Andreyev Engineering, Inc.

CLERMONT OFFICE
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▼ Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

August 19, 2009
Project No. CPGT-05-364

TO: **Kimley Horn & Associates, Inc.**
3660 Maguire Blvd., Suite 200
Orlando, Florida 32803
Attention: Mr. Fred Burkett

SUBJECT: **Geotechnical Investigation,** County Road 466A Retention Areas, Lake County, Florida

Dear Mr. Burkett:

In accordance with your request, Andreyev Engineering, Inc. has completed a soil and groundwater investigation of the proposed retention areas as part of the CR466A widening project. Our investigation consisted of drilling soil borings within the proposed retention areas for the purpose of characterizing subsurface conditions. The following report presents the results of the geotechnical study, including borings in the proposed retention areas, and engineering evaluations and recommendations for design of the proposed ponds.

PROJECT DESCRIPTION

The subject property is located immediately northwest of the intersection of US Hwy 27 and CR466A, Lake County, Florida. The project is specifically located within Sections 4, Township 19 South and Range 24 East. Based on the USGS Topographic Map "Leesburg West, FLA". The USGS Topographic Map showing the layout of the proposed project is presented on the attached **Plate 1**.

PURPOSE AND SCOPE OF INVESTIGATION

The purposes of this study were to explore subsurface conditions along the roadway and provide recommendations for site preparation and pavement section design. To accomplish this purpose, the following tasks were performed:

1. Drilled twenty seven (27) auger borings, designated as PB-1 through PB-27, to depths ranging from 5 to 30 feet within and near the proposed retention ponds.

2. Installed eight (8) shallow piezometers and conducted field permeability tests at each piezometer to determine the saturated horizontal hydraulic conductivity of the soils underlying the proposed retention areas.

3. Collected seven (7) relatively undisturbed tube samples and conducted laboratory permeability tests to determine the saturated vertical hydraulic conductivity of the soils underlying the proposed retention areas.

4. Visually classified and stratified the soil samples collected during the drilling operation and conducted laboratory index property tests (moisture and -200) on selected samples.

5. Prepared this report detailing the results of our investigation including field investigation results, evaluation of site conditions and engineering recommendations for retention pond design.

INVESTIGATION AND RESULTS

S.C.S. Soil Survey

The "Soil Survey of Lake County, Florida" published by the U.S. Department of Agriculture Soil Conservation Service (S.C.S.) was reviewed. The shallow soil types identified at the site are presented as follows:

- Candler (Astatula) sand, 0 to 5 percent slopes (AtB, 13). This soil is nearly level to gently sloping, excessively drained soil. The seasonal high groundwater table is at a depth of 72 inches or more. The permeability of Candler soil is very rapid in the surface and subsurface layers and moderately rapid in the subsoil. The hydrological group for Candler soil, 0 to 5 percent slopes is "A".

- Candler (Astatula) sand, 5 to 12 percent slopes (AtD, 15). This soil is gently to moderately sloping, excessively drained soil. The seasonal high groundwater table is at a depth of 72 inches or more. The permeability of Candler soil is very rapid in the surface and subsurface layers and moderately rapid in the subsoil. The hydrological group for Candler soil, 5 to 12 percent slopes is "A".

- Apopka fine sand, 0 to 5 percent slopes (ApB, 7). This soil is defined as nearly level to gently sloping, excessively drained soil. The seasonal high groundwater table is at a depth of more than 72 inches. The permeability of Apopka soil is very rapid in the surface, moderately rapid in the subsurface. The hydrological group for Apopka soil is "A".

- Apopka fine sand, 5 to 12 percent slopes (ApD, 8). This soil is defined as gently to moderately sloping, excessively drained soil. The seasonal high groundwater table is at a depth of more than 72 inches. The permeability of Apopka soil is very rapid in the surface, moderately rapid in the subsurface. The hydrological group for Apopka soil is "A".

- Sparr sand, 0 to 5 percent slopes (AbB, 55). This soil is defined as nearly level to gently sloping, moderately well drained soil. The seasonal high groundwater table is at a depth of 18 to 40 inches in most years. The permeability of Sparr soil is rapid in the surface and subsurface and low to moderate in the subsoil. The hydrological group for Ellzey soil is "C".

The attached **Plate 2** shows the subject property superimposed in the SCS Survey.

Soil Conditions

The boring locations are presented on **Figures 1 through 4** and the results of the borings are shown in profile form on **Figures 5 through 7**. Laboratory test results are shown at the appropriate depths adjacent to the profiles. Horizontal lines designating the interface between different materials on the profiles represent approximate boundaries. The transition between layers is typically gradual.

In general, the soils encountered in the borings consisted of surficial layers of grayish brown and light brown fine sand (strata 1 and 2) from the surface to depths ranging from 5 to 20 feet, followed by less permeable layers of slightly silty fine sand (stratum 3), silty fine sand (stratum 9) and/or clayey fine sands/clays (strata 7, 8, 10 and 11) to the depths of boring termination. A layer of weakly cemented fine sand (stratum 4) was encountered in borings PB-2, 9, 19 and 27.

Groundwater Conditions

The groundwater table was encountered at depths ranging from 2.4 to greater than 30 feet below existing grade. Based on the review of the S.C.S. Soil Survey of Lake County, review of the U.S.G.S. Topographic Map "Leesburg West, FLA.", the encountered soil conditions, and nearby water surface features, the seasonal high groundwater table can be assumed to vary in depth based on the existing grade at the boring location. The attached **Table 1** provides a summary of the estimated seasonal high groundwater at the relevant boring locations.

Permeability Tests

Eight (8) shallow piezometers were installed at the location of auger borings PB-1, 3, 5, 7, 9, 10, 21 and 22 for the purpose of conducting field permeability tests. The piezometers were installed to a depths ranging from 7 to 10 feet were screened in the bottom 3 to 5 feet with 2 inch diameter, 0.01 inch slotted PVC. The remaining casing consisted of 2 inch diameter solid PVC well casing. The piezometer was backfilled to ground surface using gravel pack.

Following piezometer installation, field permeability tests were conducted using the constant head method as per the U.S Bureau of Reclamation, 1974. The results of the tests indicated a horizontal saturated coefficient of permeability ranging from 12 to 34 feet per day. The results of the tests are presented adjacent to the soil profiles and at the tested depth intervals on **Figures 5 and 6**.

Seven (7) undisturbed tube soil samples were collected at the location of auger borings PB-12, 14, 15, 16, 17, 19 and 26 and laboratory hydraulic conductivity tests were performed to determine the vertical saturated hydraulic conductivity of the soils underlying the proposed water retention areas. The vertical hydraulic conductivity tests were performed using the falling head method. Based on the test results, the vertical saturated hydraulic conductivity of the tested soils ranged from 15 to 44 feet per day. The results of the tests are presented adjacent to the soil profiles and at the tested depth intervals on **Figures 6 and 7**.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this investigation it is our opinion that the site soil and groundwater conditions are generally suitable for operation of dry bottom retention ponds. The soil conditions in the proposed retention areas generally consisted of well drained, highly permeable fine sands. No unsuitable conditions such as buried debris, organic soils, loose or raveled soils were found to the maximum boring depth. Restrictive soils layers were encountered in some of the borings and should be considered when conducting infiltration calculations.

Infiltration and recovery analysis must be performed for the proposed pond as required by the St. John's River Water Management District. For this purpose we recommend utilizing the shallow aquifer soil and groundwater parameters presented below.

