SUBSURFACE EXPLORATION AND
GEOTECHNICAL ENGINEERING EVALUATION
OKEECHOBEE AGRICULTURAL CIVIC CENTER
OKEECHOBEE, FLORIDA

Ardaman & Associates, Inc.

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Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

File No. 02-5674
July 30, 2002

Okeechobee County
c/o HHCP Architects, Inc.
222 West Maitland Boulevard
Maitland, Florida 32751

Attention: Mr. Steve Krone, AIA

**SUBSURFACE EXPLORATION AND
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1.0 INTRODUCTION

In accordance with your request and authorization, Ardaman & Associates, Inc. has completed a subsurface exploration and geotechnical studies of the above captioned project site. We explored the general subsurface conditions in order to evaluate their suitability for supporting the proposed arena and barn 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, laboratory testing, and engineering analyses. This report describes our explorations and tests, reports their findings, and summarizes our conclusions and recommendations.

1.1 SUMMARY

In summary, based on our explorations and studies, we conclude that the soils on this site are adequate to support the proposed construction on conventional spread foundations, provided that the site is prepared as recommended in this report. Footings may be proportioned for a maximum bearing stress of 2,500 pounds per square foot [psf]. They may bear either on the existing ground or on fill or backfill, properly compacted, as described herein. For foundations designed and constructed as recommended, we expect maximum settlements less than one-half inch. The settlements due to the dead load of the structure should occur rapidly as it is erected and should have virtually ceased by the time construction is completed.

1.2 USE OF REPORT AND LIMITATIONS

Our report has been prepared specifically for this project. It is intended for the exclusive use of Okeechobee County, HHCP Architects, Inc. and their 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 on the south side of S.R. 70 in Section 13, Township 37 South, and Range 36 East in Okeechobee, Okeechobee County, Florida. A site vicinity map is presented as our Figure 1. The site is currently undeveloped and overgrown with various types of vegetation; access to the inner portions of the site is provided by paths cleared by others.

Based on our review of the 1952 U.S. Geological Survey, 7.5 Minute Series Topographic Quadrangle map of Okeechobee, Florida (photorevised 1972), the subject site appears to be relatively level with the ground surface at about elevation 25 feet with respect to the National Geodetic Vertical Datum (NGVD) of 1929.

3.0 PROJECT DESCRIPTION

We have examined a site plan prepared by LBFH, Inc. and provided to us electronically on July 8, 2002. Details of this plan have been reproduced as our Boring Location Plan, Figure 2, and shows the proposed agricultural civic center (agri-civic center) development arranged on the site. The scope of our work was limited to the propose covered horse arena and horse barn as shown on Figure 2.

Based on conversations with the project Structural Engineer (Advanced Structural Engineering) it is our understanding that the two proposed structures will range in height from 30 to 36 feet and will have a combination of non-load bearing masonry walls (wall loads less than 2 kips per lineal foot) and isolated columns. The following anticipated column loads were provided to us:

Table 1: Anticipated Column Loads

Structure	Vertical Load [kips]	Horizontal Load [kips]
Covered Horse Arena	110	130
Horse Barn	60	85

We expect that between 2 and 4 feet of fill will have to be placed to raise the site grades and that floor slab loads will be less than 150 pounds per square foot (psf).

4.0 FIELD EXPLORATION

4.1 SOIL BORINGS

To explore subsurface conditions at the site, ten (10) Standard Penetration Test (SPT) borings were performed at the locations shown on the Boring Location Plan, Figure 2. The SPT borings were completed at depths of 25 feet below the existing ground surface. This work was performed between July 15 and 16, 2002 in accordance with the procedures recommended in ASTM D-1586. The boring logs and a description of our drilling and testing procedures are included in the Appendix.

4.2 GENERAL

Our field crew chief met on the first day of our site work with representatives of Okeechobee County and were shown the boring and test locations as staked by others prior to our arrival. We estimate that the actual boring locations are within about 15 feet of the locations shown in Figure 2. If you need to know the boring locations more accurately, we recommend that you retain a surveyor.

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 in the Appendix.

6.0 GENERAL SUBSURFACE CONDITIONS

The boring logs in the Appendix 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 by the boring logs in the Appendix, the soils on the site at the locations and the depths explored consist generally of a few feet of gray to brown loose fine sands (SP) with traces of roots, followed by loose to moderately dense brown to gray fine sands with varying amounts of fines (SP to SP-SM) from depths of about 4 to 5 feet and reaching the termination depths of our borings.

6.1 USDA SOIL SURVEY

The Soil Survey of Okeechobee County, Florida, which was issued by the U.S. Department of Agriculture, Soil Conservation Service in 1971, states that the predominant surficial soil type in the area where the site is located is the Immokalee fine sand (Im) of the Immokalee Series. Complete descriptions of this soil type and the soil series to which it belongs are attached to this report. We have included the portion of the USDA soils map which includes the site as our Figure 3. In general, our soil borings encountered soil conditions very similar to those described in the USDA Soil Survey.

7.0 GROUNDWATER CONDITIONS

Our drillers observed groundwater in the boreholes at depths that ranged from 3 to 9 inches below the ground surface, as noted on the boring logs in the Appendix. 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. We expect that groundwater conditions are controlled by rainfall events. Groundwater levels above the existing ground surface (standing) 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 and root mats should be removed entirely, and any ditches present on the site should be dewatered, cleaned for compressible bottom deposits, and backfilled with granular materials placed and compacted as described below.

8.2.2 Densification

The cleared areas should be proofrolled with a 20 ton vibratory roller that exerts a centrifugal linear load not less than 340 pounds per linear inch. Any soft, yielding soils detected should be excavated and replaced with clean, compacted backfill that conforms with the recommendations below. Sufficient passes should be made during the proofrolling operations to produce dry densities not less than 98 percent of the modified Proctor (ASTM D-1557) maximum dry density of the compacted material to depths of 2 feet below the compacted surface, or 2 feet below the bottom of footings, whichever is lower. In any case, the building area should receive not less than 10 overlapping passes, half of them in each of two perpendicular directions.

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.

After the exposed surface has been proofrolled and tested to verify that the desired dry density has been obtained, the building and pavement areas may be filled to the desired grades. All fill material should conform to the recommendations below. It should be placed in uniform layers not exceeding 18 inches in loose thickness. Each layer should be compacted to a dry density not less than 98 percent of its modified Proctor (ASTM D-1557) maximum value.

Note that after completion of the general site preparation, when excavations for the construction of foundations are made through the compacted natural ground, fill or backfill, the bottoms of the excavations are to be tamped so as to densify soils loosened during or after the excavation process, or washed or sloughed into the excavation prior to the placement of forms. A plate tamper can be used for this final densification immediately prior to the placement of reinforcing steel, with previously described density requirements to be maintained below the foundation level. The groundwater must be lowered if needed to allow maintaining the required density level and a firm working surface for the placement of the foundations.

After foundation forms are removed, backfill around foundations should be placed in lifts six inches or less in thickness, with each lift individually compacted with a plate tamper. The backfill should be compacted to a dry density of at least 95% of the modified Proctor (ASTM D-1557) maximum dry density. The use of forms are recommended when the surrounding soils are sandy in nature.

Table 2: Compaction Requirements

CONDITION	MAXIMUM LIFT HEIGHT (INCHES)	EQUIPMENT	MINIMUM # OF PASSES	COMPACTION LEVEL (PERCENT)	DENSITY TEST DEPTH (FEET)
Initial Proofrolling	0	Heavy Roller	10	98	2
Additional Fill to Grade	18	Heavy Roller	6	98	1
Bottom of Footing Excavations	0	Tamper	4	98	1
Footing Overexcavation Backfill	4	Tamper	4	98	1
Backfill Around Foundations and Behind Walls	6	Tamper	4	95	1

* Percentage of modified Proctor maximum dry density - ASTM D-1557/AASHTO T-180

8.2.3 Fill Material

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 (8) 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. #200 sieve.

8.2.4 Erosion Control

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 5 feet beyond the foundation levels, with gutters disposing of rainfall runoff beyond the pad limits.

8.2.5 Quality Control

In order to verify the contractor's compliance with the above recommendations, all proofrolling and placement of compacted fill and backfill should be observed and tested by Ardaman & Associates, Inc. For your convenience, please contact our office a few days prior to proof-rolling, so that we can obtain proctor test samples and perform proctor tests in our laboratory. This will allow for the maximum proctor dry density values to be available at the time of proof-rolling and density testing.

8.2.6 Additional Recommendations

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 grill 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 net allowable bearing pressure of 2,500 pounds per square foot [psf], or less. 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. Exterior foundations should bear at least 18 inches below adjacent outside final grades. We recommend that attention be given to the apparent groundwater level when deciding on the elevation of the bottom of the foundations so as to reduce construction difficulties.

The above mentioned allowable bearing pressure refers to a net increase in pressure on the existing soils from the anticipated dead and live loads. Thus, the weight of the foundation concrete and soil backfill may be neglected in sizing computations. Furthermore, the allowable soil bearing pressure may be increased by one-third when considering cases involving short duration transient load situations, such as that case when wind loads are considered on the structure.

Foundations subjected to lateral forces will resist those forces through passive earth pressures on the vertical sides of the individual foundations located at right-angles to the direction of the load application, and by shearing forces acting on the foundation-soil interface. Following are conservative estimates of pertinent engineering properties of the shallow subsoils.

