Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

AAI File No. 08-2148
November 13, 2008

Delray Beach Housing Authority
600 North Congress Avenue, Suite 310B
Delray Beach, Florida 33445

Attention: Ms. Dorothy Ellington

**SUBSURFACE EXPLORATION AND
GEOTECHNICAL ENGINEERING EVALUATION
WEST SETTLERS OFFICE BUILDING
DELRAY BEACH, PALM BEACH COUNTY, FLORIDA**

1.0 INTRODUCTION

In accordance with your request and authorization, Ardaman & Associates, Inc. has completed a subsurface exploration and geotechnical studies for the above referenced project. We explored the general subsurface conditions in order to evaluate their suitability for supporting the proposed construction, to obtain a measure of pertinent engineering properties of subsurface materials, and to provide recommendations for site preparation and foundation design. Our work included Standard Penetration Test (SPT) borings, a field permeability test and engineering analyses. This report describes our explorations and tests, reports their findings, and summarizes our conclusions and recommendations.

Our report has been prepared specifically for this project. It is intended for the exclusive use of Delray Beach Housing Authority and its representatives. Our work has used methods and procedures consistent with local foundation engineering practices. No other warranty, expressed or implied, is made. We do not guarantee project performance in any respect, only that our work meets normal standards of professional care.

Environmental concerns, including (but not limited to) the possibility that hazardous materials or petroleum-contaminated soils or groundwater may be present on the subject site, were not included in the scope of work.

2.0 SITE LOCATION AND DESCRIPTION

The site is located at 82 NW 5th Avenue in Delray Beach, Palm Beach County, Florida (Section 17, Township 46 South and Range 43 East). A site vicinity map is presented as our Figure 1. The site is currently clear and covered by surface sands and shellrock fill.

3.0 PROJECT DESCRIPTION

We have examined a site plan prepared by Colomè & Associates, Inc. and dated August 8, 2008. Details of this plan have been reproduced as our Boring Location Plan, Figure 2, which shows a three-story office building with associated driveways and parking areas arranged on the site. We

expect the proposed structure to have a combination of either precast concrete or masonry load-bearing walls and isolated concrete and/or steel columns. For construction of this type, we anticipate maximum wall loads on the order of 8 to 12 kips per lineal foot and maximum column loads on the order of 150 to 200 kips.

4.0 FIELD EXPLORATION

4.1 SOIL BORINGS

To explore the subsurface conditions at the site, two (2) Standard Penetration Test (SPT) borings were performed at the locations shown on the Boring Location Plan, Figure 2. The borings were terminated at depths of 25 and 30 feet below the existing ground surface. Our field work was performed in general accordance with the procedures recommended in ASTM D-1586. The boring logs and a description of our drilling and testing procedures are attached to this report.

4.2 EXFILTRATION TEST

In order to estimate the hydraulic conductivity of the upper soils, one (1) constant head exfiltration test was performed at the locations shown on Figure 2. The test was performed in general accordance with methods described in the South Florida Water Management District (SFWMD) Permit Information Manual, Volume IV. Descriptions of the soils observed in the exfiltration test borehole and the test results are attached to this report. In brief, the exfiltration tests yielded a hydraulic conductivity of 9.46×10^{-5} cfs/sqf - ft head.

4.3 GENERAL

Our field exploration was conducted on November 7, 2008. The boring and test locations were laid out in the field in reference to the property boundaries, we estimate that the actual boring locations are within approximately 15 feet of the locations shown in Figure 2. The soil samples recovered from our explorations will be kept in our laboratory for 60 days, then discarded unless you request otherwise.

5.0 LABORATORY TESTING

Our drillers examined the soil recovered from the SPT sampler, placed the recovered soil samples in moisture proof containers, and maintained a log for each boring. The field soil boring logs and recovered soil samples were transported to our West Palm Beach soils laboratory from the project site. Each soil sample was then examined by a geotechnical engineer to determine their engineering classification. The visual classification of the samples was performed in accordance with the Unified Soil Classification System, USCS. The soil classifications and other pertinent data obtained from our explorations and laboratory examinations and tests are reported on the boring logs attached to this report.

6.0 GENERAL SUBSURFACE CONDITIONS

The boring logs present a detailed description of the soils encountered at the locations and the depths explored. The soil stratification shown on the boring logs is based on examination of recovered soil samples and interpretation of the driller's field logs. It indicates only the approximate boundaries between soil types. The actual transitions between adjacent soil strata may be gradual and indistinct.

As shown in the boring logs, the soils on the site at the locations and the depths explored consist generally of a surficial layer of approximately 4 to 6 inches in thickness of brown shellrock fill underlain by gray, brown and orange, very loose to loose fine sand reaching the termination of our deepest boring at 30 feet.

