Erdman Anthony of Florida, Inc.
1402 Royal Palm Beach Boulevard
Building 500
Royal Palm Beach, Florida 33411

August 1, 2007
Project No. 07-21-6719

Attention: Ms. Dana I. Gillette, P.E., P.S.M.

Subject: ***Preliminary Subsurface Study***
**Proposed Village Commons**
**900 Royal Palm Beach Boulevard**
**Royal Palm Beach, Florida**

Dear Ms. Gillette:

## INTRODUCTION

Pursuant to your written authorization dated June 19, 2007, Dunkelberger Engineering & Testing, Inc. (DE&T) has completed a subsurface study of a 160±-acre parcel of land located on the east side of Royal Palm Beach Boulevard about 0.75 mile south of Okeechobee Boulevard in Royal Palm Beach, Florida. The work included the drilling and sampling of exploratory borings, lake bottom probing and sampling, laboratory soils analysis, evaluation of the impact of the subsoils upon the proposed construction and development of recommendations for foundation design, floor slabs, pavements, earthwork and other related construction. Presented hereafter are the results of the study.

## PROJECT CONSIDERATIONS

We understand that the Village of Royal Palm Beach is in the planning phase for the development of the Village Commons community park to be located at 900 Royal Palm Beach Boulevard. A preliminary engineering plan prepared by Erdman Anthony of Florida, Inc. (undated) shows that the park will include: a 9-hole executive golf course with a clubhouse, cart barn and starter hut, pedestrian bridges and retaining walls, a sanitary sewer lift station, irrigation pumping station, miscellaneous pavilions, a maintenance building including a vehicle wash area, sporting center, an access roadway to all amenities, and vehicular parking lots for park visitors and personnel. The plan also illustrates an extensive lake system within the east and south portions of the property which will be used for canoeing and kayaking.

Comparison of the master plan of the project with a recent aerial photograph for the project locale available from the Palm Beach County Property Appraiser indicates that ten small manmade lakes exist within the property. Some of the existing water bodies will be reclaimed while others will be incorporated into the new lake system.

For foundation assessment purposes, we have assumed that the column loads of the clubhouse, pavilions, maintenance and sporting center buildings will not exceed 50 kips. Wall loads are anticipated to be of the order of 4 kips per foot.

We understand that the irrigation pumping station and sanitary sewer lift station wet well structures will bottom at 17 and 22 feet below existing grades, respectively.

New traffic signalization will be required on Royal Palm Beach Boulevard to provide safe access to and egress from the new park. The traffic signals will be mounted on mast arm type utility poles.

## SURFACE FEATURES OF SITE

The site exists as the former Traditions Golf Course. As such, the property consists of gently rolling terrain, with somewhat elevated green and tee boxes. A clubhouse and associated parking areas are situated at the extreme western portion of the golf course while a maintenance building exists in the southeastern quadrant. Based on the preliminary engineering plan prepared by Erdman Anthony of Florida, Inc, the clubhouse is to remain in-place while the parking areas and maintenance building is to be demolished.

Significant portions of the original (natural) ground surface are now covered (masked) by fill soils used to grade the former golf course. Storm drainage at the golf course was maintained utilizing a system of interconnected lakes, canals, ditches and pipe culverts. Terrain undulates on the order of 5 to 10 feet between the lowest and highest points at the site. Review of the U.S. Geological Survey Palm Beach Farms, Florida Quadrangle Map (1946 and photorevised 1983) indicates that ground elevations in the site vicinity are on the order of +19 feet with respect to the National Geodetic Vertical Datum of 1929 (NGVD).

Residential structures border the site on its north, east, south and west sides.

## SUBSURFACE CONDITIONS

### Field Exploration

Subsurface conditions at the site were explored with seventeen (17) Standard Penetration Test (SPT) borings and ten (10) auger profile borings at the locations presented on Sheet 1. The SPT borings were drilled to 20 and 25 feet below surface grades and the auger borings were advanced to 6 feet below the existing ground surface.

The SPT borings were drilled using Central Mine Equipment Model 55 (CME 55) and Mobile B-47 drilling rigs employing mud rotary techniques. Samples of the in-place materials were recovered at frequent vertical intervals using a standard split-spoon driven with a 140-pound hammer freely falling 30 inches (the Standard Penetration Test [SPT] after ASTM D 1586). The initial four feet of SPT boring TB-1 were advanced with a hand auger to avoid conflicts with underground utilities. A Brainard-Kilman Model S-214 hand held cone penetrometer was used to evaluate the shear strength and compressibility of these soils.

The auger profile borings were accomplished with a hand turned 4-inch diameter steel bucket auger. All of the borings were backfilled with soil cuttings upon their completion.

To determine the depth of water and thickness of soft bottom sediments existing within the lakes, fifteen (15) lake bottom probes were conducted at the locations shown on Sheet 1. The probes were accomplished using a small boat and 1.5" diameter plastic piping that was manually pushed into the soft sediment until firm resistance was met.

Stratigraphy

Samples recovered from the borings were placed in moisture-proof containers and returned to our laboratory for visual examination and classification in accordance with the Unified Soil Classification System (ASTM D 2487). Soils found in the borings generally consist of a 0.5 to 3.5-foot thick fill layer over naturally occurring interlayered clean sands, clayey sands and sand/shell mixtures that persist to the terminal limits of exploration. The fill is composed of sands with trace to some shell fragments. More detailed descriptions of the stratigraphy are as follows.

| **Stratum** | **Soil Type** |
|---|---|
| 1 | Brown fine to medium SAND with trace to some shell fragments and trace to some grass roots in upper 3 to 6 inches (SP) (Fill) |
| 2 | Light brown to brown fine SAND (SP) |
| 3 | Brown clayey fine SAND, trace to some gravel-sized fragmental limestone (SC) |
| 4 | Gray to brown fine to medium SAND with shell fragments, trace to some gravel-sized fragmental limestone (SP) |
| 5 | Light brown fine SAND (SP) |

The SPT N and CPT-values indicate the upper two feet of the sands to be generally very loose to loose in terms of relative density and loose to medium dense thereafter. Subsurface profiles are presented on Sheets 2A through 2D.

The results of the pond bottom probes indicate that the depth of water ranged between 4.2 and 6.2 feet on the dates of measurement (July 9 and 17, 2007). Soft bottom sediments range from 0.3 to 2.2-feet in thickness.

Groundwater

Groundwater measurements were taken in the boreholes upon completion of drilling activities. Groundwater levels in the SPT borings ranged from 3.0 to 7.5 feet below the existing ground surface on the dates drilled (June 29 to July 6, 2007). Twenty-four hour groundwater levels measured in the auger profile borings ranged between 3.0 and 5.2 feet below existing grades. Differences in levels could be due to topographic differences and influences from rainfall and drainage patterns. According to the *Altitude of the Water Table for Palm Beach County, Florida*, published by the USGS, groundwater elevations in the site area are on the order of +14 feet NGVD. Based upon the information gathered for this study, use of a wet season water table for this site of +16 feet NGVD appears to be a reasonable preliminary design assumption.

