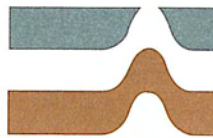


ATTACHMENT B ITB 14-057

**SUBSURFACE SOIL EXPLORATION
UTILITY UPGRADES FOR
14TH AVENUE NORTH, 13TH AVENUE NORTH,
15TH STREET AND BEMBURY SUBDIVISION
NAPLES, COLLIER CO., FL**



Ardaman & Associates, Inc.

OFFICES

Orlando, 8008 S. Orange Avenue, Orlando, Florida 32809, Phone (407) 855-3860

Bartow, 1525 Centennial Drive, Bartow, Florida 33830, Phone (863) 533-0858

Cocoa, 1300 N. Cocoa Blvd., Cocoa, Florida 32922, Phone (321) 632-2503

Fort Myers, 9970 Bavaria Road, Fort Myers, Florida 33913, Phone (239) 768-6600

Miami, 2608 W. 84th Street, Hialeah, Florida 33016, Phone (305) 825-2683

Port Charlotte, 740 Tamiami Trail, Unit 3, Port Charlotte, Florida 33954, Phone (941) 624-3393

Port St. Lucie, 460 Concourse Place NW, Unit 1, Port St. Lucie, Florida 34986, Phone (772) 878-0072

Sarasota, 2500 Bee Ridge Road, Sarasota, Florida 34239, Phone (941) 922-3526

Tallahassee, 3175 West Tharpe Street, Tallahassee, Florida 32303, Phone (850) 576-6131

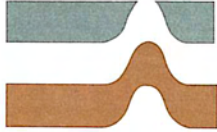
Tampa, 3925 Coconut Palm Drive, Suite 115, Tampa, Florida 33619, Phone (813) 620-3389

West Palm Beach, 2200 North Florida Mango Road, Suite 101, West Palm Beach, Florida 33409, Phone (561) 687-8200

MEMBERS:

A.S.F.E.

American Concrete Institute
American Society for Testing and Materials
Florida Institute of Consulting Engineers



Johnson Engineering, Inc.
2122 Johnson Street
Fort Myers, FL 33902

Attention: Mr. Michael Dickey, P.E.

SUBJECT: Subsurface Soil Exploration
Utility Upgrades for 14th Avenue North,
13th Avenue North, 15th Street and Bembury Subdivision
Naples, Collier County, Florida

Gentlemen:

As requested and authorized by **Johnson Engineering, Inc. (JEI)**, Ardaman & Associates, Inc. (Ardaman) has completed the subsurface soil exploration program for the utility upgrades for 14th Avenue North, 13th Avenue North, 15th Street and Bembury Subdivision in Naples, Collier County, Florida

This report documents the results of our subsurface field exploration program. It has been prepared for the exclusive use of **JEI** and their consultants in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

SCOPE

The scope of our services was limited to the following items:

1. Conducted 11 Standard Penetration Test (SPT) borings on approximately 300-ft centers to determine the nature and condition of the subsurface soils along the proposed gravity sewer alignment and one SPT boring at the proposed pump station location.
2. Reviewed each soil sample obtained from the test borings in our laboratory for further identification and classification.
3. Prepared this report to document the results of our field exploration and laboratory testing programs.

It is the intent of this report to present general information about subsurface soil and groundwater conditions in the project study area as disclosed by the test borings to the design engineer and contractors on the project.

SITE LOCATION AND PROJECT DESCRIPTION

Utility upgrades are planned for 14th Avenue North, 13th Avenue North, 15th Street and Bembury Subdivision located within Sections 34 and 35, Township 49 South, Range 25 East in Naples, Collier County, Florida. These streets are located just east of the Naples Main Post Office on Goodlette-Frank Road. Utility upgrades include construction of gravity sewer along the approximate centerline of the streets and one pump station. Sewer pipe inverts will range from 2 feet to -5 feet. Surface ground elevation ranges from 3 to 7 feet, so pipe excavation will range from 4 to 10 feet. Pump station depth is estimated to be about 17 feet.

FIELD EXPLORATION PROGRAM

Our field exploration consisted of performing 12 SPT borings within the proposed area of the utility upgrades. The SPT borings were drilled to a depth of 15 feet below the existing ground surface along the gravity sewer alignments and to a depth of 25 feet at the pump station location. The SPT borings were conducted using methods consistent with ASTM D-1586. The equipment and procedures used in the SPT borings are described in detail in the **Appendix**.