7.0 GROUNDWATER CONDITIONS

Our drillers observed groundwater in the boreholes at depths ranging from 9.50 to 9.75 feet below the ground surface, as noted on the attached boring logs. Fluctuations in groundwater level on this site should be anticipated throughout the year due to a variety of factors, the most important of which is recharge from rainfall. Groundwater levels somewhat above the present levels should be expected after periods of heavy rains.

8.0 DISCUSSIONS AND RECOMMENDATIONS

8.1 GENERAL

Based on the findings of our site exploration, our evaluation of subsurface conditions, and judgment based on our experience with similar projects, we conclude that the soils underlying this site are generally satisfactory to support the proposed construction on conventional spread foundations. However, in our opinion, the bearing capacity of the loose near-surface sands should be improved in order to reduce the risk of unsatisfactory foundation performance. The general soil improvement we recommend can be accomplished simply by proofrolling the site with a heavy vibratory roller. Following are specific recommendations for site preparation procedures and the design of foundation systems.

8.2 SITE PREPARATION RECOMMENDATIONS

8.2.1 Clearing

The building areas within lines five feet outside building perimeters, and the areas to be paved, should be cleared, grubbed and stripped of all surface vegetation, trash, debris and topsoil. Stumps should be removed entirely. Remnants of the existing construction, including old foundations, underground utility lines, concrete decks and pavement should be removed entirely from within the construction areas and their excavations/depressions backfilled with well-compacted approved fill material.

8.2.2 Proofrolling and Placement of Fill

The construction areas should be proofrolled with a heavy (10-12 ton) vibratory roller. Any soft, yielding soils detected during the proofrolling operations should be excavated and replaced with approved fill conforming with the specifications below. Sufficient passes should be made during the proofrolling operations to produce minimum dry densities of 98 percent of the Modified Proctor (ASTM D-1557) maximum dry density value of the compacted subgrade soils to depths of 2 feet below the compacted surface. The proofrolled areas should receive not less than 10 overlapping passes, half of them in each of two perpendicular directions.

After the surface has been proofrolled and tested to verify that the desired dry density has been

obtained, the construction areas may be filled to the desired grades. All fill material should conform with the specifications below. It should be placed in uniform layers, not exceeding 12 inches in loose thickness, individually compacted with a heavy vibratory roller to a minimum dry density of 98 percent of the Modified Proctor maximum dry density value of the fill material.

We recommend that the site preparation contractor closely monitor the vibrations produced during the proofrolling operations so that they do not adversely affect any nearby structures.

8.2.3 Final Compaction

Note that after completion of the general site preparation, when excavations for the construction of foundations are made through the compacted soils, the bottom of the foundation excavations should be compacted to densify soils loosened during or after the excavation process and washed or sloughed into the excavation prior to the placement of forms. A heavy-duty vibratory rammer should be used for this final compaction, immediately prior to the placement of reinforcing steel, with previously described minimum dry density requirements to be maintained below the foundation level.

After the foundations are cast and the forms are removed, backfill around the foundations should be placed in thin lifts, six inches or less in loose thickness, individually compacted with a heavy-duty vibratory rammer or vibratory plate compactor to a minimum dry density of 98 percent of the Modified Proctor maximum dry density value of the backfill material.

8.2.4 Fill Material Specifications

All fill material under the buildings and pavement should consist of clean sands or fragmented limerock, free of organics and other deleterious materials. The fill material should have not more than eight percent by dry weight passing the U.S. No. 200 sieve and no particle larger than 3 inches in diameter. Backfill behind walls, if any, should be particularly pervious, with not more than 4 percent by dry weight passing the U.S. No. 200 sieve.

8.2.5 Additional Recommendations

Care must be exercised prior to, during and after construction to prevent erosion effects or undermining of foundations. The integrity of the raised building "pad" must hence be maintained for a distance of at least five feet beyond the foundation levels, with gutters disposing of rainfall runoff beyond the pad limits.

Foundation concrete should not be cast over a foundation surface containing topsoil or organic soils, trash of any kind, surface made muddy by rainfall runoff, or groundwater rise, or loose soil caused by excavation or other construction work. Reinforcing steel should also be clean at the time of concrete casting. If such conditions develop during construction, the reinforcing steel must be lifted out and the foundation surface reconditioned and approved by the Foundation Engineer.

8.3 FOUNDATIONS

After the foundation soils have been prepared in accordance with the above site preparation recommendations, the site should be suitable for supporting the proposed structure on conventional shallow foundations proportioned for a maximum allowable bearing stress of 2,500 pounds per square foot (psf). However, to provide an adequate factor of safety against a shearing

failure in the subsoils, all continuous foundations should be at least 18 inches wide, and all individual column footings should have a minimum width of 24 inches. All foundations should bear at least 18 inches below adjacent finish grades.