Table 1 includes a summary of the boring information used for estimating the surficial aquifer parameters for use in conducting infiltration analyses. The some cases the recommended parameters presented in the table assume weighted average permeability values incorporating the surficial fine sands and deeper slightly silty and silty fine sands. Where appropriate, clay layers will be overexcavated in the pond area to access more permeable underlying material. Overexcavation is proposed for Ponds 1, 2 and 3. **Appendix A** includes sketches depicting the recommended overexcavation and calculation of the weighted average permeability values.

Factors of safety have been assigned to the horizontal saturated and vertical unsaturated hydraulic conductivity values. Additional factors of safety are not required.

CLOSURE

We appreciate the opportunity to participate in this project and we trust that the information presented herein is sufficient for your immediate needs. Should you have any questions or comments concerning the contents of this report, please do not hesitate to contact the undersigned.

Sincerely,

ANDREYEV ENGINEERING, INC.

T. Scott Cavin, P.E.
Vice President
FL Registration No. 48125

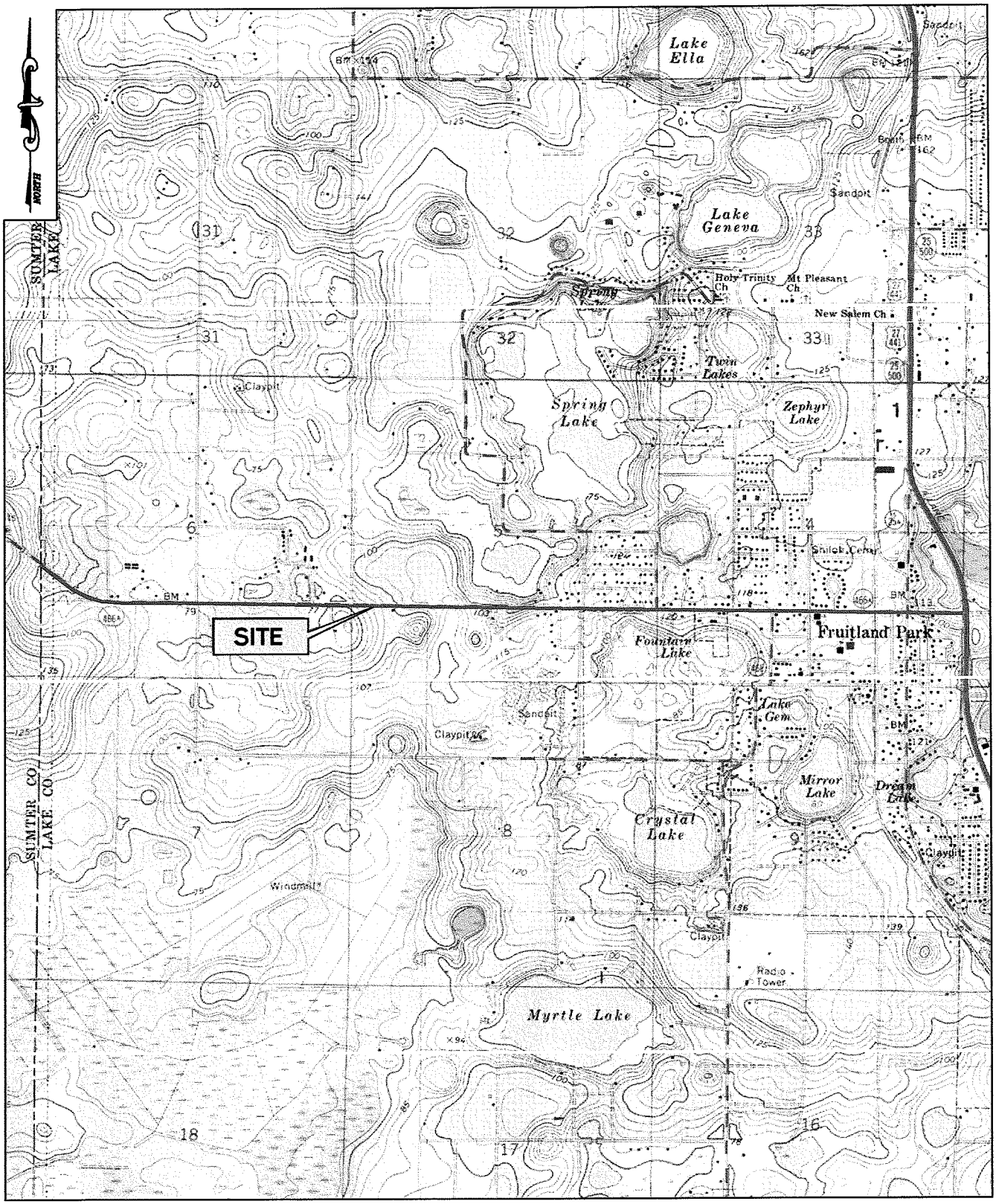
TABLE

COUNTY ROAD 466A
LADY LAKE, FLORIDA

TABLE 1
SHALLOW AQUIFER PARAMETERS FOR POND ANALYSIS

Boring	Ground Elevation at Boring (ft-NGVD)	Depth to Confining Layer (ft)	Elevation of Confining Layer (ft-NGVD)	Depth to Seasonal High Groundwater Table (ft)	Elevation of Seasonal High Groundwater Table (ft-NGVD)	Horizontal Hydraulic Conductivity (ft/day)	Vertical Hydraulic Conductivity (ft/day)	Storage Coefficient
Pond 1								
PB- 21	69.5	22	47.5	11.0	58.5	6	1	0.2
PB- 22	70	22	48	11.0	59	6	1	0.2
Average			**47.8**		**58.8**	**6**	**1**	**0.2**
Pond 2								
PB- 3	74.8	25	49.8	20	54.8	13	11.5	0.2
PB- 12	73.7	30.0	43.7	15.0	58.7	13	11.5	0.2
Average			**46.8**		**56.75**	**13**	**11.5**	**0.2**
Pond 3								
PB- 13	68.8	25.0	43.8	9.0	59.8	4.7	7.5	0.2
PB- 14	72.8	17.5	55.3	17.0	55.8	4.7	7.5	0.2
Average			**43.8**		**57.8**	**4.7**	**7.5**	**0.2**
Pond 4								
PB- 26	88.8	20	68.8	19	69.8	12.5	7.3	0.2
PB- 27	105	20	85	19	86	12.5	7.3	0.2
Average			**68.8**		**69.8**	**12.5**	**7.3**	**0.2**
Pond 5								
PB- 15	78.3	15.0	63.3	7.5	70.8	40	20	0.2
PB- 16	79.5	15.0	64.5	8.5	71	10	5	0.2
PB- 23	72.9	---	---	2.0	70.9	---	---	0.2
PB- 24	70.5	---	---	+0.5	71.0	---	---	0.2
PB- 25	69	---	---	+2.0	71.0	---	---	0.2
Average			**63.9**		**70.9**	**25.0**	**12.5**	**0.2**
Pond 6								
PB-17	120	30	90	18	102	10	5	0.2
PB-18	121	8.5	112.5	18	103	30	15	0.2
Average			**101.3**		**102.5**	**20**	**10**	**0.2**
Pond 7								
PB-20	78	15.0	63	14.5	63.5	30	15	0.2

FIGURES



REFERENCE:
U.S.G.S. LEESBURG WEST, FLA.
QUADRANGLE MAP
DATED 1966
PHOTOREVISED 1980
SECTIONS 4, 5, & 6
TOWNSHIP 19 SOUTH
RANGE 24 EAST

Andreyev Engineering, Inc.

