TABLE 1

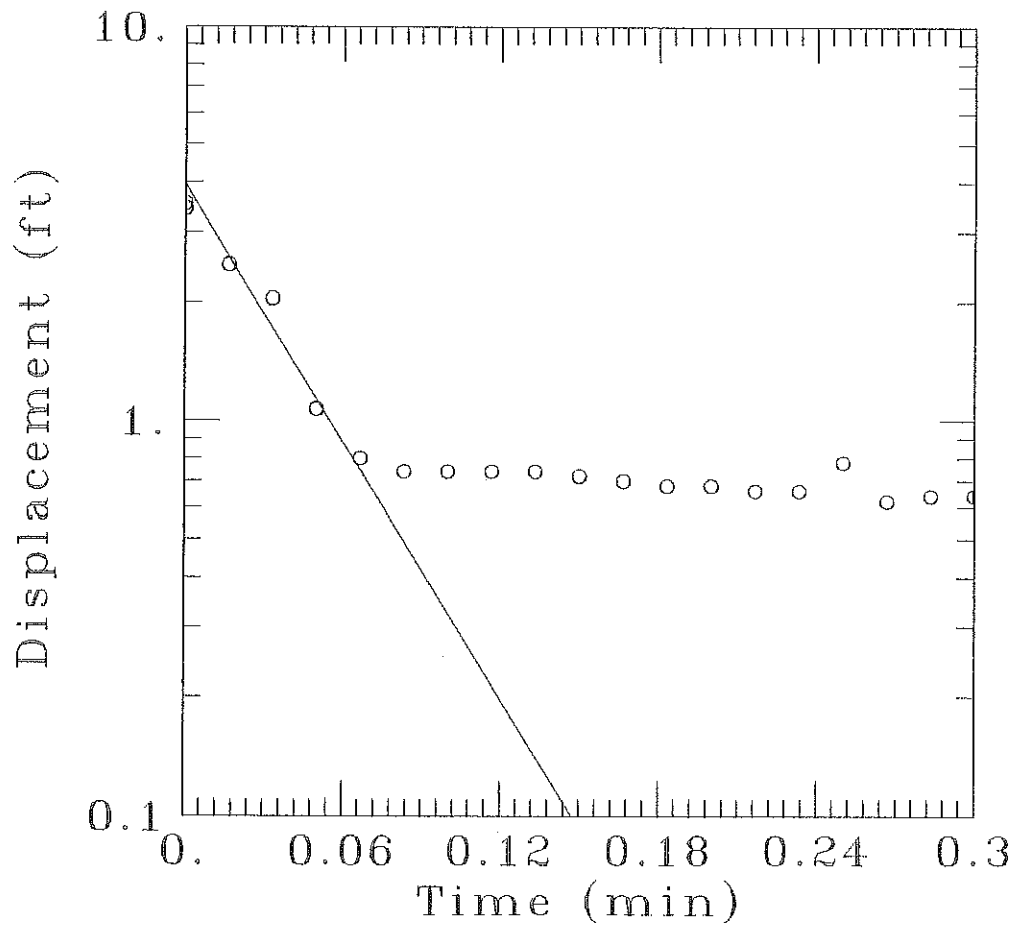
DISCOVERY BAY, AGUADILLA, PUERTO RICO

GROUNDWATER LEVELS AND PERMEABILITY ANALYSIS

MONITOR WELL NUMBER	WELL DEPTH (FT) (FT. BTOC)	WELLSCREEN LENGTH (FT.)	WELL STICK-UP (FT. AGS)	BEGINNING WATER LEVEL (FT. BTOC)	SATURATED LENGTH (FT.)	PERMEABILITY (FT./DAY)	ENDING WATER LEVEL (FT. BTOC)	SATURATED LENGTH (FT.)	PERMEABILITY (FT./DAY)
P-1	20.0	10.0	1.30	3.19	16.81	29.4	3.28	16.72	62.4
P-2	20.0	10.0	1.00	3.85	16.15	60.8	3.93	16.07	58.3
P-3	20.0	10.0	1.30	5.71	14.29	58.3	5.71	14.29	31.5
P-4	20.0	10.0	1.00	3.17	16.83	26.3	2.58	17.42	26.2
P-5	20.0	10.0	1.80	8.90	11.10	26.6	8.90	11.10	N/A
P-6	25.0	10.0	5.50	12.36	12.64	65.0	13.21	11.79	N/A
AVERAGE =						44.4			44.6

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-1 SLUG-IN TEST



DATA SET:
p1in
05/02/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-1

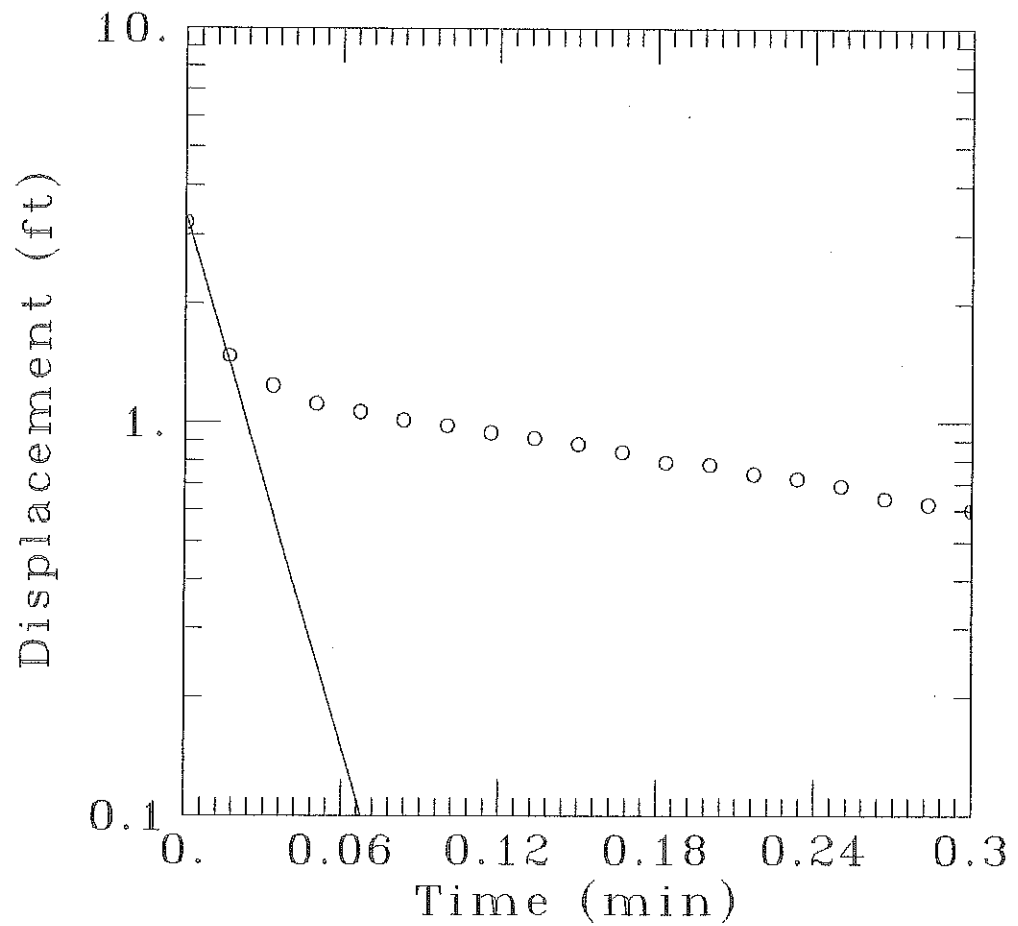
OBS. WELL:
P-1

ESTIMATED PARAMETERS:
K = 0.02045 ft/min
y0 = 3.938 ft

TEST DATA:
H0 = 3.54 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 15.51 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-1 SLUG-OUT TEST



DATA SET:
p1out
05/03/05

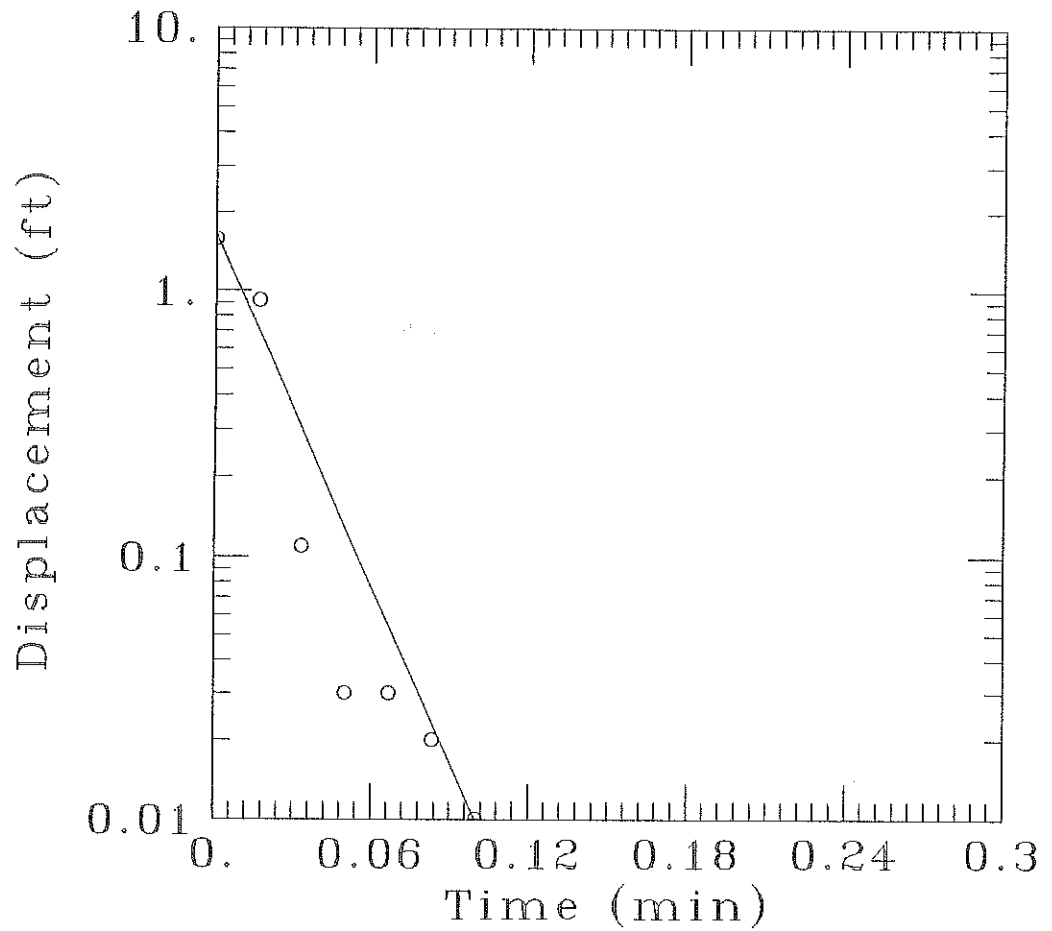
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-1
OBS. WELL:
P-1

ESTIMATED PARAMETERS:
K = 0.04333 ft/min
y0 = 3.388 ft

TEST DATA:
H0 = 3.22 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.72 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-2 SLUG-IN TEST



DATA SET:
p2in
05/02/05

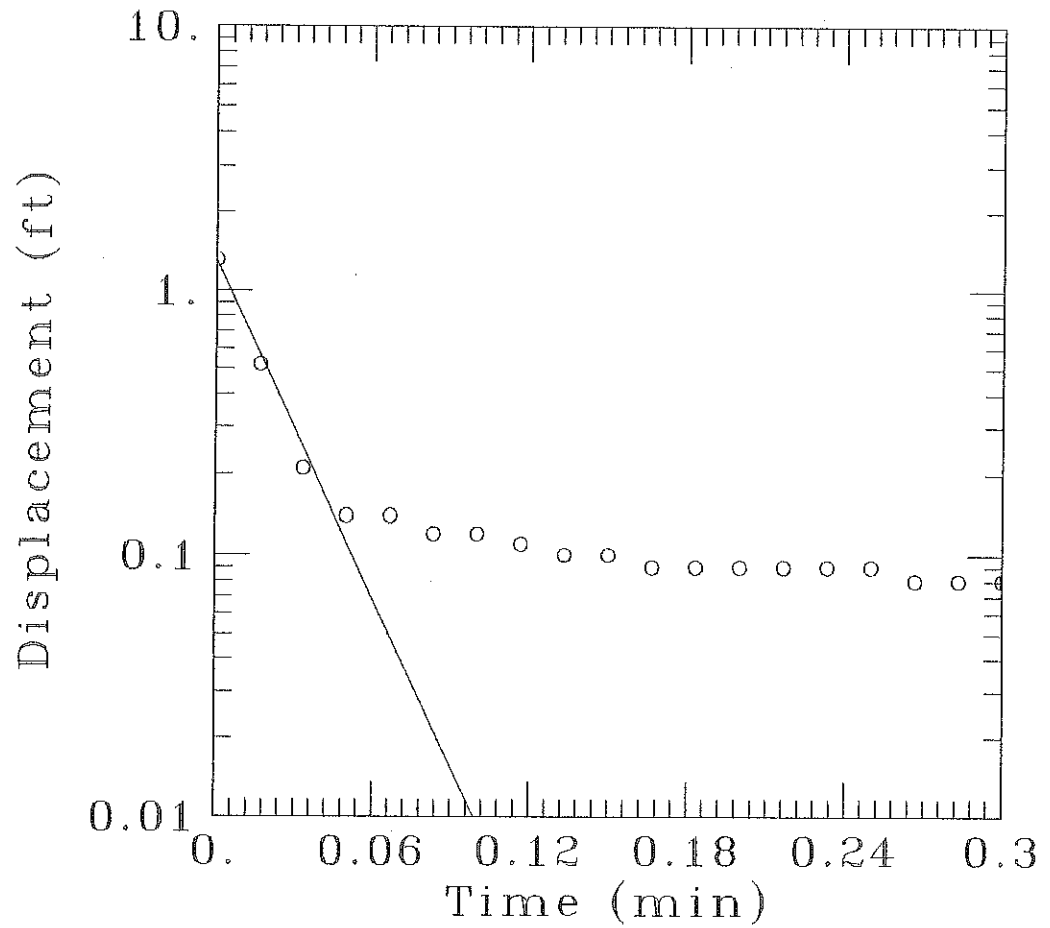
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-2
OBS. WELL:
P-2

ESTIMATED PARAMETERS:
K = 0.04222 ft/min
y0 = 1.64 ft

TEST DATA:
H0 = 1.58 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.15 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-2 SLUG-OUT TEST



DATA SET:
p2out
05/02/05

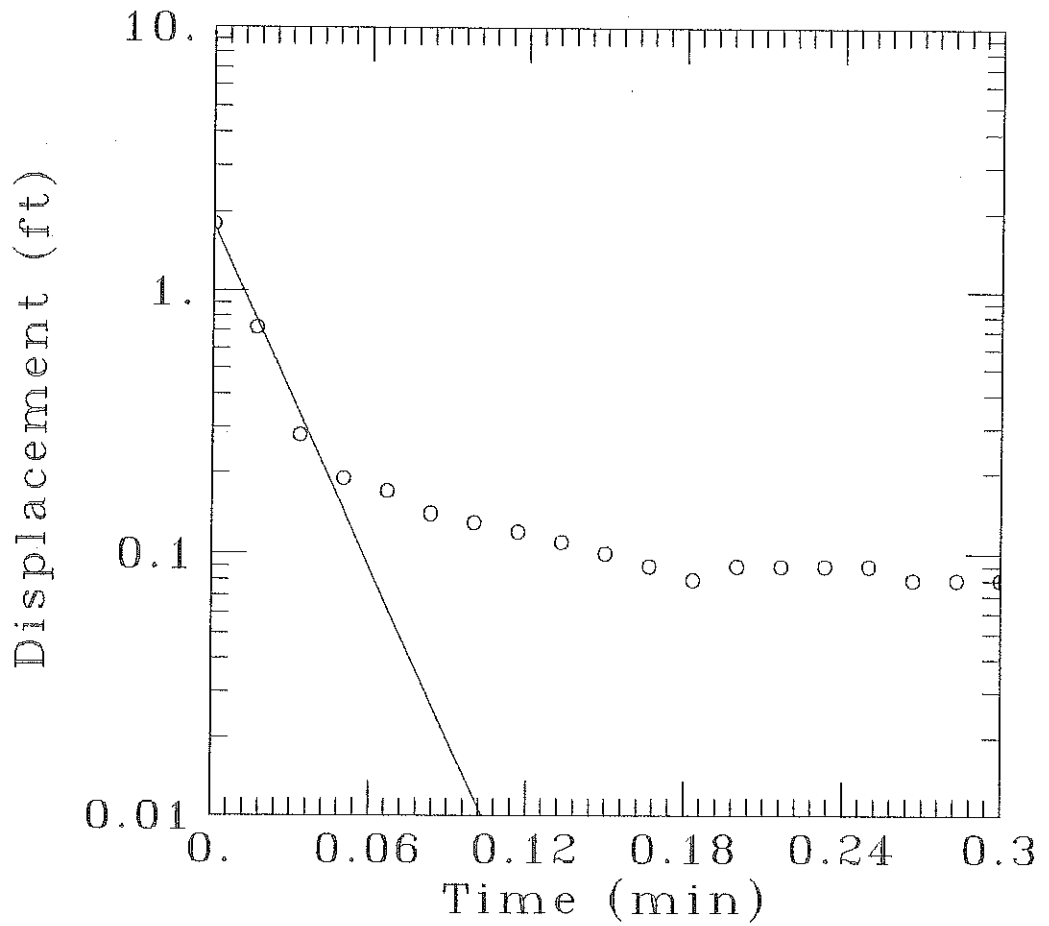
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-2
OBS. WELL:
P-2

ESTIMATED PARAMETERS:
K = 0.04047 ft/min
y0 = 1.294 ft

TEST DATA:
H0 = 1.31 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.07 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO, NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-3 SLUG-IN TEST



DATA SET:
p3in
05/02/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-3

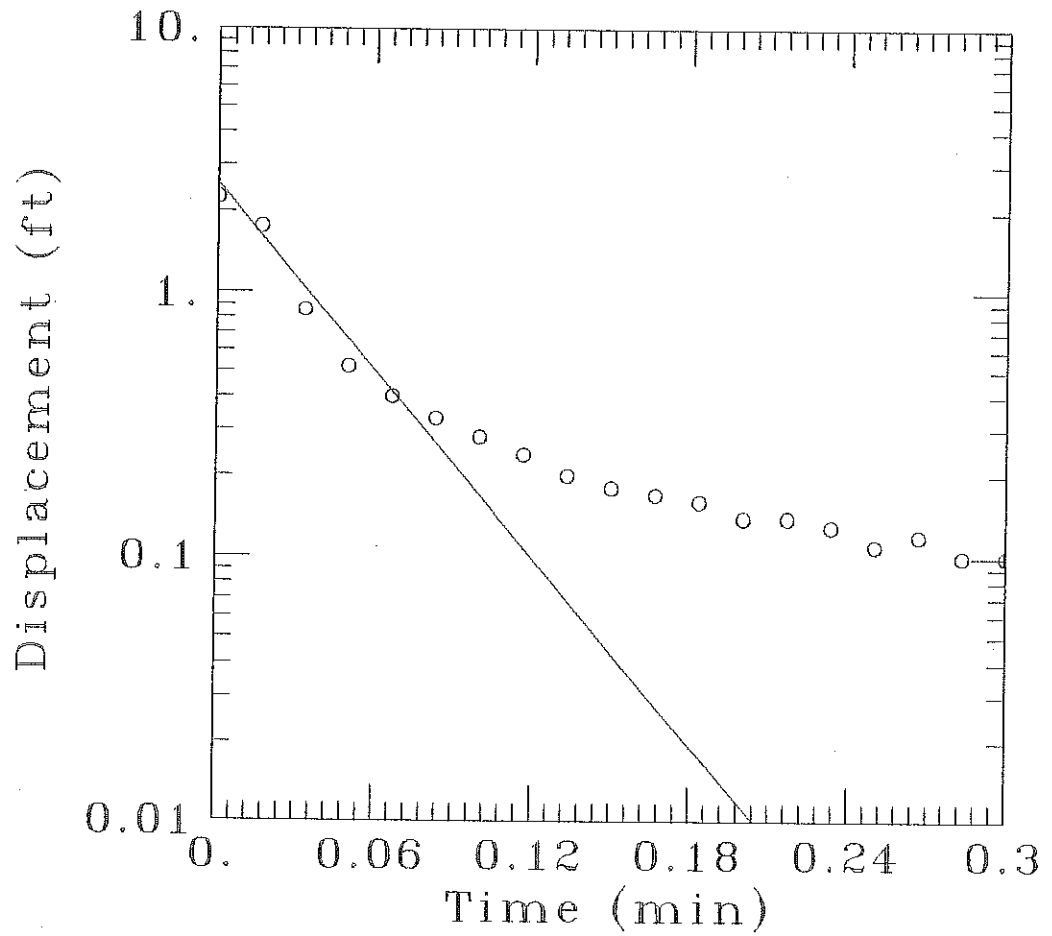
OBS. WELL:
P-3

ESTIMATED PARAMETERS:
K = 0.04055 ft/min
y0 = 1.786 ft

TEST DATA:
H0 = 1.8 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 14.29 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-3 SLUG-OUT TEST



DATA SET:
p3out
05/03/05

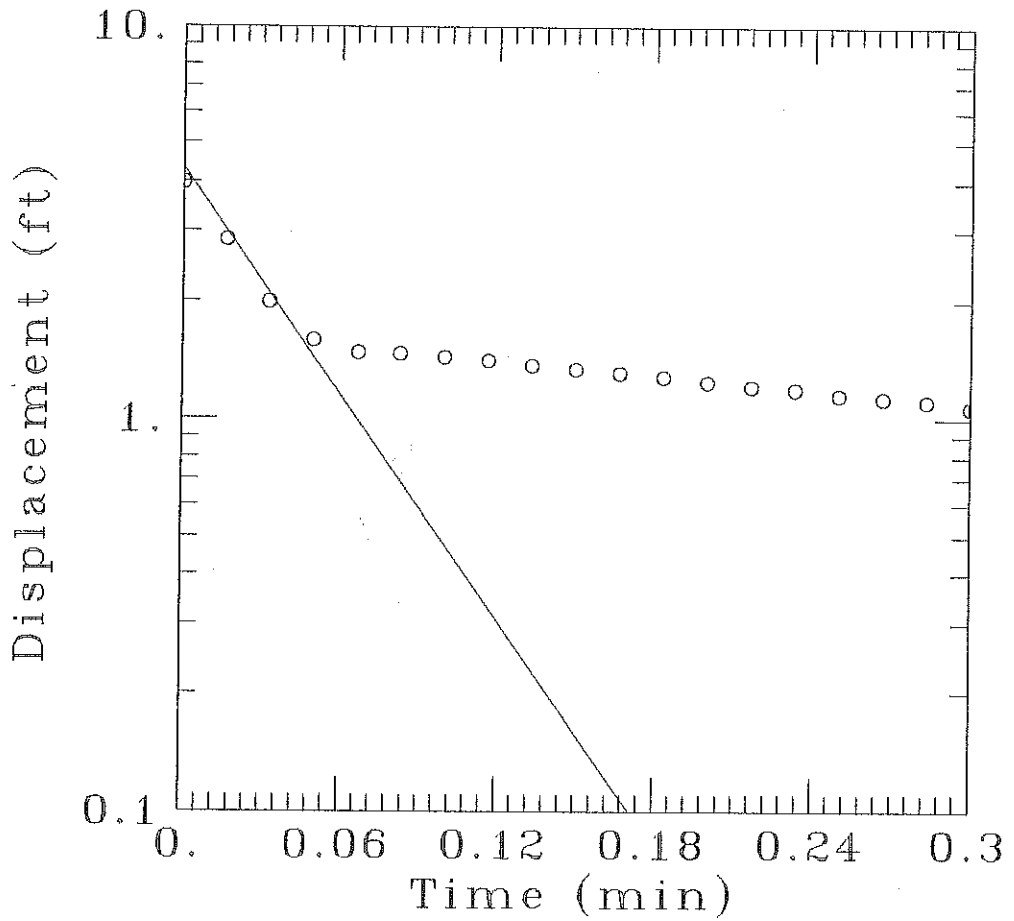
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-3
OBS. WELL:
P-3

ESTIMATED PARAMETERS:
K = 0.02189 ft/min
y0 = 2.553 ft

TEST DATA:
H0 = 2.26 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 14.29 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-4 SLUG-IN TEST



DATA SET:
p4in
05/03/05

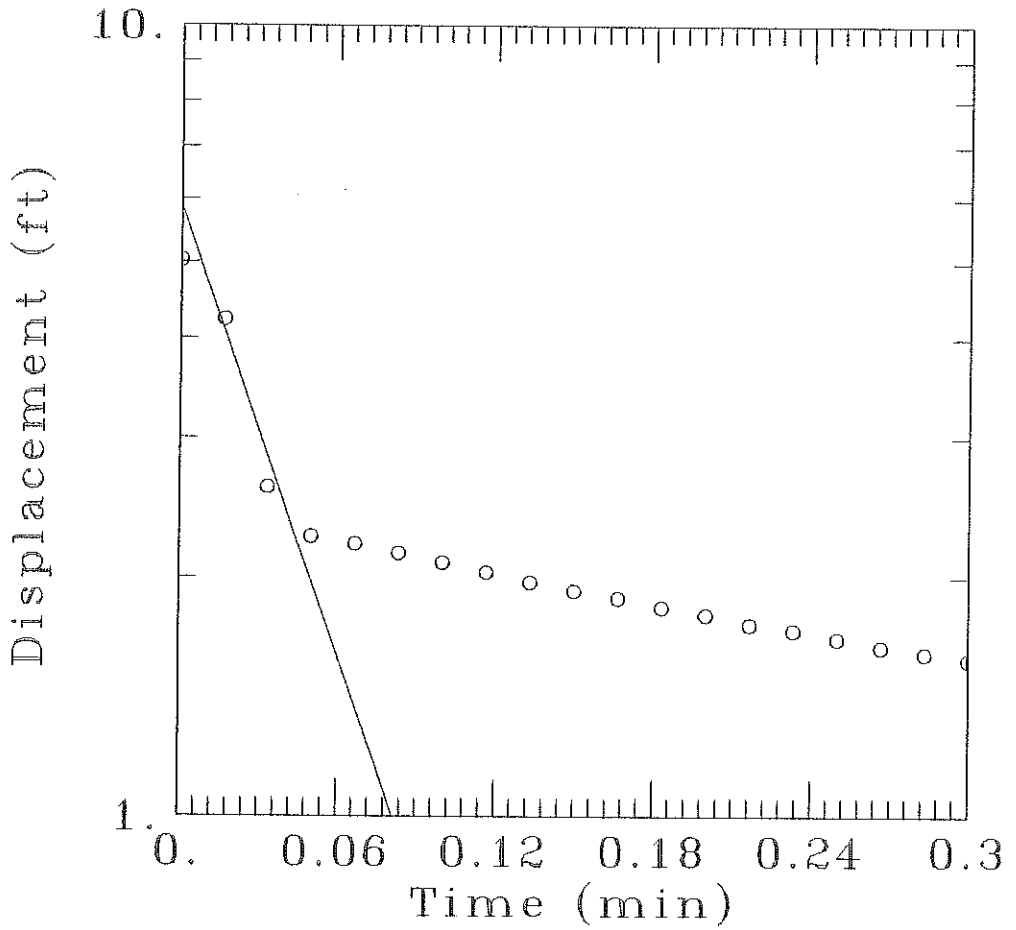
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04-21-05
TEST WELL:
P-4
OBS. WELL:
P-4

ESTIMATED PARAMETERS:
K = 0.01829 ft/min
y0 = 4.33 ft

TEST DATA:
H0 = 3.97 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.83 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-4 SLUG-OUT TEST



DATA SET:
p4out
05/03/05

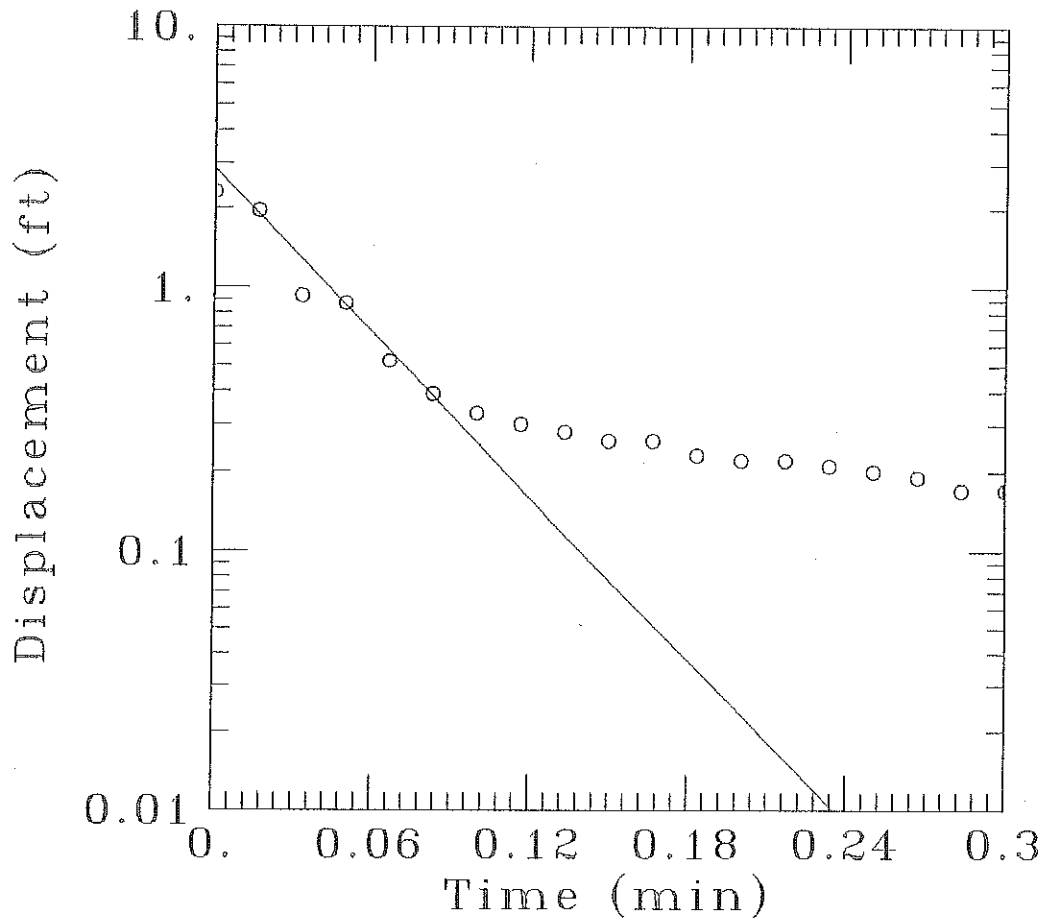
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-4
OBS. WELL:
P-4

ESTIMATED PARAMETERS:
K = 0.01818 ft/min
y0 = 5.872 ft

TEST DATA:
H0 = 5.03 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 17.42 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-5 SLUG-IN TEST



DATA SET:
p5in
05/03/05

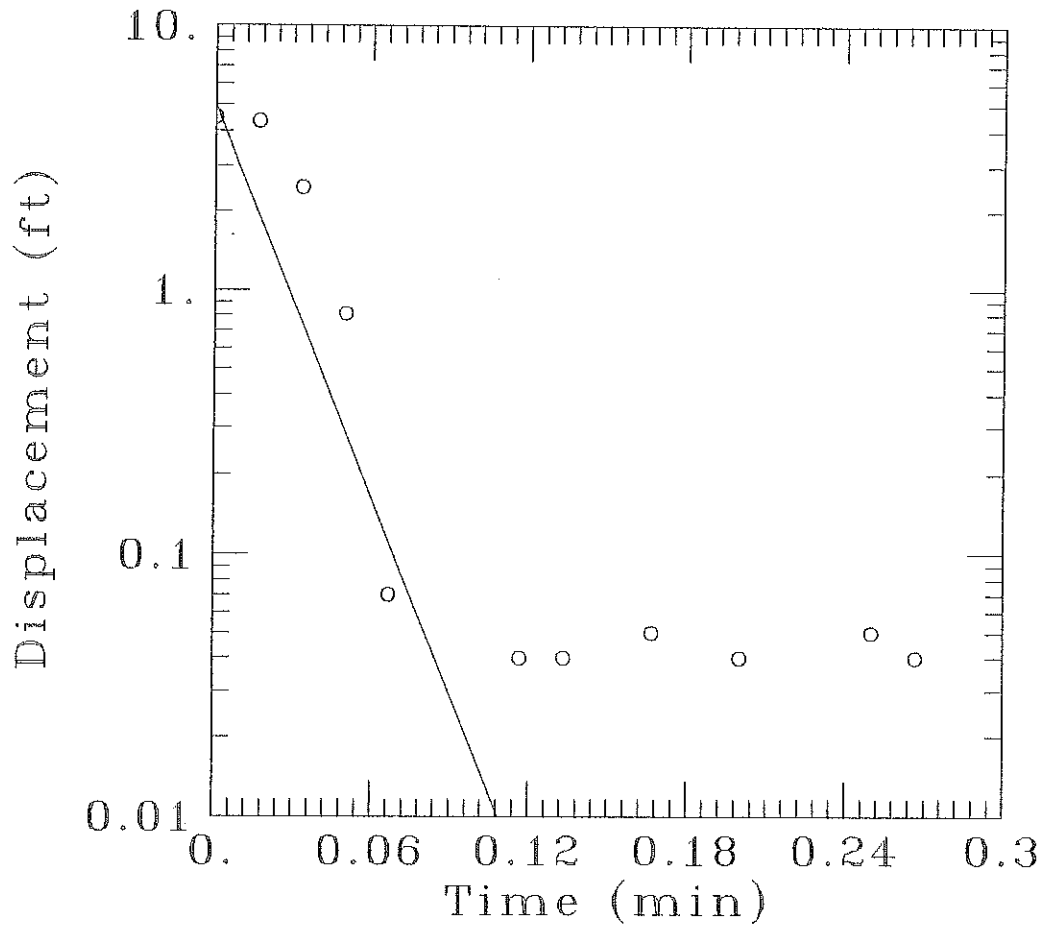
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-5
OBS. WELL:
P-5

ESTIMATED PARAMETERS:
K = 0.01849 ft/min
y0 = 2.835 ft

TEST DATA:
H0 = 2.32 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 11.1 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-6 SLUG-IN TEST



DATA SET:
p6in
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-6

OBS. WELL:
P-6

ESTIMATED PARAMETERS:
K = 0.04514 ft/min
y0 = 5.012 ft

TEST DATA:
H0 = 4.52 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 12.64 ft

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.

Hydrogeologic & Environmental Consulting

June 20, 2007

Eng. Antonio Hernandez Virella, President
AHV & Associates, Inc.
Buzon 1480, Bo. Espinar
Aguada, Puerto Rico 00602

RE: Hydrologic Assessment of Proposed Discovery Bay Marina
Espinar Ward, Aguada, Puerto Rico

Dear Eng. Hernandez:

INTRODUCTION

Hydro-Environmental Associates, Inc. (HEA) was retained by AHV & Associates, Inc. (AHV) to conduct a Hydrologic Assessment of the proposed Discovery Bay Marina Development, located in Espinar Ward, Aguada, Puerto Rico. The goal of the assessment was to address potential impacts to the groundwater quality resulting from the construction of a proposed inland marina basin, which is to extend approximately 3,900 feet inland from the existing Mean Low Water (MLW) line of the Aguadilla Bay. The excavated basin elevation is proposed to range from eight (8) to 14 feet below MLW, and the existing land surface within the proposed inner harbor area ranges from Mean Sea Level (MSL) near the coast to approximately ten feet above MSL. The Hydrologic Assessment is based upon existing information, and supplemented by a geophysical and test drilling exploration program.

PROJECT DESCRIPTION

The Discovery Bay Marina development project includes a proposed marina for berthing of up to 500 medium sized boats. The marina includes an approximate 200-foot wide entrance and navigation channel, turning basins and berthing facilities totaling approximately 60 acres. The basin will extend from the coastline, near the mouth of the Madre Viega Creek, inland approximately 3,900 feet, terminating near the intersection of Route PR-115. The proposed marina will require the excavation of surface soils to an estimated elevation of eight (8) to 14 feet below MSL. The surface soils excavated are anticipated to be used as fill material for the residential development and proposed levees. Portions of the subject site and proposed basin area are currently being used as an active sand mine. The subject site is located on the northwest coast of the island of Puerto Rico. Portions of the inland marina are proposed to be constructed using concrete and/or steel sheet pile for a retaining wall.

REGIONAL GEOGRAPHIC SETTING

The subject site lies within the alluvial deposits immediately north of the Rio Culebrinas, south and west of the Cordillera Jaicoa and the Madre Vieja Creek, and east of the Aguadilla Bay. Both the Rio Culebrinas and Madre Vieja Creek flow in a general westerly direction, bisecting the Cordillera Jaicoa, and discharging into the Atlantic Ocean. The subject site is within the flood plain of the Rio Culebrinas and the Madre Vieja Creek. A branch of the Madre Vieja Creek originates from the Rio Culebrinas approximately one-mile east of the subject site. The Cordillera Jaicoa is incised by the Rio Culebrinas, and becomes highly eroded along the south side of the incision. Geographic features in the vicinity of the subject site consist of coastal beach deposits, alluvial sediment, and karst uplands. This area is specifically detailed on the Geologic Map of the Aguadilla Quadrangle.

The coastal beach deposits form an almost continuous north-south trending ridge between Tamarindo on the north to Rincon on the south. This ridge is roughly sub-parallel to the coastal shoreline and terminates approximately 400 feet inland from the coast. Inland from the shallow ridge is an area of salt water swamps and mangroves. The topography of the subject site is relatively flat and ranges from MSL at the coast to approximately 10 feet above mean sea level (MSL) further inland. The past land use within the subject site was for sugar cane fields. With the exception of the sand mining area, the subject site is currently undeveloped.

PREVIOUS SITE INVESTIGATIONS

Initial site investigations were conducted by Foundation Engineering, Inc. during June 1998, and by Advanced Soil Engineering, Inc. (ASE) during February 2002. The work conducted by ASE consisted of advancing eight (8) soil borings throughout the site to depths ranging from 40 feet to 100 feet. Soil samples were collected and grain size analyses were conducted. Alluvial sediments, consisting of sands, silts, and clays were identified at each boring location to the total depths. 12 Additional geotechnical soil borings were conducted during May 2007 by ASE. The soil borngs were advanced to depths ranging from 40 to 100 feet. The main purpose of these geotechnical borings were to define the stratigraphy in the vicinity of the proposed sheet pile areas. A copy of the soil boring logs, as prepared by ASE are included as Appendix A.

During June 2005, HEA was retained by AHV to conduct a groundwater flow analysis of the proposed inland marina. In order for the marina to sustain a healthy aquatic environment, proper water circulation and tidal flushing is required. Due to limitations in the shape of the property, the proposed marina configuration may limit the natural circulation and flushing of seawater. Based upon site observations made during dewatering of the sand mine, it was apparent that a significant component of marina water circulation was obtained from groundwater flow discharging from the shallow aquifer within the groundwater basin of the proposed marina. The Scope of Service for this project included a preliminary evaluation of the possible ranges of flow within the surficial aquifer based upon regional soil characteristics, followed by a field investigation to determine the hydraulic

conductivity of the surficial aquifer within the basin area, and groundwater flow modeling to more accurately evaluate the rate and volume of groundwater flow contribution to the proposed marina basin. This study was based on limited field data.

The results of this study indicated that the average rate of total groundwater inflow into the proposed marina basin is approximately 2.44 million gallons per day (MGD), while maintaining the water level in the marina basin at mean sea level. Approximately 33 percent of this total flow would be generated from the base of the surficial aquifer. The report indicated that the freshwater flow into the marina basin would offset any significant salt water intrusion from the excavation. A complete copy of this report is included as Appendix B.

During December 2005, JFA Geological and Environmental Scientists, P.S.C. (JFA) conducted geophysical electrical resistivity profiling and subsurface sampling within the subject site. The objective of this investigation was to characterize the coastal hydrogeologic conditions and to estimate the configuration of the saltwater/freshwater interface underlying the western portion of proposed project site. In addition to the electrical resistivity profiling, a total of five (5) monitoring wells were installed to a depth of 50 feet. The monitoring wells were located along the western portion of the study area, near the coast. These wells are identified as WB-1 through WB-5.

The results of this study indicated that a 60 to 80 foot thick freshwater aquifer underlain by brackish water extends from beyond the southern limit of the project area to about 900 feet inland from the coast. Brackish water was found to extend from about 900 feet inland to about 275 feet inland from the coast line. Salt water was found to be present from the coast inland to about 275 feet. The data also suggested that farther south of the study area, the alluvial valley may be dominated by a significantly thicker (<100 feet) layer of freshwater aquifer.

The results of this study indicated that adverse impacts from the proposed marina excavation on the quality of the overlying freshwater surficial aquifer shall be minimal. The effects were likely to be constrained to some inland influx of brackish water within the northern half of the marina basin. In addition, the report stated that the proposed excavation would be limited to approximately 18 percent of the freshwater thickness, and that salt water intrusion shall be naturally controlled by the thickness of the freshwater aquifer and by inherent differences in density between the freshwater and saltwater layers. A complete copy of the JFA Geophysical Report is contained in Appendix C.

During April 2007, as support for this study, JFA advanced a total of five (5) additional monitoring wells. These monitoring wells were installed to depths ranging from 50 to 150 feet, and are identified as WB-6 through WB-10. Monitoring well WB-10 was installed as a background well. In situ groundwater sampling was also conducted to determine the water quality at various depths. The monitoring wells were located further inland than the previous monitoring wells, in an attempt to identify the depth of the salt water/freshwater interface. The JFA report also included a

generalized geologic cross-section throughout the proposed marina area. Appendix D contains a complete copy of the JFA Additional Drilling and Sampling Report, and includes monitoring well installation reports. Figure 1 shows the locations of all existing monitoring wells throughout the subject site.

GEOLOGIC FRAMEWORK

Based upon the previous investigations, three principal geologic units are identified within the subject site. These hydrogeologic units consist of 1). the unconsolidated deposits of Quaternary age lying within the Rio Culebrinas and Madre Vieja Creek valleys, 2). deposits of the basal San Sebastian Formation, and 3). the carbonate platform strata of the Cibao Formation.

The study area is typically underlain by Recent (Quaternary) age unconsolidated alluvial sediments generally consisting of an upper clayey sand and sandy clay. Swamp deposits consisting of sandy organic muck and peat have also been mapped on the northernmost area of the site. Underneath the upper sandy clay layer is a layer of cross bedded quartz sand and shell, with minor amounts of pebbles and cobble of volcanic rock. A consistent stiff gray alluvial silty clay layer has been identified underlying the surficial sands. The gray silty clay was identified at depths ranging from about 50 to 70 feet.

Underlying the Quaternary alluvial deposits is the San Sebastian Formation of Tertiary age. Within the subject site, the San Sebastian Formation consists of alternated clay, sandy clay, very fine sand, and soft clay lenses. Due to the depth, the San Sebastian Formation was only identified at the location of monitoring well WB-9.

Near the eastern limit of the subject site, at the location of monitoring well WB-10, the Cibao Formation of Tertiary (Miocene) age was identified. The Cibao Formation is composed of a calcareous clay and clayey sand with occasional clay lenses. It is thought that the Cibao Formation pinches out along the eastern extent of the subject site, near the location Route PR-115. It is thought that volcanic basement rocks underlie the San Sebastian Formation and Cibao Formation, however, direct drilling has not been conducted to confirm this assumption.

HYDROGEOLOGY

There does not appear to be a major source of groundwater within the subject site or in the vicinity of the subject site. Potable water is obtained from the Rio Culebrinas upstream of the site and is piped via an aqueduct system for the Espinar and Aguadilla areas. The aqueduct system is maintained by the Puerto Rico Aqueduct Storage Authority (PRASA). The only aquifer within the subject site and vicinity is a limited surficial aquifer. Based on our review of on-site lithologic data, the surficial aquifer is estimated to be approximately 50 - 60 feet in thickness across the subject site

and consists of quartz sand, shell fragments, and pebbles and cobble of volcanic rock.

Below a depth of 60 feet, a stiff to very stiff gray clay was encountered at the deep soil boring locations. These clays probably form the base of the Quaternary alluvial sediments. This clay would represent a confining layer, preventing the upward or downward movement of water from the surficial aquifer.

Underlying the Quaternary alluvial deposits is the San Sebastian Formation. The San Sebastian Formation, due to the lithology, is also a confining layer, preventing the upward or downward movement of water from the surficial aquifer. As discussed above, it is expected that volcanic basement rock underlies the San Sebastian Formation. It is suspected that the Cibao Formation, which was identified at the location of upgradient monitoring well WB-10, pinches out near the eastern portion of the subject site. The Cibao Formation, which is mainly composed of a calcareous clay, is also a confining layer, preventing upward, downward or lateral groundwater flow.

The recharge to the surficial aquifer is from predominately precipitation and infiltration from the Rio Culebrinas basin. Average precipitation in the area ranges from 60 to 70 inches per year (USGS, 1984). The persistent easterly and southeasterly tradewinds contribute to produce precipitation throughout the year, although seasonal variations occur. Due to the excessively high rates of evaporation, evapotranspiration, and runoff, only a relatively small amount of the precipitation is available for recharge to the aquifer.

Well Inventory

A well inventory was conducted by representatives of JEA during May 2007. The well inventory included review of the US EPA and Puerto Rico DNER water well databases and supplemented with a windshield survey within 1/2 mile of the subject site. The DNER database is a listing of all permitted wells within the study area, and US EPA database includes a map showing the locations of inventoried wells within the study area.

Based on a windshield search and review of the USEPA and DNER databases, there are no potable wells located within a ½ mile vicinity of the subject site. The USEPA database did identify four (4) water wells within the study area, however, upon further review, two (2) were identified for industrial use only, one was probably a hand dug well that is no longer in service, and the fourth well was actually a spring, which is identified as Ceide Spring on the US EPA map. The spring is located about ¼ mile east of the marina, east of Route PR-2. The two (2) industrial wells were identified as Aguadilla Cement #1 and #2, and are also located about ¼ mile east of the subject site to the west of Route PR-2. The last well is identified as the Julio Allende well. This well could not be located in the field, and is plotted within the Espinar Ward on the EPA database map. Due to the proximity of this well to the coastline, it would be either a very shallow hand dug well or a saltwater

well, if the well, in fact, does exist. Based on review of the Puerto Rico DNER database, there are no permitted wells located within ½ mile of the subject site.

Water Level Elevations

On May 9, 2007, during initial water quality sampling, a complete round of water level measurements were obtained within the ten (10) existing monitoring wells. An additional round of water level measurements was obtained on May 18, 2007 during monitoring well sampling. The depth of the groundwater was measured in each of the monitoring wells using an electronic water level indicator that indicates when a probe is in contact with the groundwater in the well. Measurements were obtained by lowering the tip of the probe into the well until it indicated that the water surface had been encountered and by measuring the distance from the top of the inside riser pipe to the probe. All of the measurements were recorded to the nearest 0.01-foot. In order to obtain the groundwater elevations, all water level measurements were subtracted from the individual top of casing elevations. The top of casing elevations were established by a Registered Land Surveyor and the data presented to HEA.

The results of the groundwater measurements from the May 9, 2007 field event indicated that the water level depths ranged from 2.63 to 10.41 feet below ground surface, with resultant groundwater elevations ranging from -0.94 to 6.96 feet NGVD. The general inferred direction of groundwater flow is to the northwest across the site discharging into Aguadilla Bay.

The results appear to indicate that the surficial aquifer water levels may be temporarily influenced by local sand mine dewatering due to heavy rains that had occurred during the measurement period. There is a cone of depression in the water level surface in the vicinity of the ongoing sand mining operations. Based on the water level readings, dewatering due to sand mining has lowered the surficial aquifer to as much as 5.5 feet below MSL. A summary of the groundwater measurements and elevations are presented on Table 1 of this report, and a water level contour map, showing the interpretations of the general direction of groundwater flow based on the May 9, 2007 water level readings, are presented in Figure 1.

Permeability Testing and Groundwater Flow Analysis

During the June 2005 study by HEA, single well aquifer tests were performed on six (6) monitoring wells to determine the in-situ intrinsic hydraulic conductivity (permeability) values within the surficial aquifer. The complete report presenting the results of the permeability tests are included in Appendix C of this report.

The hydraulic conductivity values derived from the on the in-situ slug tests conducted on the six monitoring wells ranged from approximately 26 to 62 feet per day (ft/d) and averaged approximately

45 ft/d. This average hydraulic conductivity value appears to be representative for the soils comprising the surficial aquifer at the site. Some variability of hydraulic conductivity values between the monitoring well locations suggests some heterogeneity within the surficial aquifer at the site. The heterogeneity would be expected in the alluvial deposits comprising the surficial aquifer.

The average hydraulic conductivity data obtained for the upper portion of the surficial aquifer, coupled with the measured hydraulic gradient and assumed porosity for sandy soils were used to determine the lateral groundwater flow velocity for the site. The horizontal groundwater flow velocity was calculated based on the following equation:

$V = Ki/n$

Where:

V = average linear velocity :	0.36 ft/day
K = hydraulic conductivity :	45.0 ft/day
i = hydraulic gradient :	6.96 feet / 4,400 feet = 0.0016 feet per foot
n = porosity :	0.20

Entering the variables obtained from the field investigation into the equation, the lateral groundwater flow velocity for the upper surficial aquifer averages approximately 0.36 feet per day or about 130 feet per year in a northwesterly direction discharging into Aguadilla Bay. Please note, however, that this groundwater flow velocity represents an average hydraulic gradient. The above estimates for groundwater flow velocity would only apply to the fraction of dissolved contamination with densities equal to that of freshwater.

SALINE WATER INTRUSION

Since saline water is denser than freshwater, it has a tendency to move under the freshwater. Conversely, since freshwater is lighter than seawater, it has a tendency to move over seawater. Seawater is approximately 2.5 percent denser than freshwater, so that a freshwater head of 10.25 feet is required to overcome each 10.0 feet of salt water head. According to the Ghyben-Herzburg relationship, if the water table in an unconfined coastal aquifer is one-foot above MSL, the saltwater/freshwater interface will be located at a depth of approximately 40 feet. In reality, there tends to be a mixing of salt water and freshwater in a “zone of diffusion” around the interface. The zone of diffusion results from a complex system of mixing of the salt water and freshwater. The size

of the zone of diffusion is controlled by the dispersive characteristics of the geologic strata (Freeze & Cherry, 1979).

The saltwater interface is the contact zone between freshwater and saltwater. Under natural conditions, the boundary between freshwater and saltwater in coastal regions depends on the balance of forces in a dynamic system that can create a contact zone that varies in thickness. Normally, freshwater moves seaward at a rate that is related to the head above sea level in the freshwater aquifer. Saltwater intrusion results when freshwater heads decrease and saltwater migrates inland. Generally, the location of the saltwater interface approaches land surface near the coast and increases in depth landward. Freshwater and saltwater mix within the zone of diffusion, but the locations of the interface and the diffusion zone are not stationary—they are in dynamic equilibrium, moving laterally and vertically depending on the head and movement of freshwater in the aquifer.

The position of the saltwater interface within the ground-water system is typically identified and delineated by chloride concentrations, total dissolved solids (TDS) concentrations, and specific-conductance ranges (Tihansky, 2004). Salinity as described in this report is based on the following ranges of chloride concentrations of: freshwater, from 0–250 milligrams per liter (mg/L); slightly saline water, from greater than 250–3,000 mg/L; moderately saline water, from greater than 3,000–10,000 mg/L; very saline water, from greater than 10,000–19,000 mg/L; and seawater, in excess of 19,000 mg/L.