8.3.1 Bearing Capacity and Settlements

Based upon the boring information and the assumed loading conditions, we estimate that the recommended allowable bearing stress will provide a minimum factor of safety in excess of two against bearing capacity failure. With the site prepared and the foundations designed and constructed as recommended, we anticipate total settlements of one inch or less, and differential settlement between adjacent similarly loaded footings of less than one half of an inch. Because of the granular nature of the subsurface soils, the majority of the settlements should occur during construction.

8.3.2 Slab-On-Grade

After the site is prepared in accordance with the recommendations provided herein, the floor slab can be placed directly on the compacted subgrade. In our opinion, a highly porous base material is not necessary. We recommend to use a minimum of 10 mil polyolefin film as the main component of a vapor barrier system.

We recommend isolating the ground floor slab from column and wall foundations. Care must be exercised in installing control joints shortly after placing the concrete, and in placing and maintaining the steel reinforcement at its designated elevation within the floor slab.

8.4 QUALITY CONTROL

In order to verify the contractor's compliance with the above recommendations, all site preparation procedures should be inspected and tested by Ardaman & Associates, Inc. We recommend that all foundation excavations be inspected by us in order to verify that foundation bearing conditions are consistent with our expectations.

9.0 CLOSURE

This report has been prepared in accordance with generally accepted local foundation engineering practice. The recommendations submitted herein are based on the data obtained from the soil borings and the assumed loading conditions previously described. This report may not account for all the possible variations that may exist between conditions observed in the borings and conditions at locations that were not explored. The nature and extent of any such variations may not become evident until further explorations are made or construction is underway. If variations are then observed, we recommend that Ardaman & Associates, Inc. be requested to inspect the actual site conditions and, if necessary, re-evaluate the recommendations of this report.

In the event any changes occur in the design, nature or location of any project facilities, Ardaman & Associates, Inc. should be requested to review the conclusions and recommendations in this report. We also recommend that we be requested to review the final foundation drawings and earthwork specifications so that our recommendations may be properly interpreted and implemented in the contract documents.

It has been a pleasure to assist you on this phase of your project. Please contact us whenever we may be of service to you, and please call if you have any questions concerning this report.

ARDAMAN & ASSOCIATES, INC.

