Ellis & Associates Inc.

Geotechnical ■ Materials Testing ■ Environmental

Integrated Engineering Services since 1970

REPORT OF
GEOTECHNICAL EXPLORATION
107 FIDDLER CRAB LANE
ST. JOHNS COUNTY, FLORIDA
E&A PROJECT NO. 4243-0001

Prepared for:

Dr. John Peterson
1145 5th Street
Los Osos, California 93402

Prepared by:

Ellis & Associates, Inc.
7064 Davis Creek Road
Jacksonville, Florida 32256

November 7, 2013

November 7, 2013

Dr. John Peterson
1145 5th Street
Los Osos, California 93402

Reference: Report of Geotechnical Exploration
107 Fiddler Crab Lane
St. Johns, Florida
E&A Project No. 4243-0001

Dear Dr. Peterson:

Ellis & Associates, Inc. has completed the requested geotechnical exploration in general accordance with our proposal dated October 17, 2013. The exploration was performed to evaluate the general subsurface conditions within the proposed building areas and to provide recommendations for site preparation and foundation support. A summary of our findings and related recommendations is provided below for your convenience; however, this report should be considered in its entirety.

In general the borings encountered very loose to dense fine sand, fine sand with silt, silty fine sand and clayey fine sand and very soft to stiff clay to the boring termination depths of 60 feet below the existing ground surface. It is our opinion that ACIP Piles, properly constructed, can support the proposed structure when embedded into the soil stratum encountered at a depth of approximately 52 feet below existing ground surface. Our estimated allowable compressive capacities for 12 inch, 14 inch, 16, and 18 inch diameter ACIP piles bearing at a depth of 52 feet below the existing ground surface are presented in the report.

We appreciate the opportunity to be your geotechnical consultant on this phase of the project and look forward to providing the materials testing and observation that will be required during the construction phase. If you have any questions, or if we may be of any further service, please contact us.

Very truly yours,

ELLIS & ASSOCIATES, INC.

Digitally signed by David W Spangler
Reason: I am approving this document
Location: Jacksonville, FL
Date: 2013.11.07 16:52:26 -05'00'

Raoaa F. Essa, P.E.
Project Engineer
Registered, Florida No. 75597

David W. Spangler, P.E.
Senior Project Engineer
Registered, Florida No. 58770

Distribution: Dr. John Peterson 1 pdf

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1.0 PROJECT INFORMATION

The project site is located at 107 Fiddler Crab Lane in St. Johns County, Florida. The general site location is shown on Figure 1.

At the time of our exploration, the site was undeveloped, with surface cover consisting of grass, brush, and trees. The site was level to gently sloping to the south. The site is surrounded with other residential structures. You provided project information via several discussions and emails.

We understand the proposed construction includes a single-family structure. We were not provided detailed structural information, for the purpose of this report; we expect the proposed structure will consist of wood frame structure or load bearing masonry walls and interior columns with a structural slab supported on a deep foundation. We expect the existing lot grade is close to the past construction grades. We understand based on information provided to you by the neighborhood developer, that residences within the subdivision have been constructed on a deep foundation system and it is anticipated that your residence will also be supported on deep foundations

If actual project information varies from these conditions, then the recommendations in this report may need to be re-evaluated. We should be contacted if any of the above project information is incorrect so that we may reevaluate our recommendations.

2.0 FIELD EXPLORATION

We performed a field exploration on October 22, 2013. The approximate boring locations are indicated on the attached Field Exploration Plan (Figure 2). Our personnel determined the boring locations using taped measurements from existing roadways and survey controls adjacent to the site. The boring locations on the referenced Field Exploration Plan should be considered accurate only to the degree implied by the method of measurement used.

We located and performed 2 Standard Penetration Test (SPT) borings, drilled to depths of approximately 60 feet below the existing ground surface, in general accordance with the methodology outlined in ASTM D 1586 to explore the subsurface conditions within the area of the proposed structure. Split-spoon soil samples recovered during performance of the borings were visually classified in the field and representative portions of the samples were transported to our laboratory for further evaluation.

3.0 LABORATORY TESTING

A geotechnical engineer classified representative soil samples obtained during our field exploration using the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. A Key to the Soil Classification System is included in Appendix A.

Selected samples of the soils encountered during the field exploration were subjected to quantitative laboratory testing to better define the composition of the soils encountered and to provide data for correlation to their anticipated strength and compressibility characteristics. The laboratory testing determined the Atterberg limits, fines and moisture contents of selected soil samples. The results of the laboratory testing are shown in the Summary of Laboratory Test Data included in Appendix B. Also, these results are shown on the Generalized Subsurface Profiles on Figure 3 and on the Log of Boring records at the respective depths from which the tested samples were recovered.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General Soil Profile

A graphical presentation of the generalized subsurface conditions is presented on Figure 3. Detailed boring records are included in Appendix A. It should be understood that the soil conditions will vary between the boring locations. The following table summarizes the soil conditions encountered.

