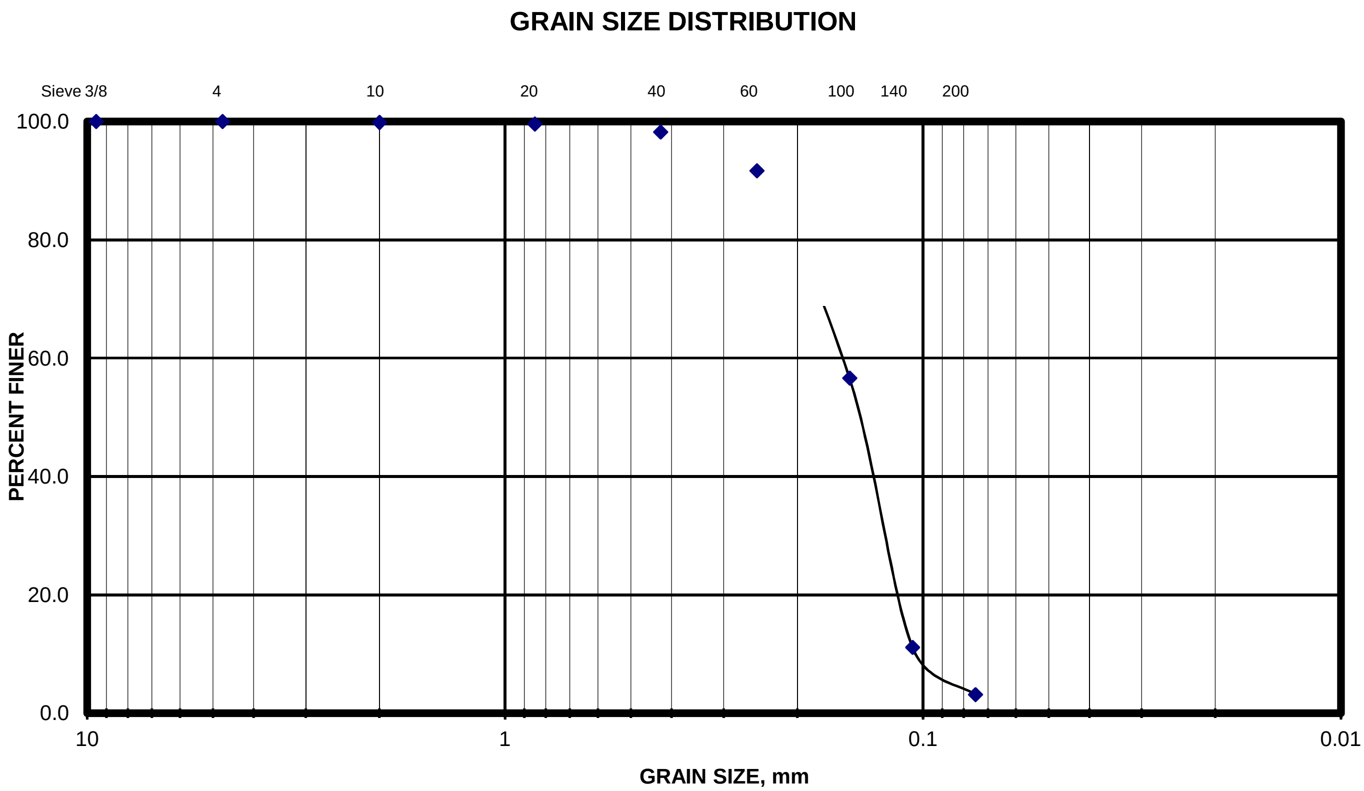
Project: Edison Ave.

Sample Location: AB-2,5'-10'

Soil Description:

Soil Classification: SP LL PI

NMC % 30.6



% Gravel		% Sand		%-200
0.0		96.8		3.2
D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

Project: Edison Ave.

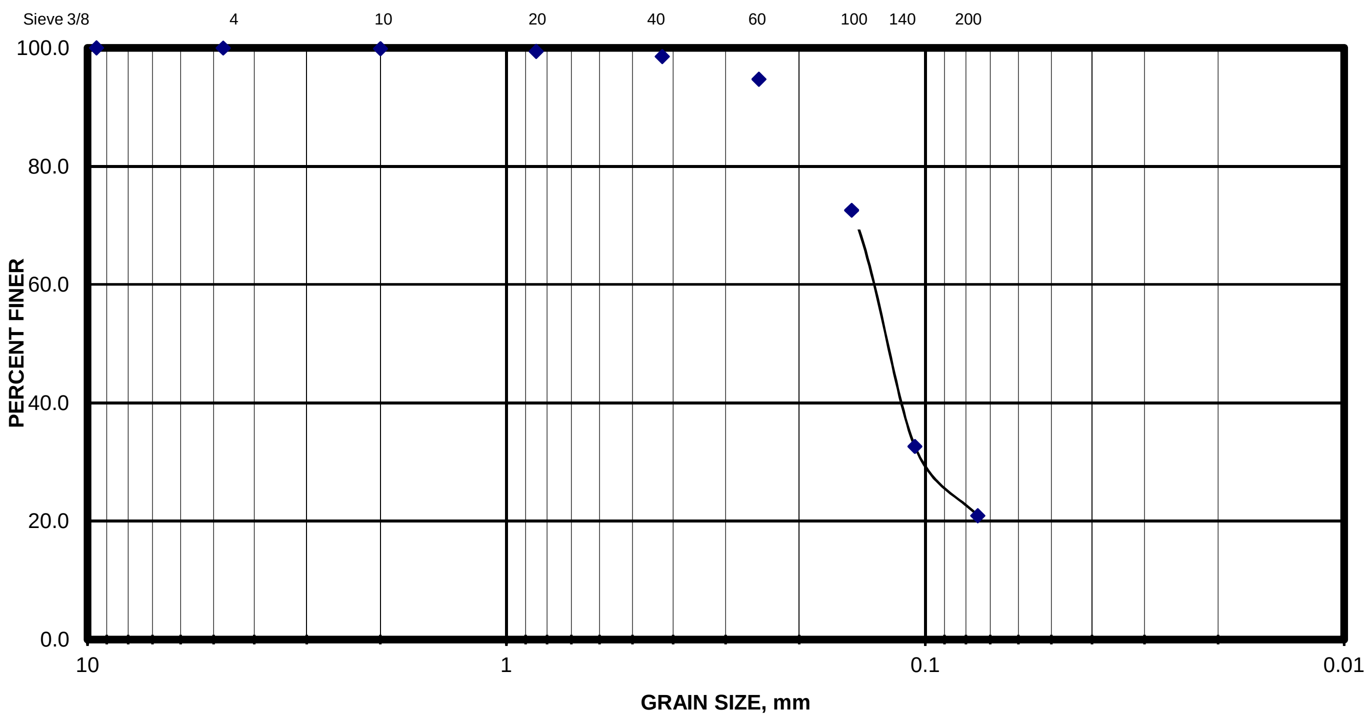
Sample Location: AB-3, 3'-5'