11/14/08

Carlos A. Giffoni, P.E.
Project Engineer
Fla. Reg. No. 64700

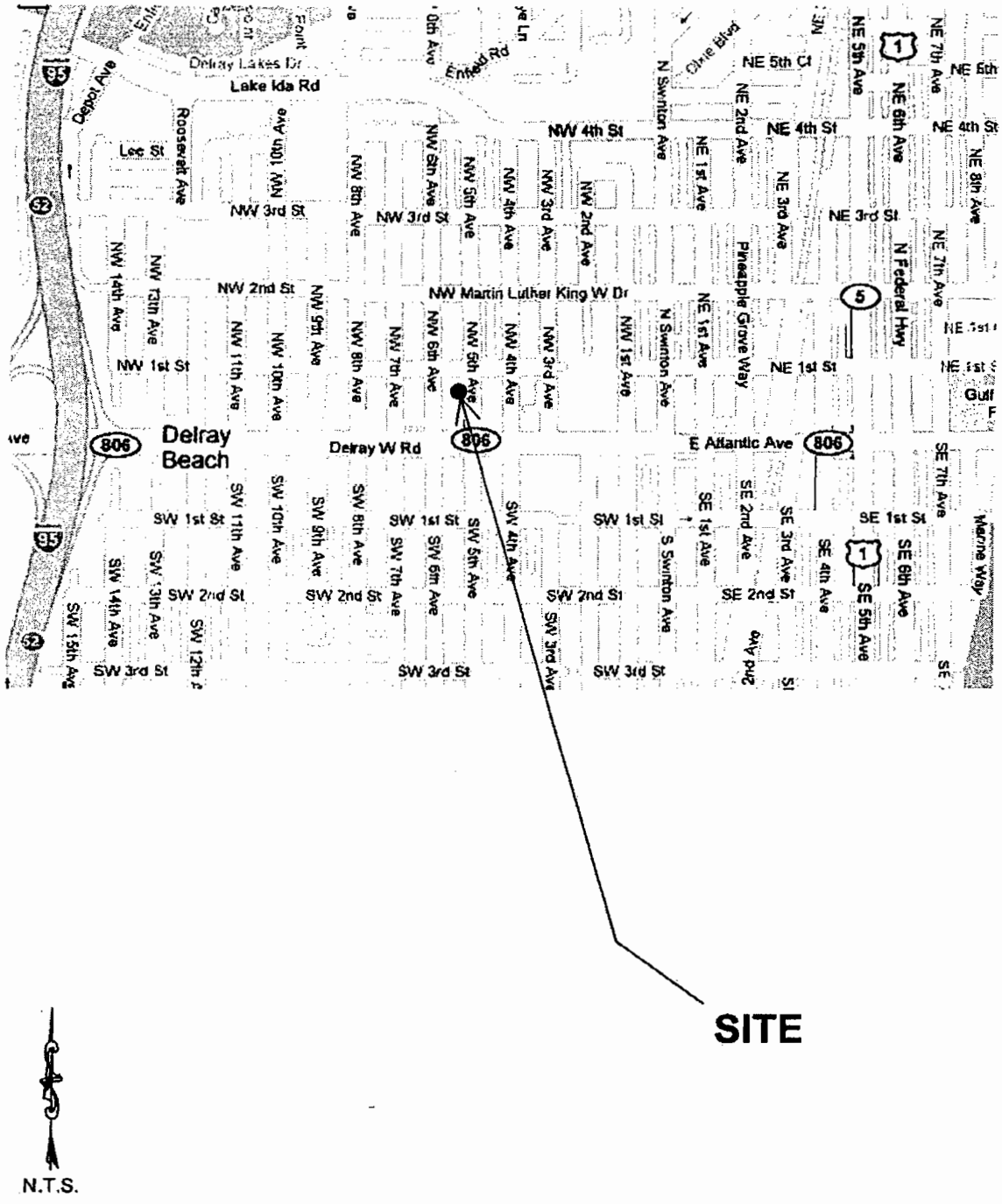
11/14/8

Roberto Fernandez, P.E.
Senior Project Engineer
Fla. Reg. No. 60070

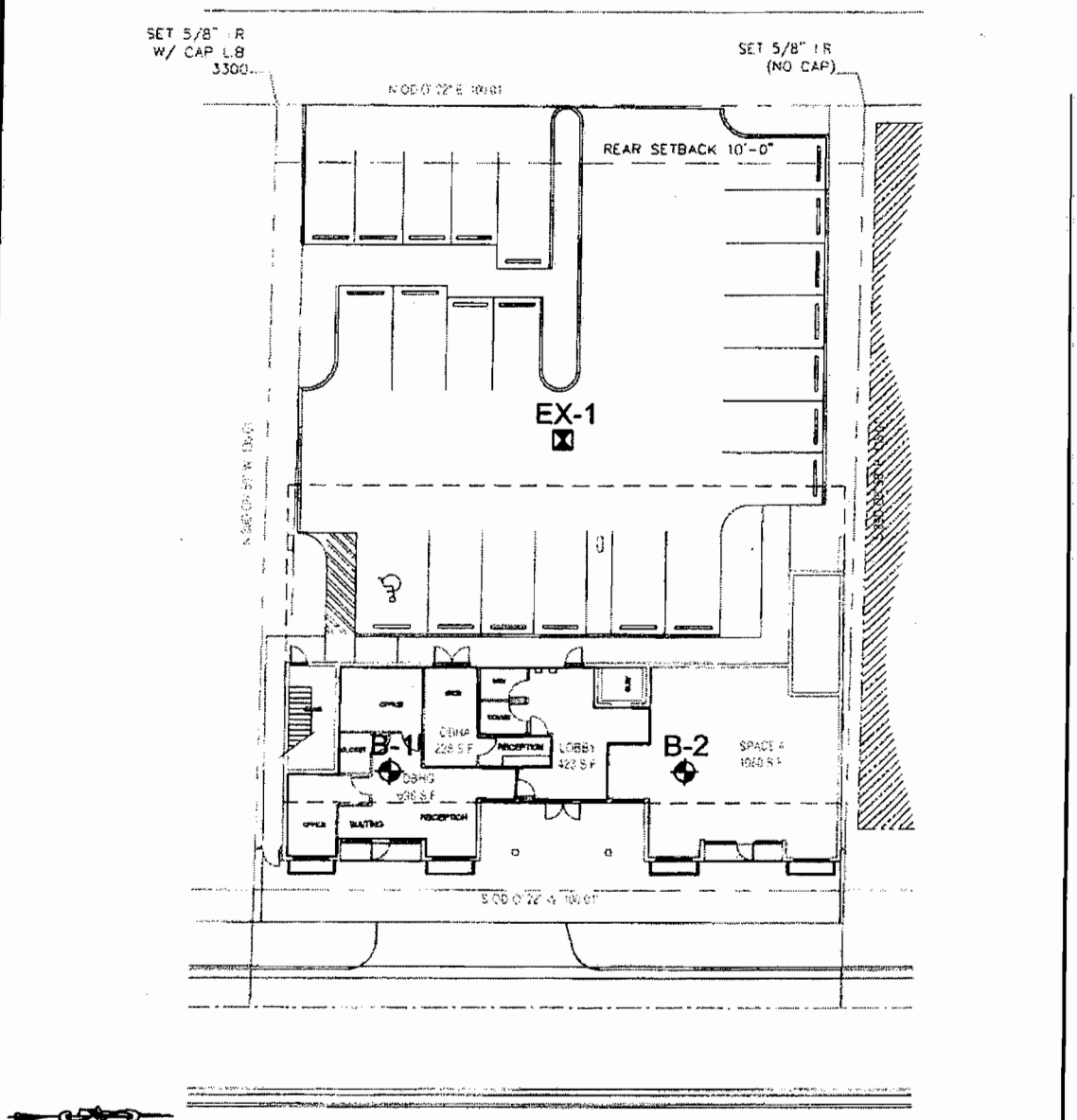
Attachments: Site Vicinity Map - Figure 1
Boring Location Plan - Figure 2
Subsurface Exploration Information
SPT Boring Logs
Exfiltration Test Report