For this report, chloride concentrations, TDS, and specific conductance are used to delineate saltwater and to indicate mixing. Saltwater (seawater) is defined as water having at least 19,000 mg/L chloride, a TDS concentration of at least 34,000 mg/L, or specific conductance value of at least 50,000 micro Siemens per centimeter (µS/cm). Freshwater is defined as water having a chloride concentration of 250 mg/L or less, and TDS of 500 mg/l or less, or specific conductance value of less than 1,000 µS/cm. The area in which the water quality falls between freshwater and saltwater is defined as the zone of diffusion. Because chloride, TDS and specific conductance values vary widely in this zone, the chloride concentration commonly is measured to delineate where water becomes nonpotable. The 250-mg/L isochlor is typically used as the saltwater interface because this is the boundary where chloride concentrations exceed the US EPA maximum drinking water contaminant level. Ground water containing approximately 1 percent seawater can increase chloride concentrations to the US EPA's maximum potable limits. Within the study area, the 250-mg/L isochlor generally corresponds to a specific conductance value of 1,000 µS/cm (which is TDS concentration less than 1,000 mg/L). Moderately saline water, with specific conductance values greater than 10,000 µS/cm, and chloride concentrations greater than 1,000 mg/L, indicates a predominant influence of seawater.

In this report, both the 10,000-µS/cm specific conductance isoline and the 250-mg/L isochlor have been mapped to delineate the limits of the saltwater/freshwater interface, although they each

represent varying levels of saline water present in the ground water within the study area. Water exceeding 250 mg/L of chloride is considered nonpotable and, therefore, represents the upper boundary of the saltwater interface. Where specific conductance of ground water exceeds 10,000 µS/cm in the study area, ground water becomes moderately saline and indicates that saltwater is likely influencing ground-water chemistry.

RESULTS

Specific Conductivity Mapping

Specific conductivity was measured from the ten (10) monitoring wells initially at two (2) and five (5) foot depth intervals initially on May 3, 2007, on May 9, 2007 during initial groundwater sampling, and on May 17 – 18, 2007 during groundwater sampling. The specific conductivity readings were used to determine the sampling depths from each monitoring well. Specific conductivity is a measurement of the ease at which an electric current passes through the water, therefore, the higher the degree of mineralization, the higher the specific conductivity. Specific conductivity of groundwater can be correlated directly with chloride concentrations and TDS to establish the limits of the saltwater/freshwater interface. Specific conductivity readings were obtained throughout the entire depth of each monitoring well to estimate the horizontal and vertical limits of the saltwater/freshwater interface at each well location.

Based on the results of the specific conductivity readings, very saline water was identified at the locations of WB-5, WB-1 and WB-2, which are the nearest monitoring wells to the coastline. The specific conductivity ranges from these three (3) monitoring wells ranged from 17,000 to 35,500 uS/cm. At the location of monitoring well WB-3, the specific conductivity readings varied from slightly saline near the surface of the water table to very saline near the bottom of the well. The specific conductivity readings ranged from 1,140 uS/cm near the surface of the water table to 35,500 uS/cm at a depth of 45 feet. Based on this data, the saltwater/freshwater interface would extend to the land surface inland approximately 1,000 feet east of the shoreline.

There appear to be two (2) small lenses of fresh water (based upon the specific conductivity values) located within the central portion of the proposed marina basin. The freshwater lenses are defined by the specific conductivity from monitoring wells WB-4, WB-6, and the upper zone of WB-8. The depths of the freshwater lenses are estimated to be between 30 feet and 60 feet in depth based upon the monitoring well data. Between the two (2) freshwater lenses, there appears to be a small area defined as slightly saline. Slightly saline water was identified at the location of monitoring well WB-7. WB-7 is located approximately 2,200 feet inland from the coastline.

Further inland from monitoring well WB-8, the water quality of the upper surficial aquifer becomes very saline at the location of WB-9 and decreases to slightly saline at the location of monitoring well

WB-10. WB-10 was installed as a background monitoring well. Monitoring well WB-9 is located approximately 3,100 feet inland from the coastline and monitoring well WB-10 is located approximately 4,400 feet inland from the coastline. The specific conductivity from monitoring well WB-9 ranged from 25,000 to 30,000 uS/cm, and from the background well WB-10 from 4,000 uS/cm to 5,600 uS/cm.

The small lenses of freshwater located within the central portion of the subject site may be due to inducing fresh surface water from the Madre Vieja Creek and direct recharge from rainfall laterally through the groundwater from mine dewatering operations. Figure 2 presents s cross section showing equal concentrations of specific conductivity through the marina basin extending from the coastline inland to the east. The cross section depicts the location of the fresh water lenses, the area of slightly saline water, moderately saline and very saline water. The cross section also shows the approximate limits of the surficial aquifer throughout the subject site. The May 2007 report prepared by JFA, as presented in Appendix D, includes the specific conductivity data from the monitoring wells.

Chloride Concentration Mapping

Chloride concentrations were obtained near the top and bottom of each monitoring well, based upon review of the initial specific conductivity readings. Chloride concentrations were obtained during the groundwater sampling event conducted on May 17 – 18 2007. Based on the results of the chloride concentrations, very saline water was identified at the locations of WB-5, WB-1 and WB-2, which are the nearest monitoring wells to the coastline. These results are consistent with the specific conductivity readings. The chloride concentrations ranged from 5,919 to 12,010 mg/l. At the location of monitoring well WB-3, the chloride concentrations varied from slightly saline near the surface of the water table to moderately saline near the bottom of the well. The chlorides ranged from 838 mg/l near the surface of the water table to 2,200 mg/l at a depth of 45 feet. Based on this data, the saltwater/freshwater interface would extend to the land surface inland approximately 1,000 feet east of the shoreline.

Based on the chloride concentrations, a single lens of freshwater was detected at the locations of monitoring well WB-4, WB-6, WB-7, and the upper portion of WB-8. Chloride concentrations ranged from 26 mg/l to 169 mg/l at the sample locations. The depth of the freshwater lens extends to approximately 60 feet, based upon the results of a grab sample collected at a depth of 70 feet using the Geoprobe sampler at the location of WB-7. The result of the chloride analyses from the Geoprobe sample was 4,669 mg/l, which would represent a moderately saline groundwater.

The results of the samples from WB-9 and the background well WB-10 detected moderately saline to very saline concentrations of chlorides, also similar to the specific conductivity readings. Chloride concentrations from monitoring well WB-9 ranged from 3,884 mg/l near the surface of the water

table to 4,403 mg/l, and from the background well WB-10 from 1,349 mg/l to 1,779 mg/l. Figure 3 presents a cross section of equal chloride concentrations through the marina basin extending from the coastline inland to the east, and Figure 4 presents a map showing the chloride distribution at a depth of ten (10) feet, which is above the proposed marina excavation depth. Table 2 presents a summary of the chloride and TDS data collected during the May 17 – 18, 2007 groundwater sampling event.

Total Dissolved Solids Mapping

TDS concentrations were also obtained during the sampling of the ten (10) monitoring wells. TDS concentrations closely followed the specific conductivity and chloride concentrations. Based on the results of the TDS concentrations, very saline water was identified at the locations of WB-5, WB-1 and WB-2, which are the nearest monitoring wells to the coastline. The TDS concentrations ranged from 12,747 to 20,101 mg/l. At the location of monitoring well WB-3, the TDS concentrations varied from slightly saline near the surface of the water table to moderately saline near the bottom of the well. The TDS ranged from 1,749 mg/l near the surface of the water table to 4,239 mg/l at a depth of 45 feet. Based on this data, the saltwater/freshwater interface would extend to the land surface inland approximately 1,000 feet east of the shoreline, similar to the chloride and specific conductivity readings.

Similar to the specific conductivity readings, two (2) lenses of freshwater were identified from the TDS concentrations. These two (2) lenses were identified based upon the TDS concentrations from monitoring wells WB-4, WB-6, and the upper portion of WB-8. TDS ranged from 385 mg/l to 493 mg/l at the sample locations. Between the two (2) freshwater lenses, there appears to be a small area defined as slightly saline. Slightly saline water was identified at the location of monitoring well WB-7. TDS ranged from 619 mg/l to 694 mg/l at the WB-7 location. According to the Geoprobe sample collected at the location of WB-7 at a depth of 70 feet, the depth of the freshwater lens extends to approximately 50 – 60 feet. The result of the TDS analyses from the Geoprobe sample was 11,547 mg/l, which would represent a very saline groundwater.

The results of the samples from WB-9 and the background well WB-10 detected moderately saline to very saline concentrations of TDS, also similar to the chlorides and specific conductivity readings. TDS concentrations from monitoring well WB-9 ranged from 6,213 mg/l near the surface of the water table to 16,138 mg/l, and from the background well WB-10 from 2,689 mg/l to 3,468 mg/l. Figure 5 presents a cross section of equal TDS concentrations through the marina basin extending from the coastline inland to the east.

Comparison With Previous Geophysical Study

Along the western portion of the proposed marina basin area (toward the coastline), the results of this project compares favorably with the results of the previous electrical resistivity profiling that was conducted by JFA during 2005. The location of the freshwater/saltwater interface at the groundwater surface was comparable, and the slope of the interface was consistent near the coastline. However, the 2005 study implied that a 60 – 80 foot thick freshwater zone extends beyond the southern and eastern limits of the proposed marina basin. This report also indicated that the saltwater layer dips abruptly downward near the eastern limit of the marina. It should be noted, however, that the previous study was very limited in the collection of groundwater samples within the upper limits of the proposed marina basin.

Based on the direct drilling and sampling conducted during this study, it appears that saline groundwater has intruded into the upper surficial aquifer near the southern and eastern limits of the proposed marina basin. The chloride, TDS, and specific conductivity readings from monitoring wells WB-9 and WB-10 indicate that slightly to moderately saline groundwater is encountered at the groundwater surface at these two (2) monitoring well locations. Monitoring well WB-10 was installed as the background well. The results also indicate that very saline groundwater is encountered below a depth of 70 feet from monitoring well WB-9. The background well indicated either slightly or moderately saline groundwater through the entire depth interval, depending on which parameter is used to define the limits of salinity. Fresh water was not encountered at either of these monitoring well locations.

GROUNDWATER IMPACTS OF PROPOSED MARINA

The Discovery Bay inland marina is proposed to be excavated to a depth of approximately eight (8) to 14 feet below MLW. Based on the results of the geotechnical borings, the bottom of the basin would not extend to, or penetrate the top of the clay confining layers separating the surface sands from the underlying basal units. The existence of the clay confining layers would retard and limit the downward migration of saline water from the marina excavation into the underlying basal units. In addition, due to the concrete and/or steel sheet pilings that are planned to encompass the western site of the marina, plus the higher hydraulic head in the surficial aquifer would limit the easterly (inland) advancement of the saline water wedge to only within the footprint of the proposed inland marina basin.

Based upon data presented in this study, very saline water has already migrated inland from the coast an approximate distance of 1,000 feet. Slightly and moderately saline water has also migrated within the central portion of the site upgradient to at least the location of background well WB-10. Therefore, the upgradient limits of the proposed marina basin have already been impacted by saline water intrusion. Based on various reports, the surficial sands within the area of the proposed marina are frequently inundated with sea water during heavy storms. However, due to the high permeability of the surficial sands, the saline water is flushed back into the sea by subsequent rainfall events,

leaving a residual groundwater quality that is slightly to very saline (chloride concentrations that range from 250 mg/l to 16,000 mg/l). It is believed that the thin lens of freshwater located in the central portion of the marina area is due to the temporary mine dewatering that is inducing surface water flow from the Madre Vieja Creek as well as direct recharge from rainfall laterally into the upper surficial aquifer within this portion of the site.

Based on the 2.5 percent density difference between saltwater and freshwater, if the seawater rises to an elevation of 10.0 feet, the freshwater head required to overcome the saltwater would be 10.25 feet. At MSL, the freshwater head required to overcome the saltwater would be only 0.025 feet. Under static conditions, the surficial aquifer water levels will range from 0.5 - 1.0 foot at or near the coastline to greater than 6.0 feet above MSL along the south and eastern portions of the marina. Therefore, the static head in the surficial aquifer is more than sufficient to overcome density differential from the salt water within the proposed inland marina basin. Precipitation within the groundwater basin, and infiltration from runoff from the Madre Vieja Creek and Rio Culebrinas would provide the source of water for recharge into the surficial aquifer in the area adjacent to the marina basin.

The results of the groundwater flow modeling that was conducted during 2005 indicated that an average of 2.44 million gallons per day of water from the surficial aquifer would be discharged into the proposed marina basin while maintaining the marina basin at MSL. The groundwater flow model assumed that there would be no concrete and/or steel sheet pilings to create a barrier to groundwater flow. In the areas where sheet pilings are included, the pilings would create a direct hydraulic barrier preventing the lateral migration of salt water. In the areas where sheet pilings are not used, the freshwater head in the surficial aquifer would create a positive flow of water from the surficial aquifer into the marina basin. As indicated in Figure 6, since there would be a positive head in the surficial aquifer, saline water intrusion would be limited to only the footprint of the proposed marina basin and would not spread laterally away from the basin area, either with or without the pilings.

However, there would be some slight degradation in water quality from the surficial sands directly below the marina basin within the fresh water zone, located in the middle of the project area. The construction of the proposed marina basin would extend the wedge of saline water inland only within the lateral and inland limits of the proposed inland marina footprint. The concrete and/or steel sheet pilings encompassing the marina, plus the higher hydraulic head in the adjacent surficial aquifer would limit the easterly (inland) advancement of the saline water wedge to only within the footprint of the proposed inland marina basin. Figure 6 shows a Hydrogeologic schematic showing a cross section with the addition of the proposed marina. The expected lateral and vertical extent of water quality impacts are indicated on Figure 6 by comparing the locations of the before and after salt water/freshwater interfaces within the surficial sands. The water quality impacts are identified on Figure 6 as the potential interface transition zone.

CONCLUSIONS

Based upon the data presented for review, the following conclusions regarding the installation of the proposed inland marina can be made:

1). There is only one aquifer within the proposed inland marina area - a localized surficial aquifer composed of surface sands.

2). The surficial aquifer extends to a depth of approximately 60 – 85 feet below land surface.

3). The surficial aquifer is localized and is not utilized as a water supply source in the area.

4). The surficial aquifer contains very saline, moderately saline and slightly saline water, based upon frequent inundation by ocean water during heavy storms.

5). The surficial aquifer is underlain by a series of confining layers, identified as a stiff alluvial clay, clays and sandy clays of the San Sebastian Formation, and calcareous clays of the Cibao Formation, that separate the surficial aquifer from the underlying volcanic rock formations.

6). These clay layers would retard the downward and lateral migration of saline water from the inland marina.

7). Based on the static water levels, the general direction of groundwater flow is toward the northwest, discharging into Aguadilla Bay. Based on the average hydraulic gradient and hydraulic conductivity, the estimated rate of groundwater flow toward the sea is about 130 feet per year.

8). There appears to be cone of depression in the vicinity of the existing sand mine. The cone of depression is probably due to temporary mine dewatering. The cone of depression may be inducing fresh surface water from the Madre Vieja Creek and direct recharge from precipitation laterally through the surficial aquifer within the central portion of the site.

9). Saline water intrusion has been documented within the upper limits of the proposed marina basin, and the aerial extent has been mapped within the entire study area.

10). There is a small lens of fresh water extending through the middle of the proposed marina basin. The lens appears to be 50 – 60 feet in depth. Saline water has been identified both upgradient and downgradient, as well as vertically, of the lens of fresh water.

11). Due to the presence of the silt/clay confining units, and the existing saline water from the surficial aquifer, the proposed inland marina would not significantly influence the downward migration of saline water.

12). The concrete and/or steel sheet pilings encompassing the marina, plus the higher hydraulic head in the adjacent surficial aquifer would limit the easterly (inland) advancement of the saline water wedge to only within the footprint of the proposed inland marina basin.

13). There would be some slight degradation in the salinity from the surficial sands in the vicinity of the proposed inland marina. The degradation would be limited only to the immediate vicinity of the proposed inland marina footprint, and would likely not extend beyond the limits of the proposed inland marina.

QUALIFICATIONS AND LIMITATIONS

The opinions, results and conclusions presented represent our best judgement and understanding of the conditions at the time and based upon the information made available during the course of the assignment. These services have been performed in accordance with generally accepted standards of performance of this level of assessment. The majority of the information obtained was from publicly available sources and other secondary sources of information produced by entities other than HEA. Although great care has been taken by HEA in compiling and checking the information contained in this report to ensure that it is current and accurate, HEA disclaims any and all liability for any errors, omission or inaccuracies in such information and data, whether attributable to inadvertence or otherwise, and for any consequence arising therefrom. The data provided hereunder, neither purports to be nor constitutes legal or medical advice. It is further understood that HEA or any of its supporting entities makes no representations or warranties of any kind, including, but not limited to, the warranties of fitness for a particular purpose of merchantability, nor any such representations or warranties to be implied with respect to customer's, its employees', clients', or customers' use thereof. HEA or any of its supporting entities shall not be liable for any special, consequential or exemplary damages resulting, in whole or in part, from customer's use of the data in this report. Liability on the part of HEA and its supporting entities is limited to the monetary value paid for this report. The report is valid only for the geographical parameters specified in this report, and any alteration or deviation from this description will require a new report. This report does not constitute a legal opinion.

We appreciate the opportunity to provide AHV with our Hydrologic Assessment of the Discovery Bay Marina Development, and look forward to our continued assistance to you on this project. Should you have questions or comments regarding our assessment and conclusions, please do not hesitate to contact us at (813) 969-6995.

Sincerely,

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.

Kenneth C. Jones, P.G.
Principal

Attachments: References, Figures 1 through 6, Tables 1 and 2, Appendices A - D

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FIGURES

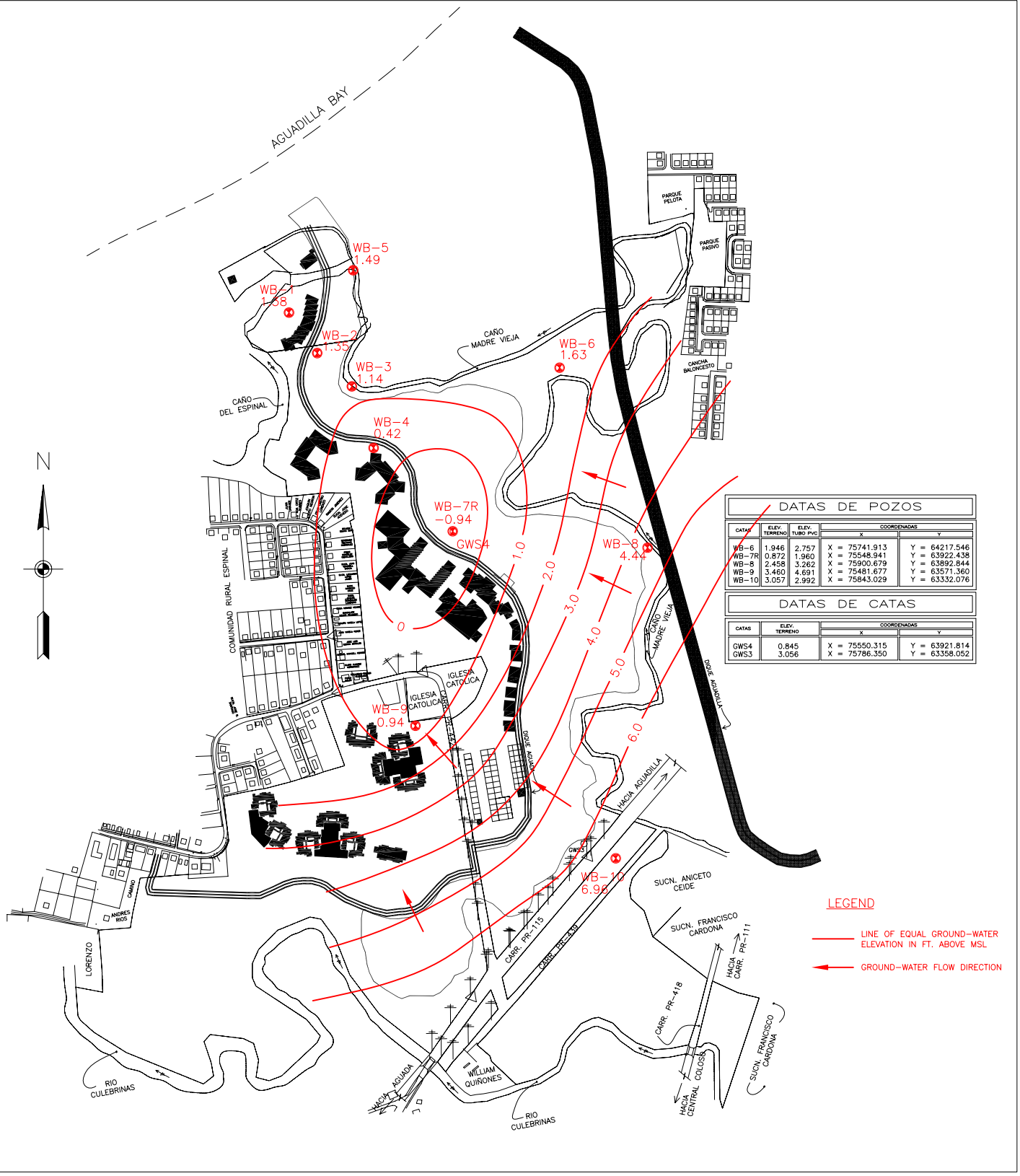
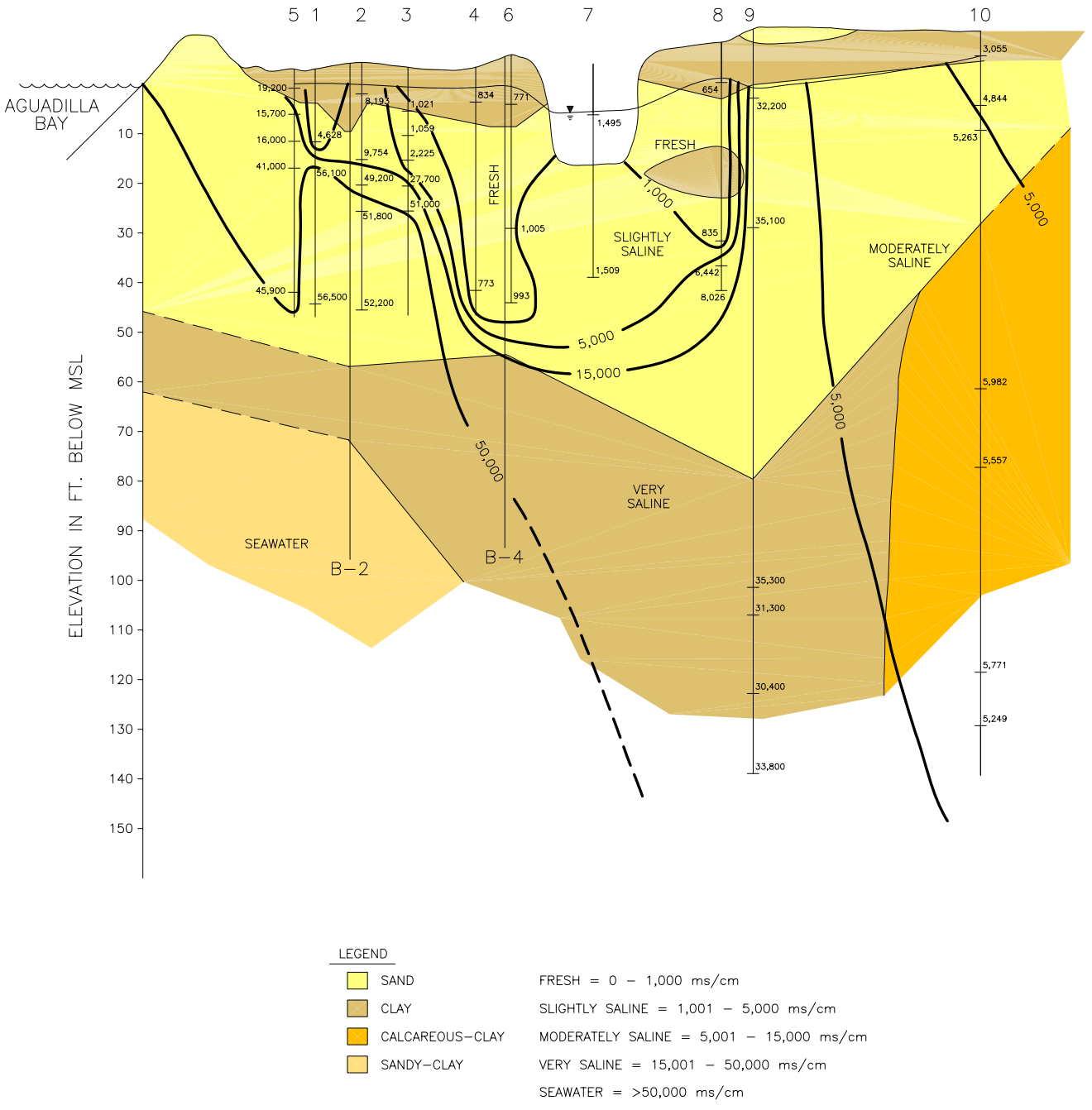


FIGURE 1 - GROUND-WATER FLOW DIRECTION MAP - 5/9/07
DISCOVERY BAY RESORT AND MARINA
ESPINAR WARD, AGUADA, PUERTO RICO

PREPARED FOR
CORDECO LAND SERVICES CORP.,
AGUADA, PUERTO RICO

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
(813) 969-6995



LEGEND

SAND	FRESH = 0 – 1,000 ms/cm
CLAY	SLIGHTLY SALINE = 1,001 – 5,000 ms/cm
CALCAREOUS–CLAY	MODERATELY SALINE = 5,001 – 15,000 ms/cm
SANDY–CLAY	VERY SALINE = 15,001 – 50,000 ms/cm
	SEAWATER = >50,000 ms/cm

FIGURE 2 -
SPECIFIC CONDUCTIVITY MAP
MAY 16 & 17, 2007
DISCOVERY BAY RESORT AND MARINA
ESPINAR WARD, AGUADA, PUERTO RICO

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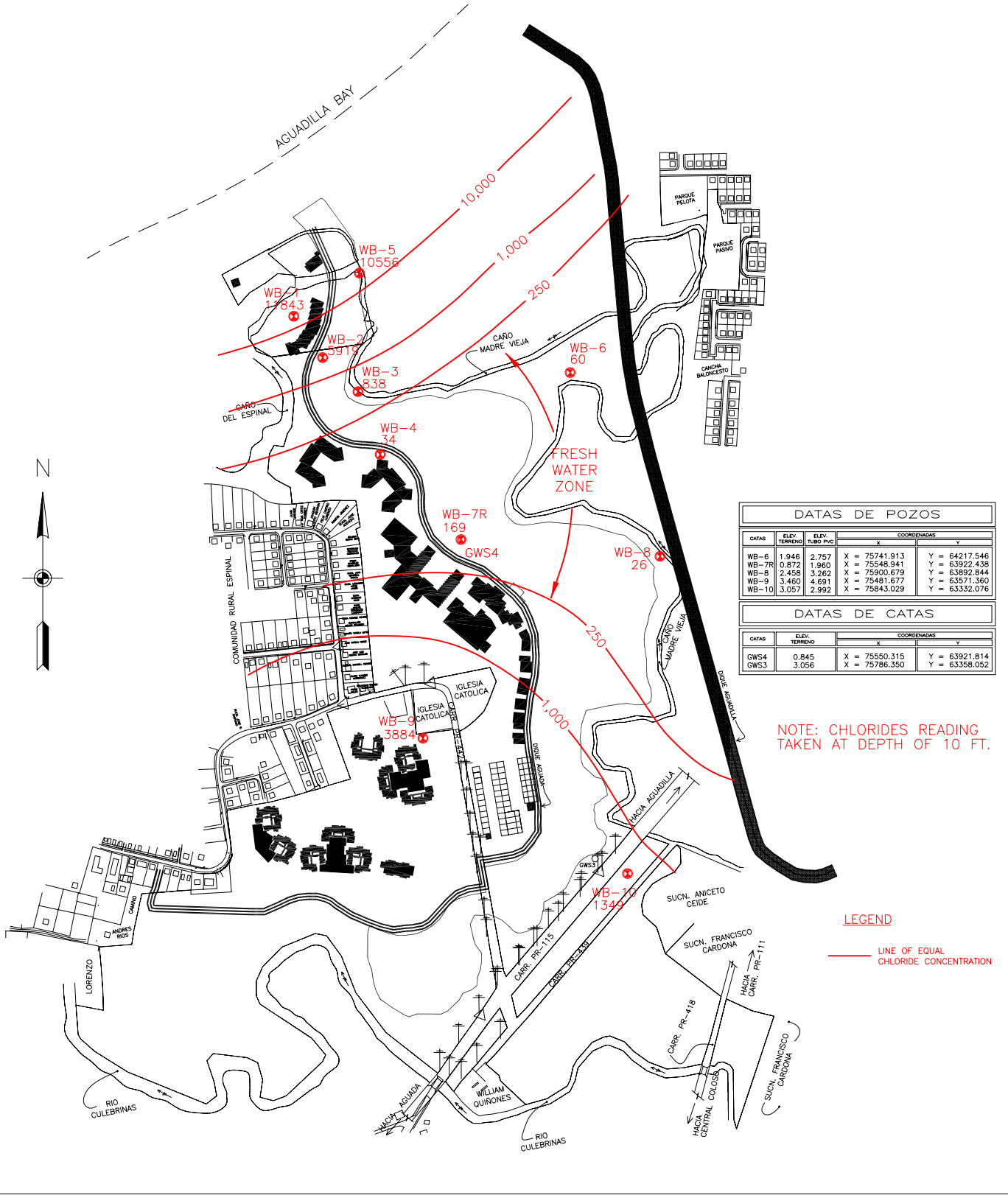
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
(813) 969-6995



DATAS DE POZOS

CATAS	ELEV. TERRENO	ELEV. TUBO PVC	COORDENADAS X	COORDENADAS Y
WB-6	1.946	2.757	X = 75741.913	Y = 64217.546
WB-7R	0.872	1.960	X = 75548.941	Y = 63922.438
WB-8	2.458	3.262	X = 75900.679	Y = 63892.844
WB-9	3.460	4.691	X = 75481.677	Y = 63571.360
WB-10	3.057	2.992	X = 75843.029	Y = 63332.076

DATAS DE CATAS

CATAS	ELEV. TERRENO	COORDENADAS X	COORDENADAS Y
GWS4	0.845	X = 75550.315	Y = 63921.814
GWS3	3.056	X = 75786.350	Y = 63358.052

NOTE: CHLORIDES READING TAKEN AT DEPTH OF 10 FT.

LEGEND

LINE OF EQUAL CHLORIDE CONCENTRATION

FIGURE 3 - CHLORIDE CONCENTRATION MAP
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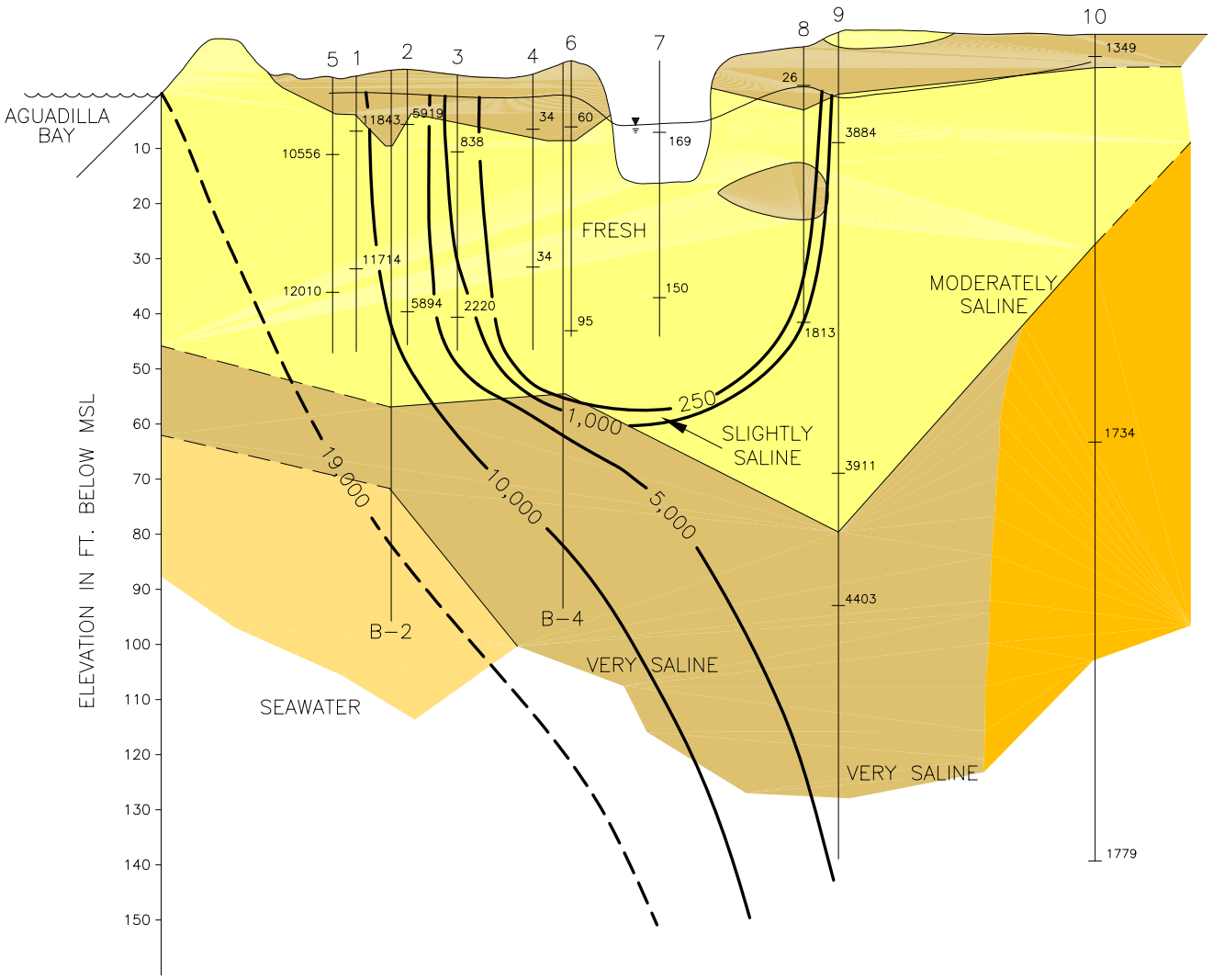
AGUADA, PUERTO RICO

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
(813) 969-6995



LEGEND

SAND	FRESH = 0 – 250 mg/l
CLAY	SLIGHTLY SALINE = 251 – 1,000 mg/l
CALCAREOUS–CLAY	MODERATELY SALINE = 1,001 – 5,000 mg/l
SANDY–CLAY	VERY SALINE = 5,001 – 19,000 mg/l
	SEAWATER = >19,000 mg/l

FIGURE 4 -
CHLORIDES MAP
DISCOVERY BAY RESORT AND MARINA
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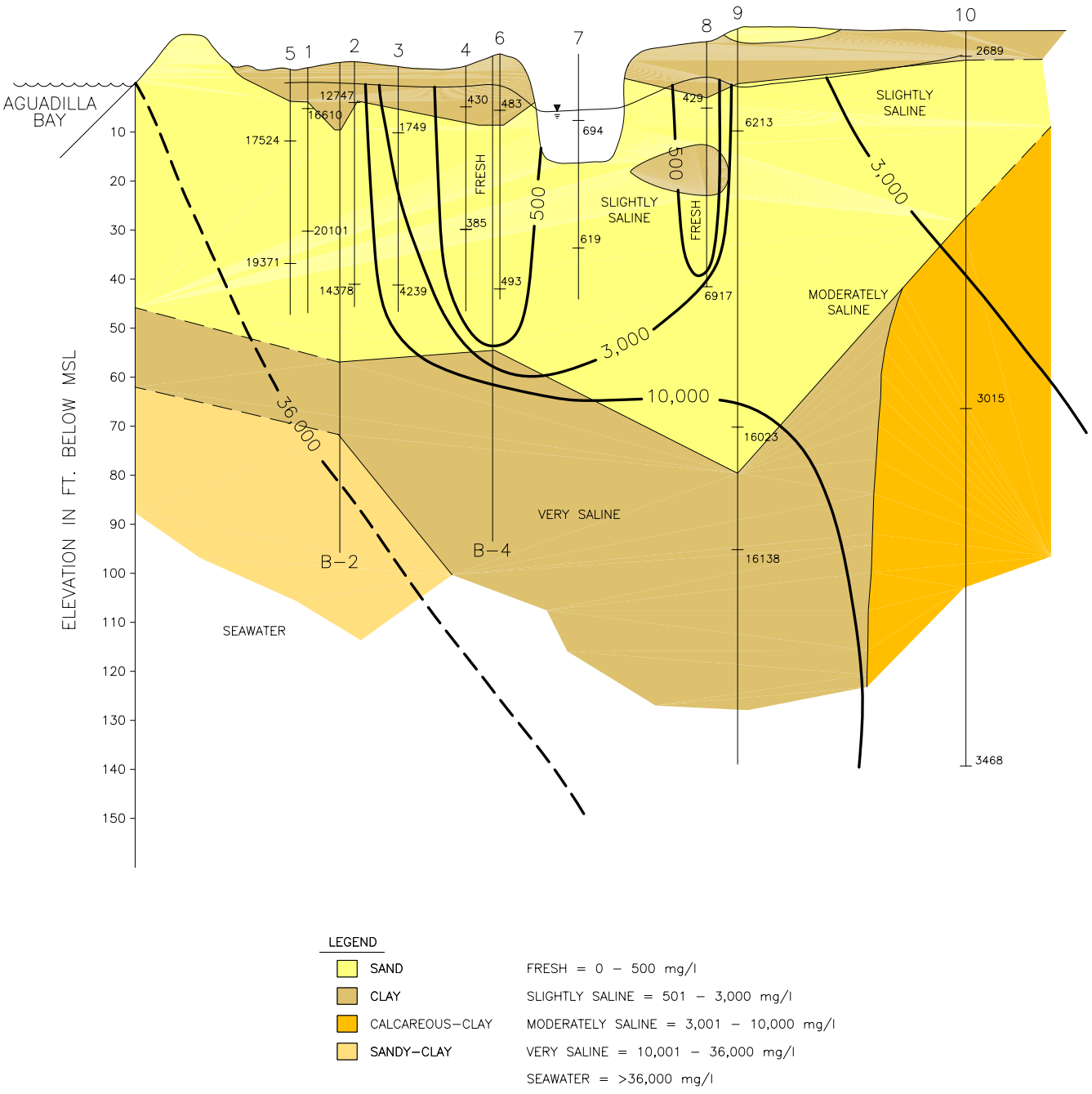

LEGEND

SAND	FRESH = 0 – 500 mg/l
CLAY	SLIGHTLY SALINE = 501 – 3,000 mg/l
CALCAREOUS–CLAY	MODERATELY SALINE = 3,001 – 10,000 mg/l
SANDY–CLAY	VERY SALINE = 10,001 – 36,000 mg/l
	SEAWATER = >36,000 mg/l

FIGURE 5 - TOTAL
DISSOLVED SOLIDS MAP
DISCOVERY BAY RESORT AND MARINA
ESPINAR WARD, AGUADA, PUERTO RICO

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AGUADA, PUERTO RICO

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ASSOCIATES, INC.
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
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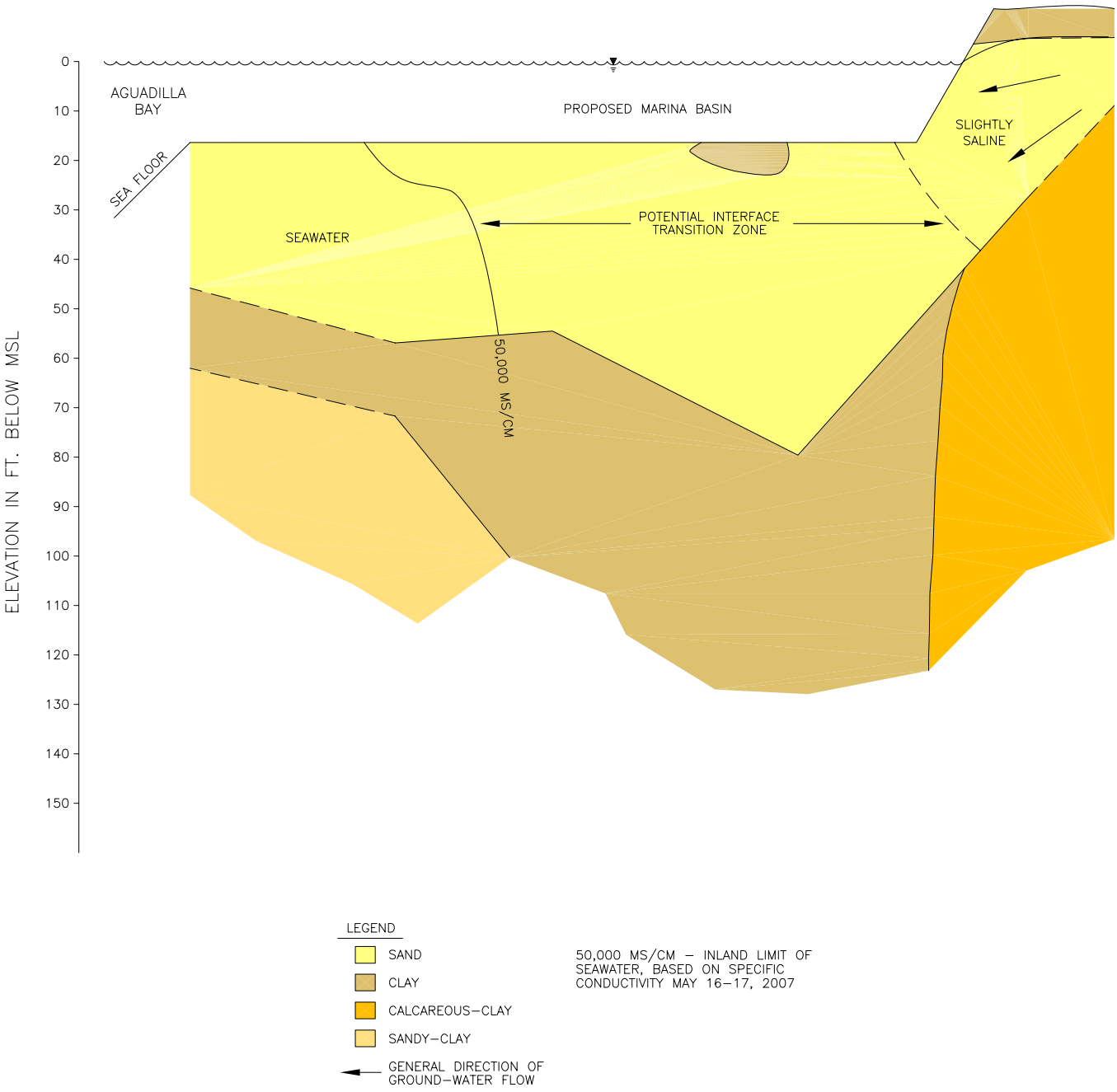

FIGURE 6 - GEOLOGIC CROSS-SECTION THROUGH MARINA AREA AFTER CONSTRUCTION
DISCOVERY BAY RESORT AND MARINA
ESPINAR WARD, AGUADA, PUERTO RICO

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CORDECO LAND SERVICES CORP.,
AGUADA, PUERTO RICO

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
(813) 969-6995

TABLES

TABLE 1: GROUNDWATER ELEVATION SUMMARY - MAY 2007

Proposed Discovery Bay Resort and Marina
Espinar Ward, Aguada, Puerto Rico

WELL ID NO.	BW-1	BW-2	BW-3	BW-4	BW-5
DIAMETER	2-inch	2-inch	2-inch	2-inch	2-inch
WELL DEPTH	47.50	47.50	47.50	47.50	47.50
SCREEN INTERVAL	2 - 47	2 - 47	2 - 47	2 - 47	2 - 47
TOC ELEVATION	5.75	7.21	5.94	5.87	6.39
GROUND ELEVATION	2.21	4.07	2.87	3.62	2.24

DATE	ELEV	DTW	ELEV	DTW	ELEV	DTW	ELEV	DTW	ELEV	DTW
5/9/2007	1.38	4.37	1.35	5.86	1.14	4.80	0.42	5.45	1.49	4.90
5/16/2007	0.35	5.40	0.31	6.90	0.04	5.90	-1.26	7.13	0.33	6.06
5/18/2007	0.21	5.54	0.37	6.84	0.08	5.86	-1.25	7.12	0.42	5.97

Note: Well WB-7 was replaced on May 14, 2007

WELL ID NO.	WB-6	WB-7R	WB-8	WB-9	WB-10
DIAMETER	1.5-inch	2-inch	2-inch	1.5-inch	1.5-inch
WELL DEPTH	50.00	50.00	50.00	150.00	150.00
SCREEN INTERVAL	5 - 50	5 - 50	5 - 50	5 - 150	5 - 150
TOC ELEVATION	9.04	6.43	10.70	15.39	9.81
GROUND ELEVATION	6.38	2.86	8.06	11.35	10.02

DATE	ELEV	DTW	ELEV	DTW	ELEV	DTW	ELEV	DTW	ELEV	DTW
5/3/2007	2.04	7.00	-2.67	9.10	4.72	5.98	0.49	14.90	7.02	2.79
5/9/2007	1.63	7.41	-0.94	7.37	4.44	6.26	0.94	14.45	6.96	2.85
5/16-17/2007	0.63	8.41	-5.49	11.92	3.38	7.32	-0.01	15.40	6.26	3.55
5/18/2007	0.64	8.40	-5.54	11.97	3.17	7.53	-0.01	15.40	6.06	3.75

TABLE 2: GROUNDWATER SAMPLING SUMMARY - MAY 17 - 18, 2007

Proposed Discovery Bay Resort and Marina

Espinar Ward, Aguada, Puerto Rico

SAMPLE NUMBER	DEPTH feet	SP COND uS/cm	TDS mg/l	CHLORIDE mg/l
WB-1A	10	17700	16610	11843
WB-1B	35	45500	20101	11714
WB-2A	10	21100	12747	5919
WB-2B	45	27800	14378	5894
WB-3A	15	1140	1749	838
WB-3B	45	35700	4239	2220
WB-4A	10	763	430	34.2
WB-4B	35	746	385	34.6
WB-5A	15	20200	17524	10556
WB-5B	40	33000	19371	12010
WB-6A	13	883	483	60
WB-6B	48	980	493	94.6
WB-7A	15	1320	694	169
WB-7B	40	1220	619	150
GWS-4	70		11597	4669
WB-8A	15	783	429	25.6
WB-8B	50	6130	3178	1421
WB-9A	20	25700	6213	3884
WB-9B	78	25900	16023	3911
WB-9C	102	25900	16138	4403
WB-10A	5	4380	2689	1349
WB-10B	75	5630	3015	1734
WB-10C	145	5600	3468	1779

APPENDICES

APPENDIX A

SOIL BORING LOGS

ADVANCED SOIL ENGINEERING, INC.

JUNE 2007

SUBSURFACE EXPLORATION LOG

ASE
ADVANCED SOIL ENGINEERING
P.O. BOX 1286
ISABELA, P.R. 00662 TEL & FAX: (787) 830 - 0366

FILE NO. 1061
BORING NO. 2
PAGE 1 OF 3

CLIENT: DISCOVERY BAY RESORT & MARINA
PROJECT: DISCOVERY BAY RESORT & MARINA
LOCATION: AGUADA, PUERTO RICO
GROUND ELEVATION:
DATE STARTED: 06/05/07
DATE FINISH: 06/05/07
GROUND WATER DEPTH: 6.0 FT.

DRILLER: M. RASUK
LAB. TECH: E. RODRIGUEZ
BORING TYPE: AUGER
BORING DIAMETER: 4"

DEPTH (FT)	SAMPLER	SAMPLE NO.	BLOWS / 6"	SPT N VALUE	SYMBOL	VISUAL - MANUAL DESCRIPTION	USCS CLASS	W (%)	Qu	Qp	γ	ϕ	LL	PI
		SS-1	2 - 3 - 4	7		Brown silty clay		38						
		SS-2	2 - 3 - 3	6		As above.		41	1.1	1.0	110.0			
5		SS-3	1 - 1 - 3	4		Gray sand trace to some clayey silt		23						
		SS-4	3 - 2 - 2	4		As above.		28						
10		SS-5	1 - 1 - 1	2		As above.		26						
15		SS-6	7 - 5 - 6	11		As above.		11			110.0	30		
20		SS-7	3 - 7 - 11	18		As above.		21						
25		SS-8	8 - 10 - 13	23		As above.		22			115.0	32		
30		SS-9	7 - 9 - 12	21		As above.		25						
35		SS-10	10 - 9 - 11	20		As above.		23						

continue

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
WH = WEIGHT OF HAMMER
SYMBOL (SEE APPENDIX NO.4 FOR MORE DETAILS)

γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
(*) ELEVATIONS TAKEN FROM PLANS PREPARED BY DESIGNER

SUBSURFACE EXPLORATION LOG

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FILE NO. 1061
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PAGE 2 OF 3

CLIENT: DISCOVERY BAY RESORT & MARINA
PROJECT: DISCOVERY BAY RESORT & MARINA
LOCATION: AGUADA, PUERTO RICO
GROUND ELEVATION:
DATE STARTED: 06/05/07
DATE FINISH: 06/05/07
GROUND WATER DEPTH: 6.0 FT.

DRILLER: M. RASUK
LAB. TECH: E. RODRIGUEZ
BORING TYPE: AUGER
BORING DIAMETER: 4"

DEPTH (FT)	SAMPLER	SAMPLE NO.	BLOWS / 6"	SPT N VALUE	SYMBOL	VISUAL - MANUAL DESCRIPTION	USCS CLASS	W (%)	Qu	Qp	γ	ϕ	LL	PI
						Gray sand trace to some clayey silt								
40		SS-11	9 - 5 - 8	13		As above.		26			110.0	30		
45		SS-12	7 - 6 - 7	13		Yellowish brown silty clay trace sand		22						
50		SS-13	6 - 8 - 10	18		As above.		21	4.8	4.0	118.3			
55		SS-14	6 - 10 - 12	22		As above.		11						
60		SS-15	5 - 5 - 9	14		Gray silty clay		32	3.0	2.8	112.4			
65		SS-16	6 - 5 - 6	11		As above.		32			115.2			
70		SS-17	5 - 5 - 8	13		As above.		36			113.2			

continue

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Qu = UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
WH = WEIGHT OF HAMMER
SYMBOL (SEE APPENDIX NO.4 FOR MORE DETAILS)

γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
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(*) ELEVATIONS TAKEN FROM PLANS PREPARED BY DESIGNER

SUBSURFACE EXPLORATION LOG

ADVANCED SOIL ENGINEERING

P.O. BOX 1286
ISABELA, P.R. 00662
TEL & FAX: (787) 830 - 0366

FILE NO. **1061**
BORING NO. **4**
PAGE 1 OF 3

CLIENT: CORDECO NORTHWEST, CORP.
PROJECT: DISCOVERY BAY RESORT & MARINA
LOCATION: AGUADA, PUERTO RICO
GROUND ELEVATION:
DATE STARTED: 05/18/07
DATE FINISH: 05/18/07
GROUND WATER DEPTH: 6.0 FT.