APPROXIMATE SCALE:	DATE: 11/10/04	ENGINEER: JD
1"=2500'	PN: CGGT-05-364	DRAWN BY: DLS

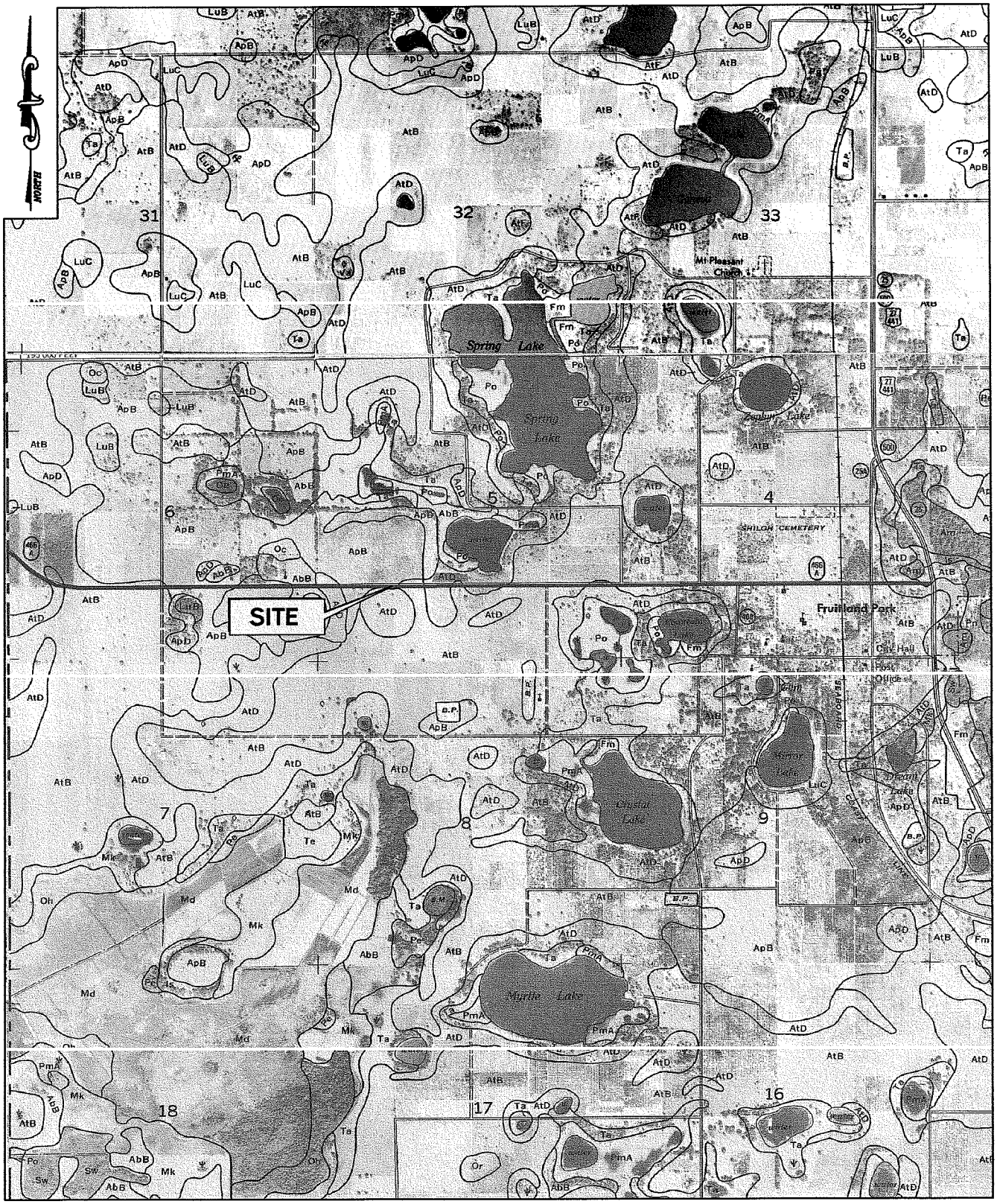
GEOTECHNICAL INVESTIGATION

COUNTY ROAD 466A

LAKE COUNTY, FL.

VICINITY MAP

Plate 1



REFERENCE:
SOIL SURVEY OF LAKE COUNTY, FLORIDA
MAP SHEET NO. 21

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION

COUNTY ROAD 466A

LAKE COUNTY, FL.

SCS SOIL SURVEY

APPROXIMATE SCALE:	DATE: 11/10/04	ENGINEER: JD
1"=2500'	PN: CGGT-05-364	DRAWN BY: DLS

Plate 2

PB-1
APPROX. EL. = 65.7
APPROX. SHWT EL. = 53.2
HORIZONTAL PERMEABILITY = 5 FT/DAY

PB-2
APPROX. EL. = 69.8
APPROX. SHWT EL. = 61.3
HORIZONTAL PERMEABILITY = 10 FT/DAY

PB-22

PB-21

POND 1
0.83 AC.

PB-12
APPROX. EL. = 73.7
APPROX. SHWT EL. = 58.7
HORIZONTAL PERMEABILITY = 20 FT/DAY

POND 2
1.20 AC.

PB-3
APPROX. EL. = 74.8
APPROX. SHWT EL. = 54.8
HORIZONTAL PERMEABILITY = 13

PB-4
APPROX. EL. = 71.6
APPROX. SHWT EL. = 57.1
HORIZONTAL PERMEABILITY = 13

ZONE A

NORTH

LEGEND:

APPROXIMATE LOCATION OF AUGER BORING

Andreyev Engineering, Inc.