Soil Description:

Soil Classification: SM LL PI

NMC % 37.5 Organic Content % 3.0

GRAIN SIZE DISTRIBUTION



% Gravel	% Sand	%-200
0.0	79.0	20.9

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

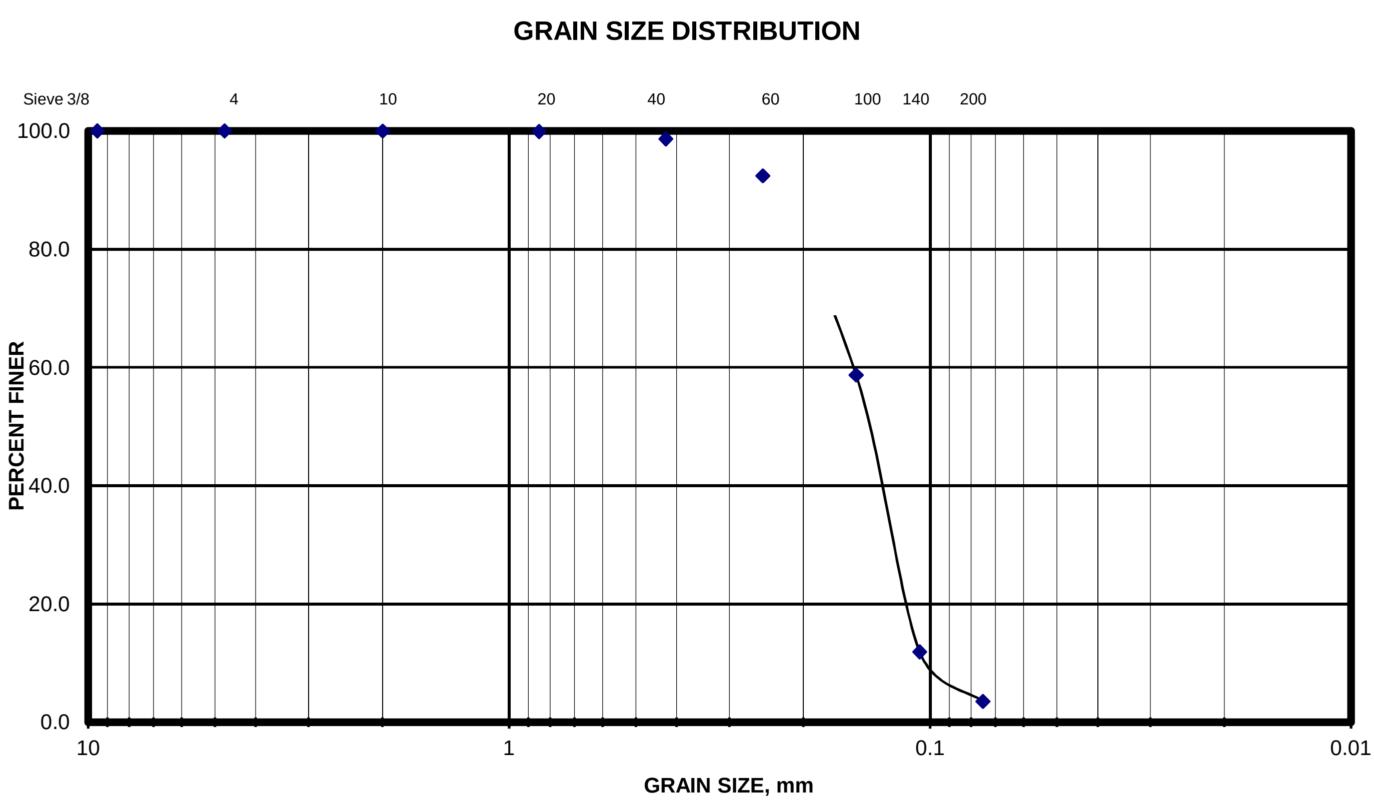
Project: Edison Ave.

Sample Location: AB-3, 5'-10'

Soil Description:

Soil Classification: SP LL PI

NMC % 22.2



% Gravel	% Sand	%-200
0.0	96.5	3.5

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

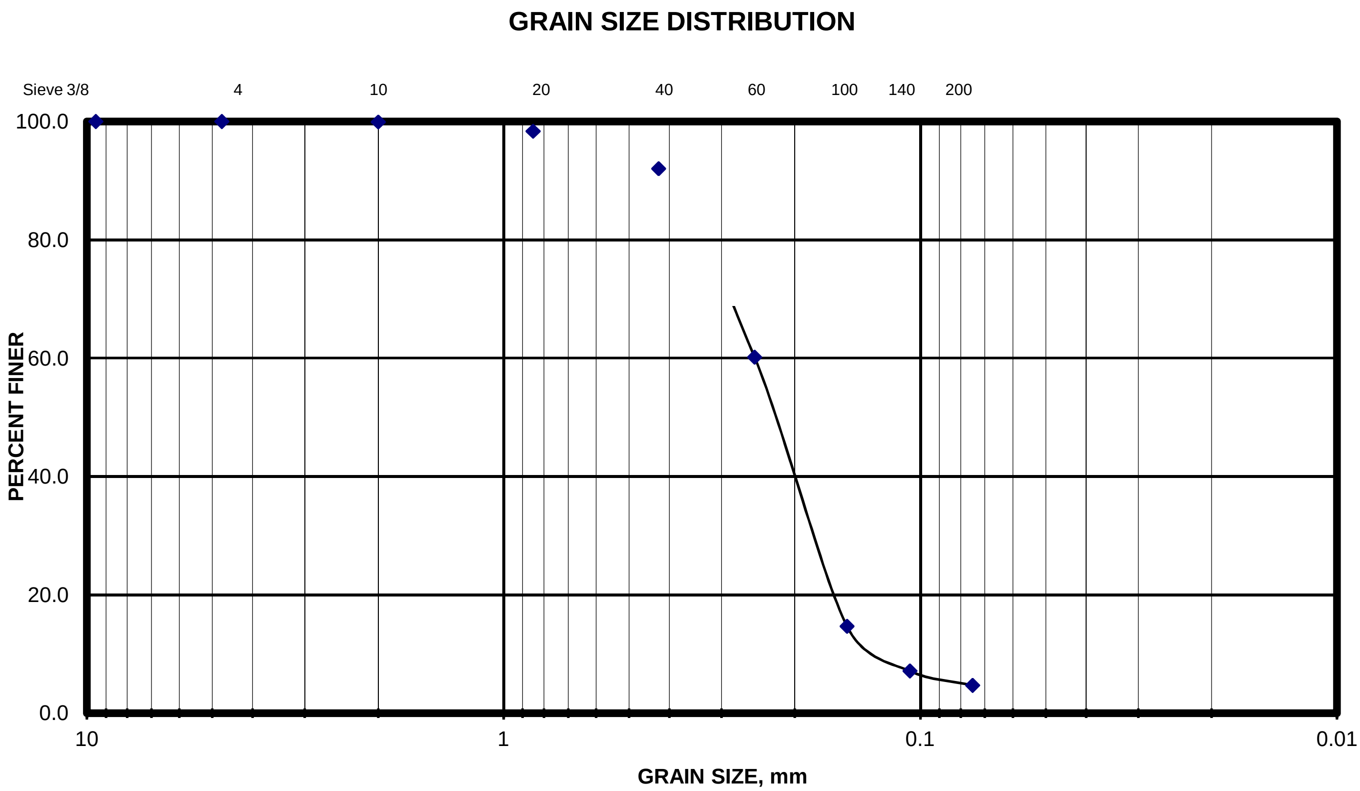
Project: Edison Ave.

Sample Location: AB-4, 5'-10'

Soil Description:

Soil Classification: SP LL PI

NMC % 29.2



% Gravel	% Sand	%-200
0.0	95.3	4.7

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

Project: Edison Ave.

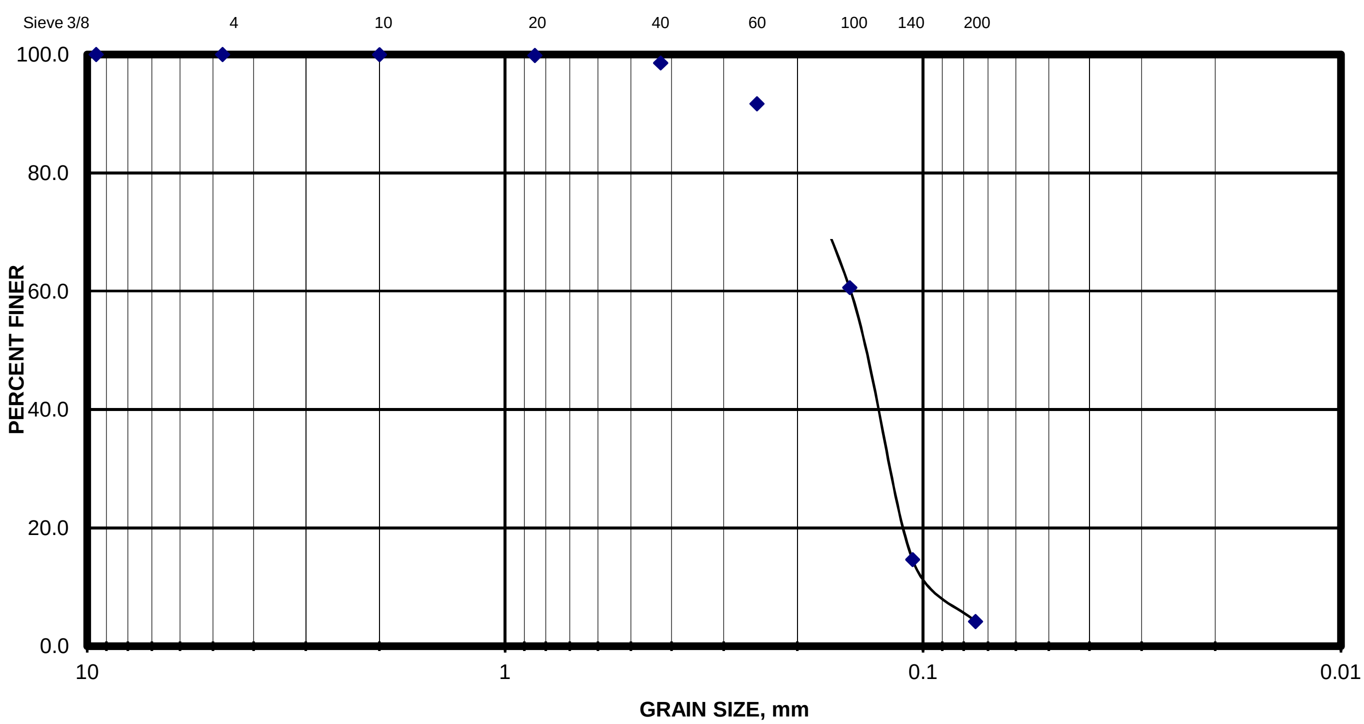
Sample Location: AB-5, 3'-5'

Soil Description:

Soil Classification: SP LL PI

NMC % 29.0 Organic Content % 0.9

GRAIN SIZE DISTRIBUTION



% Gravel	% Sand	%-200
0.0	95.8	4.2

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

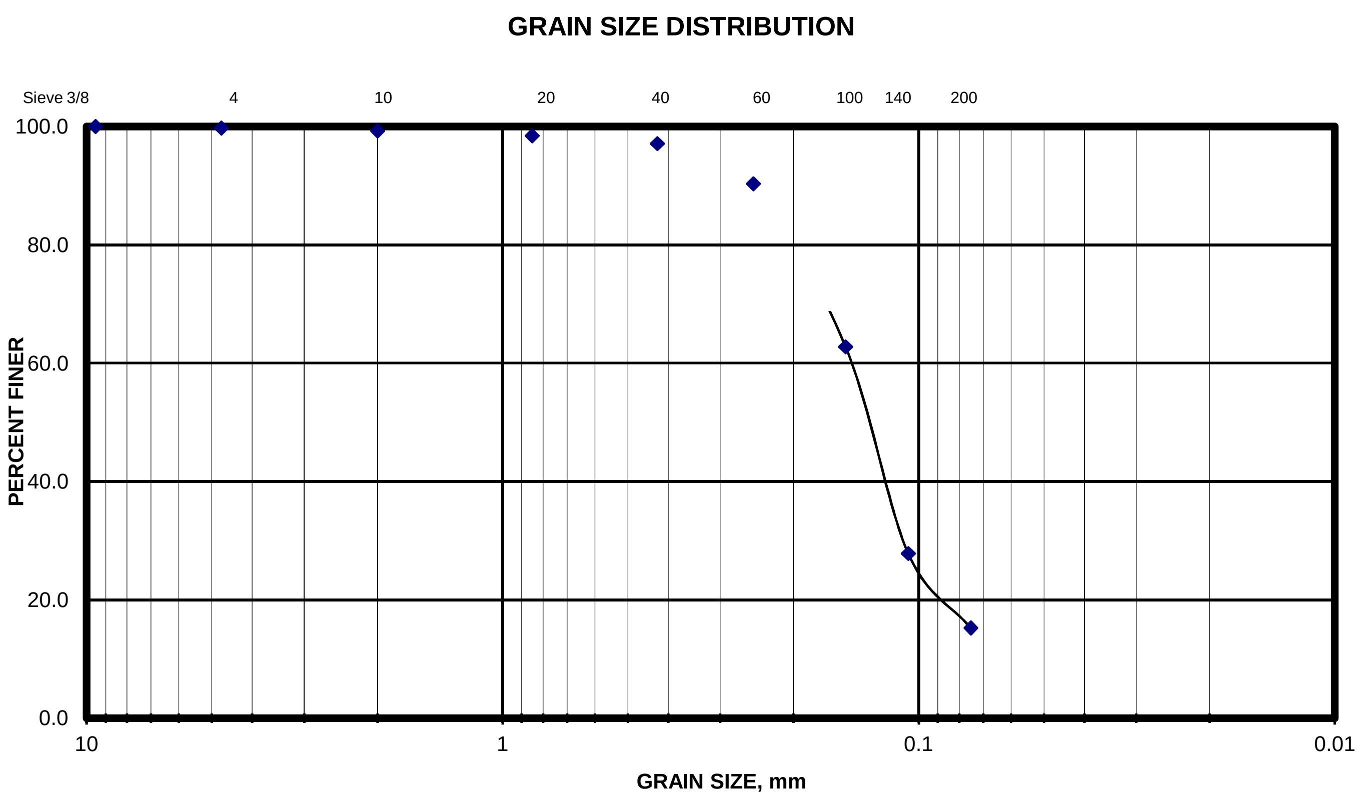
Project: Edison Ave.

Sample Location: AB-6, 2'-5'

Soil Description: 0

Soil Classification: SM LL PI

NMC % 41.2 Organic Content % 3.6



% Gravel	% Sand	%-200
0.3	84.5	15.3

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

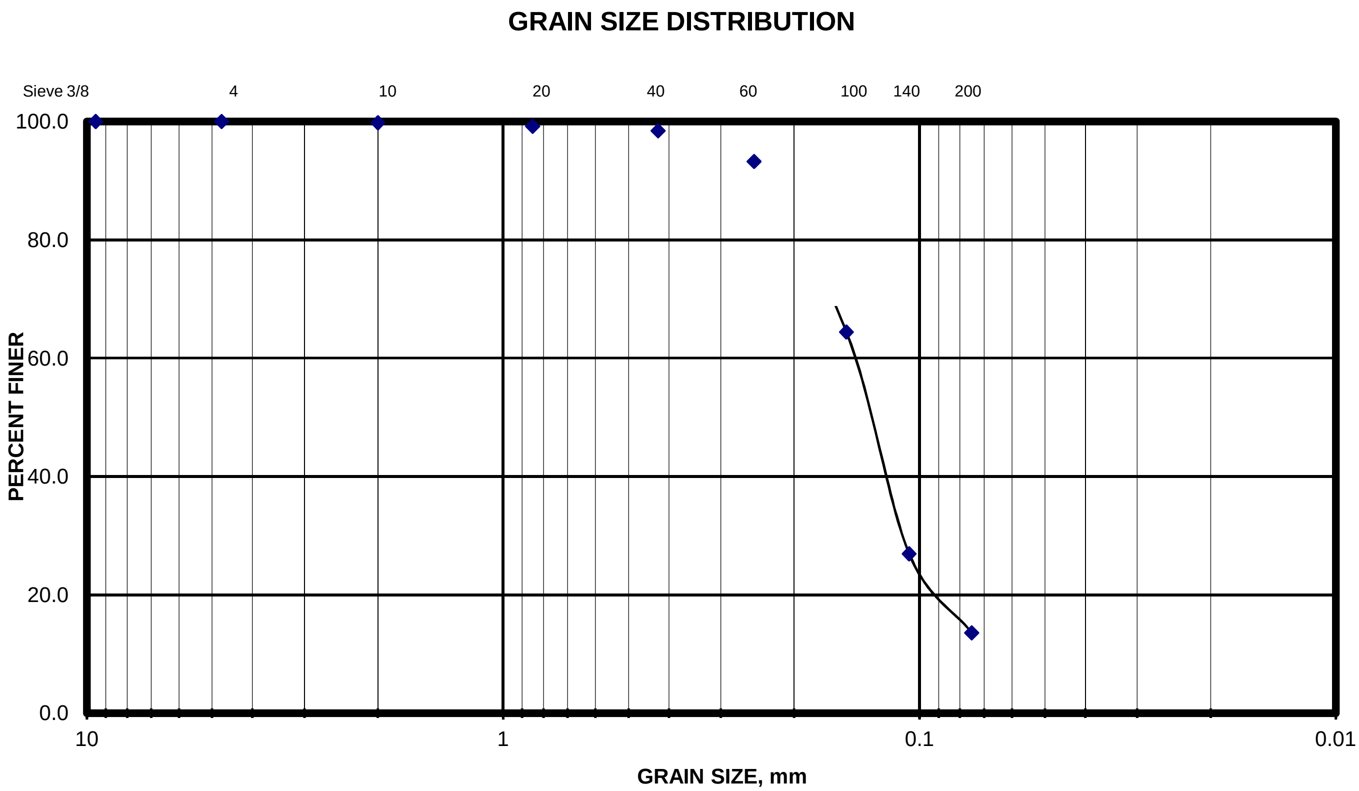
Project: Edison Ave.

