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August 10, 2018
Revision 1

Design & Construction Innovations, LLC
19337 Shumard Oak Drive
Land O Lakes, FL 34638

Attention: Mr. Roberto Saez

Reference: Geotechnical Exploration - Draft
Sea Ranch Drive Residential Development
Sea Ranch Drive
Hudson, Florida
UES Project No. 0830.1800134
UES Report No. 1589055

Dear Mr. Saez:

Universal Engineering Sciences, Inc. (UES) has completed a geotechnical exploration of the above-referenced site in Hudson, Florida. Our scope of services was in general accordance with UES Proposals #0830.0718. 10, dated July 10 and July 27, 2018, and authorized by you. Following the issue of our Geotechnical Exploration report dated July 26, 2018, the proposed project was modified and additional geotechnical services were requested.

This revised report contains the results of our study, an engineering interpretation of the subsurface data obtained with respect to the project characteristics described to us, geotechnical design recommendations, and general construction and site preparation considerations.

We appreciate the opportunity to have worked with you on this project. Please do not hesitate to contact us if you should have any questions, or if we may further assist you as your plans proceed.

Respectfully submitted,

UNIVERSAL ENGINEERING SCIENCES, INC.
Certificate of Authorization No. 549

Dušan Jovanović
Senior Project Manager

Thomas Grimm, P.E.
Geotechnical Department Manager
Professional Engineer No. 78006
Date: __________________

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ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION

Sea Ranch Drive Residential development
Sea Ranch Drive
Hudson, Pasco County, Florida

UES Project No. 0830.1800134

PREPARED FOR:

Design & Construction Innovations, LLC
19337 Shumard Oak Drive
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August 10, 2018
Revision 1

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1.0 INTRODUCTION

1.1 GENERAL

Universal Engineering Sciences (UES) has completed a geotechnical evaluation of the site of the Sea Ranch Drive residential development. This revised report contains the results of our study, an engineering interpretation of the subsurface data obtained with respect to the project characteristics described to us, and our recommendations for geotechnical design and general site preparation. Our scope of services was in general accordance with UES Proposals 0830.0718.10 dated July 10 and July 27, 2018 and authorized by you. Following the issue of our Geotechnical Exploration report dated July 26, 2018, the proposed project was modified and additional geotechnical services were requested.

1.2 PROJECT DESCRIPTION

The project site is located at the western termination of Sea Ranch Drive in Hudson, Pasco County, Florida. The site is currently a vacant undeveloped parcel that is west of an existing residential development and adjoins the Gulf of Mexico on the South, West and North.

We understand that the proposed residential development will consist of a 5-to-8-story building and associated parking. The building will consist of 50 to 100 residential units, and will include one to three levels of covered parking. We were provided with a copy of a modified concept site plan dated February 26, 2018 and used this in planning our exploration.

Preliminary design plans, grading plans, or anticipated structural loads were not available for our evaluation. We have assumed that construction will proceed at or within one foot of existing grades. Further, we have assumed that loads on continuous footings will be 5 to 10 kips per lineal foot, and loads on individual column footings will be 100 to 150 kips.

Our geotechnical recommendations are based upon the above assumptions and considerations. If any of this information is incorrect or if you anticipate any changes, please inform UES so that we may review our recommendations, and make revisions as needed.

A general location map of the project area appears in Appendix A: Site Location Map. Also included in Appendix A for your reference are a Site Aerial Photograph, USGS Site Topographic Map and Soil Survey Map.

2.0 PURPOSE AND METHODOLOGIES

2.1 PURPOSE

The purpose of our services was:

- to explore the general subsurface conditions at the site using Standard Penetration Test (SPT) borings;

- to interpret and review the subsurface conditions with respect to the proposed construction as it was described to us; and

- to provide geotechnical engineering design information and recommendations, and general recommendations for site preparation.

This report presents an evaluation of site conditions on the basis of traditional geotechnical procedures for site characterization. The recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards.

2.2 FIELD EXPLORATION

Five (5) SPT borings were completed within the proposed building footprint. The initial two SPT borings were advanced to a depth of 50 feet. An additional three (3) SPT borings were advanced following our original exploration. The additional borings were advanced to a depth of 20 feet within the footprint of the relocated building site. These borings were advanced using the rotary wash method, and samples were collected while performing the SPT at regular intervals.

We performed the SPTs in general accordance with ASTM D1586. However, at depths of 10 feet or less we sampled continuously in order to detect slight variations in the soil profile. In general, a standard split-barrel sampler (split-spoon) is driven into the soil using a 140-pound hammer free-falling 30 inches. The number of hammer blows required to drive the sampler 12 inches, after first seating it 6 inches, is designated the penetration resistance, or N value. This value is used as an index to soil strength and consistency. The top 4.5 feet of all the SPT borings were advanced using a hand auger. This technique is a part of our safety procedure due to proximity of underground utility lines that may not have been located by Sunshine 811 as requested.

Consider the indicated locations and depths to be approximate. Our drilling crew located the borings based upon measurement from prominent site features on the site. If more precise location and elevation data are desired, a registered professional land surveyor should be retained to locate the borings and determine their ground surface elevations. The Boring Location Plan is presented in Appendix B.

Unless other arrangements are agreed upon in writing, UES will store recovered soil samples for no more than 60 calendar days from the date of the report. After that date, UES will dispose of all samples.

2.3 LABORATORY TESTING

The soil samples recovered from the test borings were returned to our laboratory and visually classified by our technical staff. Two soil washes in accordance with ASTM D1140 and two organic matter analyses in accordance with ASTM D2974 were performed.

3.0 FINDINGS

3.1 SURFACE CONDITIONS

UES reviewed readily available aerial photographs, United State Geologic Survey (USGS) topographic quadrangle maps, and the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) Soil Survey of Pasco County for relevant information about the site. According to USGS topographic information, the elevation across the property is on the order of +5 feet National Geodetic Vertical Datum (NGVD). The site was undeveloped at the time of drilling and adjoins the Gulf of Mexico.

3.2 SUBSURFACE CONDITIONS

3.2.1 SOIL SURVEY

According to soil survey, there is one surficial soil group underlying this site. This soil formation is classified as Udalfic Arents-Urban land complex (31). The soil consists of a mixture of soils so intermingled that they cannot be classified at the scale used for mapping. The soils at the project site are likely a result of dredging of the adjoining Gulf of Mexico waters. The location of these groups can be observed on the Soil Survey Map provided in the Appendix A.

3.2.2 SOIL BORINGS

The boring locations and detailed subsurface conditions are illustrated in Appendix B: Boring Location Plan and Boring Logs. The classifications and descriptions shown on the logs are based upon visual characterizations of the recovered soil samples. Refer to Appendix B: Soils Classification Chart, for further explanation of the symbols and placement of data on the Boring Logs. The general subsurface soil profile on the site, based on the soil boring information, is described below. For more detailed information, please refer to the boring logs.

Beneath a one to two inch topsoil layer encountered at the surface, subsurface conditions encountered in the borings consisted of sand fill with varying quantities of silt and clays to 12 to 13.5 feet. Beneath the sand fill, a silty sand soil was encountered to 13.5 to 27 feet where limestone was encountered to the 20 to 50- foot boring termination depths. Soils were typically classified as loose to medium dense.

The water table was encountered at approximately 5 feet below existing grade, measured upon first encounter. These readings were unstabilized and are subject to fluctuation. It appears that the groundwater is deeper at the east portion of the site where the elevations are higher. The groundwater table appears to be under tidal influence.

The boring logs and related information included in this report are indicators of subsurface conditions only at the specific locations and times noted. Subsurface conditions, including groundwater levels and the presence of deleterious materials, at other locations on the site may differ significantly from conditions which, in the opinion of UES, exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

4.0 RECOMMENDATIONS

4.1 GENERAL

In this section of the report we present our geotechnical design recommendations, general site preparation recommendations and information pertaining to the construction related services UES can provide. Our recommendations are made based upon a review of the attached soil test data, our understanding of the proposed construction as it was described to us, and our stated assumptions. If the structural loads or site layout differ from those assumed or described to us, we should be retained to review the new or updated information and amend our recommendations with respect to those changes. Additionally, if subsurface conditions are encountered during construction, that were not encountered in the borings, report those conditions immediately to us for observation and recommendations.

4.2 GROUNDWATER

Based upon our visual inspection of the recovered soil samples, review of information obtained from SWFWMD and the USDA Soil Survey of Pasco County, and our knowledge of local and regional hydrogeology, our best estimate is that the seasonal high water table (SHWT) could be on the order of 2 feet below the existing grade.

It should be noted that the estimated SHWT does not provide any assurance that groundwater levels will not exceed this level in the future. Should impediments to surface water drainage exist on the site, or should rainfall intensity and duration exceed the normally anticipated amounts, groundwater levels may exceed our seasonal high estimate. Also, future development around the site could alter surface runoff and drainage characteristics, and cause our seasonal high estimate to be exceeded. We therefore recommend positive drainage be established and maintained on the site during construction. Further, we recommend permanent measures be constructed to maintain positive drainage from the site throughout the life of the project. Finally, we recommend all foundation and pavement grades account for the seasonal high groundwater conditions.

Temporary dewatering may be required for some parts of this site if construction proceeds during the wet season, particularly if deep excavations are necessary or if pumping of the surficial materials is experienced during earthworking operations. Where they were encountered, sands with silts (SP-SM), silty fine sands (SM), and clayey sands (SC) near the surface may be prone to pumping in response to normal construction vehicular traffic and earthworking operations. Therefore, we recommend that the contract documents provide for determining the depth to the groundwater table just prior to construction, and for any required remedial dewatering. Further, we recommend that the groundwater table be maintained at least 24 inches below all earthwork and compaction surfaces.