Table 3: Soil Parameters

Depth [feet]	Soil Description	Dry Unit Weight [pcf]	Submerged Unit Weight [pcf]	Friction Angle [degrees]	Cohesion [psf]
0-10	Loose to medium dense fine sand	112	62	32	0

The Rankine coefficients of lateral pressures can be obtained from the following equations:

Active pressure: $K_a = \tan^2 (45 - \phi/2)$

Passive pressure: $K_p = \tan^2 (45 + \phi/2)$

where ϕ is the friction angle of the soil (see Table 3).

A coefficient of earth pressure at rest (K_0) of 0.47 may be used in the design.

The concrete-soil interaction friction angle ϕ_f is estimated to be 26° for the upper loose to moderately dense fine sands. To obtain the coefficient of friction between the concrete foundations and the soil, use the following equation:

$$\mu = \tan (\phi_f)$$

where μ is the coefficient of friction.

The above values should be used in the design of the foundations, provided that the foundations are surrounded by well-compacted granular materials (as previously recommended) and that foundations are allowed lateral movements of up to one-quarter of an inch.

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 less than one-half inch. Because of the granular nature of the subsurface soils, the majority of the settlements should occur during construction; post-construction settlement should be minimal.

We recommend that Ardaman & Associates, Inc. inspect all footing excavations in order to verify that footing bearing conditions are consistent with expectations.

8.3.2 Slab-On-Grade

After the ground surface is proofrolled and filled, if necessary, as recommended in this report, the floor slab can be placed directly on the prepared 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. In addition, for the design of ground floor slabs a modulus of subgrade reaction of 150 pounds per cubic inch can be used provided that the slabs are underlain by at least 18 inches of well-compacted granular materials.

We recommend isolating the ground floor slab from column and wall foundations. If a "monolithic" slab foundation system is nevertheless desired, we would recommend additional tamping of the foundation excavation bottoms, and if possible, the centering of walls over the thickened slab edge. Note that if the walls are placed along the edges, they would produce an eccentric loading that might induce minor settlements along the edge of the footing. Such minor settlements would create tension stresses and possibly a minor crack in the thin section of the slab in a direction parallel to the wall.

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.

9.0 PAVEMENT RECOMMENDATIONS

We have not been provided with traffic loadings for this project and consequently, we have included two flexible pavement designs for alternate traffic volumes and types. In addition, recommendations for a rigid pavement design is presented for use in delivery areas and dumpster pads.

9.1 GENERAL

The flexible pavements designs are based on structural number analyses with the stated estimated daily traffic volumes for a 15-year pavement design life. If loading conditions differ greatly from those presented, additional pavement design analyses should be performed.

We recommend that the pavement sections be installed late in construction when most heavy construction traffic has ceased. If limerock base material is placed during construction to provide a working surface it should be proofrolled, leveled, and thickened as required prior to paving at the end of construction (EOC).

9.2 FLEXIBLE PAVEMENT SECTIONS

We recommend a pavement section consisting of an asphaltic concrete wearing surface on a calcareous base course supported on stabilized subbase over well-compacted subgrade.

After clearing and proofrolling the site surface as previously recommended, the surficial soils should be suitable to support the pavement sections. The subgrade material should be compacted to a dry density of 98% of the modified Proctor (ASTM D-1557 or AASHTO T-180) maximum dry density of the compacted soil to a depth of one foot below the surface.

9.2.1 Stabilized Subgrade

The sub-base material to a depth of twelve inches should have a Florida Bearing Value (FDOT FM 5-517) greater than 50 and it should be compacted to at least 98 percent of its modified Proctor (ASTM D-1557 or AASHTO T-180) maximum dry density. The surficial fine sand on this site does not appear to have the required FBV value. Very likely, however, it can be improved so that its FBV will exceed 50 psi by mixing it with stabilizing materials before compacting it. Otherwise, suitable materials will have to be imported. The sub-base section may be replaced by an extra thickness of base material.

Due to the high groundwater levels encountered at this site we would recommend stabilizing the subgrade with rock or sheli fragments rather than silty, clayey or sludge materials. The use of rock or shell would facilitate a more rapid drainage of excess water that might enter the base or subgrade. Based on the desired final grades, if the groundwater can rise to within 2 feet of the pavement section it may be necessary to utilize an underdrain system.

9.2.2 Base Course

The base course may be either crushed limerock, coquina, or crushed concrete, whichever is more economical. It should have a Limerock Bearing Ratio (FDOT FM 5-515) greater than 100. We recommend a base course at least six inches thick under standard pavement (automobiles and light trucks) and at least nine inches thick under heavy-duty pavement. The six-inch base course may be placed and compacted in a single layer. The nine-inch base course should be placed and compacted in two layers. All base course material should be compacted to at least 98 percent of its modified Proctor maximum dry density.

9.2.3 Asphalt Surface

We recommend an FDOT Type S-1 asphaltic wearing surface. It should have a Marshall stability not less than 1000 pounds. We recommend a wearing surface 1.5 inches thick on standard pavement and 2.0 inches thick on heavy-duty pavement. The two-inch wearing surface should be placed and compacted in two layers. Care must be exercised to place the asphalt over dry, well primed base material.

9.2.4 Flexible Pavement Summary

The above recommendations should provide high quality pavement. If greater risk of more frequent pavement maintenance and repair is acceptable, then the above recommendations could be relaxed somewhat. Table 4 summarizes the recommended flexible pavement sections.

Table 4: FLEXIBLE PAVEMENT

Traffic Group	Thickness [inches]			Structural Number
	Stabilized Subgrade	Base Course	Asphalt Surface	
Light Duty: Auto parking area, light panel and pickup trucks; average gross vehicle weight of 4,000 lbs.	12	6	1.5	2.7
Heavy Duty: Bus drop-off areas, delivery trucks; average gross vehicle weight of 25,000 lbs	12	9	2	3.5

9.3 RIGID PAVEMENT SECTION

After clearing and proofrolling the site surface as previously recommended, the surficial soils should be suitable to support the pavement sections. The subgrade material should be compacted to a dry density of 98% of the modified Proctor (ASTM D-1557 or AASHTO T-180) maximum dry density of the compacted soil to a depth of two feet below the surface. The subgrade surface should be saturated immediately prior to concrete placement to provide adequate moisture for curing of the concrete.

We recommend a five-inch thick pavement section of unreinforced Portland cement concrete. The concrete should have a minimum 28-day compressive strength of 4,000 psi. Construction control joints should be placed no more than 15 feet apart in either direction and should be at least one-quarter of the thickness of the concrete. They should be cut as soon as the concrete will support the crew and equipment (8 to 12 hours). The concrete should be cured by moist curing or by application of a liquid curing compound.

9.4 CURBING

The curbing around landscaped areas adjacent to pavement should be constructed with full-depth curb sections. Use of extruded curb sections that lie directly above the final asphalt surface, or omission of the curbing, can allow migration of irrigation water from the landscaped areas. The excess water often causes separation of the asphalt wearing surface from the base and softening of the base material, resulting in early deterioration of the pavement.

Due to the high groundwater levels encountered at this site we recommend that consideration be given to adequate drainage of irrigation water in order to avoid this situation.

10.0 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 presented in the Appendix 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.

Best regards,

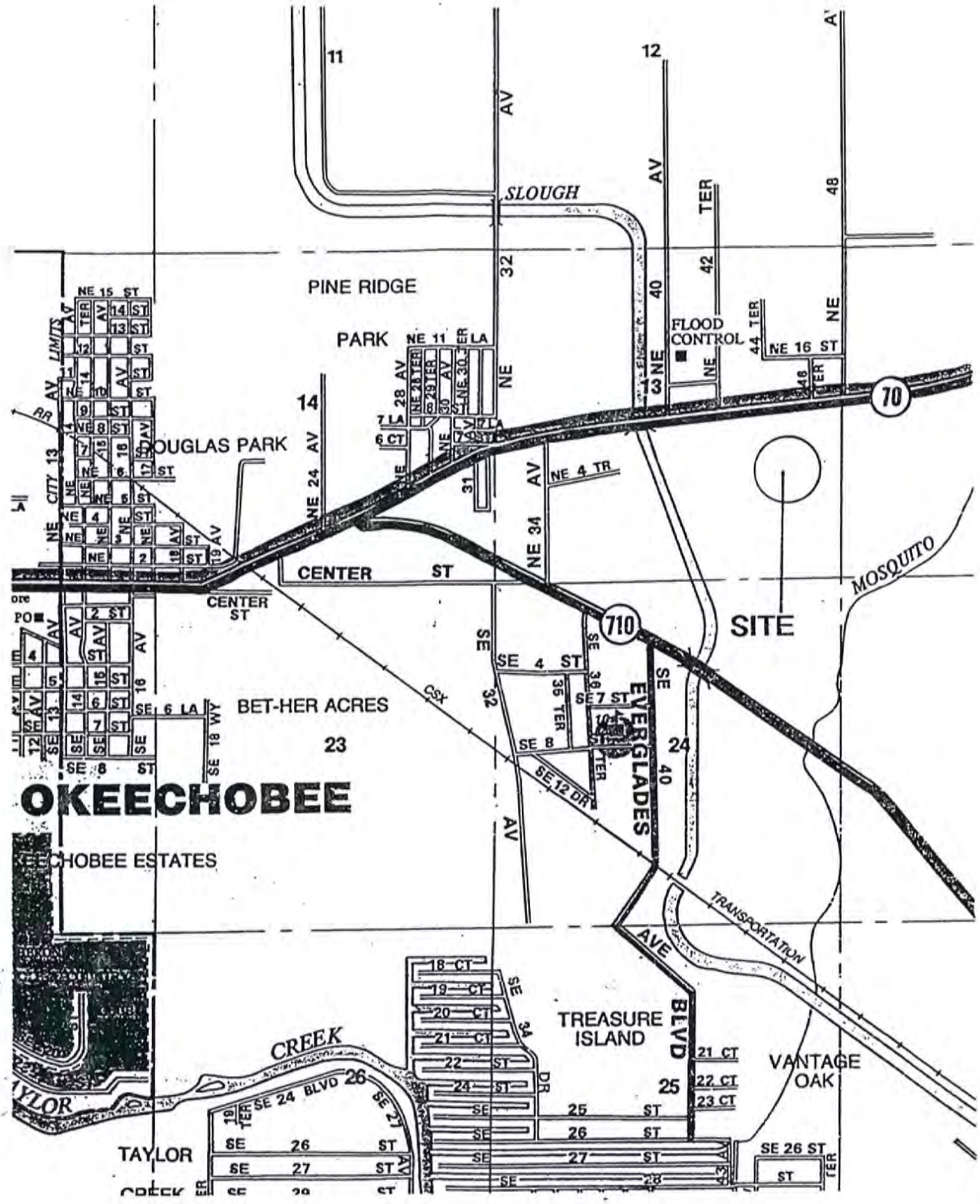
ARDAMAN & ASSOCIATES, INC.