Sample Location: AB-7, 2'-4'

Soil Description:

Soil Classification: SM LL PI

NMC % 37.2



% Gravel	% Sand	%-200
0.0	86.4	13.6

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

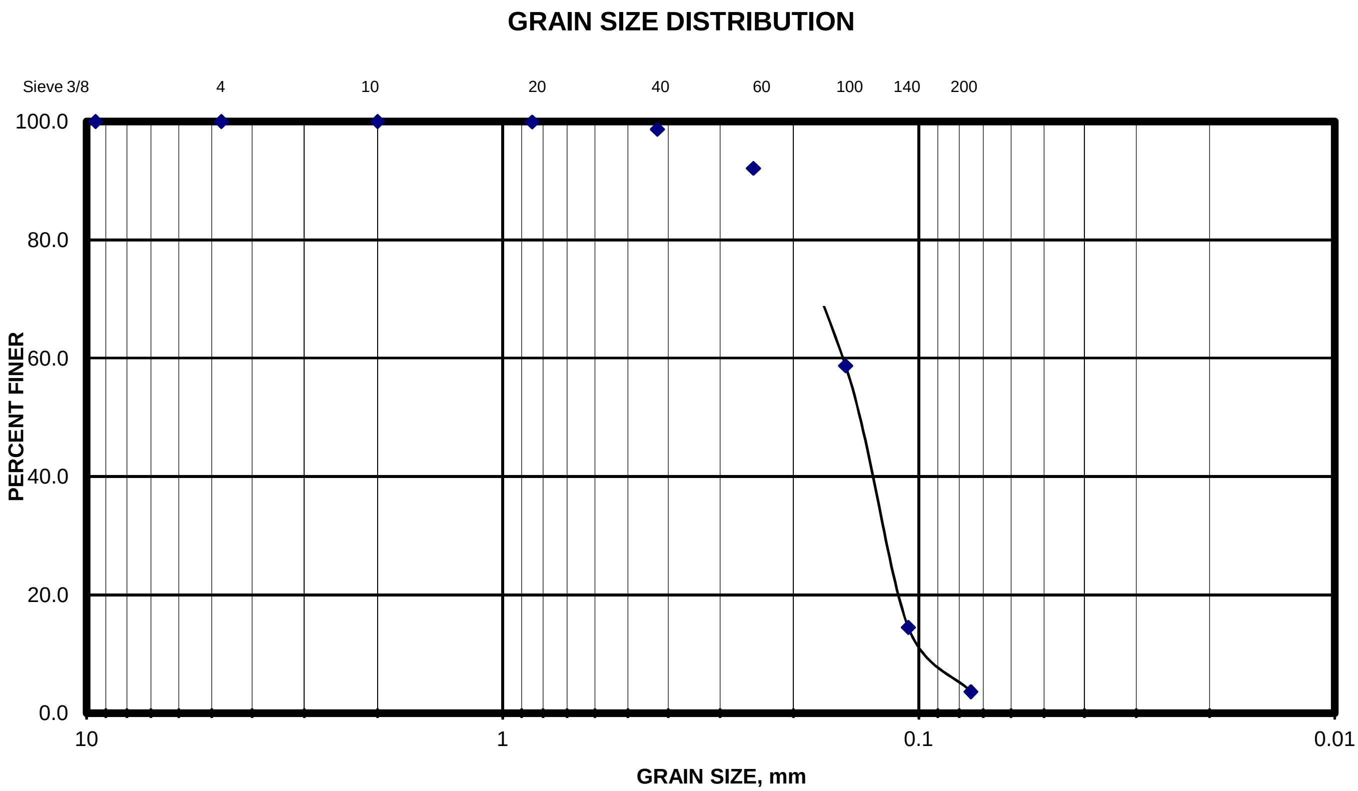
Project: Edison Ave.

Sample Location: AB-7, 5'-10'

Soil Description:

Soil Classification: SP LL PI

NMC % 29.8



% Gravel	% Sand	%-200
0.0	96.3	3.7

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

Project: Edison Ave.

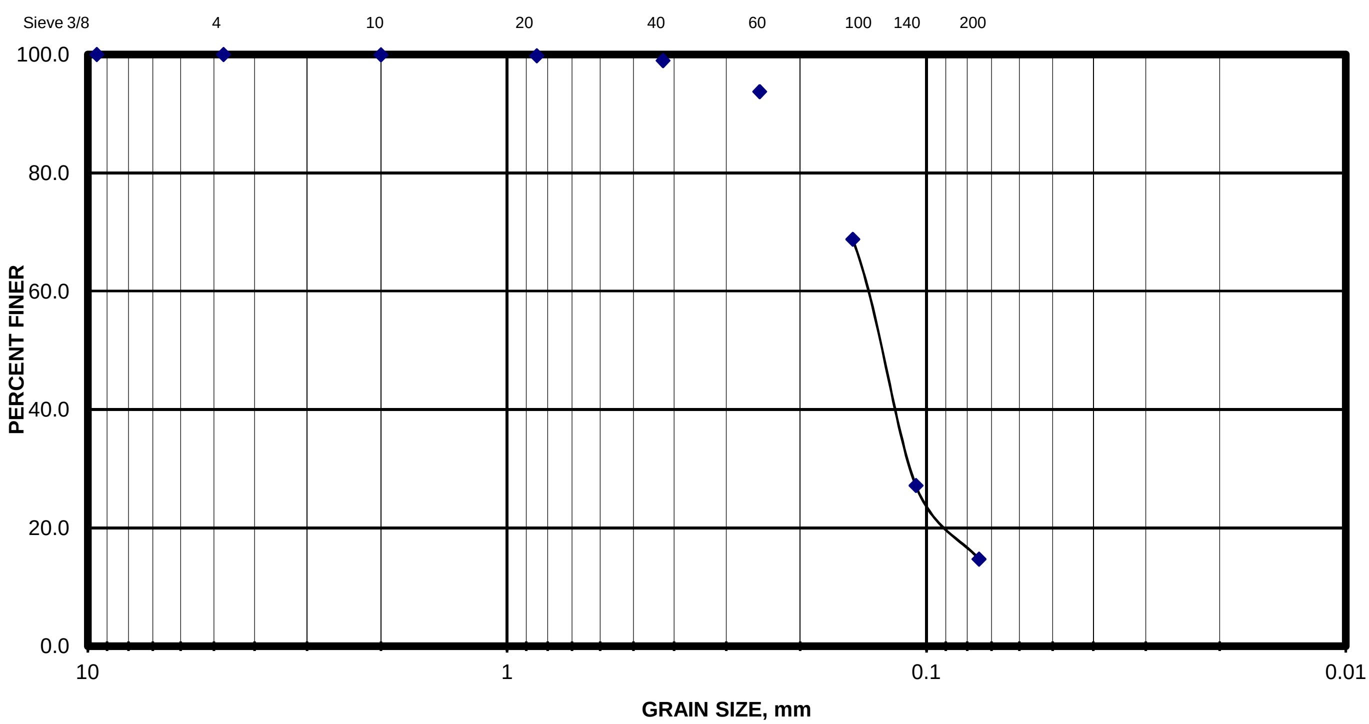
Sample Location: AB-8, 4'-5'