4.3 BUILDING FOUNDATION AND FLOOR SLAB

4.3.1 BEARING PRESSURE – SPREAD-FOOTING FOUNDATIONS

Provided foundation subgrades are prepared as recommended, we recommend using shallow strip or spread foundations sized to exert a maximum bearing pressure of 3000 pounds per square foot (psf). However, column loads in excess of 100 kips will require a deep foundation system extending into limestone. The deep foundations are anticipated to require construction into limestone encountered at an approximate depth of 13 to 27 feet. We anticipate driven concrete piling will be the most suitable foundation system.

4.3.1.1 BEARING MATERIAL

The strip footing foundation subgrades must be suitable structural fill or existing native soils compacted to at least 98% MPMDD. The 2-story building interior column foundation subgrades are recommended to be replaced as compacted structural fill to reduce anticipated settlement and increase subgrade strength. The degree of compaction must be verified to a depth of 2 feet below the base of footing elevation prior to placing foundation concrete.

4.3.1.2 FOOTING SIZE AND BEARING DEPTH

All individual foundations should be embedded at least 2.0 feet below lowest adjacent grade (finished surrounding grade, for example). Maintain minimum foundation widths of 24 inches for continuous strip footings, and 36 inches for isolated column footings, even though the maximum allowable soil bearing stress may not be developed in all cases.

4.3.1.3 ESTIMATED SETTLEMENT

For spread-footing foundations designed as recommended and site earthwork accomplished according to the recommendations provided, we estimate total foundation settlement of less than one inch, and differential settlement of less than one half inch. Differential settlement is estimated over distances of 200 feet or less. If the site is not prepared according to the guidelines provided later in this report, our estimates of total and differential settlement may be exceeded during the design life of the structure.

4.3.2 DEEP FOUNDATION

Column loading condition in excess of 100 kips will require a deep foundation system. We recommend driven concrete piling, driven to limestone bedrock. We would suggest 14-inch driven concrete pile. Depending on the loading per column, multiple piles per column may be necessary.

Based on the results of our explorations, we estimate that 14 inch square concrete piles, driven to a depth of practical refusal or a depth of 35 feet below existing grade, would provide an allowable compressional pile capacity of roughly 130 tons per pile. The pile capacities were estimated using the commercially available AllPile v7 software. A factor of safety of 2.0 was used to calculate the allowable capacity.

4.3.2.1 PILE SPACING

Piles have lower capacities in groups. Spacing them at least 3 pile diameters apart, center to center, can significantly minimize the group effect. The reduction for group effect depends upon the number of piles in a group and their respective positions.

4.3.2.2 HAMMER SELECTION AND PRE-DRIVING WAVE EQUATION ANALYSIS (WEAP)

To help prevent over-driving, we recommend the final driving criteria be carefully specified with respect to the actual pile type, pile size, and hammer size used for production. The ratio of the pile hammer or ram weight (for air and diesel hammers) to the weight of the pile typically should not be less than 0.5 and should preferably be on the order of 0.75 to 1.0. Proper selection of the pile hammer based upon pile type and ram weight and the use of proper anvil and cushioning material and thickness should result in compressive and tensile driving stresses in the piles that are within tolerable magnitudes in accordance with Section 1811 of the current Florida Building Codes and applicable supplements.

Prior to production driving, we recommend that the contractor collect and submit data pertaining to the driving system to be used to install the piles so that we can perform a Wave Equation evaluation to determine the set criteria for termination of pile driving. This analysis will also evaluate the capability of the hammer, the driving resistance, and the pile stresses expected during driving. Assumptions made for this analysis can be verified during actual driving through the use of Pile Dynamic Analyzer (PDA) tests.

4.3.2.3 QUALITY CONTROL

An engineering technician familiar with the installation of driven piles into subsurface soil conditions similar to those at this site and acting under the direction and supervision of the geotechnical engineer should witness the installation of the piles. His duties should include, but not be limited to, the following:

- Keep an accurate record of pile installation and driving procedures.
- Verify that all piles are installed to the proper driving resistance and to a depth indicative of the piles bearing in the desired bearing formation.
- Confirm the pile driving equipment is operating properly.
- Inspect the piles prior to installation for defects and confirm that the piles are not damaged during installation.

Specific requirements for driven piles are detailed in the Florida Building Code under Sections 1808 and 1809. These requirements cover group strength, installation methods, and reinforcement cover. We recommend that the piles be designed and constructed in accordance with the requirements outlined therein.

4.3.2.4 CONSTRUCTION VIBRATIONS

Vibrations produced during pile driving operations may cause distress to existing nearby structures if not properly regulated. Therefore, provisions should be made to monitor these vibrations so that any necessary modifications to the pile driving operations can be made in the field before potential damage occurs. In addition, the conditions of the existing adjacent structures should be ascertained and documented (pre-construction conditions survey) prior to pile driving and/or other vibratory operations.

4.3.3 STANDARD FLOOR SLAB

Earth-supported slabs should be constructed over compacted native soils or compacted structural fill. A fibermesh additive or welded wire mesh should be used to resist cracking. If welded wire is used, we recommend using flat wire instead of rolled. Normal weight concrete having a 28-day compressive strength (f'c) of at least 2500 pounds per square inch (psi) should be used. A modulus of subgrade reaction of 150 pounds per cubic inch (pci) can be used beneath the proposed floor slab, provided subgrades are prepared as recommended.

4.3.4 POST-TENSIONED FLOOR SLAB

If desired a post-tensioned floor slab system can be used on this project. Either standard or post-tensioned floor slab can be used. However, post-tensioned floor slab can provide additional support and reduce the potential for differential movement of the slab.

Said system could be integrated with the structural foundations or could float on-grade, and should be designed for an allowable, soil bearing stress of 3,000 pounds per square foot.

4.3.5 FLOOR SLAB MOISTURE CONTROL

Per the Florida Building Code, we recommend installing polyethylene vapor barrier between the bottom of the floor slab and the top of the compacted subgrade. We recommend installing a minimum 10-mil, polyethylene vapor barrier between the bottom of the floor slab and the top of the compacted subgrade. This will help to minimize floor dampness and moisture intrusion into the structure through the slab. Assume a coefficient of friction of 0.2 at the soil-slab interface if a vapor barrier is used. If no vapor barrier is used, assume a coefficient of friction of 0.35 at the interface.

4.3.6 ESTIMATED STRUCTURAL SETTLEMENT

For foundations designed as recommended and site earthwork accomplished according to the recommendations provided later in this report, we estimate total foundation settlement of less than one inch, and differential settlement of less than one half inch.

4.4 PAVEMENT SECTIONS

4.4.1 ASSUMPTIONS

We assume that a combination of flexible asphaltic and rigid concrete pavement sections will be used on this project. Our recommendations for both pavement types are listed in the following sections.

At the time of this exploration, specific traffic loading information was not provided to us. We have assumed the following conditions for our recommended minimum pavement design.

- the subgrade soils prepared as recommended
- resilient modulus of 7,500 psi (LBR = 20)
- a twenty (20) year design life
- terminal serviceability index (P_t) of 2.5
- reliability of 85 percent
- total equivalent 18 kip single axle loads (ESAL) up to 35,000 for light duty pavements - car and pickup truck traffic
- total ESAL up to 150,000 for heavy duty pavements – occasional heavy truck traffic (delivery, trash collection, service lanes, etc.)

4.4.2 LAYER COMPONENTS

For preliminary pavement designs, we recommend using a three-layer pavement section Based on the results of our soil borings, the assumed traffic loading information and review of the 2008 FDOT Flexible Pavement Design Manual, our minimum recommended pavement component thicknesses are presented in Table 2 below.

Light-duty:	auto parking areas; over eighty cars; light panel and pickup trucks; average gross weight of 4,000 pounds, total ESALs equals 30,000
Heavy-duty:	commercial driveways, small roadways; twenty trucks or less per day; average gross vehicle weight of 25,000 pounds, total ESALs equals 150,000

TABLE 2
MINIMUM ASPHALTIC PAVEMENT COMPONENT THICKNESSES

Service Level	Maximum Traffic Loading	Layer Component		
		Surface Course (inches)	Base Course (inches)	Stabilized Subgrade (inches)
Light Duty	up to 35,000 ESAL	1½	6	12
Heavy Duty	up to 150,000 ESAL	2	8	12

4.4.3 STABILIZED SUBGRADE

We recommend that the stabilized subgrade materials immediately beneath the base course exhibit a minimum Limerock Bearing Ratio (LBR) of 40 as specified by FDOT, or a minimum Florida Bearing Value (FBV) of 75 psi, compacted to at least 98 percent of the MPMDD per ASTM D1557.

Stabilized subgrade can be imported materials or a blend of on-site and imported materials. If a blend is proposed, we recommend that the contractor perform a mix design to find the optimum mix proportions.

Compaction testing of the stabilized subgrade should be performed to full depth at a frequency of at least one (1) test per 10,000 square feet, or a minimum of 3 tests, whichever is greater.

4.4.4 BASE COURSE

We recommend using either limerock or a crushed concrete base course material. The base utilized should have a minimum LBR of 100, and should meet current FDOT requirements for graded aggregate base. Place the base in maximum 6-inch lifts and compact each lift to a minimum density of 98 percent of the MPMDD per ASTM D1557.

Perform compliance base density testing to a depth of 1-foot at a frequency of one test per 10,000 square feet, or at a minimum of two test locations, whichever is greater.

4.4.5 FLEXIBLE SURFACE COURSE

In light duty areas where there is occasional truck traffic, but primarily passenger cars, we recommend that the surfacing consist of FDOT SuperPave (SP) asphaltic concrete. The surface course should consist of FDOT SP-9.5 fine mix for light-duty areas and FDOT SP-12.5 and/or SP-9.5 fine mix for heavy duty areas. The asphaltic concrete should be compacted to an average field density of 93 percent of the laboratory maximum density determined from specific gravity (G_{mm}) methods, with an individual test tolerance of ±2 percent. Specific requirements for the SuperPave asphaltic concrete structural course are outlined in the latest edition of FDOT, Standard Specifications for Road and Bridge Construction.