The approximate locations of the borings are shown on the attached **Figure 1–Boring Location Plan** and are also described by Station and offset on each boring log. The borings were located in the field by representatives of Ardaman, based on construction plans for the utility upgrades prepared by JEI. If a more precise location of the borings is desired, then we recommend that a registered land surveyor be employed to locate the borings on site.

LABORATORY TESTING PROGRAM

Representative soil samples obtained during the field exploration program were packaged and transferred to the laboratory of Ardaman for further visual examination classification and testing. The laboratory tests included Natural Moisture Content, Organic Content and Percent Finer than the U.S. No. 200 Sieve (percent silt and clay). The test results are presented on the attached soil boring logs at the depths from which the samples were recovered. The soil

descriptions shown on the logs are based upon visual-manual procedures in accordance with local practice. The soils recovered from the SPT borings were classified in accordance with AASHTO M 145-Recommended Practice for the Classification of Soils and Soil-Aggregate Mixture for Highway Construction Purposes. A descriptive soil classification procedure was developed for this project to supplement the AASHTO soil classifications.

GENERAL SUBSURFACE CONDITIONS

The general subsurface soil conditions encountered in the borings are presented on the attached soil boring logs. Soil stratification is based on visual examination of recovered soil samples and interpretation of the field boring logs. The stratification lines represent the approximate boundaries between the soil types, the actual transitions may be gradual.

The typical soil profile encountered in the borings is described as fine sand (A-3) from the surface to a depth of 13 feet underlain by a calcareous gravelly slightly silty fine sand (A-1-b) with variable cementation. Several borings encountered a thin stratum (typically 1 foot thick) of very dark brown slightly organic fine sand (A-8) in the 3 to 5 foot depth range. The organic content of this stratum averaged just over 5 percent so it is classified as an A-8 muck; however, material characteristics are similar to an A-3 slightly organic fine sand. Exception to the soil profile occurred at the SPT-8 boring location on Bembury Drive (STA. 27+30). At this location, a limestone or calcareous sandstone caprock layer was encountered at a depth of 8 feet and extended to 12 feet. No rock was encountered in the other borings at that depth which suggests that the caprock is an isolated occurrence. Due to the variable nature of the cementation within the gravelly slightly silty sand (A-1-b) stratum, hard caprock layers (or boulders) may exist within the upper reaches of the A-1-b stratum.

The soil information submitted herein is based on the data obtained from the soil borings presented on the soil boring logs included in this report. This report does not reflect any variations that may occur between the borings. The nature and extent of any variation may not become evident until construction.

The groundwater was encountered at the test locations at a depth of 3 to 5 feet below the existing ground surface at the time of our field exploration (06/1&2/10). The groundwater depth shown on the boring logs represents the groundwater surface encountered on the date shown. Fluctuations in groundwater level should be anticipated throughout the year due to seasonal variations in rainfall, and other factors.

DISCUSSION

The borings indicate that fine sands (A-3) should be encountered from the ground surface to below the deepest pipeline excavation for most of the gravity sewer alignment. Fine sand is a suitable pipe bedding material and suitable for reuse as backfill. The exception is the very dark brown slightly organic fine sand (A-3/A-8) stratum sometimes encountered in the 3 to 5-foot depth range. This material, if encountered, should be removed from below the pipe by bedding in at least 6-inches of fine gravel such as FDOT No. 89 Stone. This material should not be used as backfill unless it is mixed with the cleaner fine sands through the excavation process. The other exception is the silty clayey fine sand (A-2-4) encountered at a depth of 6 feet in boring SPT-8 followed by caprock to 8 feet. Pipe should be bedded in at least 6 inches of fine gravel where this soil or rock is encountered at pipe invert depths. Temporary stockpiling of all excavated soils is necessary to drain excess free water before backfilling and compaction.

Excavation for the pump station will extend to depths of about 17 feet below the ground surface. Refer to boring SPT-2 for the soil profile. Note that excavation will extend through the surficial fine sands (A-3) into the calcareous gravelly slightly silty sand (A-1-b) stratum. This stratum will likely be variably cemented and may contain cobble and boulder-size fragments. Overexcavation to a depth of 12 inches and bedding with gravel such as FDOT No. 57 stone will be necessary. The surficial fine sand (A-3) will be suitable for reuse as backfill. The thin slightly organic fine sand (A-8) stratum should not be used as backfill unless thoroughly mixed with the fine sands. The gravelly slightly silty sand (A-1-b) stratum is suitable for backfilling after removal of oversize fragments.

