F E S G r o u p

- Geotechnical Engineering
- Environmental Site Assessments
- Construction Materials Testing

June 16, 2009

Mr. John J. Pacifici, P.E.
Malcolm Pirnie, Inc.
1300 East Eighth Avenue
Suite F100
Tampa, Florida 33605

Subject: **Report of Geotechnical Exploration**
Dude Ranch Acres
Bradenton, Manatee County, Florida
FES GROUP Project No. SG09014

Dear Mr. Pacifici:

In response to your request, **FES Group, Inc. (FES GROUP)** has conducted a subsurface exploration at the subject site. Enclosed are copies of the Report of Geotechnical Exploration.

FES GROUP appreciates the opportunity to provide Geotechnical Engineering services for this important project. Should you need additional services on this or any other project, **FES GROUP** offers the expertise of a selected collection of highly experienced, and motivated, Professional Engineers providing Geotechnical Engineering, Environmental Assessment services, as well as Construction Materials Engineering and Testing services throughout the United States.

Please do not hesitate to call should there be any questions about the subsurface exploration. We look forward to the opportunity to work for your organization on this and future projects.

Sincerely,

FES GROUP, INC.

Don R. Stites
Don R. Stites, PE
Principal Geotechnical Engineer

Jeff Prenatt
Jeffrey L Prenatt
President
National Client Manager

772 30TH Avenue North
St. Petersburg, FL 33704
PH: (727) 576-2000 FX: (727) 576-2022

EXECUTIVE SUMMARY

- The subject site is located in the east portion of Bradenton, Manatee County, Florida. Specifically, the subject site commences from the northeast portion of 47th Avenue East and extends southwest to Caruso Road with an additional short extension southward along Caruso Road. The subject project is expected to consist of the installation of a sewer main, lift station, and asphalt concrete pavement component design for approximately 3,000 linear feet. The sewer main route consisted of a paved roadway that appeared to be approximately level along with a relatively level site for the proposed lift station facility.

- As recorded immediately after drilling during the time of our subsurface exploration, and corroborated through a visual observation of the obtained soil samples, groundwater was encountered at an approximate depth range of 4 to 5 feet below existing pavement/ground surface. Based on our review of the soil coloring characteristics, available published information, and the measured groundwater, it is estimated that the normal seasonal high groundwater level will be encountered approximately one foot below existing pavement/ground surface.

- The test borings generally encountered soils which were arranged in a two layer configuration. Underlying the existing pavement components, the initial soil layer generally consisted of very loose to medium dense fine SAND/slightly silty fine SAND/silty SAND (SP/SP-SM/SM) that extended to an approximate depth of 12 to 15 feet below existing pavement/ground surface. The second soil layer consisted of medium dense clayey SAND (SC) which contained some phosphates that extended to auger termination at an approximate maximum depth of 25 feet below existing pavement/ground surface. As an important exception, it should be noted that boring B-5 encountered the clayey SAND at an approximate depth of four feet below the existing ground surface elevations.

- Based upon the anticipated construction and recommended site preparation, it is expected that the foundations at the lift station structures may be designed for net maximum allowable bearing pressures which do not exceed 2,500 pounds per square foot (psf).

- The settlement associated with the shallow foundation system is expected to be on the order of one inch, with the settlement primarily occurring within 30 days of the loading application. Local dewatering of the foundation construction area, which is expected to be required, is also expected to act as a as a surcharge load and further reduce the expected settlements.

- Based upon our evaluation and analyses, the subsurface conditions encountered should be acceptable for construction and support of a flexible and/or rigid pavement structures.

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REPORT OF

GEOTECHNICAL EXPLORATION

FOR

DUDE RANCH ACRES

BRADENTON, MANATEE COUNTY, FLORIDA

Prepared for:

MALCOLM PIRNIE, INC.

Prepared by:

FES GROUP, INC.
St. Petersburg, Florida

June 16, 2009

FES GROUP Project SG09014

State of Florida Certificate of Authorization Number 26461

F E S G r o u p

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Subject: **Report of Geotechnical Exploration**
Dude Ranch Acres
Bradenton, Manatee County, Florida
FES GROUP Project No. SG09014

Dear Mr. Pacifici:

FES GROUP, Inc. (FES GROUP) has completed the requested geotechnical exploration for the above-referenced project. The results of the subsurface exploration have been evaluated and are presented in this Report of Geotechnical Exploration.

This report presents a review of the project information provided to us, a description of the site and subsurface conditions encountered as well as our foundation, earthwork and pavement recommendations for the proposed project. The Appendices to the report contain site and boring location figures, the results of our field and laboratory testing, boring logs, and site photographs.

We appreciate this opportunity to provide our services to **Malcolm Pirnie, Inc.** and we look forward to serving as your geotechnical consultant throughout this project. Should you have any questions in regards to the information presented in this report, please do not hesitate to contact us at your earliest convenience.

Sincerely,

FES GROUP, INC.

Don R. Stites
Don R. Stites, PE
Principal Geotechnical Engineer
Florida Registration No. 42290

Jeff Prenatt
Jeffrey L Prenatt
President
National Client Manager

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EXECUTIVE SUMMARY

- The subject site is located in the east portion of Bradenton, Manatee County, Florida. Specifically, the subject site commences from the northeast portion of 47th Avenue East and extends southwest to Caruso Road with an additional short extension southward along Caruso Road. The subject project is expected to consist of the installation of a sewer main, lift station, and asphalt concrete pavement component design for approximately 3,000 linear feet. The sewer main route consisted of a paved roadway that appeared to be approximately level along with a relatively level site for the proposed lift station facility.

- As recorded immediately after drilling during the time of our subsurface exploration, and corroborated through a visual observation of the obtained soil samples, groundwater was encountered at an approximate depth range of 4 to 5 feet below existing pavement/ground surface. Based on our review of the soil coloring characteristics, available published information, and the measured groundwater, it is estimated that the normal seasonal high groundwater level will be encountered approximately one foot below existing pavement/ground surface.

- The test borings generally encountered soils which were arranged in a two layer configuration. Underlying the existing pavement components, the initial soil layer generally consisted of very loose to medium dense fine SAND/slightly silty fine SAND/silty SAND (SP/SP-SM/SM) that extended to an approximate depth of 12 to 15 feet below existing pavement/ground surface. The second soil layer consisted of medium dense clayey SAND (SC) which contained some phosphates that extended to auger termination at an approximate maximum depth of 25 feet below existing pavement/ground surface. As an important exception, it should be noted that boring B-5 encountered the clayey SAND at an approximate depth of four feet below the existing ground surface elevations.

- Based upon the anticipated construction and recommended site preparation, it is expected that the foundations at the lift station structures may be designed for net maximum allowable bearing pressures which do not exceed 2,500 pounds per square foot (psf).

- The settlement associated with the shallow foundation system is expected to be on the order of one inch, with the settlement primarily occurring within 30 days of the loading application. Local dewatering of the foundation construction area, which is expected to be required, is also expected to act as a as a surcharge load and further reduce the expected settlements.

- Based upon our evaluation and analyses, the subsurface conditions encountered should be acceptable for construction and support of a flexible and/or rigid pavement structures.

2.0 INTRODUCTION

2.1 PROJECT CHARACTERISTICS

The subject project is expected to consist of the installation of a lift station facility with sewer main extending approximately 3,000 feet including new asphalt concrete pavement components. The maximum loadings associated with the proposed structures were not available at the time of this report. Based upon our previous experience with similar projects, however, the maximum loadings associated with the proposed structure are expected to be as follows:

Support Structures

Wall Load:	1 to 2 kips/linear ft.
Floor Load:	200 lbs. /sq. ft.

2.2 SITE DESCRIPTION

The subject site is located at an existing subdivision for Dude Ranch Acres, in the city of Bradenton, Manatee County, Florida and commences from the northeast portion of 47th Avenue East and extends southwest to Caruso Road with an additional short extension southward along Caruso Road. The proposed sewer main route consisted of a paved roadway that appeared to be approximately level and the proposed lift station site also appeared relatively level adjacent to Caruso Road. Photographs of the subject site during the time of our site visit have been included in the Appendix of this report.

2.3 PURPOSE AND SCOPE

The purpose of this study was to obtain information on the general subsurface conditions at the proposed project site. The subsurface materials encountered were then evaluated with respect to the available project characteristics. Engineering assessments for the following items were formulated:

- General location and description of potentially deleterious materials encountered in the borings, which may interfere with construction progress or structure performance, including existing fills or surficial/subsurface organics.
- Identification of the existing groundwater levels and estimated normal seasonal high groundwater fluctuations.

- Evaluation of a shallow foundation system to be used for support of the proposed development structures. Identification of recommended shallow foundation design parameters, including allowable bearing pressures, foundation levels and expected total and differential settlements.

- Evaluation of the suitability and availability of materials on-site that may be moved during site grading for use as structural fill.

- Pavement thickness design and construction suggestions, considering the encountered subgrade soils and the measured groundwater conditions.