DRILLER: M. RASUK
LAB. TECH: E. RODRIGUEZ
BORING TYPE: AUGER
BORING DIAMETER: 4"

DEPTH (FT)	SAMPLER	SAMPLE NO.	BLOWS / 6"	SPT N VALUE	SYMBOL	VISUAL - MANUAL DESCRIPTION	USCS CLASS	W (%)	Qu	Qp	γ	ϕ	LL	PI
		SS-1	1 - 1 - 3	4		Brown silty clay trace to some sand trace organiic matter		16						
		SS-2	5 - 5 - 3	8		As above.		54						
5		SS-3	WH-WH-WH	WH		Brown and gray silty clay trace organic matter		64		0.4				
		SS-4	WH-WH-WH	WH		As above.		69						
		SS-5	WH-WH-WH	WH		As above, organic matter (Peat)		297						
10														
		SS-6	8 - 12 - 16	28		Gray sand trace clay		23			115.0	30		
15														
		SS-7	5 - 7 - 6	13		As above.		20			110.0			
20														
		SS-8	6 - 8 - 10	18		As above.		22						
25														
		SS-9	14 - 12 - 16	28		As above.		23						
30														
		SS-10	11 - 15 - 20	35		As above.		24			120.0	32		
35						continue								

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
Q NCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
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(*) ELEVATIONS TAKEN FROM PLANS PREPARED BY DESIGNER

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FILE NO. **1061**
BORING NO. **4**

CLIENT: CORDECO NORTHWEST, CORP.
PROJECT: DISCOVERY BAY RESORT & MARINA
LOCATION: AGUADA, PUERTO RICO
GROUND ELEVATION:
DATE STARTED: 05/18/07
DATE FINISH: 05/18/07
GROUND WATER DEPTH: 6.0 FT.

DRILLER: M. RASUK
LAB. TECH: E. RODRIGUEZ
BORING TYPE: AUGER
BORING DIAMETER: 4"

DEPTH (FT)	SAMPLER	SAMPLE NO.	BLOWS / 6"	SPT N VALUE	SYMBOL	VISUAL - MANUAL DESCRIPTION	USCS CLASS	W (%)	Qu	Qp	γ	ϕ	LL	PI
						Gray sand trace clay								
40	■	SS-11	12 - 17 - 21	38		As above.		25						
45	■	SS-12	11 - 9 - 11	20		As above.		24						
50	■	SS-13	7 - 8 - 11	19		As above.		25			110.0	32		
55	■	SS-14	6 - 8 - 7	15		As above.		35						
60	■	SS-15	3 - 5 - 7	12		Black and gray silty clay trace organic matter		61		1.2				
65	■	SS-16	WH-WH-WH-	WH		As above.		66						
70	■	SS-17	WH-WH-WH-	WH		As above. continue		63		0.5	97.5			

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
(JNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
WH = WEIGHT OF HAMMER
SYMBOL (SEE APPENDIX NO.4 FOR MORE DETAILS)

γ = ESTIMATED UNIT WEIGHT - P.C.F.
ϕ = ANGLE OF INTERNAL FRICTION - DEGREES
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
(*) ELEVATIONS TAKEN FROM PLANS PREPARED BY DESIGNER

SUBSURFACE EXPLORATION LOG

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ISABELA, P.R. 00662
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FILE NO. **1061**
BORING NO. **4**
PAGE 3 OF 3

CLIENT: CORDECO NORTHWEST, CORP.
PROJECT: DISCOVERY BAY RESORT & MARINA
LOCATION: AGUADA, PUERTO RICO
GROUND ELEVATION:
DRILLER: M. RASUK
DATE STARTED: 05/18/07
LAB. TECH: E. RODRIGUEZ
DATE FINISH: 05/18/07
BORING TYPE: AUGER
GROUND WATER DEPTH: 6.0 FT.
BORING DIAMETER: 4"

DEPTH (FT)	SAMPLER	SAMPLE NO.	BLOWS / 6"	SPT N VALUE	SYMBOL	VISUAL - MANUAL DESCRIPTION	USCS CLASS	W (%)	Qu	Qp	γ	ϕ	LL	PI
						Black and gray silty clay trace organic matter								
75		SS-18	3 - 4 - 5	9		As above.		63						
80		SS-19	5 -5 - 5	10		As above.		60		1.4	103.8			
85		SS-20	5 - 4 - 5	9		As above.		38						
90		SS-21	7 - 7 - 8	15		As above.		69		1.2				
95		SS-22	6 - 6 - 8	14		As above.		66						
100		SS-23	7 - 8 - 7	15		As above.		26						
						END OF BORING								
105														

N = BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
W = NATURAL MOISTURE CONTENT - %
(JNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Qp = CALIBRATED PENETROMETER READING - T.S.F.
WH = WEIGHT OF HAMMER
SYMBOL (SEE APPENDIX NO.4 FOR MORE DETAILS)

γ = ESTIMATED UNIT WEIGHT - P.C.F.
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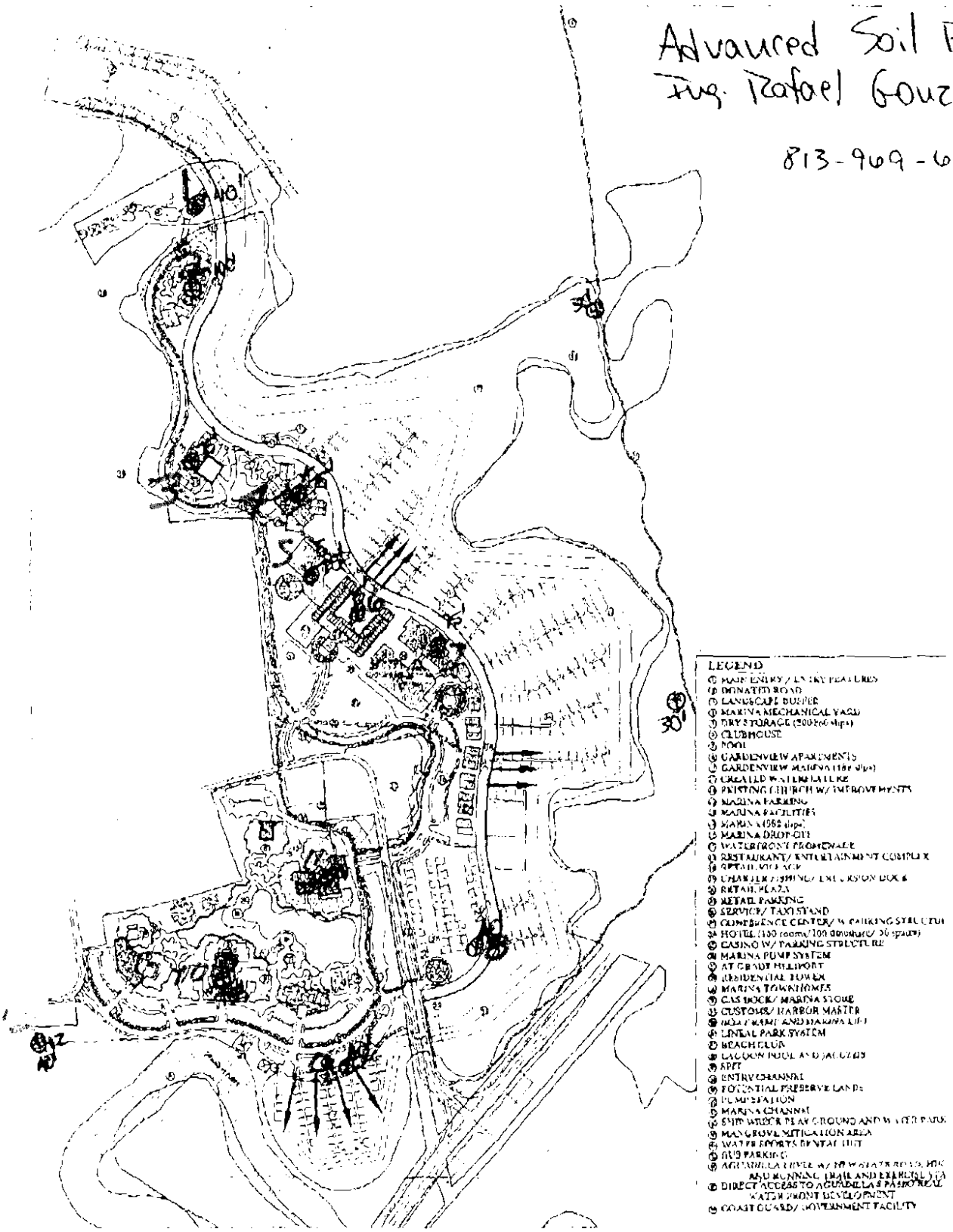
LL = LIQUID LIMIT
PI = PLASTICITY INDEX
(*) ELEVATIONS TAKEN FROM PLANS PREPARED BY DESIGNER

Advanced Soil Eng
Eng. Rafael Gonzalez
813-969-6988



Alayo Architects PC

Discovery Bay Resort & Marina

CONCEPTUAL MASTER

February 14, 2006

APPENDIX B

SUMMARY OF DISCOVERY BAY MARINA GROUNDWATER FLOW ANALYSIS, BAHIA DE AGUADILLA, PUERTO RICO

JUNE 1, 2005

TECHNICAL MEMORANDUM

Date: June 1, 2005

To: Mr. Mark Pirrello, P.E.,
Moffatt & Nichol Engineers, Inc.

From: Kenneth C. Jones, P.G.
(813) 969-6995, Fax: (813) 969-6988

Re: **Summary of Discovery Bay Marina Groundwater Flow Analysis**
Bahia de Aguadilla, Puerto Rico

INTRODUCTION

Hydro-Environmental Associates, Inc. (HEA) was retained by Cordeco Northwest Corporation (Cordeco) to conduct a groundwater flow analysis of a proposed inland marina at the above-referenced site. This Technical Memorandum and accompanying attachments complete the requirements of the Scope of Services for the project.

Moffatt & Nichol Engineers, Inc. is currently implementing a study to evaluate the potential development of the subject site as a residential complex that includes a 500-slip inland marina. The proposed marina will require the excavation of surface soils to an estimated depth of approximately 15-feet below existing ground surface. The surface soils excavated are anticipated to be used as fill material for the residential development and proposed levees. Portions of the subject site and proposed basin area are currently being used as an active sand mine. The subject site is located on the northwest coast of the island of Puerto Rico.

In order for the marina to sustain a healthy aquatic environment, proper water circulation and tidal flushing is required. Due to limitations in the shape of the property, the proposed marina configuration may possibly limit the natural circulation and flushing of seawater. Based upon site observations made during dewatering of the sand mine, it is apparent that a significant component of marina water circulation may be obtained from groundwater flow discharging from the shallow aquifer within the groundwater basin of the proposed marina. The Scope of Service for this project included a preliminary evaluation of the possible ranges of flow within the surficial aquifer based upon regional soil characteristics, followed by a field investigation to determine the hydraulic conductivity of the surficial aquifer within the basin area, and groundwater flow modeling to more accurately evaluate the rate and volume of groundwater flow contribution to the proposed marina basin. The preliminary evaluation was previously

addressed.

SITE GEOLOGY AND HYDROGEOLOGY

The subject site lies within the alluvial deposits immediately north of the Rio Culebrinas, west of the Cordillera Jaicoa, and east of the Atlantic Ocean. The Rio Culebrinas flows in a general westerly direction, bisecting the Cordillera Jaicoa, and discharging into the Atlantic Ocean. The subject site is within the flood plain of the Rio Culebrinas. The Cordillera Jaicoa is incised by the Rio Culebrinas, and becomes highly eroded along the south side of the incision. Geographic features in the vicinity of the subject site consist of coastal beach deposits, alluvial sediment, and karst uplands. This area is specifically detailed on the Geologic Map of the Aguadilla Quadrangle.

The coastal beach deposits form an almost continuous north-south trending ridge between Tamarindo on the north to Rincon on the south. This ridge is roughly sub-parallel to the coastal shoreline and terminates approximately 400 feet inland from the coast. The subject site is relatively flat at an average elevation of approximately 10 feet above mean sea level (MSL).

The surficial aquifer in the area of the site is typically composed of stratified layers of alluvial quartz sand and shell of quaternary age, with minor amounts of silt and clay. Based on our review of on-site lithologic data, the surficial aquifer is estimated to be approximately 120 feet in thickness.

Underlying the surficial aquifer is the Aymamon Limestone. Based upon our review of available geologic information in the area of the site, the Aymamon Limestone is typically composed of a pale orange to white fossiliferous, permeable limestone. The Aymamon Limestone is of Miocene age and directly underlies the alluvial sands. The Aymamon Limestone is approximately 600 feet in thickness in the vicinity of the subject site. The Aymamon Limestone is underlain by the Aguada Limestone, also of Miocene age. The Aguada Limestone consists of a hard calcarenite alternating with chalky and rubbly limestone.

MODEL CONFIGURATION AND SETUP

The marina basin was simulated using the Modular Three-Dimensional Finite Difference Groundwater Flow Model (MODFLOW ^{TM}) code, developed by McDonald and Harbaugh of the U.S. Geological Survey. The finite-difference approach is block-centered, which means that all data for a particular cell is located within the center of the cell. Layers may be simulated as confined, unconfined, or convertible. Flow associated with external influences such as wells, aerial recharge, evapotranspiration (ET), springs, drains, and rivers can also be simulated. The solution technique is by the Conjugate Gradient Procedure. Version 2.0 of Groundwater Vistas was used as a preprocessor to set up to the model and postprocessor to review and map the

results.

A series of constant head cells were used to simulate the proposed marina basin. The constant head cells in the proposed marina basin were modeled at an assumed elevation of mean sea level, which should represent average tidal conditions. To provide a conservative estimate of the groundwater influence into the proposed marina basin, the model was conducted using steady-state conditions, without the influence of precipitation or evapotranspiration.

The site, as modeled, consists of the proposed marina basin configuration as presented on the Conceptual Master Plan, dated March 28, 2005, as prepared by EDSA, Inc., Ft. Lauderdale Fla. Figure 1 presents the extent of the modeled area. The areas shaded in blue, shown on Figure 1, represent the constant head cell simulating the area of the proposed marina basin. The model was set up as a three layer hydrogeologic system, with the upper two layers representing the surficial aquifer, and the third layer representing the underlying Aymamon Limestone Aquifer. The surficial aquifer was divided into two layers to simulate the effects of the proposed marina basin. The bottom elevation of layer one was set to an elevation of -12 feet below MSL, which is the proposed bottom elevation of the marina basin.

Each model layer was discretized into 10,000 cells, 100-foot by 100-foot in size (100 rows by 100 columns). Constant head boundaries were used to define the Atlantic Ocean and the Cordillera Jaicoa outcroppings. The model elevation of the constant head boundary representing the Atlantic Ocean was assumed to be at MSL. The constant head boundary cells representing the face of the Cordillera Jaicoa to the north of the Rio Culebrinas was estimated to at an elevation of 15 feet above MSL, based upon a review of the Aguadilla USGS 7.5- minute quadrangle map. For modeling purposes, the constant head boundaries representing the face of Cordillera Jaicoa south of the Rio Culebrinas was varied linearly from a maximum of 15 feet to zero feet NGVD, based upon the general topography of the area.

The MODFLOW river package was used to simulate the Rio Culebrinas. The upstream elevation of the Rio Culebrinas was estimated to be 9.0 feet above MSL, based on review of the Aguadilla USGS 7.5-minute quadrangle map. The upstream extent of the river was located at the intersection of State Road 115. The downstream river elevation was assumed to be at MSL. Figure 1 also shows the model grid and boundaries. The areas shaded in blue represent the constant head boundaries, and the areas shaded in green represent the river cell boundaries.

The top of the surficial aquifer for the purposes of this model simulation was conservatively assumed to be flat at an assumed model elevation of 4 feet above MSL. The base of the surficial aquifer was assumed to be at -100.0 feet MSL. The base of the marina basin, as discussed above, was assumed to be at an elevation of -12 feet MSL.

AQUIFER PARAMETERS

Hydraulic conductivity (permeability) values for the surficial aquifer were based field data collected at the site by HEA representatives. In-situ hydraulic conductivity values were obtained for the site by conducting single well aquifer recovery tests (slug tests) at six (6) existing monitoring wells located at the subject site. The monitoring wells were spatially located within the actual area of the proposed marina. The monitoring wells were installed by Advanced Soil Engineering, Inc. of Isabella, P.R. These in-situ hydraulic conductivity values were required to estimate groundwater flow volumes anticipated to discharge into the marina area.

Based upon information provided by the client, as well as measurements obtained in the field, the monitoring wells were constructed using ten feet of two-inch diameter, schedule 40 PVC machine slotted wellscreen (0.010-inch slot size), and solid two-inch diameter PVC riser pipe. The monitoring wells were installed to depths ranging from 18.7 to 19.5 feet, below ground surface using the hollow-stem auger method conducted in general accordance with ASTM D1452-80 procedures.

The shallow monitoring wells were installed through the center of the hollow-stem augers and positioned at the appropriate depths. The annular space outside the well screen was filled with a natural formation sand to act as a filter pack around the slotted wellscreen portions of the well. A bentonite seal was placed above the filter pack. The remaining annular space was grouted with a cement slurry to the approximate ground surface.

Static water level depths ranged from approximately 1.89 feet, bgs in monitoring well P-1 to as much as 7.10 feet, bgs in monitoring well P-5. Monitoring well P-1 was located in the northern portion of the site near the coast, and monitoring well P-5 was located in the higher elevations of the southern portion of the site. As shown on Table 1, the saturated lengths of the wells ranged from 11.1 to 16.8 feet.

The hydraulic conductivity values were calculated from the slug tests based on the assumptions and well geometry presented by Bouwer and Rice (1976). The slug tests were performed by inserting a solid PVC and cement filled cylinder with a volume equivalent to an approximate 4.5-foot change in water level in a two-inch diameter monitoring well (1.92-inches in diameter by 4.84 feet in length). When the water level had returned to equilibrium, the cylinder was quickly removed and the water levels were allowed to return to equilibrium.

Both recovery and drawdown data were obtained using an electronic water level datalogger, manufactured by Solinst Canada Ltd, Georgetown, Ontario, Canada. The datalogger used for the slug test was the Model 3001 Levelogger®. The Model 3001 Levelogger® is approximately 7/8-inches in diameter and 4.9 inches in length with an accuracy of 0.1%. Prior to conducting the slug test, the Levelogger® was lowered to the bottom of the well and measurements were

made to ensure that the depth to groundwater had stabilized and reached equilibrium before conducting the slug test. During each of the tests, the water level datalogger recorded the depth to water to the nearest 0.01 foot at a linear measurement frequency of one reading per second. This method of collecting both drawdown and recovery data was performed since it typically provides a more accurate and reliable value of in-situ permeability.

The single well aquifer slug tests were performed on April 21, 2005 by Mr. Kenneth C. Jones, P.G., of HEA. The data collected from the slug tests were used to calculate horizontal hydraulic conductivity values in the surficial aquifer at the site. The results of these slug tests are included in Appendix A and are summarized on the enclosed Table 1. A total of 12 in-situ hydraulic conductivity tests were performed at the site, including six slug-in tests and six slug-out tests. However, two of the recovery tests for monitoring wells P-5 and P-6 were not analyzed due to disturbance of the Levelogger® during the removal of the slug from the well.

The hydraulic conductivity values derived from the on the in-situ slug tests conducted on the six monitoring wells ranged from approximately 26 to 62 feet per day (ft/d) and averaged approximately 45 ft/d. This average hydraulic conductivity value appears to be representative for the soils comprising the surficial aquifer at the site and was used in the groundwater flow model of the site to estimate groundwater discharge into the marina basin. The average hydraulic conductivity values for both the drawdown and recovery tests were essentially the same and therefore, the average value of 45 ft/d within the surficial aquifer appears reasonable. Some variability of hydraulic conductivity values between the monitoring well locations suggests some heterogeneity within the surficial aquifer at the site. The heterogeneity would be expected in the alluvial deposits comprising the surficial aquifer.

It should be noted that due to the remote nature of the site, the monitoring wells could not be developed prior to conducting the hydraulic conductivity tests and some fine sediment was noted at the bottom of the wells. It is felt that the fine sediment may have biased the test results somewhat, and that the actual value of hydraulic conductivity may be slightly higher than the values reported. Therefore, the average hydraulic conductivity value of 45 ft/d used in the groundwater flow model is likely conservative. However, the values for hydraulic conductivity should be viewed as an approximation since the slug tests provide hydraulic conductivity values for the materials immediately adjacent to the tested well screen.

The hydraulic conductivity of the Aymamon Limestone used in the model was 100 ft/d, which is typical for a limestone aquifer.

RESULTS

The results of this simulation indicate that the average rate of total groundwater inflow into the proposed marina basin is approximately 2.44 million gallons per day (MGD), while maintaining the water level in the marina basin at mean sea level. Based upon a meeting with representatives

of Moffatt & Nichol Engineers, Inc. on May 12, 2005, the marina basin was divided into 20 separate zones. The groundwater flow contribution into the marina basin was calculated from each of the cells from within these 20 zones. The groundwater flow contribution from the 20 zones were to be used as input into the overall circulation analysis of the marina basin. Based upon review of the data, approximately 22 percent of the groundwater flow is in a lateral direction from the vicinity of the Rio Culebrinas, approximately 36 percent of the flow is in a lateral direction from the north originating from the Cordillera Jaicoa, approximately 9 percent of the flow is lateral from the south, and approximately 33 percent represents upward groundwater flow from the base of the surficial aquifer. Figure 2 shows the water level contours generated at the end of the simulation.

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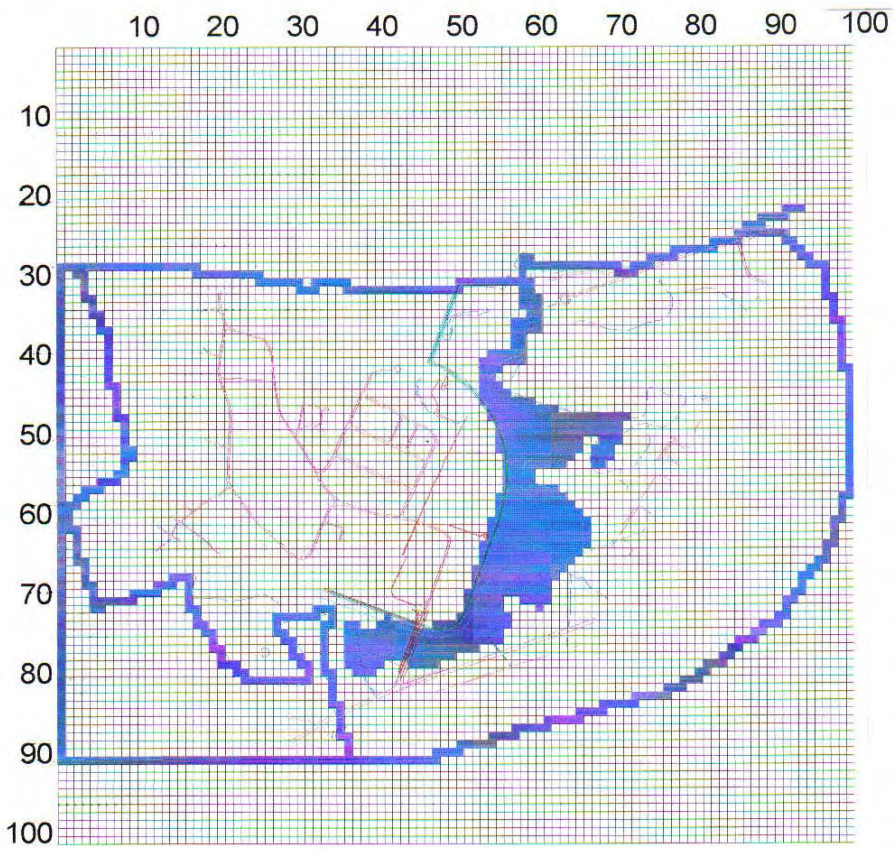
Mitchell, R.C., 1954. A Survey of the Geology of Puerto Rico. University of Puerto Rico Agricultural Experimental Experiment Station.

Advanced Soil Engineering, Inc., 2005. Cordeco Discovery Bay & Marina Soil Boring Logs.



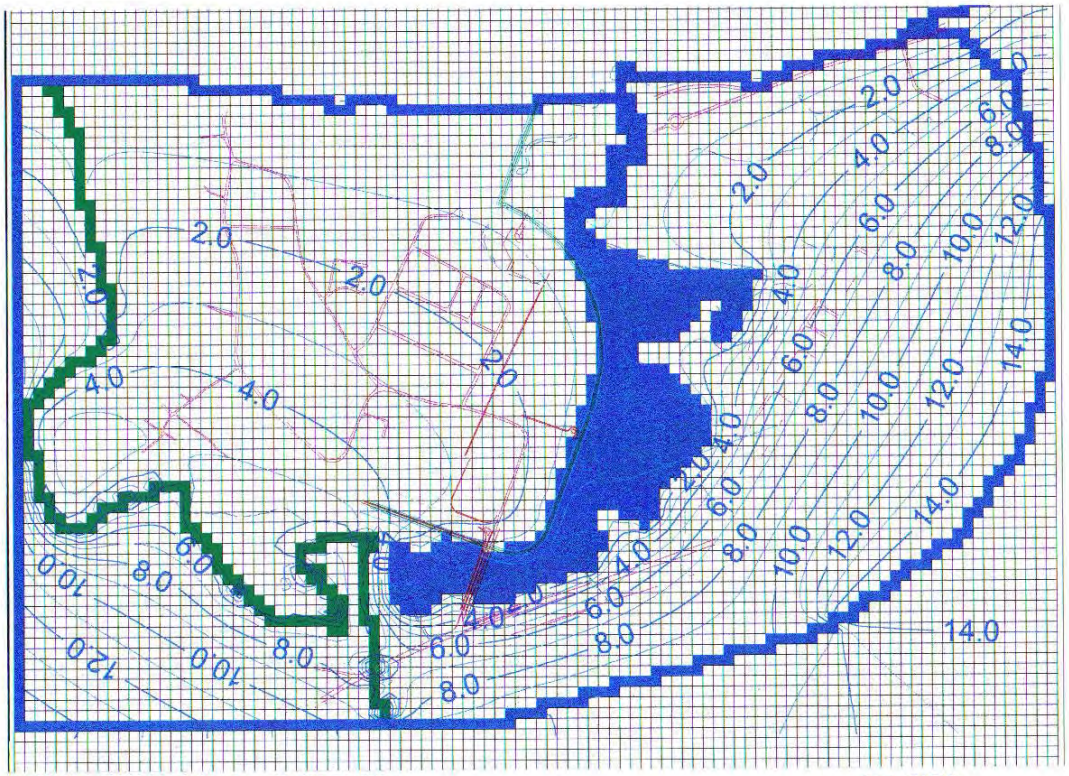
Base Map: As provided by AHV Asociados, Aguada, Puerto Rico

Scale: N.T.S.

FIGURE 1

MODEL AREA AND FINITE DIFFERENCE GRID
DISCOVERY BAY RESORT AND MARINA
AGUADILLA, PUERTO RICO

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
(813) 969-6995



Base Map: As provided by AHV Asociados, Aguada, Puerto Rico

Scale: N.T.S.

FIGURE 2

RESULTS OF GROUNDWATER FLOW MODEL
DISCOVERY BAY RESORT AND MARINA
AGUADILLA, PUERTO RICO

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
(813) 969-6995

TABLE 1

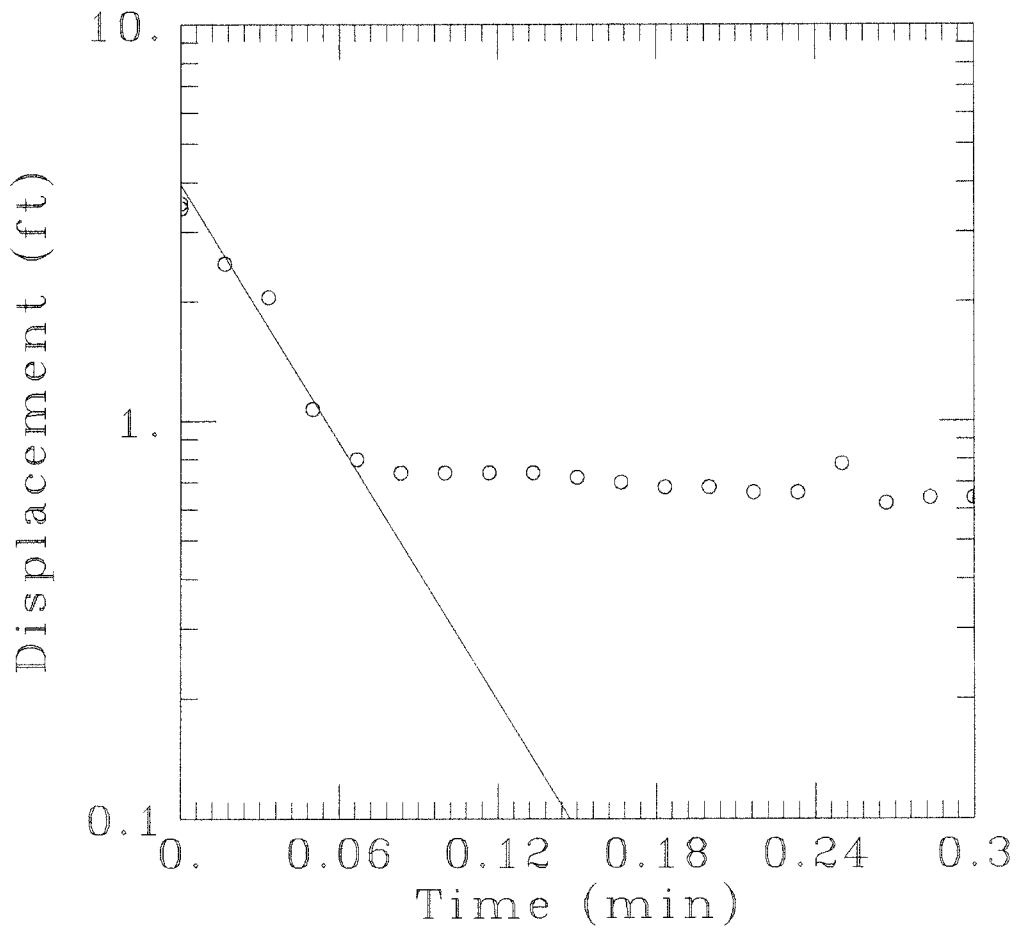
DISCOVERY BAY, AGUADILLA, PUERTO RICO

GROUNDWATER LEVELS AND PERMEABILITY ANALYSIS

MONITOR WELL NUMBER	WELL DEPTH (FT) (FT. BTOC)	WELLSCREEN LENGTH (FT.)	WELL STICK-UP (FT. AGS)	BEGINNING WATER LEVEL (FT. BTOC)	SATURATED LENGTH (FT.)	PERMEABILITY (FT./DAY)	ENDING WATER LEVEL (FT. BTOC)	SATURATED LENGTH (FT.)	PERMEABILITY (FT./DAY)
P-1	20.0	10.0	1.30	3.19	16.81	29.4	3.28	16.72	62.4
P-2	20.0	10.0	1.00	3.85	16.15	60.8	3.93	16.07	58.3
P-3	20.0	10.0	1.30	5.71	14.29	58.3	5.71	14.29	31.5
P-4	20.0	10.0	1.00	3.17	16.83	26.3	2.58	17.42	26.2
P-5	20.0	10.0	1.80	8.90	11.10	26.6	8.90	11.10	N/A
P-6	25.0	10.0	5.50	12.36	12.64	65.0	13.21	11.79	N/A
AVERAGE =						44.4			44.6

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-1 SLUG-IN TEST



DATA SET:
p1in
05/02/05

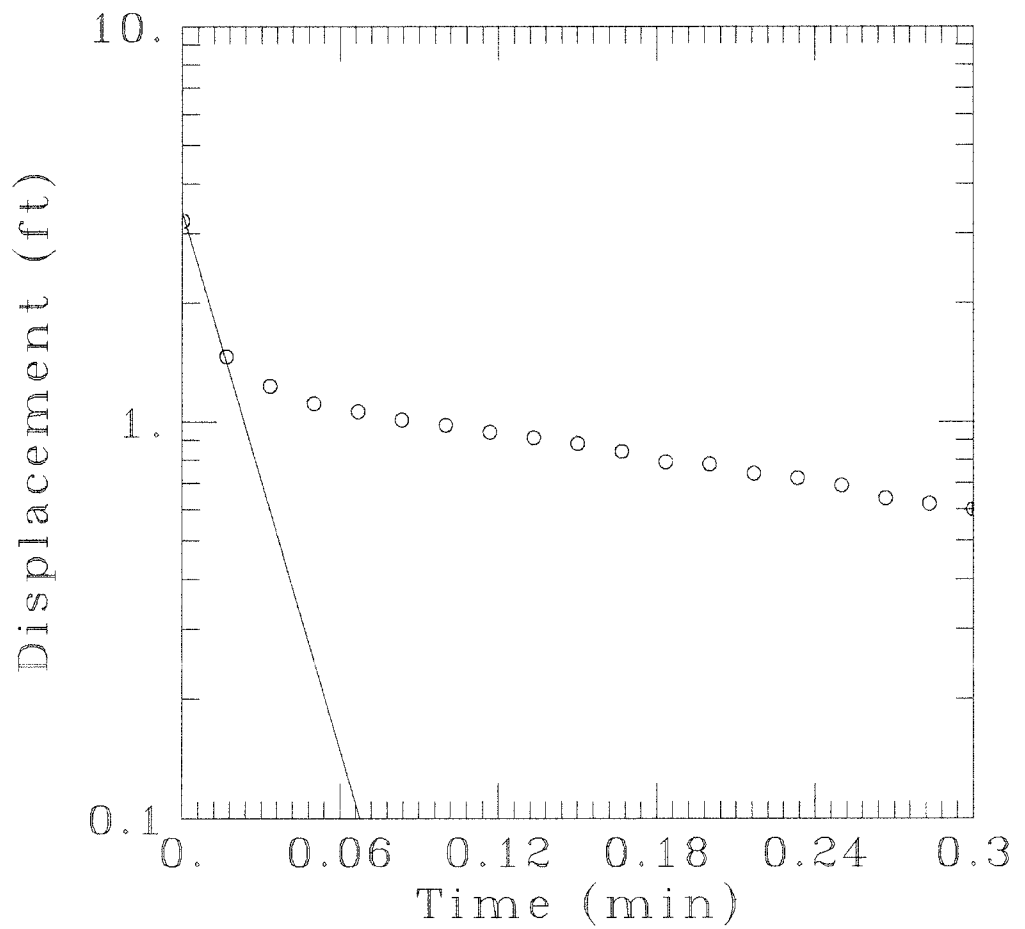
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-1
OBS. WELL:
P-1

ESTIMATED PARAMETERS:
K = 0.02045 ft/min
y0 = 3.938 ft

TEST DATA:
H0 = 3.54 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 15.51 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-1 SLUG-OUT TEST



DATA SET:
p1out
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-1

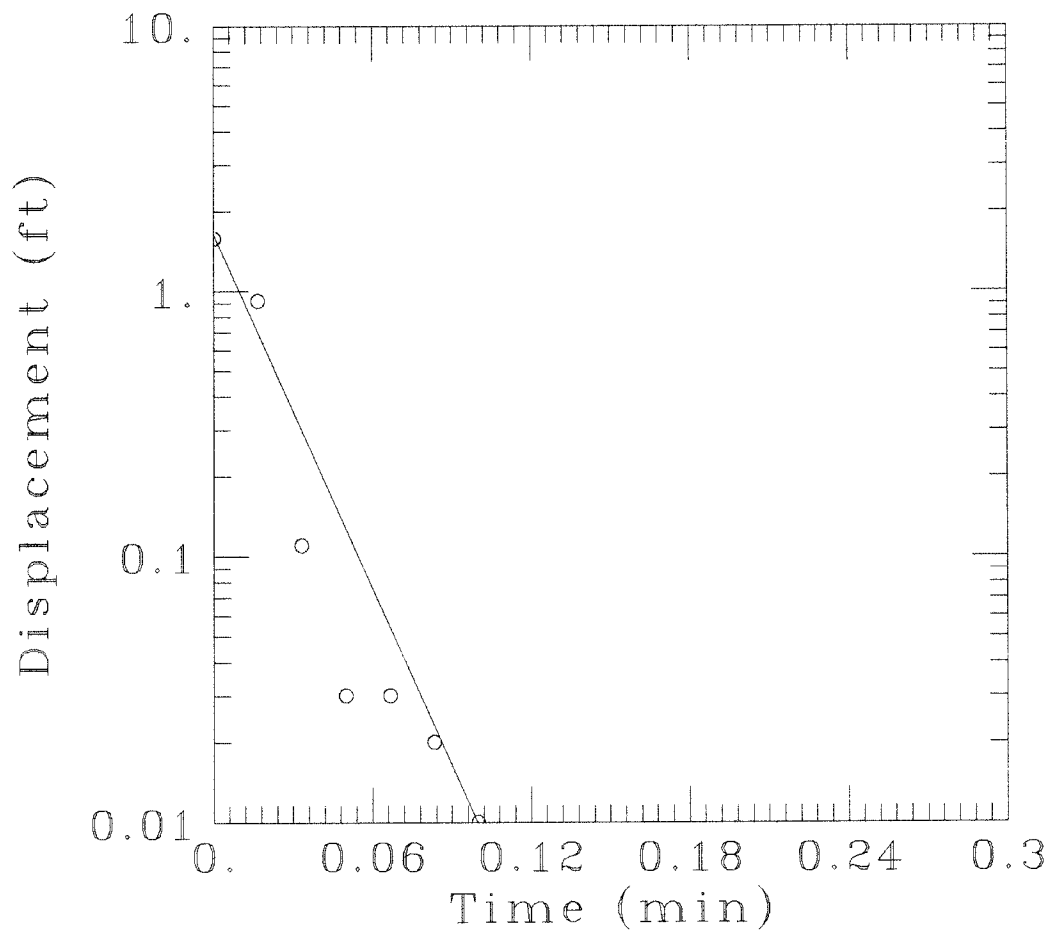
OBS. WELL:
P-1

ESTIMATED PARAMETERS:
K = 0.04333 ft/min
y0 = 3.388 ft

TEST DATA:
H0 = 3.22 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.72 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-2 SLUG-IN TEST



DATA SET:
p2in
05/02/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-2

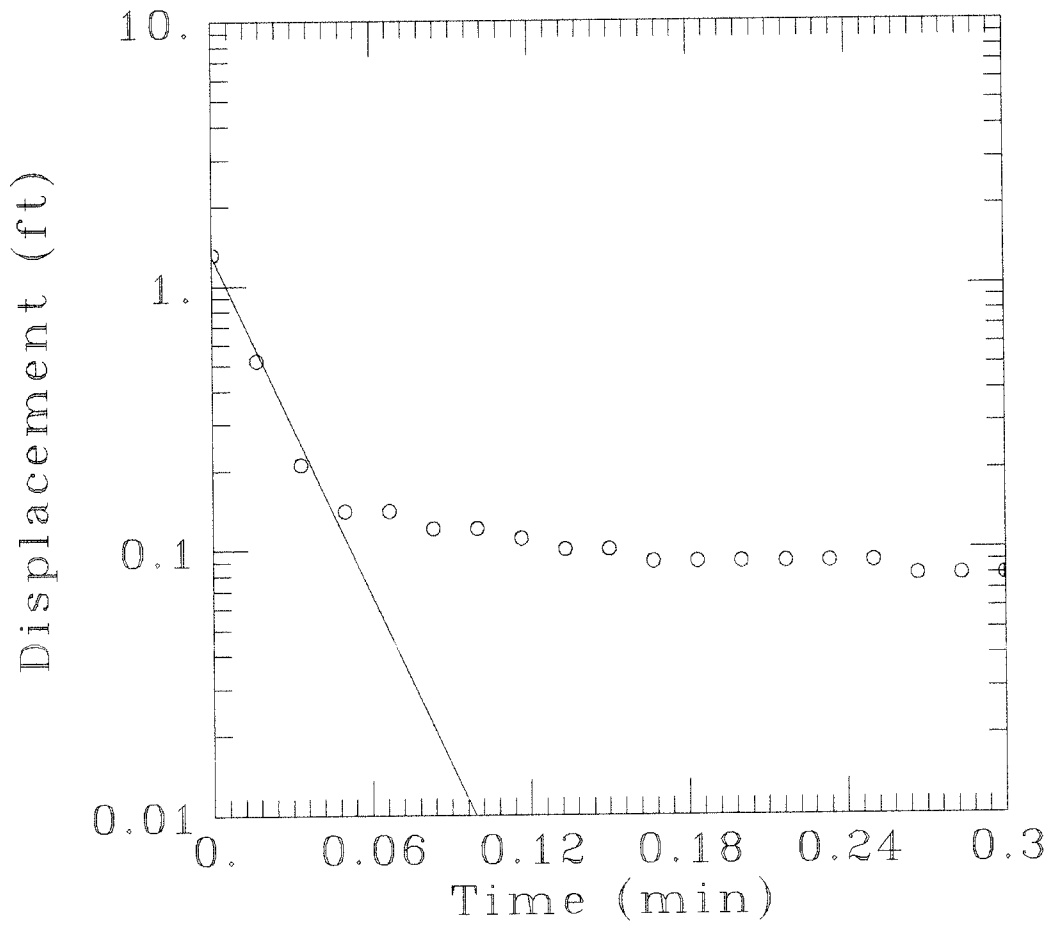
OBS. WELL:
P-2

ESTIMATED PARAMETERS:
K = 0.04222 ft/min
y0 = 1.64 ft

TEST DATA:
H0 = 1.58 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.15 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-2 SLUG-OUT TEST



DATA SET:
p2out
05/02/05

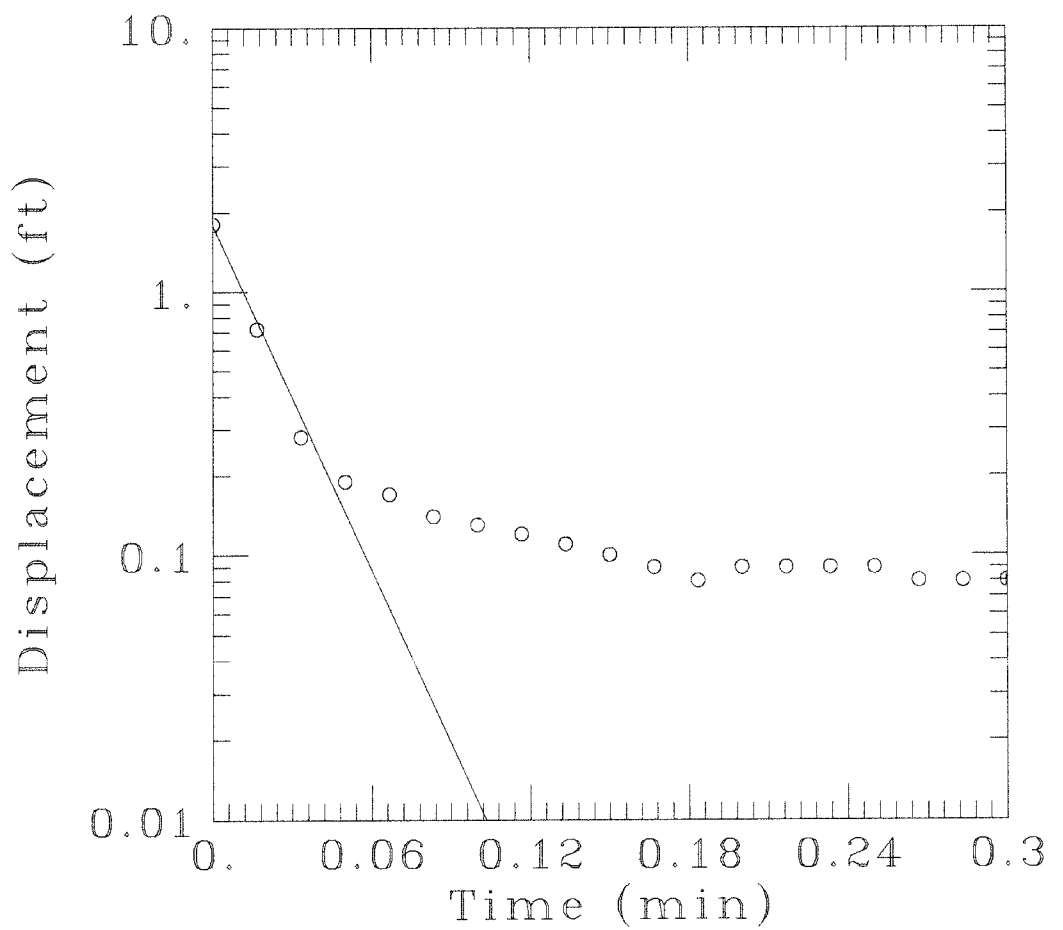
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-2
OBS. WELL:
P-2

ESTIMATED PARAMETERS:
K = 0.04047 ft/min
y0 = 1.284 ft

TEST DATA:
H0 = 1.31 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.07 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO, NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-3 SLUG-IN TEST



DATA SET:
p3in
05/02/05

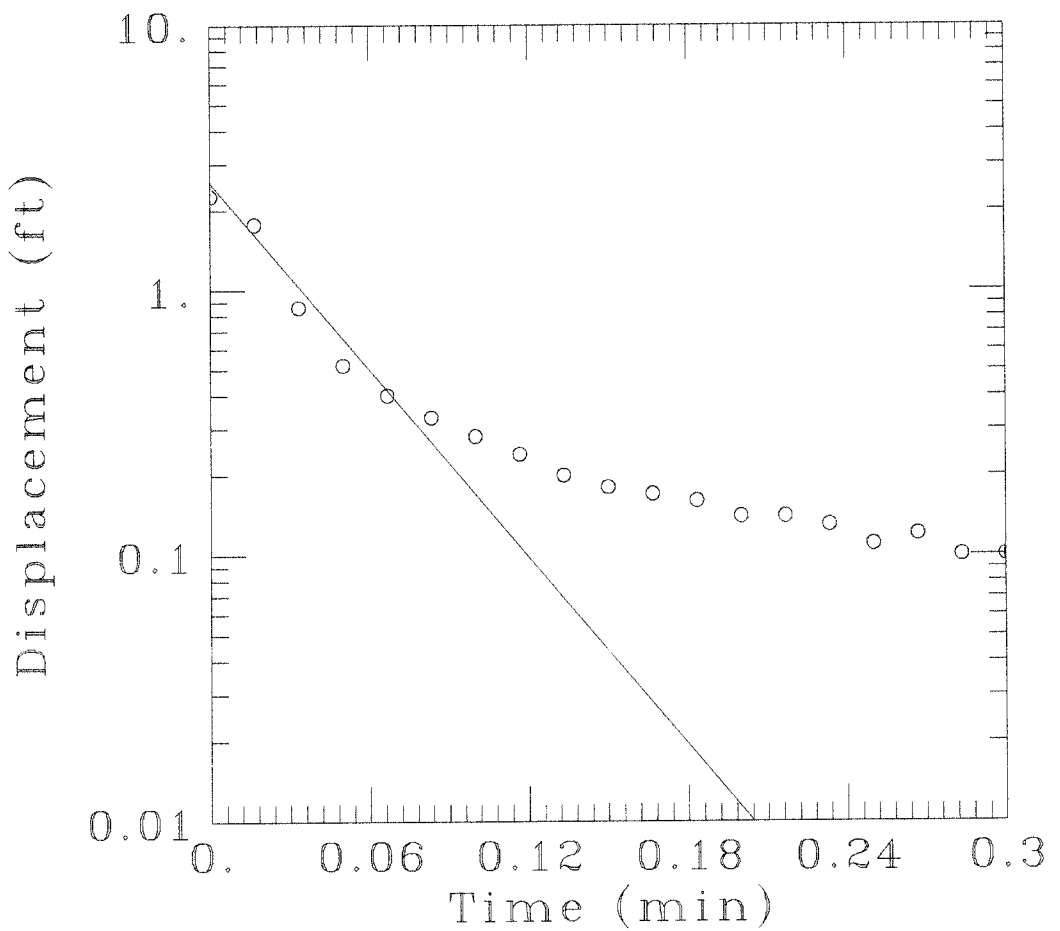
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-3
OBS. WELL:
P-3

ESTIMATED PARAMETERS:
K = 0.04055 ft/min
y0 = 1.786 ft

TEST DATA:
H0 = 1.8 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 14.29 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-3 SLUG-OUT TEST



DATA SET:
p3out
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-3

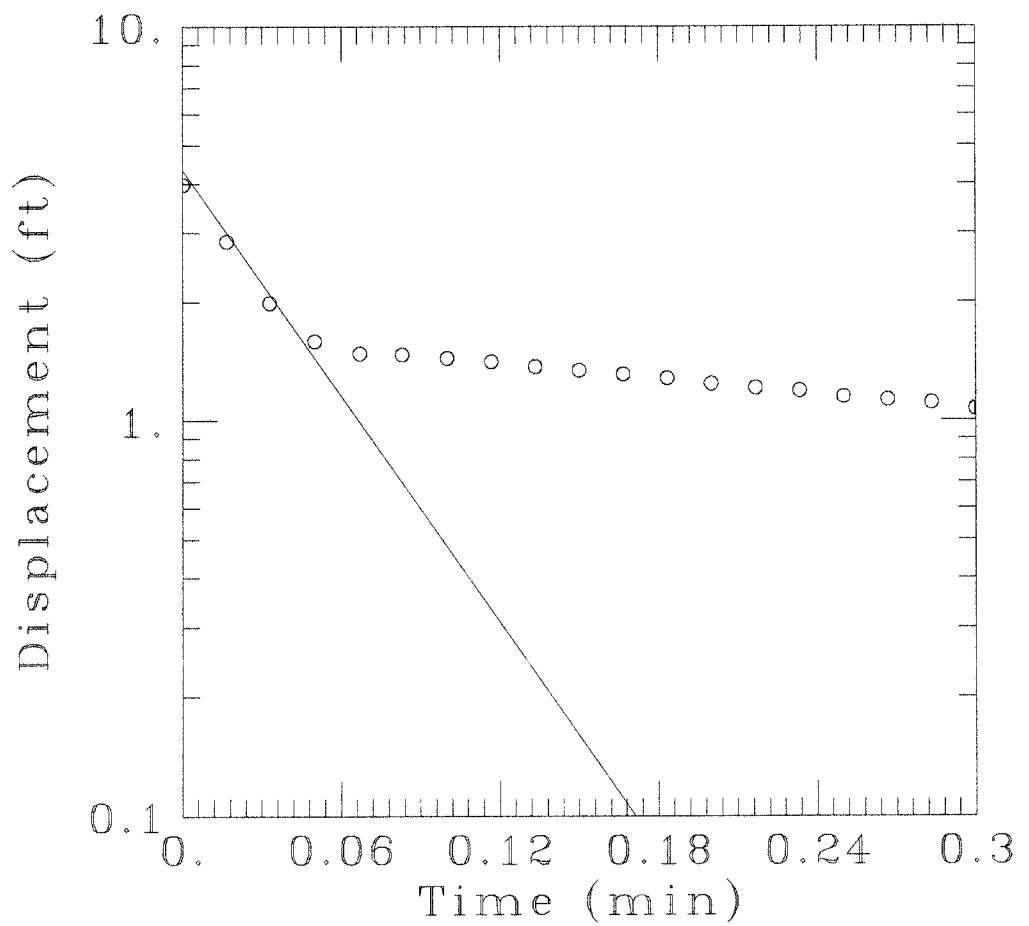
OBS. WELL:
P-3

ESTIMATED PARAMETERS:
K = 0.02189 ft/min
y0 = 2.553 ft

TEST DATA:
H0 = 2.26 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 14.29 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-4 SLUG-IN TEST