RETENTION AREA INVESTIGATION

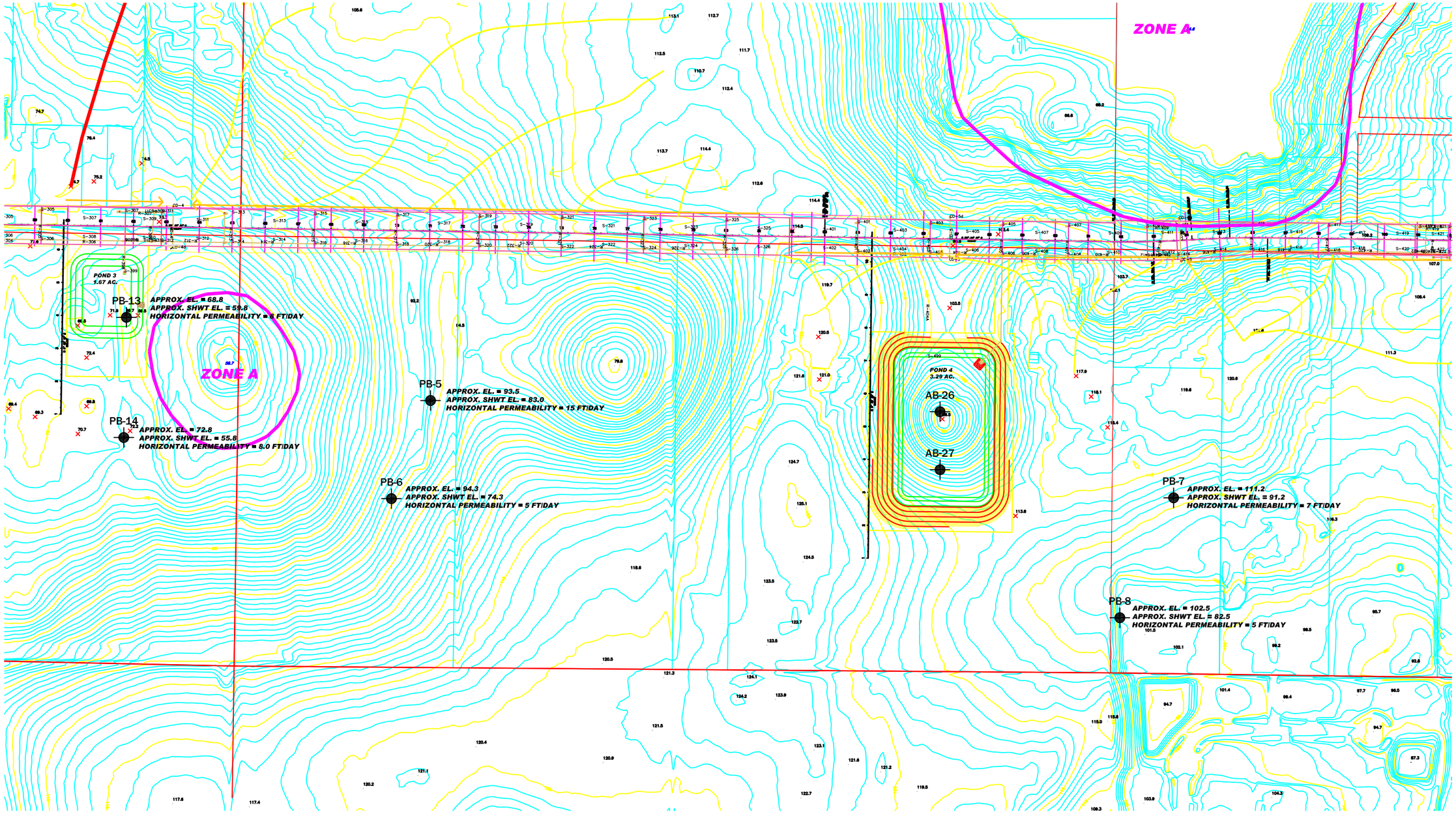
COUNTY ROAD 466A

LAKE COUNTY, FL.

LOCATION PLAN

FIGURE 1

APPROXIMATE SCALE:	DATE: 08/03/09	ENGINEER: SC
1"=300'	PN: CPGT-05-364	DRAWN BY: DLS



LEGEND:

APPROXIMATE LOCATION OF AUGER BORING

Andreyev Engineering, Inc.

RETENTION AREA INVESTIGATION

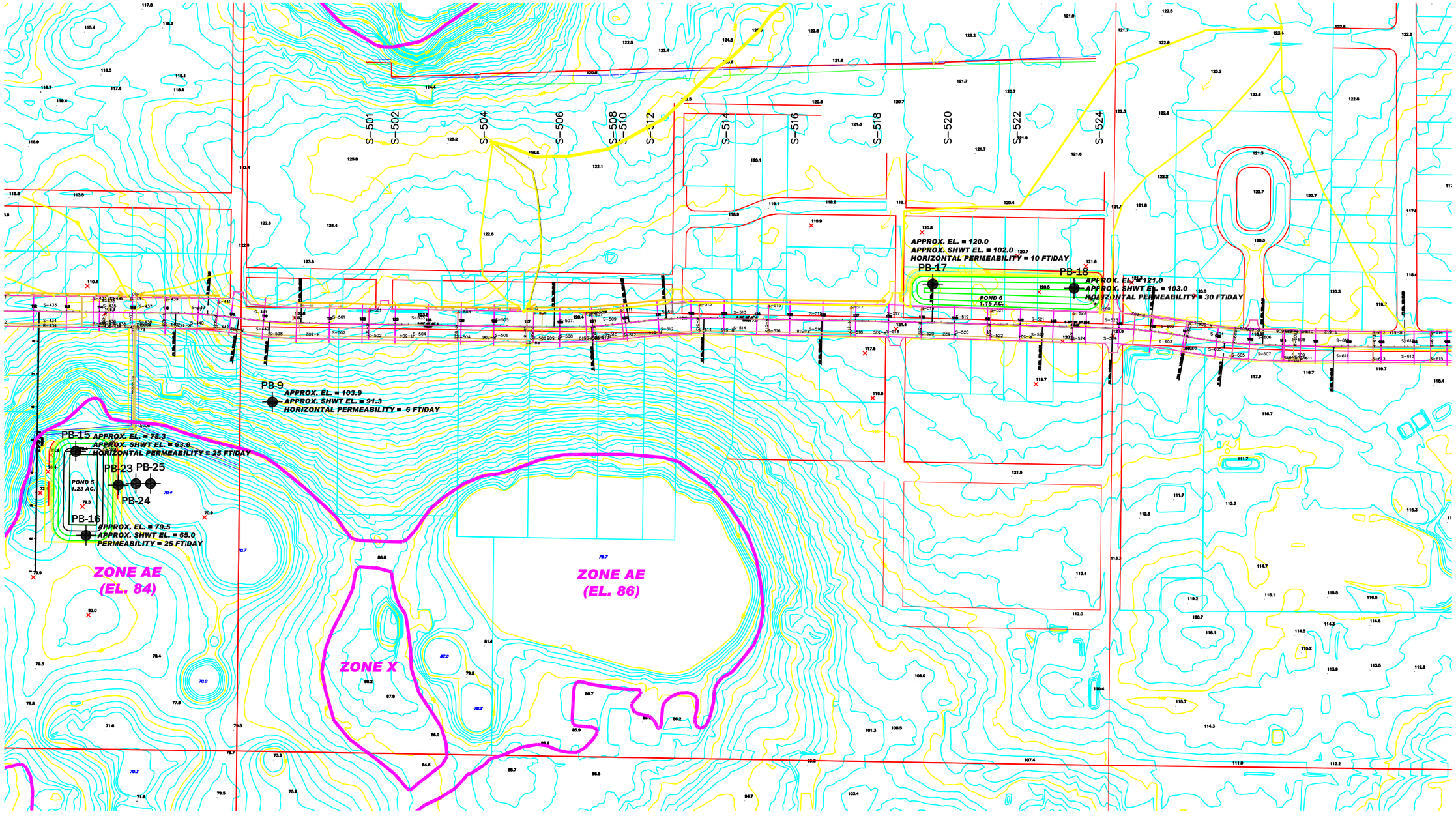
COUNTY ROAD 466A

LAKE COUNTY, FL.

LOCATION PLAN

FIGURE 2

APPROXIMATE SCALE:	DATE: 08/18/09	ENGINEER: SC
1"=300'	PN: CPGT-05-364	DRAWN BY: DLS



LEGEND:

⊕ APPROXIMATE LOCATION OF AUGER BORING

Andreyev Engineering, Inc.