- Presentation of construction recommendations, including expected ground water control measures, temporary slope stability recommendations, and unsuitable soil removal guidelines.

The following services were provided in order to achieve the preceding objectives:

- Coordinated with utility location services in order to avoid possible underground utilities.

- Visually observed the existing ground surface conditions.

- Reviewed readily-available published geologic and topographic information. This included information from the Soil Survey documents published by the United States Department of Agriculture (USDA) and Quadrangle Maps published by the United States Geological Survey (USGS).

- Executed a field subsurface exploration consisting of soil sampling. A total of six soil borings were performed along the route of the proposed sewer main and area of the proposed lift station. The test borings were extended to an approximate depth range of 6 to 25 feet below existing pavement/ground surface.

- Visually classified and stratified representative soil samples using the Unified Soil Classification System (USCS). Identified soil conditions at each boring location and formed an opinion of the site soil stratigraphy.

- Collected groundwater level measurements and estimated normal wet seasonal high groundwater levels.

- The results of the field exploration were used in the engineering analyses and in the formulation of the recommendations. The results of the subsurface exploration, including the recommendations and the data upon which they are based, are presented in this formal written report prepared by an experienced Professional Engineer.

The scope of this exploration was intended to evaluate soil conditions within the primary influence of the expected sewer pipeline and structure foundations, and does not include an evaluation of potential deep soil conditions, such as mining and/or sinkholes. An evaluation of potential deep soil conditions may be performed at your request and with your authorization. In order to perform such an evaluation, it is expected that deeper soil test borings and Ground Penetrating Radar (GPR) will be required.

The scope of our services does not include an environmental assessment or exploration for the presence or absence of hazardous or toxic materials in the soil, ground water, or surface water within or beyond the site studied. Any statements in the report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client.

2.4 REPORT FORMAT

This report begins with a discussion of the field program followed by a description of the general subsurface conditions. Evaluations are presented for the selected foundation alternative. The site vicinity maps are presented on Figures 1 and 2, the approximate soil boring locations are presented in Figure 3, the USGS topographic map is presented as Figure 4, and an aerial photograph is presented as Figure 5. The soil boring logs and site photographs are also attached to the Appendix of this report.

3.0 FIELD EXPLORATION

In order to explore the general foundation soil types and to aid in developing associated design parameters, a total of six soil borings were performed along the area of the proposed sewer pipeline and lift station. The test borings were extended to an approximate depth range of 6 to 25 feet below existing pavement/ground surface. It should be noted that the performance of boring B-6 was limited due to site access restrictions. In this regard, boring B-6 was limited to manual services.

The boring locations were determined in the field from existing pavement/ground surface features and house numbers. It is important to note that pavement/ground surface elevations at the boring locations were neither furnished nor determined prior to or during the subsurface exploration. The test boring locations presented above are depicted in Figure 3 in the Appendix. The boring locations illustrated in the Appendix should be considered accurate only to the degree implied by the method used. If more precise locations are desired, we suggest that a registered surveyor be retained.

3.1 SOIL TEST BORINGS

The soil test borings were initially performed with manual auger equipment in order to avoid potential underground utility interferences. The soil test borings were then advanced with a truck-mounted drill rig using Bentonite slurry "Mud" Rotary drilling procedures. The soil sampling was performed in general accordance with ASTM Test Designation D-1586, entitled *Penetration Test and Split-Barrel Sampling of Soils*. Samples were obtained at intervals of two feet to a depth of ten feet, and at intervals of five feet thereafter. Representative portions of these soil samples were sealed in containers, labeled and transferred to our laboratory for classification and testing.

3.2 AUGER BORINGS

The auger borings were advanced using a combination of solid stem augers, manual stainless steel "bucket" augers, and direct-push procedures. The soil sampling was performed in general accordance with ASTM Test Designation D-1452, titled "Soil Investigation and Sampling by Auger Borings." These samples were taken "continuously" from ground surface to an approximate depth range of 6 to 25 feet below ground surface.

4.0 LABORATORY TESTING

The soil samples were identified and classified in the field by the Geotechnical Engineer using the Unified Soil Classification System (USCS) in general accordance with ASTM Test Designation D-2488. Due to the structural characteristics of the proposed residences and the nature of the soils encountered, refined laboratory testing methods were not deemed necessary. Note that any soil samples obtained from the site will be properly disposed of 30 days following the submittal of the **FES GROUP** subsurface exploration report.

5.0 GENERALIZED SUBSURFACE CONDITIONS

5.1 COUNTY SOIL SURVEY

The *Soil Survey of Manatee County, Florida*, published by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS), was reviewed for general near-surface soil information within the general vicinity of the subject project. This information indicates that there are two primary soil mapping units within the proposed project area. The soil map unit characteristics are tabulated below:

SOIL SERIES	DEPTH (INCHES)	UNIFIED SOIL CLASS	PERMEABILITY RATING (INCHES/HOUR)	USDA SEASONAL HIGH GROUNDWATER TABLE DEPTH (FEET)	HYDROLOGIC GROUP
EauGallie Fine Sand (20)	0 – 28 28 – 42 42 – 50 50 – 65	SP, SP-SM SP-SM, SM SM, SM-SC, SC SP-SM, SM	6.0 – 20 0.6 – 6.0 0.6 – 6.0 2.0 – 6.0	0 – 1.0 Apparent Jun – Oct	B/D
Floridana (Immokalee - Okeelanta) Association (26)	0 – 19 19 – 36 36 – 63	SP-SM, SM SP, SP-SM SM-SC, SC	6.0 – 20 6.0 – 20 <0.2	+2.0 – 1.0 Apparent Jun – Feb	B/D

5.2 USGS TOPOGRAPHIC SURVEY

The topographic survey map published by the United States Geological Survey (USGS) entitled *Lorraine, FL*, dated 1987, was reviewed for ground surface features at the proposed project location (see Figure 4 in the Appendix of this report). Based on this review, the subject site generally appeared to consist of a residentially developed area adjacent to the north bank of Williams Creek. The natural ground surface elevation appears to be approximately +15 feet (above) the National Geodetic Vertical Datum of 1927 (NGVD). Marsh-type areas appear to be located within the general vicinity of the subject property, which is a common occurrence within the site area.

5.3 AERIAL PHOTOGRAPH

Based on the Aerial Photograph, the property is appears to be a residential developed area, consistent with site observations during the time of our site visit. A copy of the aerial photograph has been included in the Appendix of this report as Figure 5.

5.4 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the boring locations are described on the Soil Boring Logs in the Appendix of this report. The boring logs represent our interpretation of the subsurface conditions based on the field logs, and visual observation of field samples by an experienced Professional Engineer. These logs describe the visual characteristics of all soil strata encountered using the Unified Soil Classification System. Groundwater observations, sampling information and other pertinent field data and observations are also included. The lines designating the interfaces between various strata on the Soil Boring Logs represent the approximate interface locations. In addition, the transitions between strata may be gradual. Water levels shown on the Soil Boring Logs represent the conditions only at the time of our exploration. It should be understood that soil and rock conditions may vary between boring locations. The test borings generally encountered soils which were arranged in a two-layer configuration.

Underlying the existing pavement components, the initial soil layer generally consisted of very loose to medium dense fine SAND/slightly silty fine SAND/silty SAND (SP/SP-SM/SM) that extended to an approximate depth of 12 to 15 feet below existing pavement/ground surface. These soils were measured to be of very loose to loose relative density, with measured SPT N-Values generally ranging from 3 to 18 blows per foot (bpf).

The second soil layer consisted of yellowish brown to dark gray clayey SAND (SC) that extended to auger termination (an approximate maximum depth of 25 feet below existing pavement/ground surface). These soils were measured to be medium dense to dense relative density, with the measured SPT N-Values generally ranging from 15 to 46 bpf.

The subsurface exploration program indicated that the subsurface soils are generally uniform across the proposed site. As an important exception, it should be noted that boring B-5 encountered the clayey SAND at an approximate depth of four feet below the existing ground surface elevations. No "raveled" conditions indicative of sinkhole type activity were encountered during this subsurface exploration program.

5.5 GROUNDWATER CONDITIONS

As recorded immediately after drilling during the time of our subsurface exploration, and corroborated through a visual observation of the obtained soil samples, groundwater was encountered at an approximate depth range of 4 to 5 feet below existing pavement/ground surface elevations.

Groundwater levels tend to fluctuate during periods of prolonged drought and extended rainfall and may be affected by man-made influences. In addition, a seasonal effect may also occur during which higher groundwater levels are normally recorded in rainy seasons. Based on our review of the soil coloring characteristics, available published information, and the measured groundwater, it is estimated that the normal seasonal high groundwater level will be encountered approximately one foot below existing pavement/ground surface.

If the groundwater level is critical to design or construction, groundwater observation wells should be installed on-site to monitor groundwater fluctuations over a period of time and to permit more accurate determinations of wet season and dry season levels.

6.0 DESIGN RECOMMENDATIONS

The following design recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions encountered during this exploration. The test boring data was evaluated using correlations for engineering performance characteristics of similar subsurface conditions. If there is any change in these project criteria, including project location, a review must be made by **FES GROUP** to determine if any modifications to the recommendations will be required. The findings of such a review should then be presented in a supplemental report.