Laboratory Testing

Representative samples of soils recovered from the lake bottom probes were subjected to six (6) moisture content, organic content and gradation (sieve analysis) tests to provide information to aid in classification of the soils. A summary of the test results is presented in the table on the following page.

| **Boring Number** | **Moisture Content (%)** | **Organic Content (%)** | **Amount Passing No. 200 Sieve (%)** | **USCS Classification** |
|---|---|---|---|---|
| LB-1 | 164.5 | 3.3 | 57.4 | OL |
| LB-3 | 177.0 | 5.3 | 58.4 | PT |
| LB-6 | 308.8 | 10.2 | 52.5 | PT |
| LB-9 | 157.6 | 4.8 | 53.2 | OL |
| LB-11 | 239.5 | 5.4 | 58.3 | PT |
| LB-15 | 38.5 | 5.6 | 44.3 | PT |

To summarize, most of the lake bottom samples are composed of organic silt as evidenced by the high percentage of materials passing the No. 200 Sieve (52.5 and 58.4%), and peat, with organic contents exceeding 5 percent.

## GEOTECHNICAL OVERVIEW

The site is generally underlain by granular soils consisting of sandy fills and naturally occurring clean to clayey sands and sands with shell. The sandy subsoil profile is favorable for support of the proposed construction from a geotechnical viewpoint. These soils lend themselves to a conventional approach to the design and construction of foundations, floor slabs and pavements.

The results of this study also indicate the subsurface conditions at the proposed sewage lift station and irrigation pumping station locations are suitable for support of the wet well structures bottoms. Although the subsoil relative density is very loose to loose at depths of 15 to 25 feet, the subsoils below a depth of 25 feet are generally medium dense and should provide adequate support for the wet wells.

Furthermore, on-site lake excavations will produce a mix of relatively clean granular materials and clayey sands. Provided the clayey sands are reasonably well mixed with the clean sands, the excavated soils should be suitable for use as site-leveling fill and as backfill for lake reclamation activities. Site grading will need to balance earthworks, especially considering the nearly 10 feet of vertical relief over the golf course.

Ground preparation should involve the normal sequence of clearing vegetation, grubbing root systems and stripping topsoil. We estimate that these activities will result in loss of 3 to 6 inches of soil cover from the site. Portions of existing lakes will need to be reclaimed as part of the site preparation process. More detailed recommendations are provided in the sections that follow.

## BORROW SUITABILITY

On-site lake excavations to depths of 30 feet should generally produce a mixture of relatively clean sands, clayey sands and sands with shell. Provided these materials are reasonably well blended, they should be acceptable for use as site grading fill. Excavations in the on site materials can be made using conventional heavy (i.e. track-mounted) earthmoving equipment. We estimate that 1 cubic yard of excavation will result in roughly 0.8 cubic yards of compacted fill volume which assumes volume loss due to compaction (shrinkage).

Lake excavation side slopes should be considered stable when constructed at a slope of 2.5:1 (horizontal:vertical), provided such slopes do not exhibit seepage exiting on the excavation sidewalls. Sideslope stability in the excavations is predicated on an adequate, functioning dewatering system. Dewatering of the excavations may be accomplished by use of wells, wellpoints, horizontal drainage blankets and sumps or combinations thereof.

## SITE PREPARATION

Demolition of Maintenance Building, Pavements and Utilities

Preparation of the site to receive the planned construction will necessitate demolition of the parking areas associated with the clubhouse and maintenance building together with the removal of its foundation, floor slab and buried utilities. Excavations made to remove the foundations and utility lines should be cut to neat lines and grades such that earthwork equipment can enter them. The excavations should be filled to grade, in 1-foot thick (loose measure) lifts, with approved granular materials that are compacted to not less than 95 percent of the maximum dry density as determined by the Modified Proctor Test (ASTM D 1557).

Lake Reclamation

Reclamation of existing on-site lakes should be preceded by the removal of vegetation/topsoil from the banks, and excavation of all soft and loose sediments from the bottoms and sideslopes. Fill used for reclamation activities should meet the requirements prescribed under the *Fill Composition, Placement and Compaction* section. It should be placed in uniform lifts not greater than 12 inches in height and compacted to at least 95 percent of the ASTM D 1557 maximum dry density.

Reclamation will need to be accomplished in-the-dry so that bottom and sideslope cleanliness can be verified and fill densification achieved. We expect that the temporary dewatering required for this purpose can be accomplished using methods given under the *Borrow Suitability* section of the report.

If wetness persists at the bottom of these existing excavations following reasonable dewatering efforts, then an initial (bottom) lift of increased thickness, not exceeding 24 inches, may be placed to create a stable work pad. The surface of the pad should be intensively densified with the vibratory compactor until no further settlement can be visually discerned at the pad surface. Density control should be exercised in the upper 12 inches of the initial fill lift. Fill in this interval should be compacted to not less than 95 percent of the ASTM D 1557 maximum dry density. Subsequent lifts required to reach subgrade levels should be in 1-foot thick (loose measure) lifts, with approved granular materials that are compacted to not less than 95 percent of the maximum dry density as determined by the Modified Proctor Test (ASTM D 1557).

Clearing, Grubbing And Stripping

Clearing and grubbing should consist of the complete removal and disposal of timber, brush, stumps, roots, rubbish and debris and all other obstructions resting on or protruding through the surface of the existing ground and the surface of excavated areas. Unless otherwise shown on the plans, clearing and grubbing should be done in all areas of the site that are to receive new construction.

Stumps of trees should be removed in their entirety and disposed of. All areas receiving fill, structures, paving and slabs should be plowed to a depth of at least 6 inches and all roots exposed by plowing should be removed to a depth of not less than 12 inches.

Topsoil and mineral soils contaminated with organic debris should be removed from all areas receiving fill, structures, pavements and slabs. Stripped materials may be stockpiled on-site for future use in landscaped areas. The depth of stripping should generally be about 3 to 6 inches. However, tree stump and heavy root zone removal will result in up to 12 inches of volume loss in some areas.

In-Situ Densification

The surficial soils in the structure areas will require densification to enable safe use of shallow foundations. Densification of the soil should be accomplished by vibratory compaction conducted along stripped grades. Soils exposed at the stripped grades should be moisture conditioned to near the optimum for compaction prior to initiating the densification operations. The structure footprint areas, including a 10-foot perimeter margin extending beyond the maximum outside lines of the superstructures, should be thoroughly densified.

The densification should be accomplished using a self-propelled vibratory compactor which imparts a dynamic drum force of not less than 44,000 pounds. Each section of the stripped grade should be thoroughly saturated with an ample supply of water and be subjected to multiple, overlapping (minimum of 20 percent overlap) coverages of the compactor as it operates at a travel speed of no more than 1.5 miles per hour (normal walking speed). Rolling should be continued until no further settlement can be visually discerned at the ground surface. In no case, however, should any section of subgrade receive less than ten roller coverages, with five passes made in the longitudinal direction of the buildings and five in the transverse direction.

Density control should be exercised in the upper 12 inches of the improved subgrade. Soils in this interval should be compacted to not less than 95 percent of the ASTM D 1557 maximum dry density.

Fill Composition, Placement And Compaction

Site-grading fill should consist of clean, granular materials that are free of debris, cinders, combustibles, roots, sod, wood, cellulose, organic materials, and materials subject to termite attack. The organic content of the fill should be less than 2% (by weight). Fill placed to reach proposed grades should consist of sand or sand and gravel (ASTM D 2487) with a maximum size of 1 inch and not more than 10 percent passing the U.S. No. 200 Sieve. The fill should be placed in 12-inch thick lifts, and each lift should be uniformly compacted to not less than 95 percent of maximum density per ASTM D 1557.