After placement and field compaction, the surfacing should be cored to evaluate material thickness and density. Cores should be obtained at frequencies of at least one (1) core per 10,000 square feet of placed pavement or a minimum of two (2) cores per day’s production.

4.4.6 RIGID PAVEMENT OPTION

In heavily loaded and/or high traffic areas such as aprons and garbage corrals we recommend using a rigid pavement system for increased strength and durability and for longer life. Portland cement concrete pavement is a rigid system that distributes wheel loads to the subgrade soils over a larger area than a flexible asphalt pavement. This results in reduced localized stress to the subgrade soil. We recommend using a compacted subgrade below concrete pavement with the following stipulations:

1. Subgrade soils must be densified to at least 98% MPMDD to a depth of at least 1-foot directly below the bottom of concrete slab.

2. The surface of the subgrade soils must be smooth, and any disturbances or wheel rutting corrected prior to placement of concrete.

3. The subgrade soils must be moistened prior to placement of concrete.

4. Concrete pavement thickness should be uniform throughout, with exception to the thickened edges (curb or footing).

5. The bottom of the pavement should be separated from the estimated seasonal high groundwater level by at least 12 inches.

Our recommendations on slab thickness for standard duty concrete pavements are based on (1) the subgrade soils densified to at least 98% MPMDD, (2) modulus of subgrade reaction (k) equal to 150 pci, (3) a 30-year design life, and (4) total equivalent 18 kip single axle loads (ESAL) of 45,000. We recommend using the design shown in the following table for standard duty concrete pavements.

TABLE 3
RIGID PAVEMENT COMPONENT RECOMMENDATIONS - LIGHT DUTY

Minimum Pavement Thickness	Maximum Control Joint Spacing	Minimum Sawcut Depth
5 Inches	10 Feet x 10 Feet	1.25 Inches

Our recommendations on slab thickness for heavy duty concrete pavements are based on the same factors as above with the exception of the total ESAL increased to 300,000. Our recommended design for heavy duty concrete pavement is shown in Table 4 below.

TABLE 4
RIGID PAVEMENT COMPONENT RECOMMENDATIONS - HEAVY DUTY

Minimum Pavement Thickness	Maximum Control Joint Spacing	Minimum Sawcut Depth
6 Inches	14 Feet x 14 Feet	1.5 Inches

For both standard duty and heavy duty rigid pavement sections, we recommend using normal weight concrete having a 28 day compressive strength (f'_c) of 4,000 psi, and a minimum 28-day flexural strength (modulus of rupture) of at least 600 psi (based on the 3 point flexural test of concrete beam samples). Layout of the sawcut control joints should form square panels, and the depth of sawcut joints should be at least ¼ of the concrete slab thickness.

We recommend allowing Universal Engineering Sciences to review and comment on the final concrete pavement design, including section and joint details (type of joints, joint spacing, etc.), prior to the start of construction.

For further details on concrete pavement construction, please reference the "Guide to Jointing of Non-Reinforced Concrete Pavements" published by the Florida Concrete and Products

Association, Inc., and "Building Quality Concrete Parking Areas," published by the Portland Cement Association.

4.4.7 EFFECTS OF GROUNDWATER

One of the most critical influences on pavement performance in Florida is the relationship between the pavement subgrade and the seasonal high groundwater level.

It has been our experience that many roadways and parking areas have been damaged as a result of deterioration of the base and the base/surface course bond due to moisture intrusion. Regardless of the type of base selected, we recommend that the seasonal high groundwater and the bottom of the base course be separated by at least 18-inches.

At this site pavement constructed on or above existing grade should meet the minimum required separation within the eastern and central portion of the site.

Within the western portion of the site, if constructed on existing grade, the pavement will not meet the minimum required separation. This will adversely affect any moisture sensitive base material, such as limerock. Therefore, either raise the site grade using select fill until the required separation is achieved, or permanently lower the water table using underdrains, ditching, or a suitable alternative.

4.4.8 CURBING

Most pavement curbing is currently extruded curb which lies directly atop of the final asphaltic concrete surface course. Use of extruded curb or elimination of curb entirely, can allow lateral migration of irrigation water from the abutting landscape areas into the base and/or interface between the asphaltic concrete and base. This migration of water may cause base saturation and failure, and/or separation of the asphaltic concrete wearing surface from the base with subsequent rippling and pavement deterioration. For extruded curbing, we recommend that underdrain be installed behind the curb wherever anticipated storm, surface or irrigation waters may collect. In addition, landscape islands should be drained of excess water buildup using an underdrain system. Alternatively, we recommend that curbing around the landscape sections adjacent to the parking lots be constructed using full depth curb sections.

4.4.9 CONSTRUCTION TRAFFIC

Light duty roadways and incomplete pavement sections will not perform satisfactorily under construction traffic loadings. We recommend that construction traffic (construction equipment, concrete trucks, sod trucks, garbage trucks, dump trucks, etc.) be re-routed away from these roadways or that the pavement section be designed for these loadings.

4.5 RETAINING WALLS

The following values can be used for design of low retaining walls and landscape features, where sand is used as the backfill material, and where there are no surcharge loads from slopes or other sources behind the wall.

Angle of Internal Friction:	30^{0}
K_a (coef. of active earth pressure):	0.33
K_p (coef. of passive earth pressure):	3.00
K_o (coef. of earth pressure at rest):	0.50
Coefficient of Friction (Soil/Concrete interface):	0.40
Unit weight of Soil (wet):	110 pounds per cubic foot
Unit weight of Soil (submerged):	48 pounds per cubic foot

The above values are based on the use of granular, free-draining, sandy soils for the wall backfill. Soils having high fines content, particularly clays, may exhibit creep which would result in long-term deflection of retaining walls (creep). Also, soils with high fines content may contribute to hydrostatic pressure buildup with the potential for premature failure of the walls.

Assuming hand compaction equipment will be utilized, we recommend below grade and retaining wall backfill be placed in 6 to 8-inch loose layers and compacted to 95% MPMDD.

An appropriate factor of safety should be applied to these parameters. It should be noted that uplift and lateral hydrostatic pressures could be exerted on the structure any time the groundwater level is at or near its seasonal high level. These forces should also be included in the proposed design. Also, retaining walls with adjacent sloping earth embankments or subject to permanent or intermittent structural loadings may require special considerations.

4.6 SITE PREPARATION

We recommend normal, good-practice site preparation procedures. These procedures include clearing and grubbing the site, proof-rolling and proof-compacting the subgrade, and filling to grade with engineered fill as needed.

A more detailed synopsis of this work is as follows:

1. If required, perform remedial dewatering prior to any earthwork operations. We recommend temporary dewatering to reduce the likelihood of pumping of the shallow subgrade soils during normal construction operations. Maintain groundwater levels at least 24 inches below the lowest anticipated cut and/or all compaction surfaces.

2. Should any of the existing structures need to be razed prior to new site development, execute demolition according to specifications to be provided by the project Structural Engineer. Completely remove the affected structures including floor slabs, foundations, and subgrade utilities. Backfill excavated areas (i.e., footing and utility trenches) according to the guidelines discussed in Item #7 below.

3. Strip the proposed construction limits of all existing pavement sections (including base material, where present), grass, roots, topsoil, construction debris, and other deleterious materials within and 5 feet beyond the perimeter of the proposed building and in all paved areas. Expect clearing and grubbing to depths of 6 inches, on average. Deeper clearing and grubbing depths may be required where major root systems are encountered.

4. Proof-roll the subgrade with a heavily loaded, rubber-tired vehicle under the observation of a UES geotechnical engineer or his representative. Proof-rolling will help locate any

zones of especially loose or soft soils not encountered in the soil test borings. Then undercut, or otherwise treat these zones as recommended by the engineer.

5. Prior to any filling of the site, proof-compact the subgrade from the surface using suitable compaction equipment, until you obtain a minimum density of 95% MPMDD per ASTM D1557 to a depth of 2 feet below stripped grade. In order to achieve the required degree of compaction, the soils may need to be moisture conditioned until the in-situ water content is within +/- 2% of the optimum moisture content (OMC).

6. Test the subgrade for compaction at a frequency of not less than one test per 2,500 square feet per foot of depth improvement in the building areas. In paved areas, perform compliance tests on the stabilized subgrade for full depth at a frequency of one test per 10,000 square feet, or at a minimum of two test locations, whichever is greater.

7. Place fill material, as required. The fill should consist of fine to medium sand with less than 5 percent soil fines. You may use fill materials with soil fines between 5 and 12 percent, but strict moisture control may be required. Place fill in uniform 10 to 12 inch loose lifts and compact each lift to a minimum density of 95% MPMDD per ASTM D1557 at a moisture content of +/- 2% of OMC.

8. Perform compliance tests within the fill at a frequency of not less than one test per 2,500 square feet per lift in the building areas, or at a minimum of two test locations, whichever is greater. In paved areas, perform compliance tests at a frequency of not less than one test per 10,000 square feet per lift, or at a minimum of two test locations, whichever is greater.

9. Test all final footing cuts for compaction to a depth of 2 feet. Additionally, we recommend you test one out of every four column footings, and that you complete at least one test per every 50 lineal feet of wall footing.

Using vibratory compaction equipment at this site may disturb adjacent structures. We recommend you monitor nearby structures before and during proof-compaction. If disturbance is noted, halt vibratory compaction and inform Universal Engineering Sciences immediately. We will review the compaction procedures and evaluate if the compactive effort results in a satisfactory subgrade complying with our original design assumptions.