After final design plans and specifications are available, a general review by **FES GROUP** is strongly recommended as a means to check that the evaluations made in preparation of this report are correct, and that earthwork and foundation recommendations are properly interpreted and implemented.

6.1 GENERAL

The test borings encountered fine SAND/slightly silty fine SAND/silty SAND (SP/SP-SM/SM) that extended to an approximate depth of 12 to 15 feet below existing pavement/ground surface. Groundwater was encountered at an approximate depth range of 4 to 5 feet below existing pavement/ground surface, with the normal seasonal high groundwater level expected to be encountered one foot below the existing ground surface elevations.

Based upon our evaluation and analyses, following proper subgrade preparation, the subsurface soils are capable of supporting the proposed sewer pipeline and asphalt concrete pavement components. The lift station structures should be suitably supported by a shallow foundation.

6.2 SHALLOW FOUNDATIONS

Based upon the anticipated construction and recommended site preparation, shallow foundation support for the lift station structures may be designed for a net maximum allowable bearing pressure of 2,500 pounds per square foot (psf). The foundation footings should bear on approved subgrade soils and/or properly placed and compacted structural fill materials of acceptable suitability, as approved by the Geotechnical Engineer.

The foundations are expected to bear on dense slightly silty SAND at least six feet below the adjacent compacted grades and be a minimum of four feet wide. All footings should be embedded so that the

bottom of the foundation is a minimum of 16 inches below the adjacent compacted grades on all sides; interior foundations may be located at nominal depths below the concrete floor slab.

Wall footings should be a minimum of 18 inches wide and column footings should be a minimum of 24 inches wide. The minimum footing size should be used regardless of whether or not the foundation loads and allowable bearing pressures dictate a smaller size. These minimum footing size tends to provide adequate load bearing area to develop overall bearing capacity and account for minor variations in the bearing materials. Structural elements should be centered on the footings such so that loads are transferred evenly, unless the footings are adequately proportioned for eccentric loads.

6.3 SETTLEMENT

The settlement of the proposed structures is expected to occur rapidly. In this regard, the majority of expected settlements are expected to occur within 30 days following the application of the applied load. Provided that the recommended subgrade preparation operations are properly performed, the total settlement of the generator pads is expected to be less than one inch, with differential settlements on the order of 50 percent of the total settlements. The total and differential settlements of these magnitudes are usually considered tolerable for the anticipated construction; the tolerance of the proposed structure to the predicted total and differential settlements should be confirmed by the Structural Engineer.

7.0 UTILITY AND SEWER PIPELINE EXCAVATION

We expect underground utilities will be installed to an approximate maximum depth range of 5 to 10 feet below existing grade. It is currently expected that the excavation for these utilities will be open-cut slopes. If a sheetpile-supported excavation will be used, please contact **FES GROUP** for recommended earth pressure parameters for use in design. The expected underground soils are expected to consist of very loose to medium dense fine SAND/slightly silty fine SAND/silty SAND (SP/SP-SM/SM). Based on the groundwater conditions encountered during the time of the subsurface exploration, wellpoints are expected to be required to provide satisfactory dewatering for excavations.

Based on our experience with similar soil conditions, it is expected that excavation of the subsurface soils may be readily accomplished with conventional construction equipment, such as a track-mounted backhoe having a bucket capacity of two cubic yards equipped with "teeth". The use of percussion equipment and/or blasting is not expected to be required.

Following underground utility installation operations, backfill should be placed evenly on all sides of the underground structures. Backfill materials should consist of approved structural fill. It is recommended that a Geotextile Filter Fabric, such as Mirafi 140N, or approved equivalent, be properly placed between any open-graded bedding stone and any overlying structural fill soils in order to prevent infiltration of the overlying soils into the underlying open-graded material.

Structural fill materials should be properly compacted using manual compaction equipment (equipment with a total weight less than 2,000 lbs.). We further recommend that structural backfill soils be placed within two percent of the Modified Proctor optimum moisture content, and compacted to at least 98 percent of the Modified Proctor maximum dry density. Backfill lift thickness should be limited to six inches due to the lightweight equipment.

8.0 EARTH PRESSURES ON WALLS

Retaining walls should be designed to resist pressures exerted by the adjacent soils. In order to reduce the loads being applied to the underground foundation walls and to promote positive water drainage, it is recommended that a granular backfill be placed directly behind the walls and extended laterally a minimum distance equal to the wall height. These granular soils should be relatively clean, free-draining granular materials containing less than five percent passing the No. 200 sieve.

For walls that are not restrained during backfilling, and are free to rotate at the top, active earth pressures should be considered in their design. Walls that are restrained should be designed using at-rest pressures. Recommended soil parameters for the near-surface granular soils encountered are presented below:

Total Unit Weight, Ww	=	120 lbs/ft^3
Angle of Internal Friction, Ø	=	33°
At-rest Soil Pressure, Ko	=	0.50
Active Soil Pressure, Ka	=	0.33
Passive Soil Pressure, Kp =	3.00	
Coefficient of Sliding Friction, f	=	0.40

It should be noted that adequate drainage should be provided behind the walls to prevent the build-up of excess hydrostatic pressures, unless the walls are designed to support hydrostatic loading conditions, such as occurs below the groundwater elevation.

Wall rotation may be reduced by tying the wall directly into the floor slab. It is also important to note that wall damage due to excessive compaction or vibration may be avoided by utilizing hand-operated mechanical tampers. If these are used to compact the granular materials; heavy compaction equipment should not be allowed within ten (10) feet of the walls. The compaction behind these walls should be in the range of 93 to 97 percent of the Modified Proctor maximum dry density (ASTM D-1557).

9.0 PAVEMENT THICKNESS RECOMMENDATIONS

We understand that it is considered desirable to use a flexible pavement section within the proposed pavement areas. Therefore, the pavement recommendations presented in the following sections are considered minimum for the site, soil and limited traffic conditions expected. The final pavement thickness design should be determined by the project civil engineer using information obtained during the subsurface exploration program and an analysis of anticipated traffic conditions.

9.1 SUBGRADE

The initial soil layer generally consisted of fine SAND/slightly silty fine SAND/silty SAND (SP/SP-SM/SM) that extended to an approximate depth of 12 to 15 feet below existing pavement/ground surface. Based upon our evaluation and analyses, following the proper removal of any "Topsoil", the soils should be acceptable for construction and support of pavement component sections after proper subgrade preparation, provided that drainage controls are implemented. The stripped subgrade should be compacted to a minimum depth of 12 inches to at least 98 percent of the Modified Proctor maximum dry density (ASTM D1557). Any fill used to elevate the cleared pavement areas to subgrade elevation should consist of reasonably clean well-graded to fine sands, uniformly compacted to a minimum density of 98 percent of the soil Modified Proctor maximum dry density (ASTM D1557).

Note that Limerock Bearing Ratio (LBR) tests were not requested nor performed during this subsurface exploration program. We recommend that during the pavement design phase, LBR testing be performed on the natural subgrade materials and/or the proposed structural fill materials, as appropriate. Based on our experience with similar materials, the existing soils are expected to have an LBR value on the order of 18.

9.2 BASE

The choice of pavement base type will basically depend upon desired final pavement grades. If a minimum separation of 18 to 24 inches can be maintained between the bottom of the base and the normal seasonal high groundwater level, then a limerock base can be used. If a minimum separation of 12 to 18 inches can be maintained between the bottom of the base and the normal seasonal high groundwater level, a crushed concrete base can be used. For minimum separation of 6 to 12 inches between the bottom of the base and the normal seasonal high groundwater level, a soil cement base should be used.

Limerock base material should meet FDOT requirements, including compaction to 98 percent of its maximum dry density as determined by the Modified Proctor Test (ASTM D-1557) and a minimum Limerock Bearing Ratio (LBR) of 100 percent. Crushed concrete should have an LBR value of 100 percent and be graded in accordance with Florida Department of Transportation (FDOT) Standard Specification Section 204. Due to the subgrade soil conditions, it is recommended that type B stabilized subgrade (LBR = 30%) be used, as specified by the FDOT Standard Specifications for Road and Bridge Construction. As a minimum, the stabilized subgrade thickness should be equal to the thickness of the pavement base. Traffic should not be allowed on the subgrade before the base is placed to avoid rutting.

A soil cement base should be designed according to FDOT or PCA modified short cut design procedure. A strength of 300 psi should be achieved on laboratory-cured compressive strength specimens molded from samples taken from the base material as it is placed. A stabilized subgrade need not be incorporated with a soil cement base. However, the subgrade should be compacted to a minimum depth of 12 inches to at least 98% of the Modified Proctor Test maximum dry density, and should be firm and true to line and grade prior to paving. Before paving, the soil cement base should be checked for soundness. Traffic should not be allowed on the subgrade before the base is placed to avoid rutting.