The fill materials, natural sands and sands with shell (Strata 1, 2, 4 and 5) should generally meet the specified criteria mentioned above. Clayey sands (Stratum 3) will retain moisture for long periods, and therefore be more difficult to handle, place and compact. Provided these materials are well mixed and blended with the clean sands, the excavated materials should meet the specified criteria. The organic silt and peat existing at the lakes bottoms are unsuitable for use as site grading fill and should be selectively stockpiled for use in landscape areas.

## BUILDING FOUNDATIONS

A shallow foundation system consisting of conventional spread footings may be used for support of the proposed clubhouse, pavilions, maintenance and sporting center buildings. The footings should bottom within the compacted site leveling fill or in the densified natural sands and should be proportioned for an allowable bearing pressure of 2,500 pounds per square foot (psf). To assure an adequate factor of safety against a shearing failure in the subsoils: (1) footings should be based at a depth of at least 18 inches below lowest adjacent grades; (2) continuous footings should be no less than 24 inches wide; and (3) isolated footings should be at least 36 inches wide.

If the design would use monolithic thickened edge slabs, the design should recognize the potential for load eccentricity on the perimeter wall footings and the diminishment of bearing capacity resulting therefrom. Undesirable effects of load eccentricity can be reduced by designing the perimeter wall footings for pump handle effects. This will necessitate thickening the floor slab adjacent to the footing area to create the pump handle and reinforcing the pump handle for flexure. If used, the monolithic slabs should be based at a depth of at least 10 inches.

Foundations designed and constructed in accordance with the recommendations of this report are expected to sustain tolerable total settlements provided that maximum column and wall loads do not exceed 50 kips and 4 kips per foot, respectively.

Floor Slabs

A slab-on-grade may be used for the ground floors of the structures. The slabs should be cast on granular fill meeting the composition criteria described in *Fill Composition, Placement and Compaction*, and compacted to not less than 95 percent of the ASTM D 1557 maximum dry density.

We recommend that an impervious membrane be inserted between the underside of the floor slabs and the soil subgrade to reduce the potential for moisture rise. Ordinarily, a 6-mil thick film of polyethylene is sufficient for most floor slab construction. However, floor coverings which are particularly sensitive to moisture flux will require a thicker membrane or one of different composition.

## LIFT STATION AND IRRIGATION PUMPING STATION

The results of this study indicate the subsurface conditions at the proposed sewage lift station and irrigation pumping station locations are suitable for support of the wet well structure bottoms. Although the subsoil relative density is very loose to loose at depths of 15 to 25 feet, the subsoils below a depth of 25 feet are generally medium dense and should provide adequate support for the wet wells.

Discussions related to design and construction of the lift station and sewage pumping station are provided below.

Earth Retaining Walls

Retaining walls such as steel sheetpiles that may be necessary for the construction of the wet wells should be designed to accommodate the lateral earth pressures that will be imposed. The wet well should be designed using the lateral earth pressure criteria listed below.

| WET WELLS FOR LIFT STATION AND IRRIGATION PUMPING STATION | | | | | | |
|---|---|---|---|---|---|---|
| **Depth (feet)** | **Unit Weight (pcf)** | | **Angle of Internal Friction (degrees)** | **Earth Pressure Coefficient** | | |
| | **Moist** | **Buoyant** | | **$K_a$** | **$K_p$** | **$K_o$** |
| 0 - 20 | 100 | 43 | 29 | 0.35 | 2.88 | 0.52 |
| 20 - 30 | -- | 48 | 30 | 0.33 | 3.00 | 0.50 |

External stability analysis for sheetpile walls should consider the proximity of surcharge loads such as cranes, soil stockpiles and other equipment, as well as unbalanced hydrostatic conditions created by pumping, groundwater lowering or dewatering. Vibrations generated by sheetpile installation and the impact of those vibrations should be carefully monitored at the onset of construction. As a minimum, we recommend the conduct of a precondition survey of existing residences that are proximate to the construction site, all to reduce the potential for claims resulting from the construction activities.

In lieu of sheetpile supported excavations, the contractor may select open cut methodology. If this is the case, we anticipate that the wet wells will be constructed using the tremie method as follows:

(1) Open cut excavation begins using a clam shell bucket suspended from a crane.

(2) Sections of reinforced concrete pipe are placed in the cut, oriented in a vertical position.

(3) Excavation continues through the center of the pipe section, and additional pipe lengths are added as needed to reach the proposed invert elevation.

(4) The bottom of the excavation is cleaned, and the lowest section of pipe is filled with concrete, which is tremied in place.

(5) The interior of the pipe is dewatered, and the bottom slab of the wet well is formed and poured in-the-dry.

Wet Well Foundation Support

The results of this study confirm that the site of the proposed wet wells are underlain by granular soils which are in a very loose to medium dense condition. The foundation soils near the proposed wet well invert elevation (i.e. 17 and 22 feet below existing grades) should have adequate strength and bearing capacity to support the wet well structures, provided they consist of pre-drained soils similar to Strata 4 and 5, as described herein. If the excavation is supported by sheetpiles, and the bottom soils are not adequately dewatered to allow tamping to a firm condition, they should be replaced with a clean uniform gravel bed of minimum 12-inch thickness wrapped in a filter fabric. The base slab of the structures should be designed using an allowable bearing pressure of 3,000 pounds per square foot (psf). The slabs should be well reinforced to resist the forces created by unbalanced hydrostatic pressures.

Uplift forces can be resisted by the weight of soil overlying the edges of the wet well slabs, plus those within a wedge that is defined within a line sloping upward and outward from the slabs edge on a 4 vertical to 1 horizontal slope. Moist and buoyant unit weights within this zone should be considered as 110 and 43 pcf, respectively.

Excavations

Excavations should be made in accordance with all applicable State and Federal requirements. More specifically, OSHA 29 CFR part 1926 (Subpart P, Excavations) defines the subsurface profile, within the planned depths of excavation, as a sand (Type C soil). As such, temporary sideslopes in fully dewatered excavations could be made at 1-1/2:1 (horizontal:vertical) inclination or flatter in the sand. If the prescribed minimum sloping requirements cannot be met in the sands because of space limitations or other restrictions, then a sheeting or shoring system would become necessary.

In-the-dry construction of the below ground utility tie-ins will require groundwater lowering and control of groundwater seepage. Dewatering should be accomplished as described in the previous section entitled *Borrow Suitability.*

Backfill

Soils used to fill around the completed wet well structures should consist of sand (ASTM D 2487), with a maximum of 10 percent passing the U.S. No. 200 sieve. Generally, soils from the excavations should meet these criteria, based upon the results of the borings. Backfill should be placed in the dry, in lifts that do not exceed 12 inches in vertical measure. Each lift should be compacted to at least 100 percent of maximum density (ASTM D 698). We recommend the use of only relatively light, hand-held compaction equipment to limit the potential for damage to the wet well structure.

## MAST ARM SIGNALIZATION POLES

Results of the borings indicate that the proposed mast arm signalization poles are underlain by granular soils that are in a loose to medium dense condition. Design criteria for the mast arm foundations are provided on Sheet 3.

## RETAINING WALLS

Retaining wall design and construction should be based upon the wall type and materials, depth of embedment, lateral earth pressures and surcharge loads. The wall footings should be designed for an allowable bearing pressure of 2,500 pounds per square foot (psf). This is predicated upon site preparation that is completed as described earlier in the report.