Peter G. Andersen, P.E.
Senior Project Engineer
Fla. Reg. No. 57956

David P. Andre, P.E.
Branch Manager
Fla. Reg. No. 53969

cc: Okeechobee County - Mr. Donnie Oden
LBFH, Inc. - Mr. Jeff Sumner, P.E.

PGA/DPA:aw



SITE VICINITY MAP

N.T.S

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE EXPLORATION
OKEECHOBEE AGRI-CIVIC CENTER PROJECT
OKEECHOBEE, FLORIDA

FILE NO.	APPROVED BY:	FIGURE:
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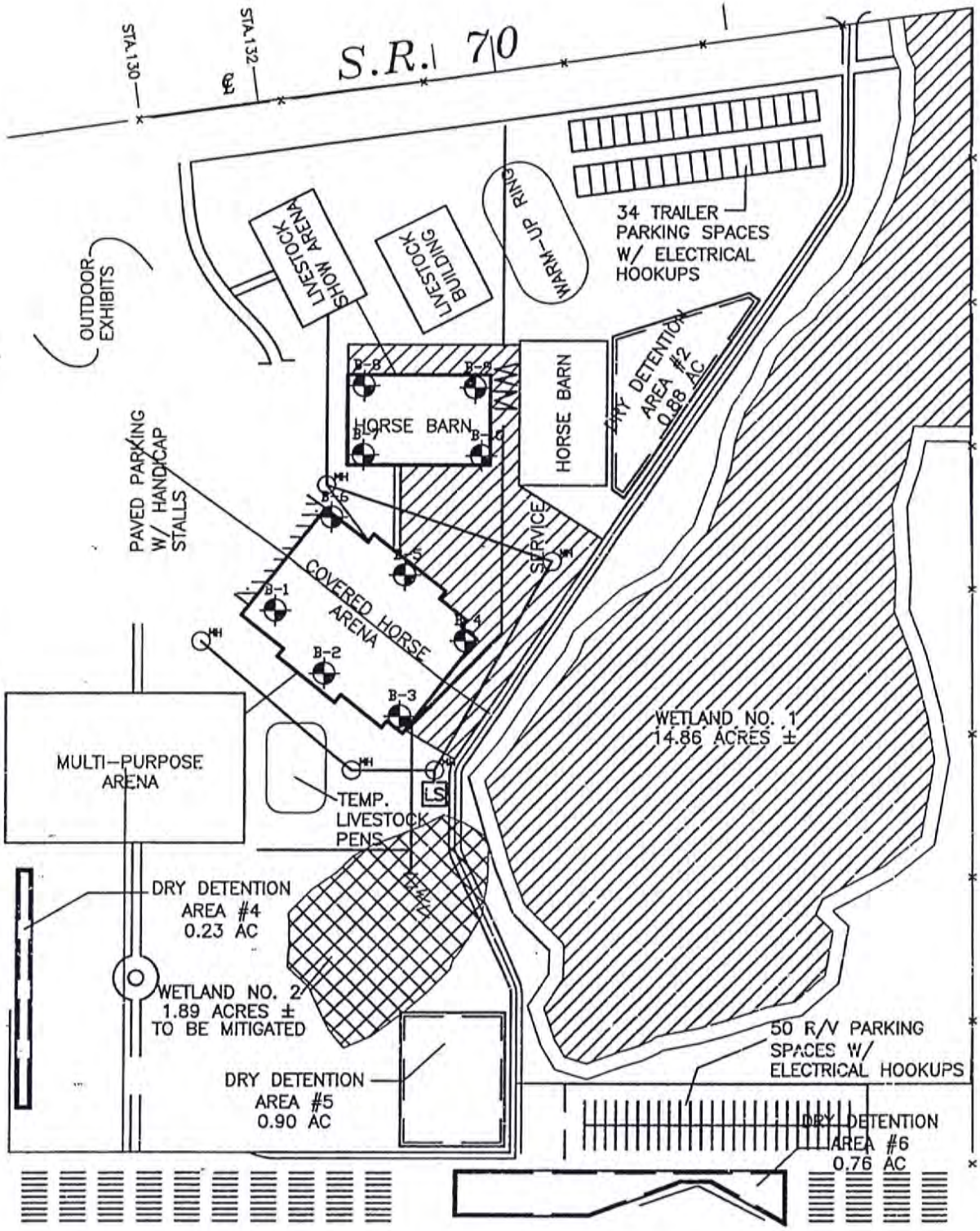

LEGEND:

B-# SPT Boring

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FIGURE 2 REPRODUCED FROM SITE PLAN BY LBFH, INC.

BORING LOCATION PLAN

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SUBSURFACE EXPLORATION
OKEECHOBEE AGRI-CIVIC CENTER PROJECT
OKEECHOBEE, FLORIDA

FILE NO.	APPROVED BY:	FIGURE:
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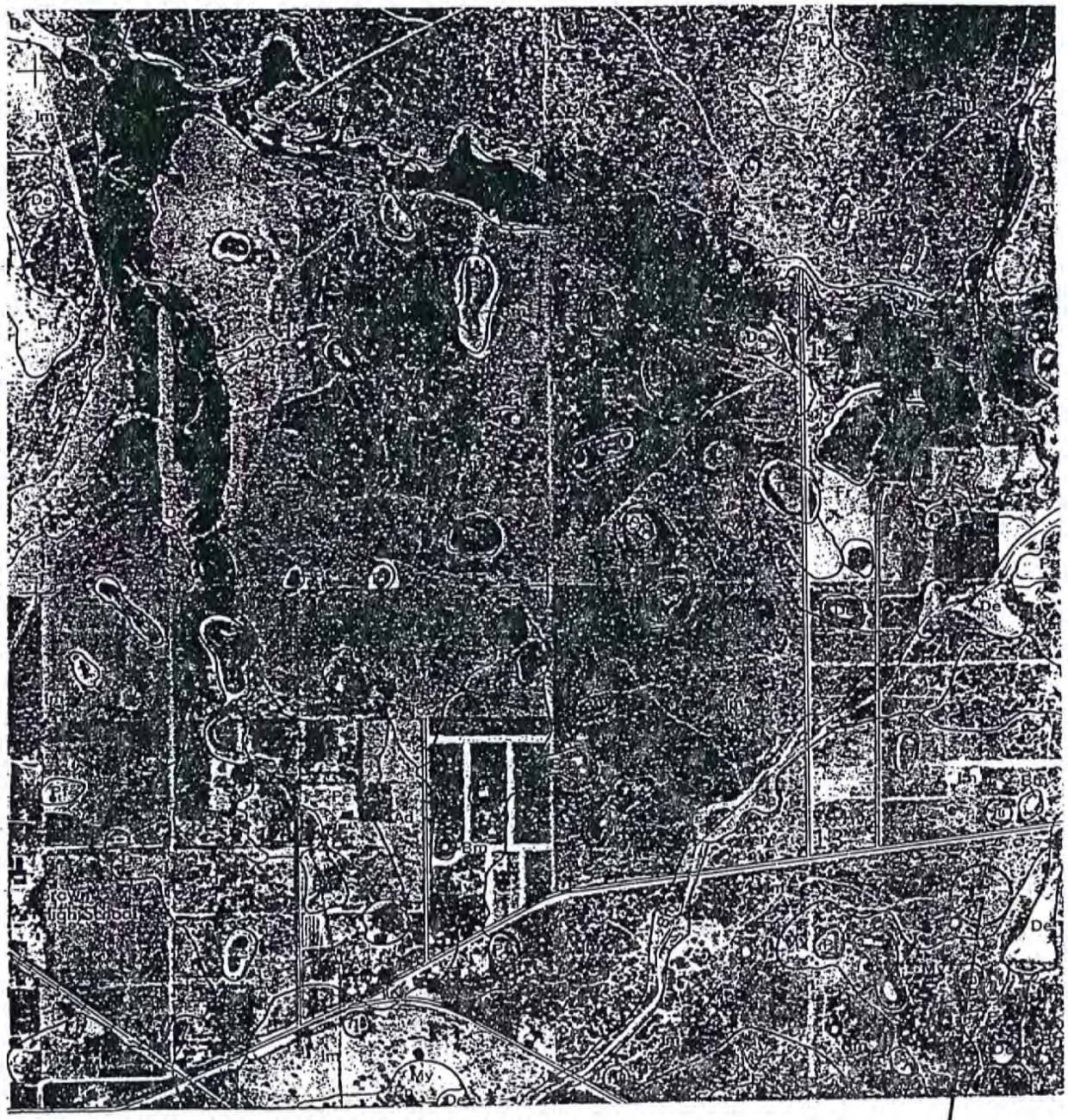

USDA SOILS MAP

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TAKEN FROM USDA-SCS SOILS SURVEY OF OKEECHOBEE COUNTY, 1971 EDITION

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SUBSURFACE EXPLORATION
OKEECHOBEE AGRI-CIVIC
CENTER PROJECT
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FILE NO.	APPROVED BY:	FIGURE:
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Immokalee fine sand (Im).—This deep, poorly drained, nearly level, sandy soil is in broad flatwoods areas in all parts of the county.