As a guideline for pavement design, we recommend that the limerock, crushed concrete and soil cement base materials be a minimum of six inches thick under light duty areas and eight inches thick under heavily-traveled driving areas.

9.3 ASPHALT CONCRETE

The asphalt concrete structural course should consist of at least 1½ to 2 inches of Type S asphalt concrete material. We recommend that at least 1½ inches of asphalt concrete be used in the light duty areas and 2 inches be used in heavily-traveled driving areas. Type S-I or S-III should be used because of their durability qualities. If Type S-I is selected the asphalt should be placed at least 1½ inches thick because of the larger size of the coarse aggregate. The asphalt concrete should meet standard FDOT material requirements and placement procedures as outlined in the current FDOT *Standard Specifications for Road and Bridge Construction.* The asphalt should be compacted to a minimum of 96% of the Marshall maximum laboratory unit weight.

9.4 FLEXIBLE ASPHALT PAVEMENT

The following pavement designs are based upon the design methods described in the FDOT *Flexible Pavement Design Manual for New Construction and Pavement Rehabilitation* (Document No. 625-010-002-b, dated April 1, 1993). These designs present the recommended range of 18-kip-equivalent single axle loads for the "light duty" and "heavy duty" pavement sections presented.

Pavement Duty	Pavement Structural Section		SSV	Structural Number	18 Kip Equivalent Single Axle Loads (lbs)
Light	1½" Type S Asphalt Concrete	6" Crushed Limerock	5.0	1.74	40,000
	1½" Type S Asphalt Concrete	6" Soil Cement	5.0	1.56	20,000
Heavy	2" Type S Asphalt Concrete	8" Crushed Limerock	5.0	2.32	200,000
	2" Type S Asphalt Concrete	8" Soil Cement	5.0	2.08	100,000

Note: Crushed concrete is considered to be similar as crushed limerock

10.0 CONSTRUCTION CONSIDERATIONS

10.1 FILL PLACEMENT AND SUBGRADE PREPARATION

The following are our recommendations for overall site preparation and mechanical densification work for construction of the proposed sewer pipeline and lift station supporting foundation, based on the anticipated construction and our boring results. These recommendations should be used as a guideline for the project general specifications prepared by the Design Engineer.

1. Prior to construction, the location of any existing underground utility lines within the construction area should be established. Provision should then be made to relocate any interfering utility lines from the construction area to appropriate locations. In this regard, it should be noted that if underground pipes are not properly removed or plugged, they may serve as conduits for subsurface erosion which subsequently may result in excessive settlements.

2. The existing "Topsoil" and pavement should be removed to the satisfaction of the Geotechnical Engineer; it is recommended that the clearing operations extend at least two feet beyond the structure perimeters.

3. The exposed subgrade should then be evaluated as directed by **FES GROUP** to confirm that all unsuitable materials, if any, have been removed and that the soils are capable of supporting the proposed pavement structure.

4. It is recommended that within the pump station structure area, the natural ground be compacted to a dry density of at least 95 percent of the Modified Proctor Test maximum dry density (ASTM D-1557) to a minimum depth of one foot below the foundation bearing elevation.

5. Within the pavement areas the natural in-place soils need to be compacted to a dry density of at least 98 percent of the Modified Proctor Test maximum dry density (ASTM D-1557) as tested to a depth of one foot below the stripped grade.

6. Following satisfactory completion of the compaction operations, the proposed pump station and pavement structure areas may be brought up to finished subgrade levels, as required. Fill should consist of fine sand with less than 12 percent passing the No. 200 sieve, and be free of rubble, organics, clay, debris and other unsuitable material. Fill should be tested and approved by **FES GROUP** prior to acquisition. Approved sand fill should be placed in loose lifts not exceeding six inches in thickness. It is recommended that the fill soils be compacted to a dry density of at least 95 percent of the Modified Proctor Test maximum dry density (ASTM D-1557) within the pump station structure areas and 98 percent of the Modified Proctor Test maximum dry density (ASTM D-1557) within the pavement areas.

7. Soil moisture content may need to be controlled in order to facilitate proper compaction. If additional moisture is necessary to achieve the compaction objectives of imported fill, then water should be applied in such a way that will not cause erosion or removal of the subgrade soils. A moisture content within two percentage points of the optimum indicated by the Modified Proctor Test (ASTM D-1557) is recommended prior to compaction of the natural ground and fill.

8. It is considered essential that all foundation excavations should be observed and evaluated by the Geotechnical Engineer or his representative to explore the extent of any fill and excessively loose, soft, or otherwise undesirable materials.

9. A representative from **FES GROUP** should be retained to provide on-site observation of earthwork and ground modification activities. Density tests should be performed within the top one foot of compacted existing ground, after each fill lift, and at the bottom of foundation excavations. It is important that **FES GROUP** be retained to observe that the subsurface conditions are as we have discussed and reported herein, and that foundation construction, ground modification and fill placement are in accordance with our recommendations.

10.2 GROUNDWATER CONTROL

Groundwater levels should be determined immediately prior to excavations and construction. We recommend that groundwater be kept at least 36 inches below the lowest working area to facilitate construction operations proper material placement and compaction. It is currently expected that well-points are expected to be required to properly control groundwater during excavation operations.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against any detrimental change in conditions, such as physical disturbance or rain water. Surface runoff water should be drained away from the excavations and not be allowed to pond. If possible, all foundation concrete should be placed the same day that the excavations are made. If this is not possible, the foundation excavations should be adequately protected in the interim.

10.3 TEMPORARY SIDE SLOPES

Side slopes for temporary excavations are expected to remain stable at two horizontal to one vertical (2H:1V) for short dry periods of time to a maximum excavation depth of ten feet. Where restrictions do not permit slopes to be constructed as recommended above, the excavation should be shored and braced in accordance with current OSHA requirements. During foundation construction, excavated materials should not be stockpiled at the top of any slope within a horizontal distance equal to the excavation depth.

10.4 ON-SITE SOIL SUITABILITY

All materials to be used for backfill or compacted fill construction should be evaluated and, if necessary, tested by **FES GROUP** prior to placement to determine if they are suitable for the intended use. In general, based upon the boring results, the majority of the on-site fine SAND (SP), and slightly silty SAND (SP-SM) are expected to be SUITABLE for use as structural fill. The silty SAND (SM) is expected to be suitable following mixing with some of the "cleaner" on site soils. Suitable structural fill materials should consist of fine to medium sand with less than 12 percent passing the No. 200 sieve, and be free of rubble, organics, clay, debris and other unsuitable material. The clayey SAND (SC) is expected to be UNSUITABLE for use as structural fill.

11.0 BASIS FOR RECOMMENDATIONS

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This company is not responsible for the conclusions, opinions or recommendations made by others based upon this data.

The scope of the exploration was intended to evaluate soil conditions within the primary influence of the proposed sewer pipeline and shallow foundation structures and does not include an evaluation of potential deep soil conditions, such as sinkholes. The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated. Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions between borings will be different from those at specific boring locations and that conditions will not be as anticipated by the designers or contractors. In addition, the construction process itself may alter soil conditions.

If any subsoil variations become evident during the course of this project, a re-evaluation of the recommendations contained in this report will be necessary after we have had an opportunity to observe the characteristics of the conditions encountered. The applicability of this report should also be reviewed in the event that significant changes occur in the design, nature or location of the proposed construction.

The recommendations provided herein are based in part upon project information provided to us and they apply only to the specific project and site discussed in this report. If the project information is incorrect or if additional information is available, the correct or additional information should be conveyed to us for review. Our recommendations may then be modified, if necessary. Experienced geotechnical personnel should observe and document the construction procedures used and the conditions encountered. Unanticipated conditions and inadequate procedures should be reported to the design team. We recommend that the owner retain **FES GROUP** to provide these services based upon our familiarity with the project, the subsurface conditions, and the intent of the recommendations and design criteria.