Lateral earth pressure calculations should include the following geotechnical design criteria.

| **Design Parameter** | | **Depth - Feet** | |
|---|---|---|---|
| | **Fill** | **0 - 5** | **5 - 10** |
| Soil Unit Weight | 110 | 100 | 43 |
| Angle of Internal Friction (degrees) | 30 | 29 | 29 |
| Cohesion (psf) | | 0 | 0 |
| Coefficient of Lateral Earth Pressure | | | |
| - $K_A$ (Active) | 0.33 | 0.35 | 0.35 |
| - $K_P$ (Passive) | 3.00 | 2.88 | 2.88 |
| - $K_O$ (At Rest) | 0.50 | 0.52 | 0.52 |

Surcharge loads should be added as appropriate.

## PAVEMENTS

The pavement sections should be constructed on subgrade soil prepared as described in the previous sections of this report. The sections presented below are typically used in this geographic area.

| **Heavy Duty Pavement** | |
|---|---|
| ***Component*** | ***Thickness and Composition*** |
| Wearing Course | 1.5 inches Type S asphaltic concrete |
| Base Course | 8 inches of crushed aggregate (LBR = 100 minimum) |
| Subbase | 12 inches of stabilized subgrade material (LBR = 40 minimum) |

| **Light Duty Pavement** | |
|---|---|
| ***Component*** | ***Thickness and Composition*** |
| Wearing Course | 1 inch Type S asphaltic concrete |
| Base Course | 6 inches of crushed aggregate (LBR = 100 minimum) |
| Subbase | 12 inches of stabilized subgrade material (LBR = 30 minimum) |

The sections given above are intended as a guideline only as the pavement should be designed specifically for the vehicle load intensities and frequencies anticipated during the life of the project.

Crushed aggregate for the base course should meet the requirements of Sections 911 or 913A of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction." The base materials should have a Limerock Bearing Ratio (LBR) of at least 100 and be compacted to not less than 98 percent of the AASHTO T-180 maximum dry density. Subbase materials should be densified to an equivalent relative compaction. Subgrade soils receiving flexible paving should be uniformly compacted to 95 percent density (AASHTO T-180).

## PEDESTRIAN BRIDGES

### General

The subsurface profile for the project site consists of relatively clean sands. After compaction, these soils should provide adequate support for spread footing foundations. We have not considered a piling foundation for the pedestrian bridges but will do so if required, all as part of a supplemental study.

### Excavations

The subsoils at the proposed pedestrian bridge abutments consist of loose to medium dense, relatively clean sands and clayey sands. Excavations to the proposed substructure bottom levels can be made using conventional heavy earthmoving equipment (e.g. a track mounted backhoe). Footing areas should be excavated, formed and maintained in a dry condition until the substructure concrete is cast. Depending upon design structure bottom levels, and considering the measured depths to groundwater, it is possible that the bridge abutment foundations may bottom below the water table. Therefore, temporary dewatering may be required to lower the groundwater level and enable foundation and earthwork construction to proceed in the dry. The required construction dewatering should provide for a lowered groundwater level that is at least 24 inches below the proposed footing bottom level.

Foundation Design Criteria

A shallow foundation system (spread footings) may be used for support of the pedestrian bridges. The foundations should be based in the compacted natural soils and/or granular fill and proportioned for an allowable bearing pressure of 2,500 pounds per square foot (psf). The design bearing capacity is influenced by the proximity of the canal side slopes to the proposed foundations. To provide an adequate factor of safety against a shearing failure in the subsoils: (1) the footings should bottom not less than 2 feet below finished earth grades, (2) the footings should have a minimum width of 36 inches, and (3) the minimum horizontal distance from the face of the canal slope to edge of footing should be maintained at 4 feet. Footings should include both top and bottom reinforcing steel to promote beam action and to better enable the footings to span over localized zones of weak soils. The design should include an anticipation of scour, and the minimum dimensions described above refer to the post-scour condition. We recommend the canal slopes in the vicinity of the bridge foundations be protected with a slope cover to limit the potential for erosion and/or scour.

Foundations subject to lateral forces will resist the thrusts by earth pressure acting on the vertical faces of the footings located at right angles to the load direction and shearing resistance mobilized on the footing bottoms. Earth pressure resistance available from well-compacted moist granular backfill should be determined using an equivalent fluid pressure of 165 pounds per square foot per foot depth. Shearing resistance at the base of the footings should be calculated using a friction factor of 0.35. Use of the above values assumes that the footings can tolerate a horizontal translation on the order of one-quarter inch.

Individual footing areas should be excavated, formed and have the structural concrete cast in the dry. The excavation bottoms should be tamped with a hand held or walk behind compactor prior to placement of reinforcement steel. The compaction efforts need to achieve 95% maximum dry density (ASTM D 1557) for a minimum depth of 24 inches below the footing excavation bottoms, and should extend to a horizontal margin of 3 feet beyond the edges of the proposed footings. This may require that the footing excavations be undercut by 12 inches and the resulting excavation bottom be compacted as described above. Subsequently, the undercut soils should be replaced and recompacted as well.

Backfill placed around poured concrete foundations should be consistent with recommendations described under the *Fill Composition, Placement And Compaction* section of the report.

## ENVIRONMENTAL FACTORS

Past use of the site as a golf course involved use of turf chemicals which have resulted in soil and groundwater quality impacts from arsenic. These soil quality impacts will likely necessitate that the site preparation activities be closely interfaced with an environmental soil management plan that is intended to minimize human exposure to soils that have arsenic concentrations above State cleanup target levels. The presence of arsenic within the groundwater of the site at concentrations above the State cleanup target level may also place some restrictions on dewatering that is needed in connection with lake reclamation activities, new lake excavations, and installation of underground utilities that are founded below the ambient water table.

## LIMITATIONS OF STUDY

DE&T has completed a preliminary subsurface study for Erdman Anthony of Florida, Inc. in connection with the Village Commons community park to be located at 900 Royal Palm Beach Boulevard in the Village of Royal Palm Beach, Florida. The purpose of the study was to explore on a limited basis the subsurface conditions of the site and provide geotechnical criteria for the design and construction of the project. DE&T warrants that the recommendations and professional advice presented in this report were promulgated based on recognized practice in the disciplines of soil mechanics, foundation engineering, and engineering geology. No other warranties are expressed or implied.

As this study involved widely spaced borings for a conceptual site plan, we recommend additional geotechnical work be completed for the project as the plans develop. Such work should include additional SPT borings and an appropriate level of geotechnical engineering.

A representative of DE&T should be on-site during site preparation to verify the successful implementation of the recommendations discussed herein.

The recommendations in this report related to construction dewatering were provided for Erdman Anthony of Florida, Inc. for design purposes only. We recommend that contractors bidding this project align themselves with an experienced hydrogeologist for design of the construction dewatering means and methods. Such work is beyond the scope of our contract with Erdman Anthony of Florida, Inc.

____oOo____

DE&T appreciates the opportunity to assist you on this project. We trust that the information provided in the report is clear and understandable. Should it require any clarification or amplification, however, please contact us.