Soil Description:

Soil Classification: SM LL PI

NMC % 35.1 Organic Content % 2.0

GRAIN SIZE DISTRIBUTION



% Gravel	% Sand	%-200
0.0	85.3	14.7

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

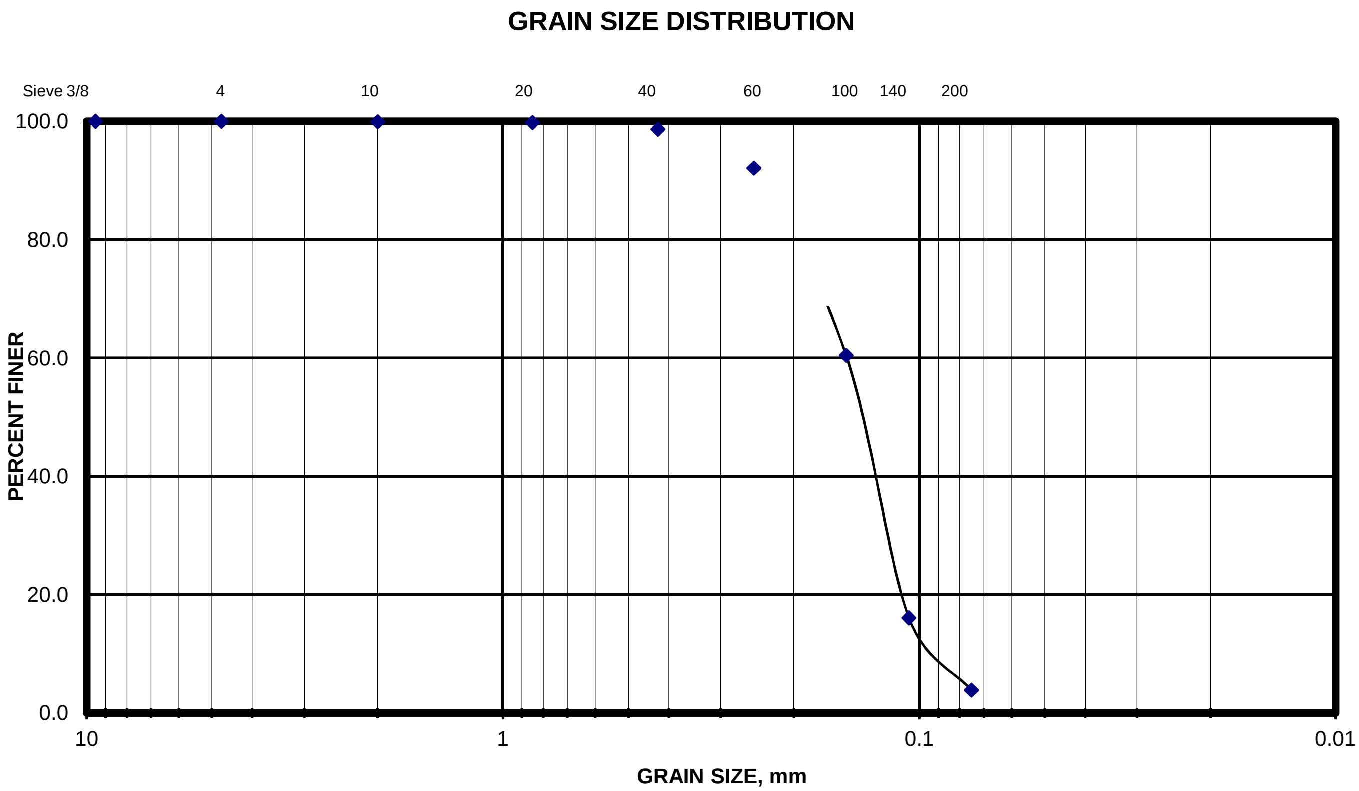
Project: Edison Ave.

Sample Location: AB-8, 5'-10'

Soil Description:

Soil Classification: SP LL PI

NMC % 26.2



% Gravel	% Sand	%-200
0.0	96.1	3.9

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

Project: Edison Ave.