DATA SET:
p4in
05/03/05

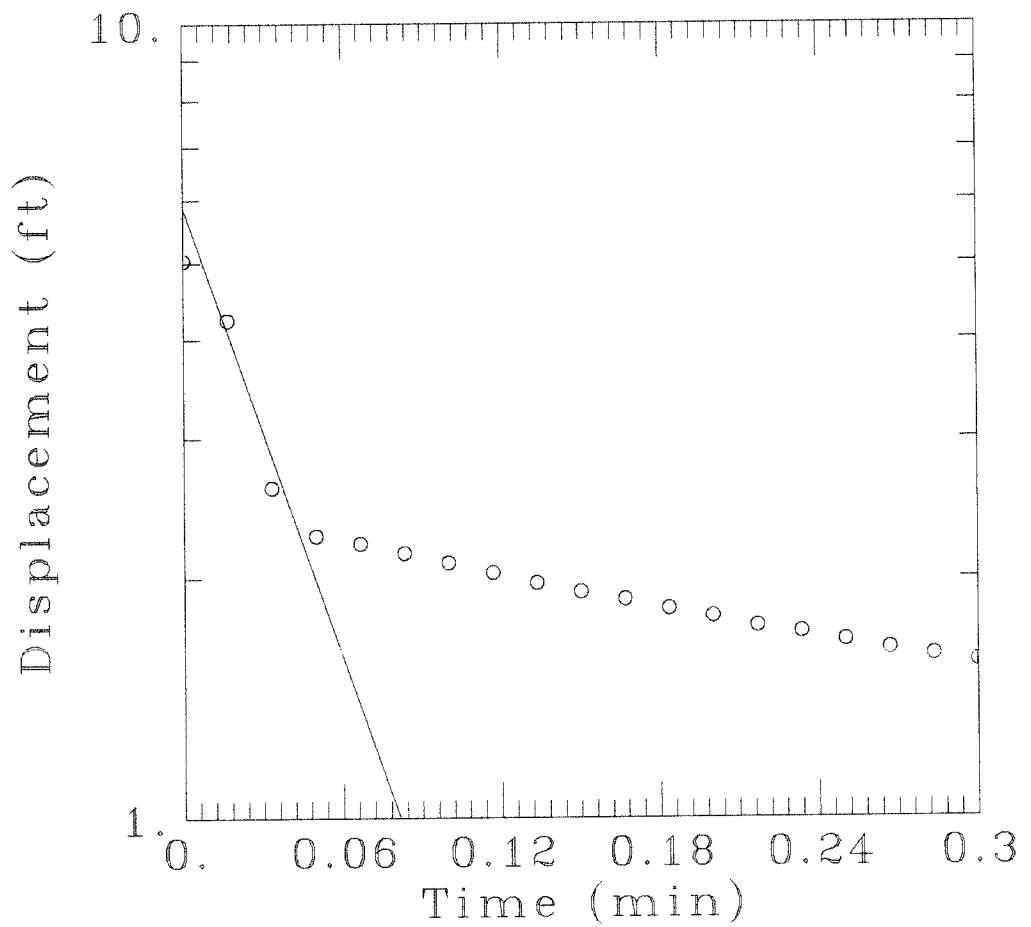
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04-21-05
TEST WELL:
P-4
OBS. WELL:
P-4

ESTIMATED PARAMETERS:
K = 0.01829 ft/min
y0 = 4.33 ft

TEST DATA:
H0 = 3.97 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 18.83 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-4 SLUG-OUT TEST



DATA SET:
p4out
05/03/05

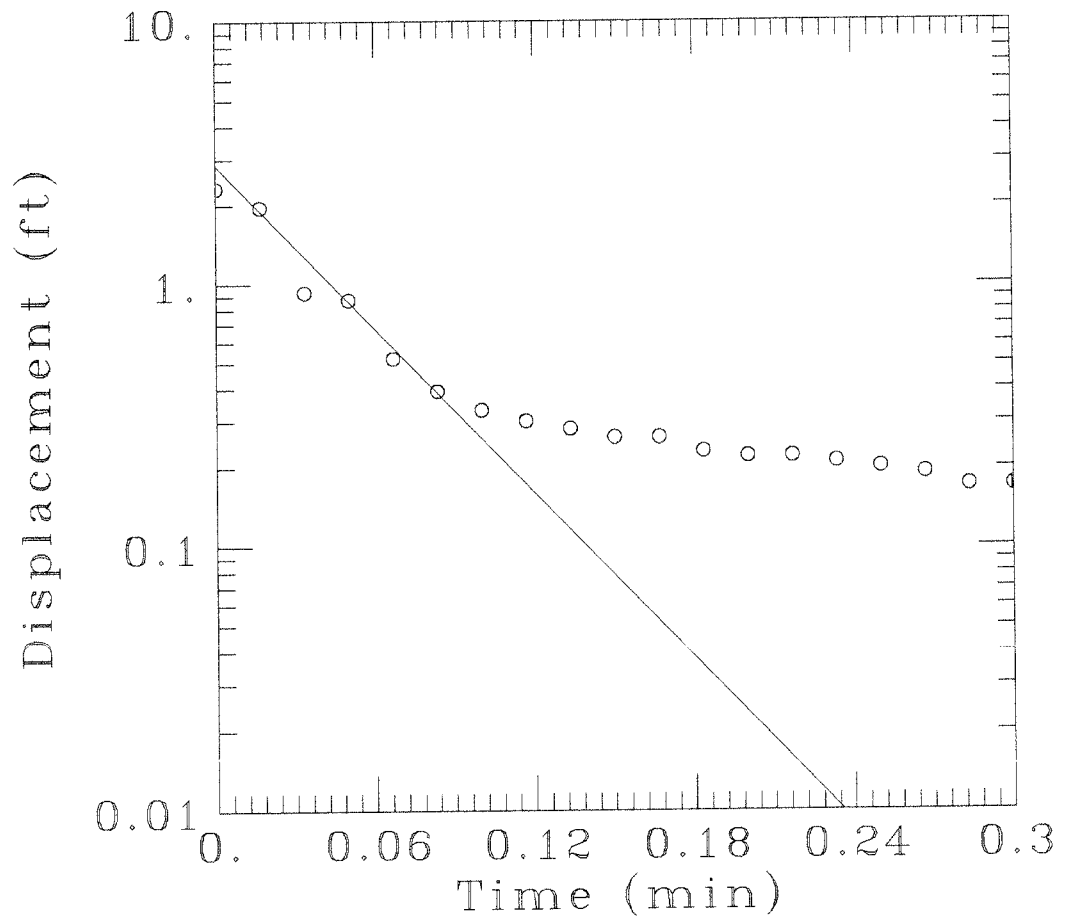
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-4
OBS. WELL:
P-4

ESTIMATED PARAMETERS:
K = 0.01818 ft/mn
y0 = 5.872 ft

TEST DATA:
H0 = 5.03 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 17.42 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-5 SLUG-IN TEST



DATA SET:
p5in
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-5

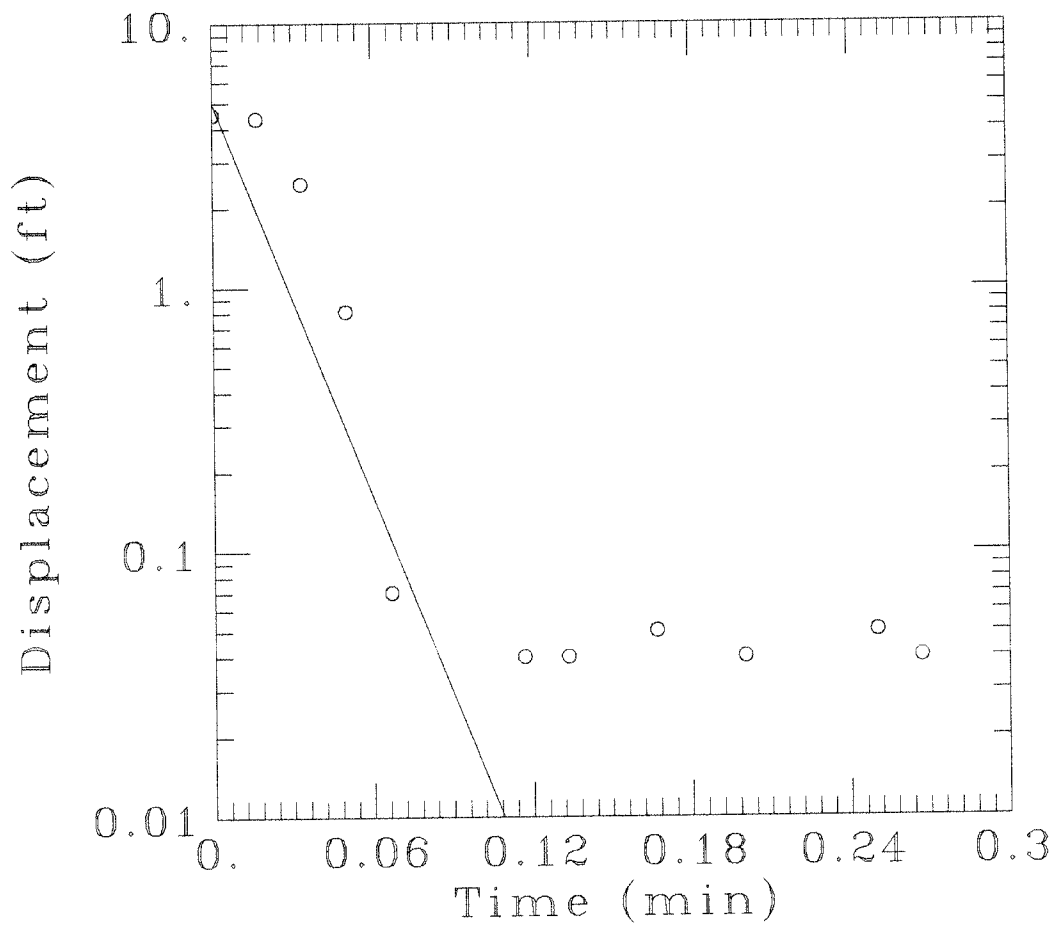
OBS. WELL:
P-5

ESTIMATED PARAMETERS:
K = 0.01849 ft/min
y0 = 2.835 ft

TEST DATA:
H0 = 2.32 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 11.1 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-6 SLUG-IN TEST



DATA SET:
p6in
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-6

OBS. WELL:
P-6

ESTIMATED PARAMETERS:
K = 0.04614 ft/min
y0 = 5.012 ft

TEST DATA:
H0 = 4.52 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 12.64 ft

APPENDIX C

RESULTS FROM GEOPHYSICAL ELECTRICAL RESISTIVITY PROFILING AND SUBSURFACE SAMPLING AND TESTING WORK, GROUNDWATER INVESTIGATION, PROPOSED DISCOVERY BAY MARINA SITE, ESPINAR WARD, AGUADA, PR

DECEMBER 20, 2005

See EIS Appendix F – 1

Ground Water Investigation December 20, 2005

APPENDIX D

SAUMMARY OF RESULTS FROM ADDITIONAL FIELD WORK ON SUBSURFACE SAMPLING, GROUNDWATER AND TESTING WORK, GROUNDWATER INVESTIGATION, PROPOSED DISCOVERY BAY MARINA SITE, ESPINAR WARD, AGUADA, PR

JUNE 5, 2007

JFA Geological & Environmental Scientists, P.S.C.

P.O. Box 250423
Aguadilla, PR 00604-0423
State Road 107, Km. 3.1
Borinquen Ward, Aguadilla, PR
Tel. 787 882-3762
Fax 787 882-5456

TECHNICAL LETTER REPORT

June 6, 2007

To: Ing. Antonio Hernández Virella
AHV & Associates
Box 1480, Espinar Ward
Aguada, PR 00602

From: Geol. Jaime Feliciano

Re: Summary of Results from Additional Field Work on Subsurface Sampling, Groundwater and Testing Work, Groundwater Investigation, Proposed Discovery Bay Marina Site, Espinar Ward, Aguada, PR

Introduction

As per the request of Ing. Antonio Hernández Virella of AHV & Associates, JFA Geological & Environmental Scientists, P.S.C. (JFA) has conducted additional field activities that included subsurface soil sampling, monitoring well installation and groundwater sampling and testing work at the site of the above-referenced project.

The study was conducted with the primary objective of providing additional field hydrogeologic data to Mr. Kenneth Jones of HYDRO-ENVIRONMENTAL ASSOCIATES from Tampa, Fla., consultants for the proposed project. Preliminary designs indicate that the marina will involve the excavation of surficial soils to a depth of 15 ft. below ground surface (bgs), encompassing an area of approximately 60 acres. The objective of the investigation was to enhance/complement a previous study on saltwater intrusion conditions at the site performed by JFA on December of 2005.

Generalized Geologic and Hydrogeologic Setting

The geology of the study area has been generally described on the Geologic Map of the Aguadilla Quadrangle by W.H. Monroe, U.S.G. S., 1969 (Figure 1, Appendix 1.0). This coastal and flood plain area is primarily underlain by Recent (Quaternary) Age, unconsolidated alluvial sediments (Qa) consisting of clayey sand and sandy clay, containing scattered pebbles and cobbles of volcanic rocks. Coeval swamp deposits consisting of sandy organic muck and peat have been mapped on the northernmost area of the site, overlying the alluvial sediments. Closer to the coastline, the surficial geology is comprised of recent beach deposits, consisting of cross bedded quartz sand and shell fragments.

According to the map, the unconsolidated alluvial sediments would overlie Tertiary Age, Carbonate platform strata of the Cibao Formation at the project site. This formation consists of thick layers of calcarenite, chalky limestone and calcareous clay layers within average thickness of approximately 200-250 meters. Deposits from the basal San Sebastián Formation could also lie underneath the alluvial deposits.

Lithologic descriptions of the above-described alluvial sediments confirming the geologic setting at the site have also been conducted at the site. The studies have been performed by means of subsurface geotechnical borings and the corresponding reports conducted by Advanced Soil Engineering and by Foundation Engineering, Co. on February of 2002 and June 1998, respectively.

Hydrogeologic data from the study area are limited to a regional generalized assessment by the U.S.G.S. on the hydrogeology of northwestern Puerto Rico (T.D. Veve and B.E. Taggart, U.S.G.S. 1996). More recently, in June of 2005, Moffatt and Nichol, Engineers (MNE), have conducted a groundwater flow analysis at the proposed project area. Their evaluation was based on available regional soil characteristics, and field measurements of hydraulic conductivity in the surficial aquifer underlying the site.

According to their reports, two main hydrogeologic units underlie the site. The first aquifer consists of an upper unconfined aquifer composed of stratified unconsolidated alluvial sediments with an assigned thickness of 120 ft bgs. This aquifer is in turn underlain by a limestone formation aquifer of Tertiary Age with an assigned thickness of 600 ft.

MNE has detected groundwater levels in wells varying from 1.89 ft bgs in a well on the northern (coastal) portion of the site, to about 7.10 ft near the southern limit of the proposed project. They have also estimated an average hydraulic conductivity in the surficial aquifer of 45 ft/day, based on hydraulic slug tests performed in the monitoring wells. Based on the above information, MNE has modeled the hydrogeology at the site to simulate the groundwater flow contribution into the proposed marina excavation. Their results indicate that the average rate of total groundwater inflow into the proposed marina

basin will average 2.44 million gallons per day (MGD). Approximately 33% of this total inflow will be generated from the base of the surficial aquifer. Groundwater flow directions generated from the analysis suggest a general north-northeast trend across the alluvial valley, towards the mouth of the Madre Vieja Creek.

The previous water level measurements obtained by JFA on 2005, indicated that groundwater was encountered at the borings drilled at depths varying between 1.23 and 3.5 ft. bgs. Additional measurements obtained from monitoring wells near the coastal area indicate a general groundwater flow of the surficial aquifer in a north-northeast direction and very low hydraulic gradients. No water level measurements had been obtained form areas to the south of the proposed marina basin.

Field Methodology

The additional field work for the groundwater investigation at the site has been conducted by integrating lithological data and groundwater levels and conductivity measurements. The goal was to establish a hydrogeologic profile within the area extending near the coastline and through the proposed excavation for the marina. The resulting "best fit" profile would essentially trend roughly north, northwest-southeast, perpendicular to the existing coastline (Figure 2).

The test hole and monitoring well data were obtained in accessible areas along the proposed profile. Drilling and sampling comprised 5 additional subsoil test holes that were advanced to depths between 50-153 ft., and the installation of four 1.5-inch and one 2-inch, fully-screened monitoring wells with depths varying between 43.08 and 151.00 feet below ground surface. Two locations were selected for the collection of additional grab groundwater samples at pre-determined depths by means of the Geoprobe Screenpoint 16 Groundwater Sampling System.

Drilling and groundwater testing activities were performed during the period of April 11 to May 18, 2007. JFA performed drilling and monitoring well installation at locations WB-6, WB-7R and WB-8 (50-feet depth wells). Advance Soils Engineers performed subsurface soil sampling and groundwater well installation of wells WB-9 and WB-10 (150-feet depth wells).

Groundwater testing included the collection of groundwater levels and temperature and conductivity readings in units of µs/cm with a Solinst Model 107TCL. In addition, a groundwater sampling event was conducted on May 18, 2007 to analyze samples for total dissolved solids (TDS), chloride and sulfates (Methods SM 2540 C, SM 4500 Cl E, and ASTM D 516-90,02, respectively).

Subsoil Sampling and Groundwater Monitoring Well Installation

A total of five (5) additional, fully-screened groundwater monitoring wells were installed in the study area for the collection of subsoil data and groundwater temperature and conductivity measurements. The locations of test holes and monitoring wells (WB-6 through WB-10) are shown in Figure 2. Available subsoil descriptions from previous geotechnical and hydrogeological studies at the site have indicated generally uniform stratigraphic conditions dominated by sand deposits and a very shallow (2-5 ft.) water table.

The subsoil sampling and groundwater monitoring well installations were performed by means of Geoprobe® 6610-DT direct push soil-probing rig as well as by means of the Hollow Stem Auger Standard Penetration Test. Samples were collected with the Geoprobe® macro-core sampler and the split spoon sampler at pre-selected depths or as dictated by geologic conditions.

In general, the subsoil sampling confirms the above-described geologic setting and revealed the presence of the following geologic layered sequence (Alluvial Deposits) in the area of the borings:

> 0-0.2 ft. - Thin layer of top soil, consisting of medium to stiff sandy clay, with little roots and wood fragments, dark brown, dark yellowish brown.
>
> 0.2-10.0 ft. - Stiff to very stiff sandy clay and/or clay, yellowish brown, dark brown.
>
> 10.0-40.0 ft. - Loose, light yellowish brown, fine to medium sand (grades with depth into coarse sand), trace fine gravel.
>
> 40.0-50.0 - Dense to medium dense, coarse to medium sand, little shell fragments, dark gray, olive gray with a trace of organic odor.
>
> Well WB-9:
> 0-50.0 ft. - As above (alluvial deposits).
> 107.0 - 150.0 - Stiff to very stiff sandy clay, alternated with medium stiff clay and clayey sand, little subangular to subrounded fine gravel, olive brown. (Assigned to deposits of the San Sebastián Formation).
>
> Well WB-10:
> 0-38.0 ft. - As above (alluvial deposits).
> 38.0 - 150.0 ft. - Alternated chalky, sandy and fossiliferous limestone surrounded by calcareous clay matrix. This is part of the Cibao Formation underlying the Alluvial deposits described above.

A generalized geologic cross-section from the site and based on the results of the subsoil description is presented on Figure 3.

Monitoring wells were installed by means of the DT32 (dual-tube) system and hollow stem auger method. Monitoring locations WB-6, WB-8, WB-9, and WB-10 were constructed as fully-screened wells to the attained depths and were constructed of a 1.5-inch, schedule 40 PVC material. A 2.5 section of PVC riser pipe was installed at the top of each well. Well WB-7R was constructed of 2-inch, schedule 40 PVC material. The wells were surface-finished with a steel protective cover and a cement-bentonite apron. Complete subsoil and well construction logs are presented in Appendix 2.0.

Groundwater Levels

Groundwater was encountered at the borings drilled at depths varying between 15 and 20 ft. bgs. Additional measurements obtained from the top of the casings of monitoring wells and latter converted into GW elevations above MSL. A summary of groundwater levels and elevations is presented in Table 1.0.

Conductivity Measurements

The results of the groundwater conductivity measurements collected on May 16-17 2007 are presented in the well logs in Appendix 3.0. All wells were developed with submersible pumps and/or air surging prior to performing the collection of measurements. The wells were left to stabilize for a minimum of 24 hours following development.

Conductivity and temperature measurements were obtained with an electronic water level, temperature and conductivity meter (Model 107 TLC) from Solinst. The instrument was properly calibrated prior to its use with buffer solutions provided by the manufacturer. A summary of all conductivity and temperature readings obtained prior to development and sampling are provided on the boring logs and tables in Appendix 3.0. Measurements include the first data logging after well installation and flushing with potable water as well as the measurements following air surging (pressurized air through a tremie pipe) and or pumping during development, prior to sampling.

Groundwater Sampling

As indicated above, a groundwater sampling event was conducted on May 18, 2007 to analyze samples for total dissolved solids (TDS), chloride and sulfates (Methods SM 2540 C, SM 4500 Cl E, and ASTM D 516-90,02, respectively). Samples were collected at 1.5-inch wells using a bladder pump, while samples from the 2.0-inch wells were collected by means of an electrical submersible pump.

Samples were obtained at various depths as shown in the following table. Note that conductivity measurements were obtained with the Horiba U10 Water Quality Checker.

Sample	Depth (ft.)	Time	Cond. (ms/cm)
WB-1A	10.0	1400	17.7
WB-1B	35.0	1405	45.5
WB-2A	10.0	1325	21.1
WB-2B	45.0	1330	27.8
WB-3A	15.0	1305	1.14
WB-3B	45.0	1310	35.5
WB-4A	10.0	1250	0.763
WB-4B	35.0	1255	0.746
WB-5A	15.0	1345	20.2
WB-5B	40.0	1350	33.0
WB-6A	13.0	1240	0.883
WB-6B	48.0	1335	0.98
WB-7A	15.0	1226	1.32
WB-7B	40.0	1235	1.22
WB-8A	15.0	1125	0.783
WB-8B	50.0	1150	6.13
WB-9A	20.0	1435	25.7
WB-9B	78.0	1525	25.9
WB-9C	102.0	1600	25.9
WB-10A	5.0	0905	4.38
WB-10B	75.0	0945	5.63
WB-10C	145.0	1025	5.60

Notes:
Analysis: **TDS, Chloride, Sulfates**
Sample Collection: **JFA**

An additional grab groundwater sample was collected at 70.0 ft. bgs at location GSW-4. An attempt was made to collect an additional grab groundwater sample at location GWS-3. However, the presence of a thick layer of organic and impermeable clay yielded no groundwater at the target depth. Field sampling logs and groundwater parameters as well as chain of custody documentation are presented in Appendix 4.0. Certified laboratory results are included in Appendix 5.0.

APPENDIX 1.0 Figures and Tables

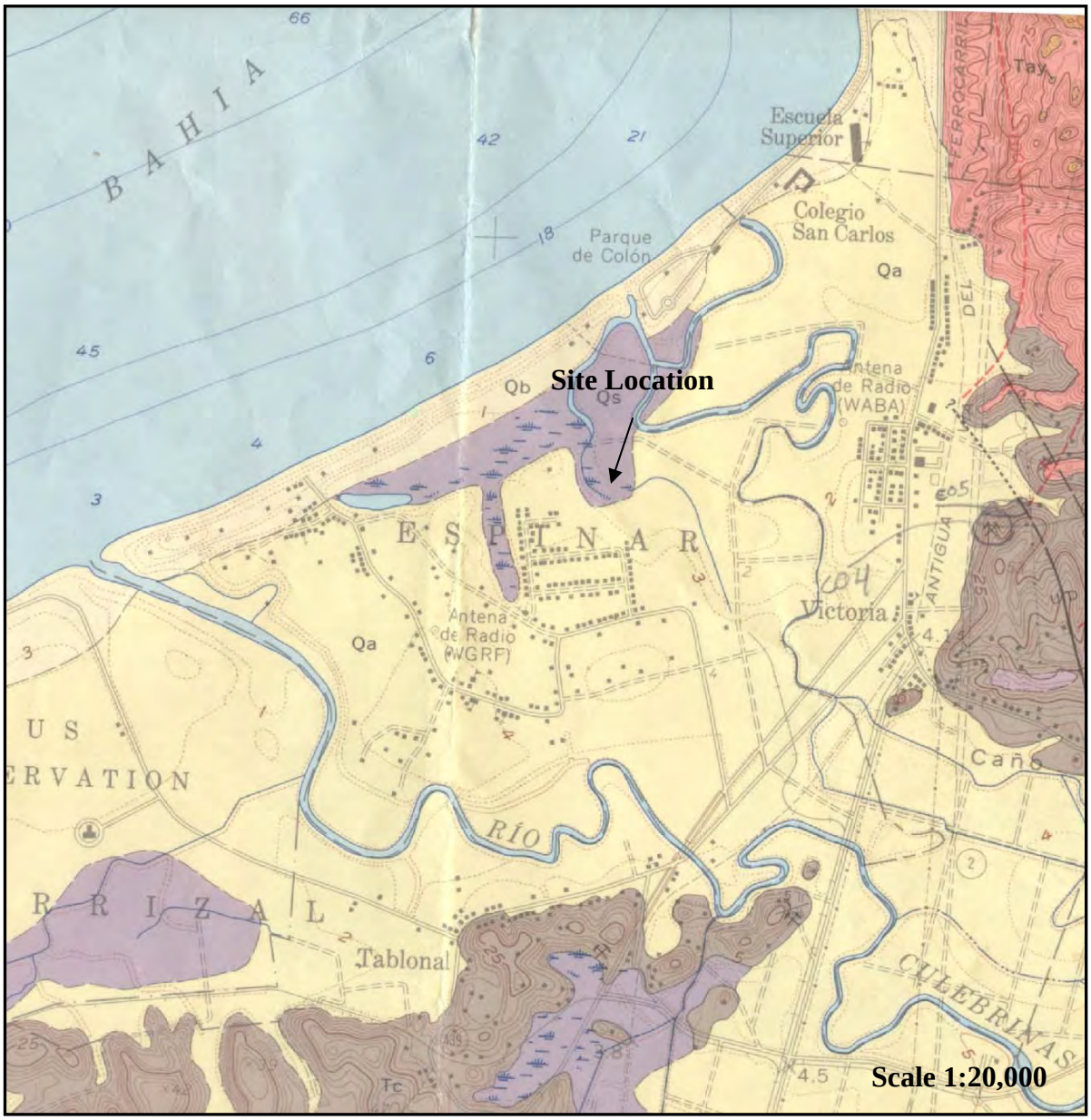


Figure 1. Geologic map of the proposed study area. (Adapted from the USGS Aguadilla Geologic Map, 1962).

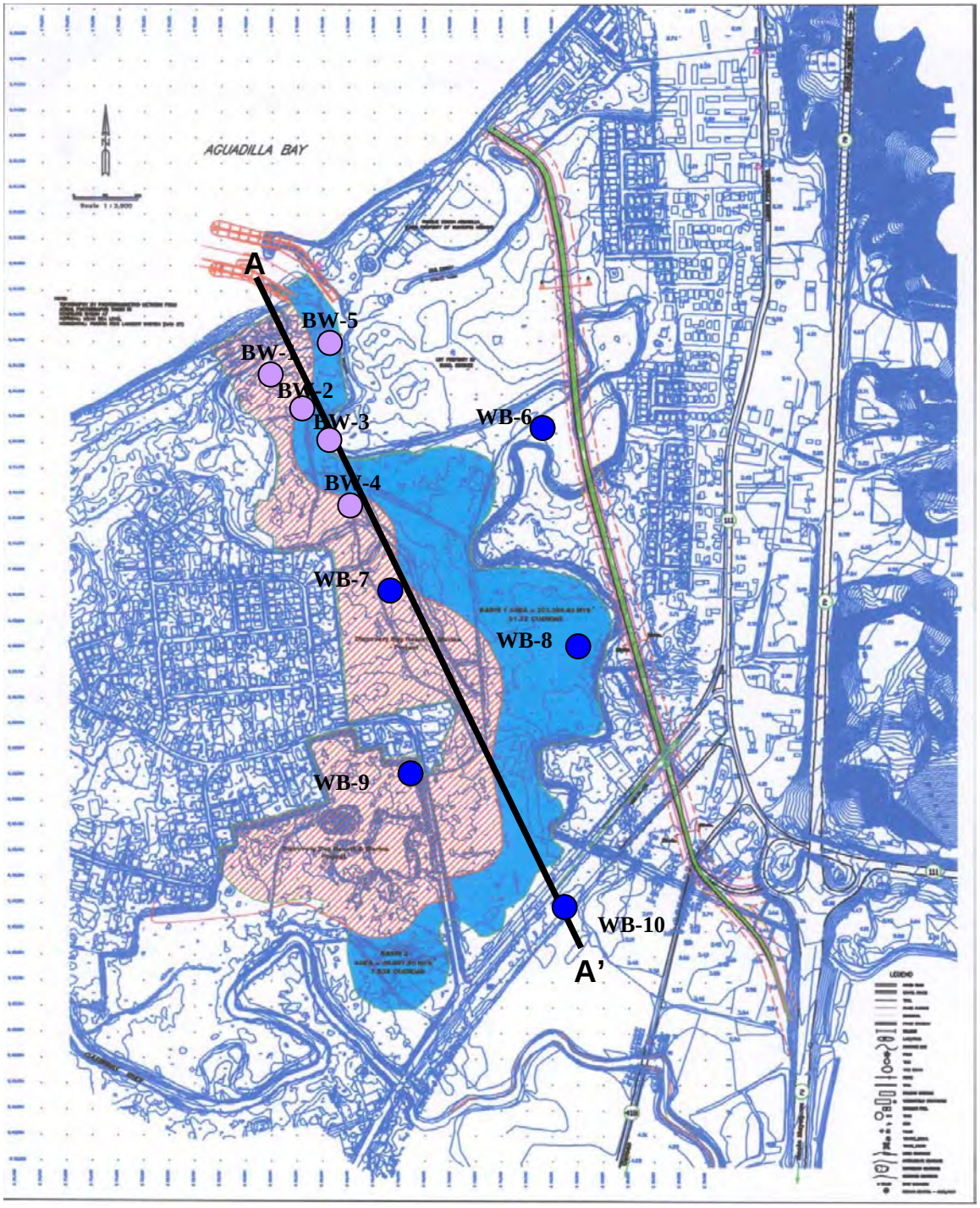


Figure 2. Locations of Additional Subsoil and Monitoring Wells.

- Wells WB-6, WB-7 and WB-8 to depths of 50 ft, and wells WB-9 and WB-10 of 150 ft.
- Existing Monitoring Wells.

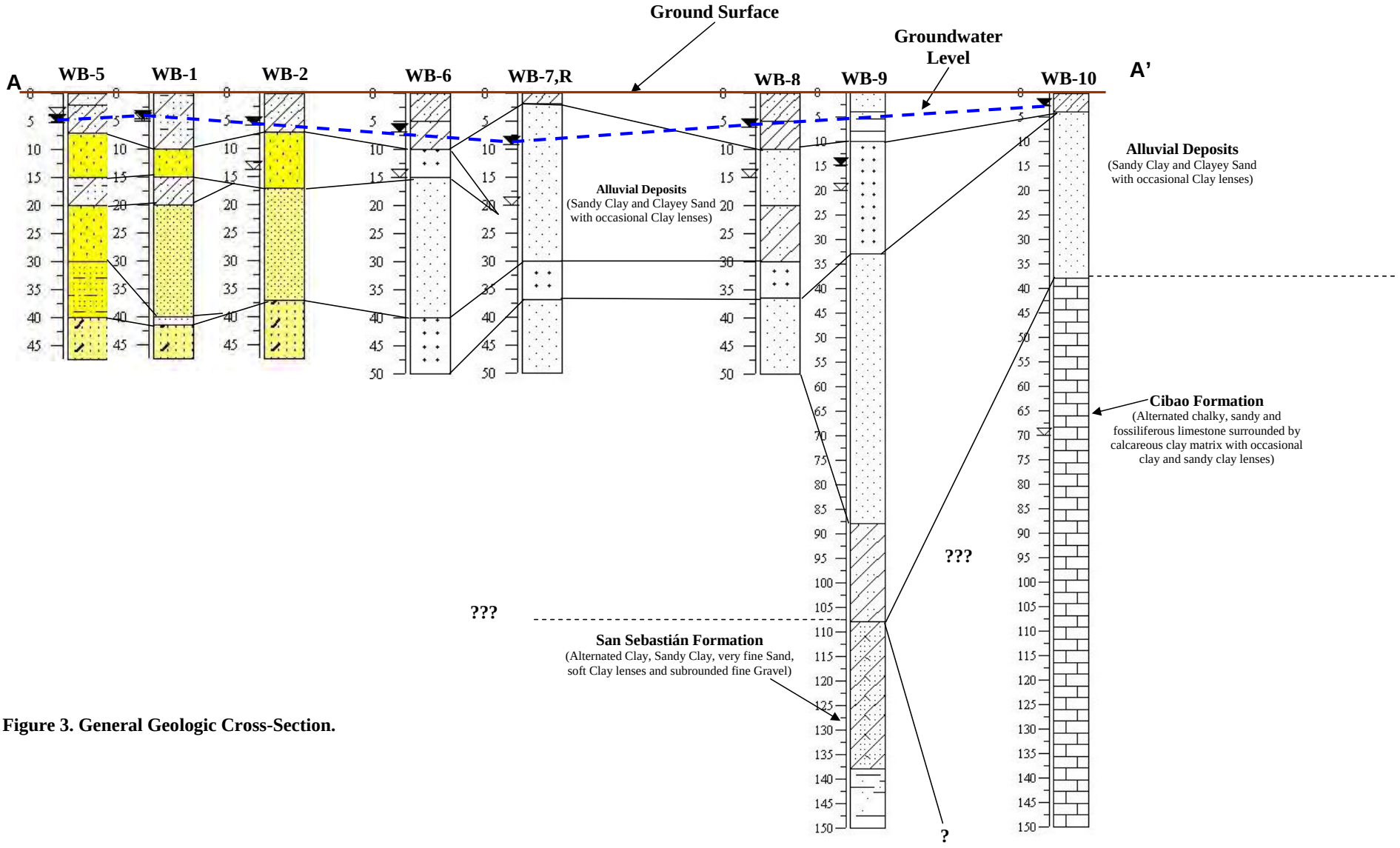


Figure 3. General Geologic Cross-Section.

Table 1.0

x(Easting)	y(Northing)	z (GS Elev ft.)	z (PVC Elev ft.)	GW Level ft. (top of PVC)	Well/Boring ID
75264.034	64346.488	2.214	5.753	5.54	BW-1
75307.395	64286.785	4.067	7.213	6.84	BW-2
75345.304	64200.250	2.873	5.940	5.86	BW-3
75417.247	64080.354	3.615	5.865	7.12	BW-4
75355.321	64375.048	2.244	6.386	5.97	BW-5
75741.913	64217.546	6.383	9.043	8.40	WB-6
75548.941	63922.438	2.860	6.429	11.97	WB-7,R
75900.679	63892.844	8.062	10.699	7.53	WB-8
75481.677	63571.360	11.349	15.386	15.40	WB-9
75843.029	63332.076	10.027	9.814	3.75	WB-10
75661.150	63836.384	---	---	---	GWS-1
75783.600	63684.850	---	---	---	GWS-2
75786.350	63358.052	10.024	---	---	GWS-3
75550.315	63921.814	2.772	---	---	GWS-4

2005 Study Data
2007 Study Data

GS- Ground Surface
GW- Ground Water
PVC- top of PVC case

APPENDIX 2.0 Subsoil and Well Construction Logs with Conductivity and Temperature Measurements

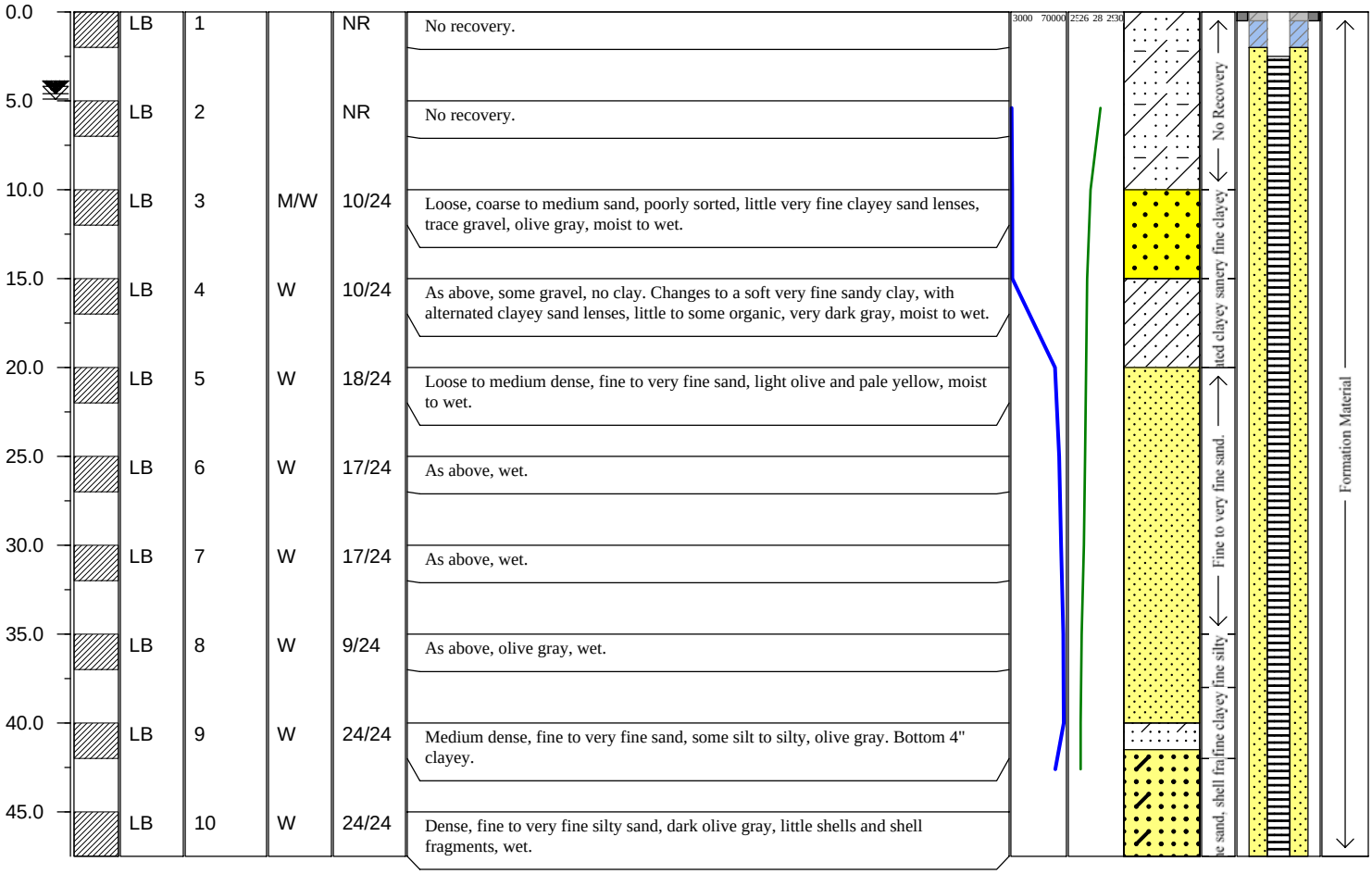
JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-1

PROJECT NUMBER: **291-05** CLIENT: **Cordeco Northwest Corp.**
PROJECT NAME: **Groundwater Investigation Discovery Bay Marina**
LOCATION: **Aguada, PR**
DRILLING CO: **JFA Geological & Environmental Scientists**
DRILLING METHOD: **DT-32 Geoprobe**
FOREMAN: **D. González**
GEOLOGIST: **G. García**
DATE BEGUN: **11/29/05** DATE COMPLETED: **11/29/05**

BOREHOLE/WELL DIAM.: **3.5"/2.0"**
TOTAL DEPTH (ft.): **47.5'**
GROUND SURFACE ELEVATION: **0.675 mts.**

STATIC WATER LEVEL (Measured fromTop of Casing)	
Depth (ft)	**5.40**
Time	**1105**
*Date	**5/16/2007**

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	RECOVERY	SOIL/ROCK DESCRIPTION
0.0		LB	1		NR	No recovery.
5.0		LB	2		NR	No recovery.
10.0		LB	3	M/W	10/24	Loose, coarse to medium sand, poorly sorted, little very fine clayey sand lenses, trace gravel, olive gray, moist to wet.
15.0		LB	4	W	10/24	As above, some gravel, no clay. Changes to a soft very fine sandy clay, with alternated clayey sand lenses, little to some organic, very dark gray, moist to wet.
20.0		LB	5	W	18/24	Loose to medium dense, fine to very fine sand, light olive and pale yellow, moist to wet.
25.0		LB	6	W	17/24	As above, wet.
30.0		LB	7	W	17/24	As above, wet.
35.0		LB	8	W	9/24	As above, olive gray, wet.
40.0		LB	9	W	24/24	Medium dense, fine to very fine sand, some silt to silty, olive gray. Bottom 4" clayey.
45.0		LB	10	W	24/24	Dense, fine to very fine silty sand, dark olive gray, little shells and shell fragments, wet.



Key:
- Water Level During Drilling
- Static Water Level
- SS-Split Spoon Sample
- RC-Rock Core Sample
- M-Moist
- SM-Slightly Moist
- D-Dry
- W-Wet
- ND-Non Detected
- Conductivity
- Temperature

***NOTE: Conductivity & Temperature Measured Same DATE**

JFA Geological & Environmental Scientists | **FIELD BOREHOLE LOG** | BOREHOLE NUMBER **WB-2**

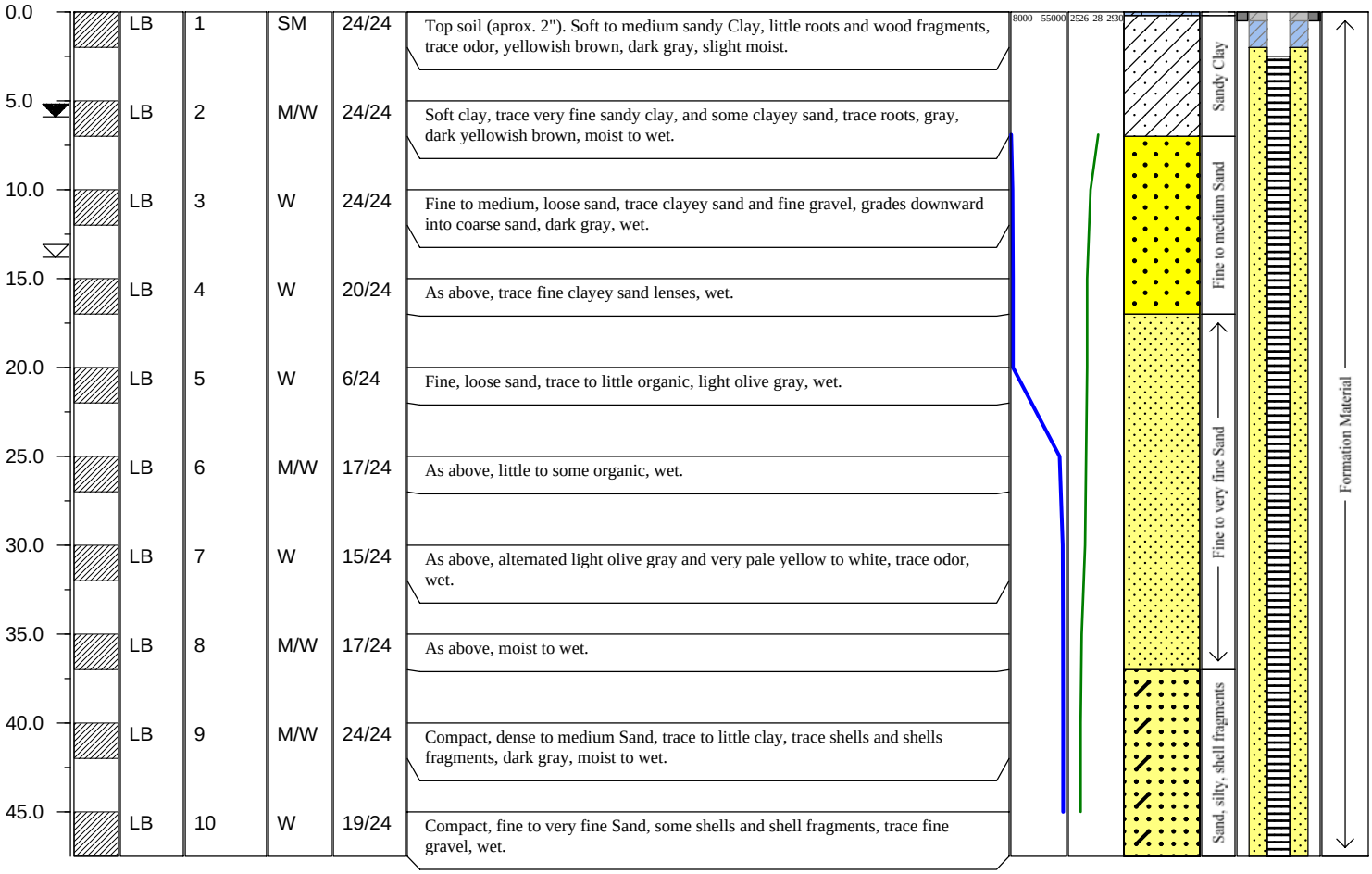
PROJECT NUMBER: **291-05** CLIENT: **Cordeco Northwest Corp.**
PROJECT NAME: **Groundwater Investigation Discovery Bay Marina**
LOCATION: **Aguada, PR**
DRILLING CO: **JFA Geological & Environmental Scientists**
DRILLING METHOD: **DT-32 Geoprobe**
FOREMAN: **D. González**
GEOLOGIST: **G. García**
DATE BEGUN: **12/1/05** DATE COMPLETED: **12/1/05**

BOREHOLE/WELL DIAM.: **3.5"/2.0"**
TOTAL DEPTH (ft.): **47.5**
GROUND SURFACE ELEVATION: **1.24 mts.**

STATIC WATER LEVEL (Measured fromTop of Casing)	
Depth (ft)	**6.90**
Time	**1200**
*Date	**5/16/2007**

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	RECOVERY	SOIL/ROCK DESCRIPTION
0.0		LB	1	SM	24/24	Top soil (aprox. 2"). Soft to medium sandy Clay, little roots and wood fragments, trace odor, yellowish brown, dark gray, slight moist.
5.0		LB	2	M/W	24/24	Soft clay, trace very fine sandy clay, and some clayey sand, trace roots, gray, dark yellowish brown, moist to wet.
10.0		LB	3	W	24/24	Fine to medium, loose sand, trace clayey sand and fine gravel, grades downward into coarse sand, dark gray, wet.
15.0		LB	4	W	20/24	As above, trace fine clayey sand lenses, wet.
20.0		LB	5	W	6/24	Fine, loose sand, trace to little organic, light olive gray, wet.
25.0		LB	6	M/W	17/24	As above, little to some organic, wet.
30.0		LB	7	W	15/24	As above, alternated light olive gray and very pale yellow to white, trace odor, wet.
35.0		LB	8	M/W	17/24	As above, moist to wet.
40.0		LB	9	M/W	24/24	Compact, dense to medium Sand, trace to little clay, trace shells and shells fragments, dark gray, moist to wet.
45.0		LB	10	W	19/24	Compact, fine to very fine Sand, some shells and shell fragments, trace fine gravel, wet.

Conductivity (µS/cm) | Temperature (°F) | LITHOLOGY | FORMATION TYPE | WELL INSTALLATION | WELL CONST.