4.7 WEATHER CONSIDERATIONS DURING EARTHWORK OPERATIONS

The rainy season in Central Florida normally occurs between the months of June through September with the potential for additional heavy rainfall continuing through the end of the hurricane season in November. During this period, frequent afternoon thunderstorms are likely, with short periods of intense rainfall. The natural groundwater level typically rises to the estimated seasonal high level during the latter part of the rainy season. If construction proceeds during the drier portions of the year (December through May), the earthwork operations on the existing sandy surface soils should progress relatively easily with proper moisture control using a conventional methods. Where the exposed subgrade soil consists of clayey sands, the site contractor should take adequate precautions to grade the work areas to shed any rain run-off and work in small areas (equivalent to a days' work).

However, during the rainy season and following prolonged and/or heavy rainfall, exposed subgrade soils consisting of clayey sands will most likely result in saturated and pumping conditions due to the perched or standing water conditions. Further, short periods of intense rainfall can saturate surface soils, leading to instability during compaction and placement. In the event that heavy rainfall during construction activities resulted in unstable saturated conditions, the exposed saturated subgrade soils should be windowed and aerated to reduce the moisture contents prior to further earthwork operations. Under extreme circumstances, it may be necessary to import “dry” clean sands or recycled crushed concrete (or crushed #57 stones) to stabilize the subgrade soils and obtain a stable workable platform.

Finally, to minimize the potential for moisture related instability during compaction especially during the wet season, we recommend that fill material consist of sands with less than 5 percent soil fines passing a No. 200 sieve.

4.8 CONSTRUCTION RELATED SERVICES

UES operates and maintains an in-house, FDOT certified Construction Materials Testing laboratory. Our technicians are highly trained and experienced, and our engineering staff is already familiar with the details of your project. Therefore, we recommend the owner retain UES to perform construction materials testing and field observations on this project. This includes monitoring all stripping and grading, observation of foundation excavation and construction, verification of pavement subgrade and all other construction testing and inspection services that may be needed on this project.

The geotechnical engineering design does not end with the advertisement of the construction documents. It is an on-going process throughout construction. Because of our familiarity with the site conditions and the intent of the engineering design, our engineers are the most qualified to address problems that might arise during construction in a timely and cost-effective manner.

5.0 LIMITATIONS

During the early stages of most construction projects, geotechnical issues not addressed in this report may arise. Because of the natural limitations inherent in working with the subsurface, it is not possible for a geotechnical engineer to predict and address all possible subsurface variations. A Geoprofessional Business Association (GBA) publication, "Important Information About This Geotechnical Engineering Report" appears in Appendix C, and will help explain the nature of geotechnical issues. Further, we present documents in Appendix C: Constraints and Restrictions, to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the facilities is changed. If changes are contemplated, UES must review them to assess their impact on this report's applicability. Also, note that UES is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of this report's subsurface data or engineering analyses without the express written authorization of UES.

* * * * * * * * *

APPENDIX A

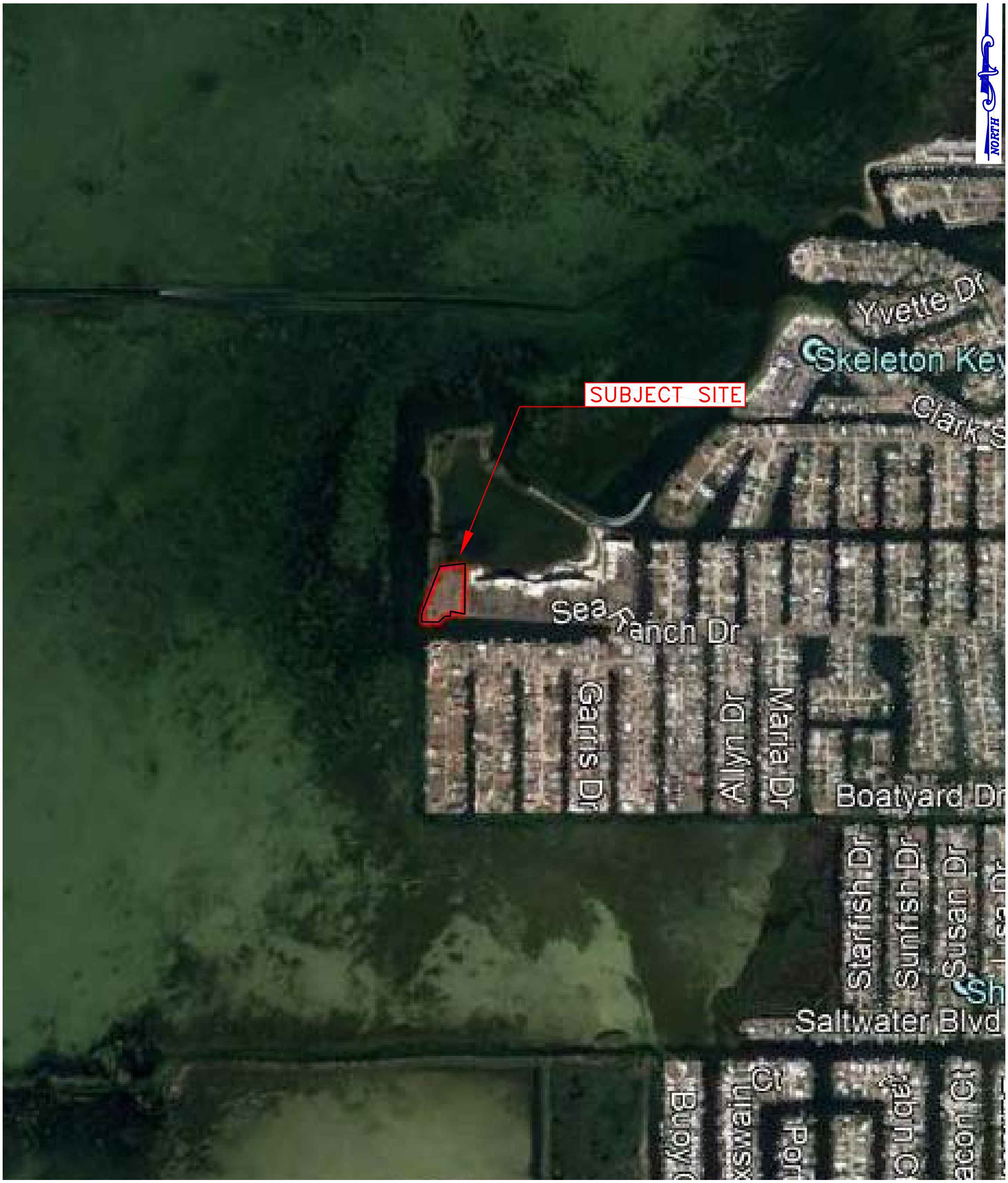
SITE LOCATION
5913 Sea Ranch Drive
Hudson, FL

UNIVERSAL
ENGINEERING SCIENCES

PROPOSED SEA RANCH DRIVE RESIDENTIAL DEVELOPMENT
SEA RANCH DRIVE
HUDSON, PASCO COUNTY, FLORIDA

SITE LOCATION MAP

CLIENT: DESING & CONSTRUCCTION INNOVATIONS, LLC		DRAWN BY: SC	DATE: JULY 19, 2018
SCALE: NOT TO SCALE	PROJECT NO: 0830.1800134	REVIEWED BY: TG	APPENDIX: A



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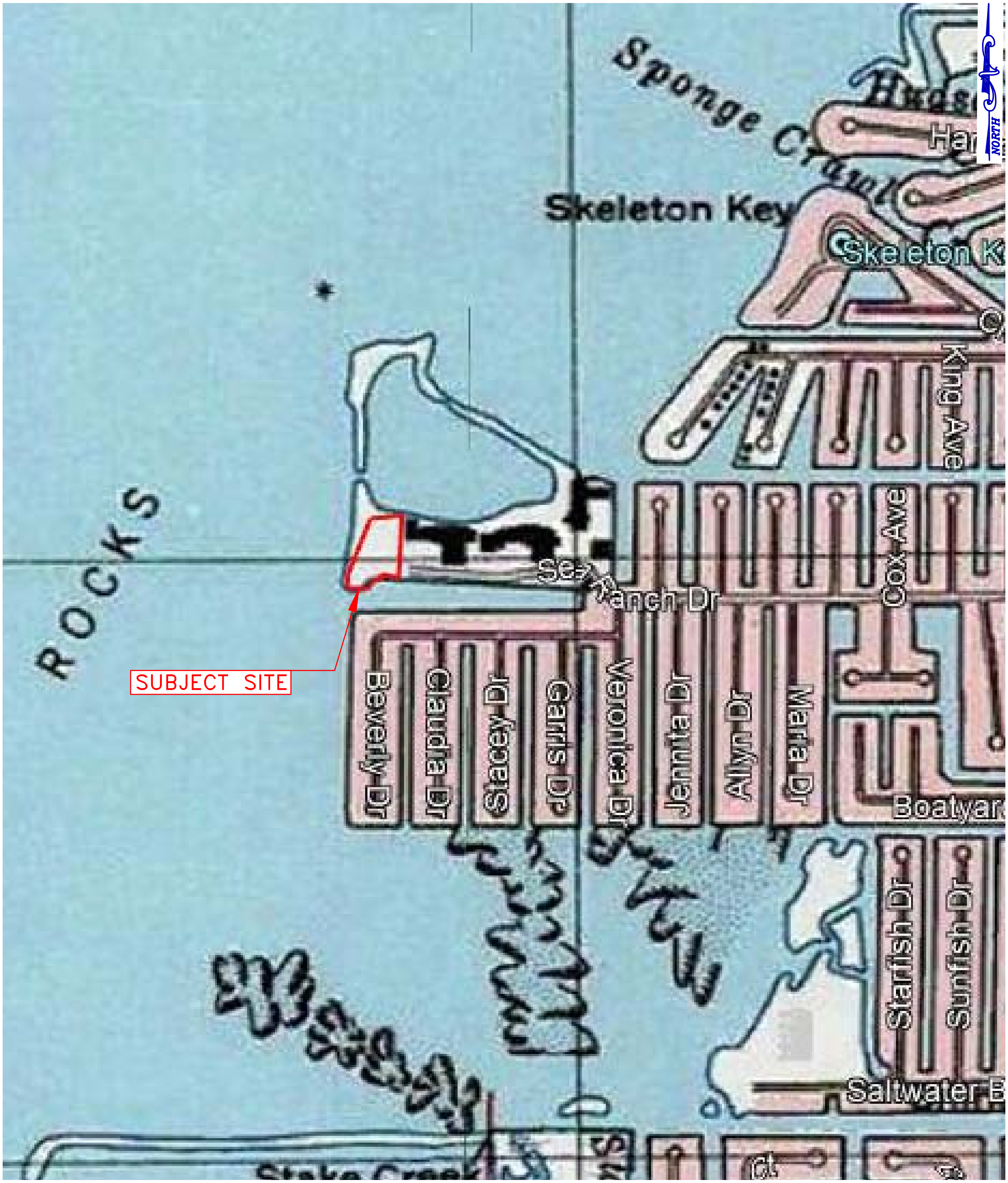
PROPOSED SEA RANCH DRIVE RESIDENTIAL DEVELOPMENT
SEA RANCH DRIVE
HUDSON, PASCO COUNTY, FLORIDA