CLOSURE

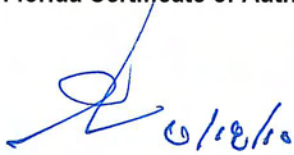
While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations characteristic of the subsurface materials of the region are anticipated and may be encountered. The boring logs and related information are based on the driller's logs and visual examination of selected samples in the laboratory. The delineation between soil types shown on the logs is approximate and the description represents our interpretation of subsurface conditions at the designated boring locations and on the particular date drilled.

Ardaman Project No. 10-4517
June 17, 2010

If you have any questions about this report, please contact this office.

Very truly yours,

Ardaman & Associates, Inc.
Florida Certificate of Authorization No. 00005950



Gary A. Drew, P.E.
Branch Manager/Vice President

GAD/egs

ATTACHMENTS

- **BORING LOCATION PLAN (FIGURE 1)**
- **SPT BORING LOGS**

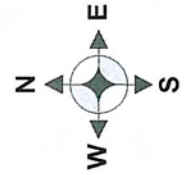
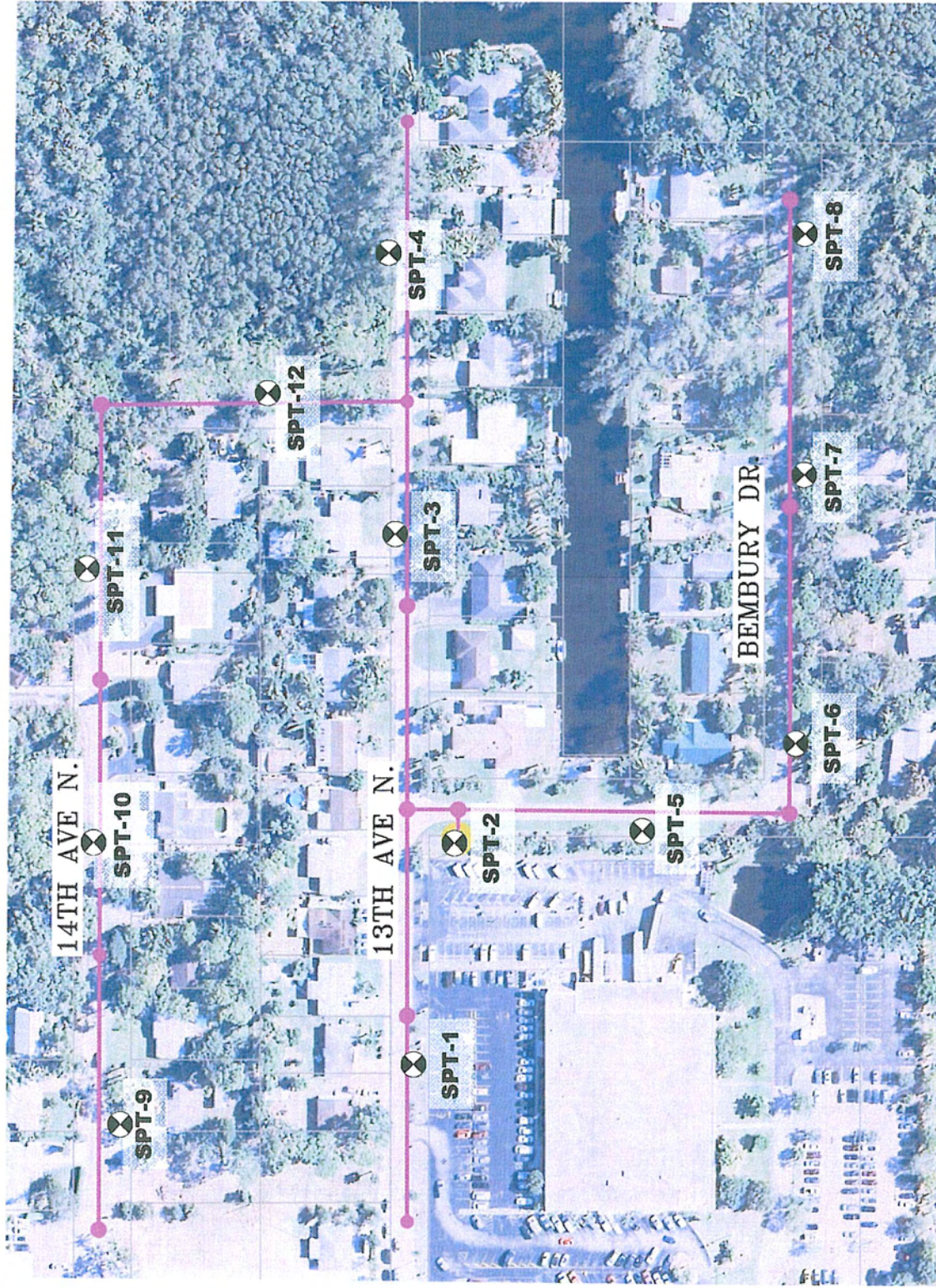
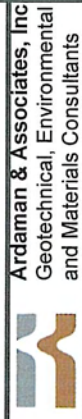


FIGURE 1
BORING LOCATION PLAN

SOURCE: JOHNSON ENGINEERING, INC.