In a typical profile the surface layer is very strongly acid, very dark gray fine sand about 6 inches thick. The subsurface layer is light-gray to white fine sand about 29 inches thick. An organic pan layer, about 20 inches thick, is at a depth of about 35 inches. The upper part of this pan is weakly cemented, black fine sand, and the lower part is mottled dark reddish-brown fine sand. Below is strongly acid, brown fine sand. The water table normally is at a depth of about 30 inches.

Typical profile of Immokalee fine sand (along Spicy Island Road, 300 feet west of U.S. Highway No. 441, and about 7½ miles north of the center of Okeechobee):

A1—0 to 6 inches, very dark gray (10YR 3/1) fine sand; weak, fine, crumb structure; very friable; many fine and medium roots; has a salt-and-pepper appearance in places because of mixing of organic matter and light-gray sand; very strongly acid; clear, smooth boundary.

A21—6 to 12 inches, light-gray (10YR 6/1) fine sand; many, coarse, faint, gray mottles and a few, coarse, distinct, dark-gray mottles; single grain; loose; common, fine, medium roots; very strongly acid; gradual, wavy boundary.

A22—12 to 35 inches, white (10YR 8/1) fine sand; single grain; loose; a few, fine, very dark gray streaks in root channels; a few, fine, medium and coarse roots; very strongly acid; ½ to 1 inch transitional layer that has a wavy boundary.

B21h—35 to 43 inches, black (10YR 2/1) fine sand; massive in place, but crushes to weak, fine, crumb structure; firm and weakly cemented, but friable when crushed; lower 2 inches grades to dark reddish brown (5YR 2/2); common fine and medium roots; very strongly acid; clear, wavy boundary.

B22h—43 to 54 inches, dark reddish-brown (5YR 3/3) fine sand; single grain; loose; common, fine and medium, dark reddish-brown (5YR 2/2) mottles; weakly cemented; a few, fine and medium roots; strongly acid; gradual, wavy boundary.

C—54 to 72 inches +, brown (10YR 4/3) fine sand; a few, fine, faint, light-gray, dark-brown, and pale-brown mottles; single grain; loose; strongly acid.

This soil is fine sand to a depth of 72 inches or more, and in all layers the reaction is strongly acid to very strongly acid. The A1 horizon is gray to black and 2 to 8 inches thick. The A2 horizon is light gray to white and 22 to 40 inches thick. The organic pan (B21h horizon) occurs at a depth between 30 and 48 inches and commonly consists of two parts. The upper part is black to dark reddish brown, is weakly cemented, and ranges from about 2 to 10 inches in thickness. The lower part is very dark brown to dark reddish brown and is mottled. It generally is thicker and less cemented than the upper part. Brownish- to grayish-colored layers occur below the pan. During the wet season the water table rises to near the surface for short periods, but it recedes to a depth of 48 inches or more during the dry season.

Included with this soil in mapping are small areas of Myakka, Pomello, St. Johns, Basinger, and Placid soils. This soil is similar to the Myakka soil, but depth to the organic pan is greater. It is not so well drained as the Pomello soil. Its surface layer (A1 horizon) is thinner than that in the St. Johns soil, and depth to the organic pan is greater. Unlike the Basinger and Placid soils, Immokalee fine sand has an organic pan.

Although Immokalee fine sand is periodically wet, it is rapidly permeable and responds readily to simple drainage practices. It is droughty during dry periods because its available water capacity is low. Fertility and content of organic matter are low.

Most areas of this soil remain in the native flatwoods and are used for range. The vegetation consists chiefly of saw-palmettos and grasses but includes scattered pines. Many areas are in improved pastures of high quality. Such crops as tomatoes and watermelons are grown on a small acreage under a high level of management that includes complete water control. This soil is poorly suited to citrus. Capability unit IVw–2; Acid Flatwoods range site; woodland group 4.

Immokalee fine sand (Im). - This deep, poorly drained, nearly level, sandy soil is in broad flatwoods areas in all parts of the county.

In a typical profile the surface layer is very strongly acid, very dark gray fine sand about 6 inches thick. The subsurface layer is light-gray to white fine sand about 29 inches thick. An organic pay layer, about 20 inches thick, is at a depth of about 35 inches. The upper part of this pan is weakly cemented, black fine sand, and the lower part is mottled dark reddish-brown fine sand. Below is strongly acid, brown fine sand. The water table normally is at a depth of about 30 inches.

Typical profile of Immokalee fine sand (along Spicy Island Road, 300 feet west of U.S. Highway No. 441, and about 7½ miles north of the center of Okeechobee):

A1-0 to 6 inches, very dark gray (10YR 3/1) fine sand; weak, fine, crumb structure; very friable; many fine and medium roots; has a salt-and-pepper appearance in places because of mixing of organic matter and light-gray sand; very strongly acid; clear, smooth boundary.

A21-6 to 12 inches, light-gray (10YR 6/1) fine sand; many, coarse, faint,gray mottles and a few, coarse, distinct, dark-gray mottles; single grain; loose; common, fine, medium roots; very strongly acid; gradual, wavy boundary.

A22-12 to 35 inches, white (10YR 8/1) fine sand; single grain; loose; a few, fine, very dark gray streaks in root channels; a few fine, medium and coarse roots; very strongly acid; ½ to 1 inch transitional layer that has a wavy boundary.

B21h-35 to 43 inches, black (10YR 2/1) fine sand; massive in place, but crushes to weak, fine, crumb structure; firm and weakly cemented, but friable when crushed; lower 2 inches grades to dark reddish brown (5YR 2/2); common fine and medium roots; very strongly acid; clear, wavy boundary.

B22h-43 to 54 inches, dark reddish-brown (5YR 3/3) fine sand; single grain; loose; common, fine and medium, dark reddish-brown (5YR 2/2) mottles; weakly cemented; a few, fine and medium roots; strongly acid; gradual, wavy boundary.

C-54 to 72 inches +, brown (10YR 4/3) fine sand; a few, fine, faint, light-gray, dark-brown, and pale-brown mottles; single grain; loose; strongly acid.

This soil is fine sand to a depth of 72 inches or more, and in all layers the reaction is strongly acid to very strongly acid. The A1 horizon is gray to black and 2 to 8 inches thick. The A2 horizon is light gray to white and 22 to 40 inches thick. The organic pan (B21h horizon) occurs at a depth between 30 and 48 inches and commonly consists of two parts. The upper part is black to dark reddish brown, is weakly cemented, and ranges from about 2 to 10 inches in thickness. The lower part is very dark brown to dark reddish brown and is mottled. It generally is thicker and less cemented than the upper part. Brownish- to grayish-colored layers occur below the pan. During the wet season the water table rises to near the surface for short periods, but it recedes to a depth of 48 inches or more during the dry season.

Included with this soil in mapping are small areas of Myakka, Pomello, St. Johns, Basinger, and Placid soils. This soil is similar to the Myakka soil, but depth to the organic pan is greater. It is not so well drained as the Pomello soil. Its surface layer (A1 horizon) is thinner than that in the St. Johns soil, and depth to the organic pan is greater. Unlike the Basinger and Placid soils, Immokalee fine sand is an organic pan.

Subsurface Exploration Information

Ardaman & Associates, Inc.

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 CME 45 drill rig or a CME 55 drill rig (or a portable tripod 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-coupled 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 six inches or less. After the test is completed, the sampler is removed from the borehole and opened.

The driller examines and classifies the soil recovered by the sampler. He places representative soil specimens from each test in closed glass jars or plastic bags and takes 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 United Soil Classification System (USCS). Jar samples are retained in our laboratory for sixty days, then discarded unless our clients request otherwise.

After completion of a test boring, the water level in the borehole is recorded.