APPENDIX

FIGURES

FES GROUP, INC.
GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION INSPECTION SERVICES

772 30TH AVENUE NORTH
ST. PETERSBURG, FLORIDA 33704
PHONE: 727-576-2000 FAX: 727-576-2022

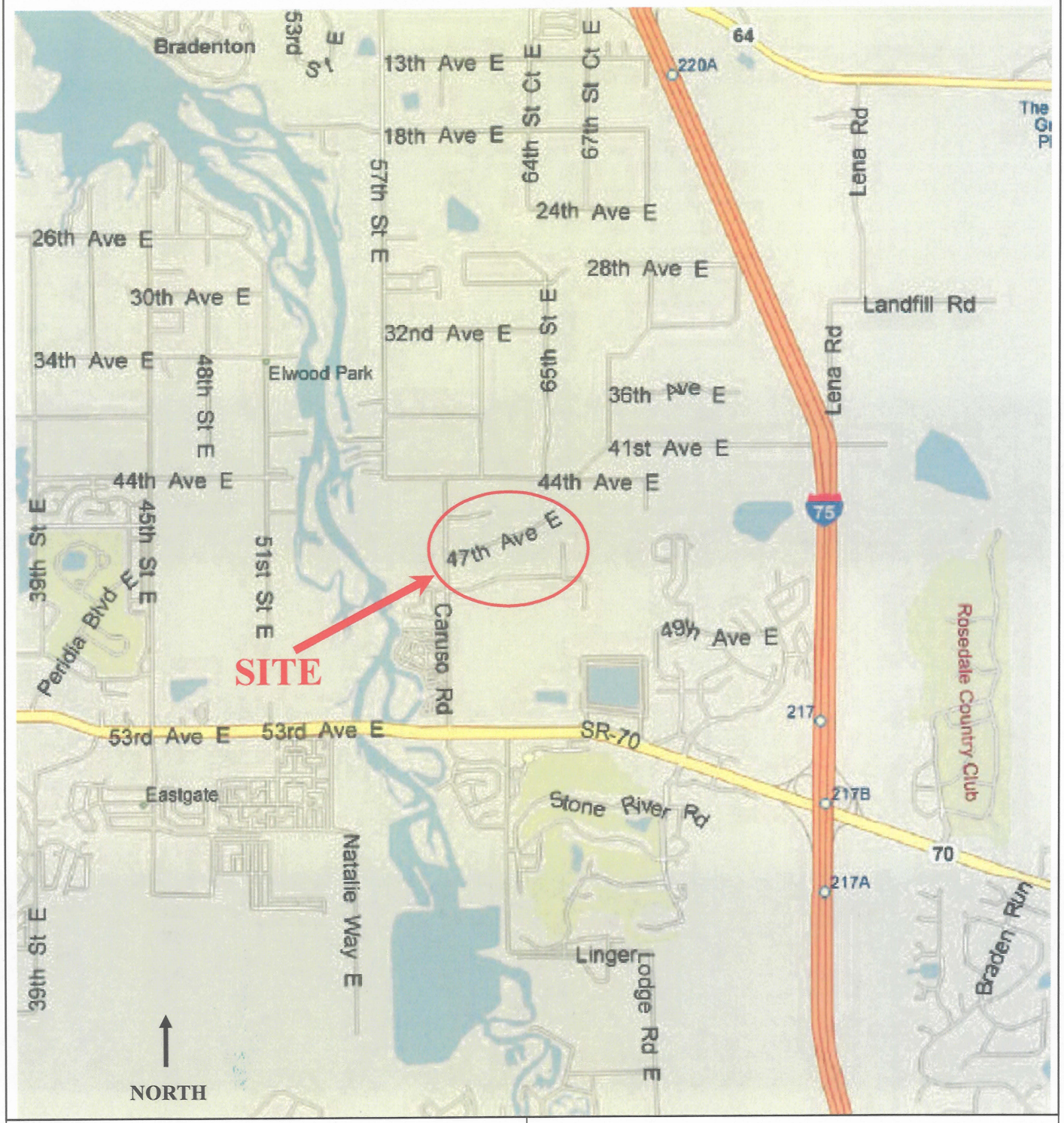
DUDE RANCH ACRES SEWER SERVICES

47TH AVENUE EAST TO CARUSO ROAD
BRADENTON, MANATEE COUNTY, FLORIDA

DATE:	SCALE:	FES REPORT NO:
JUNE 16, 2009	**N/A**	**SG09014**

FIGURE – 1

GENERAL VICINITY MAP



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GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION INSPECTION SERVICES

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DUDE RANCH ACRES SEWER SERVICES

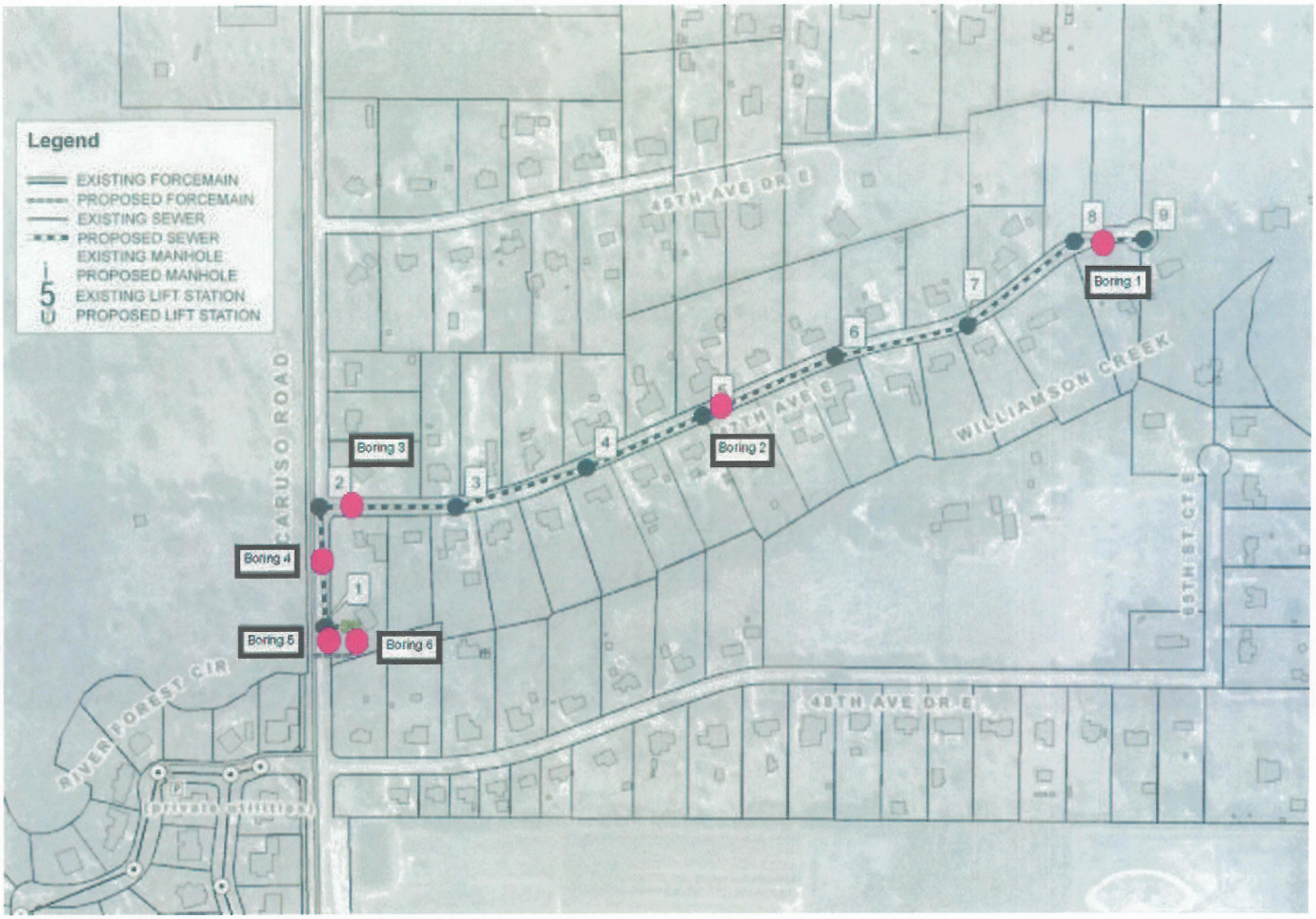
47TH AVENUE EAST TO CARUSO ROAD
BRADENTON, MANATEE COUNTY, FLORIDA

SITE BOUNDARIES ARE APPROXIMATE

DATE:	SCALE:	FES REPORT NO:
JUNE 16, 2009	**N/A**	**SG09014**

FIGURE – 2

SITE VICINITY MAP



NORTH

Source: Manatee County Public Works Department - Sanitary Sewer Service for Dude Ranch Acres

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DUDE RANCH ACRES SEWER SERVICES

47TH AVENUE EAST TO CARUSO ROAD
BRADENTON, MANATEE COUNTY, FLORIDA

DATE:	SCALE:	FES REPORT NO:
JUNE 16, 2009	**N/A**	**SG09014**

FIGURE – 3

TEST BORING LOCATION PLAN

Source: USGS 7.5 Minute Series *Lorraine, Florida* Quadrangle Topographic Map

SITE BOUNDARIES ARE APPROXIMATE

NORTH

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DUDE RANCH ACRES SEWER SERVICES

47TH AVENUE EAST TO CARUSO ROAD
BRADENTON, MANATEE COUNTY, FLORIDA

DATE:	SCALE:	FES REPORT NO:	FIGURE – 4
JUNE 16, 2009	**N/A**	**SG09014**	**TOPOGRAPHIC MAP**

NORTH

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DUDE RANCH ACRES SEWER SERVICES