Very truly yours,

**DUNKELBERGER ENGINEERING & TESTING, INC.**

Jason DuBois
Engineering Associate

Kevin E. Aubry, P.E.
Geotechnical Services Manager
FL Registration No. 38175

6719rpt:jd

cc: Addressee (3) … *hand delivery*

Attachments: Sheet 1 – Boring and Lake Bottom Probe Location Plan
Sheets 2A through 2D – Subsurface Profiles
Sheet 3 – Subsurface Profiles For Mast Arm Signalization Poles


LEGEND

TB-1 - STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER

AB-1 - AUGER BORING LOCATION AND NUMBER

LB-1 - LAKE BOTTOM PROBE LOCATION AND NUMBER

Locations are approximate

SECTION: 26
TOWNSHIP: 43S
RANGE: 41E
PALM BEACH COUNTY, FLORIDA

0' 250' 500' 1000'

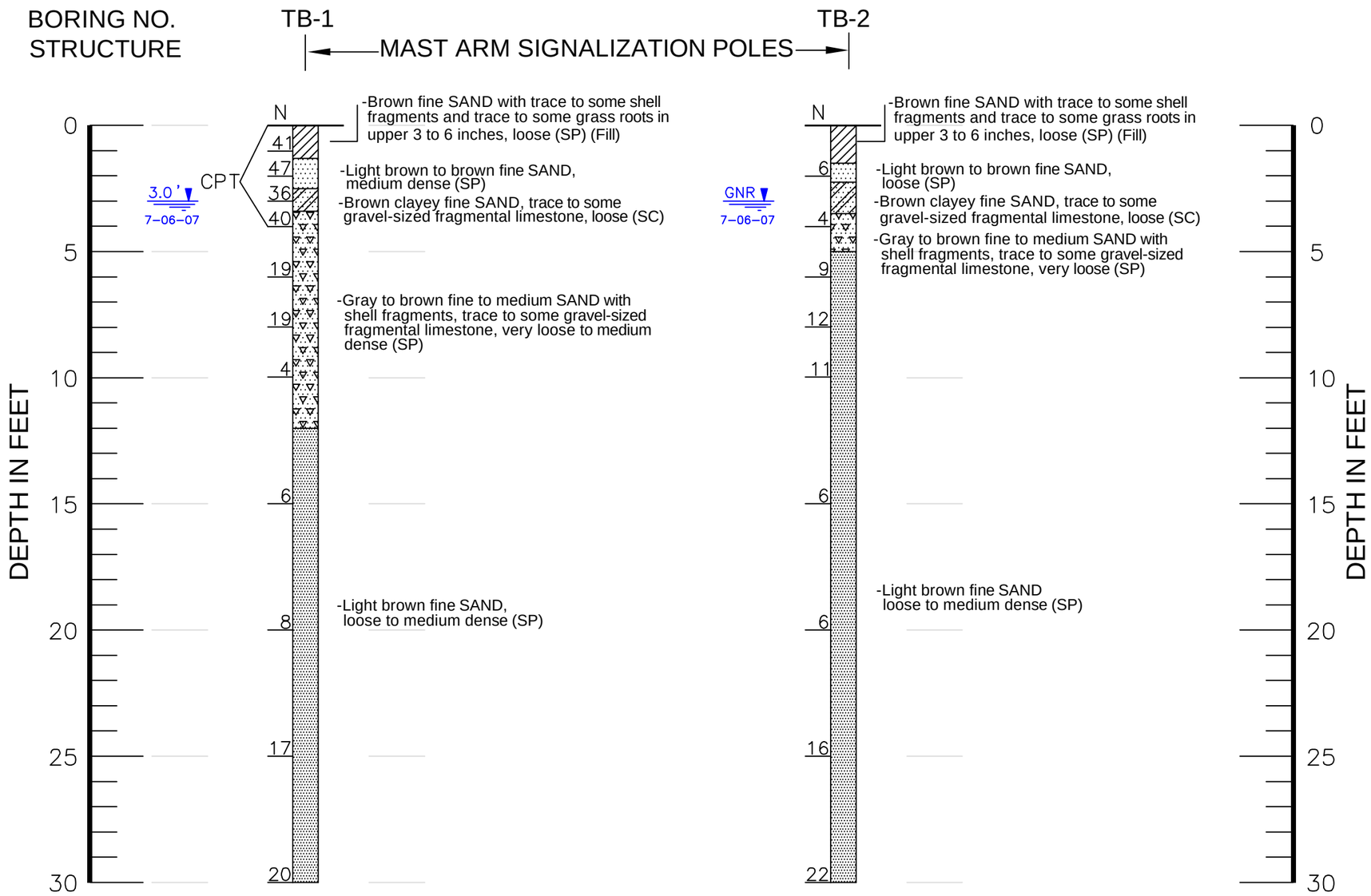
Scale: 1" = 500'

| | |
|---|---|
| DRAWN | GD |
| CHECKED | JD |
| APPROVED | KA |
| SCALE | 1"= 500' |
| REVISED | |

BORING AND LAKE BOTTOM PROBE LOCATION PLAN
PROPOSED VILLAGE COMMONS
900 ROYAL PALM BEACH BOULEVARD
ROYAL PALM BEACH, FLORIDA

DUNKELBERGER ENGINEERING & TESTING, INC.
Geotechnical • Materials Testing/Inspection • Environmental

| DATE | PROJ. NO. | SHEET |
|---|---|---|
| 7-27-07 | 07-21-6719 | 1 |




## GENERAL LEGEND

TB-1 – Standard Penetration Test (SPT) Boring and number

SP – Unified Soil Classification System Group Symbol (ASTM D 2487)

3.0' ▼ 7-06-07 – Depth of groundwater (Feet) & date measured

GNR ▼ 7-06-07 – Groundwater level not recorded on date drilled

## NOTES

(1) Borings were drilled on July 6, 2007, using a Mobile B-47 drilling rig.

(2) "N" indicates the number of blows of a 140 pound hammer, freely falling a distance of 30 inches, required to drive a 2-inch diameter sampler 12 inches (ASTM D 1586)

(3) "CPT" indicates the resistance in tsf to the advance of a Brainard-Kilman Model S-214 hand-held cone penetrometer

(4) Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.

(5) The groundwater depth shown on the subsurface profile represents the groundwater surface on the date shown. Groundwater level fluctuations should be anticipated throughout the year.