SITE AERIAL PHOTOGRAPH

CLIENT: DESING & CONSTRUCCTION INNOVATIONS, LLC		DRAWN BY: SC	DATE: JULY 19, 2018
SCALE: NOT TO SCALE	PROJECT NO: 0830.1800134	REVIEWED BY: TG	APPENDIX: A



UNIVERSAL
ENGINEERING SCIENCES

PROPOSED SEA RANCH DRIVE RESIDENTIAL DEVELOPMENT
SEA RANCH DRIVE
HUDSON, PASCO COUNTY, FLORIDA

SITE TOPOGRAPHIC MAP

CLIENT: DESING & CONSTRUCCTION INNOVATIONS, LLC
DRAWN BY: SC
DATE: JULY 19, 2018
SCALE: NOT TO SCALE
PROJECT NO: 0830.1800134
REVIEWED BY: TG
APPENDIX: A

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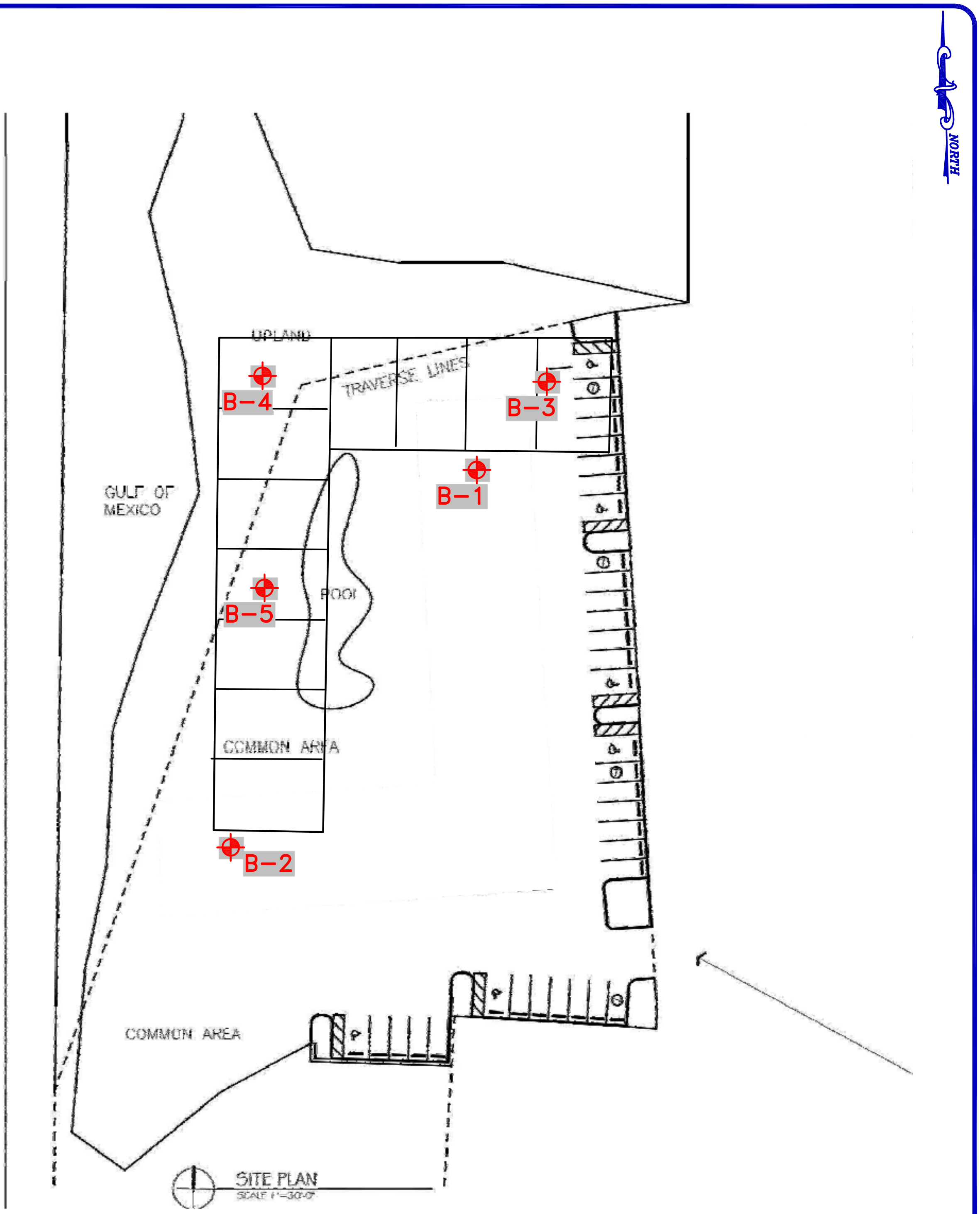
PROPOSED SEA RANCH DRIVE RESIDENTIAL DEVELOPMENT
SEA RANCH DRIVE
HUDSON, PASCO COUNTY, FLORIDA

SOIL SURVEY MAP

CLIENT: DESING & CONSTRUCCTION INNOVATIONS, LLC		DRAWN BY: SC	DATE: JULY 19, 2018
SCALE: NOT TO SCALE	PROJECT NO: 0830.1800134	REVIEWED BY: TG	APPENDIX: A

APPENDIX B



LEGEND:

⊕ B-4 Approximate SPT boring location

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PROPOSED SEA RANCH DRIVE RESIDENTIAL DEVELOPMENT
SEA RANCH DRIVE
HUDSON, PASCO COUNTY, FLORIDA

BORING LOCATION PLAN

CLIENT: DESING & CONSTRUCCTION INNOVATIONS, LLC
DRAWN BY: SC
DATE: JULY 19, 2018
SCALE:
PROJECT NO: 0830.1800134
REVIEWED BY: TG
APPENDIX: B

BORING LOG

PROJECT NO.: 0830.1800134
APPENDIX:
PAGE: 1

PROJECT: Proposed Sea Ranch Residential Development
Sea Ranch Drive
Hudson, FL

ENGINEER: Thomas Grimm, P.E.

CLIENT: Design & Construction Innovations, LLC

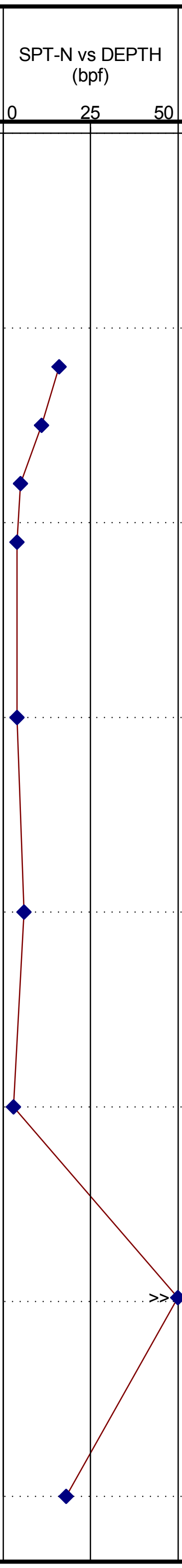
LOCATION: SEE BORING LOCATION PLAN

REMARKS:

BORING DESIGNATION: **B-01**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft):
WATER TABLE (ft): 5.0
DATE OF READING: 7-23-2018
EST. W.S.W.T. (ft):

DATE STARTED: 7/23/18
DATE FINISHED: 7/23/18
DRILLED BY: PH
TYPE OF SAMPLING: SPT



DEPTH (ft)	SAMPLE	N (bpf)	GWT	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		Kh (ft/day)	ORG (%)	DEPTH (ft)
							LL	PI			
0				Brown sand with rock (SP) - Fill							0
				Brown clayey sand (SC) -Fill							
5			▼	Gray silty sand with limestone (SM)							5
		16									
		11									
		5									
10		4									10
				Tan limestone							
15		4									15
20		6									20
25		3									25
30		56/11"									30
35		18									35