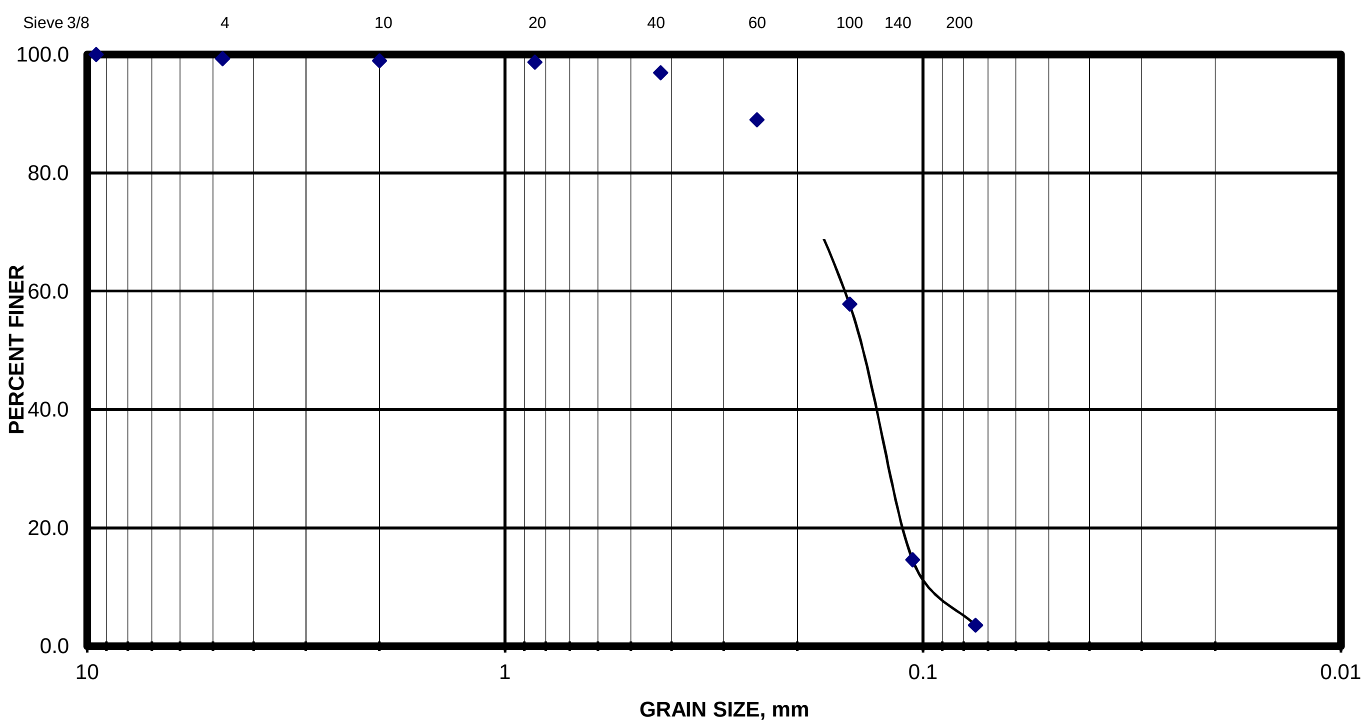
Sample Location: AB-9, 4'-5'

Soil Description:

Soil Classification: SP LL PI

NMC % 25.2

GRAIN SIZE DISTRIBUTION



% Gravel	% Sand	%-200
0.7	95.8	3.6

D60	D30	D10	CC	CU

GRAIN SIZE DISTRIBUTION TEST REPORT

MC SQUARED, INC.

Project No. T111413.258 Date: 12/24/2014

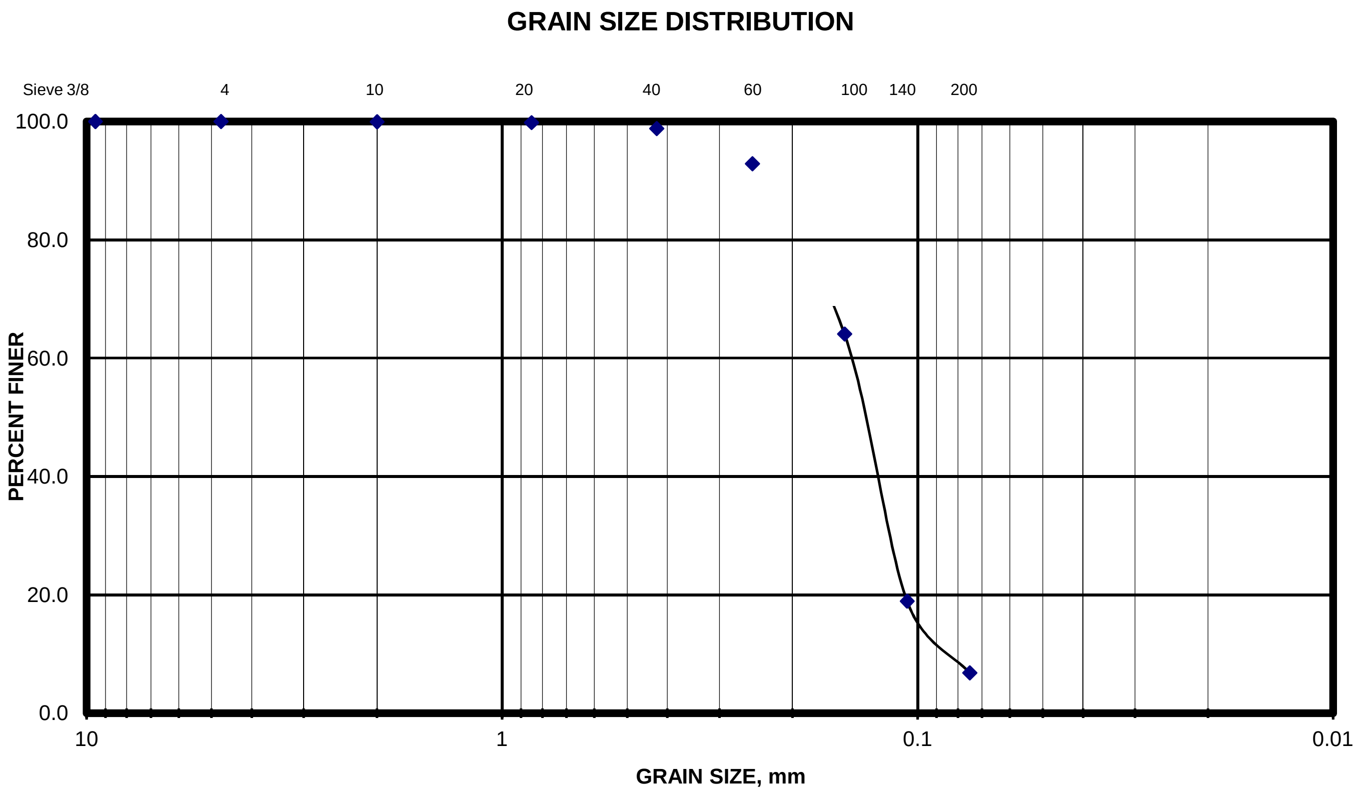
Project: Edison Ave.