SUMMARY OF FOUNDATION DESIGN PARAMETERS

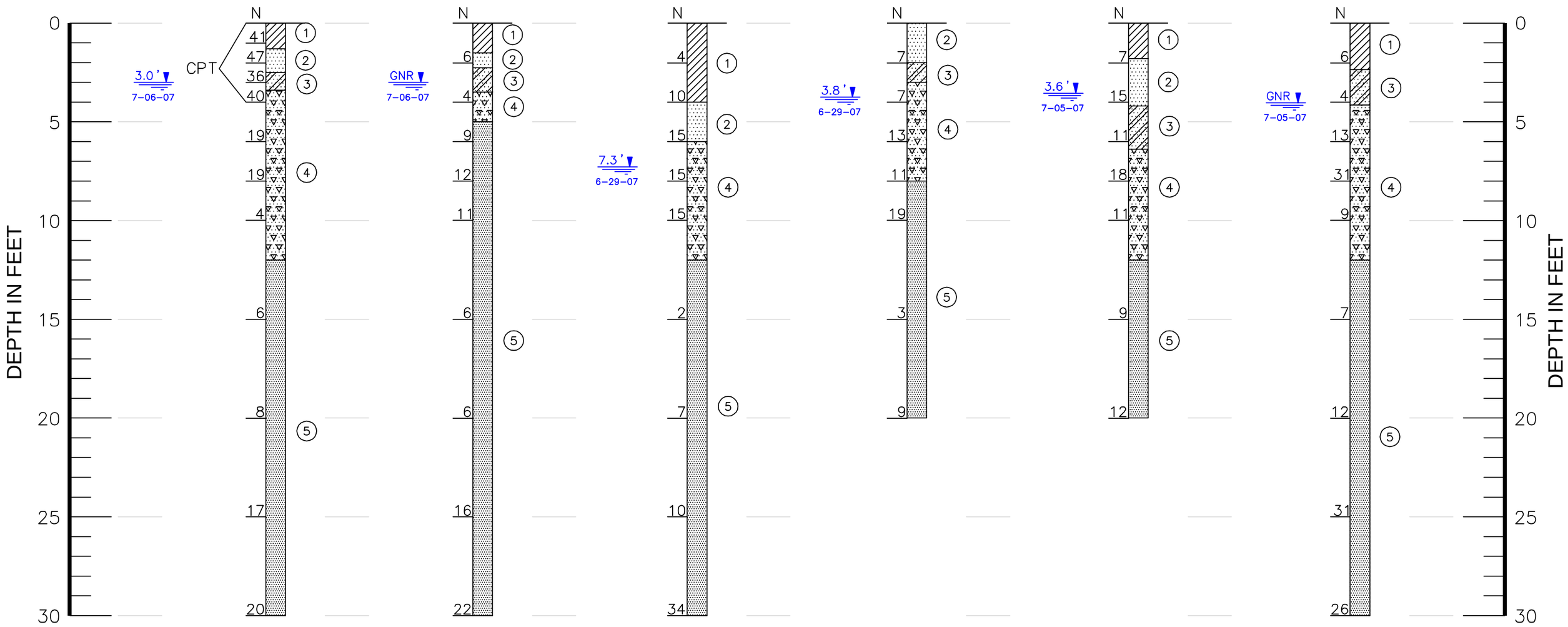
| Boring No. | Depth (feet) | Range of SPT - N | Unit Weights (pounds per cubic foot) Moist | Unit Weights (pounds per cubic foot) Bouyant | Angle of Interval Friction (degrees) | Effective Cohesion (kPa) | Earth Pressure Coefficients Ka | Earth Pressure Coefficients Kp |
|---|---|---|---|---|---|---|---|---|
| TB-1 | 0.0 - 5.0 | 10 | 100 | 43 | 29 | 0 | 0.347 | 2.88 |
| | 5.0 - 9.0 | 19 | - | 48 | 30 | 0 | 0.333 | 3.00 |
| | 9.0 - 22.0 | 8 | - | 43 | 29 | 0 | 0.347 | 2.88 |
| | 22.0 - 30.0 | 17 | - | 48 | 30 | 0 | 0.333 | 3.00 |
| TB-2 | 0.0 - 5.0 | 4 - 6 | 100 | 43 | 29 | 0 | 0.347 | 2.88 |
| | 5.0 - 10.0 | 9 - 12 | - | 43 | 29 | 0 | 0.347 | 2.88 |
| | 10.0 - 20.0 | 6 | - | 43 | 29 | 0 | 0.347 | 2.88 |
| | 20.0 - 30.0 | 16 - 22 | - | 48 | 30 | 0 | 0.333 | 3.00 |

| | |
|---|---|
| DRAWN | JD |
| CHECKED | KA |
| APPROVED | KA |
| SCALE | 1" = 5' |

SUBSURFACE PROFILES
PROPOSED VILLAGE COMMONS
900 ROYAL PALM BEACH BOULEVARD
ROYAL PALM BEACH, FLORIDA

DUNKELBERGER ENGINEERING & TESTING, INC.
Geotechnical • Materials Testing/Inspection • Environmental

| DATE | PROJ. NO. | SHEET |
|---|---|---|
| 7-27-07 | 07-21-6719 | 3 |




## LEGEND

(1) Brown fine SAND with trace to some shell fragments and trace to some grass roots in upper 3 to 6 inches (SP) (Fill)

(2) Light brown to brown fine SAND (SP)

(3) Brown clayey fine SAND, trace to some gravel-sized fragmental limestone (SC)

(4) Gray to brown fine to medium SAND with shell fragments, trace to some gravel-sized fragmental limestone (SP)

(5) Light brown fine SAND (SP)

N – Indicates the number of blows of a 140 pound hammer, freely falling a distance of 30 inches, required to drive a 2-inch diameter sampler 12 inches (ASTM D 1586)

CPT – Indicates the resistance in tsf to the advance of a Brainard-Kilman Model S-214 hand-held cone penetrometer

SP – Unified Soil Classification System Group Symbol (ASTM D 2487)

TB-1 – Standard Penetration Test (SPT) boring and number

3.0' 7-06-07 – Depth of groundwater (feet) & date measured

GNR 7-06-07 – Groundwater level not recorded on date drilled

## NOTES

(1) Borings were drilled on June 29 through July 6, 2007 using Central Mine Equipment Model 55 (CME 55) and Mobile B-47 drilling rigs.

(2) Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.

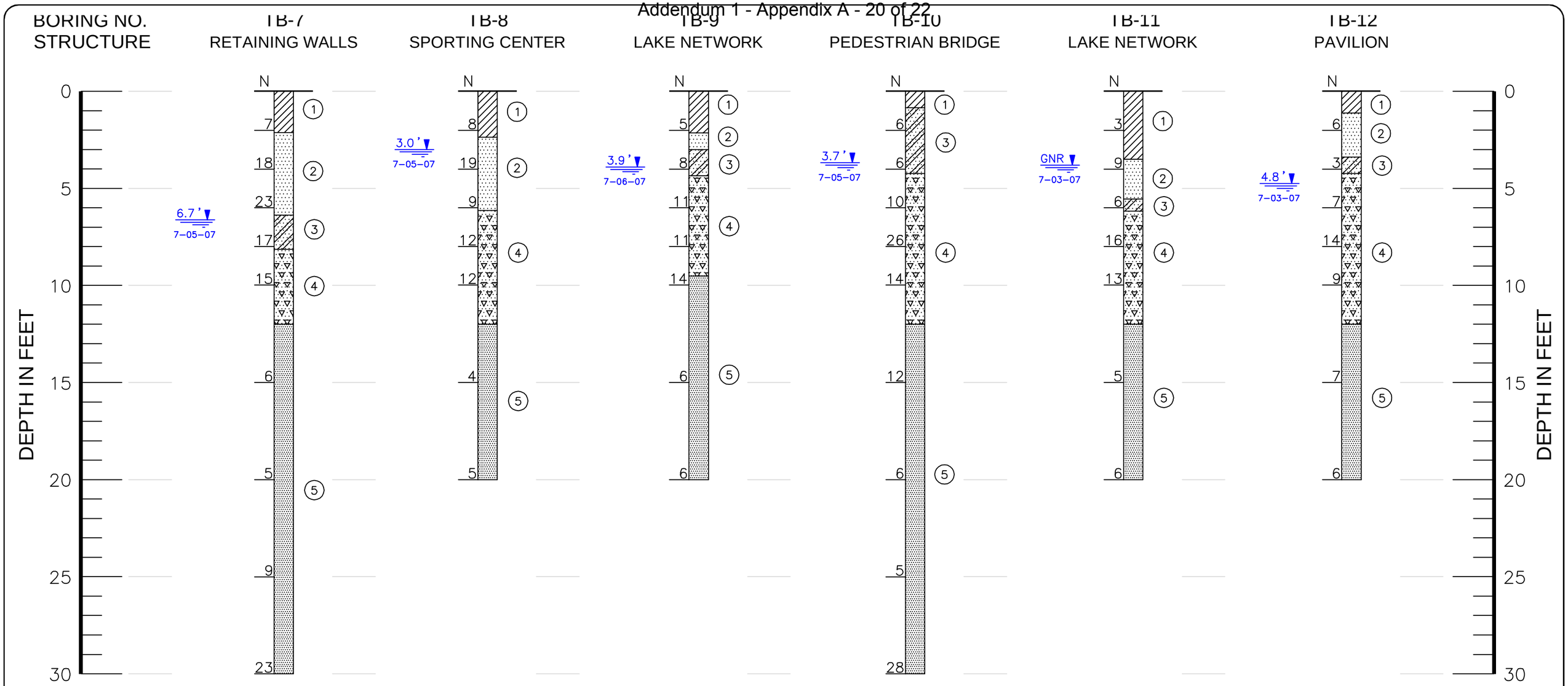
(3) Groundwater depths shown on the subsurface profiles represent groundwater surfaces on the dates shown. Groundwater level fluctuations should be anticipated throughout the year.