ENGINEERING CLASSIFICATION OF SOILS

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

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

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

LEGEND FOR BORING LOGS

N:	Number of blows to drive a 2-inch OD split spoon sampler 12 inches using a 140-pound hammer dropped 30 inches
R:	Refusal (less than six inches advance of the split spoon after 50 hammer blows)
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)
+40:	Percent retained above a No. 40 sieve
US:	Undisturbed sample obtained with a thin-wall Shelby tube
k:	Permeability (feet per minute, unless otherwise noted)
DD:	Dry density (pounds per cubic foot)
TW:	Total unit weight (pounds per cubic foot)

ABBREVIATIONS USED ON BORING LOGS

bk	black	crs	coarse	orn	orange
bkn	broken	dr	dark	org	organic
br	brown	f	fine	sl	slightly
calc	calcareous	frag	fragments	si	silty
cem	cemented	gr	gray	v	very
cmtn	cementation	gn	green	w.	with
cl	clay	med	medium		

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-1

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

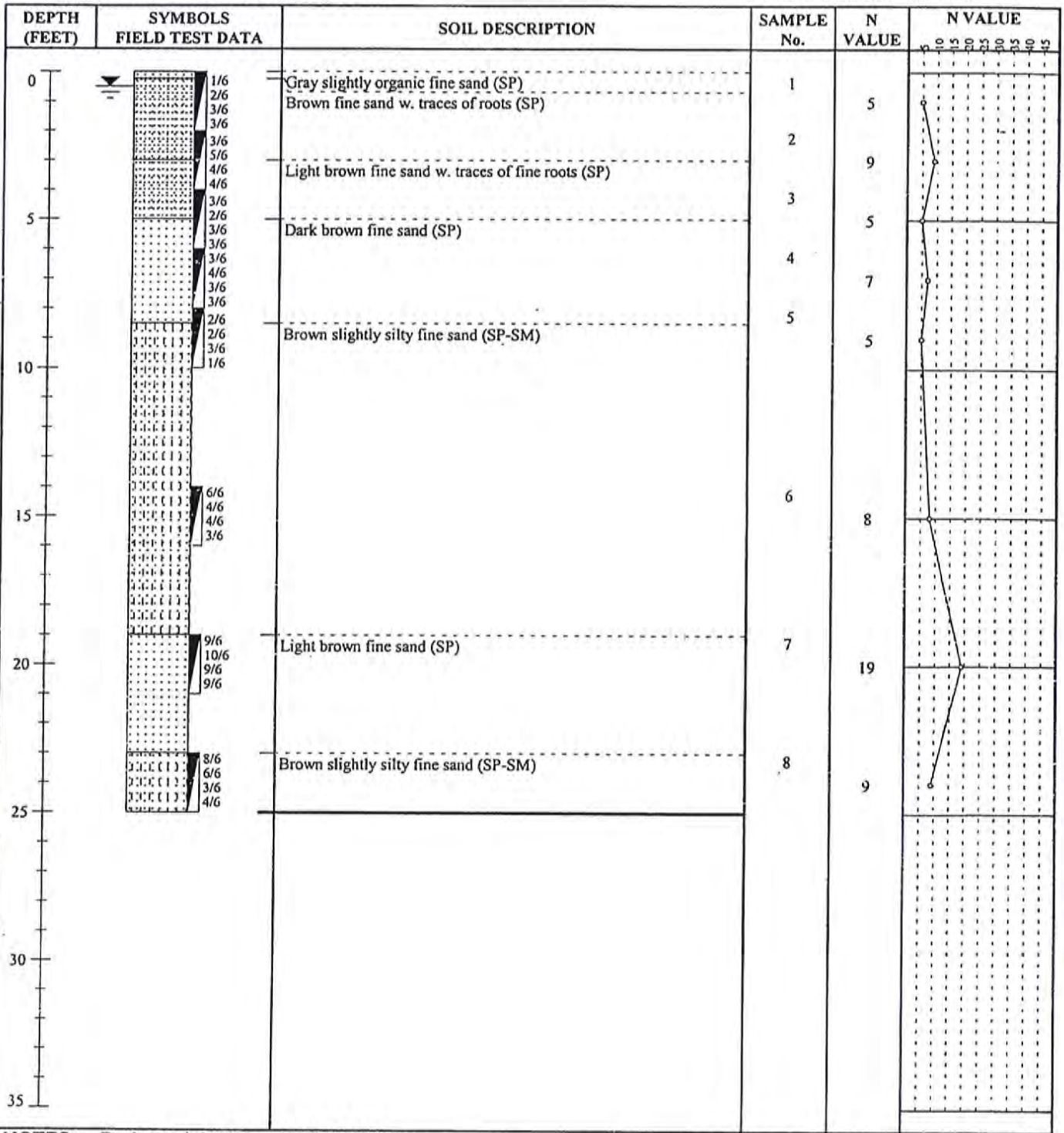
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.5 FEET

DATE DRILLED: 07/15/02



NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-2

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

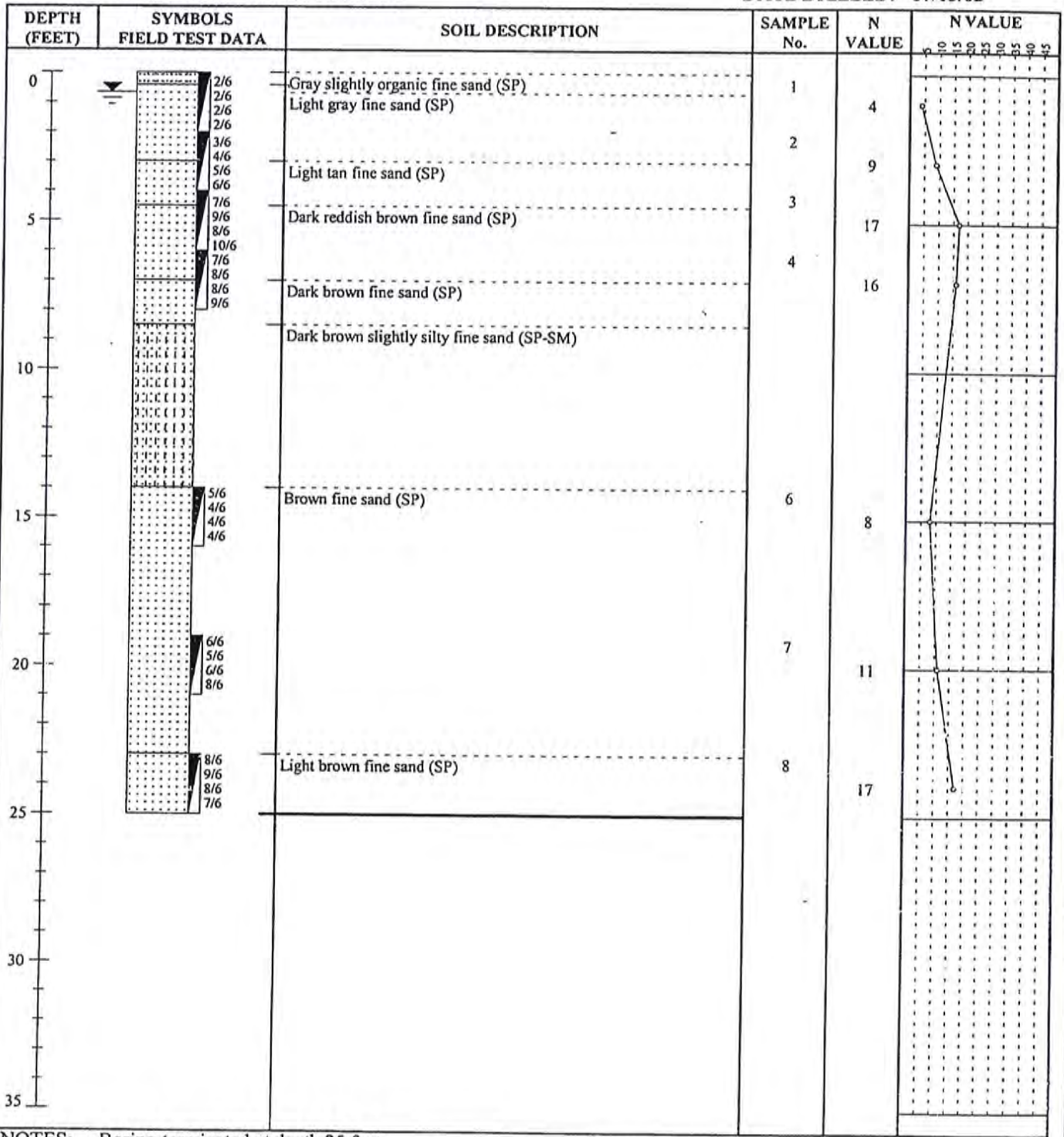
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.67 FEET