GENERAL SOIL PROFILE: BUILDING AREA			
TYPICAL DEPTH (ft)			
FROM	TO	SOIL DESCRIPTION	USCS[1]
Ground surface	4.5 to 8	Loose fine sand and fine sand with clay	(SP & SP-SC)
4.5 to 8	22	Very Loose silty fine sand and very soft sandy clay and clay with sand	(SM & CH)
22	43	Very loose to dense fine sand, fine sand with silt, silty fine sand, and clayey fine sand	(SP, SP-SM, SM, & SC)
43	48	Soft to stiff clay and clay with shell fragments	(CH)
48	60	Loose to dense fine sand with silt and silty fine sand with shell fragments	(SP-SM, & SM)

(1) Unified Soil Classification System

4.2 Groundwater Level

Groundwater was encountered at each boring location and recorded at the time of drilling at the ground surface to a depth of 1 foot below the existing ground surface. We note that groundwater levels will fluctuate due to seasonal climatic variations, tidal fluctuations, surface water runoff patterns, construction operations, and other interrelated factors. The groundwater depth at each boring location is noted on the Generalized Subsurface Profiles and on the Log of Boring records.

5.0 DESIGN RECOMMENDATIONS

5.1 General

Our geotechnical engineering evaluation of the site and subsurface conditions at the property, with respect to the planned construction and assumed loading conditions and our recommendations for site preparation and foundation support, are based on (1) our site observations, (2) the field and laboratory test data obtained, and (3) our understanding of the project information and structural conditions as presented in this report.

If the structural conditions are incorrect, or should the location of the structure be changed, please contact us so that we can review our recommendations. Also, the discovery of any site or subsurface conditions during construction that deviate from the data obtained during this geotechnical exploration should also be reported to us for our evaluation.

The recommendations presented in the subsequent sections of this report present design and construction techniques that are appropriate for the planned construction. We recommend that we be provided the opportunity to review the foundation plans and earthwork specifications to verify that our recommendations have been properly interpreted and implemented.

5.2 Deep Foundation Design Recommendations

Very loose silty fine sand andvery soft clay were encountered in the borings to depths of 22 to 33 feet below the existing ground surface. Based on the results of the field exploration the subject structure should be supported on deep foundation system. Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed structure when constructed on a properly designed auger-cast in place (ACIP) pile foundation system.

5.2.1 Allowable Compressive Capacities

It is our opinion that ACIP Piles, properly constructed, can support the proposed structure when embedded into the soil stratums encountered at a depth of at least 50 feet below the existing grade. Our estimated allowable compressive capacities for 12 inch, 14 inch, 16 and 18 inch diameter ACIP piles bearing at a depth of 52-feet below the existing ground surface are presented below.

Pile Bearing depth (ft.)	Allowable Compressive Capacity (tons)			
	12 inch Pile	14 inch Pile	16 inch Pile	18 inch Pile
52	28	34	40	46

Our evaluation included assumption for a scourable soil zone of 5 feet below existing site grades. These capacities include a theoretical factor of safety 2 for skin friction and 3 for end bearing failure.

The allowable pile capacity is a function of the structural strength of the grout and the strength of the supporting soil. We recommend the ACIP Piles be constructed with a minimum grout strength of 4,000 psi. The design pile compressive capacity should not exceed the allowable capacity of the structural member as governed by appropriate codes.

5.2.2 Pile Group Effects

We recommend a center-to-center minimum pile spacing of 2.5 to 3 times the pile diameter. Using this minimum spacing, we anticipate that any capacity reductions due to group effects of individual piles which are installed within a group of piles should be small and therefore should be considered insignificant in the design of the foundation system.

5.2.3 Settlement

With the deep foundation system properly installed to bear at the minimum depths and spacings noted above, at the design load, we estimate that the settlement of an individual pile will be on the order of 0.5 inches or less. This settlement estimate is based upon the use of (1) the field test data obtained during our geotechnical exploration, which has been correlated to geotechnical strength and compressibility characteristics of the subsurface soils beneath the site, and (2) published theoretical and empirical methods of settlement analysis for deep foundations bearing on soils similar to those at this site.

We note that the placement of fill on the lot will induce some consolidation of the underlying very soft clayey soils. Grade supported elements (such as sidewalks, driveways, and utility pipes) should be designed to allow for settlement induced by the placement of fill material. The design should also account for some differential settlement between the grade supported structures and the residential structure supported on a deep foundation.

6.0 CONSTRUCTION RECOMMENDATIONS

Site preparation as outlined in this section should be performed to provide more uniform foundation bearing conditions, to reduce the potential for post-construction settlements of the planned structure.

6.1 Construction Techniques

ACIP Piles should be formed by rotating a continuous, hollow-flight auger to the desired pile tip elevation followed by slow withdrawal of the auger while pumping a mortar grout under pressure through the auger. The pressure of the pumped mortar grout at the auger tip or injection point should be sufficient to (1) fill the pile shaft created by the augering process and withdrawal, (2) prevent "necking" or shaft area reductions due to lateral inward squeezing of any adjacent soft soils, and (3) cause an outward flow of mortar into the adjacent soils. A pressure head within the hollow auger stem equivalent to approximately 10 feet of grout above the adjacent ground surface should be maintained to help verify that a proper grout pressure exists at the injection point. A sudden drop in the sustained pressure head often indicates that a soft zone or void has been encountered and therefore continued mortar injection at this level should be performed until the pressure head has been re-established. Pre-augering and withdrawal of the auger before concreting may result in a reduction of the in-place shear strength characteristics of the adjacent soils and this may require additional pile embedment upon re-augering and concreting. We recommend a reputable contractor, with at least 5 years experience, install the ACIP Piles.