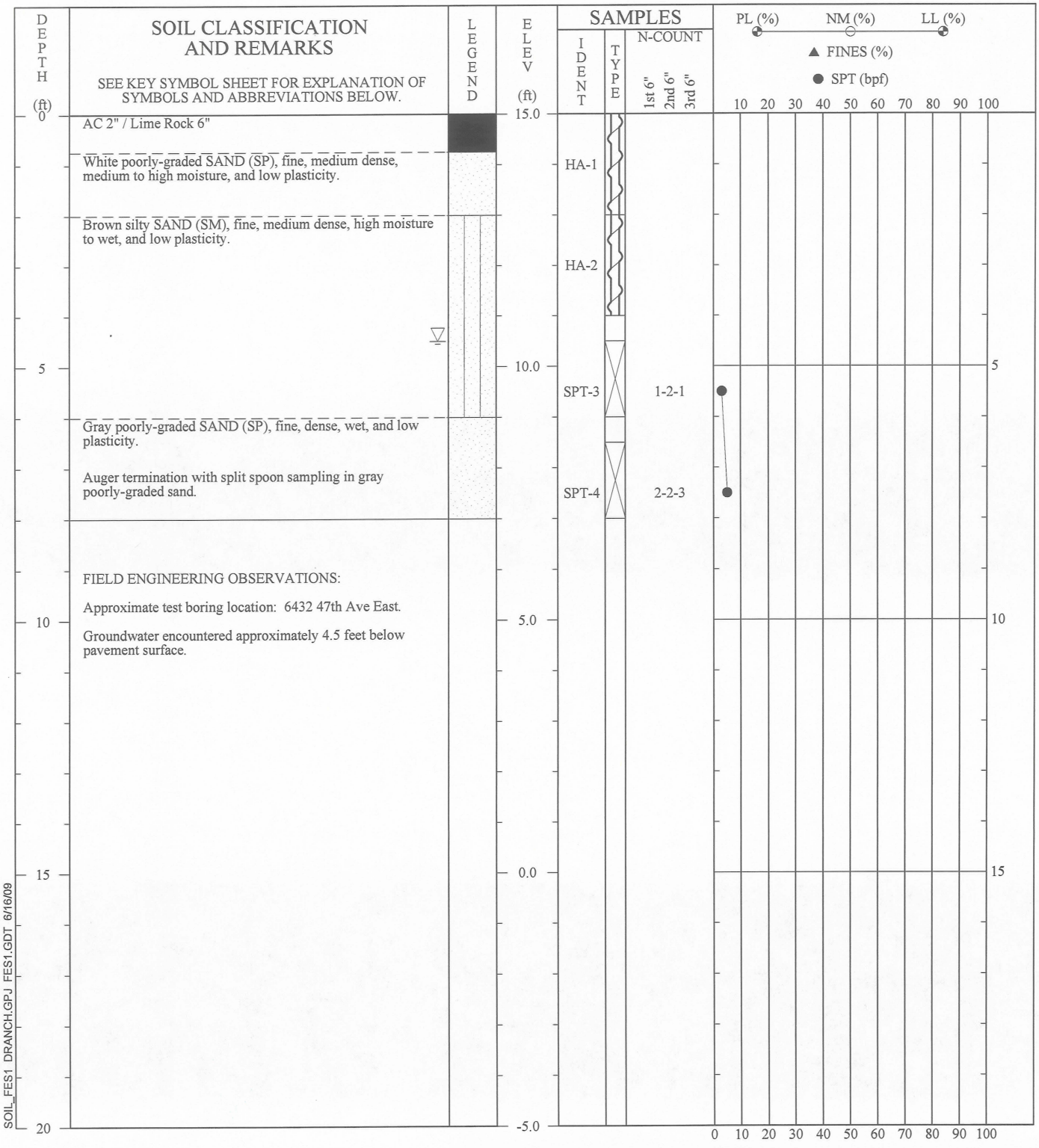
47TH AVENUE EAST TO CARUSO ROAD
BRADENTON, MANATEE COUNTY, FLORIDA

DATE:	SCALE:	FES REPORT NO:
JUNE 16, 2009	**N/A**	**SG09014**

FIGURE – 5

AERIAL PHOTOGRAPH

SOIL BORING LOGS



SOIL_FES1 DRANCH.GPJ FES1.GDT 6/16/09

DRILLER:	AES Services
EQUIPMENT:	CME-75
METHOD:	Mud Rotary
HOLE DIA.:	8 in
REMARKS:	N Count = SPT value in blows per foot (140 lb hammer free-falling 30 inches). SPT = Standard Penetration Test (split spoon sampler). Borehole backfilled with drill cuttings & patched with Asphalt Concrete (AC).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Dude Ranch Sewer Services **BORING NO.:** B-1
COORD N:
COORD E:
DRILLED: May 25, 2009
PROJ. NO.: SG09014 **PAGE** 1 **OF** 1

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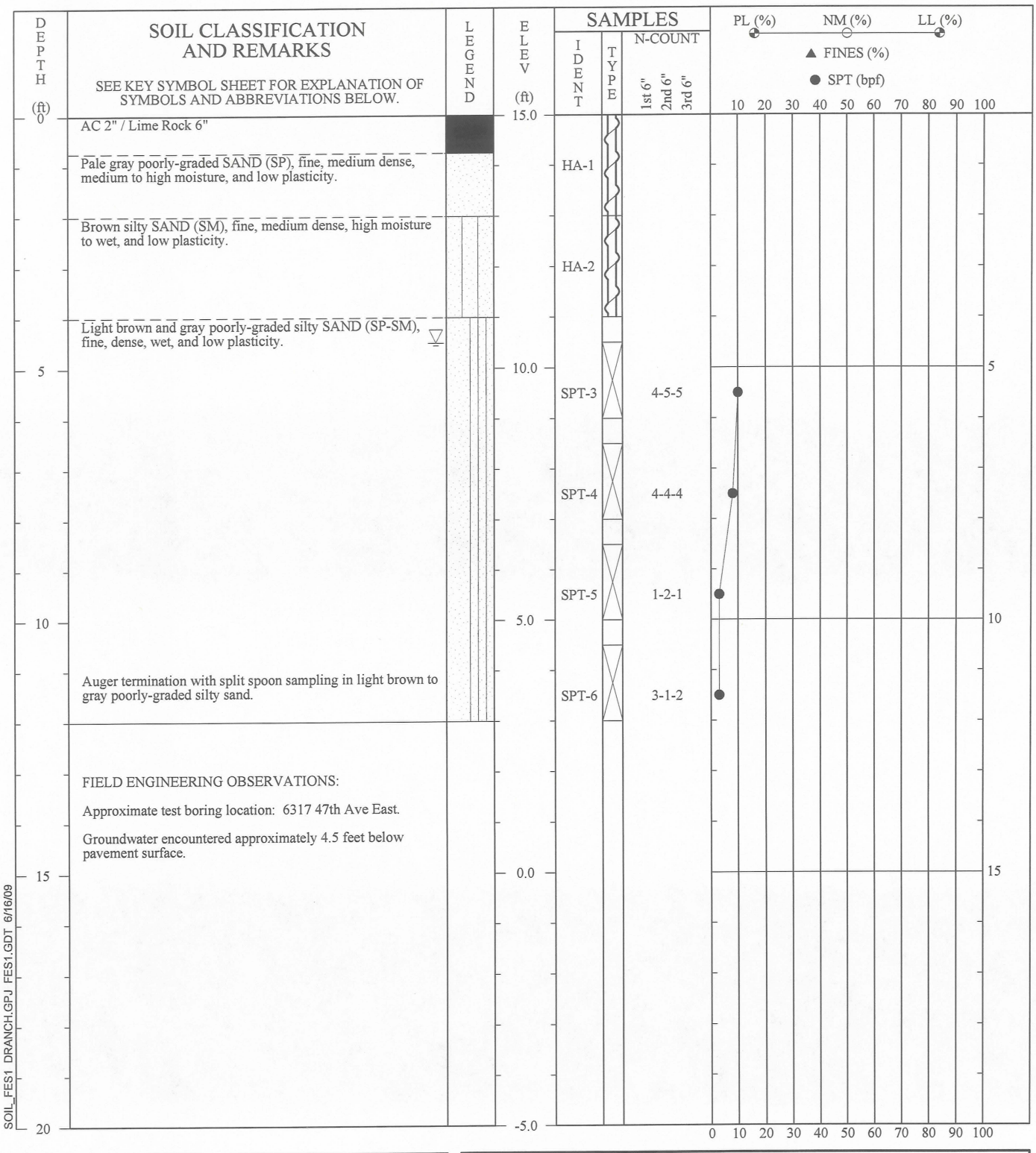

DRILLER:	AES Services
EQUIPMENT:	CME-75
METHOD:	Mud Rotary
HOLE DIA.:	8 in
REMARKS:	N Count = SPT value in blows per foot (140 lb hammer free-falling 30 inches). SPT = Standard Penetration Test (split spoon sampler). Borehole backfilled with drill cuttings & patched with Asphalt Concrete (AC).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Dude Ranch Sewer Services **BORING NO.:** B-2
COORD N:
COORD E:
DRILLED: May 25, 2009
PROJ. NO.: SG09014 **PAGE** 1 **OF** 1