Key:
- Water Level During Drilling
- Static Water Level

***NOTE: Conductivity & Temperature Measured Same DATE**

SS-Split Spoon Sample | RC-Rock Core Sample | M-Moist | SM-Slightly Moist | D-Dry | W-Wet | ND-Non Detected

Conductivity
Temperature

JFA Geological & Environmental Scientists	WELL LOG	BOREHOLE NUMBER WB-3

PROJECT NUMBER: **291-05** CLIENT: **Cordeco Northwest Corp.** BOREHOLE/WELL DIAM.: **3.5"/2.0"**

PROJECT NAME: **Groundwater Investigation Discovery Bay Marina** TOTAL DEPTH (ft.): **47.5**

LOCATION: **Aguada, PR** GROUND SURFACE ELEVATION: **0.876 mts.**

DRILLING CO: **JFA Geological & Environmental Scientists**

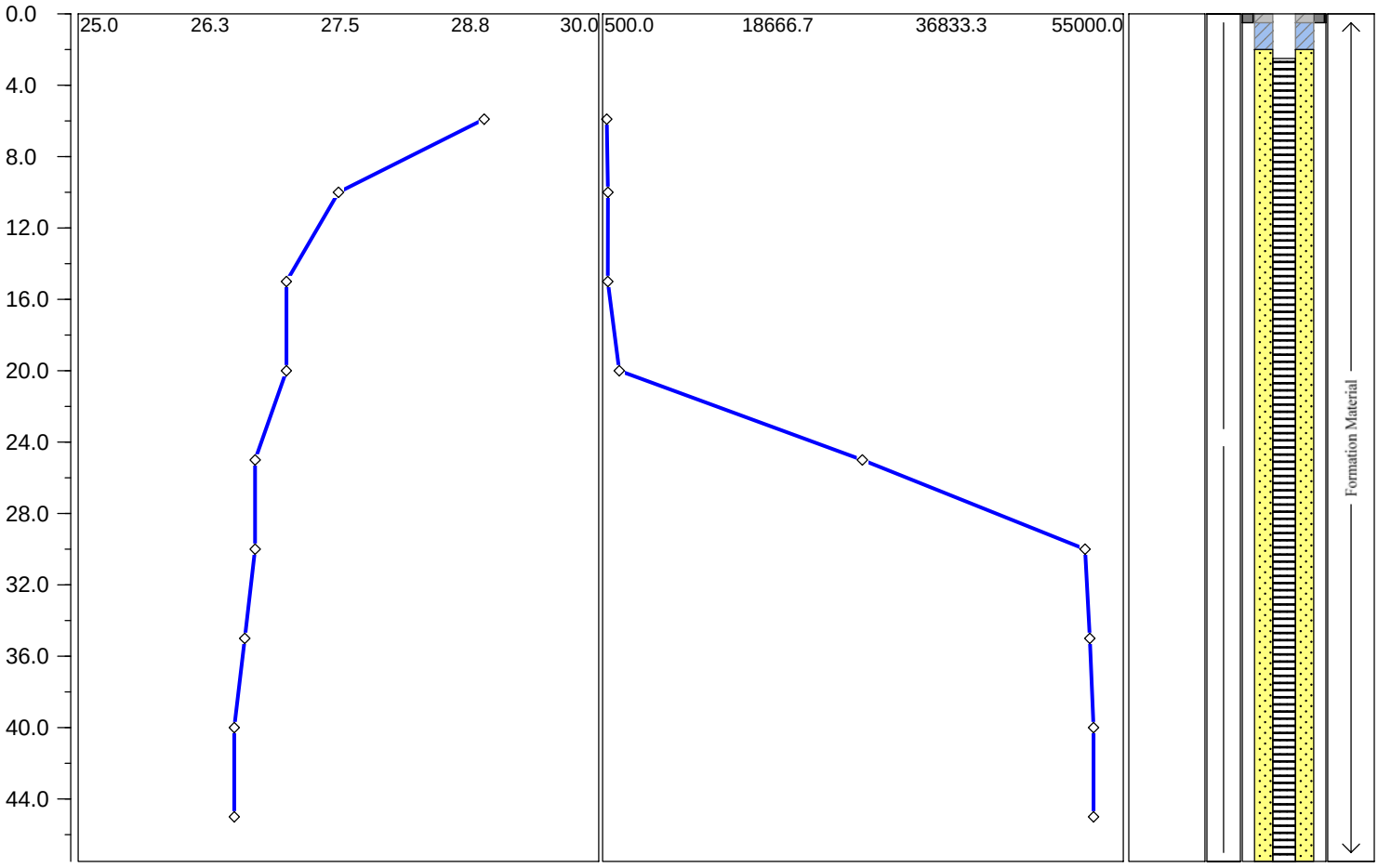
DRILLING METHOD: **DT-32 Geoprobe**

FOREMAN: **D. González**

GEOLOGIST: **G. García**

DATE BEGUN: **11/30/05** DATE COMPLETED: **11/30/05**

STATIC WATER LEVEL (Measured fromTop of Casing)	
Depth (ft)	**5.90**
Time	**1220**
*Date	**5/16/2007**



Key:

***NOTE: Conductivity & Temperature Measured Same DATE**

Water Level During Drilling SS-Split Spoon Sample LB- Large Bore Sampler D-Dry M-Moist ND-Non Detected

Static Water Level RC-Rock Core Sample MC-Macro Core Sample SM-Slightly Moist W-Wet

JFA Geological & Environmental Scientists	WELL LOG	BOREHOLE NUMBER WB-4

PROJECT NUMBER: **291-05** CLIENT: **Cordeco Northwest Corp.** BOREHOLE/WELL DIAM.: **3.5"/2.0"**

PROJECT NAME: **Groundwater Investigation Discovery Bay Marina** TOTAL DEPTH (ft.): **47.5**

LOCATION: **Aguada, PR** GROUND SURFACE ELEVATION: **1.102 mts.**

DRILLING CO: **JFA Geological & Environmental Scientists**

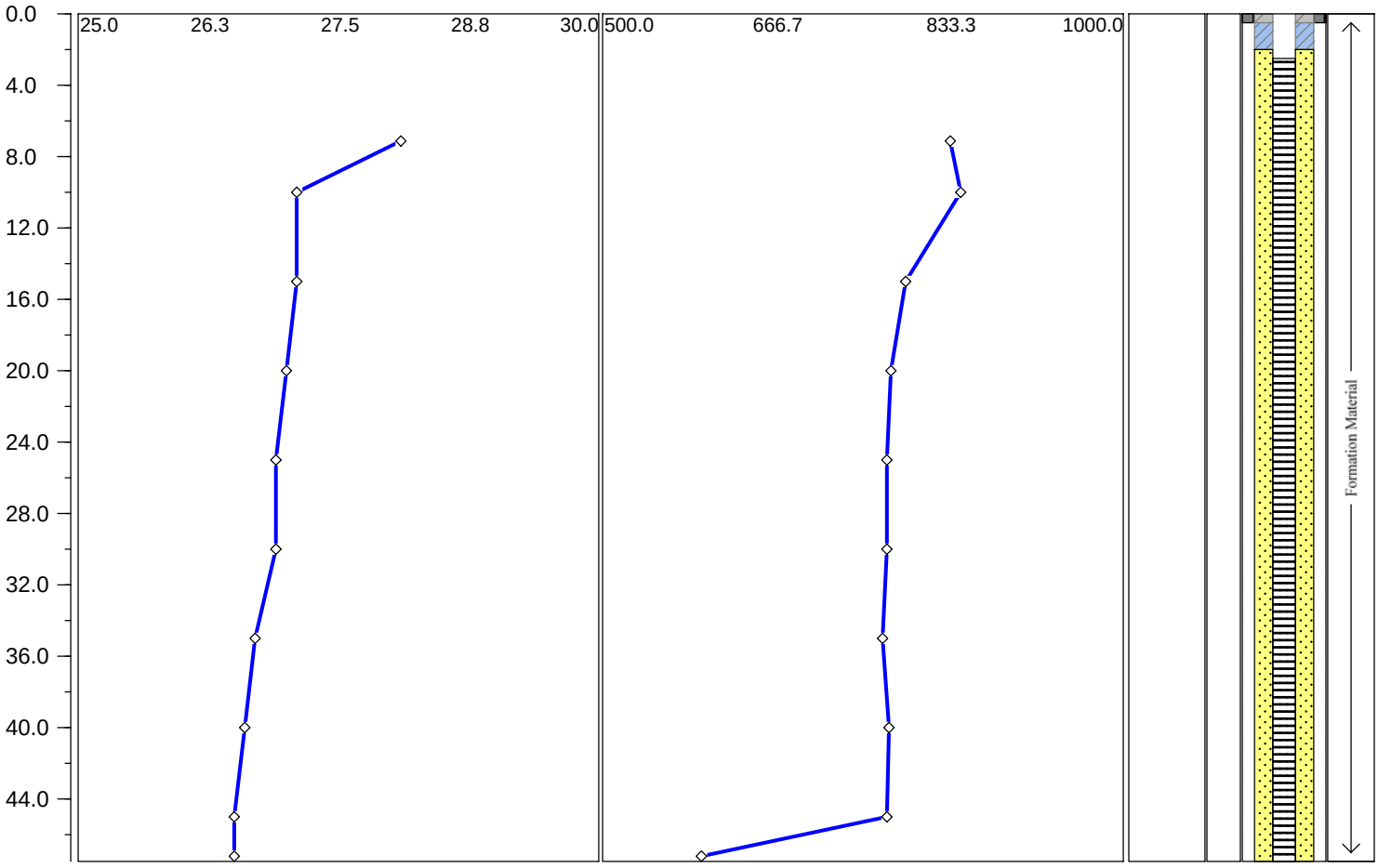
DRILLING METHOD: **DT-32 Geoprobe**

FOREMAN: **D. González**

GEOLOGIST: **G. García**

DATE BEGUN: **11/30/05** DATE COMPLETED: **11/30/05**

STATIC WATER LEVEL (Measured fromTop of Casing)	
Depth (ft)	**7.13**
Time	**1240**
*Date	**5/16/2007**



Key:

***NOTE: Conductivity & Temperature Measured Same DATE**

Water Level During Drilling SS-Split Spoon Sample LB- Large Bore Sampler D-Dry M-Moist ND-Non Detected

Static Water Level RC-Rock Core Sample MC-Macro Core Sample SM-Slightly Moist W-Wet

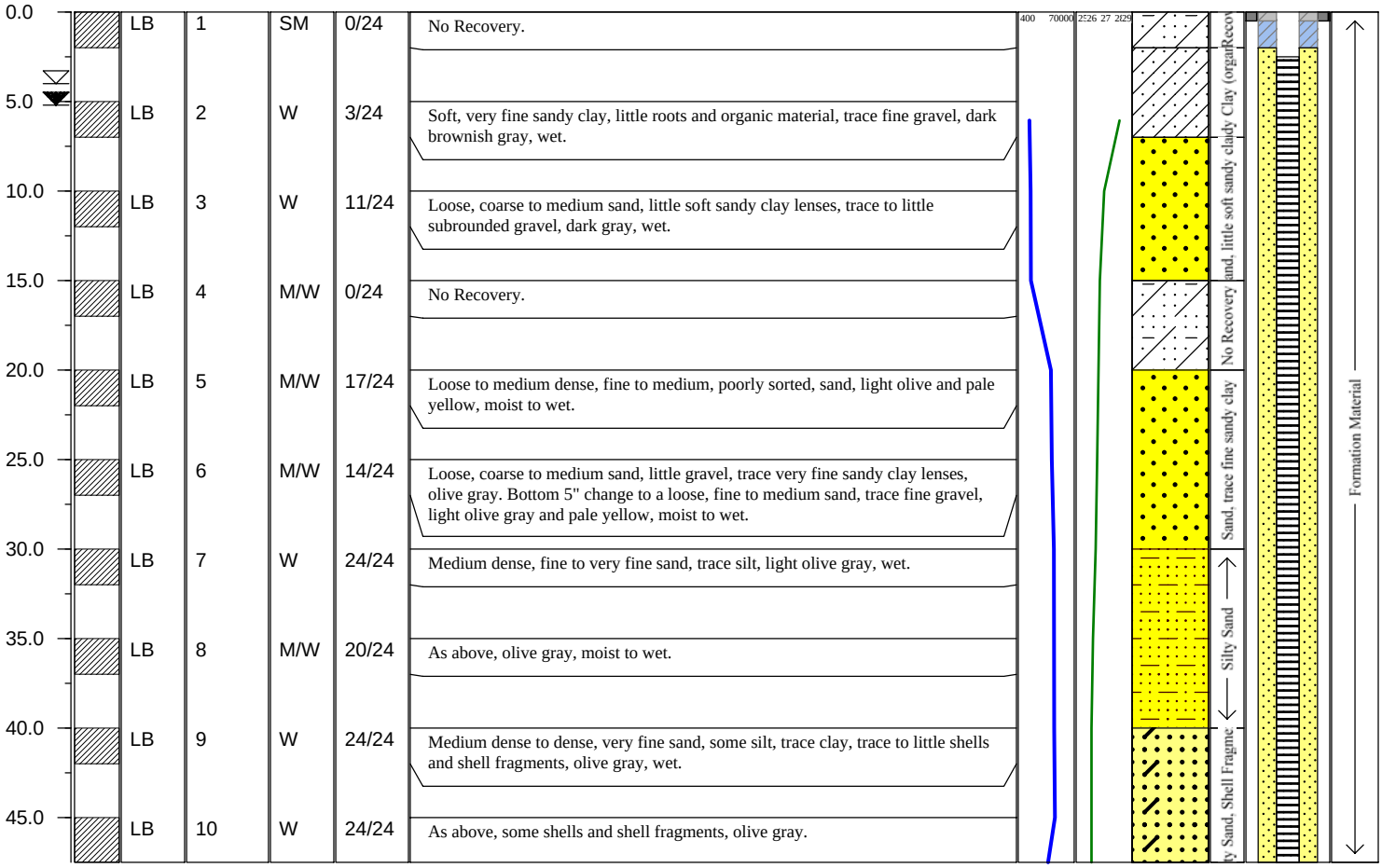
JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-5

PROJECT NUMBER: **291-05** CLIENT: **Cordeco Northwest Corp.**
PROJECT NAME: **Groundwater Investigation Discovery Bay Marina**
LOCATION: **Aguada, PR**
DRILLING CO: **JFA Geological & Environmental Scientists**
DRILLING METHOD: **DT-32 Geoprobe**
FOREMAN: **D. González**
GEOLOGIST: **G. García**
DATE BEGUN: **12/2/05** DATE COMPLETED: **12/2/05**

BOREHOLE/WELL DIAM.: **3.5"/2.0"**
TOTAL DEPTH (ft.): **47.5**
GROUND SURFACE ELEVATION: **0.684 mts.**

STATIC WATER LEVEL (Measured fromTop of Casing)	
Depth (ft)	**6.06**
Time	**1140**
*Date	**5/16/2007**

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	RECOVERY	SOIL/ROCK DESCRIPTION
0.0		LB	1	SM	0/24	No Recovery.
5.0		LB	2	W	3/24	Soft, very fine sandy clay, little roots and organic material, trace fine gravel, dark brownish gray, wet.
10.0		LB	3	W	11/24	Loose, coarse to medium sand, little soft sandy clay lenses, trace to little subrounded gravel, dark gray, wet.
15.0		LB	4	M/W	0/24	No Recovery.
20.0		LB	5	M/W	17/24	Loose to medium dense, fine to medium, poorly sorted, sand, light olive and pale yellow, moist to wet.
25.0		LB	6	M/W	14/24	Loose, coarse to medium sand, little gravel, trace very fine sandy clay lenses, olive gray. Bottom 5" change to a loose, fine to medium sand, trace fine gravel, light olive gray and pale yellow, moist to wet.
30.0		LB	7	W	24/24	Medium dense, fine to very fine sand, trace silt, light olive gray, wet.
35.0		LB	8	M/W	20/24	As above, olive gray, moist to wet.
40.0		LB	9	W	24/24	Medium dense to dense, very fine sand, some silt, trace clay, trace to little shells and shell fragments, olive gray, wet.
45.0		LB	10	W	24/24	As above, some shells and shell fragments, olive gray.



Key:
- Water Level During Drilling
- Static Water Level

SS-Split Spoon Sample
RC-Rock Core Sample

***NOTE: Conductivity & Temperature Measured Same DATE**

M-Moist
SM-Slightly Moist

D-Dry
W-Wet

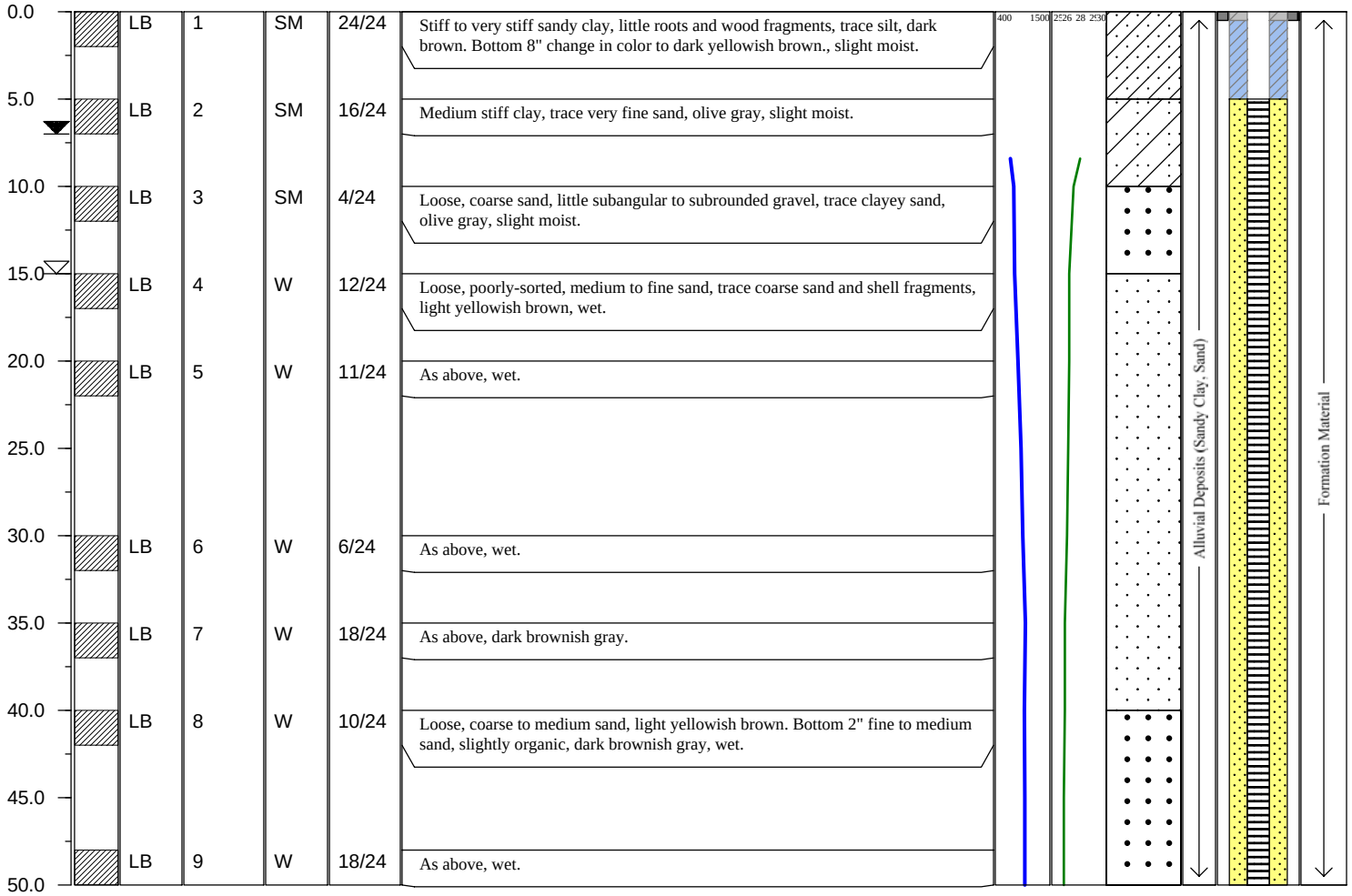
ND-Non Detected
Conductivity
Temperature

JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-6

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Corp.**
PROJECT NAME: **Additional Work Geologic & Hydrogeologic Characterization**
LOCATION: **Aguada, PR**
DRILLING CO: **JFA Geological & Environmental Scientists**
DRILLING METHOD: **Geoprobe®**
FOREMAN: **D. González**
GEOLOGIST: **G. García**
DATE BEGUN: **4/9/2007** DATE COMPLETED: **4/11/2007**

BOREHOLE/WELL DIAM.: **3.5"/1.5"**
TOTAL DEPTH (ft.): **50.0'**
GROUND SURFACE ELEVATION: ---

STATIC WATER LEVEL (Measured fromTop of Casing)	
Depth (ft)	**8.41**
Time	**915**
*Date	**5/17/2007**



Key:
- Water Level During Drilling
- Static Water Level

***NOTE: Conductivity & Temperature Measured Same DATE**

SS-Split Spoon Sample
RC-Rock Core Sample

M-Moist
SM-Slightly Moist

D-Dry
W-Wet

ND-Non Detected
Conductivity
Temperature

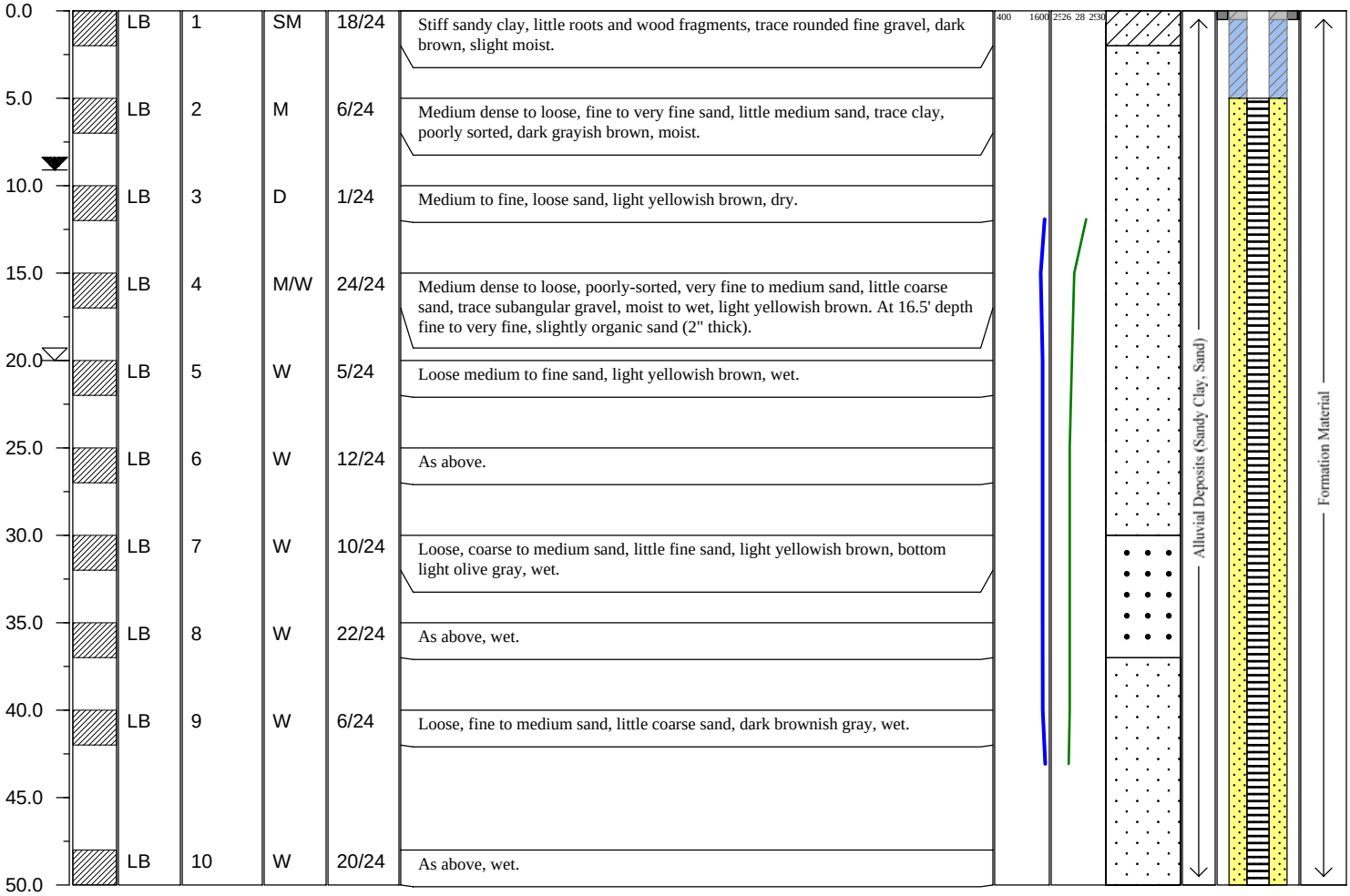
JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-7,R

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Corp.**
PROJECT NAME: **Additional Work Geologic & Hydrogeologic Characterization**
LOCATION: **Aguada, PR**
DRILLING CO: **JFA Geological & Environmental Scientists**
DRILLING METHOD: **Geoprobe®**
FOREMAN: **D. González**
GEOLOGIST: **G. García**
DATE BEGUN: **5/14/2007** DATE COMPLETED: **5/14/2007**

BOREHOLE/WELL DIAM.: **3.5"/1.5"**
TOTAL DEPTH (ft.): **50.0'**
GROUND SURFACE ELEVATION: **---**

STATIC WATER LEVEL (Measured fromTop of Casing)	
Depth (ft)	**11.92**
Time	**1300**
*Date	**5/16/2007**

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	RECOVERY	SOIL/ROCK DESCRIPTION
0.0		LB	1	SM	18/24	Stiff sandy clay, little roots and wood fragments, trace rounded fine gravel, dark brown, slight moist.
5.0		LB	2	M	6/24	Medium dense to loose, fine to very fine sand, little medium sand, trace clay, poorly sorted, dark grayish brown, moist.
10.0		LB	3	D	1/24	Medium to fine, loose sand, light yellowish brown, dry.
15.0		LB	4	M/W	24/24	Medium dense to loose, poorly-sorted, very fine to medium sand, little coarse sand, trace subangular gravel, moist to wet, light yellowish brown. At 16.5' depth fine to very fine, slightly organic sand (2" thick).
20.0		LB	5	W	5/24	Loose medium to fine sand, light yellowish brown, wet.
25.0		LB	6	W	12/24	As above.
30.0		LB	7	W	10/24	Loose, coarse to medium sand, little fine sand, light yellowish brown, bottom light olive gray, wet.
35.0		LB	8	W	22/24	As above, wet.
40.0		LB	9	W	6/24	Loose, fine to medium sand, little coarse sand, dark brownish gray, wet.
45.0						
50.0		LB	10	W	20/24	As above, wet.



Key:
- Water Level During Drilling
- Static Water Level

***NOTE: Conductivity & Temperature Measured Same DATE**

SS-Split Spoon Sample
RC-Rock Core Sample

M-Moist
SM-Slightly Moist

D-Dry
W-Wet

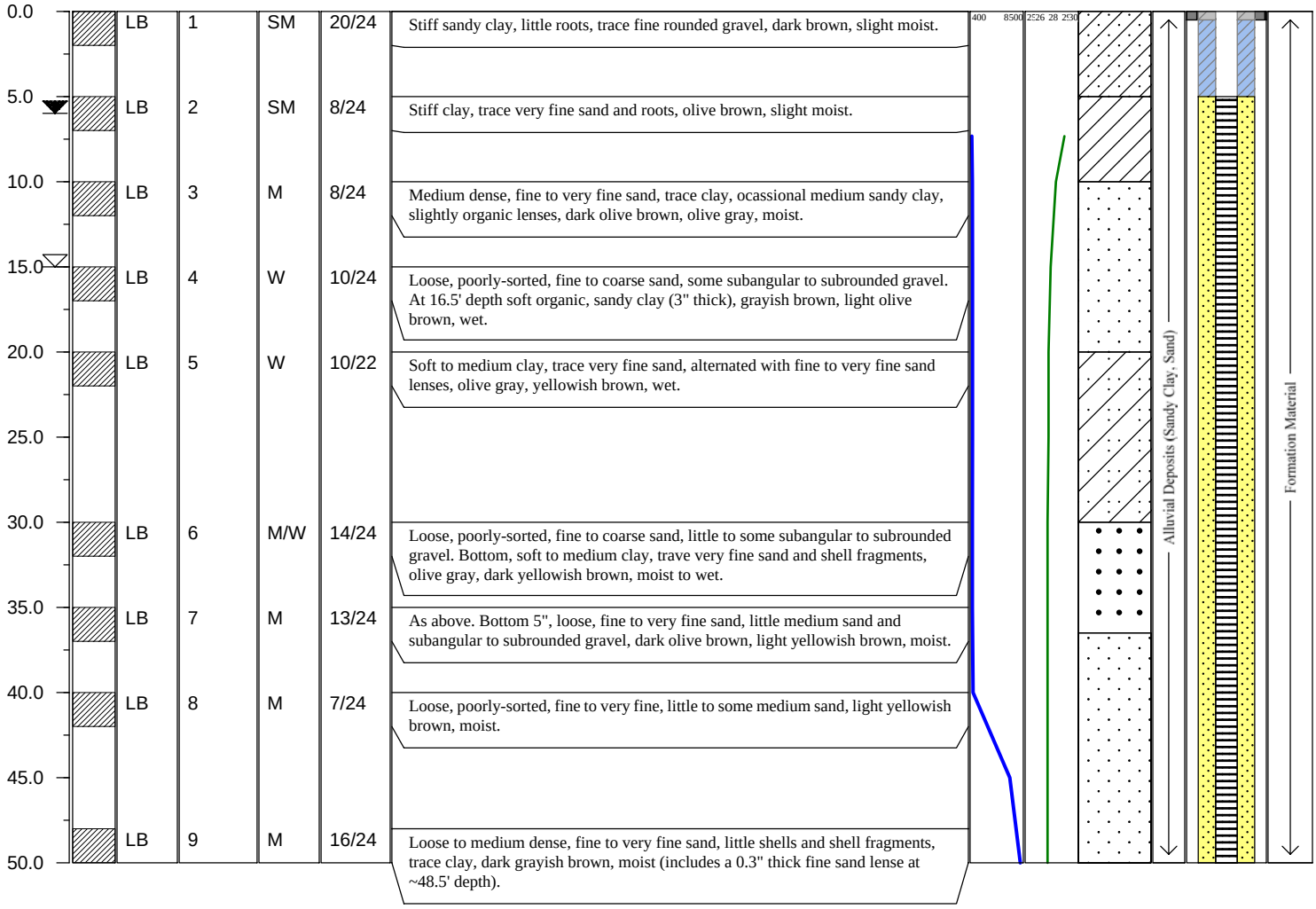
ND-Non Detected
Conductivity
Temperature

JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-8

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Corp.**
PROJECT NAME: **Additional Work Geologic & Hydrogeologic Characterization**
LOCATION: **Aguada, PR**
DRILLING CO: **JFA Geological & Environmental Scientists**
DRILLING METHOD: **Geoprobe®**
FOREMAN: **D. González**
GEOLOGIST: **G. García**
DATE BEGUN: **4/10/2007** DATE COMPLETED: **4/11/2007**

BOREHOLE/WELL DIAM.: **3.5"/1.5"**
TOTAL DEPTH (ft.): **50.0'**
GROUND SURFACE ELEVATION: **---**

STATIC WATER LEVEL (Measured fromTop of Casing)	
Depth (ft)	**7.32**
Time	**935**
*Date	**5/17/2007**



Key:
- Water Level During Drilling
- Static Water Level

***NOTE: Conductivity & Temperature Measured Same DATE**

SS-Split Spoon Sample
RC-Rock Core Sample

M-Moist
SM-Slightly Moist
D-Dry
W-Wet

ND-Non Detected
Conductivity
Temperature

JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-9

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Co.** BOREHOLE/WELL DIAM.: **4.5"/1.5"**

PROJECT NAME: **Additional Work on Geologic & Hydrogeologic Characterization** TOTAL DEPTH (ft.): **150.0'**

LOCATION: **Aguada, PR** WELL DEPTH (ft.): GROUND SURFACE ELEVATION: **n/a**

DRILLING CO: **JFA Geological & Environmental Scientists**

DRILLING METHOD: **Hollow Stem Auger**

FOREMAN: **M. Razuk**

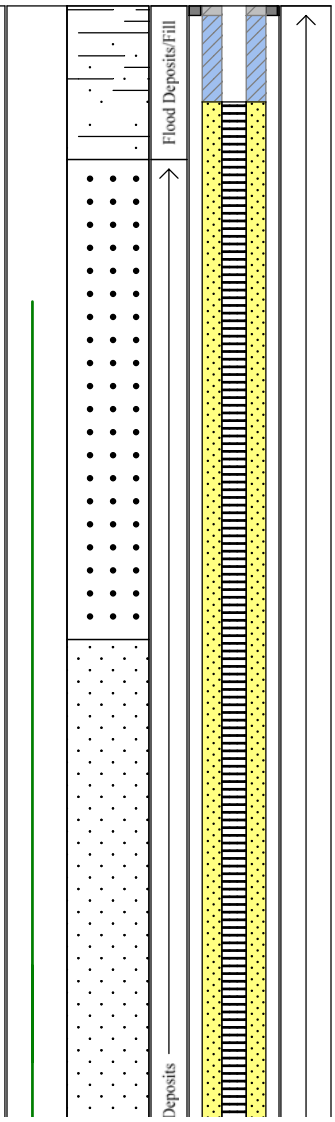
GEOLOGIST: **G. García**

DATE BEGUN: **4/23/2007** DATE COMPLETED: **4/26/2007**

STATIC WATER LEVEL (Measured fromTop of Casing)		
Depth (ft)	**15.40**	
Time	**835**	
*Date	**5/17/2007**	

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	SPT-Blows/6"	N-Value	RECOVERY	SOIL/ROCK DESCRIPTION
0.0		SS	1	SM	7-6-7-6	13		Medium dense to loose, medium to fine sand (little partly cemented sand), little subangular to subrounded gravel, trace clay, light brown, slight moist.
		SS	2	SM	6-4-3-2	7		As above, slight moist.
5.0		SS	3	SM	1-1-3-3	4		Medium to stiff calcareous clay, containing little to some subangular to subrounded chalk and limestone gravel, surrounded by some loose fine to medium sand (little partly-cemented sand), pale reddish yellow, dark brown, slight moist.
		SS	4	SM/M	3-3-2-6	5		As above, slight moist to moist.
		SS	5	M	10-9-9	18		Loose, ocassional partly cemented, fine to medium sand, poorly sorted, light yellowish brown, moist.
10.0		SS	6	W	5-5-4	9		
15.0		SS	7	W	4-8-13	21		Loose, poorly sorted, poorly graded, fine to coarse sand, little partly-cemented, light yellowish brown, wet.
20.0		SS	8	W	50/6"	50/6"		As above, wet.
25.0		SS	9	W	20-28-50/2"	50/2"		As above, wet.
30.0		SS	10	M/W	11-12-22	34		As above, wet.
35.0		SS	11	M/W	18-26-34	60		Loose, little well indurated, fine to very fine, poorly sorted sand, dark brownish gray, moist to wet.
40.0		SS	12	W	12-13-17	30		As above, moist to wet.
45.0		SS	13	M	10-10-13	23		As above, wet.
50.0								As above, moist.
55.0								

Conductivity (µS/cm)	Temperature (°F)	LITHOLOGY	FORMATION TYPE	WELL INSTALLATION	WELL CONST.



Key:

Water Level During Drilling

Static Water Level

***NOTE: Conductivity & Temperature Measured Same DATE**

SS-Split Spoon Sample

RC-Rock Core Sample

M-Moist

SM-Slightly Moist

D-Dry

W-Wet

ND-Non Detected

Conductivity

Temperature

JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-9

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Co.** BOREHOLE/WELL DIAM.: **4.5"/1.5"**

PROJECT NAME: **Additional Work on Geologic & Hydrogeologic Characterization** TOTAL DEPTH (ft.): **150.0'**

LOCATION: **Aguada, PR** WELL DEPTH (ft.): GROUND SURFACE ELEVATION: **n/a**

DRILLING CO: **JFA Geological & Environmental Scientists**

DRILLING METHOD: **Hollow Stem Auger**

FOREMAN: **M. Razuk**

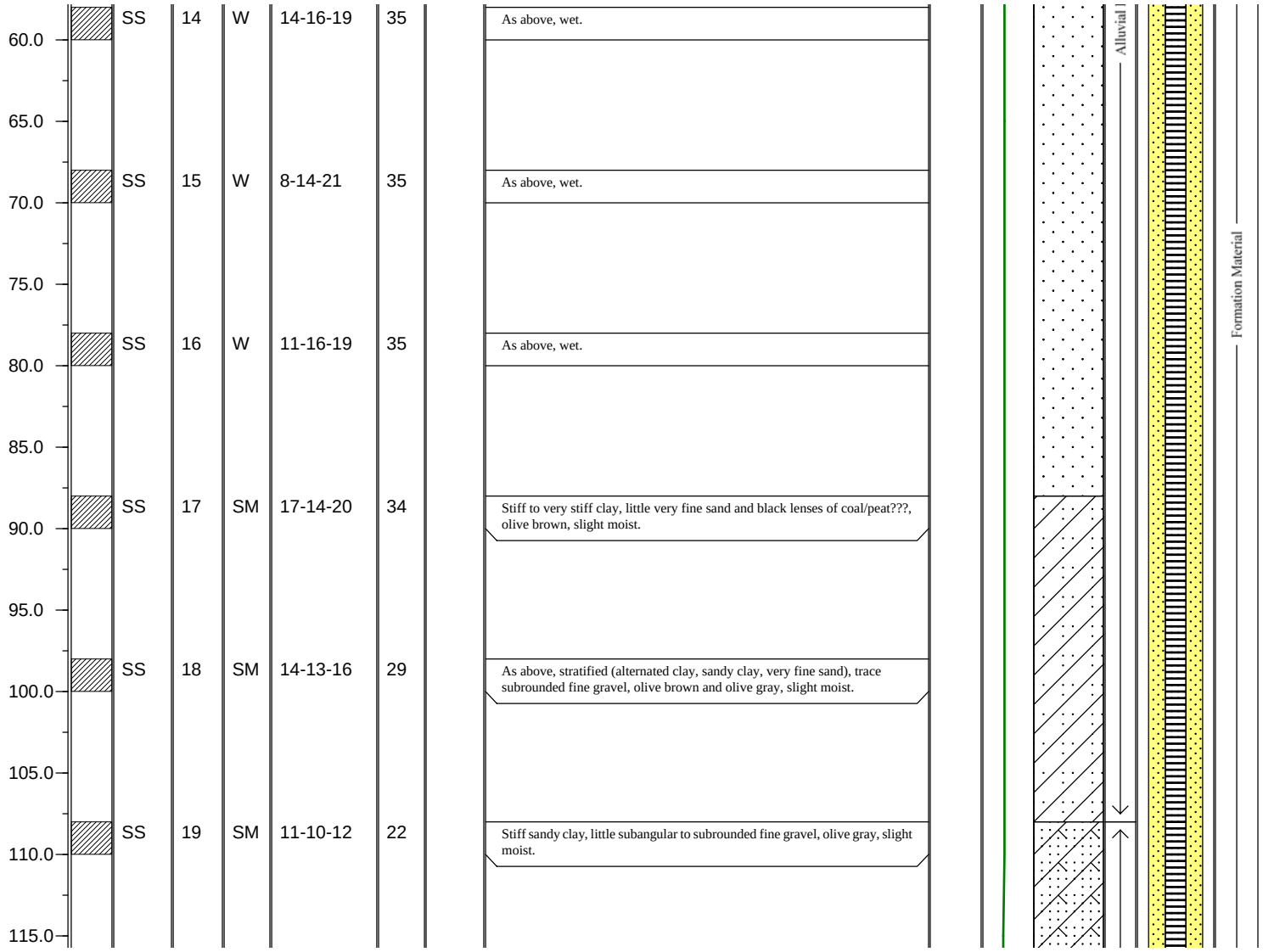
GEOLOGIST: **G. García**

DATE BEGUN: **4/23/2007** DATE COMPLETED: **4/26/2007**

STATIC WATER LEVEL (Measured fromTop of Casing)		
Depth (ft)	**15.40**	
Time	**835**	
*Date	**5/17/2007**	

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	SPT-Blows/6"	N-Value	RECOVERY	SOIL/ROCK DESCRIPTION
60.0		SS	14	W	14-16-19	35		As above, wet.
65.0								
70.0		SS	15	W	8-14-21	35		As above, wet.
75.0								
80.0		SS	16	W	11-16-19	35		As above, wet.
85.0								
90.0		SS	17	SM	17-14-20	34		Stiff to very stiff clay, little very fine sand and black lenses of coal/peat???, olive brown, slight moist.
95.0								
100.0		SS	18	SM	14-13-16	29		As above, stratified (alternated clay, sandy clay, very fine sand), trace subrounded fine gravel, olive brown and olive gray, slight moist.
105.0								
110.0		SS	19	SM	11-10-12	22		Stiff sandy clay, little subangular to subrounded fine gravel, olive gray, slight moist.
115.0								

Conductivity (µS/cm)	Temperature (°F)	LITHOLOGY	FORMATION TYPE	WELL INSTALLATION	WELL CONST.



Key:

***NOTE: Conductivity & Temperature Measured Same DATE**

Water Level During Drilling

Static Water Level

SS-Split Spoon Sample

RC-Rock Core Sample

M-Moist

SM-Slightly Moist

D-Dry

W-Wet

ND-Non Detected

Conductivity

Temperature

JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-9

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Co.** BOREHOLE/WELL DIAM.: **4.5"/1.5"**

PROJECT NAME: **Additional Work on Geologic & Hydrogeologic Characterization** TOTAL DEPTH (ft.): **150.0'**

LOCATION: **Aguada, PR** WELL DEPTH (ft.): GROUND SURFACE ELEVATION: **n/a**

DRILLING CO: **JFA Geological & Environmental Scientists**

DRILLING METHOD: **Hollow Stem Auger**

FOREMAN: **M. Razuk**

GEOLOGIST: **G. García**

DATE BEGUN: **4/23/2007** DATE COMPLETED: **4/26/2007**

STATIC WATER LEVEL (Measured fromTop of Casing)		
Depth (ft)	**15.40**	
Time	**835**	
*Date	**5/17/2007**	

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	SPT-Blows/6"	N-Value	RECOVERY	SOIL/ROCK DESCRIPTION	Conductivity (µS/cm)	Temperature (°F)	LITHOLOGY	FORMATION TYPE	WELL INSTALLATION	WELL CONST.
120.0		SS	20	M	7-8-13 9-14-20	21 34		Medium stiff clay, trace very fine sand and fine subrounded gravel, olive gray, moist.						
125.0														
130.0		SS	21	M				Stiff sandy clay, little subangular to subrounded fine gravel, olive brown, moist.				San Sebastián Formation		
135.0														
140.0		SS	22	M/W	7-9-11	20		Medium dense clayey sand, little subrounded gravel, olive brown, moist to wet.						
145.0														
150.0		SS	23	W	6-8-10	18		As above, wet.						

Key:

- Water Level During Drilling
- Static Water Level

***NOTE: Conductivity & Temperature Measured Same DATE**

SS-Split Spoon Sample
RC-Rock Core Sample

M-Moist
SM-Slightly Moist

D-Dry
W-Wet

ND-Non Detected
Conductivity
Temperature

JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-10

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Co.** BOREHOLE/WELL DIAM.: **4.5"/1.5"**

PROJECT NAME: **Additional Work on Geologic & Hydrogeologic Characterization** TOTAL DEPTH (ft.): **150.0'**

LOCATION: **Aguada, PR** WELL DEPTH (ft.): GROUND SURFACE ELEVATION: **n/a**

DRILLING CO: **JFA Geological & Environmental Scientists**

DRILLING METHOD: **Hollow Stem Auger**

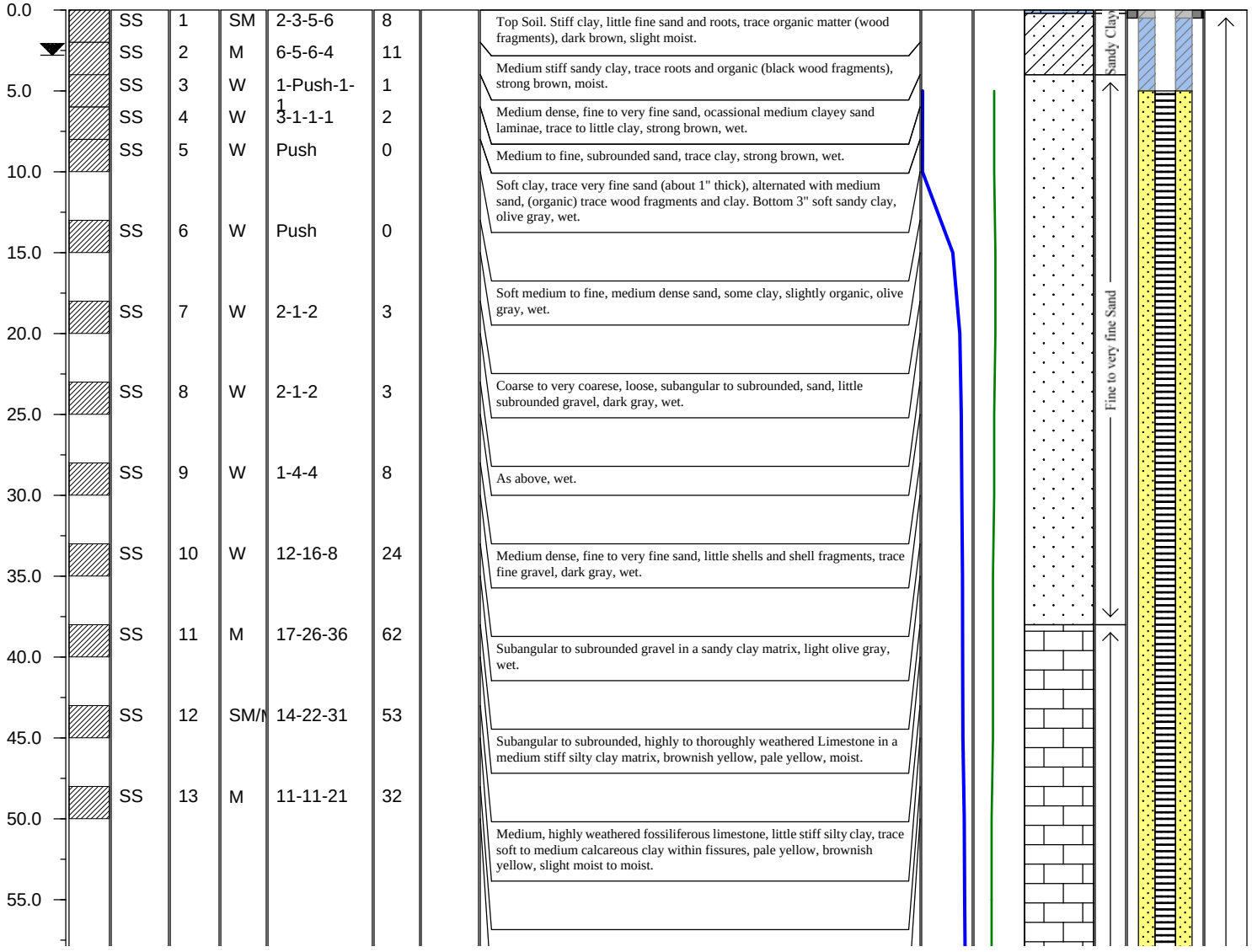
FOREMAN: **M. Razuk**

GEOLOGIST: **G. García**

DATE BEGUN: **4/18/2007** DATE COMPLETED: **4/20/2007**

STATIC WATER LEVEL (Measured fromTop of Casing)		
Depth (ft)	**3.55**	
Time	**805**	
*Date	**5/17/2007**	

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	SPT-Blows/6"	N-Value	RECOVERY	SOIL/ROCK DESCRIPTION
0.0		SS	1	SM	2-3-5-6	8		Top Soil. Stiff clay, little fine sand and roots, trace organic matter (wood fragments), dark brown, slight moist.
		SS	2	M	6-5-6-4	11		Medium stiff sandy clay, trace roots and organic (black wood fragments), strong brown, moist.
5.0		SS	3	W	1-Push-1-1	1		Medium dense, fine to very fine sand, ocassional medium clayey sand laminae, trace to little clay, strong brown, wet.
		SS	4	W	3-1-1-1	2		Medium to fine, subrounded sand, trace clay, strong brown, wet.
		SS	5	W	Push	0		Soft clay, trace very fine sand (about 1" thick), alternated with medium sand, (organic) trace wood fragments and clay. Bottom 3" soft sandy clay, olive gray, wet.
10.0		SS	6	W	Push	0		
15.0		SS	7	W	2-1-2	3		Soft medium to fine, medium dense sand, some clay, slightly organic, olive gray, wet.
20.0		SS	8	W	2-1-2	3		Coarse to very coarese, loose, subangular to subrounded, sand, little subrounded gravel, dark gray, wet.
25.0		SS	9	W	1-4-4	8		As above, wet.
30.0		SS	10	W	12-16-8	24		Medium dense, fine to very fine sand, little shells and shell fragments, trace fine gravel, dark gray, wet.
35.0		SS	11	M	17-26-36	62		Subangular to subrounded gravel in a sandy clay matrix, light olive gray, wet.
40.0		SS	12	SM/W	14-22-31	53		Subangular to subrounded, highly to thoroughly weathered Limestone in a medium stiff silty clay matrix, brownish yellow, pale yellow, moist.
45.0		SS	13	M	11-11-21	32		Medium, highly weathered fossiliferous limestone, little stiff silty clay, trace soft to medium calcareous clay within fissures, pale yellow, brownish yellow, slight moist to moist.
50.0								
55.0								



Key:

***NOTE: Conductivity & Temperature Measured Same DATE**

- Water Level During Drilling
- Static Water Level
- SS-Split Spoon Sample
- RC-Rock Core Sample
- M-Moist
- SM-Slightly Moist
- D-Dry
- W-Wet
- ND-Non Detected
- Conductivity
- Temperature

JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-10

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Co.** BOREHOLE/WELL DIAM.: **4.5"/1.5"**

PROJECT NAME: **Additional Work on Geologic & Hydrogeologic Characterization** TOTAL DEPTH (ft.): **150.0'**

LOCATION: **Aguada, PR** WELL DEPTH (ft.): GROUND SURFACE ELEVATION: **n/a**

DRILLING CO: **JFA Geological & Environmental Scientists**

DRILLING METHOD: **Hollow Stem Auger**

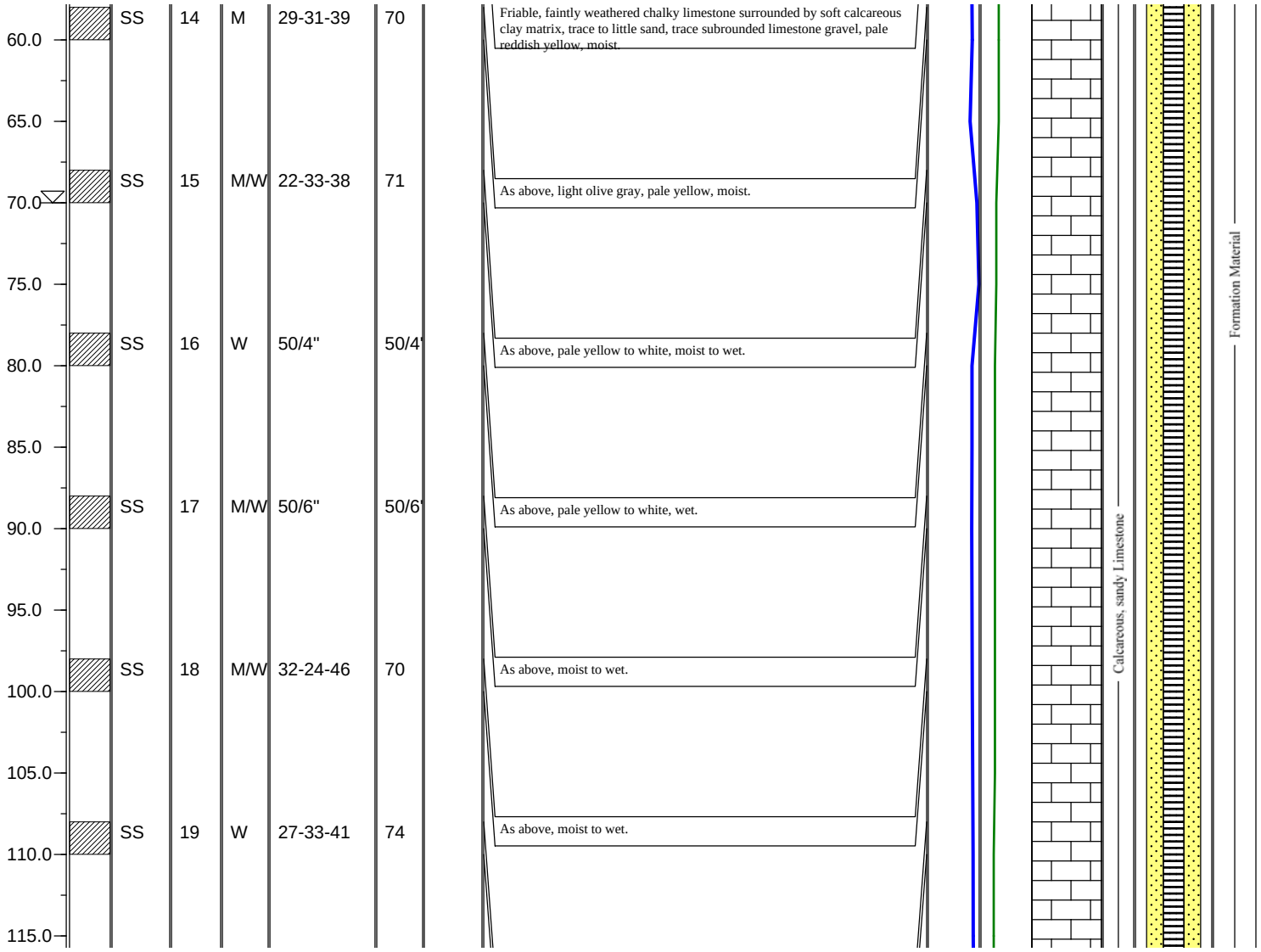
FOREMAN: **M. Razuk**

GEOLOGIST: **G. García**

DATE BEGUN: **4/18/2007** DATE COMPLETED: **4/20/2007**

STATIC WATER LEVEL (Measured fromTop of Casing)		
Depth (ft)	**3.55**	
Time	**805**	
*Date	**5/17/2007**	

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	SPT-Blows/6"	N-Value	RECOVERY	SOIL/ROCK DESCRIPTION
60.0		SS	14	M	29-31-39	70		Friable, faintly weathered chalky limestone surrounded by soft calcareous clay matrix, trace to little sand, trace subrounded limestone gravel, pale reddish yellow, moist.
65.0								
70.0 ▽		SS	15	M/W	22-33-38	71		As above, light olive gray, pale yellow, moist.
75.0								
80.0		SS	16	W	50/4"	50/4"		As above, pale yellow to white, moist to wet.
85.0								
90.0		SS	17	M/W	50/6"	50/6"		As above, pale yellow to white, wet.
95.0								
100.0		SS	18	M/W	32-24-46	70		As above, moist to wet.
105.0								
110.0		SS	19	W	27-33-41	74		As above, moist to wet.
115.0								



Key:

▽ Water Level During Drilling

▼ Static Water Level

***NOTE: Conductivity & Temperature Measured Same DATE**

SS-Split Spoon Sample

RC-Rock Core Sample

M-Moist SM-Slightly Moist D-Dry W-Wet

ND-Non Detected

Conductivity

Temperature

JFA Geological & Environmental Scientists	FIELD BOREHOLE LOG	BOREHOLE NUMBER WB-10

PROJECT NUMBER: **334-07** CLIENT: **Cordeco Northwest Co.** BOREHOLE/WELL DIAM.: **4.5"/1.5"**

PROJECT NAME: **Additional Work on Geologic & Hydrogeologic Characterization** TOTAL DEPTH (ft.): **150.0'**

LOCATION: **Aguada, PR** WELL DEPTH (ft.): GROUND SURFACE ELEVATION: **n/a**

DRILLING CO: **JFA Geological & Environmental Scientists**

DRILLING METHOD: **Hollow Stem Auger**

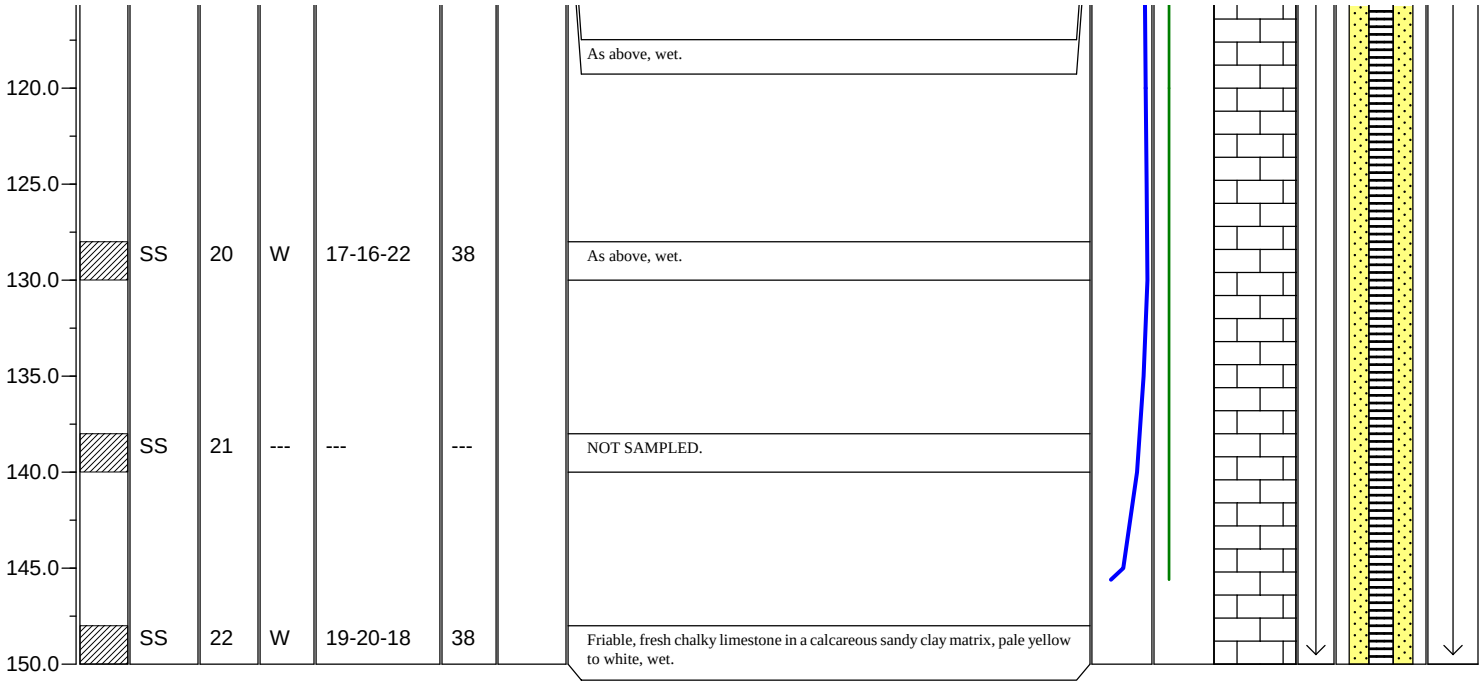
FOREMAN: **M. Razuk**

GEOLOGIST: **G. García**

DATE BEGUN: **4/18/2007** DATE COMPLETED: **4/20/2007**

STATIC WATER LEVEL (Measured fromTop of Casing)		
Depth (ft)	**3.55**	
Time	**805**	
*Date	**5/17/2007**	

DEPTH (ft.)	SAMPLE INTERVAL	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	SPT-Blows/6"	N-Value	RECOVERY	SOIL/ROCK DESCRIPTION	Conductivity (µS/cm)	Temperature (°F)	LITHOLOGY	FORMATION TYPE	WELL INSTALLATION	WELL CONST.
120.0								As above, wet.						
125.0														
130.0		SS	20	W	17-16-22	38		As above, wet.						
135.0														
140.0		SS	21	---	---	---		NOT SAMPLED.						
145.0														
150.0		SS	22	W	19-20-18	38		Friable, fresh chalky limestone in a calcareous sandy clay matrix, pale yellow to white, wet.						