CC:Colomé & Associates, Inc. - Ms. Liz Colomé

CAG/RF:cag



Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants	SUBSURFACE EXPLORATION WEST SETTLERS OFFICE BUILDING 82 NW 5TH AVENUE DELRAY BEACH, FLORIDA	SITE VICINITY MAP Figure No. 1	File No.: 08-2148 Prepared By: CAG Date: 11/12/08



Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants	SUBSURFACE EXPLORATION WEST SETTLERS OFFICE BUILDING 82 NW 5TH AVENUE DELRAY BEACH, FLORIDA	BORING LOCATION PLAN Figure No. 2	File No.: 08-2148 Prepared By: CAG Date: 11/12/08

Ardaman & Associates, Inc.

Geotechnical, Environmental and Materials Consultants

SUBSURFACE EXPLORATION INFORMATION

GENERAL

Our borings describe subsurface conditions only at the locations drilled and at the time drilled. They provide no information about subsurface conditions below the bottom of the boreholes. At locations not explored, surface conditions that differ from those observed in the borings may exist and should be anticipated.

The information reported on our boring logs is based on our drillers' logs and on visual examination in our laboratory of disturbed soil samples recovered from the borings. The distinction shown on the logs between soil types is approximate only. The actual transition from one soil to another may be gradual and indistinct.

The groundwater depth shown on our boring logs is the water level the driller observed in the borehole when it was drilled. These water levels may have been influenced by the drilling procedures, especially in borings made by rotary drilling with bentonitic drilling mud. An accurate determination of groundwater level requires long-term observation of suitable monitoring wells. Fluctuations in groundwater levels throughout the year should be anticipated.

The absence of a groundwater level on certain logs indicates that no groundwater data is available. It does not mean that no groundwater will be encountered at that boring location.

STANDARD PENETRATION TEST BORINGS

The Standard Penetration Test is a widely accepted method of testing foundation soils in place. The N-Value obtained from the test has been correlated empirically with various soil properties. These empirical correlations allow satisfactory estimates to be made of how the soil is likely to behave when subjected to foundation loads. Tests are usually performed in the boreholes at intervals of five feet. In addition, our Firm performs tests continuously in the interval directly below the expected foundation bearing grade where the soil will be most highly stressed.

Boreholes where Standard Penetration Tests will be performed are drilled with a truck-mounted drilling rig. The boreholes are advanced by rotary drilling with a winged bit that makes a hole about three inches in diameter. A bentonitic drilling mud is recirculated in order to remove the cuttings and support the walls of the borehole. The drag bit is specially modified to direct the mud upward and reduce disturbance of the soil ahead of the bit. If access is not available for our truck-mounted drilling equipment, portable tripod drilling equipment can be used instead.

Occasionally, running or squeezing ground is encountered that cannot be stabilized by the drilling mud alone. In addition, drilling mud may be lost into the soil or rock strata that are unusually pervious. In such cases, flush-joint steel casing with an outside diameter of about 3.5 inches is driven as a liner for the borehole.