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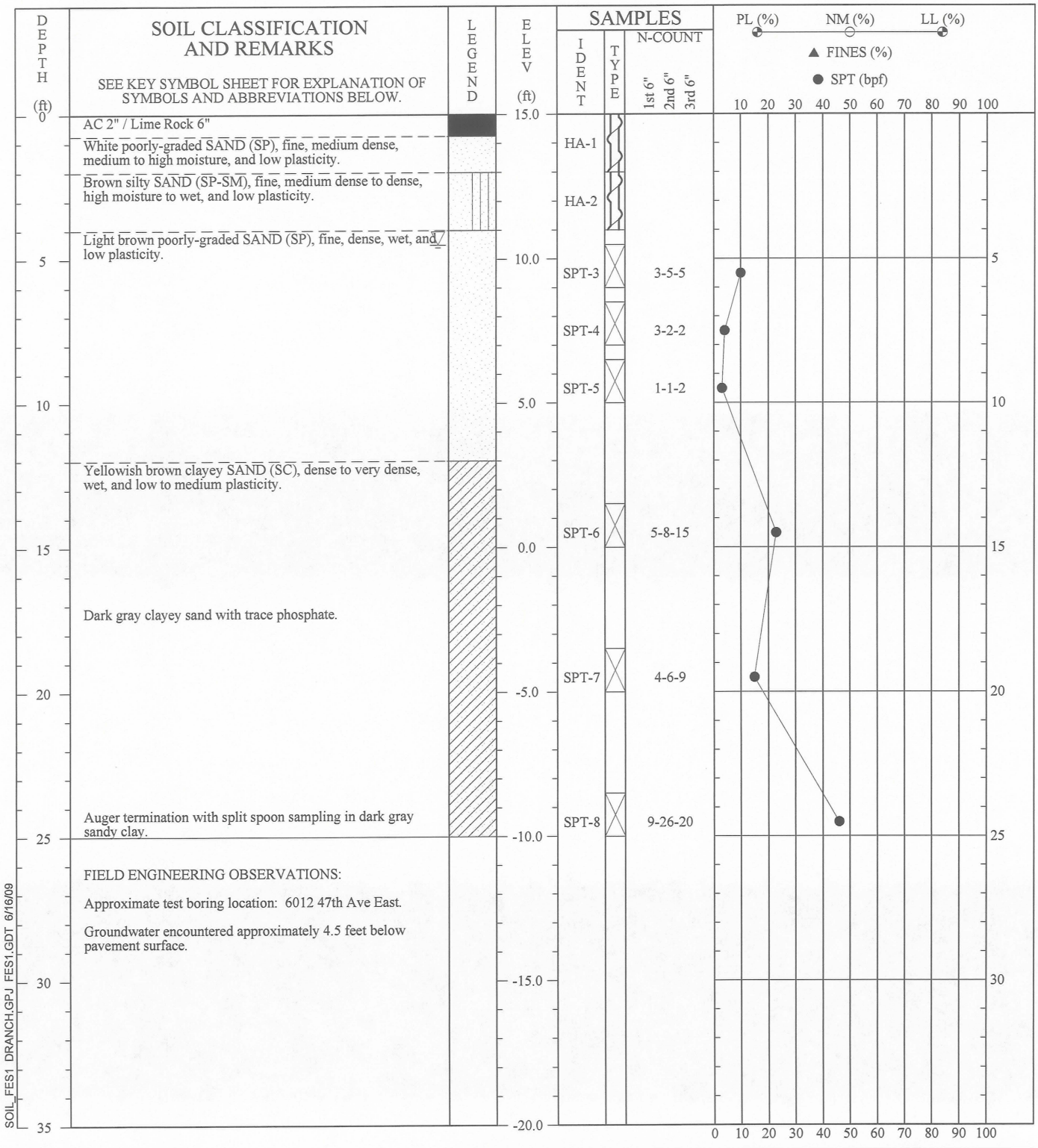

DRILLER:	AES Services
EQUIPMENT:	CME-75
METHOD:	Mud Rotary
HOLE DIA.:	8 in
REMARKS:	N Count = SPT value in blows per foot (140 lb hammer free-falling 30 inches). SPT = Standard Penetration Test (split spoon sampler). Borehole backfilled with drill cuttings & patched with Asphalt Concrete (AC).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Dude Ranch Sewer Services **BORING NO.:** B-3
COORD N:
COORD E:
DRILLED: May 25, 2009
PROJ. NO.: SG09014 **PAGE** 1 **OF** 1

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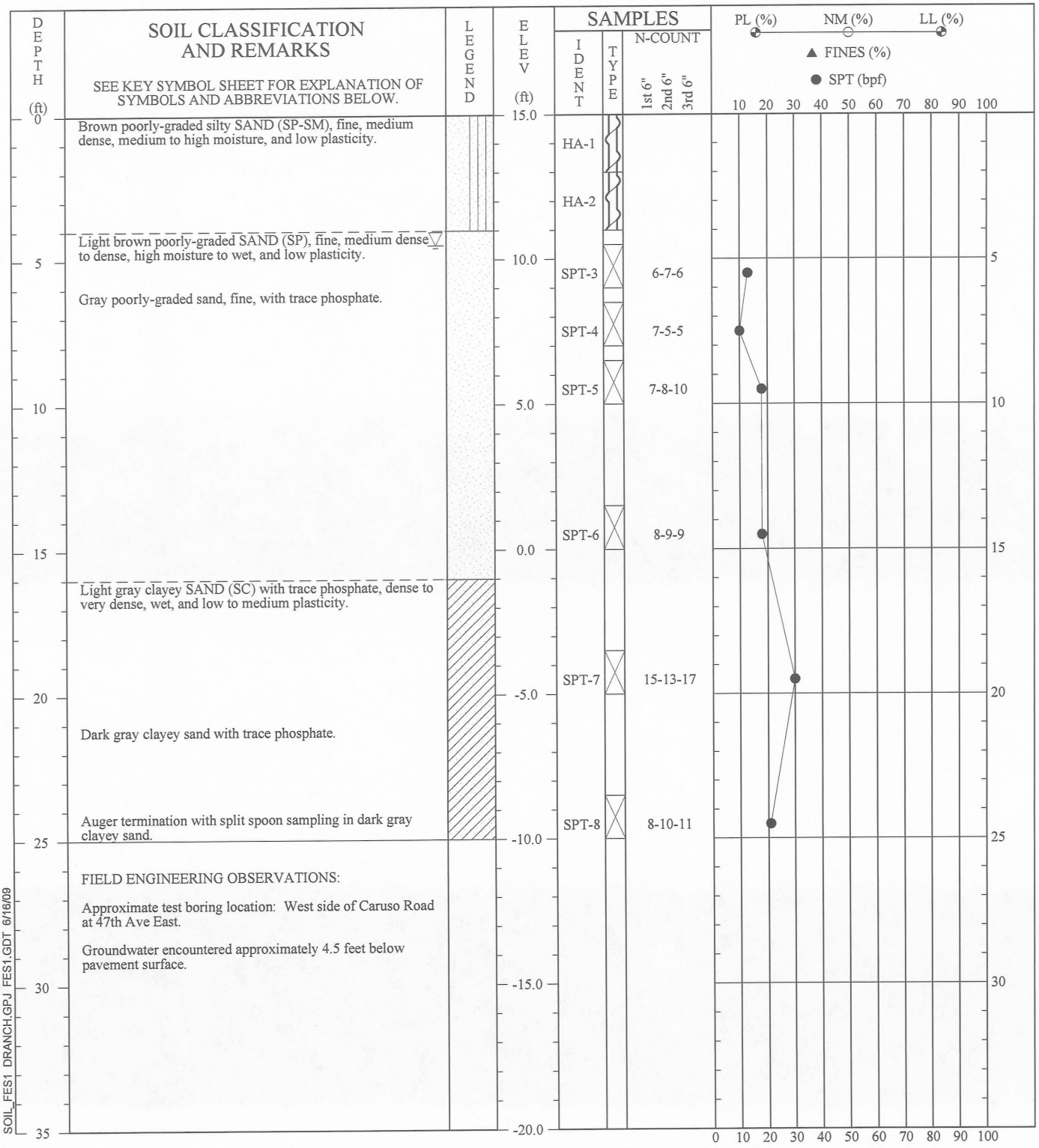

DRILLER:	AES Services
EQUIPMENT:	CME-75
METHOD:	Mud Rotary
HOLE DIA.:	8 in
REMARKS:	N Count = SPT value in blows per foot (140 lb hammer free-falling 30 inches). SPT = Standard Penetration Test (split spoon sampler). Borehole backfilled with drill cuttings.