RETENTION AREA INVESTIGATION

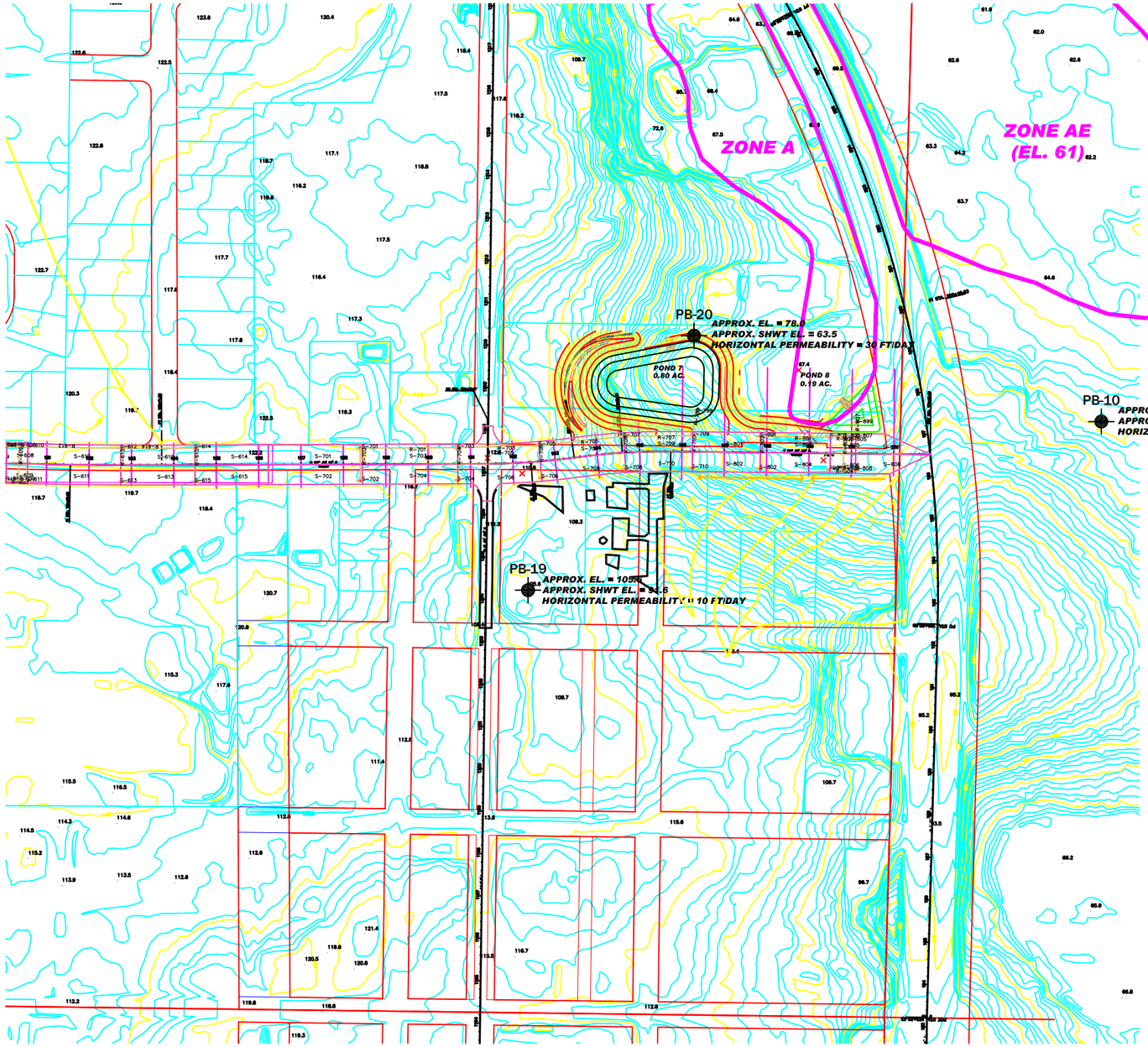
COUNTY ROAD 466A

LAKE COUNTY, FL.

LOCATION PLAN

FIGURE 3

APPROXIMATE SCALE:	DATE: 08/03/09	ENGINEER: SC
1"=300'	PN: CPGT-05-364	DRAWN BY: DLS



LEGEND:

APPROXIMATE LOCATION OF AUGER BORING

Andreyev Engineering, Inc.

RETENTION AREA INVESTIGATION

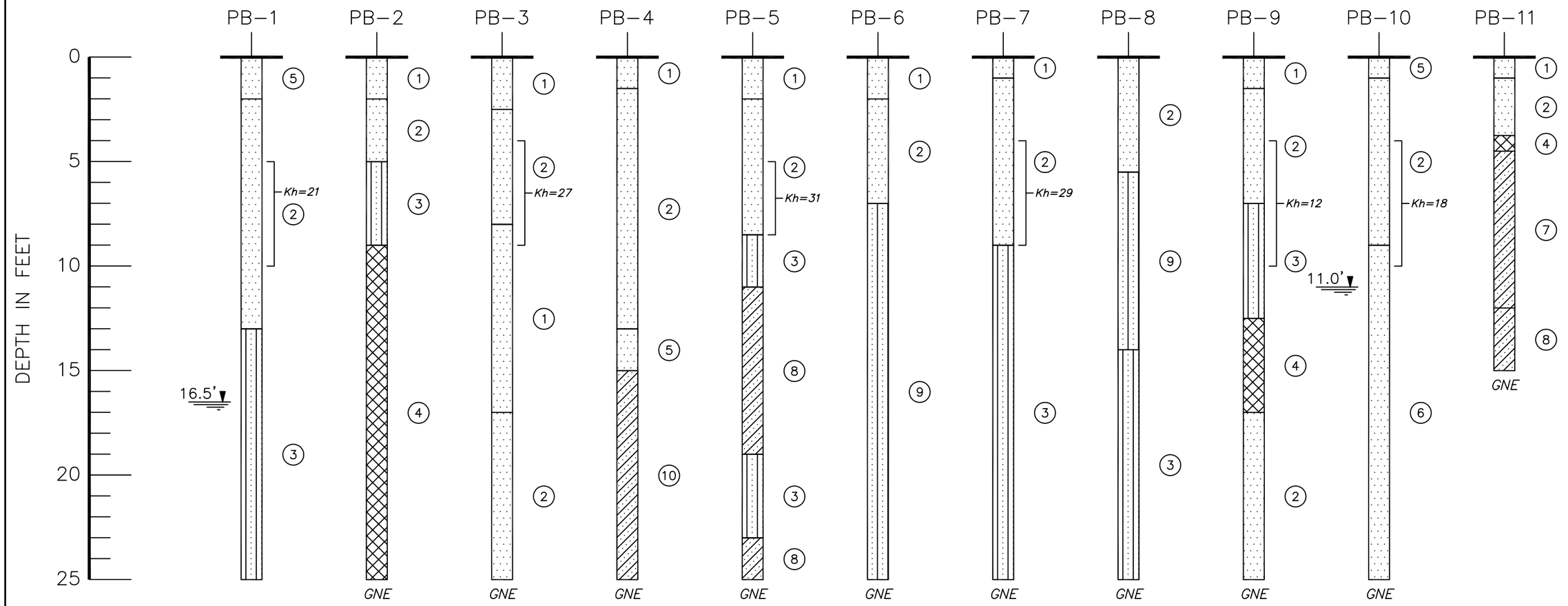
COUNTY ROAD 466A

LAKE COUNTY, FL.

LOCATION PLAN

FIGURE 4

APPROXIMATE SCALE:	DATE: 08/03/09	ENGINEER: SC
1"=300'	PN: CPGT-05-364	DRAWN BY: DLS



LEGEND:

- (1) GRAYISH–BROWN FINE SAND (SP)
- (2) LIGHT BROWN TO ORANGISH–BROWN FINE SAND (SP)
- (3) LIGHT BROWN TO BROWN SLIGHTLY SILTY FINE SAND (SP–SM)
- (4) BROWN TO LIGHT BROWN HIGHLY CEMENTED FINE SAND (HARDPAN)(SP)
- (5) DARK GRAY FINE SAND (SP)
- (6) BROWN FINE TO MEDIUM SAND (SP)
- (7) GRAY & REDDISH–BROWN MOTTLED CLAYEY FINE SAND (SC)
- (8) BROWN & ORANGISH–BROWN MOTTLED CLAYEY FINE SAND (SC)
- (9) ORANGISH–BROWN SILTY FINE SAND (SM)
- (10) GRAYISH–BROWN CLAYEY FINE SAND (SC)
- (11) GRAYISH–BROWN TO BROWN CLAY (CH)

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

1.0' DEPTH TO GROUNDWATER, SEPTEMBER, 2007

GNE GROUNDWATER NOT ENCOUNTERED

Kh HORIZONTAL COEFFICIENT OF PERMEABILITY, IN FEET PER DAY

Andreyev Engineering, Inc.