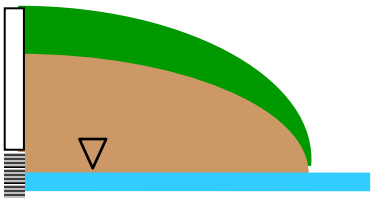
Key:

***NOTE: Conductivity & Temperature Measured Same DATE**

- Water Level During Drilling
- Static Water Level
- SS-Split Spoon Sample
- RC-Rock Core Sample
- M-Moist
- SM-Slightly Moist
- D-Dry
- W-Wet
- ND-Non Detected
- Conductivity
- Temperature

APPENDIX 3.0 Groundwater Conductivity and Temperature Measurements

JFA Geological & Environmental Scientists, P.S.C.



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Aguadilla, PR 00604-0423
State Road 107, Km. 3.1
Borinquen Ward, Aguadilla, PR
Tel. 787 882-3762
Fax 787 882-5456

Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-16-2007

Project Location: Discovery Bay Marina Well Installation Date: 11-29-2005

Time: 1105 Weather: Sunny

Well ID: WB-1 Measuring Point: Top of PVC

Depth to Bottom (ft): 42.60 Reference Elevation (ft): _____

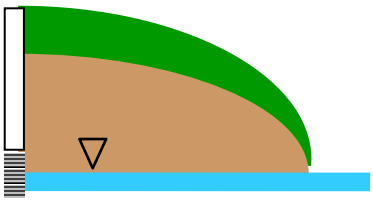
Depth to Water (ft): 5.40 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
5.40	3892	27.9	
10	4547	27.0	
15	4628	26.7	
20	56.1 M	26.6	
25	61.1	26.5	
30	63.4	26.4	
35	66.1	26.2	
40	66.7	26.1	
42.60	56.5	26.1	Bottom

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

JFA Geological & Environmental Scientists, P.S.C.



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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-16-2007

Project Location: Discovery Bay Marina Well Installation Date: 12-1-2005

Time: 1200 Weather: Sunny

Well ID: WB-2 Measuring Point: Top of PVC

Depth to Bottom (ft): 50.67 Reference Elevation (ft): _____

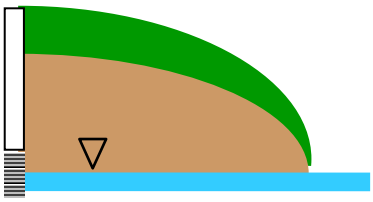
Depth to Water (ft): 6.90 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
6.90	8193	27.9	
10	9367	27.0	
15	9636	26.7	
20	9754	26.6	
25	49.2 M	26.5	
30	51.8	26.4	
35	52.1	26.2	
40	52.2	26.1	
45	52.2	26.1	
50	52.2	26.1	
50.67	31.1	26.0	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

JFA Geological & Environmental Scientists, P.S.C.



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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-16-2007

Project Location: Discovery Bay Marina Well Installation Date: 11-30-2005

Time: 1220 Weather: Sunny

Well ID: WB-3 Measuring Point: Top of PVC

Depth to Bottom (ft): 50.47 Reference Elevation (ft): _____

Depth to Water (ft): 5.90 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
5.90	946	28.9	
10	1061	27.5	
15	1059	27.0	
20	2255	27.0	
25	27.7 M	26.7	
30	51.0	26.7	
35	51.5	26.6	
40	51.9	26.5	
45	51.9	26.5	
50	52.0	26.4	
50.47	29.2	26.4	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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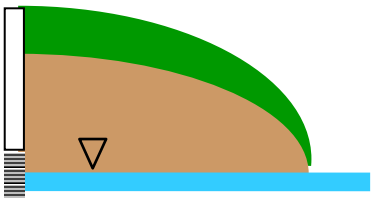

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-16-2007

Project Location: Discovery Bay Marina Well Installation Date: 11-30-2005

Time: 1240 Weather: Sunny

Well ID: WB-4 Measuring Point: Top of PVC

Depth to Bottom (ft): 47.21 Reference Elevation (ft): _____

Depth to Water (ft): 7.13 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
7.13	834	28.1	
10	844	27.1	
15	791	27.1	
20	777	27.0	
25	773	26.9	
30	773	26.9	
35	769	26.7	
40	775	26.6	
45	773	26.5	
47.21	595	26.5	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-16-2007

Project Location: Discovery Bay Marina Well Installation Date: 12-2-2005

Time: 1140 Weather: Sunny

Well ID: WB-5 Measuring Point: Top of PVC

Depth to Bottom (ft): 47.51 Reference Elevation (ft): _____

Depth to Water (ft): 6.06 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
6.06	14.2 M	28.1	
10	15.7	27.0	
15	16.0	26.7	
20	41.0	26.6	
25	42.0	26.5	
30	44.7	26.4	
35	44.9	26.2	
40	45.0	26.1	
45	45.9	26.1	
47.50	37.4	26.1	Bottom.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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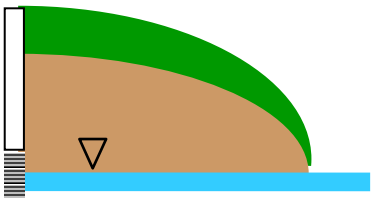

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-16-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-11-2007

Time: 915 Weather: Sunny

Well ID: WB-6 Measuring Point: Top of PVC

Depth to Bottom (ft): 51.93 Reference Elevation (ft): _____

Depth to Water (ft): 8.41 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
8.41	703	27.6	
10	771	27.0	
15	789	26.6	
20	855	26.6	
25	918	26.5	
30	953	26.4	
35	1005	26.2	
40	985	26.2	
45	993	26.1	
50	993	26.1	
51.93	771	26.1	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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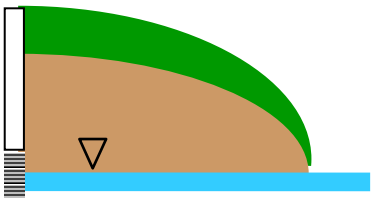

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-16-2007

Project Location: Discovery Bay Marina Well Installation Date: 5-14-2007

Time: 1300 Weather: Sunny

Well ID: WB-7,R Measuring Point: Top of PVC

Depth to Bottom (ft): 51.93 Reference Elevation (ft): _____

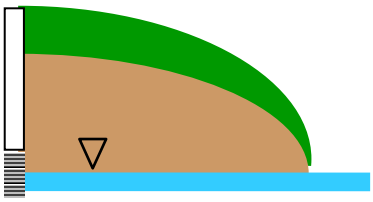
Depth to Water (ft): 8.41 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
11.92	1495	28.2	
15	1411	27.1	
20	1450	26.9	
25	1451	26.7	
30	1452	26.7	
35	1452	26.7	
40	1456	26.7	
43.08	1509	26.6	Bottom.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

JFA Geological & Environmental Scientists, P.S.C.



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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-17-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-11-2007

Time: 935 Weather: Sunny

Well ID: WB-8 Measuring Point: Top of PVC

Depth to Bottom (ft): 52.11 Reference Elevation (ft): _____

Depth to Water (ft): 7.32 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
7.32	654	28.7	
10	725	27.9	
15	746	27.4	
20	749	27.2	
25	746	27.2	
30	742	27.1	
35	739	27.1	
40	835	27.1	
45	6442	27.1	
50	8026	27.1	
52.11	7814	27.1	Bottom. No Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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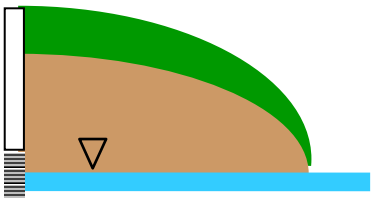

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-17-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-26-2007

Time: 835 Weather: Sunny

Well ID: WB-9 Measuring Point: Top of PVC

Depth to Bottom (ft): 151.00 Reference Elevation (ft): _____

Depth to Water (ft): 15.40 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
15.40	32.2 M	26.7	
20	33.2	26.7	
25	33.6	26.7	
30	34.2	26.7	
35	34.7	26.7	
40	35.1	26.7	
45	35.2	26.7	
50	35.3	26.7	
55	35.3	26.7	
60	35.3	26.7	
65	35.3	26.7	
70	35.3	26.7	

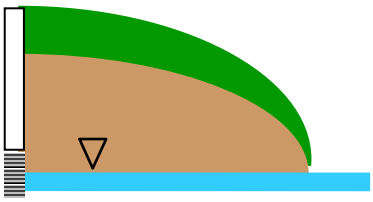
Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

Cont. (WB-9, 5/17/2007)

75	35.3	26.7	
80	35.3	26.7	
85	35.3	26.7	
90	35.3	26.7	
95	35.3	26.7	
100	35.3	26.7	
105	35.3	26.7	
110	35.3	26.7	
115	31.3	26.6	
120	31.1	26.6	
125	30.4	26.6	
130	30.4	26.6	
135	31.4	26.6	
140	31.4	26.6	
145	31.4	26.6	
150	33.8	26.6	
151	34.9	26.6	Bottom.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

JFA Geological & Environmental Scientists, P.S.C.



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State Road 107, Km. 3.1
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Tel. 787 882-3762
Fax 787 882-5456

Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-17-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-20-2007

Time: 805 Weather: Sunny

Well ID: WB-10 Measuring Point: Top of PVC

Depth to Bottom (ft): 145.60 Reference Elevation (ft): _____

Depth to Water (ft): 3.55 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
5	3055	26.6	
10	3048	26.6	
15	4844	26.7	
20	5263	26.7	
25	5349	26.6	
30	5379	26.6	
35	5416	26.5	
40	5429	26.5	
45	5441	26.5	
50	5527	26.4	
55	5550	26.4	
60	5591	26.4	

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

Cont. (WB-10, 5/17/2007)

65	5462	26.4	
70	5859	26.2	
75	5982	26.2	
80	5576	26.1	
85	5574	26.1	
90	5557	26.1	
95	5575	26.1	
100	5589	26.1	
105	5612	26.1	
110	5640	26.0	
115	5647	26.0	
120	5683	26.0	
125	5732	26.0	
130	5771	26.0	
135	5583	26.0	
140	5249	26.0	
145	4565	26.0	
145.60	3948	26.0	No Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 11-29-2005

Time: 1310 Weather: Sunny

Well ID: WB-1 Measuring Point: Top of PVC

Depth to Bottom (ft): 42.60 Reference Elevation (ft): _____

Depth to Water (ft): 4.37 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
4.37	3096	27.2	
10	7694	26.9	
15	25.7 M	26.7	
20	53.1	26.6	
25	57.0	26.5	
30	58.3	26.4	
35	63.2	26.2	
40	63.7	26.1	
42.60	49.2	26.1	Bottom

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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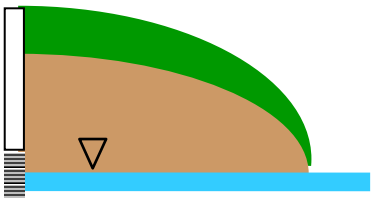

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 12-1-2005

Time: 1250 Weather: Sunny

Well ID: WB-2 Measuring Point: Top of PVC

Depth to Bottom (ft): 50.40 Reference Elevation (ft): _____

Depth to Water (ft): 5.86 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
5.86	6938	27.4	
10	8688	26.9	
15	8899	26.7	
20	9038	26.7	
25	39.2 M	26.6	
30	41.9	26.4	
35	42.4	26.2	
40	49.3	26.1	
45	53.5	26.1	
50	53.5	26.1	
50.40	18.7	26.0	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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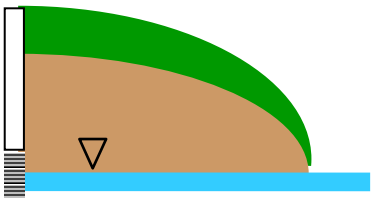

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 11-30-2005

Time: 1240 Weather: Sunny

Well ID: WB-3 Measuring Point: Top of PVC

Depth to Bottom (ft): 50.55 Reference Elevation (ft): _____

Depth to Water (ft): 4.80 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
4.8	1479	27.7	
10	1512	27.0	
15	1567	26.9	
20	1786	26.9	
25	34.0 M	26.7	
30	45.0	26.7	
35	48.8	26.6	
40	48.8	26.5	
45	48.9	26.5	
50	48.9	26.5	
50.55	19.1	26.4	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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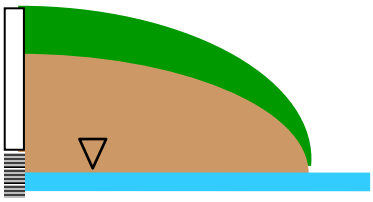

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Fax 787 882-5456

Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 11-30-2005

Time: 1225 Weather: Sunny

Well ID: WB-4 Measuring Point: Top of PVC

Depth to Bottom (ft): 47.00 Reference Elevation (ft): _____

Depth to Water (ft): 5.45 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
5.45	827	27.4	
10	844	27.0	
15	747	27.0	
20	740	27.0	
25	720	27.0	
30	734	27.0	
35	727	26.9	
40	736	26.7	
45	727	26.6	
47.00	1008	26.5	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s):_____

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 12-2-2005

Time: 1300 Weather: Sunny

Well ID: WB-5 Measuring Point: Top of PVC

Depth to Bottom (ft): 46.60 Reference Elevation (ft): _____

Depth to Water (ft): 4.90 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
4.90	5453	27.1	
10	7862	26.7	
15	8722	26.6	
20	8832	26.5	
25	39.0 M	26.5	
30	41.6	26.4	
35	42.1	26.2	
40	42.2	26.1	
45	42.3	26.1	
46.60	33.7	26.1	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s):_____

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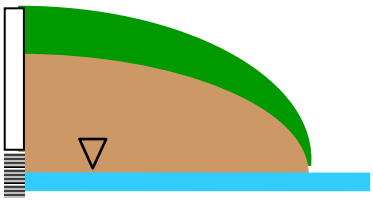

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-11-2007

Time: 1215 Weather: Sunny

Well ID: WB-6 Measuring Point: Top of PVC

Depth to Bottom (ft): 52.08 Reference Elevation (ft): _____

Depth to Water (ft): 7.41 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
7.41	903	27.4	
10	899	27.0	
15	900	26.7	
20	903	26.6	
25	918	26.4	
30	916	26.1	
35	916	26.1	
40	920	26.1	
45	916	26.1	
50	915	26.0	
52.08	711	26.0	Bottom. Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s):_____

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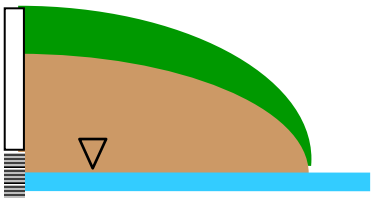

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 5-14-2007

Time: 1138 Weather: Sunny

Well ID: WB-7 Measuring Point: Top of PVC

Depth to Bottom (ft): 33.10 Reference Elevation (ft): _____

Depth to Water (ft): 7.37 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
7.37	2063	27.5	
10	2101	27.1	
15	1650	26.9	
20	1689	26.7	
25	1693	26.6	
30	1706	26.6	
33.10	1631	26.6	Filled with Sand.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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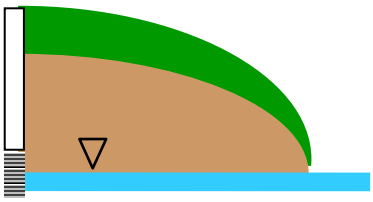

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Borinquen Ward, Aguadilla, PR
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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-11-2007

Time: 1150 Weather: Sunny

Well ID: WB-8 Measuring Point: Top of PVC

Depth to Bottom (ft): 52.84 Reference Elevation (ft): _____

Depth to Water (ft): 6.26 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
6.26	699	28.4	
10	722	27.9	
15	707	27.5	
20	709	27.2	
25	711	27.1	
30	713	27.1	
35	709	27.1	
40	756	27.2	
45	1852	27.1	
50	3525	27.1	
52.84	3220	27.1	Bottom. No Sediment.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-26-2007

Time: 1050 Weather: Sunny

Well ID: WB-9 Measuring Point: Top of PVC

Depth to Bottom (ft): 150.00 Reference Elevation (ft): _____

Depth to Water (ft): 14.45 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
14.45	28.4 M	27.1	
20	28.6	26.9	
30	29.6	26.7	
40	30.0	26.7	
50	30.1	26.7	
60	30.2	26.7	
70	30.2	26.7	
80	30.2	26.7	
90	30.2	26.7	
100	30.2	26.7	
110	30.1	26.7	
120	29.8	26.6	
130	28.9	26.6	
140	30.1	26.6	
150	32.1	26.6	

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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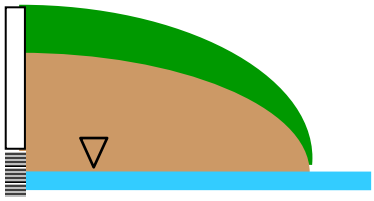

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-9-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-20-2007

Time: 1000 Weather: Sunny

Well ID: WB-10 Measuring Point: Top of PVC

Depth to Bottom (ft): 147.60 Reference Elevation (ft): _____

Depth to Water (ft): 2.85 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
2.85	676	26.9	
10	891	26.7	
20	900	26.7	
30	901	26.7	
40	909	26.7	
50	926	26.6	
60	936	26.6	
70	929	26.5	
80	947	26.4	
90	952	26.2	
100	972	26.1	
110	997	26.1	
120	1012	26.1	
130	1028	26.0	
140	1033	26.0	
147.60	1304	26.0	

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-3-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-11-2007

Time: 1042 Weather: Sunny

Well ID: WB-6 Measuring Point: Top of PVC

Depth to Bottom (ft): 51.68 Reference Elevation (ft): _____

Depth to Water (ft): 7.00 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
8	791	28.2	
10	789	27.1	
12	758	26.7	
14	781	26.5	
16	827	26.5	
18	830	26.4	
20	850	26.2	
22	881	26.1	
24	940	26.1	
26	970	26.1	
28	983	26.1	
30	983	26.0	
32	976	26.0	
34	967	26.0	
36	967	26.0	
38	967	26.0	
40	968	26.0	
42	975	26.0	
44	976	26.0	
46	976	26.0	
48	977	26.0	
50	977	26.0	
51.68	797	26.0	

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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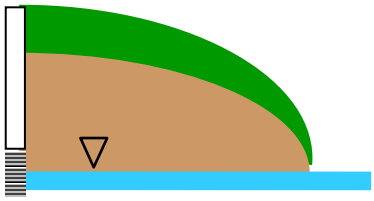

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-3-2007

Project Location: Discovery Bay Marina Well Installation Date: 5-14-2007

Time: 1300 Weather: Sunny

Well ID: WB-7 Measuring Point: Top of PVC

Depth to Bottom (ft): 32.91 Reference Elevation (ft): _____

Depth to Water (ft): 9.10 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 2.0

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
10	1756	27.2	
12	1660	27.0	
14	1601	26.9	
16	1604	26.9	
18	1608	26.9	
20	1610	26.9	
22	1622	26.9	
24	1634	26.7	
26	1636	26.7	
28	1638	26.7	
30	1646	26.7	
32	1649	26.7	
32.91	1567	26.7	Bottom.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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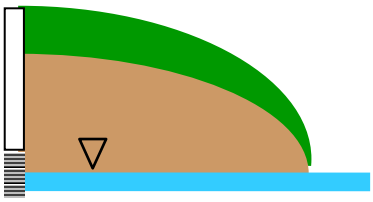

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-3-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-11-2007

Time: 1140 Weather: Sunny

Well ID: WB-8 Measuring Point: Top of PVC

Depth to Bottom (ft): 52.20 Reference Elevation (ft): _____

Depth to Water (ft): 5.98 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
6	470	29.0	
8	564	28.1	
10	594	27.7	
12	599	27.4	
14	600	27.2	
16	600	27.2	
18	600	27.2	
20	600	27.2	
22	601	27.1	
24	601	27.1	
26	601	27.1	
28	601	27.1	
30	604	27.1	

WB-8 (Cont.)

32	601	27.1	
34	612	27.1	
36	682	27.1	
38	634	27.1	
40	645	27.1	
42	731	27.1	
44	1879	27.1	
46	5882	27.1	
48	6667	27.1	
50	7165	27.1	
52	4975	27.1	
52.20	3156	27.1	Bottom.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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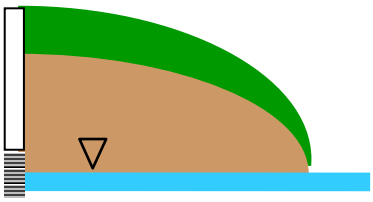

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Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-3-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-26-2007

Time: 0940 Weather: Sunny

Well ID: WB-9 Measuring Point: Top of PVC

Depth to Bottom (ft): 154.45 Reference Elevation (ft): _____

Depth to Water (ft): 14.90 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
14.90	23.5 M	27.0	
16	23.9	27.0	
18	25.5	26.9	
20	25.6	26.9	
22	25.6	26.9	
24	25.7	26.9	
26	25.8	26.9	
28	25.7	26.9	
30	25.7	26.9	
32	26.0	26.9	
34	26.0	26.9	
36	26.0	26.9	
38	26.0	26.9	

WB-9 (Cont.)

40	26.0	26.9	
42	26.1	26.9	
44	26.2	26.9	
46	26.2	26.9	
48	26.2	26.9	
50	26.2	26.9	
52	26.3	26.7	
54	26.3	26.7	
56	26.3	26.7	
58	26.2	26.7	
60	26.3	26.7	
62	26.3	26.7	
64	26.3	26.7	
66	26.3	26.7	
68	26.3	26.7	
70	26.3	26.7	
72	26.3	26.7	
74	26.3	26.7	
76	26.2	26.7	
78	26.3	26.7	
80	26.2	26.7	
82	26.2	26.7	
84	26.2	26.7	
86	26.3	26.7	
88	26.2	26.7	
90	26.2	26.7	
92	26.0	26.7	
94	25.9	26.7	

WB-9 (Cont.)

96	25.8	26.7	
98	25.8	26.7	
100	25.8	26.7	
102	25.9	26.7	
104	25.8	26.7	
106	25.7	26.7	
108	25.7	26.7	
110	25.7	26.7	
112	25.4	26.7	
114	25.3	26.7	
116	25.4	26.7	
118	25.4	26.7	
120	25.4	26.7	
122	25.3	26.6	
124	25.3	26.6	
126	25.3	26.6	
128	25.1	26.6	
130	25.2	26.6	
132	25.3	26.6	
134	25.4	26.6	
136	25.5	26.6	
138	25.5	26.6	
140	25.5	26.6	
142	25.5	26.6	
144	25.5	26.6	
146	25.5	26.6	
148	27.0	26.6	
150	27.7	26.6	Bottom.

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

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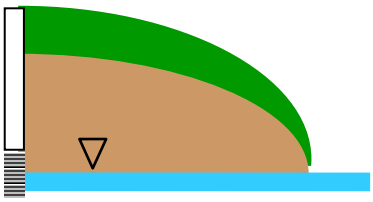

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Aguadilla, PR 00604-0423
State Road 107, Km. 3.1
Borinquen Ward, Aguadilla, PR
Tel. 787 882-3762
Fax 787 882-5456

Well Temperature & Conductivity Log

Project No.: 334-07 Date: 5-3-2007

Project Location: Discovery Bay Marina Well Installation Date: 4-20-2007

Time: 0840 Weather: Sunny

Well ID: WB-10 Measuring Point: Top of PVC

Depth to Bottom (ft): 148.89 Reference Elevation (ft): _____

Depth to Water (ft): 2.79 GW Elevation (ft): _____

Water Column (ft): _____ Diameter of Casing (in): 1.5

Depth (ft)	Conductivity (µs/cm)	Temperature (°C)	Observations
2.79	631	27.0	
4	633	27.0	
6	601	26.9	
8	642	26.9	
10	660	26.9	
12	631	26.7	
14	628	26.7	
16	628	26.7	
18	649	26.7	
20	638	26.7	
22	635	26.7	
24	636	26.7	
26	646	26.7	
28	643	26.7	

WB-10 (Cont.)

30	642	26.7	
32	640	26.7	
34	641	26.7	
36	643	26.7	
38	647	26.7	
40	647	26.7	
42	649	26.7	
44	652	26.7	
46	655	26.7	
48	661	26.7	
50	661	26.7	
52	664	26.7	
54	664	26.7	
56	668	26.7	
58	671	26.7	
60	671	26.7	
62	671	26.7	
64	671	26.7	
66	672	26.6	
68	672	26.6	
70	671	26.6	
72	672	26.6	
74	671	26.6	
76	667	26.6	
78	668	26.6	
80	666	26.6	
82	666	26.6	
84	672	26.5	
86	675	26.5	

WB-10 (Cont.)

88	683	26.5	
90	692	26.5	
92	692	26.5	
94	686	26.5	
96	683	26.4	
98	676	26.4	
100	667	26.4	
102	667	26.2	
104	667	26.2	
106	667	26.2	
108	668	26.2	
110	667	26.2	
112	669	26.2	
114	668	26.2	
116	667	26.1	
118	667	26.1	
120	668	26.1	
122	668	26.1	
124	669	26.1	
126	672	26.1	
128	673	26.1	
130	673	26.1	
132	673	26.1	
134	672	26.1	
136	673	26.1	
138	673	26.1	

WB-10 (Cont.)

140	673	26.1	
142	675	26.1	
144	683	26.0	
146	717	26.0	
148	711	26.0	
148.89	2316	26.0	Bottom/Sand/Sediment

Instrument: *Solinst*® 107-TLC Meter, M2/150ft Data Collector(s): _____

APPENDIX 4.0 Field Sampling Logs, Groundwater Parameters and Chain of Custody

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State Road 107, Km. 3.1
Borinquen Ward, Aguadilla, PR
Tel. 787 882-3762
Fax 787 882-5456

Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 11-29-2005
Project Location: Discovery Bay Marina
Sampling Date: 5-18-2007
Time: 1355
Weather: Sunny
Well ID: WB-1
Measuring Point: Top of PVC
Depth to Bottom: 42.60 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 5.54 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 2.0
Gallons per Foot: _____
Purging Method: Surge Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	7.52	6.82				
Cond. (ms/cm)	17.7	45.5				
Tº (ºC)	27.5	26.9				
Sal. (%)	1.05	2.91				
Time	1400	1405				
Color:		Odor:			Other:	

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**10.0**	**1400**	**17.7**
B	**35.0**	**1405**	**45.5**

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Fax 787 882-5456

Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 12-1-2005
Project Location: Discovery Bay Marina
Sampling Date: 5-18-2007
Time: 1320
Weather: Sunny
Well ID: WB-2
Measuring Point: Top of PVC
Depth to Bottom: 50.67 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 6.84 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 2.0
Gallons per Foot: _____
Purging Method: Surge Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	6.85	6.68				
Cond. (ms/cm)	21.1	27.8				
Tº (ºC)	27.2	26.9				
Sal. (%)	1.29	1.72				
Time	1325	1330				
Color:		Odor:			Other:	

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**10.0**	**1325**	**21.1**
B	**45.0**	**1330**	**27.8**

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Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 11-30-2005
Project Location: Discovery Bay Marina
Sampling Date: 5-18-2007
Time: 1300
Weather: Sunny
Well ID: WB-3
Measuring Point: Top of PVC
Depth to Bottom: 50.47 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 5.86 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 2.0
Gallons per Foot: _____
Purging Method: Surge Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	6.55	6.35				
Cond. (ms/cm)	1.14	35.5				
Tº (ºC)	27.8	27.4				
Sal. (%)	2.05	2.24				
Time	1305	1310				
Color:		Odor:			Other:	

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**15.0**	**1305**	**1.14**
B	**45.0**	**1310**	**35.5**

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Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 11-30-2005
Project Location: Discovery Bay Marina
Sampling Date: 5-18-2007
Time: 1245
Weather: Sunny
Well ID: WB-4
Measuring Point: Top of PVC
Depth to Bottom: 47.21 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 7.12 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 2.0
Gallons per Foot: _____
Purging Method: Surge Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	7.44	7.33				
Cond. (ms/cm)	.763	.746				
Tº (ºC)	28.3	27.2				
Sal. (%)	0.03	0.03				
Time	1250	1255				
Color:		Odor:			Other:	

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**10.0**	**1250**	**0.763**
B	**35.0**	**1255**	**0.746**

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Fax 787 882-5456

Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 12-2-2005
Project Location: Discovery Bay Marina
Sampling Date: 5-18-2007
Time: 1340
Weather: Sunny
Well ID: WB-5
Measuring Point: Top of PVC
Depth to Bottom: 47.50 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 5.97 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 2.0
Gallons per Foot: _____
Purging Method: Surge Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	7.24	6.77				
Cond. (ms/cm)	20.2	33.0				
Tº (ºC)	27.3	26.6				
Sal. (%)	1.21	2.05				
Time	1345	1350				
Color:		Odor:			Other:	

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**15.0**	**1345**	**20.2**
B	**40.0**	**1350**	**33.0**

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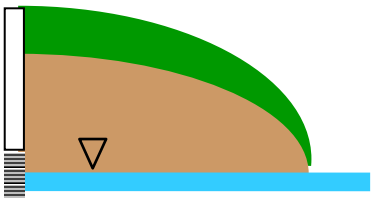

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Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 4-11-2007
Project Location: Discovery Bay Marina
Sampling Date: 5-17-2007
Time: 1115
Weather: Sunny
Well ID: WB-6
Measuring Point: Top of PVC
Depth to Bottom: 51.93 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 8.40 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 1.5
Gallons per Foot: _____
Purging Method: Bladder Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	5.45	6.46	6.57	6.96		
Cond. (ms/cm)	0.92	0.883	1.00	0.98		
Tº (ºC)	36.5	33.5	34.8	32.4		
Sal. (%)	0.04	0.03	0.04	0.04		
Time	1222	1240	1323	1335		
Color:		Odor:		Other:		

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**13.0**	**1240**	**0.883**
B	**48.0**	**1335**	**0.98**

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Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 5-14-2007
Project Location: Discovery Bay Marina
Sampling Date: 5-18-2007
Time: 1220
Weather: Sunny
Well ID: WB-7,R
Measuring Point: Top of PVC
Depth to Bottom: 43.08 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 11.97 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 2.0
Gallons per Foot: _____
Purging Method: Surge Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	7.64	7.12				
Cond. (ms/cm)	1.32	1.22				
Tº (ºC)	28.3	27.3				
Sal. (%)	0.06	0.05				
Time	1226	1235				
Color:		Odor:			Other:	

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**15.0**	**1226**	**1.32**
B	**40.0**	**1235**	**1.22**

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Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 4-11-2007
Project Location: Discovery Bay Marina
Sampling Date: 5-18-2007
Time: 1125
Weather: Sunny
Well ID: WB-8
Measuring Point: Top of PVC
Depth to Bottom: 52.11 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 7.53 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 1.5
Gallons per Foot: _____
Purging Method: Bladder Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	6.06	6.58	6.84	7.19		
Cond. (ms/cm)	.870	.783	1.02	6.13		
Tº (ºC)	28.6	28.1	29.5	29.6		
Sal. (%)	0.03	0.03	0.04	0.32		
Time	1120	1125	1138	1150		
Color:		Odor:		Other:		

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**15.0**	**1125**	**0.783**
B	**50.0**	**1150**	**6.13**

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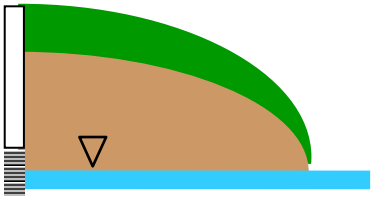

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Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 4-26-2007
Project Location: Discovery Bay Marina
Sampling Date: 5-17-2007
Time: 1405
Weather: P. Cloudy
Well ID: WB-9
Measuring Point: Top of PVC
Depth to Bottom: 151.00 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 15.40 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 1.5
Gallons per Foot: _____
Purging Method: Bladder Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	6.41	6.52	6.59	6.80	6.71	6.42
Cond. (ms/cm)	25.2	25.7	25.7	25.9	25.8	25.9
Tº (ºC)	27.6	26.9	31.0	29.7	28.8	28.3
Sal. (%)	1.55	1.58	1.57	1.59	1.59	1.59
Time	1427	1435	1510	1525	1542	1600
Color:		Odor:		Other:		

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**20.0**	**1435**	**25.7**
B	**78.0**	**1525**	**25.9**
C	**102.0**	**1600**	**25.9**

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Fax 787 882-5456

Monitoring Well Sampling Log

Project No.: 334-07
Installation Date: 4-20-2007
Project Location: Discovery Bay Marina
Sampling Date: 5-18-2007
Time: 0820
Weather: Sunny
Well ID: WB-10
Measuring Point: Top of PVC
Depth to Bottom: 145.60 ft.
Reference Elevation (ft): _____
Depth to Water (DTW): 3.75 ft.
GW Elevation (ft): _____
Water Column: _____ ft.
Diameter of Casing (in): 1.5
Gallons per Foot: _____
Purging Method: Bladder Pump
Gallons in Well (1Vol.): _____
Final DTW (ft.): _____
Total Volume (3): _____ gal.

	Purged Volumes					
Parameters	Start	1st: ____ (gal)	2nd: ____ (gal)	3rd: ____ (gal)	4th: ____ (gal)	5th: ____ (gal)
pH	4.91	5.95	6.44	6.77	6.99	7.01
Cond. (ms/cm)	4.90	4.38	4.94	5.63	5.58	5.60
Tº (ºC)	27.0	26.8	30.5	30.9	28.2	28.4
Sal. (%)	0.25	0.22	0.26	0.29	0.29	0.29
Time	0900	0905	0930	0945	1009	1025
Color:		Odor:			Other:	

Sampling Time:
Analysis: **TDS, Chloride, Sulfates**
Sample Collector(s): **JFA**

Sample	Depth (ft.)	Time	Cond. (ms/cm)
A	**5.0**	**0905**	**4.38**
B	**75.0**	**0945**	**5.63**
C	**145.0**	**1025**	**5.60**

ENVIRONMENTAL QUALITY LABORATORIES, INC.

SAMPLE DELIVERY SLIP & CHAIN OF CUSTODY

PO BOX 11458, SAN JUAN, PR 00910-1458 • TEL. (787) 288-6420, FAX (787) 288-6465, e-mail: info@eqlab.com

CLIENT NAME: JFA, P.S.C. CLIENT ID: 123301 W.O. #: SITE NAME: Discovery Bay Site CLIENT REP: N. Feliciano
P.O. #: PWSID #: FOLDER #: PROJECT: Hydrogeology Contract. EQLAB REP: J. Fuentes

SAMPLE INFORMATION		CONTAINER INFORMATION			FIELD TESTING		ANALYSIS REQUESTED
SAMPLE #: MATRIX: GW SOURCE: WB-1-A	DATE: 5-18-07 TIME: 1400 TYPE: Grab	TYPE: Crystal COLOR: Clear VOLUME: 1L PRESERVATIVE: Cool					TDS, Chloride, Sulfates
SAMPLE #: MATRIX: GW SOURCE: WB-1-B	DATE: 5-18-07 TIME: 1405 TYPE: Grab	TYPE: Crystal COLOR: Clear VOLUME: 1L PRESERVATIVE: Cool					As above.
SAMPLE #: MATRIX: GW SOURCE: WB-2-A	DATE: 5-18-07 TIME: 1325 TYPE: Grab	TYPE: Crystal COLOR: Clear VOLUME: 1L PRESERVATIVE: Cool					As above.
SAMPLE #: MATRIX: GW SOURCE: WB-2-B	DATE: 5-18-07 TIME: 1330 TYPE: Grab	TYPE: Crystal COLOR: Clear VOLUME: 1L PRESERVATIVE: Cool					As above.
SAMPLE #: MATRIX: GW SOURCE: WB-3-A	DATE: 5-18-07 TIME: 1305 TYPE: Grab	TYPE: Crystal COLOR: Clear VOLUME: 1L PRESERVATIVE: Cool					As above.
SAMPLE #: MATRIX: GW SOURCE: WB-3-B	DATE: 5-18-07 TIME: 1310 TYPE: Grab	TYPE: Crystal COLOR: Clear VOLUME: 1L PRESERVATIVE: Cool					As above.

CUSTODY RECORD	SIGNATURE	DATE	TIME
Collected in field by:		5-18-07	1600
Fixed in field by:		" "	1600
Released to EQLF by:		5-21-07	1300
Received by EQLF:		5-21-07	1300
Released to EQLL by:			
Received by EQLL:			

SPECIAL INSTRUCTIONS / COMMENTS:

- Rush analysis requested 3 days.

*EQLF = Eqlabs' Field Personnel.
*EQLL = Eqlabs' Log-in Personnel.

Arrival Temperature: _____ Signature: _____

Eqlabs' general terms and conditions on reverse side of this document.

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PO BOX 11458, SAN JUAN, PR 00910-1458 • TEL. (787) 288-6420, FAX (787) 288-6465, e-mail: info@eqlab.com

CLIENT NAME: JFA P.S.C. | CLIENT ID: 23301 | W.O. #: | SITE NAME: Discovery Bay Site | CLIENT REP: N. Febres
P.O. #: | PWSID #: | FOLDER #: | PROJECT: Hydrograph Chart | EQLAB REP: J. Fuentes

SAMPLE INFORMATION		CONTAINER INFORMATION			FIELD TESTING		ANALYSIS REQUESTED
SAMPLE #: WB-4-A MATRIX: GW SOURCE:	DATE: 5-15-07 TIME: 1250 TYPE: Grab	TYPE: Crystal PRESERVATIVE: Cool	COLOR: Clear	VOLUME: 1L			TDS, Chloride, Sulfates
SAMPLE #: WB-4-B MATRIX: GW SOURCE:	DATE: 5-15-07 TIME: 1255 TYPE: Grab	TYPE: Crystal PRESERVATIVE: Cool	COLOR: clear	VOLUME: 1L			As above.
SAMPLE #: WB-5-A MATRIX: GW SOURCE:	DATE: 5-18-07 TIME: 1345 TYPE: Grab	TYPE: Crystal PRESERVATIVE: Cool	COLOR: Clear	VOLUME: 1L			As above.
SAMPLE #: WB-5-B MATRIX: GW SOURCE:	DATE: 5-18-07 TIME: 1350 TYPE: Grab	TYPE: Crystal PRESERVATIVE: Cool	COLOR: Clear	VOLUME: 1L			As above.
SAMPLE #: WB-6-A MATRIX: GW SOURCE:	DATE: 5-17-07 TIME: 1240 TYPE: Grab	TYPE: Plastic PRESERVATIVE: Cool	COLOR:	VOLUME: 750 ml			As above.
SAMPLE #: WB-6-B MATRIX: GW SOURCE:	DATE: 5-18-07 TIME: 1345 TYPE: Grab	TYPE: Plastic PRESERVATIVE: Cool	COLOR:	VOLUME: 750 ml			As above.

CUSTODY RECORD	SIGNATURE	DATE	TIME
Collected in field by:		5-18-07	1600
Fixed in field by:	"	"	"
Released to EQLF by:		5-21-07	
Received by EQLF:		5-21-07	1300
Released to EQLL by:			
Received by EQLL:			

SPECIAL INSTRUCTIONS / COMMENTS:

Rush analysis requested, 3 Days.

*EQLF = Eqlabs' Field Personnel.
*EQLL = Eqlabs' Log-in Personnel.

Arrival Temperature: _____ Signature: _____

Eqlabs' general terms and conditions on reverse side of this document.

ENVIRONMENTAL QUALITY LABORATORIES, INC.

SAMPLE DELIVERY SLIP & CHAIN OF CUSTODY

PO BOX 11458, SAN JUAN, PR 00910-1458 • TEL. (787) 288-6420, FAX (787) 288-6465, e-mail: info@eqlab.com

CLIENT NAME: JFA OSC. CLIENT ID: 123301 W.O. #: SITE NAME: Discovery Bay CLIENT REP: N. Feliciano
P.O. #: PWSID #: FOLDER #: PROJECT: Hydrogeol Charact EQLAB REP: J. Fuentes

SAMPLE INFORMATION		CONTAINER INFORMATION			FIELD TESTING	ANALYSIS REQUESTED
SAMPLE #: MATRIX: GW SOURCE: WB-7-A	DATE: 5-18-07 TIME: 1230 TYPE: Grab	TYPE: Crystal PRESERVATIVE: Cool	COLOR: Clear	VOLUME: 1 L		TDS, Chlorides, Sulfates
SAMPLE #: MATRIX: GW SOURCE: WB-7-B	DATE: 5-18-07 TIME: 1235 TYPE: Grab	TYPE: Crystal PRESERVATIVE: Cool	COLOR: Clear	VOLUME: 1L		As above.
SAMPLE #: MATRIX: GW SOURCE: WB-8-A	DATE: 5-18-07 TIME: 1235 TYPE: Grab	TYPE: Plastic PRESERVATIVE: Cool	COLOR:	VOLUME: 750ml		As above.
SAMPLE #: MATRIX: GW SOURCE: WB-8-B	DATE: 5-18-07 TIME: 1150 TYPE: Grab	TYPE: Plastic PRESERVATIVE: Cool	COLOR:	VOLUME: 750 ml		As above.
SAMPLE #: MATRIX: GW SOURCE: WB-9-A	DATE: 5-17-07 TIME: 1435 TYPE: Grab	TYPE: Plastic PRESERVATIVE: Cool	COLOR:	VOLUME: 1,000 ml		As above.
SAMPLE #: MATRIX: GW SOURCE: WB-9-B	DATE: 5-17-07 TIME: 1525 TYPE: Grab	TYPE: Plastic PRESERVATIVE: Cool	COLOR:	VOLUME: 1,000 ml		As above.

CUSTODY RECORD	SIGNATURE	DATE	TIME
Collected in field by:		5-18-07	1600
Fixed in field by:		5-18-07	"
Released to EQLF by:		5-21-07	
Received by EQLF:		5-21-07	1300
Released to EQLL by:			
Received by EQLL:			

SPECIAL INSTRUCTIONS / COMMENTS:
- Rush analysis requested 3 days.

*EQLF = Eqlabs' Field Personnel.
*EQLL = Eqlabs' Log-in Personnel.

Arrival Temperature: _____ Signature: _____

Eqlabs' general terms and conditions on reverse side of this document.

ENVIRONMENTAL QUALITY LABORATORIES, INC.

SAMPLE DELIVERY SLIP & CHAIN OF CUSTODY

PO BOX 11458, SAN JUAN, PR 00910-1458 • TEL. (787) 288-6420, FAX (787) 288-6465, e-mail: info@eqlab.com

M- 18583

LIMS'# _____

CLIENT NAME: JFA PSC. CLIENT ID: 123301 W.O. #: SITE NAME: Discovery Bay Site CLIENT REP: N. Feliciano
P.O. #: PWSID #: FOLDER #: PROJECT: Hydrogeol Charact EQLAB REP: J. Fuentes

SAMPLE INFORMATION		CONTAINER INFORMATION	FIELD TESTING		ANALYSIS REQUESTED
SAMPLE #: MATRIX: GW SOURCE: MW-9-C	DATE: 5-17-07 TIME: 1600 TYPE: Grab	TYPE: Plastic COLOR VOLUME: 1,000 ml PRESERVATIVE: Cool			TDS, Chloride, Sulfate
SAMPLE #: MATRIX: GW SOURCE: MW-10-A	DATE: 5-15-07 TIME: 0905 TYPE: Grab	TYPE: Plastic COLOR VOLUME: 1,000 ml PRESERVATIVE: Cool			As above.
SAMPLE #: MATRIX: GW SOURCE: MW-10-B	DATE: 5-16-07 TIME: 0945 TYPE: Grab	TYPE: Plastic COLOR VOLUME: 1,000 ml PRESERVATIVE: Cool			As above.
SAMPLE #: MATRIX: GW SOURCE: MW-10-C	DATE: 5-17-07 TIME: 1025 TYPE: Grab	TYPE: Plastic COLOR VOLUME: 1,000 ml PRESERVATIVE: Cool			As above.
SAMPLE #: MATRIX: GW SOURCE: Duplicate	DATE: 5-18-07 TIME: 1200 TYPE: Grab	TYPE: Plastic COLOR VOLUME: 750 ml PRESERVATIVE: Cool			As above.
SAMPLE #: MATRIX: GW SOURCE: GWS-4	DATE: 5-17-07 TIME: 1345 TYPE: Grab	TYPE: Plastic COLOR VOLUME: 750 ml PRESERVATIVE: Cool			As above.

CUSTODY RECORD	SIGNATURE	DATE	TIME
Collected in field by:		5-18-07	1600
Fixed in field by:	"	"	"
Released to EQLF by:		5-21-07	1300
Received by EQLF:		5-21-07	1300
Released to EQLL by:			
Received by EQLL:			

SPECIAL INSTRUCTIONS / COMMENTS:
- Rush analysis requested. 3 days.

*EQLF = Eqlabs' Field Personnel.
*EQLL = Eqlabs' Log-in Personnel.

Arrival Temperature: _____ Signature: _____

Eqlabs' general terms and conditions on reverse side of this document.

APPENDIX 5.0 Certified Laboratory Results

TECHNICAL MEMORANDUM

Date: June 1, 2005

To: Mr. Mark Pirrello, P.E.,
Moffatt & Nichol Engineers, Inc.

From: Kenneth C. Jones, P.G.
(813) 969-6995, Fax: (813) 969-6988

Re: **Summary of Discovery Bay Marina Groundwater Flow Analysis**
Bahia de Aguadilla, Puerto Rico

INTRODUCTION

Hydro-Environmental Associates, Inc. (HEA) was retained by Cordeco Northwest Corporation (Cordeco) to conduct a groundwater flow analysis of a proposed inland marina at the above-referenced site. This Technical Memorandum and accompanying attachments complete the requirements of the Scope of Services for the project.

Moffatt & Nichol Engineers, Inc. is currently implementing a study to evaluate the potential development of the subject site as a residential complex that includes a 500-slip inland marina. The proposed marina will require the excavation of surface soils to an estimated depth of approximately 15-feet below existing ground surface. The surface soils excavated are anticipated to be used as fill material for the residential development and proposed levees. Portions of the subject site and proposed basin area are currently being used as an active sand mine. The subject site is located on the northwest coast of the island of Puerto Rico.

In order for the marina to sustain a healthy aquatic environment, proper water circulation and tidal flushing is required. Due to limitations in the shape of the property, the proposed marina configuration may possibly limit the natural circulation and flushing of seawater. Based upon site observations made during dewatering of the sand mine, it is apparent that a significant component of marina water circulation may be obtained from groundwater flow discharging from the shallow aquifer within the groundwater basin of the proposed marina. The Scope of Service for this project included a preliminary evaluation of the possible ranges of flow within the surficial aquifer based upon regional soil characteristics, followed by a field investigation to determine the hydraulic conductivity of the surficial aquifer within the basin area, and groundwater flow modeling to more accurately evaluate the rate and volume of groundwater flow contribution to the proposed marina basin. The preliminary evaluation was previously

addressed.