Ardaman & Associates, Inc
 Geotechnical, Environmental
 and Materials Consultants

14th AVE. N., 13th AVE. N., 15th ST.
 AND BEMBURY SUBDIVISION
 NAPLES, COLLIER CO., FL

Drawn By: ES	Checked By: GD	Date: 6/15/10
File No. 10-4517	Approved By: Gary A. Drew, P.E.	Figure No. 1

BORING LOCATION: 13th Ave. N., STA. 15+80,
7'Lt., (SEE FIGURE 1-BLP)
DATE DRILLED: 6/02/10 START: FINISH:
GROUND SURFACE ELEVATION:
WATER TABLE DEPTH: 3' TIME: DATE: 6/02/10

CLIENT: JOHNSON ENGINEERING, INC.
PROJECT: 14th Ave. N., 13th Ave. N.,
LOCATION: 15th St. & Bembury Subdivision
Naples, Collier Co., FL
DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW


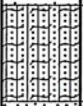



DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX	
0	37-17-16	33	1		A-3	Asphalt and baserock. Gray to brown fine sand.							
16-15-17	32	2											
4	9-7-5	12											
	5-4-5	9	3										
	3-3-3	6											
8	2-2-2	4	4										
	1-1-2	3	5										
12													
	1-0-0	0	6										
16						TERMINATED AT 15.5'							
20													
24													
28													

BORING LOCATION: Lift STA., Bembury Dr.,
 STA. 37+35, 18' Lt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/01/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 3' TIME: DATE: 6/01/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX
0	3-4-4	8	1		A-3	Gray to brown fine sand.						
4	4-4-5	9	2									
4	3-4-5	9			A-8	Very dark brown slightly organic fine sand.		23	2			
	4-4-4	8	3									
	2-2-2	4	4		A-3	Gray to brown fine sand.						
8	1-1-1	2										
	1-1-1	2	5									
12												
16	1-0-0	0	6		A-1-b	Gray calcareous gravelly (cemented sands) slightly silty fine sand.	Hard drilling at 15.5'					
20	5-7-7	14	7									
24	8-6-5	11	8					17	10			
28						TERMINATED AT 25.5'						

BORING LOCATION: 13th Ave. N., STA. 23+00,
9' Rt. (SEE FIGURE 1-BLP)

DATE DRILLED: 6/02/10 START: FINISH:

GROUND SURFACE ELEVATION:

WATER TABLE DEPTH: 4.0' TIME: DATE: 6/02/10

CLIENT: JOHNSON ENGINEERING, INC.

PROJECT: 14th Ave. N., 13th Ave. N.,

LOCATION: 15th St. & Bembury Subdivision
Naples, Collier Co., FL

DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW

DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX
0	15-6-2	8	1		A-3	Asphalt and baserock. Gray to brown fine sand.						
	7-7-5	12	2		A-8	Very dark brown slightly organic fine sand.						
4	4-3-6	9	3		A-3	Gray to brown fine sand.						
	8-9-11	20										
	8-6-2	8	4									
8	1-0-0	0										
	0-0-0	0										
12					A-1-b	Gray calcareous gravelly (cemented sands) slightly silty fine sand.						
	1-5-3	8	5									
16						TERMINATED AT 15.0'						
20												
24												
28												

BORING LOCATION: 13th Ave. N., STA. 20+85,
6' Rt. (SEE FIGURE 1-BLP)

DATE DRILLED: 6/02/10 START: FINISH:

GROUND SURFACE ELEVATION:

WATER TABLE DEPTH: 3.5' TIME: DATE: 6/02/10

CLIENT: JOHNSON ENGINEERING, INC.