After the borehole has been advanced to the depth where a Standard Penetration Test will be performed, the soil sampler used to run the test is attached to the end of the drill rods and lowered to the bottom of the borehole. The testing procedure used conforms closely to the methods recommended in ASTM D-1586. The sampler used has a split-barrel 24 inches long and an outside diameter of 2.0 inches. It is driven into the ground below the bottom of the borehole using a hammer that weighs 140 pounds and falls 30 inches. The driller records the number of hammer blows needed to advance the sampler in successive increments of six inches. The total number of blows required to advance the sampler the second and third six-inch increments constitutes the test result; that is, the N-value at the depth. The test is completed after the sampler has been driven not more than 24 inches or when refusal is encountered, whichever occurs first. Refusal occurs when 50 hammer blows advance the sampler less than 6 inches. After the test is completed, the sampler is removed from the borehole and opened.

The drillers examines and classifies the soil recovered by the sampler, place representative soil specimens from each test in glass jars or plastic bags and take them to our laboratory. In the laboratory, additional evaluations and tests are performed, if needed. The driller's classifications may be adjusted, if necessary, to conform more closely with the Unified Soil Classification System (USCS). Jar samples are retained in our laboratory for sixty days, then discarded unless our clients request otherwise.

The following tables relate N-values to a qualitative description of the relative soil density.

	Description	SPT N Value
Cohesionless Soils	Very loose	0-4
	Loose	5-9
	Medium dense	10-29
	Dense	30-49
	Very dense	50+

	Description	SPT N Value
Cohesive Soils	Very soft	0-2
	Soft	3-4
	Medium stiff	5-8
	Stiff	9-15
	Very stiff	16-30
	Hard	31+

SFWMD EXFILTRATION TESTS

In order to estimate the hydraulic conductivity of the upper soils, constant head or falling head exfiltration tests can be performed. These tests are performed in accordance with methods described in the South Florida Water Management District (SFWMD) Permit Information Manual, Volume IV. In brief, a 6 to 9 inch diameter test hole is augered to the desired test depth (typically 6 feet), then a screen is lowered into the test hole, the depths of the test hole and groundwater level are recorded, then the surroundings of the test hole are saturated by pouring water into the screen as needed to maintain the water level in the test hole at the ground surface for 10 minutes.

If a constant head test is performed, the rate of pumping will be recorded at fixed intervals of 1 minute for a total of 10 minutes, following the saturation period.

If a falling head test is performed (typically for relatively high permeability soils), water is added until the water level reaches the ground surface. Then the water flow is stopped and the drop in water level for discrete time intervals is recorded until the water level in the test hole has dropped to at least half the distance to the groundwater table.

LEGEND FOR BORING LOGS

The following abbreviations are often used in our boring logs:

MC:	Moisture content (percent of dry weight)
OC:	Organic content (percent of dry weight)
PL:	Moisture content at the plastic limit
LL:	Moisture content at the liquid limit
PI:	Plasticity index (LL-PL)
Qu:	Unconfined compressive strength (tons per square foot, unless otherwise noted)
-200:	Percent passing a No. 200 sieve (200 wash)

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STANDARD PENETRATION TEST BORING LOG

BORING B-1

PROJECT: West Settlers Office Building
82 NW 5th Avenue, Delray Beach, Palm Beach County, Florida