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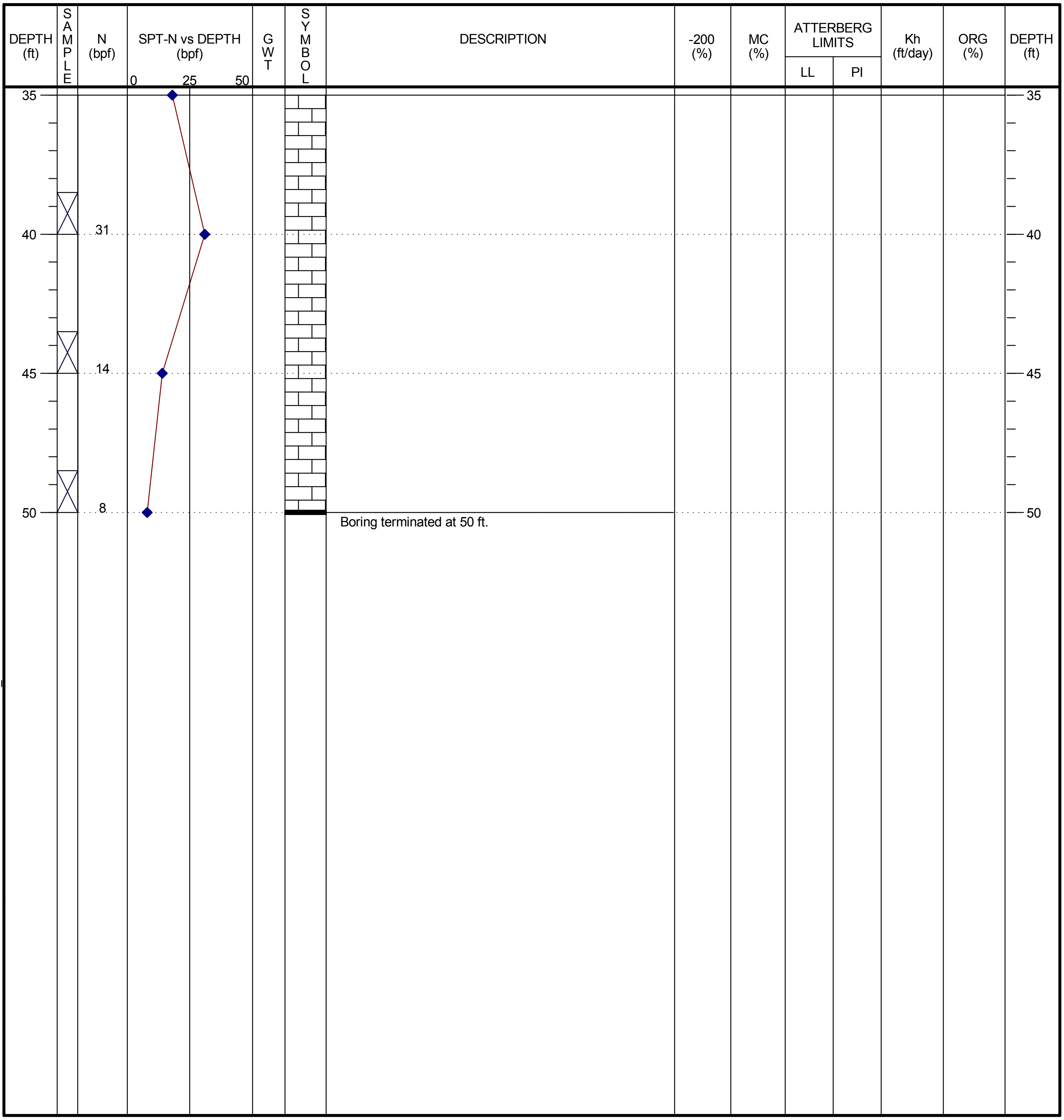
BORING LOG

PROJECT NO.: 0830.1800134
APPENDIX:
PAGE: 2

PROJECT: Proposed Sea Ranch Residential Development
Sea Ranch Drive
Hudson, FL

BORING DESIGNATION: **B-01**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:



DEPTH (ft)	SAMPLE	N (bpf)	SPT-N vs DEPTH (bpf)	GWT	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	Kh (ft/day)	ORG (%)	DEPTH (ft)
35													35
40	☒	31											40
45	☒	14											45
50	☒	8				Boring terminated at 50 ft.							50

BORING LOG

PROJECT NO.: 0830.1800134
APPENDIX:
PAGE: 3

PROJECT: Proposed Sea Ranch Residential Development
Sea Ranch Drive
Hudson, FL

ENGINEER: Thomas Grimm, P.E.

CLIENT: Design & Construction Innovations, LLC

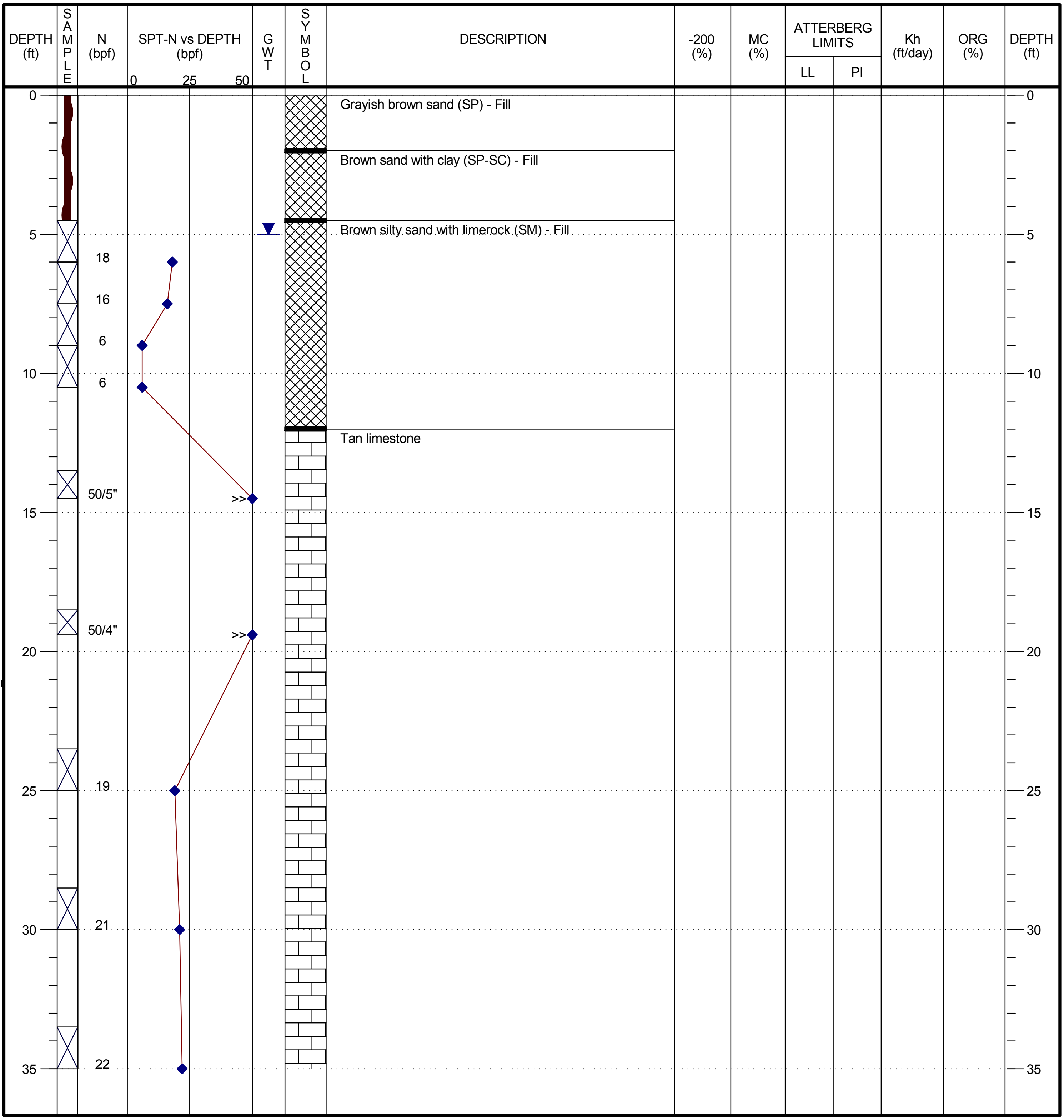
LOCATION: SEE BORING LOCATION PLAN

REMARKS:

BORING DESIGNATION: **B-02**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft):
WATER TABLE (ft): 5.0
DATE OF READING: 7-23-2018
EST. W.S.W.T. (ft):

DATE STARTED: 7/23/18
DATE FINISHED: 7/23/18
DRILLED BY: PH
TYPE OF SAMPLING: SPT



Grayish brown sand (SP) - Fill

Brown sand with clay (SP-SC) - Fill

Brown silty sand with limerock (SM) - Fill

Tan limestone

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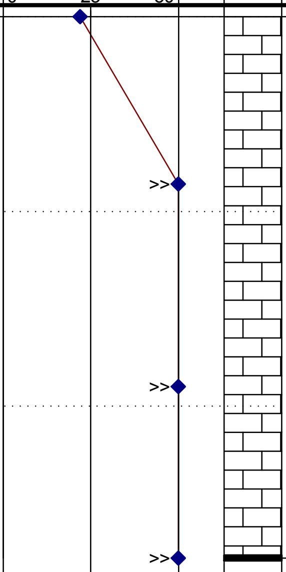
BORING LOG

PROJECT NO.: 0830.1800134
APPENDIX:
PAGE: 4

PROJECT: Proposed Sea Ranch Residential Development
Sea Ranch Drive
Hudson, FL

BORING DESIGNATION: **B-02**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (ft)	SAMPLE	N (bpf)	SPT-N vs DEPTH (bpf) 0 25 50	GWT	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	Kh (ft/day)	ORG (%)	DEPTH (ft)
35													35
	☒	50/3"	>>										
40													40
	☒	50/5"	>>										
45													45
	☒	50/5"	>>			Boring terminated at 48.9 ft.							