DATE DRILLED: 07/15/02



NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-3

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

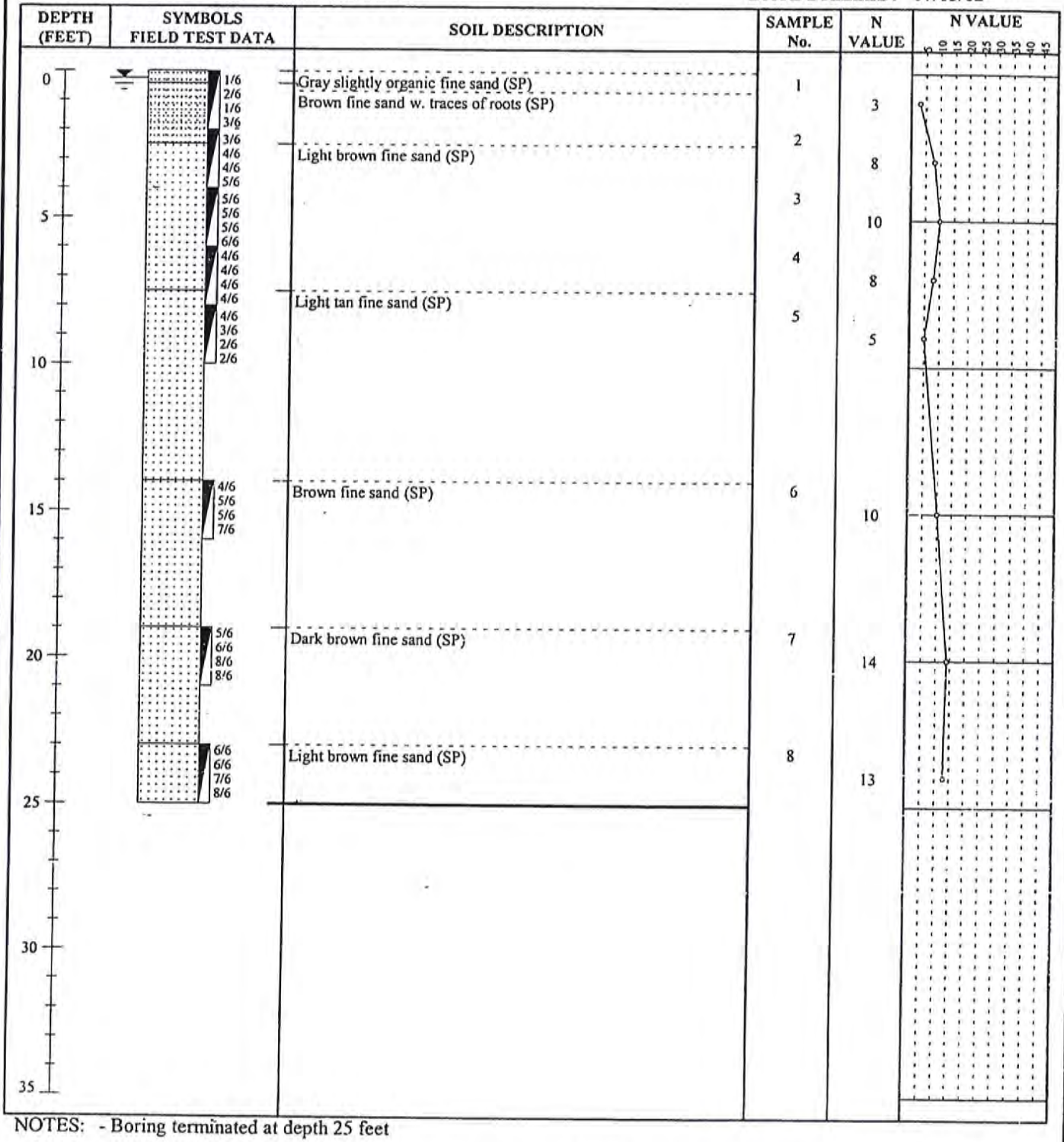
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.25 FEET

DATE DRILLED: 07/15/02



NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-4

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

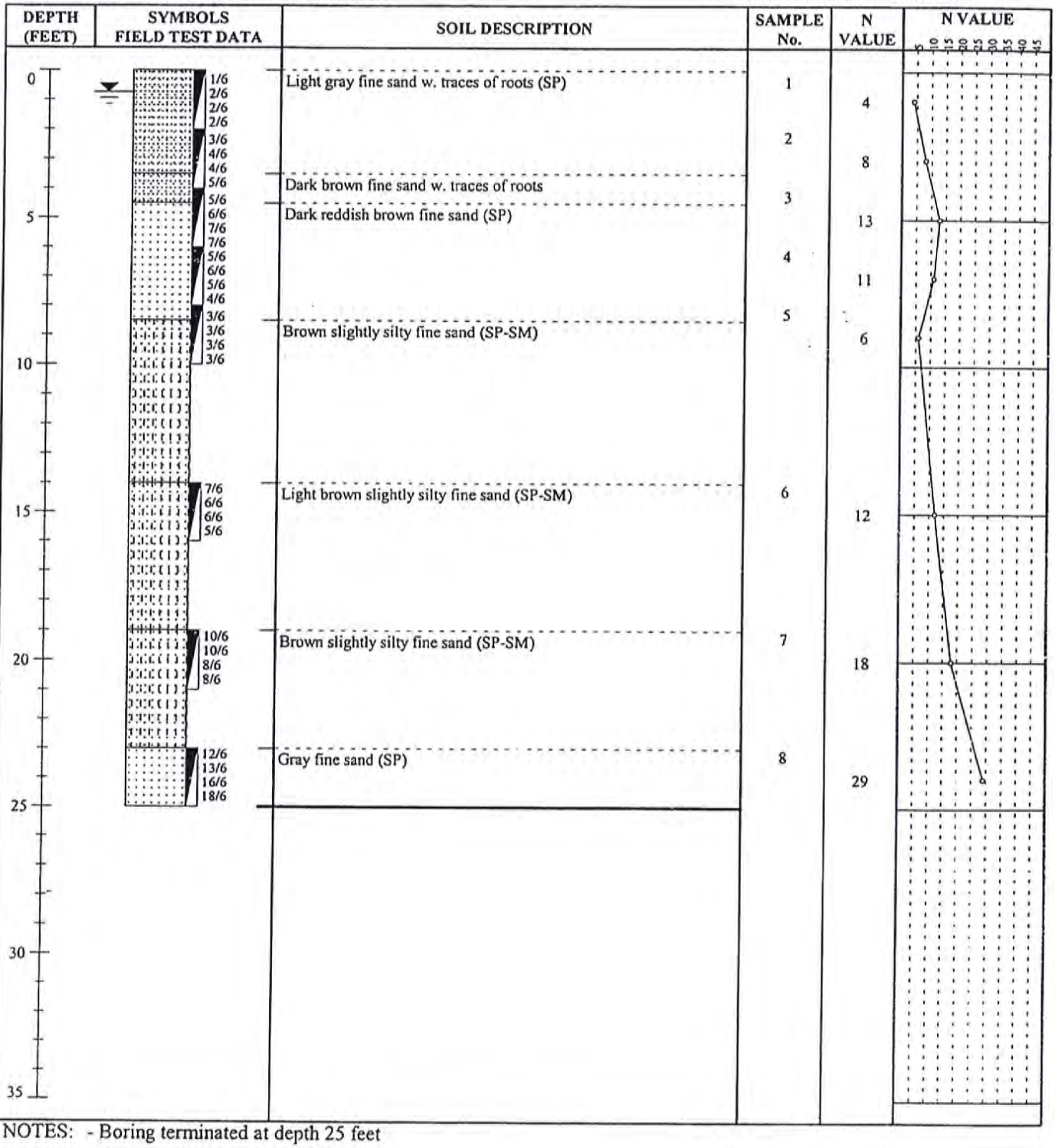
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.75 FEET

DATE DRILLED: 07/15/02



NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-5

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

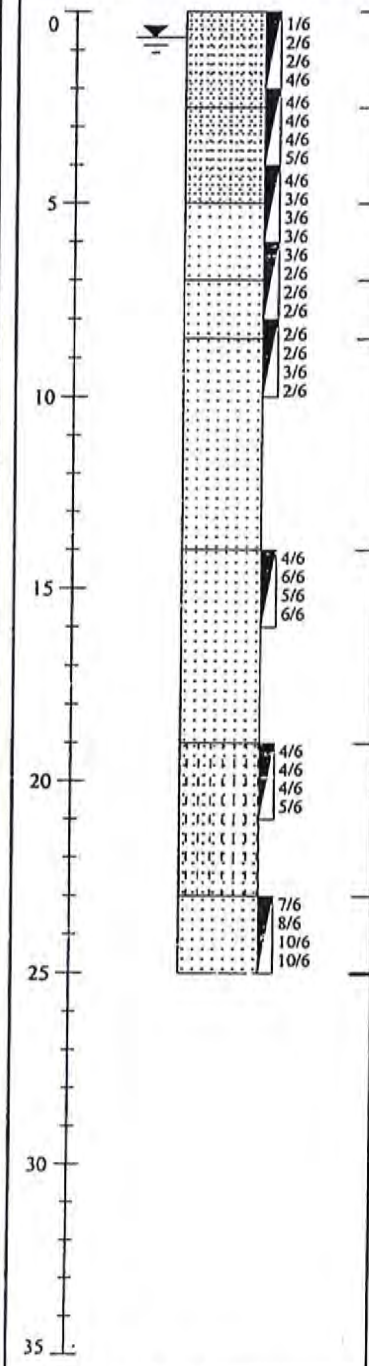
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.67 FEET

DATE DRILLED: 07/15/02



DEPTH (FEET)	SYMBOLS FIELD TEST DATA	SOIL DESCRIPTION	SAMPLE No.	N VALUE
0		Light gray fine sand w. traces of roots (SP)	1	4
		Light brown fine sand w. traces of roots (SP)	2	8
5		Brown fine sand (SP)	3	6
		Dark reddish brown fine sand (SP)	4	4
		Brown fine sand (SP)	5	5
10		Light brown fine sand (SP)	6	11
15		Brown slightly silty fine sand (SP-SM)	7	8
20		Gray fine sand (SP)	8	18
25				
30				
35				