6.2 Installation Sequences

Construction of ACIP Piles located within six pile diameters, center-to-center, should not be performed until the adjacent pile has achieved its initial set, which typically occurs approximately 24 hours after pile construction. This time delay allows the "green" cement grout in the adjacent recently constructed pile to harden, and reduces the potential for loss of grout into the adjacent pile during the augering process.

6.3 Steel Placement

If lateral loads or uplift will be exerted on the piles, steel reinforcement will be required within the piles, at the determination of the project structural engineer. After augering to the desired pile tip level and the auger removed, the steel reinforcement can be statically pushed into recently concreted piles (i.e., while the grout is still "green"). Typically, up to approximately 30 to 40 feet of steel rebar can be placed by this method. The alignment and concrete cover of the rebar, when placed by this method, can vary. Accordingly, it is recommended that centralizers be placed every 5 feet to ensure proper concrete coverage.

7.0 QUALITY CONTROL TESTING

We recommend that Ellis & Associates, Inc. be retained to perform the construction material testing and observations required for this project, to verify that our recommendations have been satisfied. Due to our familiarity with the project, we are the most qualified to address problems that may arise during construction, since we are familiar with the intent of our engineering design.

We recommend that our firm be provided the opportunity to make a general review of the foundation plans and the foundation construction and earthwork specification. If necessary, we will suggest any modifications that may be required in order to verify that our recommendations have been properly interpreted and implemented.

The quality of the pile foundation is dependent upon the skill, experience, and techniques used by the foundation contractor. Since the piles are not visible or accessible for direct inspection after construction, and since problems during installation are not as evident and easily observed as with driven piles, we recommend that a geotechnical engineer or their representative, observe, and monitor the auger-grouted concrete pile installations. His/her duties should consist of, but not be limited to, the following:

1. Verify that the piles are augered to the design tip bearing level.
2. Monitor the auger withdrawal rate and grouting operations to help verify that a sufficient mortar grout pressure head is maintained above the injection point during construction.
3. Confirm that the grout pumping equipment is operating satisfactorily throughout the construction process.
4. Record the volume of mortar grout required to construct the pile.
5. Obtain samples of the fluid grout mixture for slump testing and for molding of test cylinders for strength verification of the hardened grout.
6. Monitor the installation of steel reinforcement (if required) to verify that the size, length, configuration, and placement of the steel conforms to the job specifications.