RETENTION AREA INVESTIGATION

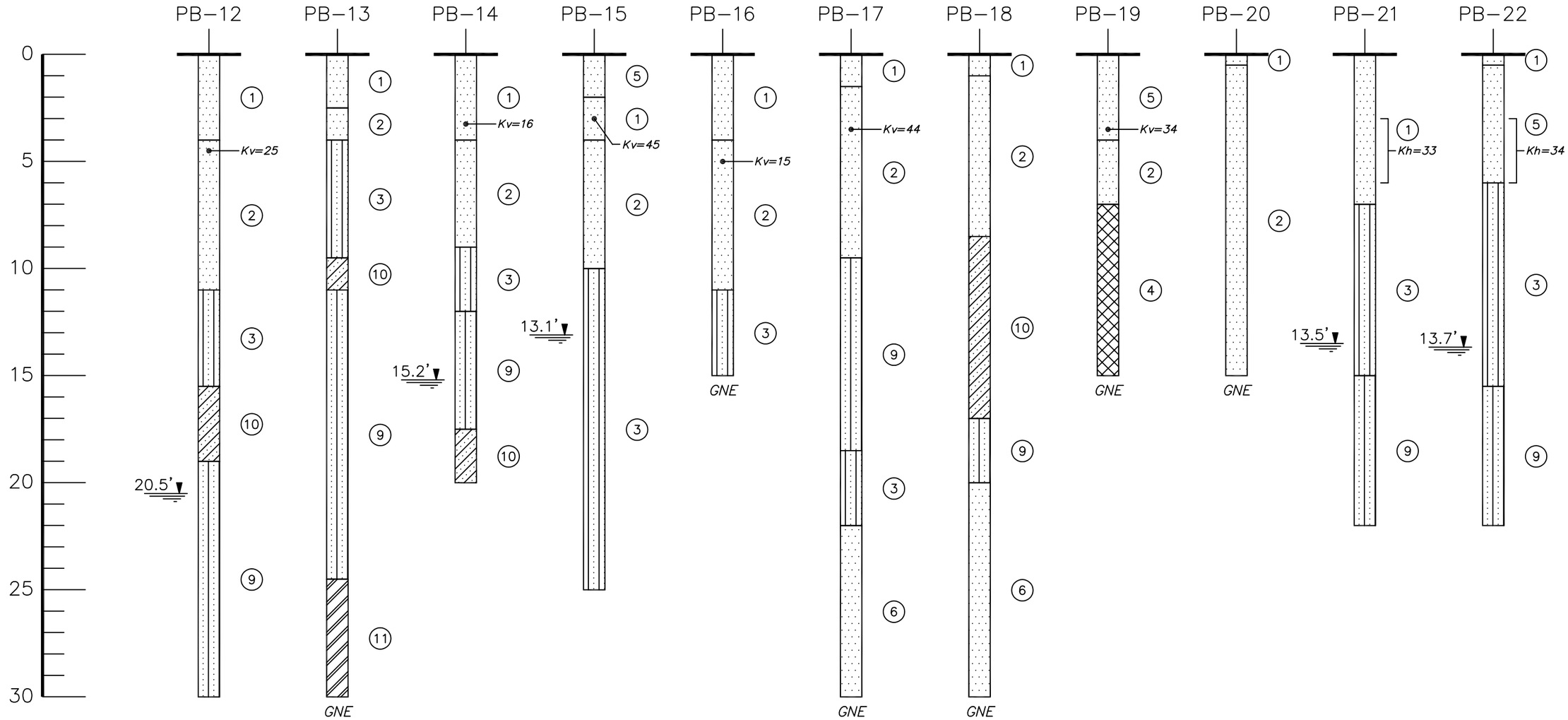
COUNTY ROAD 466A

LAKE COUNTY, FL.

SOIL PROFILES

FIGURE 5

APPROXIMATE SCALE:	DATE: 08/03/09	ENGINEER: SC
1"=5'	PN: CPGT–05–364	DRAWN BY: DLS



LEGEND:

- (1) GRAYISH–BROWN FINE SAND (SP)
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- (11) GRAYISH–BROWN TO BROWN CLAY (CH)

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

1.0' DEPTH TO GROUNDWATER, SEPTEMBER, 2007 & JUNE, 2009

GNE GROUNDWATER NOT ENCOUNTERED

Kv VERTICAL COEFFICIENT OF PERMEABILITY, IN FEET PER DAY

Andreyev Engineering, Inc.

RETENTION AREA INVESTIGATION

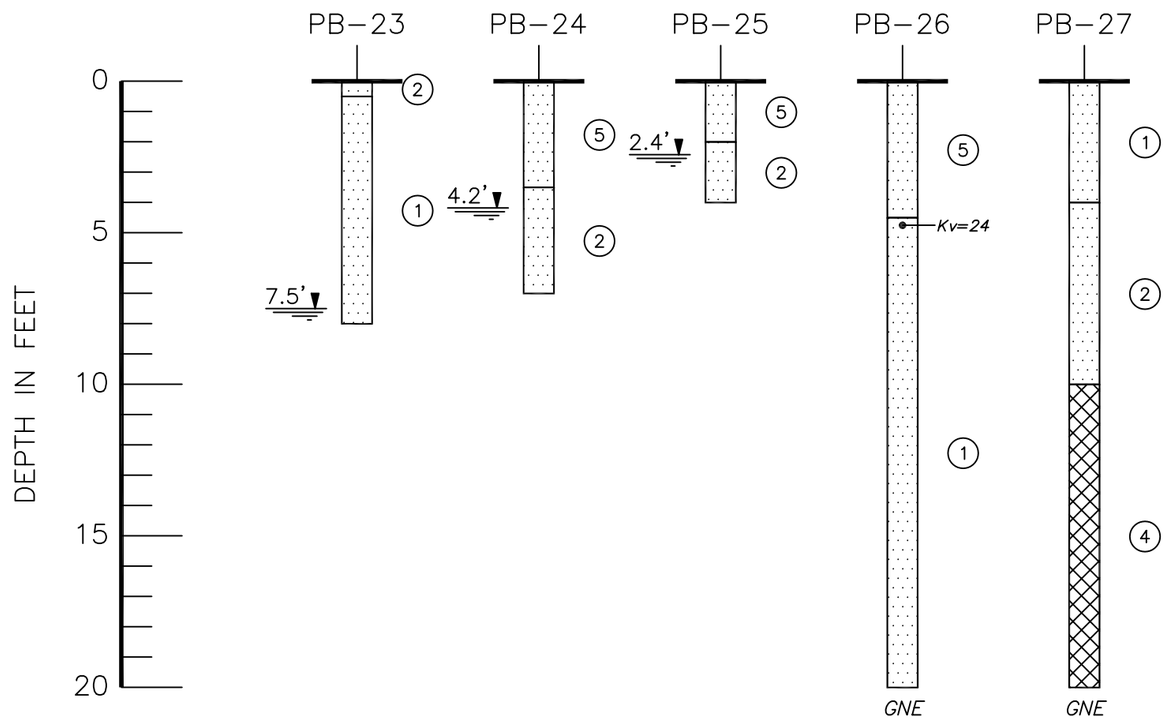
COUNTY ROAD 466A

LAKE COUNTY, FL.