SITE GEOLOGY AND HYDROGEOLOGY

The subject site lies within the alluvial deposits immediately north of the Rio Culebrinas, west of the Cordillera Jaicoa, and east of the Atlantic Ocean. The Rio Culebrinas flows in a general westerly direction, bisecting the Cordillera Jaicoa, and discharging into the Atlantic Ocean. The subject site is within the flood plain of the Rio Culebrinas. The Cordillera Jaicoa is incised by the Rio Culebrinas, and becomes highly eroded along the south side of the incision. Geographic features in the vicinity of the subject site consist of coastal beach deposits, alluvial sediment, and karst uplands. This area is specifically detailed on the Geologic Map of the Aguadilla Quadrangle.

The coastal beach deposits form an almost continuous north-south trending ridge between Tamarindo on the north to Rincon on the south. This ridge is roughly sub-parallel to the coastal shoreline and terminates approximately 400 feet inland from the coast. The subject site is relatively flat at an average elevation of approximately 10 feet above mean sea level (MSL).

The surficial aquifer in the area of the site is typically composed of stratified layers of alluvial quartz sand and shell of quaternary age, with minor amounts of silt and clay. Based on our review of on-site lithologic data, the surficial aquifer is estimated to be approximately 120 feet in thickness.

Underlying the surficial aquifer is the Aymamon Limestone. Based upon our review of available geologic information in the area of the site, the Aymamon Limestone is typically composed of a pale orange to white fossiliferous, permeable limestone. The Aymamon Limestone is of Miocene age and directly underlies the alluvial sands. The Aymamon Limestone is approximately 600 feet in thickness in the vicinity of the subject site. The Aymamon Limestone is underlain by the Aguada Limestone, also of Miocene age. The Aguada Limestone consists of a hard calcarenite alternating with chalky and rubbly limestone.

MODEL CONFIGURATION AND SETUP

The marina basin was simulated using the Modular Three-Dimensional Finite Difference Groundwater Flow Model (MODFLOW ^{TM}) code, developed by McDonald and Harbaugh of the U.S. Geological Survey. The finite-difference approach is block-centered, which means that all data for a particular cell is located within the center of the cell. Layers may be simulated as confined, unconfined, or convertible. Flow associated with external influences such as wells, aerial recharge, evapotranspiration (ET), springs, drains, and rivers can also be simulated. The solution technique is by the Conjugate Gradient Procedure. Version 2.0 of Groundwater Vistas was used as a preprocessor to set up to the model and postprocessor to review and map the

results.

A series of constant head cells were used to simulate the proposed marina basin. The constant head cells in the proposed marina basin were modeled at an assumed elevation of mean sea level, which should represent average tidal conditions. To provide a conservative estimate of the groundwater influence into the proposed marina basin, the model was conducted using steady-state conditions, without the influence of precipitation or evapotranspiration.

The site, as modeled, consists of the proposed marina basin configuration as presented on the Conceptual Master Plan, dated March 28, 2005, as prepared by EDSA, Inc., Ft. Lauderdale Fla. Figure 1 presents the extent of the modeled area. The areas shaded in blue, shown on Figure 1, represent the constant head cell simulating the area of the proposed marina basin. The model was set up as a three layer hydrogeologic system, with the upper two layers representing the surficial aquifer, and the third layer representing the underlying Aymamon Limestone Aquifer. The surficial aquifer was divided into two layers to simulate the effects of the proposed marina basin. The bottom elevation of layer one was set to an elevation of -12 feet below MSL, which is the proposed bottom elevation of the marina basin.

Each model layer was discretized into 10,000 cells, 100-foot by 100-foot in size (100 rows by 100 columns). Constant head boundaries were used to define the Atlantic Ocean and the Cordillera Jaicoa outcroppings. The model elevation of the constant head boundary representing the Atlantic Ocean was assumed to be at MSL. The constant head boundary cells representing the face of the Cordillera Jaicoa to the north of the Rio Culebrinas was estimated to at an elevation of 15 feet above MSL, based upon a review of the Aguadilla USGS 7.5- minute quadrangle map. For modeling purposes, the constant head boundaries representing the face of Cordillera Jaicoa south of the Rio Culebrinas was varied linearly from a maximum of 15 feet to zero feet NGVD, based upon the general topography of the area.

The MODFLOW river package was used to simulate the Rio Culebrinas. The upstream elevation of the Rio Culebrinas was estimated to be 9.0 feet above MSL, based on review of the Aguadilla USGS 7.5-minute quadrangle map. The upstream extent of the river was located at the intersection of State Road 115. The downstream river elevation was assumed to be at MSL. Figure 1 also shows the model grid and boundaries. The areas shaded in blue represent the constant head boundaries, and the areas shaded in green represent the river cell boundaries.

The top of the surficial aquifer for the purposes of this model simulation was conservatively assumed to be flat at an assumed model elevation of 4 feet above MSL. The base of the surficial aquifer was assumed to be at -100.0 feet MSL. The base of the marina basin, as discussed above, was assumed to be at an elevation of -12 feet MSL.

AQUIFER PARAMETERS

Hydraulic conductivity (permeability) values for the surficial aquifer were based field data collected at the site by HEA representatives. In-situ hydraulic conductivity values were obtained for the site by conducting single well aquifer recovery tests (slug tests) at six (6) existing monitoring wells located at the subject site. The monitoring wells were spatially located within the actual area of the proposed marina. The monitoring wells were installed by Advanced Soil Engineering, Inc. of Isabella, P.R. These in-situ hydraulic conductivity values were required to estimate groundwater flow volumes anticipated to discharge into the marina area.

Based upon information provided by the client, as well as measurements obtained in the field, the monitoring wells were constructed using ten feet of two-inch diameter, schedule 40 PVC machine slotted wellscreen (0.010-inch slot size), and solid two-inch diameter PVC riser pipe. The monitoring wells were installed to depths ranging from 18.7 to 19.5 feet, below ground surface using the hollow-stem auger method conducted in general accordance with ASTM D1452-80 procedures.

The shallow monitoring wells were installed through the center of the hollow-stem augers and positioned at the appropriate depths. The annular space outside the well screen was filled with a natural formation sand to act as a filter pack around the slotted wellscreen portions of the well. A bentonite seal was placed above the filter pack. The remaining annular space was grouted with a cement slurry to the approximate ground surface.

Static water level depths ranged from approximately 1.89 feet, bgs in monitoring well P-1 to as much as 7.10 feet, bgs in monitoring well P-5. Monitoring well P-1 was located in the northern portion of the site near the coast, and monitoring well P-5 was located in the higher elevations of the southern portion of the site. As shown on Table 1, the saturated lengths of the wells ranged from 11.1 to 16.8 feet.

The hydraulic conductivity values were calculated from the slug tests based on the assumptions and well geometry presented by Bouwer and Rice (1976). The slug tests were performed by inserting a solid PVC and cement filled cylinder with a volume equivalent to an approximate 4.5-foot change in water level in a two-inch diameter monitoring well (1.92-inches in diameter by 4.84 feet in length). When the water level had returned to equilibrium, the cylinder was quickly removed and the water levels were allowed to return to equilibrium.

Both recovery and drawdown data were obtained using an electronic water level datalogger, manufactured by Solinst Canada Ltd, Georgetown, Ontario, Canada. The datalogger used for the slug test was the Model 3001 Levelogger®. The Model 3001 Levelogger® is approximately 7/8-inches in diameter and 4.9 inches in length with an accuracy of 0.1%. Prior to conducting the slug test, the Levelogger® was lowered to the bottom of the well and measurements were

made to ensure that the depth to groundwater had stabilized and reached equilibrium before conducting the slug test. During each of the tests, the water level datalogger recorded the depth to water to the nearest 0.01 foot at a linear measurement frequency of one reading per second. This method of collecting both drawdown and recovery data was performed since it typically provides a more accurate and reliable value of in-situ permeability.

The single well aquifer slug tests were performed on April 21, 2005 by Mr. Kenneth C. Jones, P.G., of HEA. The data collected from the slug tests were used to calculate horizontal hydraulic conductivity values in the surficial aquifer at the site. The results of these slug tests are included in Appendix A and are summarized on the enclosed Table 1. A total of 12 in-situ hydraulic conductivity tests were performed at the site, including six slug-in tests and six slug-out tests. However, two of the recovery tests for monitoring wells P-5 and P-6 were not analyzed due to disturbance of the Levelogger® during the removal of the slug from the well.

The hydraulic conductivity values derived from the on the in-situ slug tests conducted on the six monitoring wells ranged from approximately 26 to 62 feet per day (ft/d) and averaged approximately 45 ft/d. This average hydraulic conductivity value appears to be representative for the soils comprising the surficial aquifer at the site and was used in the groundwater flow model of the site to estimate groundwater discharge into the marina basin. The average hydraulic conductivity values for both the drawdown and recovery tests were essentially the same and therefore, the average value of 45 ft/d within the surficial aquifer appears reasonable. Some variability of hydraulic conductivity values between the monitoring well locations suggests some heterogeneity within the surficial aquifer at the site. The heterogeneity would be expected in the alluvial deposits comprising the surficial aquifer.

It should be noted that due to the remote nature of the site, the monitoring wells could not be developed prior to conducting the hydraulic conductivity tests and some fine sediment was noted at the bottom of the wells. It is felt that the fine sediment may have biased the test results somewhat, and that the actual value of hydraulic conductivity may be slightly higher than the values reported. Therefore, the average hydraulic conductivity value of 45 ft/d used in the groundwater flow model is likely conservative. However, the values for hydraulic conductivity should be viewed as an approximation since the slug tests provide hydraulic conductivity values for the materials immediately adjacent to the tested well screen.

The hydraulic conductivity of the Aymamon Limestone used in the model was 100 ft/d, which is typical for a limestone aquifer.

RESULTS

The results of this simulation indicate that the average rate of total groundwater inflow into the proposed marina basin is approximately 2.44 million gallons per day (MGD), while maintaining the water level in the marina basin at mean sea level. Based upon a meeting with representatives

of Moffatt & Nichol Engineers, Inc. on May 12, 2005, the marina basin was divided into 20 separate zones. The groundwater flow contribution into the marina basin was calculated from each of the cells from within these 20 zones. The groundwater flow contribution from the 20 zones were to be used as input into the overall circulation analysis of the marina basin. Based upon review of the data, approximately 22 percent of the groundwater flow is in a lateral direction from the vicinity of the Rio Culebrinas, approximately 36 percent of the flow is in a lateral direction from the north originating from the Cordillera Jaicoa, approximately 9 percent of the flow is lateral from the south, and approximately 33 percent represents upward groundwater flow from the base of the surficial aquifer. Figure 2 shows the water level contours generated at the end of the simulation.

REFERENCES

Environmental Simulations, Inc., 1998. Guide to Using Groundwater Vistas.

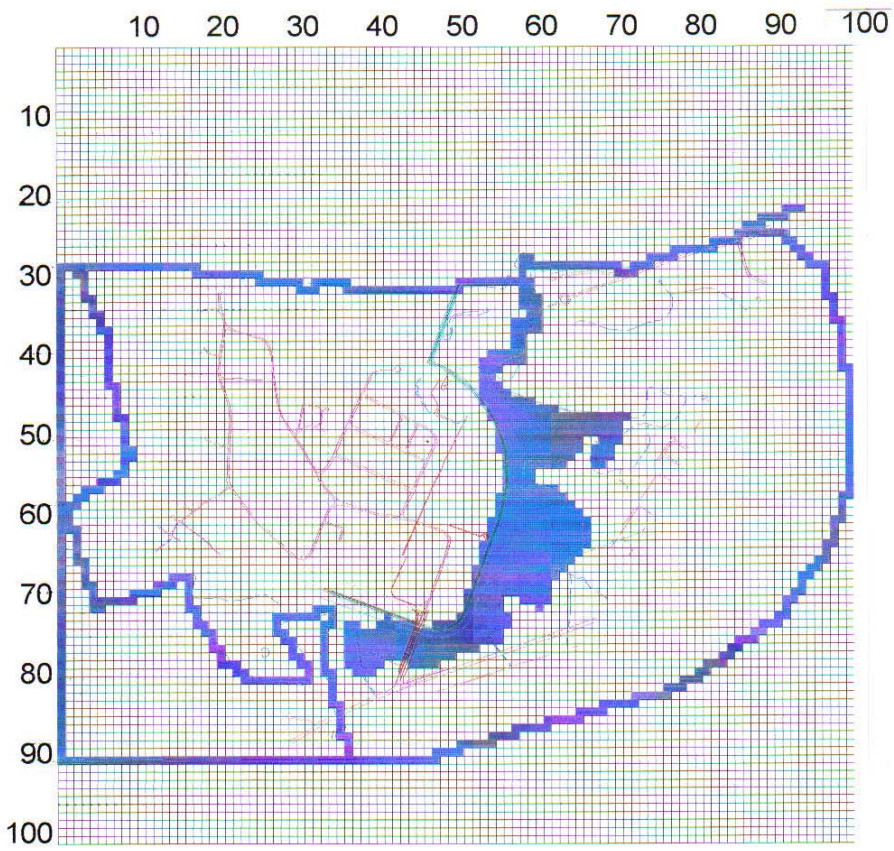
McDonald, M.G. and A. W. Harbaugh, 1988. A Modular Three-Dimensional Finite Difference Ground-Water Flow Model. Techniques of the United States Geological Survey, Open File Report 83-875.

Monroe, W. H., 1969. Geologic Map of the Aguadilla Quadrangle, Puerto Rico. Unites States Geological Survey, Miscellaneous Geologic Investigations MAP I-569.

ESDA, 2005. Discovery Bay Resort and Marina, Puerto Rico, Conceptual Master Plan.

Mitchell, R.C., 1954. A Survey of the Geology of Puerto Rico. University of Puerto Rico Agricultural Experimental Experiment Station.

Advanced Soil Engineering, Inc., 2005. Cordeco Discovery Bay & Marina Soil Boring Logs.

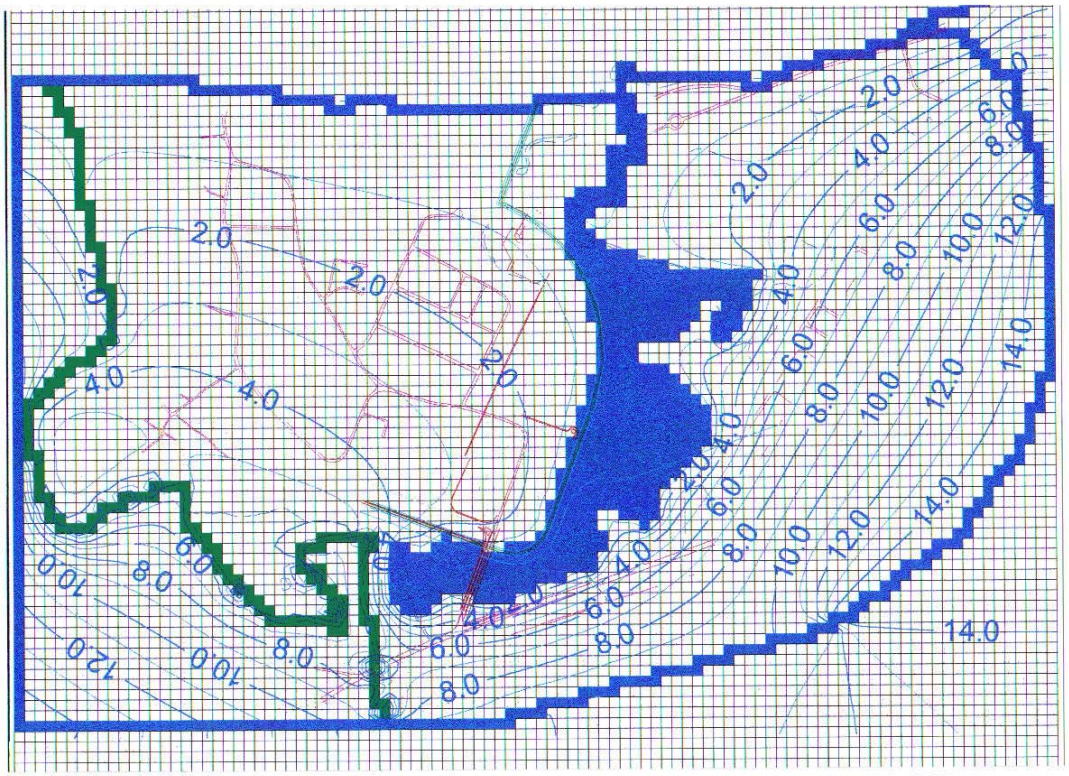


Base Map: As provided by AHV Asociados, Aguada, Puerto Rico **Scale: N.T.S.**

FIGURE 1

MODEL AREA AND FINITE DIFFERENCE GRID
DISCOVERY BAY RESORT AND MARINA
AGUADILLA, PUERTO RICO

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
(813) 969-6995



Base Map: As provided by AHV Asociados, Aguada, Puerto Rico

Scale: N.T.S.

FIGURE 2

RESULTS OF GROUNDWATER FLOW MODEL
DISCOVERY BAY RESORT AND MARINA
AGUADILLA, PUERTO RICO

HYDRO-ENVIRONMENTAL ASSOCIATES, INC.
10014 N. Dale Mabry Hwy., #205
Tampa, Florida 33618
(813) 969-6995

TABLE 1

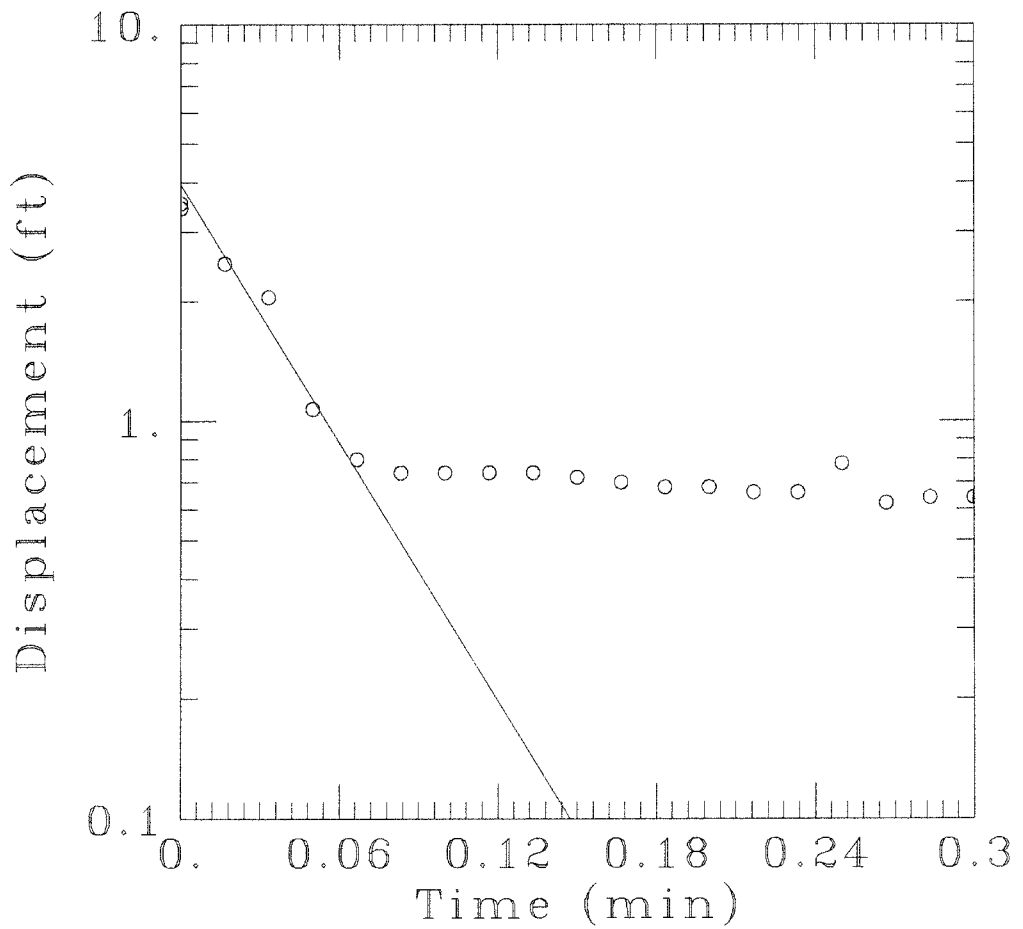
DISCOVERY BAY, AGUADILLA, PUERTO RICO

GROUNDWATER LEVELS AND PERMEABILITY ANALYSIS

MONITOR WELL NUMBER	WELL DEPTH (FT) (FT. BTOC)	WELLSCREEN LENGTH (FT.)	WELL STICK-UP (FT. AGS)	BEGINNING WATER LEVEL (FT. BTOC)	SATURATED LENGTH (FT.)	PERMEABILITY (FT./DAY)	ENDING WATER LEVEL (FT. BTOC)	SATURATED LENGTH (FT.)	PERMEABILITY (FT./DAY)
P-1	20.0	10.0	1.30	3.19	16.81	29.4	3.28	16.72	62.4
P-2	20.0	10.0	1.00	3.85	16.15	60.8	3.93	16.07	58.3
P-3	20.0	10.0	1.30	5.71	14.29	58.3	5.71	14.29	31.5
P-4	20.0	10.0	1.00	3.17	16.83	26.3	2.58	17.42	26.2
P-5	20.0	10.0	1.80	8.90	11.10	26.6	8.90	11.10	N/A
P-6	25.0	10.0	5.50	12.36	12.64	65.0	13.21	11.79	N/A
AVERAGE =						44.4			44.6

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-1 SLUG-IN TEST



DATA SET:
p1in
05/02/05

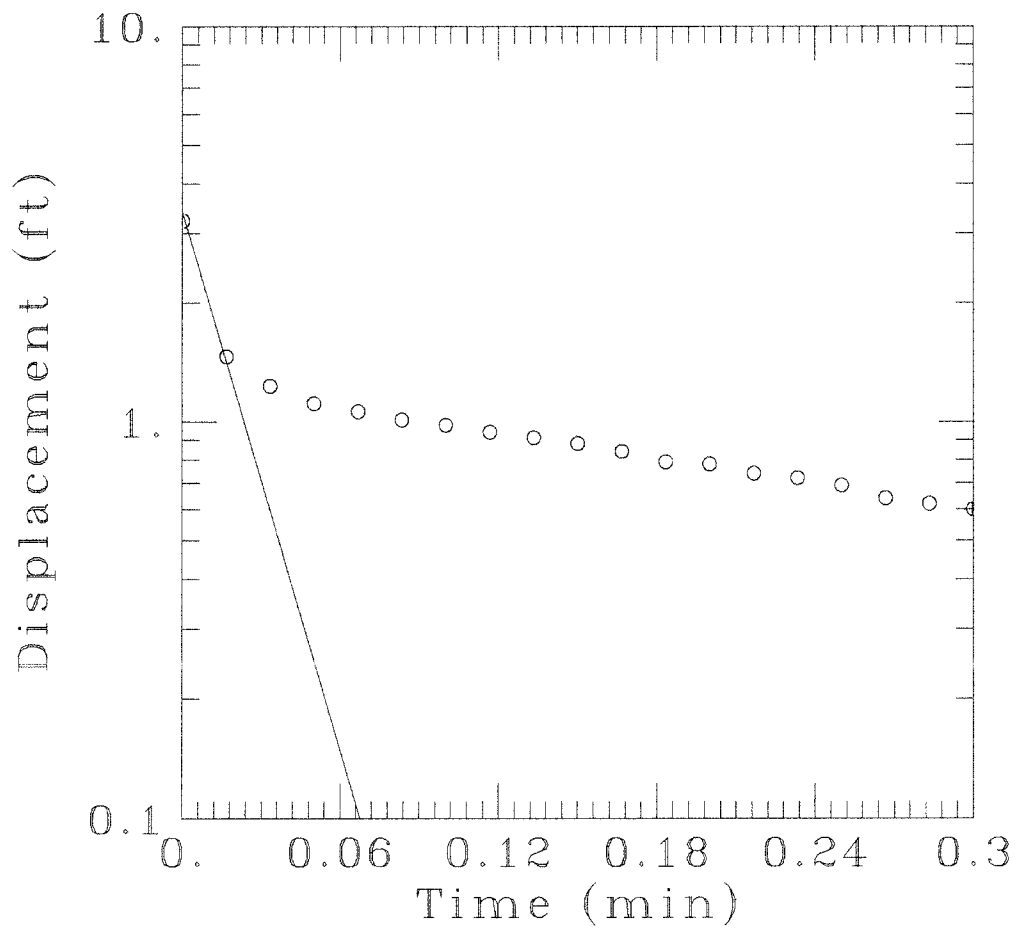
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-1
OBS. WELL:
P-1

ESTIMATED PARAMETERS:
K = 0.02045 ft/min
y0 = 3.938 ft

TEST DATA:
H0 = 3.54 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 15.51 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-1 SLUG-OUT TEST



DATA SET:
p1out
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-1

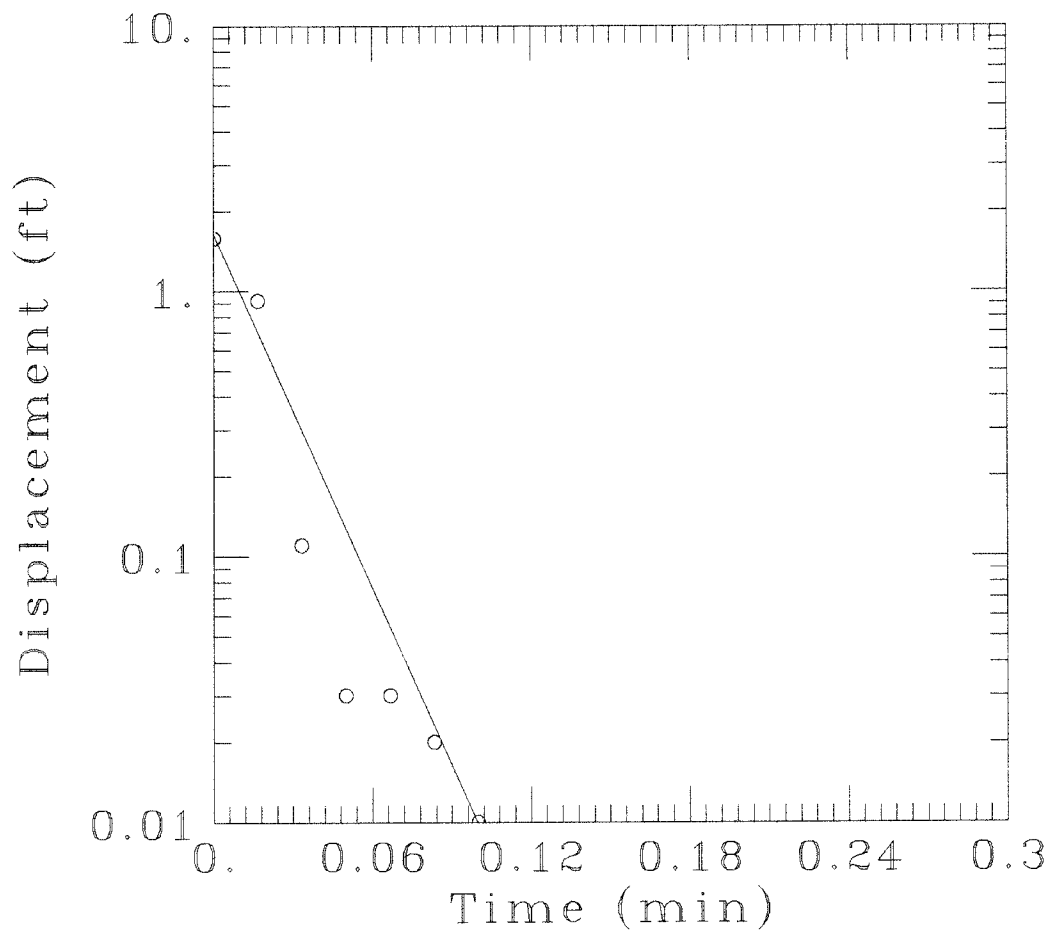
OBS. WELL:
P-1

ESTIMATED PARAMETERS:
K = 0.04333 ft/min
y0 = 3.388 ft

TEST DATA:
H0 = 3.22 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.72 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-2 SLUG-IN TEST



DATA SET:
p2in
05/02/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-2

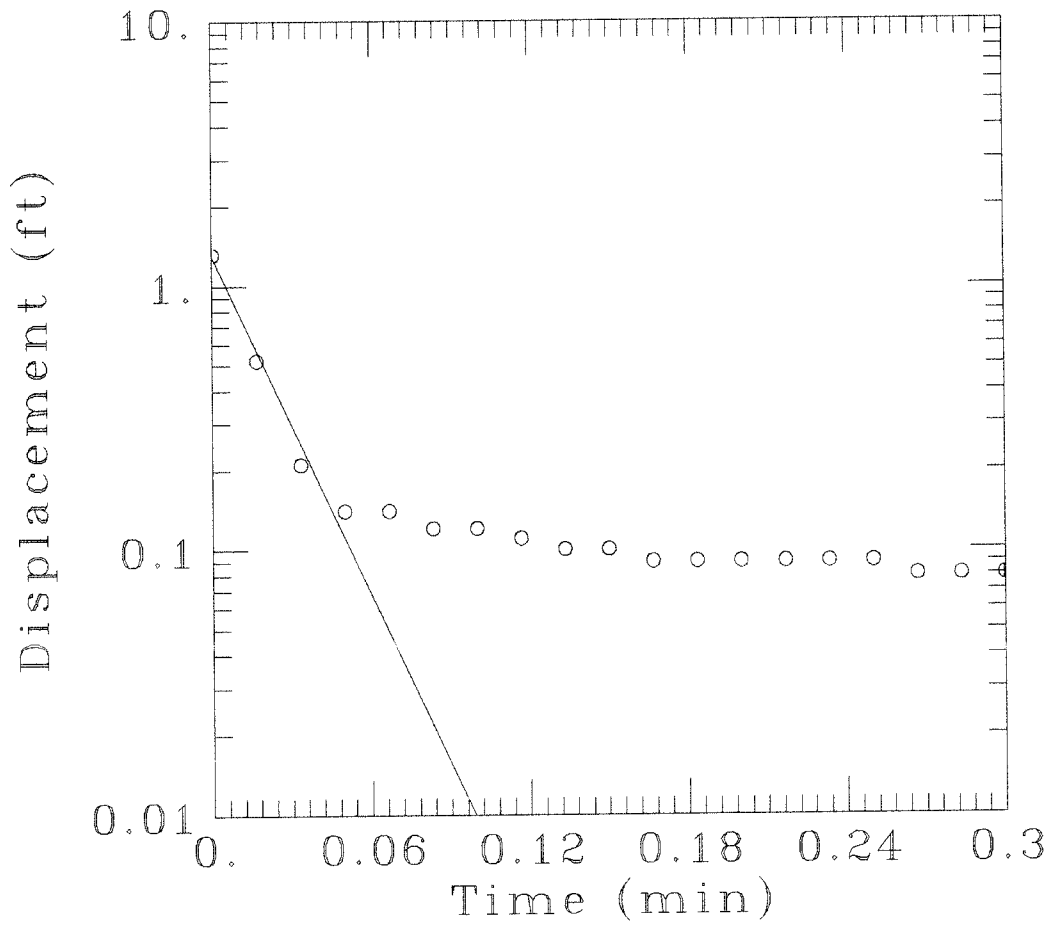
OBS. WELL:
P-2

ESTIMATED PARAMETERS:
K = 0.04222 ft/min
y0 = 1.64 ft

TEST DATA:
H0 = 1.58 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.15 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-2 SLUG-OUT TEST



DATA SET:
p2out
05/02/05

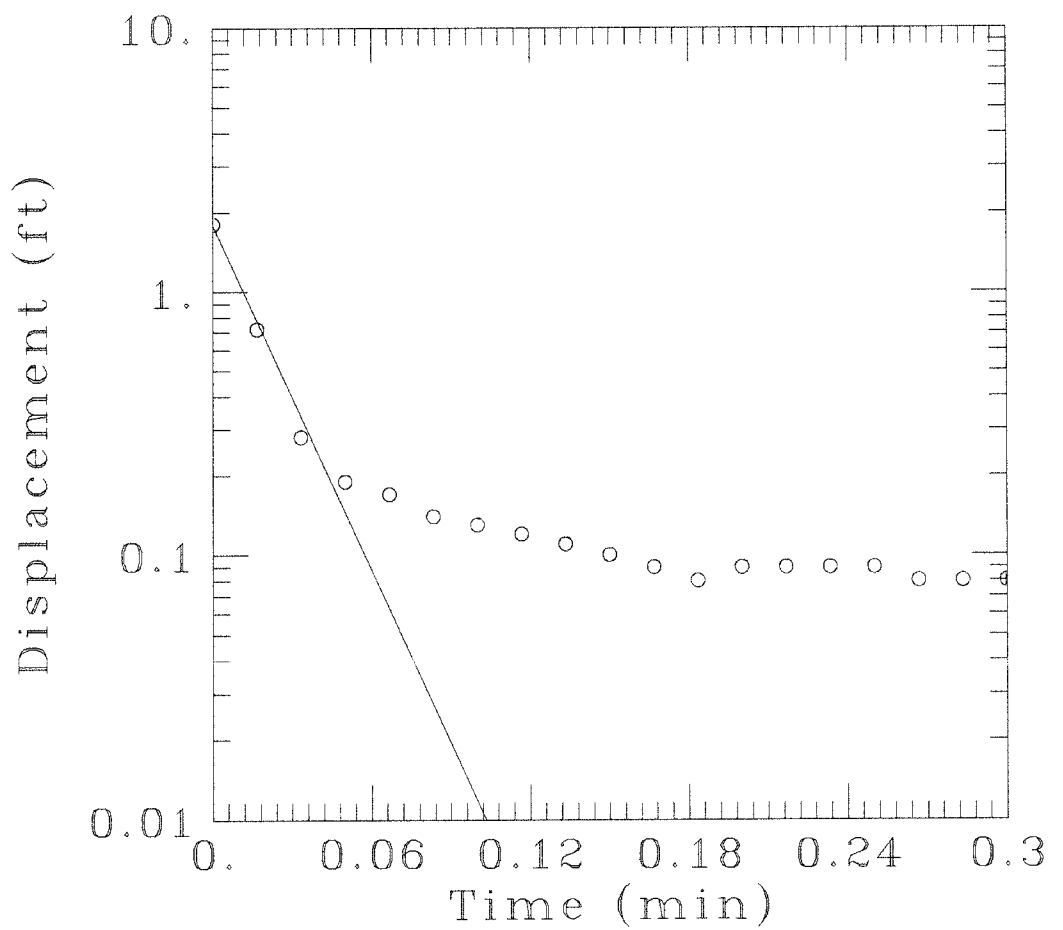
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-2
OBS. WELL:
P-2

ESTIMATED PARAMETERS:
K = 0.04047 ft/min
y0 = 1.284 ft

TEST DATA:
H0 = 1.31 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 16.07 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO, NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-3 SLUG-IN TEST



DATA SET:
p3in
05/02/05

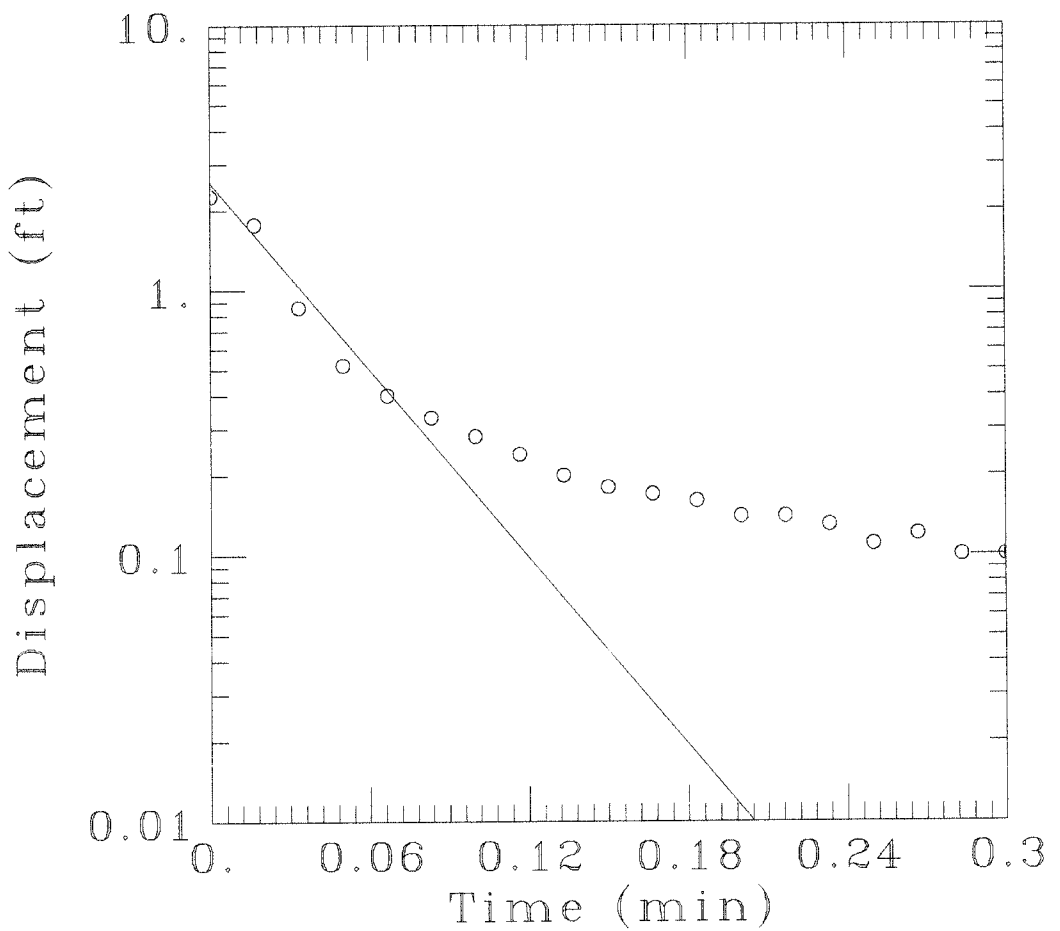
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-3
OBS. WELL:
P-3

ESTIMATED PARAMETERS:
K = 0.04055 ft/min
y0 = 1.786 ft

TEST DATA:
H0 = 1.8 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 14.29 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-3 SLUG-OUT TEST



DATA SET:
p3out
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-3

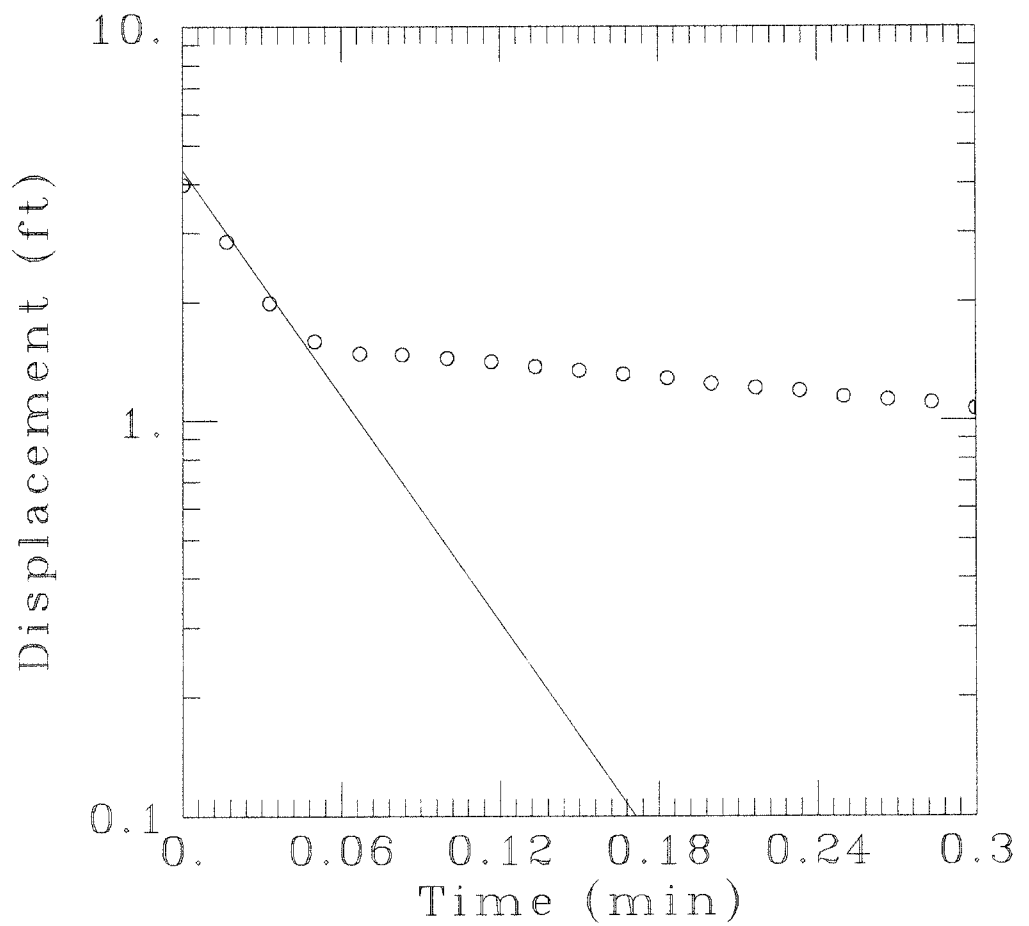
OBS. WELL:
P-3

ESTIMATED PARAMETERS:
K = 0.02189 ft/min
y0 = 2.553 ft

TEST DATA:
H0 = 2.26 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 14.29 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-4 SLUG-IN TEST



DATA SET:
p4in
05/03/05

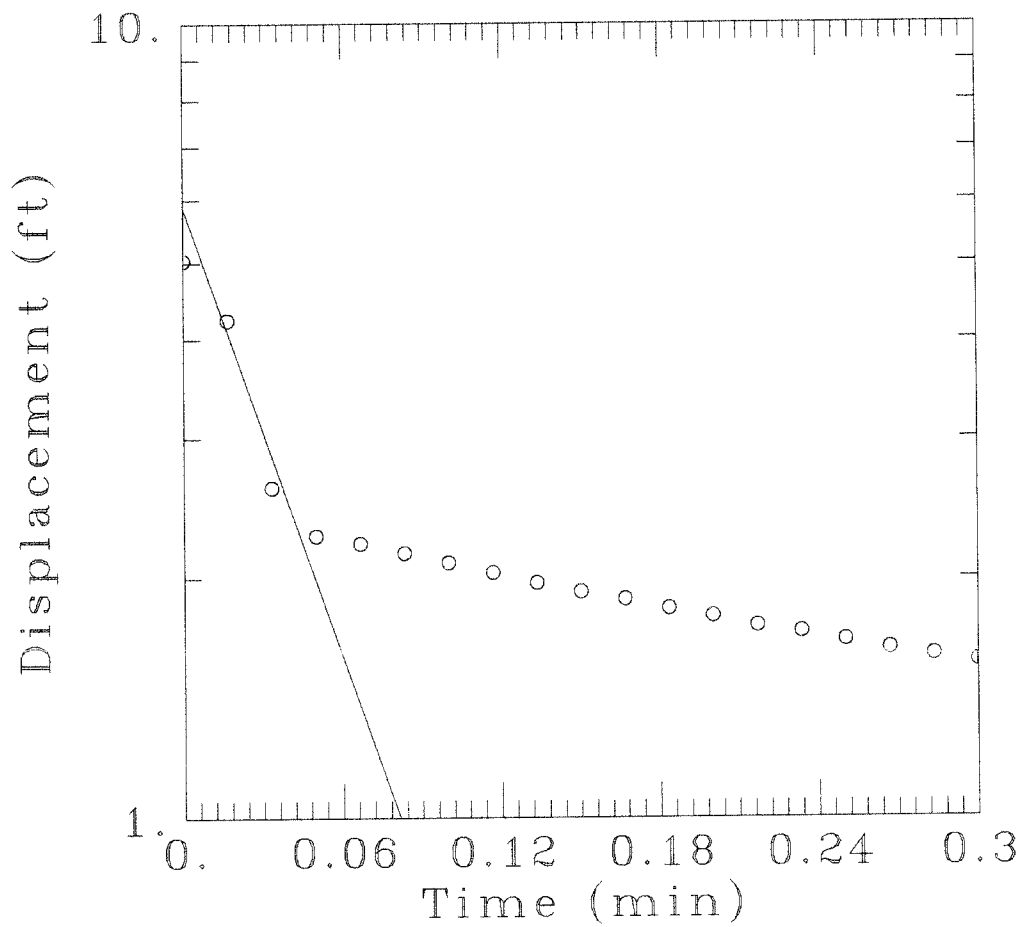
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04-21-05
TEST WELL:
P-4
OBS. WELL:
P-4

ESTIMATED PARAMETERS:
K = 0.01829 ft/min
y0 = 4.33 ft

TEST DATA:
H0 = 3.97 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 18.83 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-4 SLUG-OUT TEST



DATA SET:
p4out
05/03/05

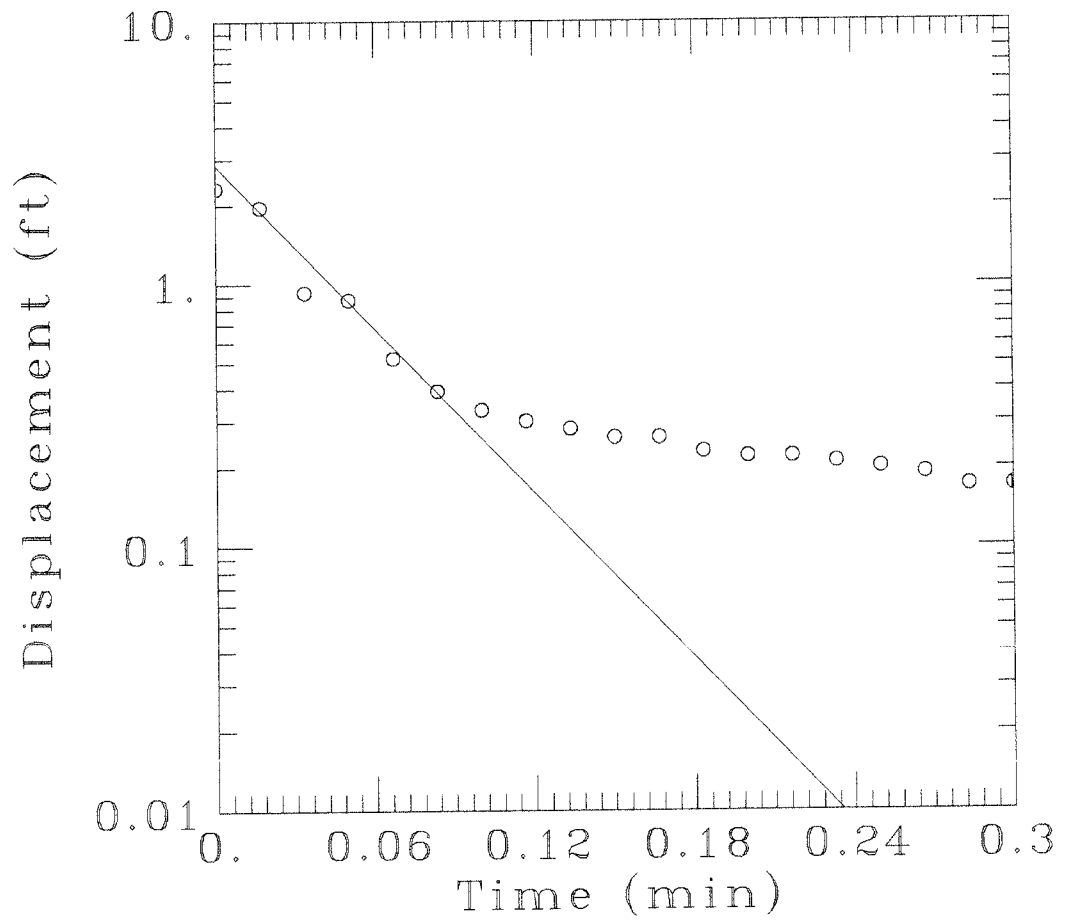
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
04/26/05
TEST WELL:
P-4
OBS. WELL:
P-4

ESTIMATED PARAMETERS:
K = 0.01818 ft/mn
y0 = 5.872 ft

TEST DATA:
H0 = 5.03 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 17.42 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-5 SLUG-IN TEST



DATA SET:
p5in
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-5

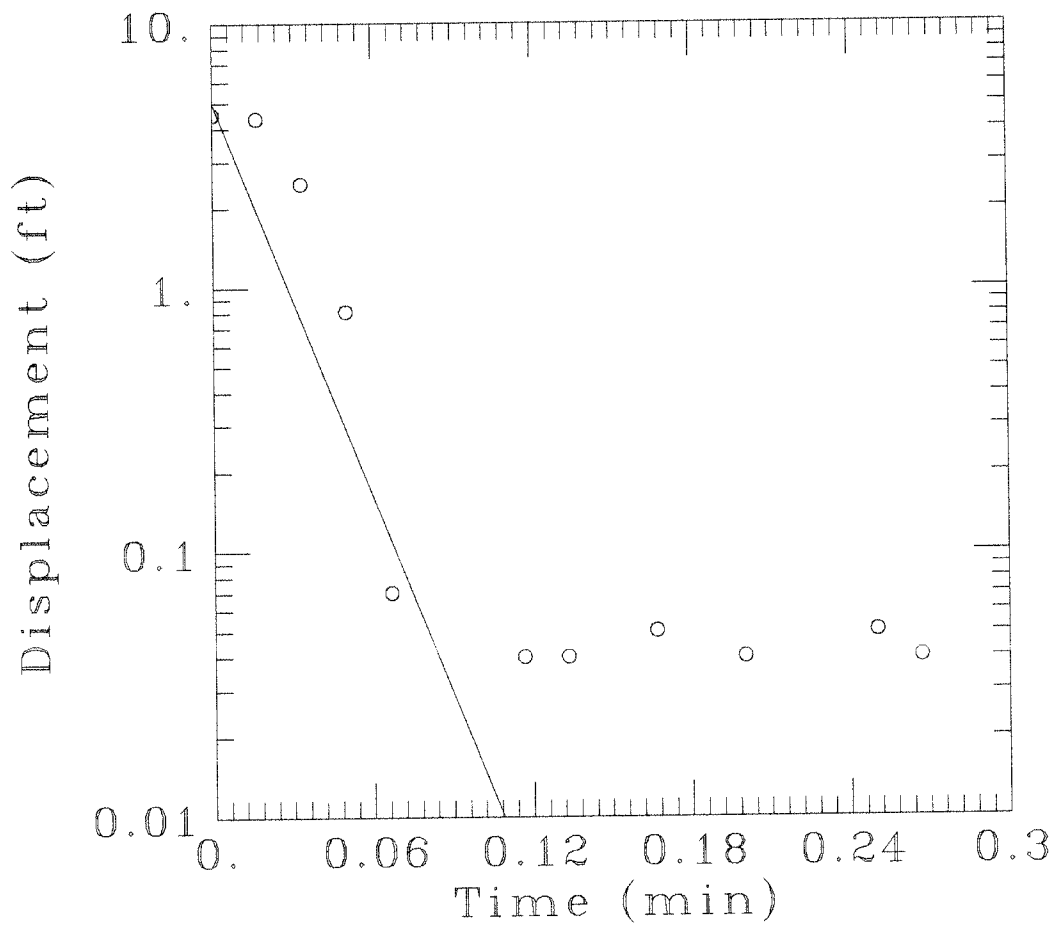
OBS. WELL:
P-5

ESTIMATED PARAMETERS:
K = 0.01849 ft/min
y0 = 2.835 ft

TEST DATA:
H0 = 2.32 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 11.1 ft

HYDRO-ENVIRONMENTAL ASSOCIATES	Client: CORDECO NW
Project No.: 05-4131A	Location: AGUADILLA, PR

DISCOVERY BAY P-6 SLUG-IN TEST



DATA SET:
p6in
05/03/05

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
04/26/05

TEST WELL:
P-6

OBS. WELL:
P-6

ESTIMATED PARAMETERS:
K = 0.04614 ft/min
y0 = 5.012 ft

TEST DATA:
H0 = 4.52 ft
rc = 0.08 ft
rw = 0.25 ft
L = 10. ft
b = 50. ft
H = 12.64 ft

Patrones de Salinidad y de Elevación Mareal en el Caño Madre Vieja

Sometido a

Ing. Antonio Hernández Virella
Discovery Bay Resort & Marina

3 de agosto de 2007

Preparado por

Jorge E. Capella, Ph.D.
Aguadilla, PR

Tabla de Contenido

Trasfondo del Problema

El Ing. Antonio Hernández Virella solicitó un estudio de la distribución, y de los cambios, en la salinidad de las aguas del Caño Madre Vieja debidos al flujo y al reflujo de la marea en el litoral costero. Dicho estudio constituye un componente adicional de los estudios ambientales requeridos para el Discovery Bay Resort & Marina, proyecto propuesto por CORDECO Northwest Corp.