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SOIL TEST BORING RECORD

PROJECT: Dude Ranch Sewer Services **BORING NO.:** B-4
COORD N:
COORD E:
DRILLED: May 25, 2009
PROJ. NO.: SG09014 **PAGE** 1 **OF** 1

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ST PETERSBURG, FLORIDA 33704
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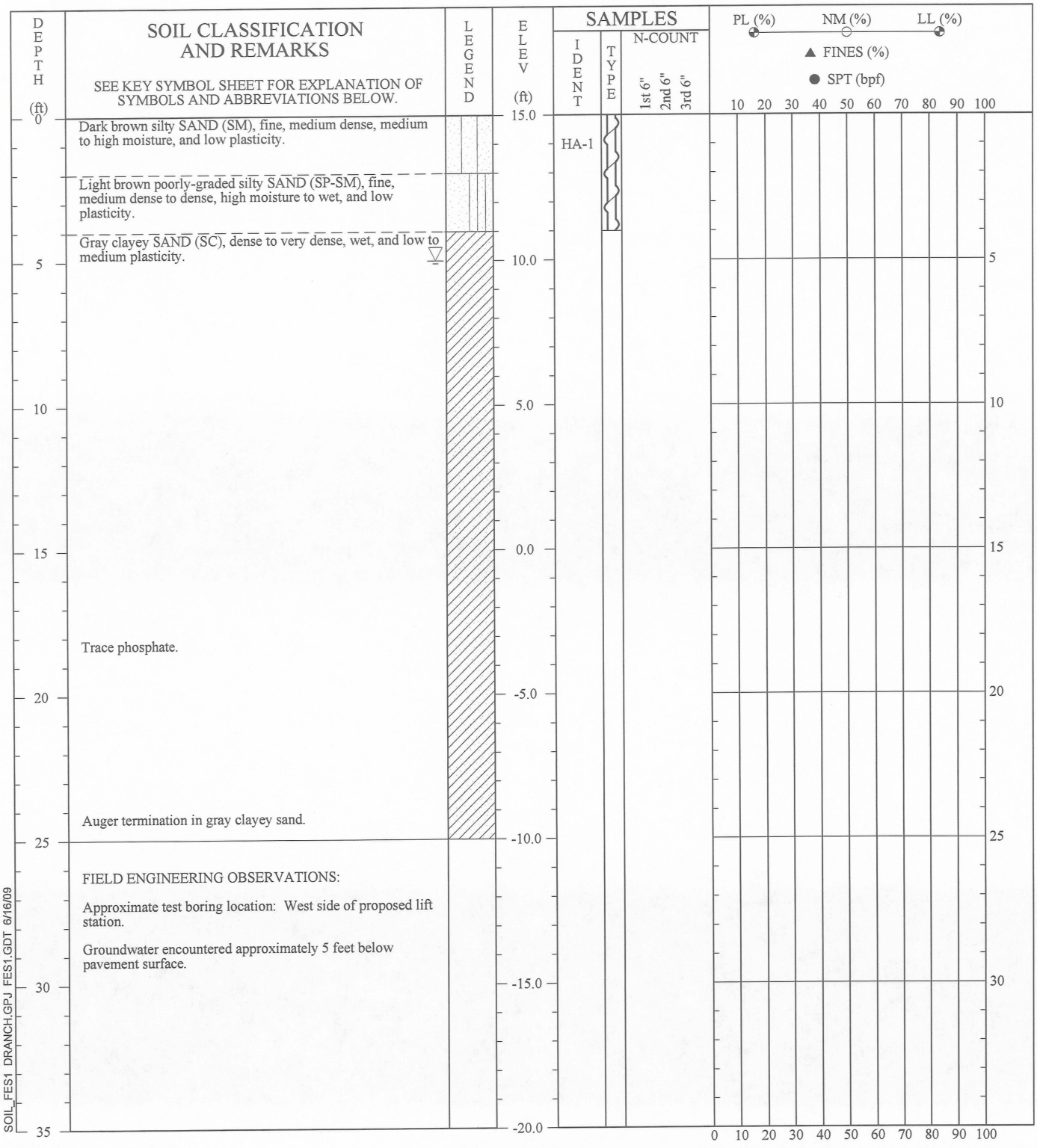

DRILLER:	AES Services
EQUIPMENT:	CME-75
METHOD:	Mud Rotary
HOLE DIA.:	8 in
REMARKS:	N Count = SPT value in blows per foot (140 lb hammer free-falling 30 inches). SPT = Standard Penetration Test (split spoon sampler). Borehole backfilled with drill cuttings.

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SOIL TEST BORING RECORD

PROJECT: Dude Ranch Sewer Services **BORING NO.:** B-5
COORD N:
COORD E:
DRILLED: May 25, 2009
PROJ. NO.: SG09014 **PAGE 1 OF 1**

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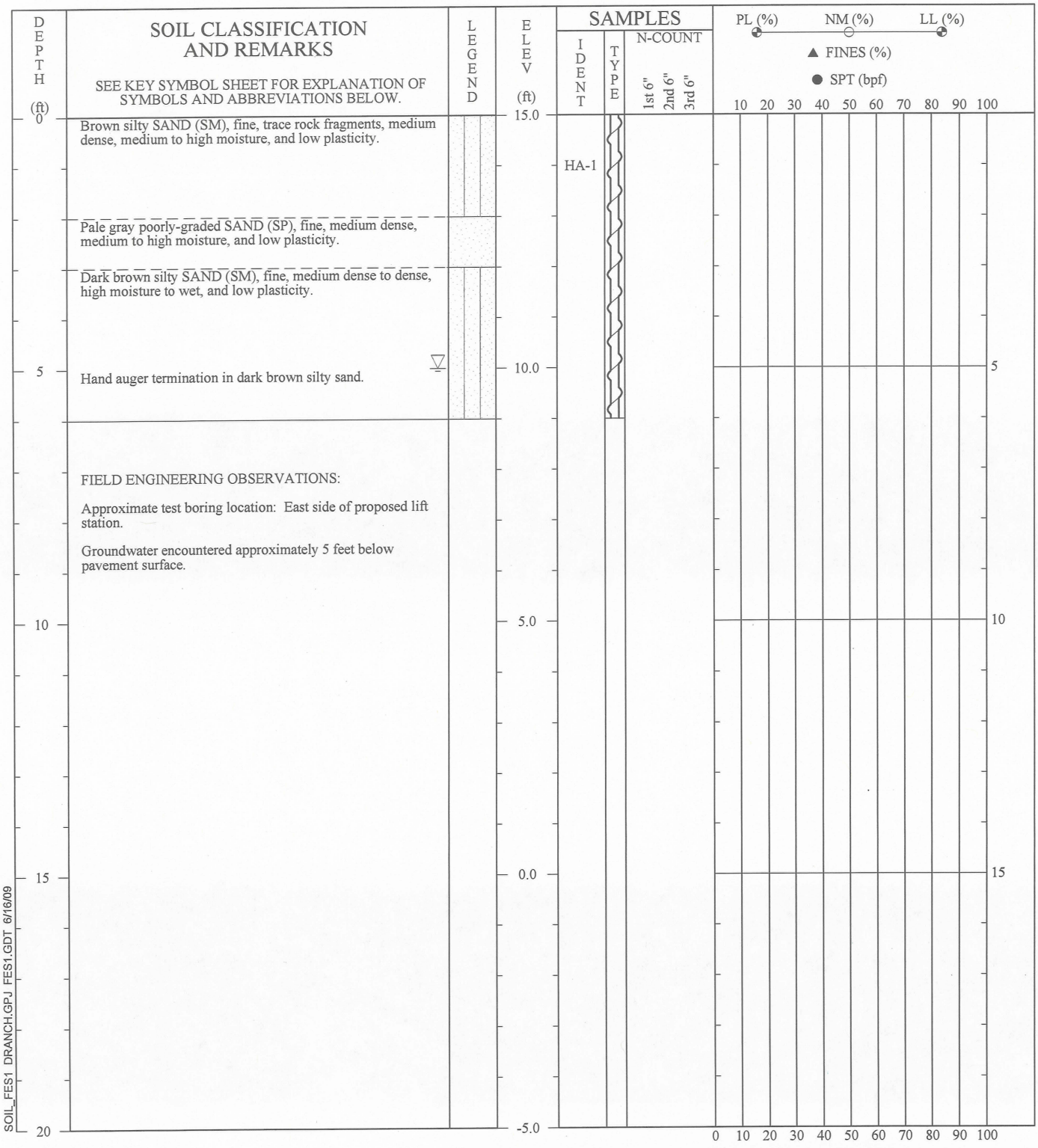

SOIL_FES1 DRANCH.GPJ FES1.GDT 6/16/09

DRILLER:	AES Services
EQUIPMENT:	CME-75
METHOD:	Mud Rotary
HOLE DIA.:	8 in
REMARKS:	N Count = SPT value in blows per foot (140 lb hammer free-falling 30 inches). SPT = Standard Penetration Test (split spoon sampler). Borehole backfilled with drill cuttings.

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SOIL TEST BORING RECORD

PROJECT: Dude Ranch Sewer Services **BORING NO.:** B-6
COORD N:
COORD E:
DRILLED: May 25, 2009
PROJ. NO.: SG09014 **PAGE 1 OF 1**

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SITE PHOTOGRAPHS

Photograph No. 1: View of subject site, looking west on 47th Avenue East.

Photograph No. 2: View of subject site, looking along 47th Avenue East.

Photograph No. 3: View of typical residence along 47th Avenue East.

Photograph No. 4: View of Caruso Road.