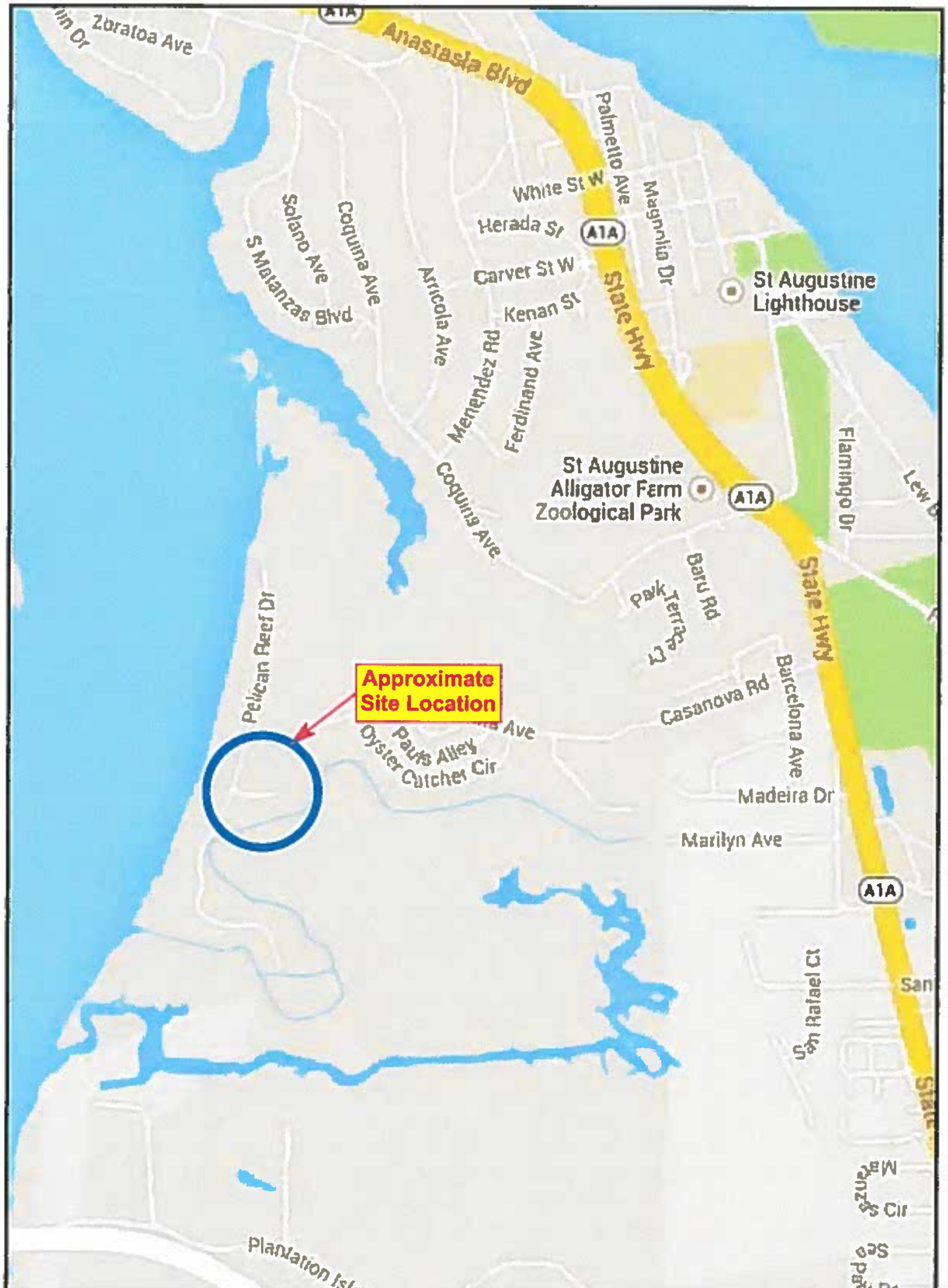
8.0 REPORT LIMITATIONS

Our geotechnical exploration has been performed, our findings obtained, and our recommendations prepared, in accordance with generally accepted geotechnical engineering principles and practices. Ellis & Associates, Inc. is not responsible for any independent conclusions, interpretation, opinions, or recommendations made by others based on the data contained in this report.

Our scope of services was intended to evaluate the soil conditions within the zone of soil influenced by the foundation system. Our scope of services does not address geologic conditions, such as sinkholes or soil conditions existing below the depth of the soil borings.

This report does not reflect any variations that may occur adjacent to or between soil borings. The discovery of any site or subsurface condition during construction that deviates from the data obtained during this geotechnical exploration should be reported to us for our evaluation. Also, in the event of any change to the assumed structural conditions or the location of the structures, please contact us so that we can review our recommendations. We recommend that we be provided the opportunity to review the foundation plans to verify that our recommendations have been properly interpreted and implemented.

FIGURES



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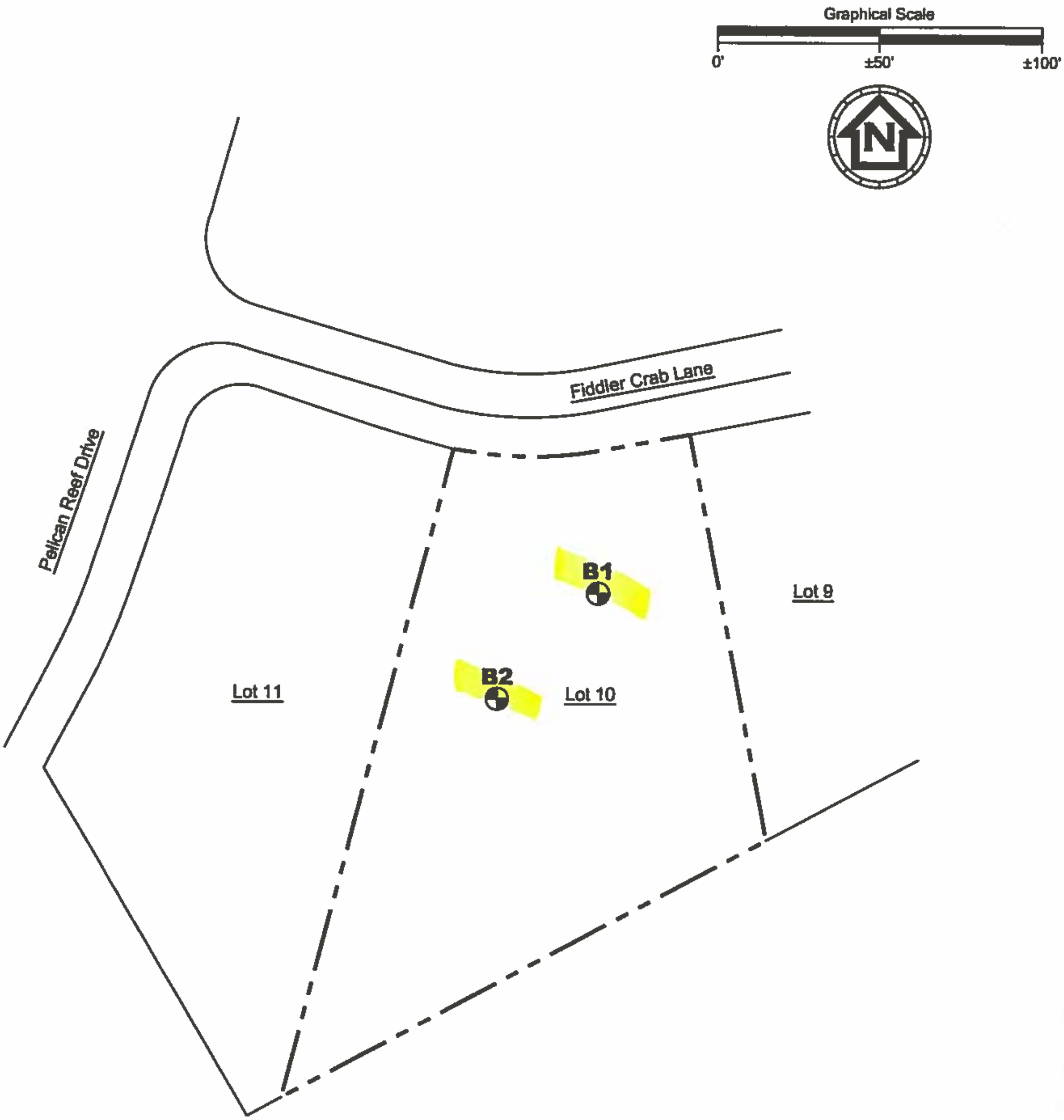
Site Location Plan