N VALUE

NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-6

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

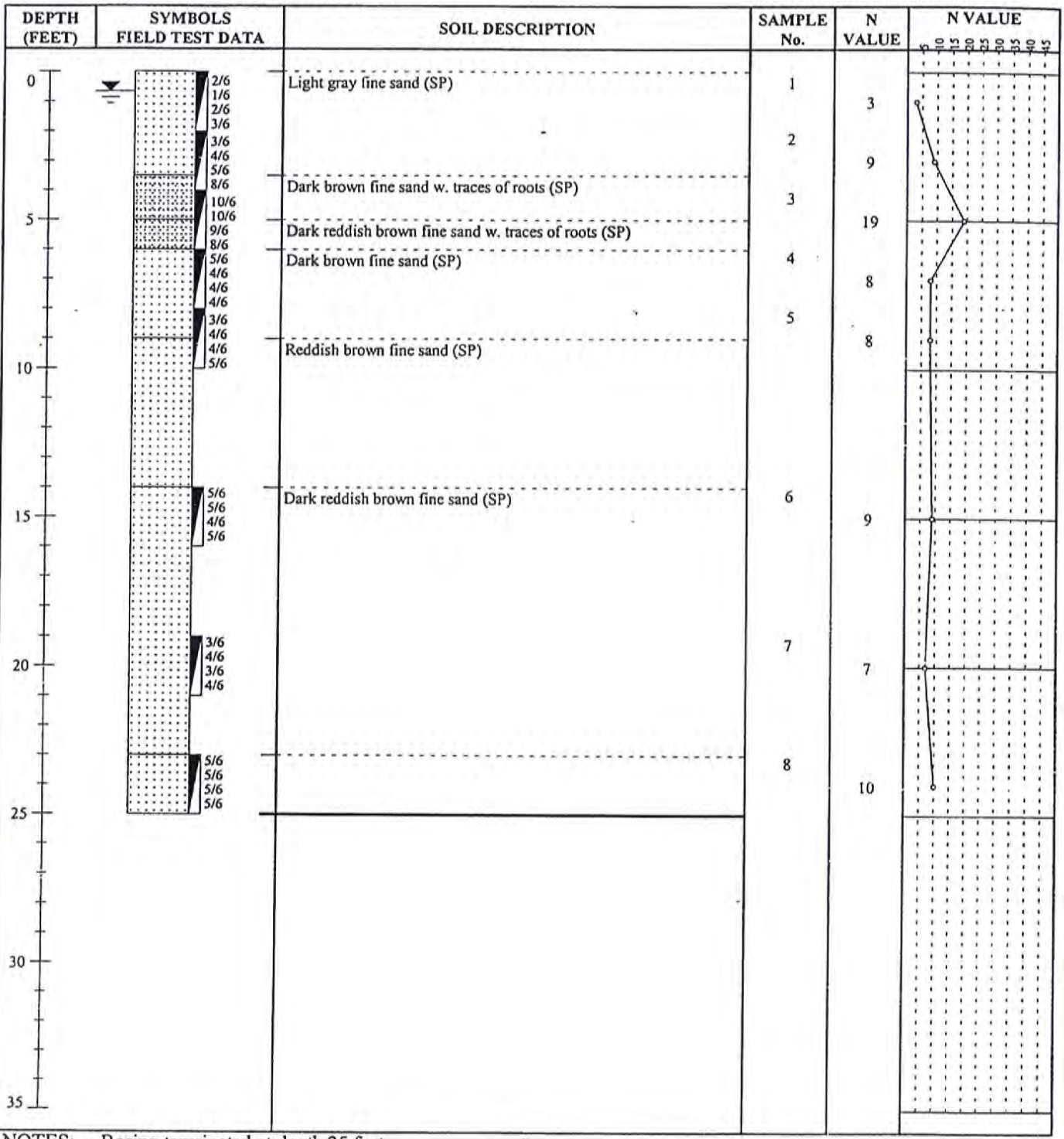
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.67 FEET

DATE DRILLED: 07/15/02



NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-7

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

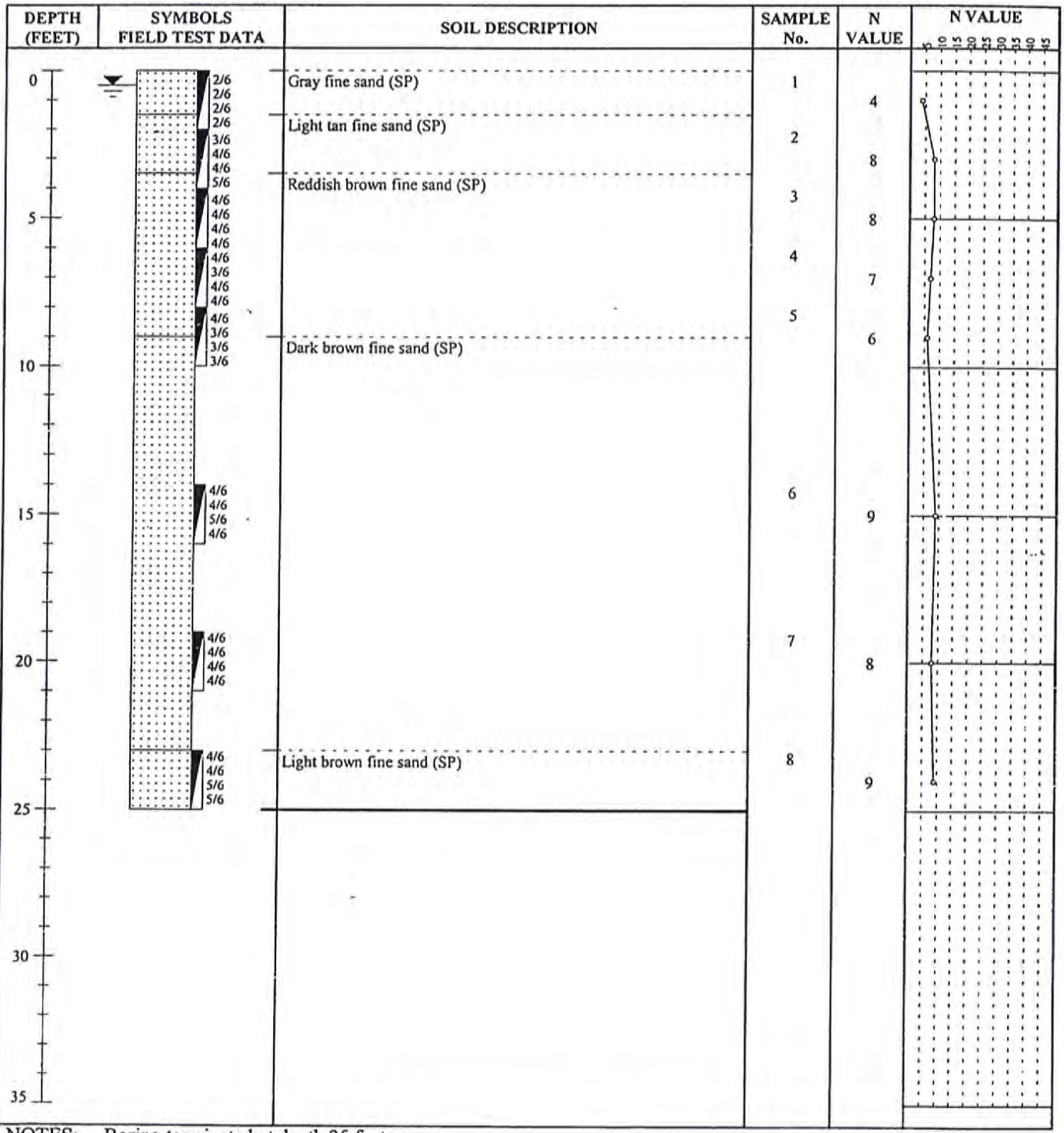
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.5 FEET

DATE DRILLED: 07/16/02



NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-8

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

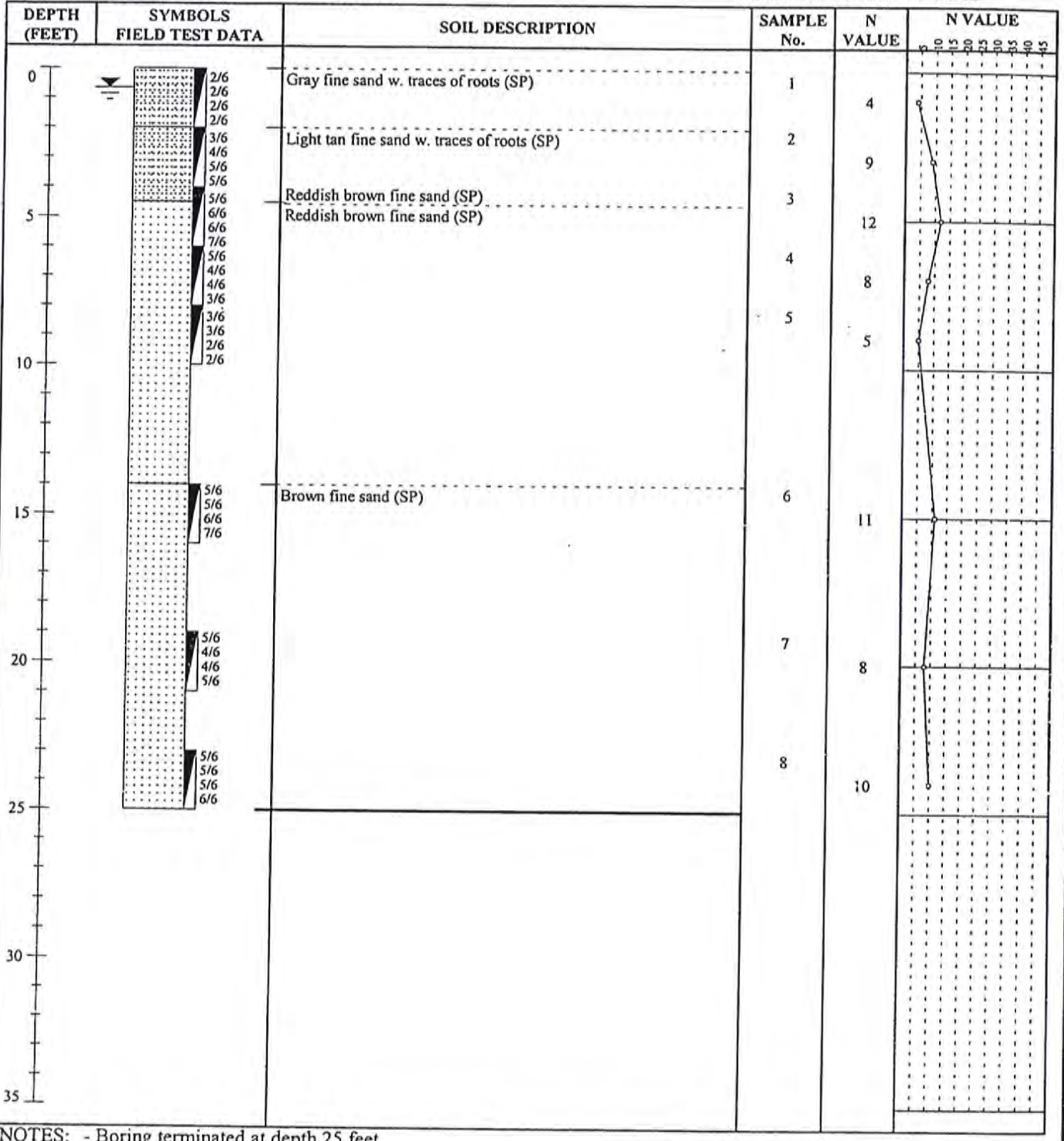
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.67 FEET