SOIL PROFILES

APPROXIMATE SCALE:	DATE: 08/03/09	ENGINEER: SC
1"=5'	PN: CPGT–05–364	DRAWN BY: DLS

FIGURE 6



LEGEND:

1. GRAYISH–BROWN FINE SAND (SP)
2. LIGHT BROWN TO ORANGISH–BROWN FINE SAND (SP)
3. LIGHT BROWN TO BROWN SLIGHTLY SILTY FINE SAND (SP–SM)
4. BROWN TO LIGHT BROWN HIGHLY CEMENTED FINE SAND (HARDPAN)(SP)
5. DARK GRAY FINE SAND (SP)
6. BROWN FINE TO MEDIUM SAND (SP)
7. GRAY & REDDISH–BROWN MOTTLED CLAYEY FINE SAND (SC)
8. BROWN & ORANGISH–BROWN MOTTLED CLAYEY FINE SAND (SC)
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1.0' DEPTH TO GROUNDWATER, SEPTEMBER, 2007 & JUNE, 2009

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Kv VERTICAL COEFFICIENT OF PERMEABILITY, IN FEET PER DAY

Andreyev Engineering, Inc.

RETENTION AREA INVESTIGATION

COUNTY ROAD 466A

LAKE COUNTY, FL.

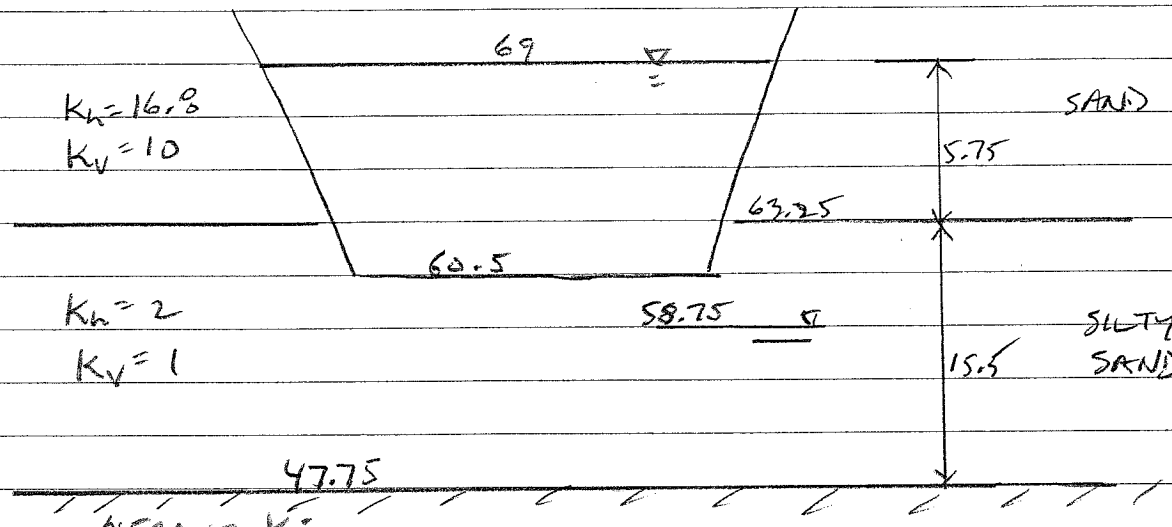
SOIL PROFILES

APPROXIMATE SCALE:	DATE: 08/18/09	ENGINEER: SC
1"=5'	PN: CPGT–05–364	DRAWN BY: DLS

FIGURE 7

APPENDIX A

POND 1

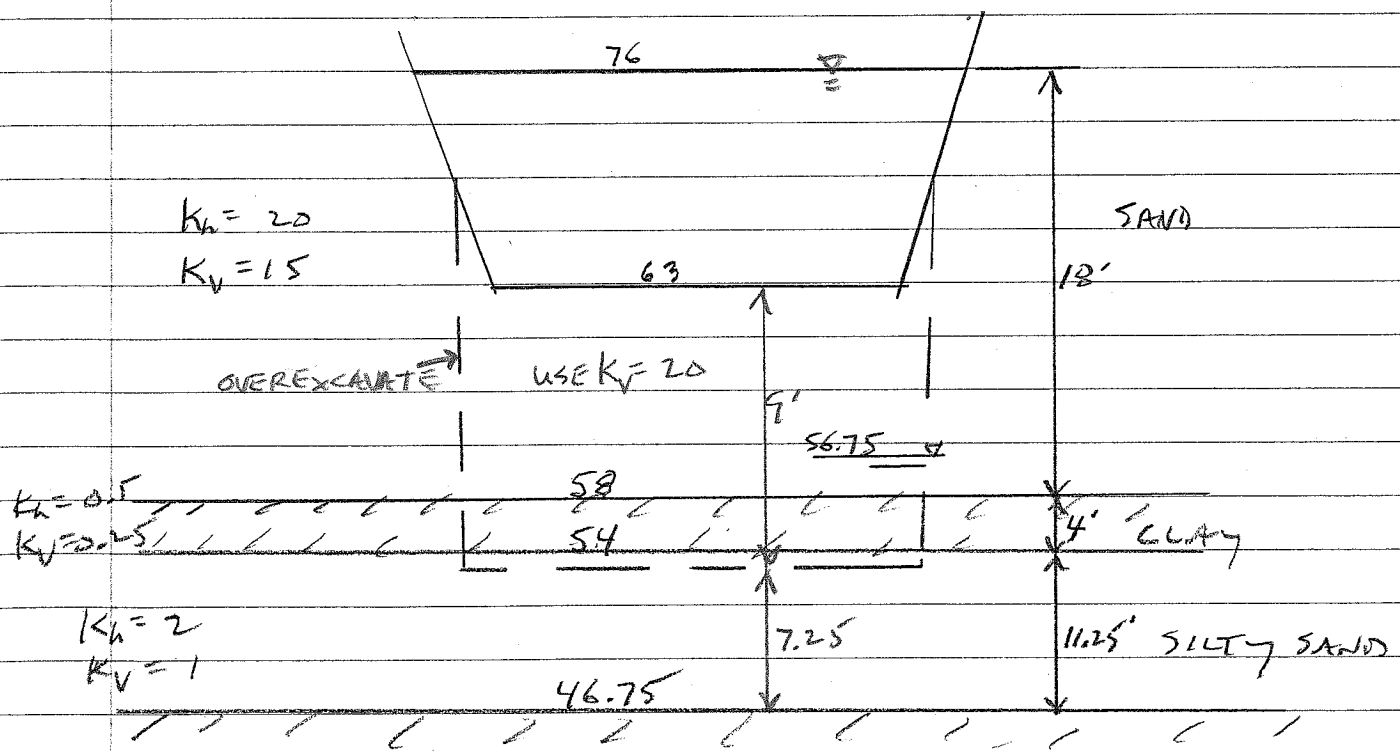


AVERAGE K:

$$K_h = \frac{5.75(16.8) + 15.5(2)}{21.25} = 6$$

$$K_V = 1$$

POND 2

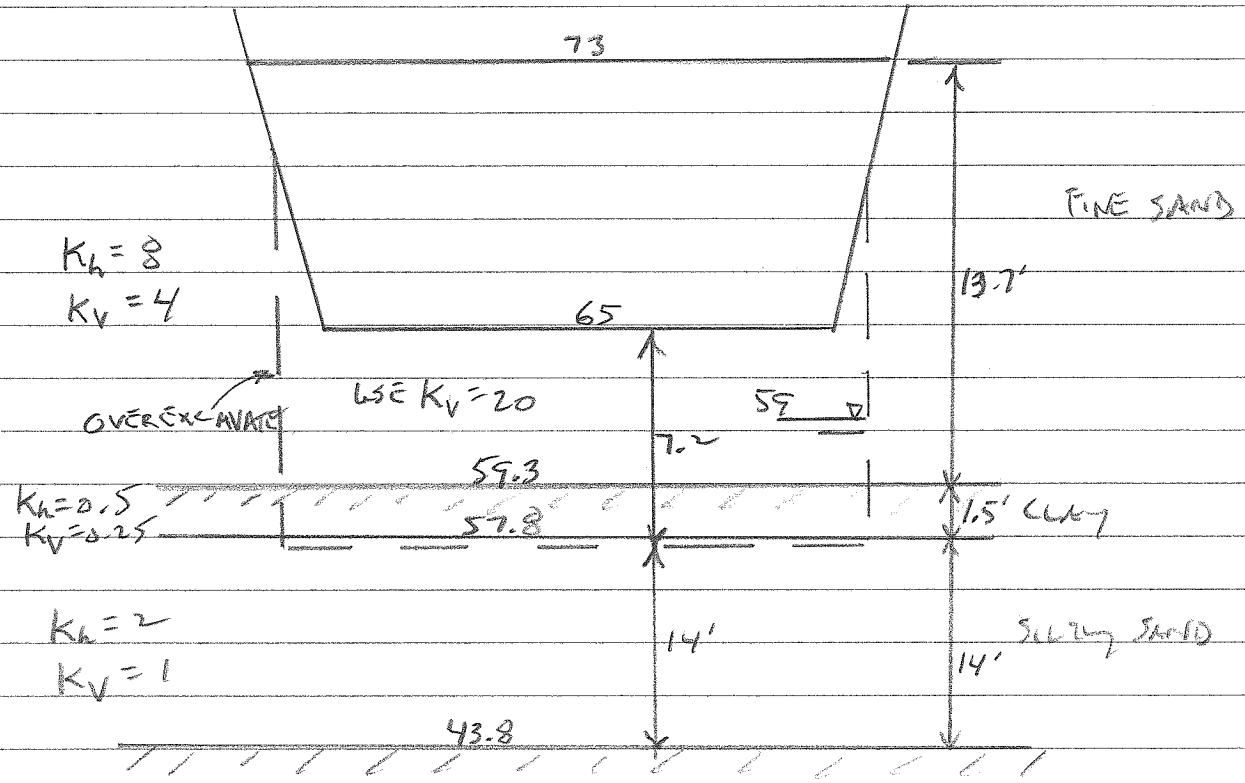


AVERAGE K:

$$K_h = \frac{13(20) + 4(0.5) + 11.25(2)}{29.25} = 13 \text{ ft/day}$$

$$K_V = \frac{9(20) + 7.25(1)}{16.25} = 11.5 \text{ ft/day}$$

POND 3

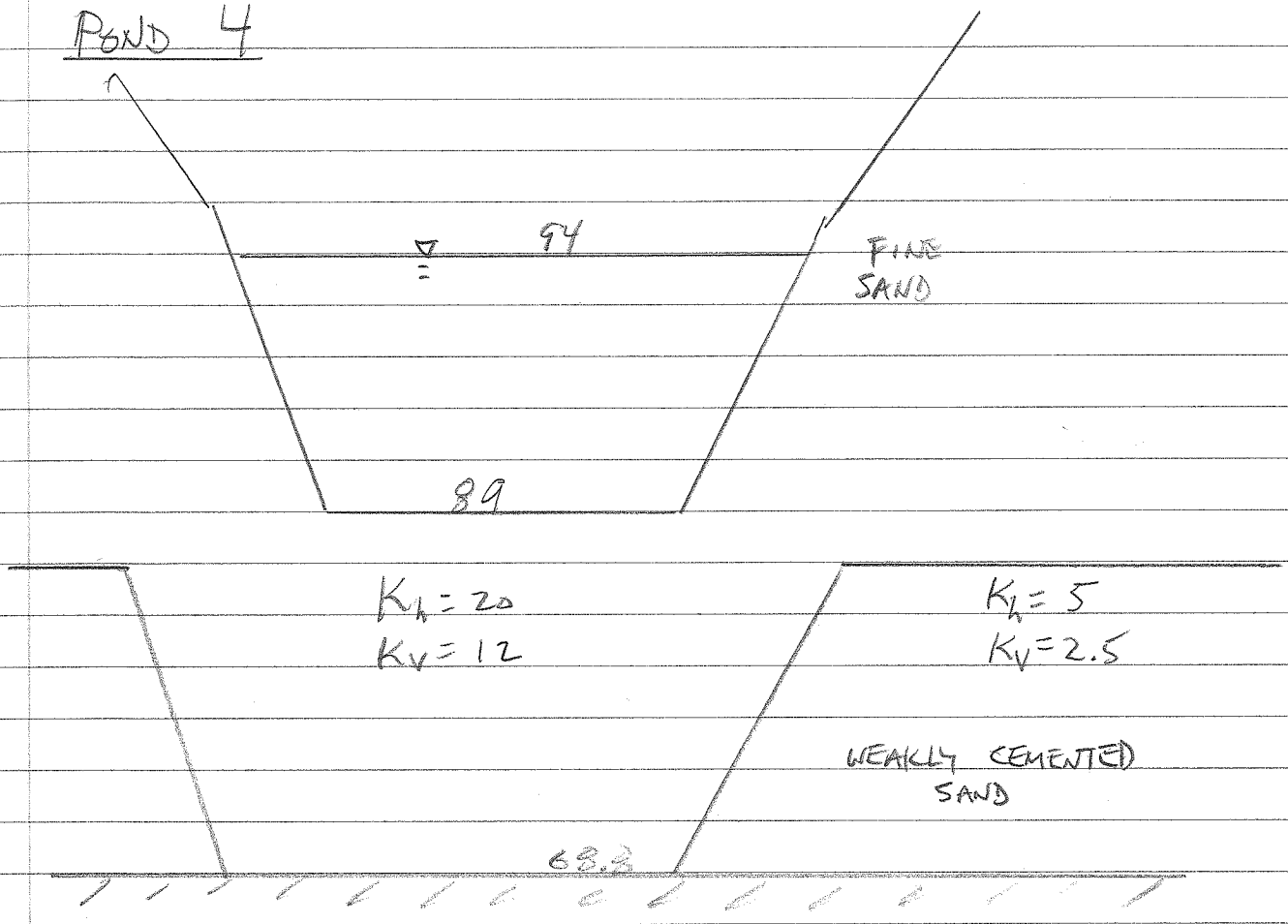


AVERAGE K:

$$K_h = \frac{13.7(8) + 1.5(0.5) + 14(2)}{29.2} = 4.7 \text{ ft/day}$$

$$K_V = \frac{7.2(20) + 14(1)}{21.2} = 7.5 \text{ ft/day}$$

POND 4



AVERAGE K

$$K_h = \frac{20+5}{2} = 12.5 \text{ ft/day}$$

$$K_V = \frac{12+2.5}{2} = 7.3 \text{ ft/day}$$