107 Fiddler Crab Lane

St. Johns County, Florida

Date: 10/28/13	Project No.: 4243-0001	Figure 1

IAS - 42430001



LEGEND

⊕ Approximate Location of Standard Penetration Test (SPT) Boring

Ellis & Associates Inc.

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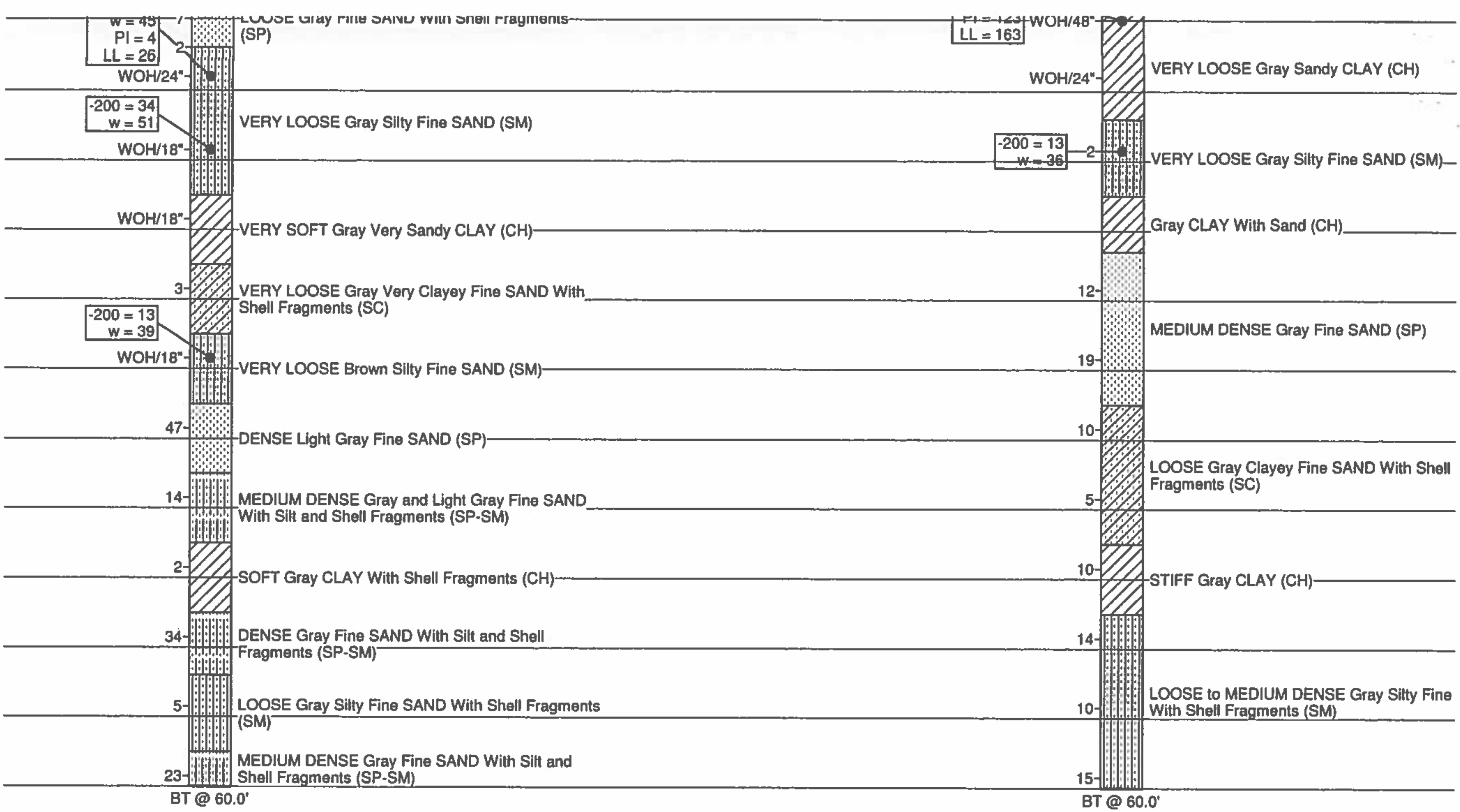
Field Exploration Plan

107 Fiddler Crab Lane

St. Johns County, Florida

Date: 10/28/13	Project No.: 4243-0001	Figure 2

AS - 42430001



LEGEND

Fine SAND (SP)	N Standard Penetration Resistance, Blows/Foot	-200 % Passing No. 200 U.S. Standard Sieve
Fine SAND With Clay (SP-SC)	SP Unified Soil Classification System	w Natural Moisture Content (%)
Clayey Fine SAND (SC)	▼ Groundwater Level at Time of Drilling	PL Plastic Limit