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BORING LOG

PROJECT NO.: 0830.1800134
APPENDIX:
PAGE: 5

PROJECT: Proposed Sea Ranch Residential Development
Sea Ranch Drive
Hudson, FL

ENGINEER: Thomas Grimm, P.E.

CLIENT: Design & Construction Innovations, LLC

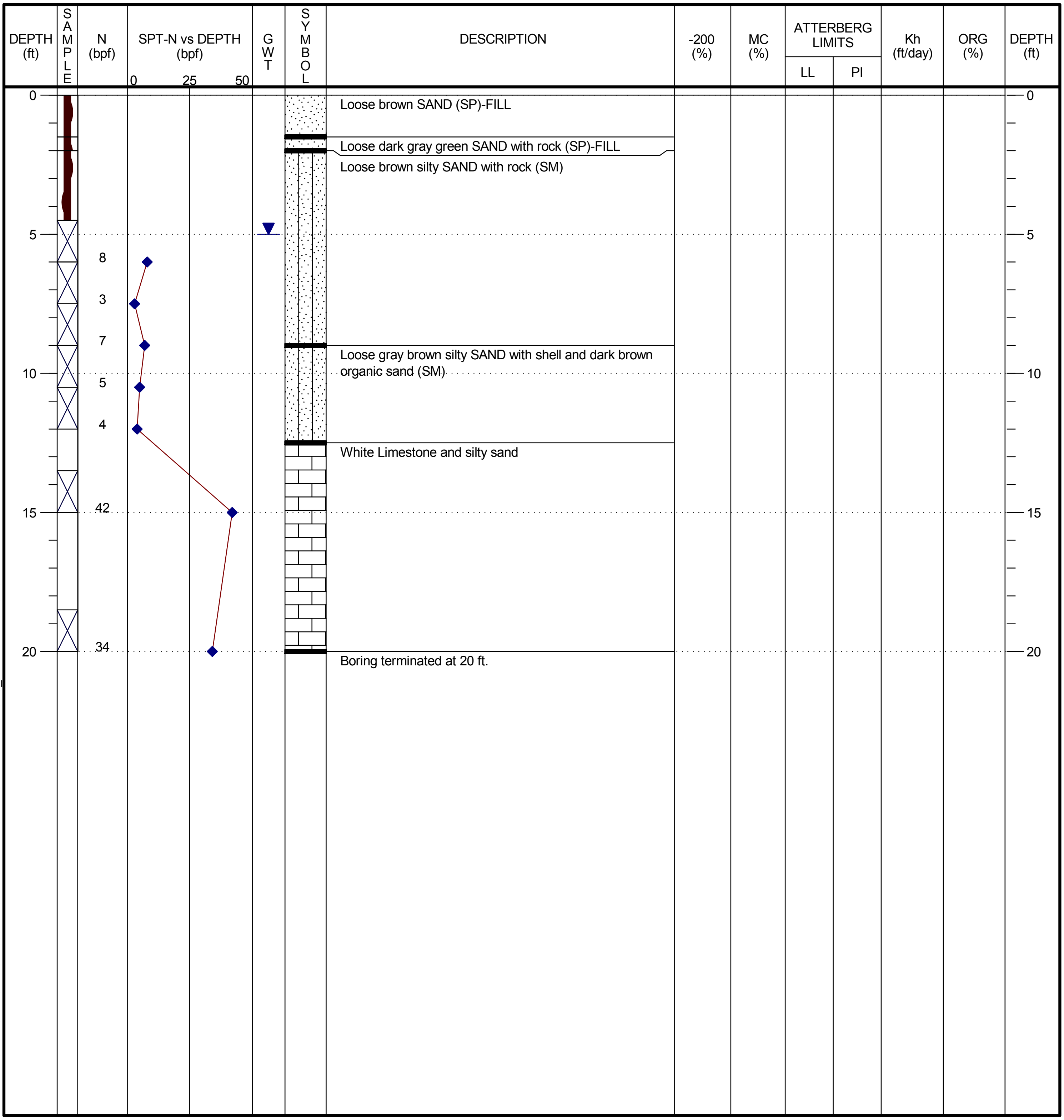
LOCATION: SEE BORING LOCATION PLAN

REMARKS:

BORING DESIGNATION: **B-03**
SHEET: **1 of 1**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft):
WATER TABLE (ft): 5
DATE OF READING: 8-6-2018
EST. W.S.W.T. (ft):

DATE STARTED: 8/6/18
DATE FINISHED: 8/6/18
DRILLED BY: JH
TYPE OF SAMPLING: SPT



DEPTH (ft)	N (bpf)	GWT	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	Kh (ft/day)	ORG (%)	DEPTH (ft)
0			Loose brown SAND (SP)-FILL							0
			Loose dark gray green SAND with rock (SP)-FILL							
			Loose brown silty SAND with rock (SM)							
5		▼								5
	8									
	3									
	7		Loose gray brown silty SAND with shell and dark brown organic sand (SM)							
10	5									10
	4									
			White Limestone and silty sand							
15	42									15
20	34		Boring terminated at 20 ft.							20

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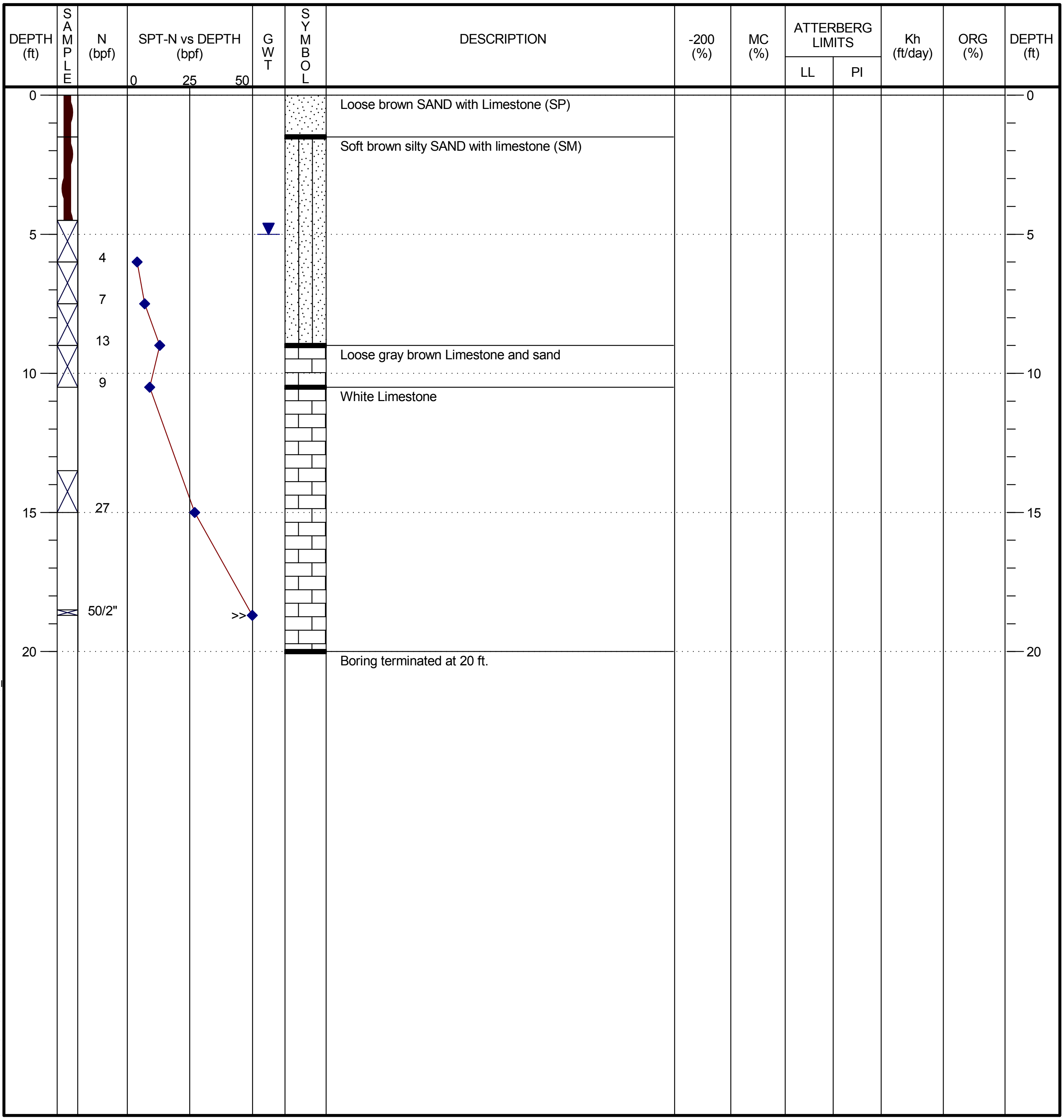
BORING LOG

PROJECT NO.: 0830.1800134
APPENDIX:
PAGE: 6

PROJECT: Proposed Sea Ranch Residential Development
Sea Ranch Drive
Hudson, FL
ENGINEER: Thomas Grimm, P.E.
CLIENT: Design & Construction Innovations, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: **B-04**
SHEET: **1 of 1**
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft):
WATER TABLE (ft): 5
DATE OF READING: 8-6-2018
EST. W.S.W.T. (ft):
DATE STARTED: 8/6/18
DATE FINISHED: 8/6/18
DRILLED BY: PH
TYPE OF SAMPLING: SPT



DEPTH (ft)	N (bpf)	GWT	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	Kh (ft/day)	ORG (%)	DEPTH (ft)
0			Loose brown SAND with Limestone (SP)							0
			Soft brown silty SAND with limestone (SM)							
5		▼								5
	4									
	7									
	13		Loose gray brown Limestone and sand							
10										10
	9		White Limestone							
15	27									15
	50/2"									
20			Boring terminated at 20 ft.							20

NEW UES BORING LOG 1800134 5913 SEA RANCH RESIDENCE.GPJ UES_NEW.GDT 8/10/18

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BORING LOG

PROJECT NO.: 0830.1800134
APPENDIX:
PAGE: 7

PROJECT: Proposed Sea Ranch Residential Development
Sea Ranch Drive
Hudson, FL

ENGINEER: Thomas Grimm, P.E.