| | |
|---|---|
| DRAWN | GD |
| CHECKED | JD |
| APPROVED | KA |
| SCALE | 1" = 5' |
| REVISED | |

SUBSURFACE PROFILES
PROPOSED VILLAGE COMMONS
900 ROYAL PALM BEACH BOULEVARD
ROYAL PALM BEACH, FLORIDA

DUNKELBERGER ENGINEERING & TESTING, INC.
Geotechnical Materials Testing/Inspection Environmental

| DATE | PROJ. NO. | SHEET |
|---|---|---|
| 7-27-07 | 07-21-6719 | 2A |




## LEGEND

(1) Brown fine SAND with trace to some shell fragments and trace to some grass roots in upper 3 to 6 inches (SP) (Fill)

(2) Light brown to brown fine SAND (SP)

(3) Brown clayey fine SAND, trace to some gravel-sized fragmental limestone (SC)

(4) Gray to brown fine to medium SAND with shell fragments, trace to some gravel-sized fragmental limestone (SP)

(5) Light brown fine SAND (SP)

N – Indicates the number of blows of a 140 pound hammer, freely falling a distance of 30 inches, required to drive a 2-inch diameter sampler 12 inches (ASTM D 1586)

SP – Unified Soil Classification System Group Symbol (ASTM D 2487)

TB-7 – Standard Penetration Test (SPT) boring and number

6.7' 7-05-7 – Depth of groundwater (feet) & date measured

GNR 7-03-07 – Groundwater level not recorded on date drilled

## NOTES

(1) Borings were drilled on June 29 through 6, 2007 using Central Mine Equipment Model 55 (CME 55) and Mobile B-47 drilling rigs.

(2) Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.

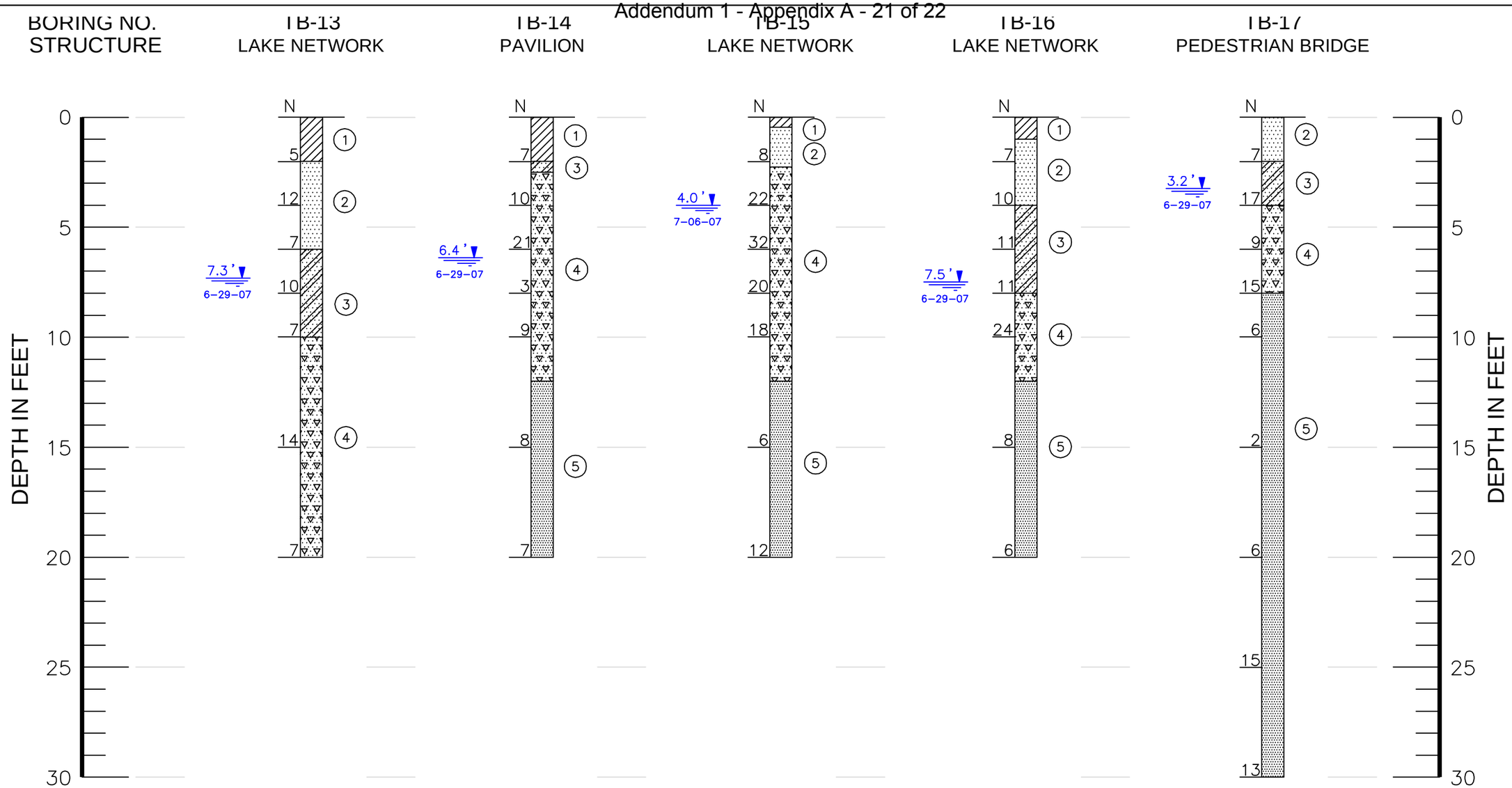
(3) Groundwater depths shown on the subsurface profiles represent groundwater surfaces on the dates shown. Groundwater level fluctuations should be anticipated throughout the year.