APPENDIX A

SOIL BORING LOGS
FIELD EXPLORATION PROCEDURES
KEY TO SOIL CLASSIFICATION

FIELD EXPLORATION PROCEDURES

Standard Penetration Test (SPT) Borings

The Standard Penetration Test (SPT) borings were made in general accordance with the latest revision of ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils". The borings were advanced by rotary (or "wash-n-chop") drilling techniques. At 2 ½ to 5 foot intervals, a split-barrel sampler inserted to the borehole bottom and driven 18 inches into the soil using a 140 pound hammer falling on the average 30 inches per hammer blow. The number of hammer blows for the final 12 inches of penetration is termed the "penetration resistance, blow count, or N-value". This value is an index to several in-place geotechnical properties of the material tested, such as relative density and Young's Modulus.

After driving the sampler 18 inches (or less if in hard rock-like material), the sampler was retrieved from the borehole and representative samples of the material within the split-barrel were containerized and sealed. After completing the drilling operations, the samples for each boring were transported to our laboratory where they were examined by our engineer in order to verify the driller's field classification. The retrieved samples will be kept in our facility for a period of six (6) months unless directed otherwise.

Ellis & Associates Inc.

Project No.: 4243-0001
Boring No.: B1
Sheet 1 of 3

LOG OF BORING

Project: 107 Fiddler Crab Lane
Client: Dr. John Peterson
Drill Rig: ATV
Driller: DK Register
Boring Location: See Field Exploration Plan
Drill Rod: AWJ
Drill Mud: Super Gel-X
Casing Size:
Length of Casing:
Groundwater Depth: 1 ft Time: Drilling Date: 10/22/13
Boring Begun: 10/22/13
Boring Completed: 10/22/13

SHEAR STRENGTH (ksf) legend: ⊙ Pocket Penetrometer Undisturbed Sample; ● Pocket Penetrometer Disturbed Sample; ▼ Torvane; ● Unconfined Compression; ⊠ Triaxial Compression

Scales: Moisture Content (%) 0, 15, 30, 45, 60; Shear Strength 0, 1, 2

SAMPLE NO.	DEPTH, FEET	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	○PLASTIC LIMIT / + MOISTURE CONTENT / ◇LIQUID LIMIT	SHEAR STRENGTH (ksf)
	0	Topsoil						
1		LOOSE Brown to Light Brown Fine SAND With Clay and Shell Fragments (SP-SC)	2, 2, 4, 5	6				
2		LOOSE Gray Fine SAND With Clay and Shell Fragments (SP-SC)	2, 4, 5, 5	9				
3	5	LOOSE Gray Fine SAND With Shell Fragments (SP)	1, 3, 4, 1	7				
4		VERY LOOSE Gray Silty Fine SAND (SM)	WOH/6", 1, 1, 1	2				
5			WOH/24"	WOH/24"		19	○◇ +	
	10							
6	15		WOH/18"	WOH/18"		34	+	
7	20	VERY SOFT Gray Very Sandy CLAY (CH)	WOH/18"	WOH/18"				
8	25	VERY LOOSE Gray Very Clayey Fine SAND With Shell Fragments (SC)	1, 2, 1	3				

BORING 42430001.GPJ ELLIS ASSOCIATES.GDT 11/7/13

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LOG OF BORING

Project No.: 4243-0001
Boring No.: B1
Sheet 2 of 3

Project: 107 Fiddler Crab Lane
Client: Dr. John Peterson
Drill Rig: ATV
Driller: DK Register
Boring Location: See Field Exploration Plan
Drill Rod: AWJ
Drill Mud: Super Gel-X
Casing Size:
Length of Casing:
Groundwater Depth: 1 ft Time: Drilling Date: 10/22/13
Boring Begun: 10/22/13
Boring Completed: 10/22/13

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	○PLASTIC LIMIT / + MOISTURE CONTENT (%) / ◇LIQUID LIMIT (0 15 30 45 60)	SHEAR STRENGTH (ksf) (0 1 2)
	25		VERY LOOSE Gray Very Clayey Fine SAND With Shell Fragments (SC) *(Continued)*						
			VERY LOOSE Brown Silty Fine SAND (SM)						
9	30			WOH/18"	WOH/18"		13	+ (approx. 36)	
			DENSE Light Gray Fine SAND (SP)						
10	35			14 21 26	47				
			MEDIUM DENSE Gray and Light Gray Fine SAND With Silt and Shell Fragments (SP-SM)						
11	40			5 6 8	14				
			SOFT Gray CLAY With Shell Fragments (CH)						
12	45			1 1 1	2				
			DENSE Gray Fine SAND With Silt and Shell Fragments (SP-SM)						
13				5 15					

Legend (Shear Strength): ⊙ Pocket Penetrometer Undisturbed Sample; ● Pocket Penetrometer Disturbed Sample; ▼ Torvane; ● Unconfined Compression; ⊠ Triaxial Compression

G 42430001.GPJ ELLIS ASSOCIATES.GDT 11/7/13

Ellis & Associates Inc.