CLIENT: Design & Construction Innovations, LLC

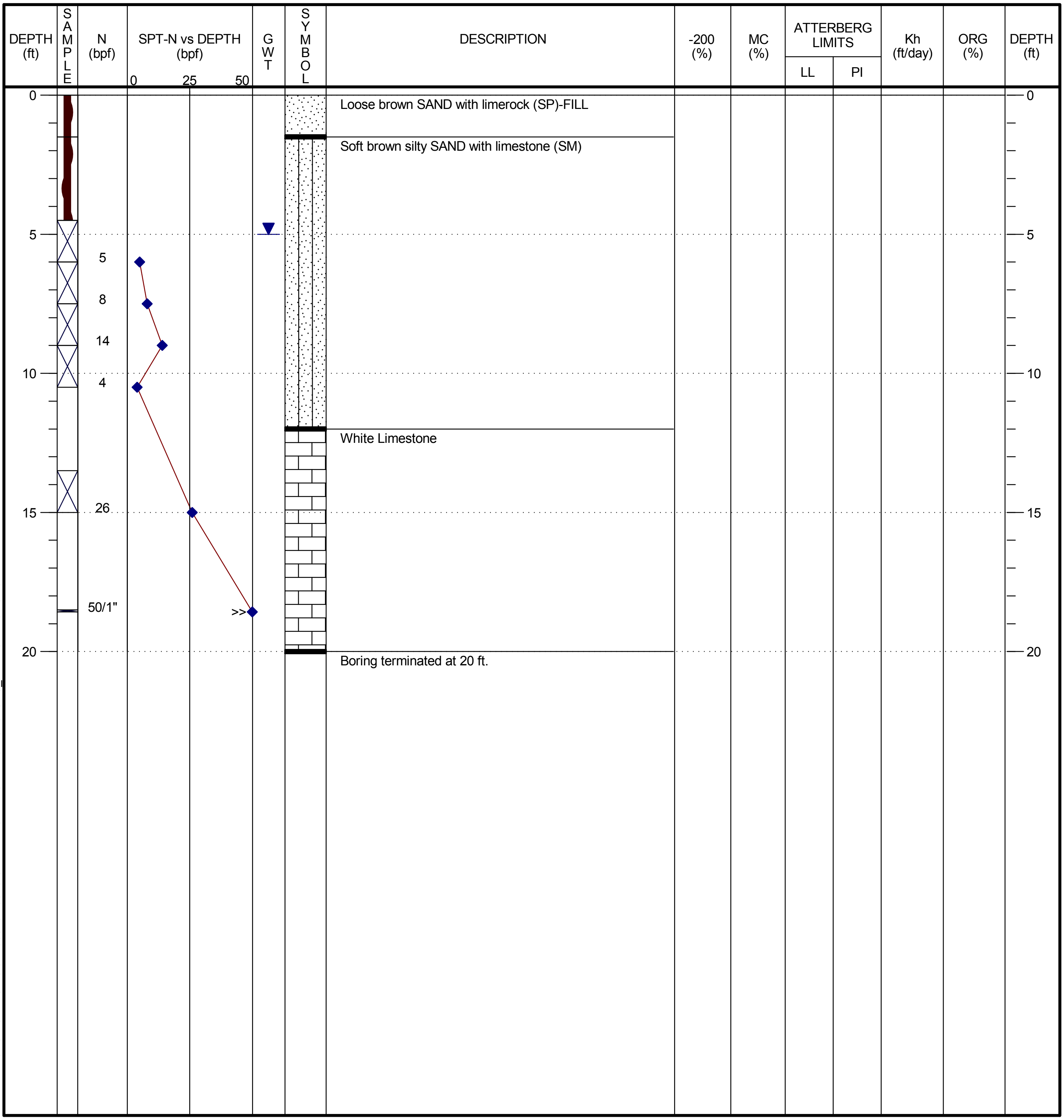
LOCATION: SEE BORING LOCATION PLAN

REMARKS:

BORING DESIGNATION: **B-05**
SHEET: **1 of 1**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft):
WATER TABLE (ft): 5
DATE OF READING: 8-6-2018
EST. W.S.W.T. (ft):

DATE STARTED: 8/6/18
DATE FINISHED: 8/6/18
DRILLED BY: PH
TYPE OF SAMPLING: SPT



DEPTH (ft)	SAMPLE	N (bpf)	GWT	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	Kh (ft/day)	ORG (%)	DEPTH (ft)
0				Loose brown SAND with limerock (SP)-FILL							0
				Soft brown silty SAND with limestone (SM)							
5			▼								5
	☒	5									
	☒	8									
	☒	14									
10	☒	4									10
				White Limestone							
15	☒	26									15
		50/1"									
20				Boring terminated at 20 ft.							20

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SOIL CLASSIFICATION CHART

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE-GRAINED SOILS (major portions retained on No. 200 sieve): includes (1) clean gravel and sands and (2) silty or clayey gravels and sands. Condition is rated according to relative density as determined by laboratory tests or standard penetration resistance tests.

Descriptive Terms	Relative Density	SPT Blow Count
Very loose	0 to 15 %	< 4
Loose	15 to 35 %	4 to 10
Medium dense	35 to 65 %	10 to 30
Dense	65 to 85 %	30 to 50
Very dense	85 to 100 %	> 50

FINE-GRAINED SOILS (major portions passing on No. 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings, SPT blow count, or unconfined compression tests.

Descriptive Terms	Unconfined Compressive Strength kPa	SPT Blow Count
Very soft	< 25	< 2
Soft	25 to 50	2 to 4
Medium stiff	50 to 100	4 to 8
Stiff	100 to 200	8 to 15
Very stiff	200 to 400	15 to 30
Hard	> 400	> 30

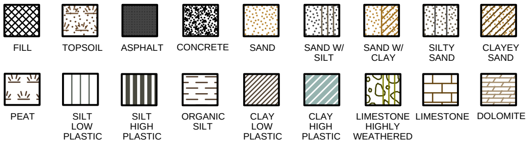
GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.

2. Surface elevations are based on topographic maps and estimated locations.

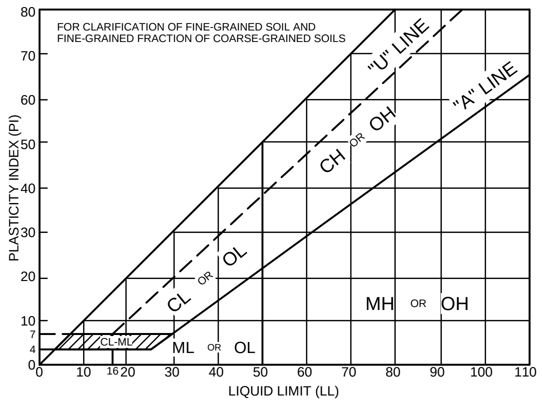
3. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not guaranteed to be representative of subsurface conditions at other locations or times.

SOIL SYMBOLS



OTHER SYMBOLS

▼	Measured Water Table Level	▽	Estimated Seasonal High Water Table

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria			
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, Depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows:	Less than 5 percent........ GW, GP, SW, SP More than 12 percent....... GM, GC, SM, SC 5 to 12 percent....... Borderline cases requiring dual symbols*	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines			Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures			Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-silt mixtures			Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines			$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly-graded sands, gravelly sands, little or no fines			Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures			Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures			Atterberg limits above "A" line or P.I. greater than 7	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	 Plasticity Chart			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
			OL	Organic silts and organic silty clays of low plasticity				
	Silts and Clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or disto-maceous fine sandy or silty soils, organic silts				
			CH	Inorganic clays of high plasticity, fat clays				
			OH	Organic clays of medium to high plasticity, organic silts				
	Highly Organic Soils		Pt	Peat and other highly organic soils				

Particle Size				
Material	Silt or clay	Sand Fine	Sand Medium	Sand Coarse
Sieve sizes	< #200	#200 to #40	#40 to #10	#10 to #4
mm	< 0.074	0.074 to 0.42	0.42 to 2.00	2.00 to 4.76

Particle Size				
Material	Gravel Fine	Gravel Coarse	Cobble	Boulders
Sieve	#4 to 3/4 in.	3/4 in. to 3 in.	3 in. to 12 in.	12 in. to 36 in.
mm	4.76 to 19.1	19.1 to 76.2	76.2 to 304.8	304.8 to 914.4

* When the percent passing a No. 200 sieve is between 5% and 12%, a dual symbol is used to denote the soil. For example; SP-SC, poorly-graded sand with clay content between 5% and 12%.

APPENDIX C

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

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CONSTRAINTS AND RESTRICTIONS

WARRANTY

Universal Engineering Sciences has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until construction begins. If variations appear, we may have to re-evaluate our recommendations after performing on-site observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Universal Engineering Sciences, as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Universal Engineering Sciences of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Universal Engineering Sciences to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Universal Engineering Sciences is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Universal Engineering Sciences.

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Universal Engineering Sciences.

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other explorations to determine those conditions that may affect construction operations. Universal Engineering Sciences cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Universal Engineering Sciences to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Universal Engineering Sciences to locate any such buried objects. Universal Engineering Sciences cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of exploration. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.