| | |
|---|---|
| DRAWN | GD |
| CHECKED | JD |
| APPROVED | KA |
| SCALE | 1" = 5' |
| REVISED | |

SUBSURFACE PROFILES
PROPOSED VILLAGE COMMONS
900 ROYAL PALM BEACH BOULEVARD
ROYAL PALM BEACH, FLORIDA

DUNKELBERGER ENGINEERING & TESTING, INC.
Geotechnical Materials Testing/Inspection Environmental

| DATE | PROJ. NO. | SHEET |
|---|---|---|
| 7-27-07 | 07-21-6719 | 2B |




## LEGEND

1. Brown fine SAND with trace to some shell fragments and trace to some grass roots in upper 3 to 6 inches (SP) (Fill)
2. Light brown to brown fine SAND (SP)
3. Brown clayey fine SAND, trace to some gravel-sized fragmental limestone (SC)
4. Gray to brown fine to medium SAND with shell fragments, trace to some gravel-sized fragmental limestone (SP)
5. Light brown fine SAND (SP)

N – Indicates the number of blows of a 140 pound hammer, freely falling a distance of 30 inches, required to drive a 2-inch diameter sampler 12 inches (ASTM D 1586)

SP – Unified Soil Classification System Group Symbol (ASTM D 2487)

TB-13 – Standard Penetration Test (SPT) boring and number

7.3' 6-29-07 – Depth of groundwater (feet) & date measured

## NOTES

(1) Borings were drilled on June 29 through July 6, 2007 using Central Mine Equipment Model 55 (CME 55) and Mobile B-47 drilling rigs.

(2) Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.

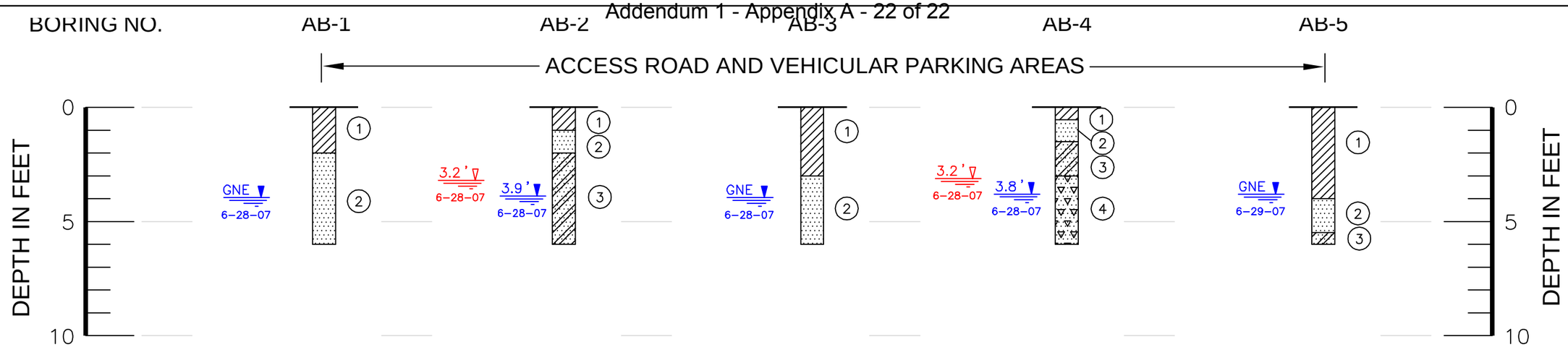
(3) Groundwater depths shown on the subsurface profiles represent groundwater surfaces on the dates shown. Groundwater level fluctuations should be anticipated throughout the year.

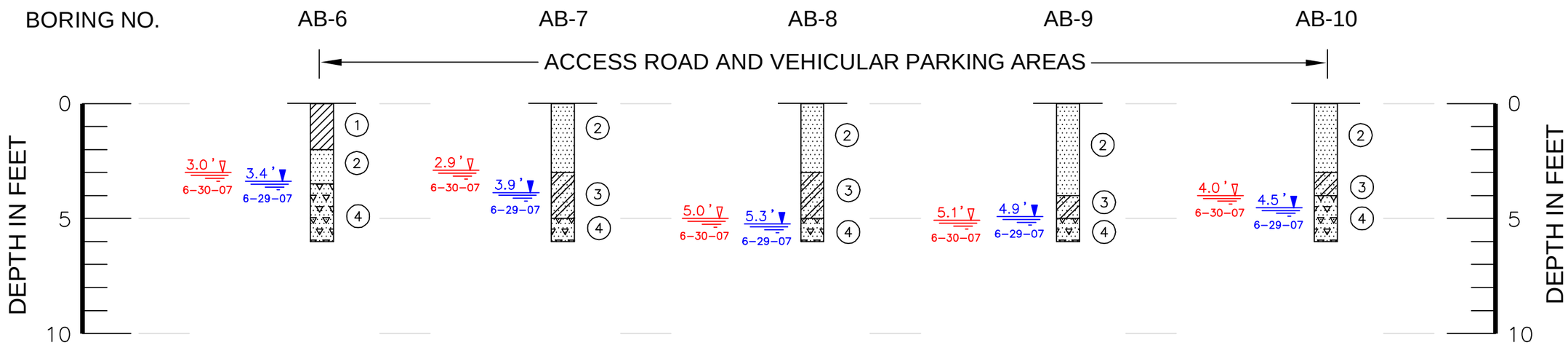
| | |
|---|---|
| DRAWN | GD |
| CHECKED | JD |
| APPROVED | KA |
| SCALE | 1" = 5' |
| REVISED | |

SUBSURFACE PROFILES
PROPOSED VILLAGE COMMONS
900 ROYAL PALM BEACH BOULEVARD
ROYAL PALM BEACH, FLORIDA

DUNKELBERGER ENGINEERING & TESTING, INC.
Geotechnical Materials Testing/Inspection Environmental

| DATE | PROJ. NO. | SHEET |
|---|---|---|
| 7-27-07 | 07-21-6719 | 2C |




## LEGEND

1. Brown fine SAND with trace to some shell fragments and trace to some grass roots in upper 3 to 6 inches (SP) (Fill)
2. Light brown to brown fine SAND (SP)
3. Brown clayey fine SAND, trace to some gravel-sized fragmental limestone (SC)
4. Gray to brown fine to medium SAND with shell fragments, trace to some gravel-sized fragmental limestone (SP)
5. Light brown fine SAND (SP)

SP – Unified Soil Classification System Group Symbol (ASTM D 2487)

AB-1 – Auger boring and number

3.9' 6-28-07 – Depth of groundwater (feet) & date measured

3.2' 6-29-07 – Depth of groundwater (feet) & date measured (Stabilized Reading)

GNE 6-28-07 – Groundwater level not encountered on date drilled

## NOTES

(1) Borings were drilled on July 28 and 29, 2007 using hand-turned augering equipment.

(2) Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.

(3) Groundwater depths shown on the subsurface profiles represent groundwater surfaces on the dates shown. Groundwater level fluctuations should be anticipated throughout the year.

| | |
|---|---|
| DRAWN | GD |
| CHECKED | JD |
| APPROVED | KA |
| SCALE | 1" = 5' |
| REVISED | |

SUBSURFACE PROFILES
PROPOSED VILLAGE COMMONS
900 ROYAL PALM BEACH BOULEVARD
ROYAL PALM BEACH, FLORIDA

DUNKELBERGER ENGINEERING & TESTING, INC.
Geotechnical Materials Testing/Inspection Environmental

| DATE | PROJ. NO. | SHEET |
|---|---|---|
| 7-27-07 | 07-21-6719 | 2D |