LOG OF BORING

Project No.: 4243-0001
Boring No.: B1
Sheet 3 of 3

Project: 107 Fiddler Crab Lane
Client: Dr. John Peterson
Drill Rig: ATV
Driller: DK Register
Boring Location: See Field Exploration Plan
Drill Rod: AWJ
Drill Mud: Super Gel-X
Casing Size:
Length of Casing:
Groundwater Depth: 1 ft Time: Drilling Date: 10/22/13
Boring Begun: 10/22/13
Boring Completed: 10/22/13

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	○PLASTIC LIMIT + MOISTURE CONTENT (%) ◇LIQUID LIMIT (0 15 30 45 60)	SHEAR STRENGTH (ksf) (0 1 2)
	50		DENSE Gray Fine SAND With Silt and Shell Fragments (SP-SM) *(Continued)*						
			LOOSE Gray Silty Fine SAND With Shell Fragments (SM)						
14	55			3 2 3	5				
			MEDIUM DENSE Gray Fine SAND With Silt and Shell Fragments (SP-SM)						
15	60			7 10 13	23				
			Boring Terminated @ 60 ft.						
	65								
	70								
	75								

Shear strength legend: ⊙ Pocket Penetrometer Undisturbed Sample; ◐ Pocket Penetrometer Disturbed Sample; ▼ Torvane; ● Unconfined Compression; ⊠ Triaxial Compression

Remarks

LOG OF BORING 42430001.GPJ ELLIS ASSOCIATES.GDT 11/7/13

Ellis & Associates Inc.

Project No.: 4243-0001
Boring No.: B2
Sheet 1 of 3

LOG OF BORING

Project: 107 Fiddler Crab Lane
Client: Dr. John Peterson
Drill Rig: ATV
Driller: DK Register
Boring Location: See Field Exploration Plan
Drill Rod: AWJ
Drill Mud: Super Gel-X
Casing Size:
Length of Casing:
Groundwater Depth: 0 ft Time: Drilling Date: 10/22/13
Boring Begun: 10/22/13
Boring Completed: 10/22/13

SHEAR STRENGTH (ksf): ⊙ Pocket Penetrometer Undisturbed Sample; ● Pocket Penetrometer Disturbed Sample; ▼ Torvane; ● Unconfined Compression; ⊠ Triaxial Compression

Plastic Limit (○), Moisture Content (+), Liquid Limit (◇) scale (%): 0, 45, 90, 135, 180. Shear strength scale (ksf): 0, 1, 2

SAMPLE NO.	DEPTH, FEET	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT / MOISTURE CONTENT / LIQUID LIMIT
	0	Topsoil					
1		LOOSE Light Gray Fine SAND With Shell Fragments (SP)	2, 2, 4	6			
2			5, 2, 3, 1	4			
			WOH/48"				
3	5	VERY LOOSE Gray Sandy CLAY (CH)		WOH/48"		71	○ + ◇
4							
			WOH/24"				
5				WOH/24"			
	10						
		VERY LOOSE Gray Silty Fine SAND (SM)					
6	15		1, 1, 1	2		13	+
		Gray CLAY With Sand (CH)					
7	20						
		MEDIUM DENSE Gray Fine SAND (SP)					
8	25		5, 6, 6	12			

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Project No.: 4243-0001
Boring No.: B2
Sheet 2 of 3

LOG OF BORING

Project: 107 Fiddler Crab Lane
Client: Dr. John Peterson
Drill Rig: ATV
Driller: DK Register
Boring Location: See Field Exploration Plan
Drill Rod: AWJ
Drill Mud: Super Gel-X
Casing Size:
Length of Casing:
Groundwater Depth: 0 ft Time: Drilling Date: 10/22/13
Boring Begun: 10/22/13
Boring Completed: 10/22/13

SAMPLE NO.	DEPTH, FEET	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	○PLASTIC LIMIT + MOISTURE CONTENT (%) ◇LIQUID LIMIT (0 45 90 135 180)	SHEAR STRENGTH (ksf) (0 1 2)
	25	MEDIUM DENSE Gray Fine SAND (SP) *(Continued)*						
9	30		7 10 9	19				
		LOOSE Gray Clayey Fine SAND With Shell Fragments (SC)						
10	35		6 6 4	10				
11	40		4 3 2	5				
		STIFF Gray CLAY (CH)						
12	45		3 4 6	10				
		LOOSE to MEDIUM DENSE Gray Silty Fine SAND With Shell Fragments (SM)						
13			7 7					

Shear strength legend: ⊙ Pocket Penetrometer Undisturbed Sample; ● Pocket Penetrometer Disturbed Sample; ▼ Torvane; ● Unconfined Compression; ⊠ Triaxial Compression

E&A Ellis & Associates inc.

Project No.: 4243-0001
Boring No.: B2
Sheet 3 of 3

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	50		LOOSE to MEDIUM DENSE Gray Silty Fine SAND With Shell Fragments (SM) *(Continued)*						
14	55			4 4 6	10				
15	60			5 7 8	15				
			Boring Terminated @ 60 ft.						
	65								
	70								
	75								

Shear strength legend: ⊙ Pocket Penetrometer Undisturbed Sample; ⊕ Pocket Penetrometer Disturbed Sample; ▼ Torvane; ● Unconfined Compression; ⊠ Triaxial Compression

Remarks

E&A Ellis & Associates Inc.