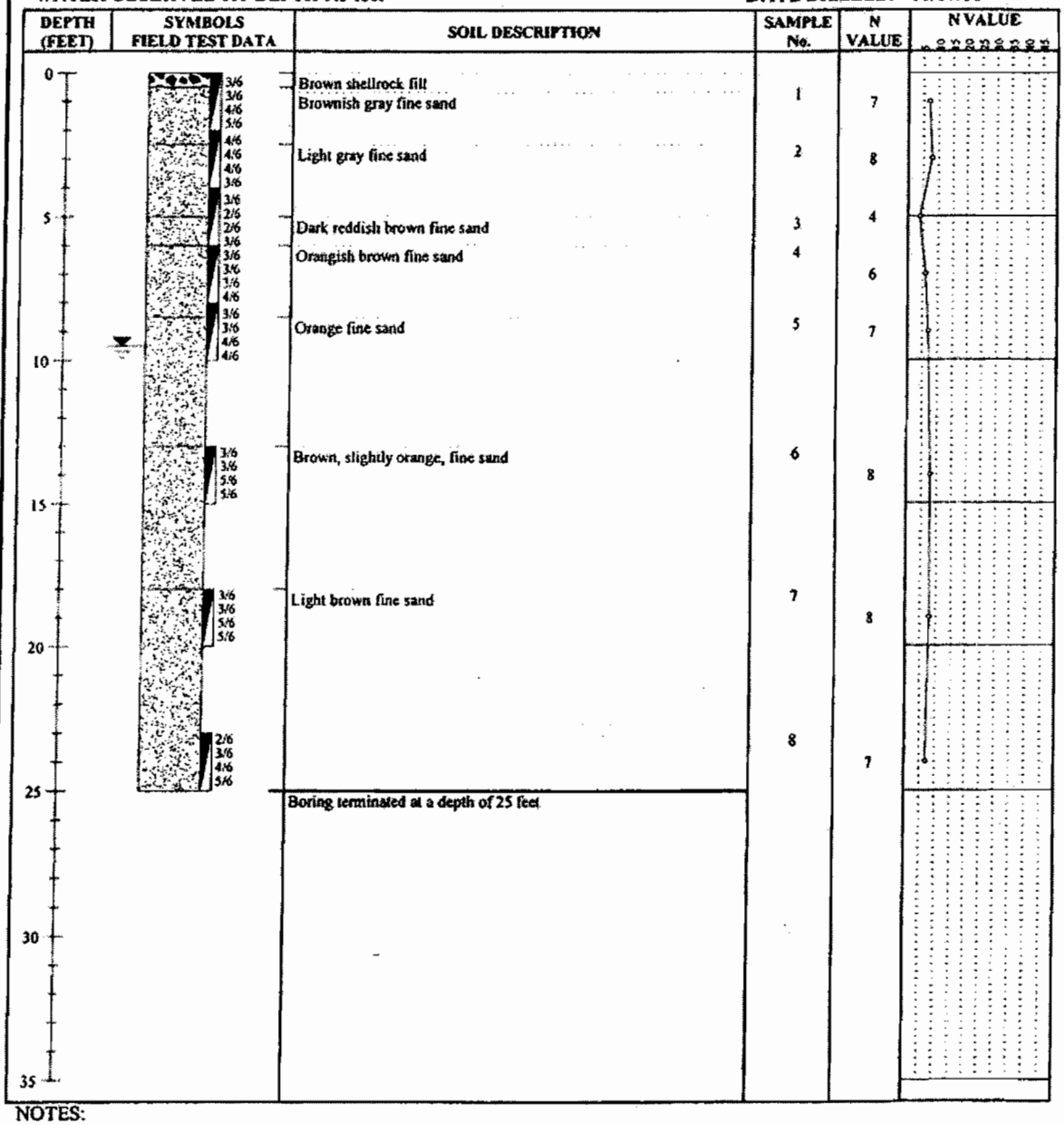
FILE No.: 08-2148

BORING LOCATION: As per plan
N- 26°27'46.9" W- 80°04'42.0"

DRILL CREW: DG/JH

WATER OBSERVED AT DEPTH 9.5 feet

DATE DRILLED: 11/07/08



NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN" 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

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STANDARD PENETRATION TEST BORING LOG

BORING B-2

PROJECT: West Settlers Office Building
82 NW 5th Avenue, Delray Beach, Palm Beach County, Florida