PROJECT: 14th Ave. N., 13th Ave. N.,

LOCATION: 15th St. & Bembury Subdivision
Naples, Collier Co., FL

DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW

DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX
0	16-4-4	8	1		A-3	Asphalt and baserock. Gray to brown fine sand.						
4	4-4-3	7										
4	3-2-1	3			A-8	Very dark brown slightly organic fine sand.		34	2	5.2		
	2-4-7	11	2		A-3	Gray to brown fine sand.						
	7-9-6	15	3									
8	4-4-2	6	4									
	2-2-1	3	5									
12					A-1-b	Gray calcareous gravelly (cemented sands) slightly silty fine sand.						
	3-7-6	13	6									
16						TERMINATED AT 15.5'						
20												
24												
28												

BORING LOCATION: Bembury Dr., STA. 35+50,
 12' Lt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/01/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 3.5' TIME: DATE: 6/01/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX
0	7-6-6	12	1		A-3	Gray to brown fine sand.						
	5-5-5	10	2									
4	2-2-3	5	3									
	1-1-1	2	4									
	1-1-2	3	4									
8	2-2-2	4	5			A-3	Light gray fine sand, trace shell fragments.					
	5-7-7	14	5									
12			6				TERMINATED AT 15.0'					
	3-3-3	6	6									
16												
20												
24												
28												

BORING LOCATION: Bembury Dr., STA. 33+00,
 10' Lt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/01/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 4.0' TIME: DATE: 6/01/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX	
0	4-5-4	9	1		A-3	Gray to brown fine sand.							
	7-6-9	15	2										
4	9-8-8	16											
	5-6-6	12	3										
	4-4-3	7	4										
8	1-0-1	1											
	2-2-2	4	5										
12					A-3	Light gray fine sand, trace shell fragments.							
	1-1-23	24	6										
16						TERMINATED AT 15.5'							
20													
24													
28													

BORING LOCATION: Bembury Dr., STA. 30+30,
 6' Lt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/01/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 4.5' TIME: DATE: 6/01/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX
0						Asphalt and baserock.						
16-11-9	20	1			A-3	Gray to brown fine sand.						
8-3-4	7	2			A-8	Very dark brown slightly organic fine sand.		31	3	5.5		
3-5-6	11				A-3	Gray to brown fine sand.						
4												
3-12-17	29	3										
12-7-12	19	4										
8												
11-3-7	10											
10-8-8	16	5			A-3	Light gray fine sand, trace shell fragments.						
12												
					A-1-b	Gray calcareous gravelly (cemented sands) slightly silty fine sand.						
15-12-7	19	6										
16						TERMINATED AT 15.5'						
20												
24												
28												

BORING LOCATION: Bembury Dr., STA. 27+30,
 6' Lt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/01/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 5.0' TIME: DATE: 6/01/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX
0	28-9-9	18	1		A-3	Asphalt and baserock. Gray to brown fine sand.						
	8-8-7	15										
4	3-2-3	5	2		A-8	Very dark brown slightly organic fine sand.						
	2-2-2	4	3		A-3	Gray to brown fine sand.						
	2-2-3	5	4		A-2-4	Brown silty clayey fine sand.		18	17			
8	3-50/4"	50/4"	5			Weathered Limestone/Calcareous Sandstone. Hard Bedded Limestone/Calcareous Sandstone.						
					SP-SM	Gray calcareous gravelly (cemented sands) slightly silty fine sand.						
12												
	10-6-5	11	6									
16						TERMINATED AT 15.0'						
20												
24												
28												

BORING LOCATION: 14th Ave. N., STA. 3+25,
 11' Rt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/02/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 4.5' TIME: DATE: 6/02/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

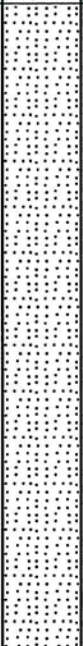

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX	
0	6-4-3	7	1		A-3	Gray to brown fine sand.							
	5-4-5	9	2										
	5-6-7	13											
4	3-2-3	5	3										
	2-2-2	4	4										
8	1-1-2	3											
	1-1-1	2	5										
12													
	1-0-0	0	6										
16						TERMINATED AT 15.5'							
20													
24													
28													

BORING LOCATION: 14th Ave. N., STA. 6+20,
 12' Lt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/02/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 4.5' TIME: DATE: 6/02/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX	
0	4-5-4	9	1		A-3	Gray to brown fine sand.							
	4-3-3	6	2										
4	2-4-6	10											
	5-5-7	12	3										
	7-7-9	16	4										
8	6-2-2	4											
	1-0-1	1	5										
12													
	7-8-6	14	6		A-1-b	Gray calcareous gravelly (cemented sands) slightly silty fine sand.							
16						TERMINATED AT 15.5'							
20													
24													
28													

BORING LOCATION: 14th Ave. N., STA. 8+60,
 6' Lt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/02/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 4.0' TIME: DATE: 6/02/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW










DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX
0	15-7-7	14	1		A-3	Asphalt and baserock.						
					A-3	Gray to brown fine sand.						
	8-8-8	16	2		A-8	Very dark brown slightly organic fine sand.						
4	7-10-8	18			A-3	Gray to brown fine sand.						
	8-8-9	17	3									
	8-6-8	14	4									
8	3-3-3	6										
	1-1-1	2	5									
12					A-1-b	Gray calcareous gravelly (cemented sands) slightly silty fine sand.						
	5-8-8	16	6									
16						TERMINATED AT 15.5'						
20												
24												
28												

BORING LOCATION: 15th St. N., STA. 11+80,
 6' Lt. (SEE FIGURE 1-BLP)
 DATE DRILLED: 6/02/10 START: FINISH:
 GROUND SURFACE ELEVATION:
 WATER TABLE DEPTH: 4.0' TIME: DATE: 6/02/10

CLIENT: JOHNSON ENGINEERING, INC.
 PROJECT: 14th Ave. N., 13th Ave. N.,
 LOCATION: 15th St. & Bembury Subdivision
 Naples, Collier Co., FL
 DRILL CREW: WOOTEN/LEGATES LOGGED BY: G. DREW

DRILL MAKE & MODEL: CME-55 BIT: 3-7/8" Dia. Tri. Roll. DRILLING RODS: NW
 DRILLING METHOD: ROTARY WASH WITH DRILLING FLUID WEATHER CONDITIONS: PARTLY CLOUDY/HOT

DEPTH, FT.	BLOWS PER SIX INCHES	SPT N-VALUE	SAMPLE NO.	GRAPHIC LOG	AASHTO	SOIL DESCRIPTION	REMARKS	% WATER CONTENT	PERCENT FINES	% ORGANIC CONTENT	LIQUID LIMIT	PLAST. INDEX
0	24-13-9	22	1		A-3	Asphalt and baserock. Gray to brown fine sand.						
	6-7-6	13	2									
4	7-7-8	15										
	10-8-9	17	3									
	8-6-6	12	4									
8	5-5-6	11										
	4-5-4	9	5									
12												
	4-5-4	9	6		A-1-b	Gray calcareous gravelly (cemented sands) slightly silty fine sand.						
16						TERMINATED AT 15.5'						
20												
24												
28												

APPENDIX

- **SOIL BORING, SAMPLING AND TESTING METHODS
PROJECT SOIL DESCRIPTION PROCEDURE - UNIFIED**

APPENDIX

- **SOIL BORING, SAMPLING AND TESTING METHODS
PROJECT SOIL DESCRIPTION PROCEDURE - AASHTO**

SOIL BORING, SAMPLING AND TESTING METHODS

STANDARD PENETRATION TEST

The Standard Penetration Test (SPT) is a widely accepted method of in situ testing of foundation soils (ASTM D-1586). A 2-foot (0.6 m) long, 2-inch (50 mm) O.D. split-barrel sampler attached to the end of a string of drilling rods is driven 18 inches (0.45 m) into the ground by successive blows of a 140-pound (63.5 Kg) hammer freely dropping 30 inches (0.76 m). The number of blows needed for each 6 inches (0.15 m) of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch (0.15 m) increments penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual description of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load. The following tables relate N-values to a qualitative description of soil density and, for cohesive soils, an approximate unconfined compressive strength (Q_u):

Cohesionless Soils:	<u>N-Value</u>	<u>Description</u>	
	0 to 4	Very loose	
	4 to 10	Loose	
	10 to 30	Medium dense	
	30 to 50	Dense	
	Above 50	Very dense	

Cohesive Soils:	<u>N-Value</u>	<u>Description</u>	<u>Q_u</u>
	0 to 2	Very soft	Below 0.25 tsf (25 kPa)
	2 to 4	Soft	0.25 to 0.50 tsf (25 to 50 kPa)
	4 to 8	Medium stiff	0.50 to 1.0 tsf (50 to 100 kPa)
	8 to 15	Stiff	1.0 to 2.0 tsf (100 to 200 kPa)
	15 to 30	Very stiff	2.0 to 4.0 tsf (200 to 400 kPa)
	Above 30	Hard	Above 4.0 tsf (400 kPa)

The tests are usually performed at 5-foot (1.5 m) intervals. However, more frequent or continuous testing is done by our firm through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or prevent the loss of circulating fluid. After completion of a test boring, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed by backfilling with neat cement.