KEY TO SOIL CLASSIFICATION

Description of Compactness or Consistency in Relation To Standard Penetration Resistance

COARSE GRAINED SOILS (Sands and Gravels)	
N-Value	**Compactness**
0 – 3	Very Loose
4 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
51 and Greater	Very Dense

FINE GRAINED SOILS (Silts and Clays)	
N-Value	**Consistency**
0 – 1	Very Soft
2 – 4	Soft
5 – 8	Firm
9 – 15	Stiff
16 – 30	Very Stiff
31 and Greater	Hard

DESCRIPTION OF SOIL COMPOSITION**

(Unified Soil Classification System)

MAJOR DIVISION		Group Symbol	LABORATORY CLASSIFICATION CRITERIA		SOIL DESCRIPTION
			FINER THAN 200 SIEVE %	SUPPLEMENTARY REQUIREMENTS	
Coarse grained (over 50% by weight coarser than No. 200 sieve)	Gravelly soils (over half of coarse fraction larger than No. 4)	GW	<5*	D_{60}/D_{10} greater than 4, $D_{30}^2 / (D_{60} \times D_{10})$ between 1 & 3	Well graded gravels, sandy gravels
		GP	<5*	Not meeting above gradation for GW	Gap graded or uniform gravels, sandy gravels
		GM	>12*	PI less than 4 or below A-line	Silty gravels, silty sandy gravels
		GC	>12*	PI over 7 above A-line	Clayey gravels, clayey sandy gravels
	Sandy soils (over half of coarse fraction finer than No. 4)	SW	<5*	D_{60}/D_{10} greater than 6, $D_{30}^2 / (D_{60} \times D_{10})$ between 1 & 3	Well graded sands, gravelly sands
		SP	<5*	Not meeting above gradation requirements	Gap graded or uniform sands, gravelly sands
		SM	>12*	PI less than 4 or below A-line	Silty sands, silty gravelly sands
		SC	>12*	PI over 7 and above A-line	Clayey sands, clayey gravelly sands
Fine grained (over 50% by weight finer than No. 200 sieve)	Low compressibility (liquid limit less than 50)	ML	Plasticity chart		Silts, very fine sands, silty or clayey fine sands, micaceous silts
		CL	Plasticity chart		Low plasticity clays, sandy or silty clays
		OL	Plasticity chart, organic odor or color		Organic silts and clays of low plasticity
	High compressibility (liquid limit more than 50)	MH	Plasticity chart		Micaceous silts, diatomaceous silts, volcanic ash
		CH	Plasticity chart		Highly plastic clays and sandy clays
		OH	Plasticity chart, organic odor or color		Organic silts and clays of high plasticity
Soils with fibrous organic matter		PT	Fibrous organic matter; will char, burn or glow		Peat, sandy peats, and clayey peat

* For soils having 5 to 12 percent passing the No. 200 sieve, use a dual symbol such as SP-SM.
** Standard Classification of Soils for Engineering Purposes (ASTM D 2487)

SAND/GRAVEL DESCRIPTION MODIFIERS	
Modifier	**Sand/Gravel Content**
Trace	<15%
With	15% to 29%
Sandy/Gravelly	>29%

ORGANIC MATERIAL MODIFIERS	
Modifier	**Organic Content**
Trace	1% to 2%
Few	2% to 4%
Some	4% to 8%
Many	>8%

SILT/CLAY DESCRIPTION MODIFIERS	
Modifier	**Silt/Clay Content**
Trace	<5%
With	5% to12%
Silty/Clayey	13% to 35%
Very	>35%

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SUMMARY OF LABORATORY TEST RESULTS

Project: 107 Fiddler Crab Lane
Client: Dr. John Peterson
Project No.: 4243-0001

Boring/ Sample No.	Sample Depth (ft.)	Organic Content %	Fines Content %	Natural Moisture Content %	Atterberg Limits Liquid Limit %	Atterberg Limits Plastic Limit %	Atterberg Limits Plasticity Index	Pocket Pen. (tsf)
B1-5	8-10		19	45	26	22	4	
B1-6	13.5-15		34	51				
B1-9	28.5-30		13	39				
B2-3	4-6		71	93	163	40	123	
B2-6	13.5-15		13	36				

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LABORATORY TEST PROCEDURES

Percent Fines Content

The percent fines or material passing the No. 200 mesh sieve of the sample tested was determined in general accordance with the latest revision of ASTM D 1140. The percent fines are the soil particles in the silt and clay size range.

Natural Moisture Content

The water content of the sample tests was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ratio of "pore" or "free" water in a given mass of material to the mass of solid material particles.

Atterberg Limits

The Atterberg Limits consist of the Liquid Limit (LL) and the Plastic Limit (PL). The LL and PL were determined in general accordance with the latest revision of ASTM D 4318. The LL is the water content of the material denoting the boundary between the liquid and plastic states. The PL is the water content denoting the boundary between the plastic and semi-solid states. The Plasticity Index (PI) is the range of water content over which a soil behaves plastically and is denoted numerically by the difference between the LL and the PL. The water content of the sample tested was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ration of "pore" or "free" water in a given mass of material to the mass of solid material particles.