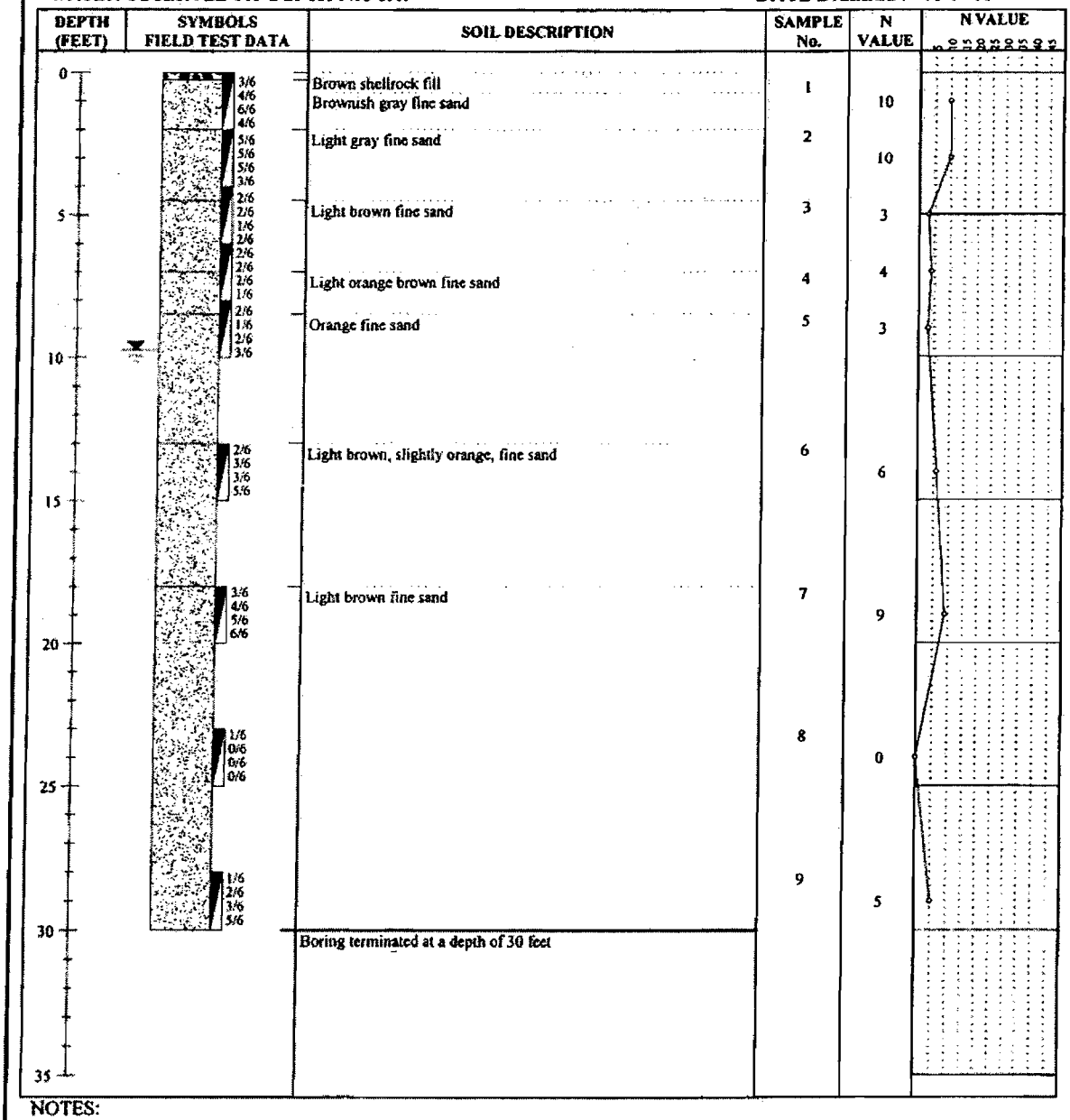
FILE No.: 08-2148

BORING LOCATION: As per plan
N- 26°27'47.4" W- 80°04'42.0"

DRILL CREW: DG/JH

WATER OBSERVED AT DEPTH 9.75 feet

DATE DRILLED: 11/07/08



NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN" 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

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Ardaman & Associates, Inc.

SFWMD USUAL OPEN-HOLE TEST
EX-1

PROJECT: West Settlers Office Building
82 NW 5th Avenue, Delray Beach, Palm Beach County, Florida

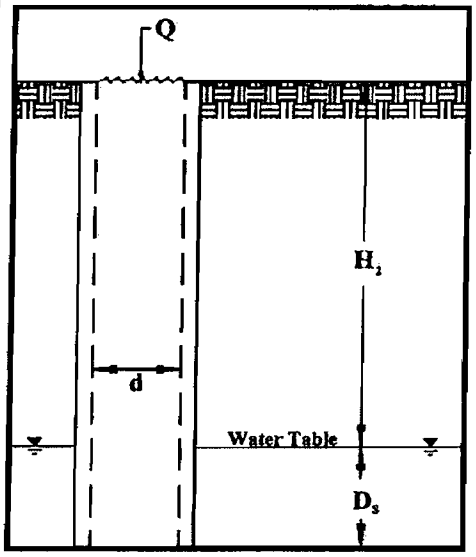
FILE No.: 08-2148

TEST LOCATION: As per plan
N- 26°27'47.1" W- 80°04'42.4"

DRILL CREW: DG/JH

GROUNDWATER OBSERVED AT DEPTH Not encountered

TEST DATE: 11/07/08



$$K = \frac{4Q}{\pi d(2H_2^2 + 4H_2D_s + H_2 d)}$$

Q ["Stabilized" Flow Rate (cfs)] = 2.79×10^{-3}

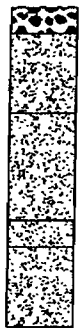
K [Hydraulic Conductivity (cfs/sqf - ft head)] = 9.46×10^{-5}

d [Diameter of Test Hole (ft)] = 0.5

H_2 [Depth to Water Table (ft)] = 6+

* D_s [Saturated Hole Depth (ft)] = 0

* By Groundwater

DEPTH	SYMBOLS	SOIL DESCRIPTION	SAMPLE No.
0 1 2 3 4 5 6		Brown shellrock fill Drak gray fine sand Light gray fine sand Dark reddish brown fine sand Brown fine sand	

NOTES: Groundwater was observed in our SPT borings at depths of 9.5 to 9.75 feet below the ground surface

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