DATE DRILLED: 07/16/02



NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-9

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

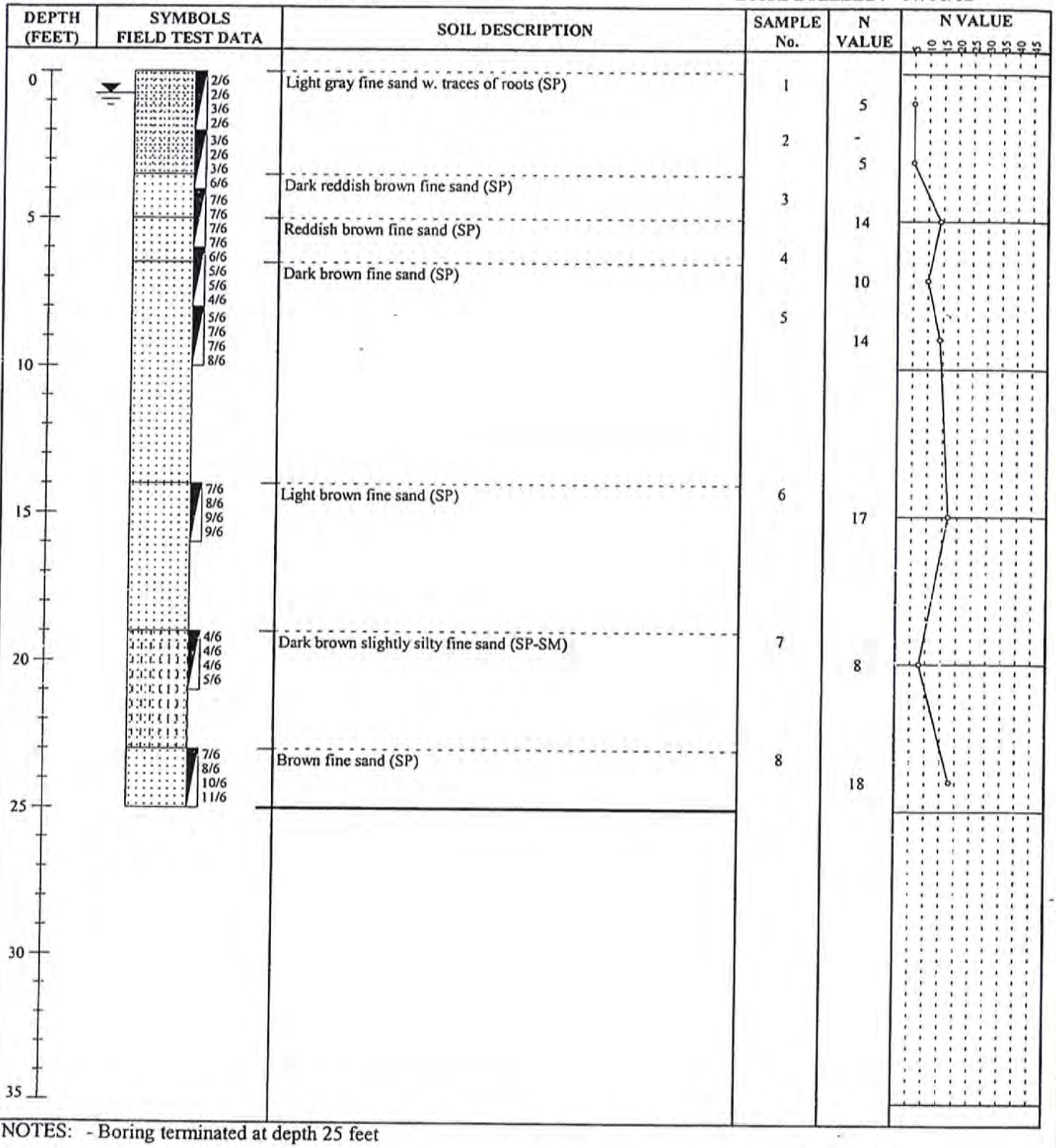
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.75 FEET

DATE DRILLED: 07/16/02



NOTES: - Boring terminated at depth 25 feet

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

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-10

PROJECT: Proposed Okeechobee Agri-Civic Center
Okeechobee, Florida

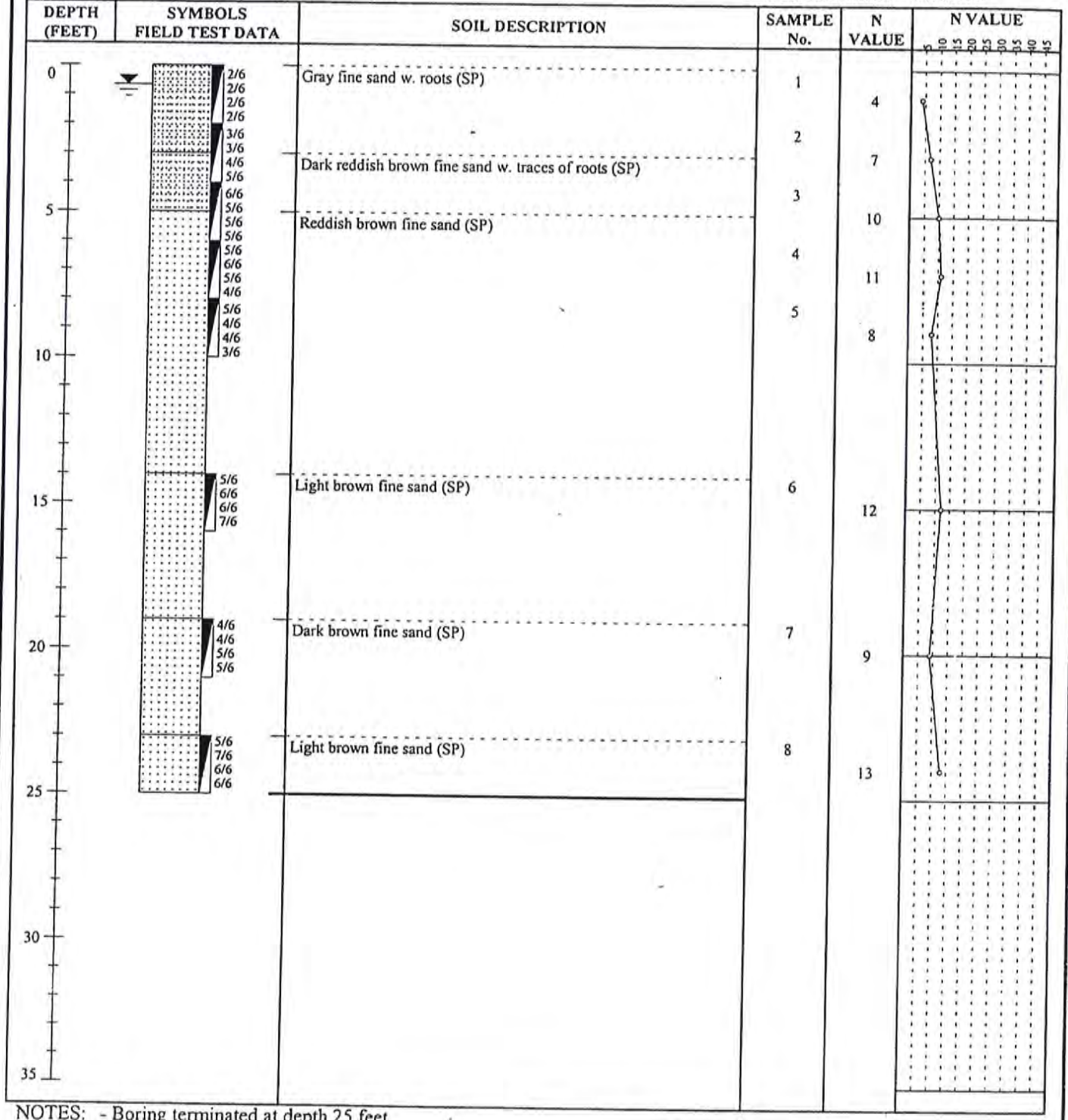
FILE No.: 02-5674

BORING LOCATION: As per plan

DRILL CREW: CS/JH

WATER OBSERVED AT DEPTH 0.67 FEET

DATE DRILLED: 07/16/02



NOTES: - Boring terminated at depth 25 feet

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