Representative split-spoon samples from each sampling interval and from different strata are brought to our laboratory in air-tight jars for classification and testing, if necessary. Afterwards, the samples are discarded unless prior arrangements have been made.

POWER AUGER BORINGS

Auger borings are used when a relatively large, continuous sampling of soil strata close to the ground surface is desired. A 4-inch (100 mm) diameter, continuous flight, helical auger with a cutting head at its end is screwed into the ground in 5-foot (1.5 m) sections. It is powered by the rotary drill rig. The sample is recovered by withdrawing the auger out of the ground without

rotating it. The soil sample so obtained, is described and representative samples put in bags or jars and returned to the laboratory for classification and testing, if necessary.

HAND AUGER BORINGS

Hand auger borings are used, if soil conditions are favorable, when the soil strata are to be determined within a shallow (approximately 5-foot [1.5 m]) depth or when access is not available to power drilling equipment. A 3-inch (75 mm) diameter hand bucket auger with a cutting head is simultaneously turned and pressed into the ground. The bucket auger is retrieved at approximately 6-inch (0.15 m) intervals and its contents emptied for inspection. Sometimes post-hole diggers are used, especially in the upper 3 feet (1 m) or so. The soil sample obtained is described and representative samples put in bags or jars and transported to the laboratory for classification and testing, if necessary.

UNDISTURBED SAMPLING

Undisturbed sampling implies the recovery of soil samples in a state as close to their natural condition as possible. Complete preservation of in situ conditions cannot be realized; however, with careful handling and proper sampling techniques, disturbance during sampling can be minimized for most geotechnical engineering purposes. Testing of undisturbed samples gives a more accurate estimate of in situ behavior than is possible with disturbed samples.

Normally, we obtain undisturbed samples by pushing a 2.875-inch (73 mm) I.D., thin wall seamless steel tube 24 inches (0.6 m) into the soil with a single stroke of a hydraulic ram. The sampler, which is a Shelby tube, is 30 inches (0.8 m) long. After the sampler is retrieved, the ends are sealed in the field and it is transported to our laboratory for visual description and testing, as needed. Undisturbed sampling is noted on the boring logs as thus "U".

LABORATORY TEST METHODS

Soil samples returned to our laboratory are looked at again by a geotechnical engineer or geotechnician to obtain more accurate descriptions of the soil strata. Laboratory testing is performed on selected samples as deemed necessary to aid in soil classification and to help define engineering properties of the soils. The test results are presented on the soil boring logs at the depths at which the respective sample was recovered, except that grain size distributions or selected other test results may be presented on separate tables, figures or plates as discussed in this report. The soil descriptions shown on the logs are based upon visual-manual procedures in accordance with local practice. Soil classification is in general accordance with AASHTO M-145 or ASTM D-3282: The Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes and is also based on visual-manual procedures. Following is a list of abbreviations that may appear in the Remarks column on the boring logs indicating that additional testing was performed.

- DD - Dry Density of Undisturbed Sample
- k - Hydraulic Conductivity (Coefficient of Permeability)
- Qu - Unconfined Compression Strength; ASTM D-2166 (soil), D-2938 (rock)
- Consol - One-Dimensional Consolidation test performed on subsample from undisturbed sample; ASTM D-2425 (report usually presented in Appendix)
- LBR - Limerock Bearing Ratio (FM 5-515)

THE PROJECT SOIL DESCRIPTION PROCEDURE FOR SOUTHWEST FLORIDA ⁽¹⁾
For use with the AASHTO M-145 or ASTM D 3282 soil classification system only
CLASSIFICATION OF SOILS AND SOIL-AGGREGATE MIXTURES FOR HIGHWAY
CONSTRUCTION PURPOSES

BROKEN ROCK/BOULDERS: > 3" (75 mm)

GRAVEL: 3" (75 mm) to #10 (2 mm) sieve

Descriptive adjectives:

0 - 5%	--	no mention of gravel in description
5 - 15%	--	trace
15 - 29%	--	some
30 - 49%	--	gravelly (shell, limerock, cemented sands)

SANDS

COARSE SAND: #10 (2 mm) to #40 (425 μ m)

FINE SAND: #40 (425 μ m) TO #200 (75 μ m)

Descriptive adjectives:

0 - 5%	--	no mention of sand in description
5 - 15%	--	trace
15 - 29%	--	some
30 - 49%	--	sandy

SILT/CLAY: < #200 (75 μ m) sieve

SILTY OR SILT: PI < 4

SILTY CLAYEY OR SILTY CLAY: 4 \leq PI \leq 10

CLAYEY OR CLAY: PI > 10

Descriptive adjectives:

< - 5%	--	clean (no mention of silt or clay in description)
5 - 15%	--	slightly
16 - 35%	--	clayey, silty, or silty clayey
36 - 49%	--	very

ORGANIC SOILS (MUCK) and HIGHLY ORGANIC SOILS AND MATTER (PEAT)

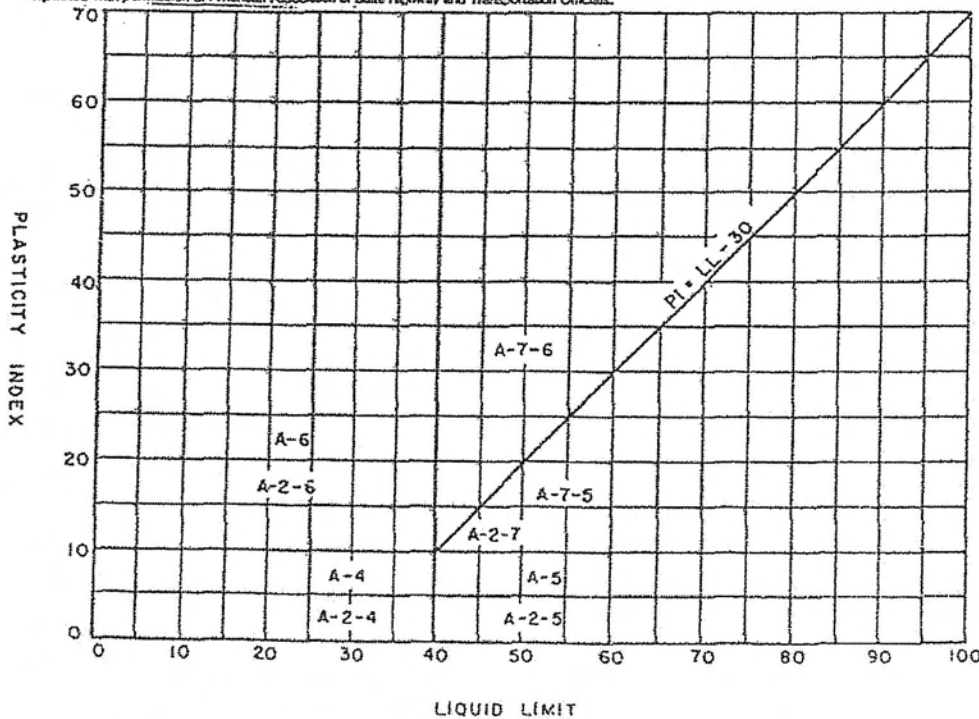
Organic Content	Descriptive Adjectives	Classification
0 - 2.5%	usually no mention of organics in description	See Above
2.6 - 5%	slightly organic	add * to symbol
5-30%	organic sand or silt	A-8
5-30%	clayey organic silt	A-8
30-75%	sandy peat	A-8
30-75%	silty peat	A-8
> 75%	amorphous peat	A-8
> 75%	fibrous peat	A-8

THE PROJECT SOIL DESCRIPTION PROCEDURE FOR SOUTHWEST FLORIDA ⁽¹⁾
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CLASSIFICATION OF SOILS AND SOIL-AGGREGATE MIXTURES FOR HIGHWAY
CONSTRUCTION PURPOSES

TABLE 2 Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35% or less passing No. 200)							Silt-Clay Materials (More than 35% passing No. 200)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				
Sieve analysis, % passing:											
No. 10 (2.00 mm)	50 max	...	...	...	...	...	...	...	...	...	...
No. 40 (425 μm)	30 max	50 max	51 min	...	...	...	...	...	...	...	...
No. 200 (75 μm)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40 (425 μm):											
Liquid limit	...	...	...	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max	...	H.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min ^a
Usual types of significant constituent materials	Stone, Fragments, Gravel and Sand		Fine Sand	Silty or Clayey Gravel and Sand				Silty Soils		Clayey Soils	
General rating as subgrade	Excellent to Good							Fair to Poor			

^a Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Fig. 1).
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NOTE—A-2 soils contain less than 35% finer than 200 sieve.

FIG. 1 Liquid Limit and Plasticity Index Ranges for Silt-Clay Materials

(1) This soil description procedure was developed specifically for projects in southwest Florida where the AASHTO soil classification is used because it is believed that the terminology will be better understood as a result of local practice. It is not intended to supplant other visual-manual classification procedures for description and identification of soils such as ASTM D 2488.