Sample Location: AB-10, 5'-10'

Soil Description:

Soil Classification: SP-SM LL PI

NMC % 28.2



% Gravel	% Sand	%-200
0.0	93.2	6.8

D60	D30	D10	CC	CU

TEST PROCEDURES

The general field procedures employed by MC Squared, Inc. (**MC²**) are summarized in the American Society for Testing and Materials (ASTM) Standard D420 which is entitled "Investigating and Sampling Soil and Rock". This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in-situ methods as well as borings.

Standard Drilling Techniques

To obtain subsurface samples, borings are drilled using one of several alternate techniques depending upon the subsurface conditions. Some of these techniques are:

In Soils:

a) Continuous hollow stem augers.
b) Rotary borings using roller cone bits or drag bits, and water or drilling mud to flush the hole.
c) "Hand" augers.

In Rock:

a) Core drilling with diamond-faced, double or triple tube core barrels.
b) Core boring with roller cone bits.

The drilling method used during this exploration is presented in the following paragraph.

Hollow Stem Augering: A hollow stem augers consists of a hollow steel tube with a continuous exterior spiral flange termed a flight. The auger is turned into the ground, returning the cuttings along the flights. The hollow center permits a variety of sampling and testing tools to be used without removing the auger.

Core Drilling: Soil drilling methods are not normally capable of penetrating through hard cemented soil, weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound, continuous rock. Material which cannot be penetrated by auger or rotary soil-drilling methods at a reasonable rate is designated as “refusal material”. Core drilling procedures are required to penetrate and sample refusal materials.

Prior to coring, casing may be set in the drilled hole through the overburden soils, to keep the hole from caving and to prevent excessive water loss. The refusal materials are then cored according to ASTM D-2113 using a diamond-studded bit fastened to the end of a hollow, double or triple tube core barrel. This device is rotated at high speeds, and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run, the core barrel is brought to the surface, the core recovery is measured, and the core is placed, in sequence, in boxes for storage and transported to our laboratory.

Sampling and Testing in Boreholes

Several techniques are used to obtain samples and data in soils in the field; however the most common methods in this area are:

a) Standard Penetration Testing

b) Undisturbed Sampling
c) Dynamic Cone Penetrometer Testing
d) Water Level Readings

The procedures utilized for this project are presented below.

Standard Penetration Testing: At regular intervals, the drilling tools are removed and soil samples obtained with a standard 2 inch diameter split tube sampler connected to an A or N-size rod. The sampler is first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140 pound safety hammer falling 30 inches. Generally, the number of hammer blows required to drive the sampler the final 12 inches is designated the "penetration resistance" or "N" value, in blows per foot (bpf). The split barrel sampler is designed to retain the soil penetrated, so that it may be returned to the surface for observation. Representative portions of the soil samples obtained from each split barrel sample are placed in jars, sealed and transported to our laboratory.

The standard penetration test, when properly evaluated, provides an indication of the soil strength and compressibility. The tests are conducted according to ASTM Standard D1586. The depths and N-values of standard penetration tests are shown on the Boring Logs. Split barrel samples are suitable for visual observation and classification tests but are not sufficiently intact for quantitative laboratory testing.

Water Level Readings: Water level readings are normally taken in the borings and are recorded on the Boring Records. In sandy soils, these readings indicate the approximate location of the hydrostatic water level at the time of our field exploration. In clayey soils, the rate of water seepage into the borings is low and it is generally not possible to establish the location of the hydrostatic water level through short-term water level readings. Also, fluctuation in the water level should be expected with variations in precipitation, surface run-off, evaporation, and other factors. For long-term monitoring of water levels, it is necessary to install piezometers.

The water levels reported on the Boring Logs are determined by field crews immediately after the drilling tools are removed, and several hours after the borings are completed, if possible. The time lag is intended to permit stabilization of the groundwater level that may have been disrupted by the drilling operation.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the cave-in zone.

BORING LOGS

The subsurface conditions encountered during drilling are reported on a field boring log prepared by the Driller. The log contains information concerning the boring method, samples attempted and recovered, indications of the presence of coarse gravel, cobbles, etc., and observations of groundwater. It also contains the driller's interpretation of the soil conditions between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are kept on file in our office.

After the drilling is completed a geotechnical professional classifies the soil samples and prepares the final Boring Logs, which are the basis for our evaluations and recommendations.

SOIL CLASSIFICATION

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our Boring Logs.

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary; grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties are presented in this report.

The following table presents criteria that are typically utilized in the classification and description of soil and rock samples for preparation of the Boring Logs.

Relative Density of Cohesionless Soils From Standard Penetration Test		Consistency of Cohesive Soils	
Very Loose	≤ 4 bpf	Very Soft	≤ 2 bpf
Loose	5 - 10 bpf	Soft	3 - 4 bpf
Medium Dense	11 - 30 bpf	Firm	5 - 8 bpf
Dense	31 - 50 bpf	Stiff	9 - 15 bpf
Very Dense	> 50 bpf	Very Stiff	16 - 30 bpf
		Hard	30 – 50 bpf
(bpf = blows per foot, ASTM D 1586)		Very Hard	> 50 bpf

Relative Hardness of Rock		Particle Size Identification	
Very Soft	Hard Rock disintegrates or easily compresses to touch; can be hard to very hard soil.	Boulders	Larger than 12"
		Cobbles	3" - 12"
Soft	May be broken with fingers.	Gravel	
		Coarse	3/4" - 3"
Moderately Soft	May be scratched with a nail, corners and edges may be broken with fingers.	Fine	4.76mm - 3/4"
		Sand	
		Coarse	2.0 - 4.76 mm
Moderately Hard	Light blow of hammer required to break samples.	Medium	0.42 - 2.00 mm
		Fine	0.42 - 0.074 mm
Hard	Hard blow of hammer required to break sample.	Fines (Silt or Clay)	Smaller than 0.074 mm

Rock Continuity		Relative Quality of Rocks	
RECOVERY = $\frac{\text{Total Length of Core}}{\text{Length of Core Run}}$ x 100 %		**RQD** = $\frac{\text{Total core, counting only pieces > 4" long}}{\text{Length of Core Run}}$ x 100 %	
Description	Core Recovery %	Description	RQD %
Incompetent	Less than 40	Very Poor	0 - 25 %
Competent	40 - 70	Poor	25 - 50 %
Fairly Continuous	71 - 90	Fair	50 - 75 %
Continuous	91 - 100	Good	75 - 90 %
		Excellent	90 - 100 %