Como complemento al estudio de salinidad, y para la definición de la zona marítimo-terrestre, el Lcdo. Patricio Martines solicito un estudio de las elevaciones mareales a lo largo de caño. Estos dos estudios son complementarios ya que los patrones de salinidad en el cano responden a la influencia de la marea. El estudio de las elevaciones fue diseñado para enlazar con las estaciones de muestreo de salinidad.

Localización, Flujo, y Mareas

El Caño Madre Vieja (CMV) transcurre aproximadamente de este a oeste bordeando la frontera norte del Valle del Coloso, donde comienza el acantilado de la Formación Aymamón. El caño se nutre de aguas de la precipitación montañosa, de la precipitación sobre la cuenca del Valle del Coloso, y de aguas subterráneas. El CMV corre aproximadamente paralelo al Río Culebrinas pero su caudal es mucho menor.

El Caño Madre Vieja conecta con el mar en la Bahía de Aguada-Aguadilla justo al sur del Parque Colón, según esta ilustrado geográficamente en la Figura 1. La ruta precisa del caño en la Figura 2 fue trazada mediante el uso de posiciones de GPS. La Figura 3 presenta una vista hacia el este (tierra adentro) de la boca del caño; el Parque Colón queda a la izquierda mientras que el mar abierto queda a la derecha y atrás. La foto en la Figura 3 fue tomada el 10 de junio a las 2:40 p.m., cuando el nivel del mar se acercaba al nivel de la marea alta, según podemos apreciar en la Figura 4. Los bañistas que aparecen en la Figura 3 nos permiten estimar en aproximadamente 0.5 m ($\sim$2 pies) la profundidad de la entrada al caño durante la marea alta. Durante la marea baja la entrada al caño esta casi totalmente cerrada.

Durante la temporada seca (meses primavera) la entrada del caño frecuentemente se cierra completamente con arena para luego ser abierta durante eventos de precipitación intensa con la llegada del verano. El flujo promedio de agua a través del caño depende de la cantidad de precipitación en la región caliza de Aymamón y en el Valle del Coloso y varia desde cero, en tiempos de sequía, hasta un máximo caudaloso, pero indeterminado, durante eventos intensos de lluvia.

Las mareas a lo largo de la costa oeste de PR son del tipo mixto pero predominantemente semidiurnas. O sea, ocurren dos ciclos de marea diarios (semidiurnos) pero estos varían en amplitud a lo largo de un periodo quincenal (componente diurno variable, “fortnightly”). En la Figura 4 podemos apreciar un régimen de marea semidiurna con picos diarios de aproximadamente igual amplitud. Es de esperarse que la entrada máxima de agua de mar al caño, provocando la salinidad mas alta en las aguas del caño, ocurra durante la marea alta cerca de la Luna Nueva o la Luna Llena (o sea durante las mareas de primavera o

"spring tides"), especialmente cuando la marea de primavera coincida con la declinación lunar máxima.

La gráfica de la Figura 5 nos enseña ciclos de amplitud diferente durante el día (desigualdad diurna o "diurnal inequality"). La Luna Nueva y el máximo en declinación lunar coincidieron el 14 de junio y causaron la marea mas alta de esa quincena.

El CMV consiste principalmente de un canal angosto durante su travesía hacia el mar. Tierra adentro dicho canal transcurre por zonas de humedales y observamos una transición rápida a bosque de mangle según nos acercamos al mar, según podemos apreciar en la Figura 6. El canal angosto entre mangles descarga a una cuenca mas ancha y profunda en la posición identificada como Entrada al Caño en la Figura 6. Esta cuenca (Fig. 7) recibe el caudal del CMV y además del Caño del Espinar y de otro caño que bordea el Parque Colón. El Caño Madre Vieja en su totalidad comprende el canal y de la cuenca.

La Figura 8 nos ilustra las profundidades a lo largo de un transecto que conecta la estación costera y las estaciones indicadas en la Figura 6. Debemos notar que la estación identificada como el Hoyo alcanza una profundidad de 6.7 m (22 pies). El Hoyo esta localizado en la intersección de los tres caños que descargan a la cuenca.

Descripción del Muestreo y de los Métodos Utilizados

Estudio de Salinidad

El 14 de junio se ocuparon cinco estaciones dentro del CMV las cuales están indicadas en las Figuras 2 y 6: Se efectuaron mediciones de salinidad en las aguas profundas de la bahía (estación de referencia, ocupada al principio y al final del muestreo), en aguas costeras justo fuera de la entrada del Caño Madre Vieja, en el punto mas angosto de la entrada (la estación llamada Rampa) y en varias estaciones dentro del caño. Para estos fines se utilizó un "YSI 556 Multiparameter System" (ver especificaciones al final de este documento) con la capacidad de medir temperatura, salinidad, y oxígeno disuelto en el agua. Si obtuvieron perfiles verticales en cada estación, a intervalos de 1 m, excepto en la Rampa para así cuantificar la estratificación vertical de cada parámetro. Dado que el caño permaneció abierto durante la marea alta, se utilizó una embarcación de poco calado (yola aguadillana) para muestrear caño adentro, hasta donde nos fue posible la navegación. Nótese que la marea alta ocurrió tarde en la noche lo cual dificultó la logística del muestreo.

Debido a una calibración defectuosa por parte de la compañía de alquiler de equipo fue necesario ajustar las salinidades demasiado altas obtenidas con el YSI. El día del muestreo las aguas en la estación de referencia mar afuera y en la estación costera frente a la entrada al caño exhibían una alta transparencia poco común para el área lo cual indica poca influencia de los ríos y la presencia de aguas principalmente oceánicas en la bahía.

En la Figura 9 vemos las salinidades superficiales en la estación CaTS del Departamento de Ciencias Marinas. En junio del 2007 CaTS se ocupó el día 12 y se observó un valor de 35.8 (nótese que no se utilizan unidades para la salinidad). En la estación costera CREWS se observó un valor similar durante el 14 de junio. Se procedió a compensar ("offset") las salinidades obtenidas por el YSI para obtener un valor de 35.8 en la estación de referencia.

El YSI midió un valor promedio de 38.5 en esta estación por lo tanto todas las salinidades medidas con el YSI fueron ajustadas mediante la resta de 2.7.

Es importante aclarar que a pesar de una incertidumbre máxima del orden de $\pm$ 1 unidad en los valores absolutos de salinidad obtenidos en este estudio (ver Fig. 9) las diferencias en salinidad son muy robustas. El valor de 35.8 debe ser interpretado como la salinidad de las aguas costeras fuera del caño, o sea, las salinidades dentro del caño siempre son menores de 35.8 debido a la mezcla del agua de mar con el agua de origen pluvial.

Estudio de Elevación Mareal

Las elevaciones del nivel del agua a lo largo del canal del CMV durante un ciclo de marea fueron monitoreadas el 27 de junio de 2007, durante otro evento de mareas altas. La marea durante el 27 de junio de 2007 está graficada en la Figura 10 mientras que los datos del mareógrafo de Aguadilla aparecen en la Figura 11. Se establecieron seis estaciones a lo largo del caño cuyas posiciones están indicadas en las Figuras 12 y 13.

Cada estación consistió de un tubo graduado en pies y pulgadas los cuales fueron enterrados en el lecho del caño durante la marea baja según esta ilustrado en la Figura 14. Se leyó el nivel del agua, redondeado a la 0.5 pulgada mas cercana, aproximadamente cada hora hasta una vez pasada la marea alta.

Resultados

Salinidad

Bajo las condiciones observadas correspondientes a comienzos del verano cuando la salida al mar del CMV está abierta, y bajo el efecto de mareas de primavera, el estuario del CMV mantiene un intercambio vigoroso con el mar y la estratificación vertical de sus aguas, tanto en la cuenca como en el canal, es muy pronunciada. Las Figuras 15 a 21 indican la presencia de una capa superficial relativamente poco profunda, del orden de 1 m de grosor, y caracterizada por salinidades relativamente bajas. Bajo esta capa superficial encontramos un haloclino (zona vertical que exhibe un gradiente abrupto en salinidad) muy bien definido en todas las estaciones de muestreo bajo el cual encontramos una zona interior, y relativamente homogénea, de salinidades mas altas.

Las salinidades interiores por lo general alcanzan valores de 98% a 99%, relativos a la salinidad de la estación de referencia mar afuera mientras que las salinidades de la capa superficial varían de forma regular con la fase de la marea. Las salinidades de la capa superficial son altas con el subir la marea (entrada de agua de mar al caño) y mas bajas según baja la marea (mayor flujo del caño al mar). En las partes mas profundas de la cuenca se acumula agua salada, mas pesada, mientras que el agua fresca, y mas liviana, fluye sobre ésta. En el canal probablemente se establece una clásica cuña de sal cuya penetración tierra adentro es proporcional al flujo de agua fresca en el caño.

La parte mas profunda del sistema estuarino del CMV está localizada en la estación del Hoyo donde las profundidades alcanzan 6.7 m (22 pies). Es aquí donde se encuentra la mayor acumulación de agua salada y donde observamos una anomalía en el patrón de salinidades interiores altas. Como podemos apreciar en las Figuras 15 y 16 además de las

dos capas descritas anteriormente, superficial e interior, en el Hoyo encontramos una capa cerca del fondo la cual esta caracterizada por una baja en salinidad y bajo oxígeno disuelto. La permanencia de esta cuenca batimétrica en un ambiente de alta sedimentación y la presencia de agua relativamente fresca y anóxica cerca del fondo en su parte mas profunda sugiere la existencia de un manantial submarino o de una zona de afloramiento de aguas subterráneas en el lugar.

Elevación Mareal

Como podemos apreciar en la Figura 22 el flujo y reflujo de la marea en la cuenca y en las estaciones mas próximas al mar en el canal del CMV (estaciones 5 y 6 en las Figuras 12 y 13) es comparable en fase y en amplitud a la marea costera en la Bahía de Aguada-Aguadilla. Además, se observa una disminución en la amplitud de las oscilación mareal según procedemos tierra adentro.

El la Figura 23 se ha graficado la elevación mareal como función de la distancia a lo largo del CMV partiendo desde la Rampa. El por ciento de elevación relativo al mar también se ha graficado en esta figura. El decrecimiento en el por ciento de elevación entre las estaciones 5 y 1 es aproximadamente lineal lo cual nos permite calcular fácilmente la respuesta mareal para cualquier posición del canal. En la estación 1 observamos un aumento negativo (una baja) en el nivel del agua durante la marea alta el cual corresponde a la respuesta hidráulica de las aguas del caño como consecuencia de la propagación de la onda mareal.

Los árboles de mangle (adultos) localizados mas tierra adentro a lo largo del CMV se encontraron en la estación 4. Estos son dos árboles solitarios, uno de mangle rojo y del otro no estoy seguro. La estación 5 esta completamente rodeada de mangle. Esta observación es consistente con la merma en la amplitud mareal entre estas dos estaciones y nos permite especular que poco agua salada llega mas allá de la estación 4.

Lista de Figuras

Figura 22. Resultados del estudio de la elevación mareal en el Caño Madre Vieja. La localización de las estaciones de muestreo está indicada en las Figuras 12 y 13. Para fines de comparación la elevación de la marea de Aguadilla fue ajustada tal que la altura de la marea baja fuera igual a cero. La elevación de la marea de Aguadilla durante la marea baja fue de 2.3 pulgadas relativas al MLLW.

Figura 23. Elevación mareal, y por ciento de elevación mareal, como función de la distancia a lo largo del Caño Madre Vieja. Los por cientos de elevación fueron calculados relativos a la marea en la estación de NOAA en la Bahía de Aguada-Aguadilla.

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- Three-year warranty on the instrument; one-year on the probes
- GLP assisting, records calibration data in memory
- Available with 4, 10, and 20-m cable lengths
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- Optional Barometer – Internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure. (Choose 556-02)
- Optional Flow Cell - The 5083 flow cell can be used for ground water applications or anytime water is pumped for sampling.
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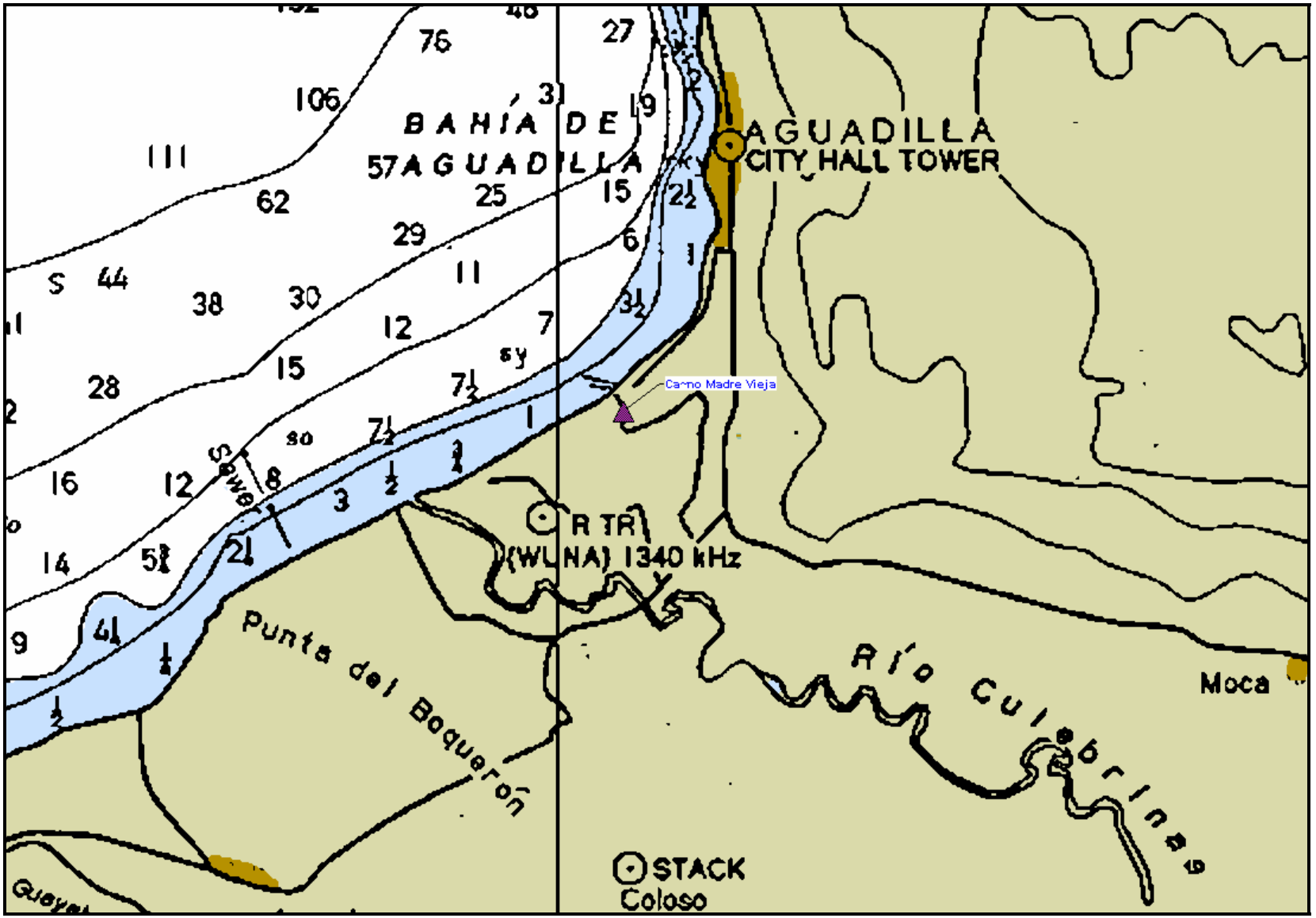
BAHÍA DE AGUADILLA
AGUADILLA
CITY HALL TOWER
Camino Madre Vieja
R TR
(WLNA) 1340 kHz
Punta del Boquerón
Río Culebrinas
Moca
STACK
Coloso

Figura 1.

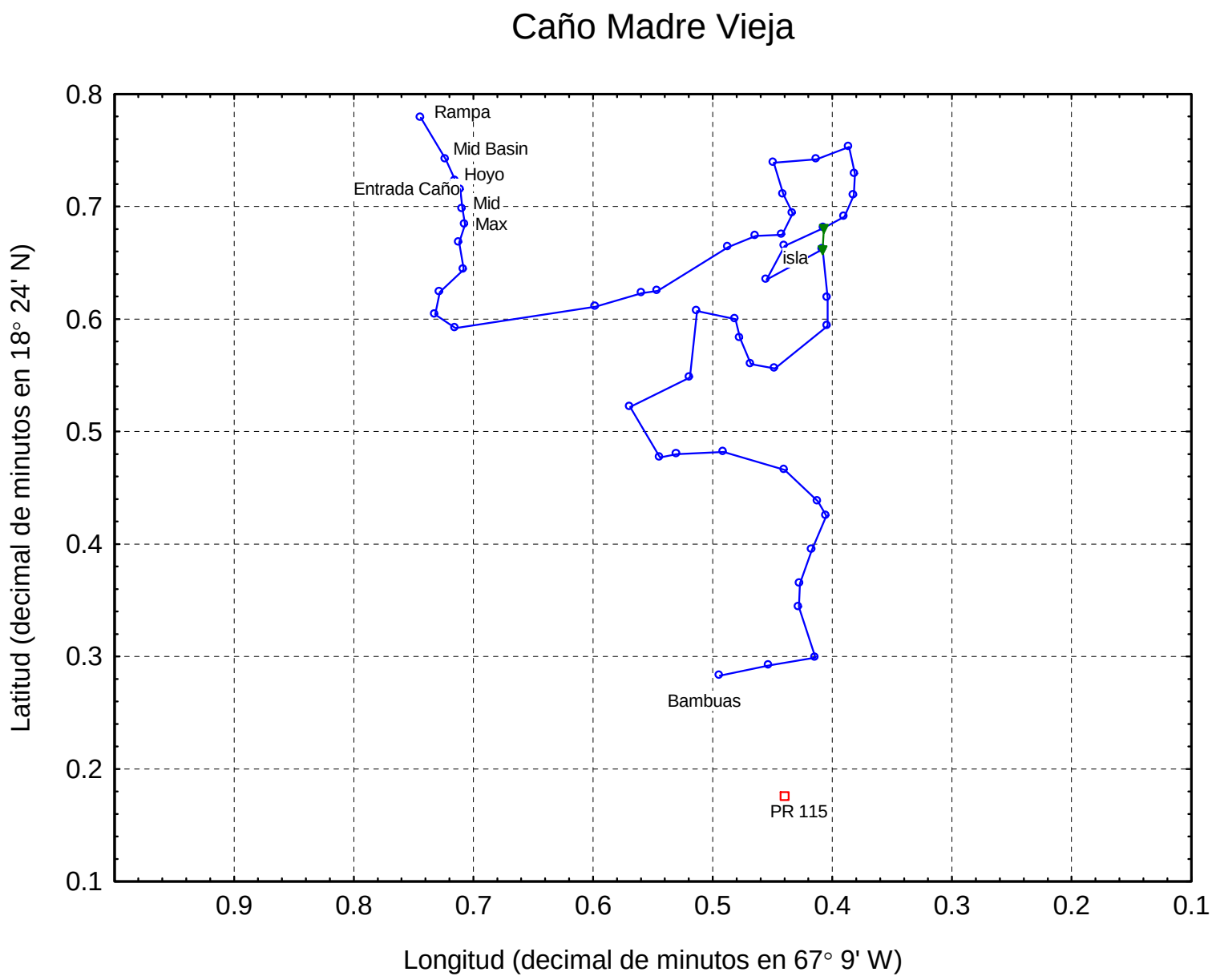
Caño Madre Vieja
Rampa
Mid Basin
Hoyo
Entrada Caño
Mid
Max
isla
Bambuas
PR 115
Latitud (decimal de minutos en 18° 24' N)
Longitud (decimal de minutos en 67° 9' W)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figura 2.

Figura 3.

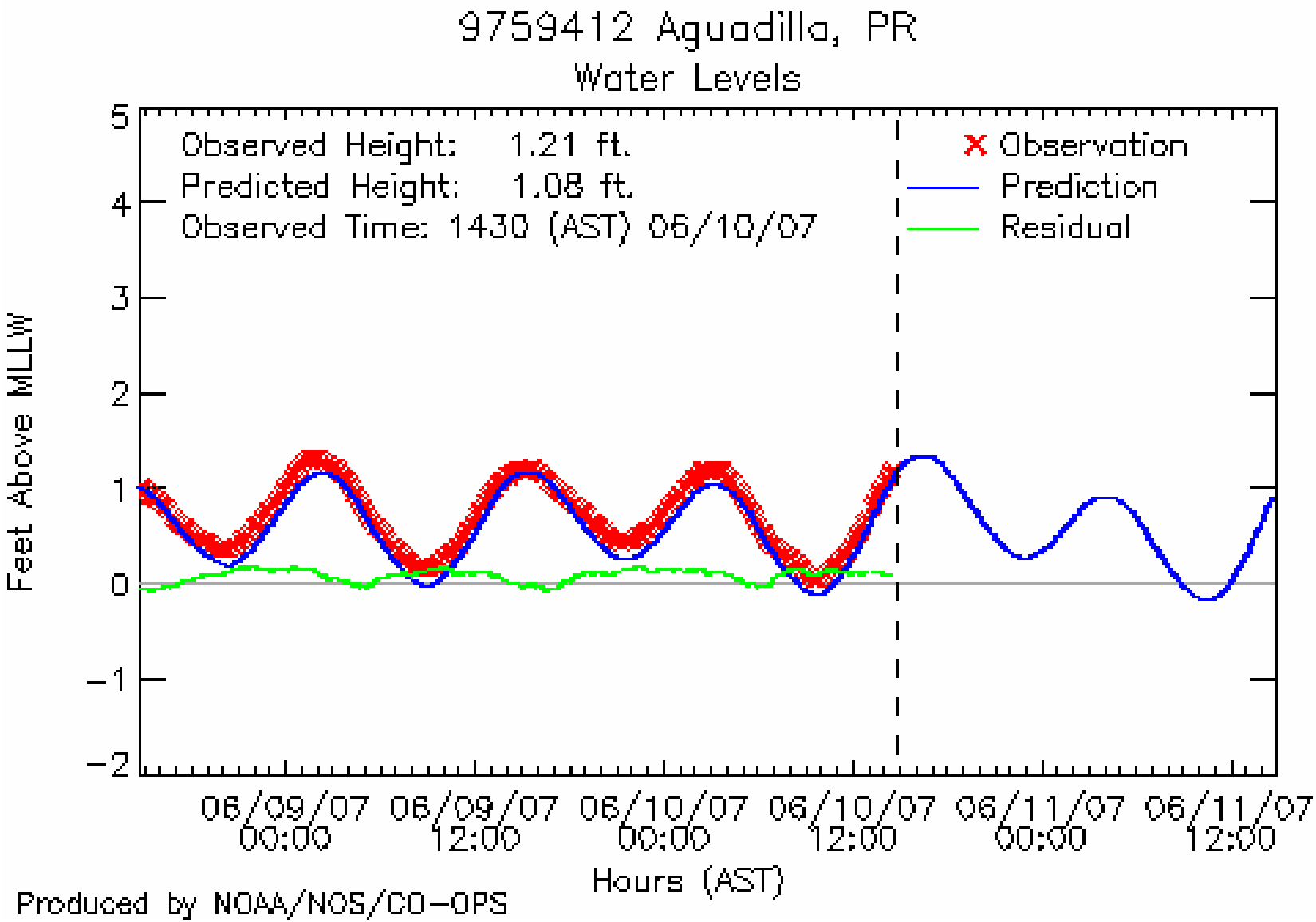
9759412 Aguadilla, PR
Water Levels
Observed Height: 1.21 ft.
Predicted Height: 1.08 ft.
Observed Time: 1430 (AST) 06/10/07
Observation
Prediction
Residual
Feet Above MLLW
5
4
3
2
1
0
−1
−2
06/09/07 00:00
06/09/07 12:00
06/10/07 00:00
06/10/07 12:00
06/11/07 00:00
06/11/07 12:00
Hours (AST)
Produced by NOAA/NOS/CO-OPS

Figura 4.

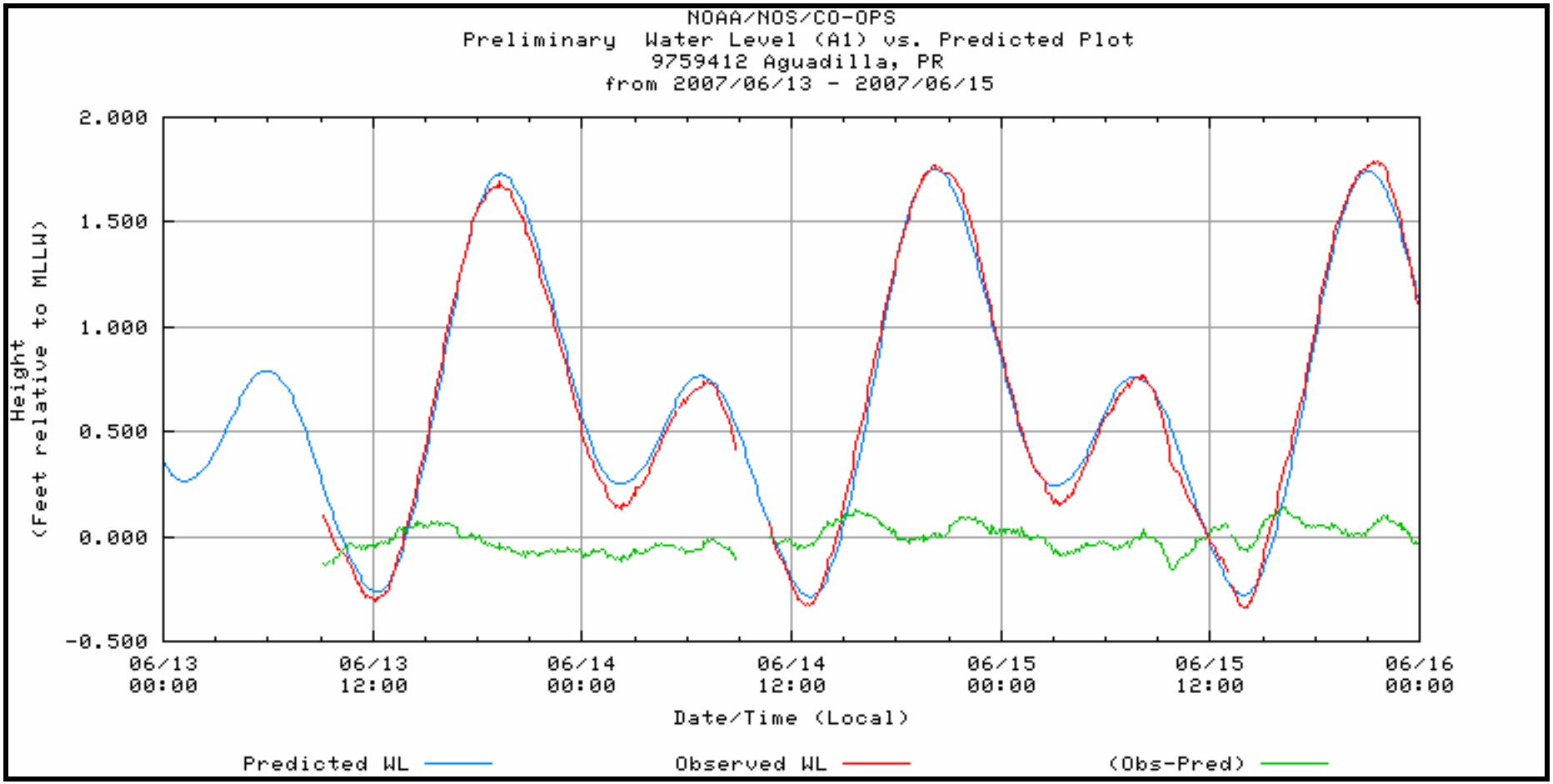
NOAA/NOS/CO-OPS
Preliminary Water Level (A1) vs. Predicted Plot
9759412 Aguadilla, PR
from 2007/06/13 - 2007/06/15
Height
(Feet relative to MLLW)
2.000
1.500
1.000
0.500
0.000
-0.500
06/13
00:00
06/13
12:00
06/14
00:00
06/14
12:00
06/15
00:00
06/15
12:00
06/16
00:00
Date/Time (Local)
Predicted WL
Observed WL
(Obs-Pred)

Figura 5.

Figura 6.

Figura 7.

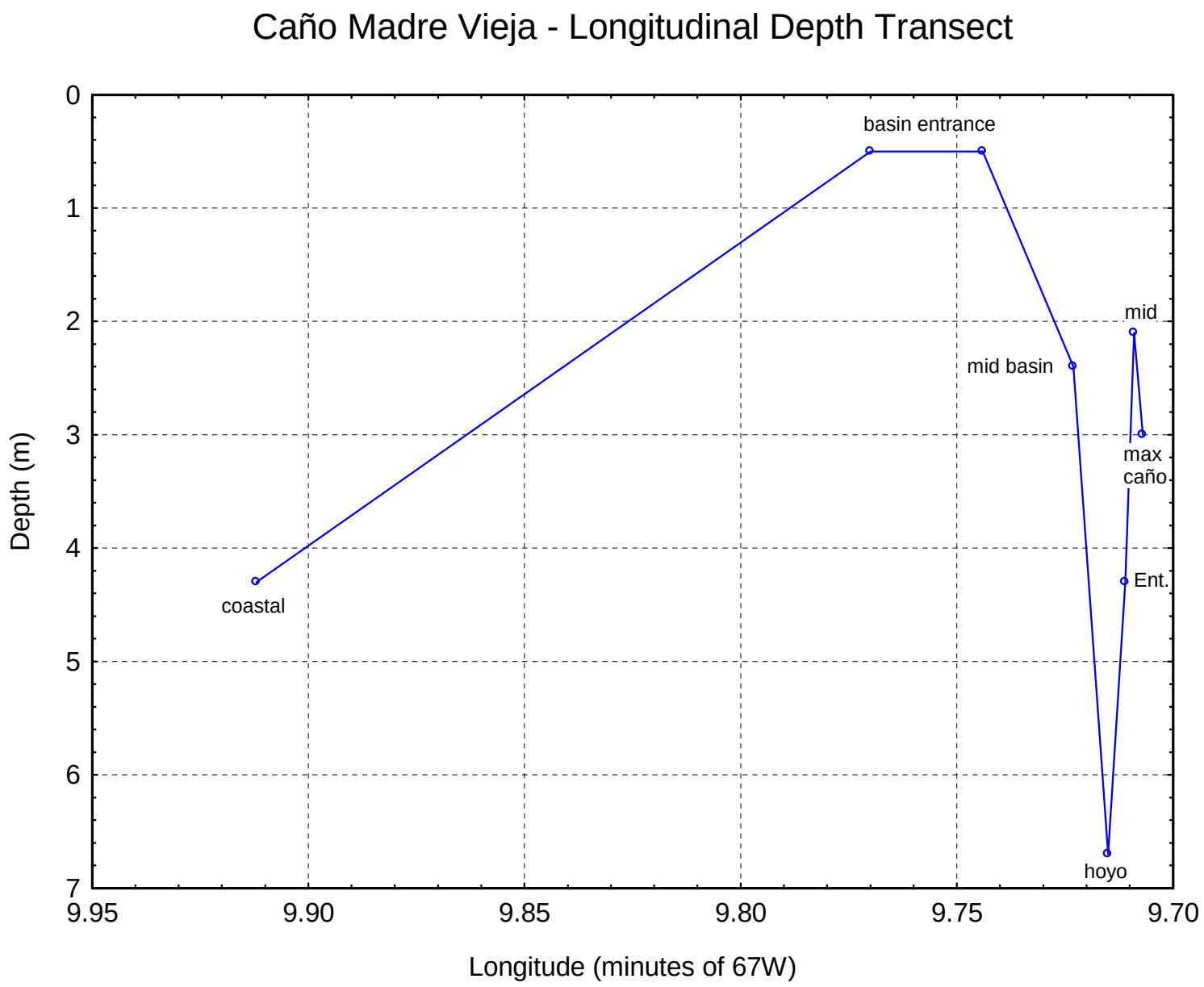
Caño Madre Vieja - Longitudinal Depth Transect
Depth (m)
0
1
2
3
4
5
6
7
9.95
9.90
9.85
9.80
9.75
9.70
Longitude (minutes of 67W)
basin entrance
mid
mid basin
max
caño
Ent.
coastal
hoyo

Figura 8.

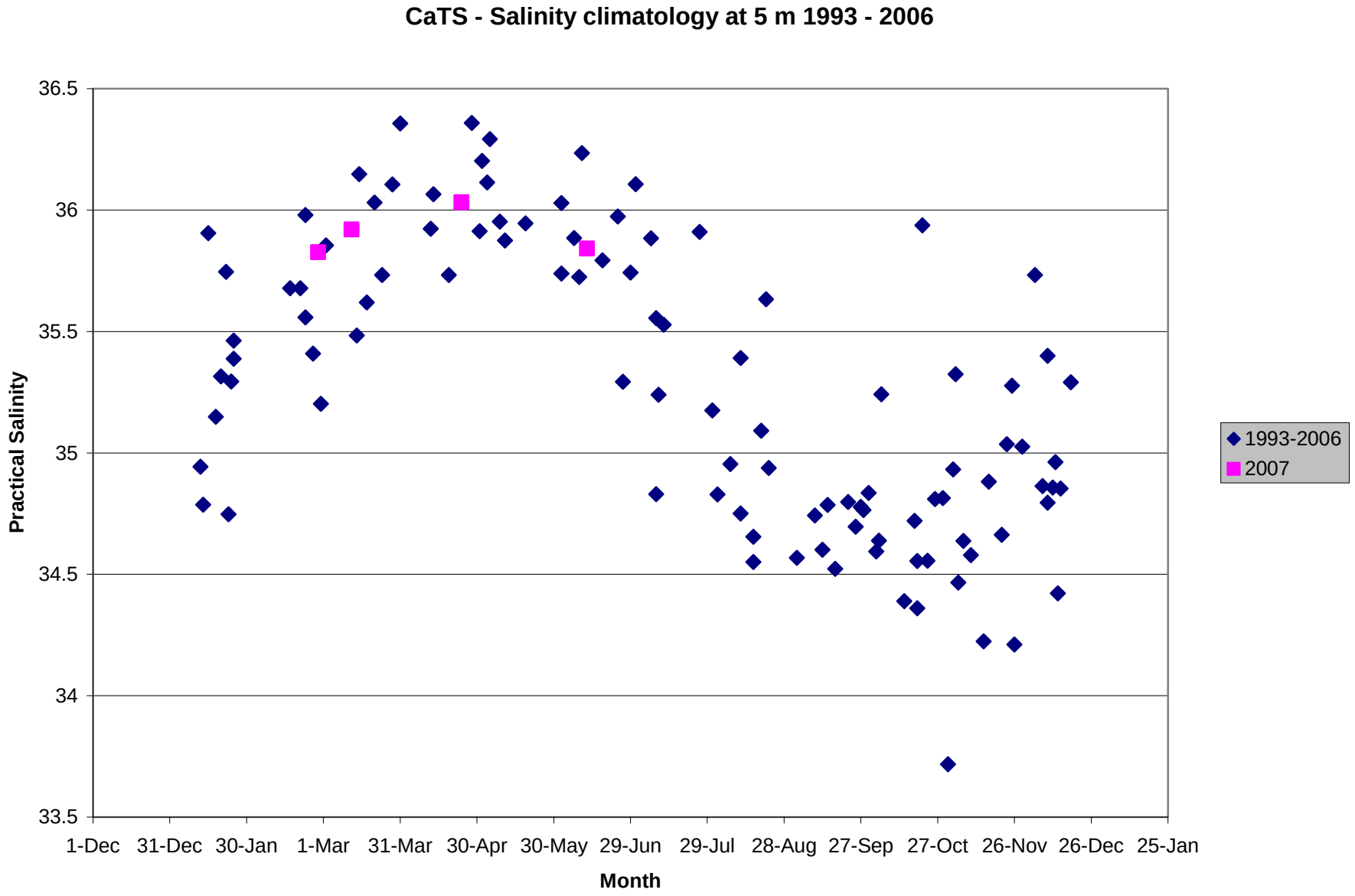
CaTS - Salinity climatology at 5 m 1993 - 2006
Practical Salinity
36.5
36
35.5
35
34.5
34
33.5
1-Dec
31-Dec
30-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
25-Jan
Month
1993-2006
2007

Figura 9.

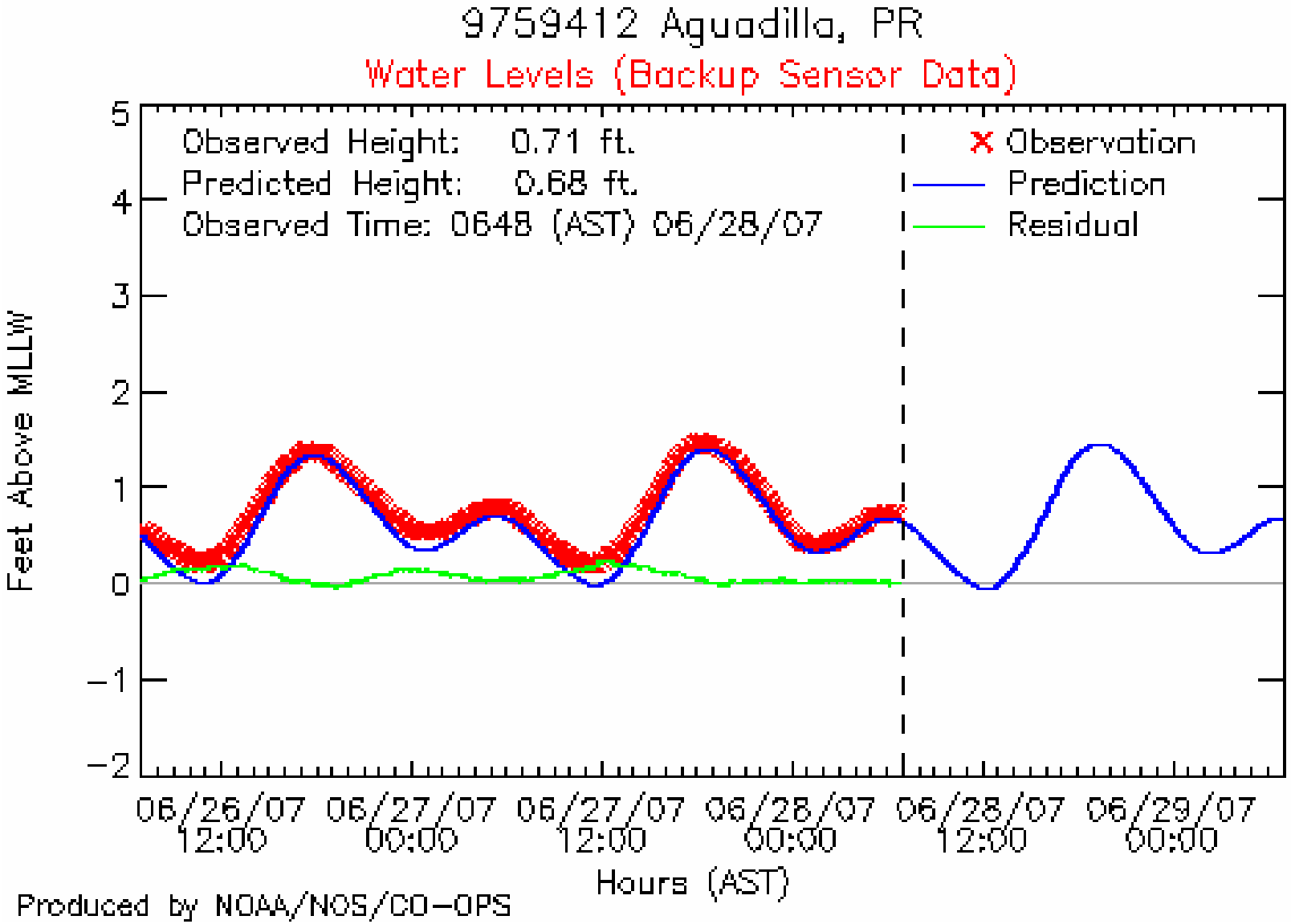
9759412 Aguadilla, PR
Water Levels (Backup Sensor Data)
Observed Height: 0.71 ft.
Predicted Height: 0.68 ft.
Observed Time: 0648 (AST) 06/28/07
Observation
Prediction
Residual
Feet Above MLLW
5
4
3
2
1
0
−1
−2
06/26/07 12:00
06/27/07 00:00
06/27/07 12:00
06/28/07 00:00
06/28/07 12:00
06/29/07 00:00
Hours (AST)
Produced by NOAA/NOS/CO-OPS

Figura 10.

Aguadilla, PR **Station ID: 9759412**

Station Information

Latitude: **18° 27.5' N** Mean Range: **1.05 ft.**

Longitude: **67° 10.1' W** Diurnal Range: **1.40 ft.**

Established: **Feb 9 1976**

Present Installation: **Jun 19 2006**

Time Meridian: **60**

Mean Range (MN): The difference in height between mean high water and mean low water.

Diurnal Range (GT): The difference in height between mean higher high water and mean lower low water.

Mean High Water (MHW): A tidal datum. The average of all the high water heights observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

Mean Low Water (MLW): A tidal datum. The average of all the low water heights observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

Mean Higher High Water (MHHW): A tidal datum. The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

Mean Lower Low Water (MLLW): A tidal datum. The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

Figura 11.


Proposed Jetties
Proposed Marina
Río Culebrinas
Caño Madre Vieja
Legend
USGS Gauge Location
N
Margarita Dam
Discovery Bay Resort and Marina
Aguada, Puerto Rico
0 125 250 500
Meters
Carr 440
Carr 442
Carr 441
Carr 439
Carr 115
Carr 116
Carr 4439
Carr 418
Carr 2
Carr 9989
Carr 111
Carr 4443
Carr 125
Carr 443
Carr 22

Figura 12.

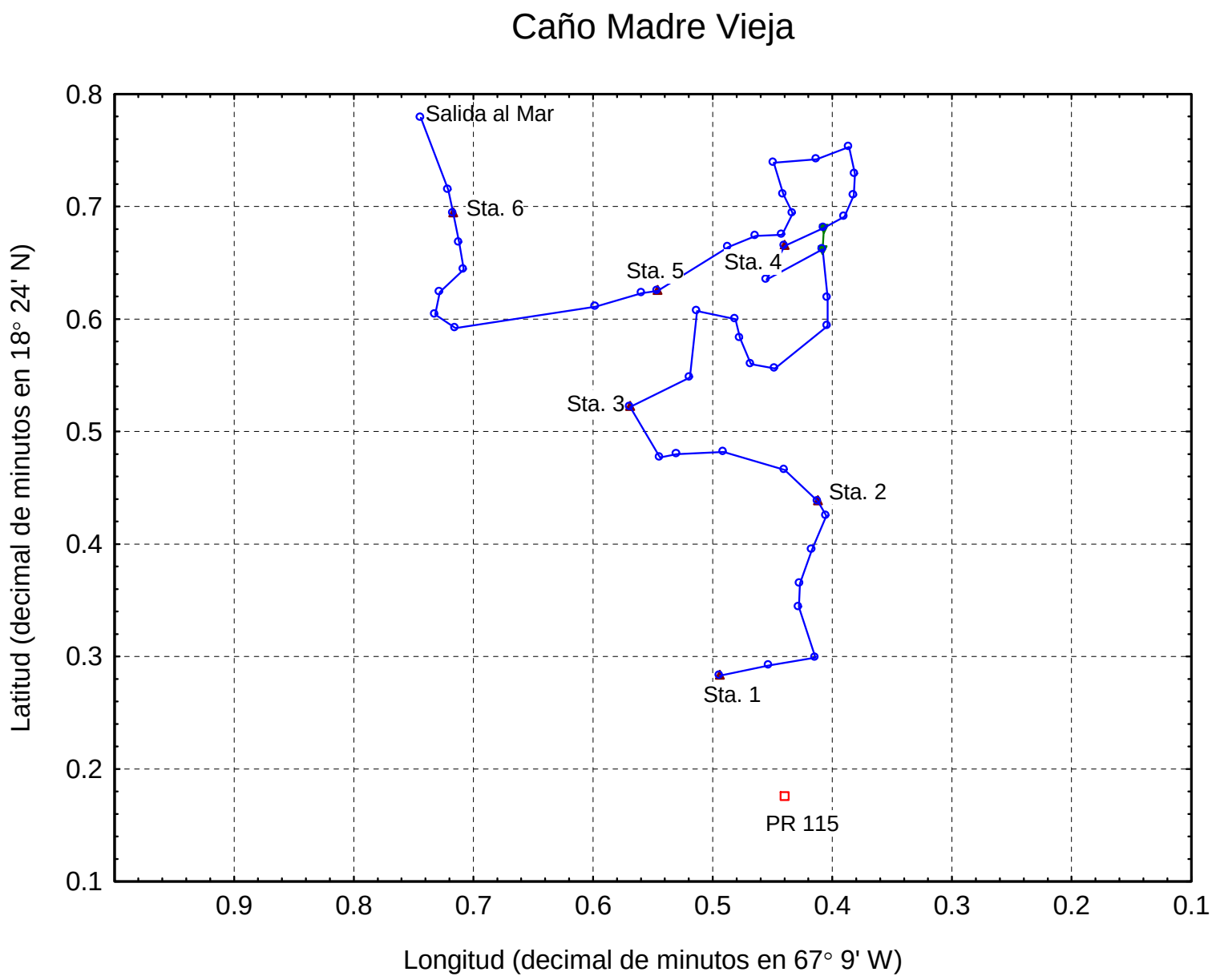
Caño Madre Vieja
Salida al Mar
Sta. 6
Sta. 5
Sta. 4
Sta. 3
Sta. 2
Sta. 1
PR 115
Latitud (decimal de minutos en 18° 24' N)
Longitud (decimal de minutos en 67° 9' W)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figura 13.

Figura 14.

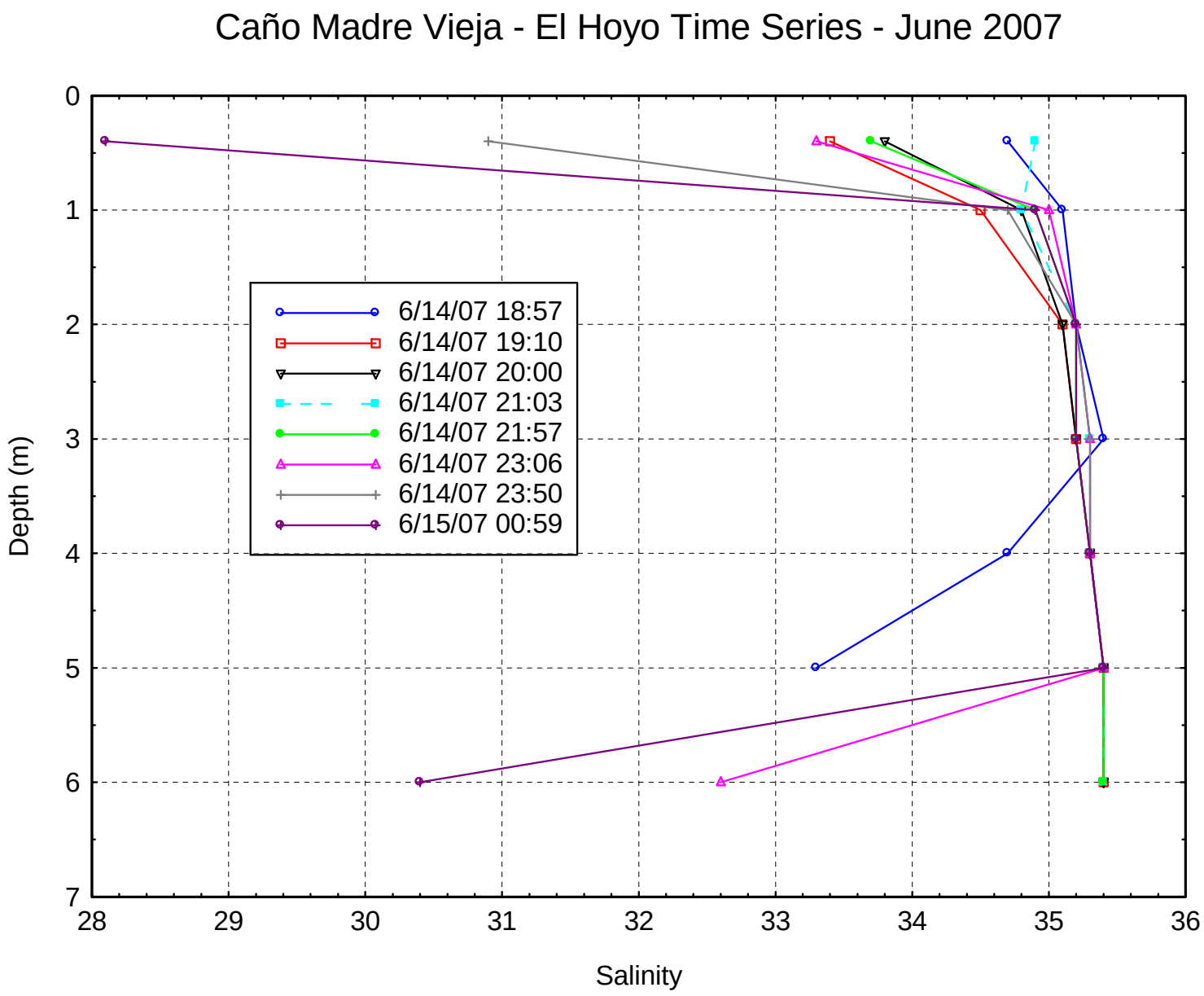
Caño Madre Vieja - El Hoyo Time Series - June 2007
Depth (m)
Salinity
0
1
2
3
4
5
6
7
28
29
30
31
32
33
34
35
36
6/14/07 18:57
6/14/07 19:10
6/14/07 20:00
6/14/07 21:03
6/14/07 21:57
6/14/07 23:06
6/14/07 23:50
6/15/07 00:59

Figura 15.

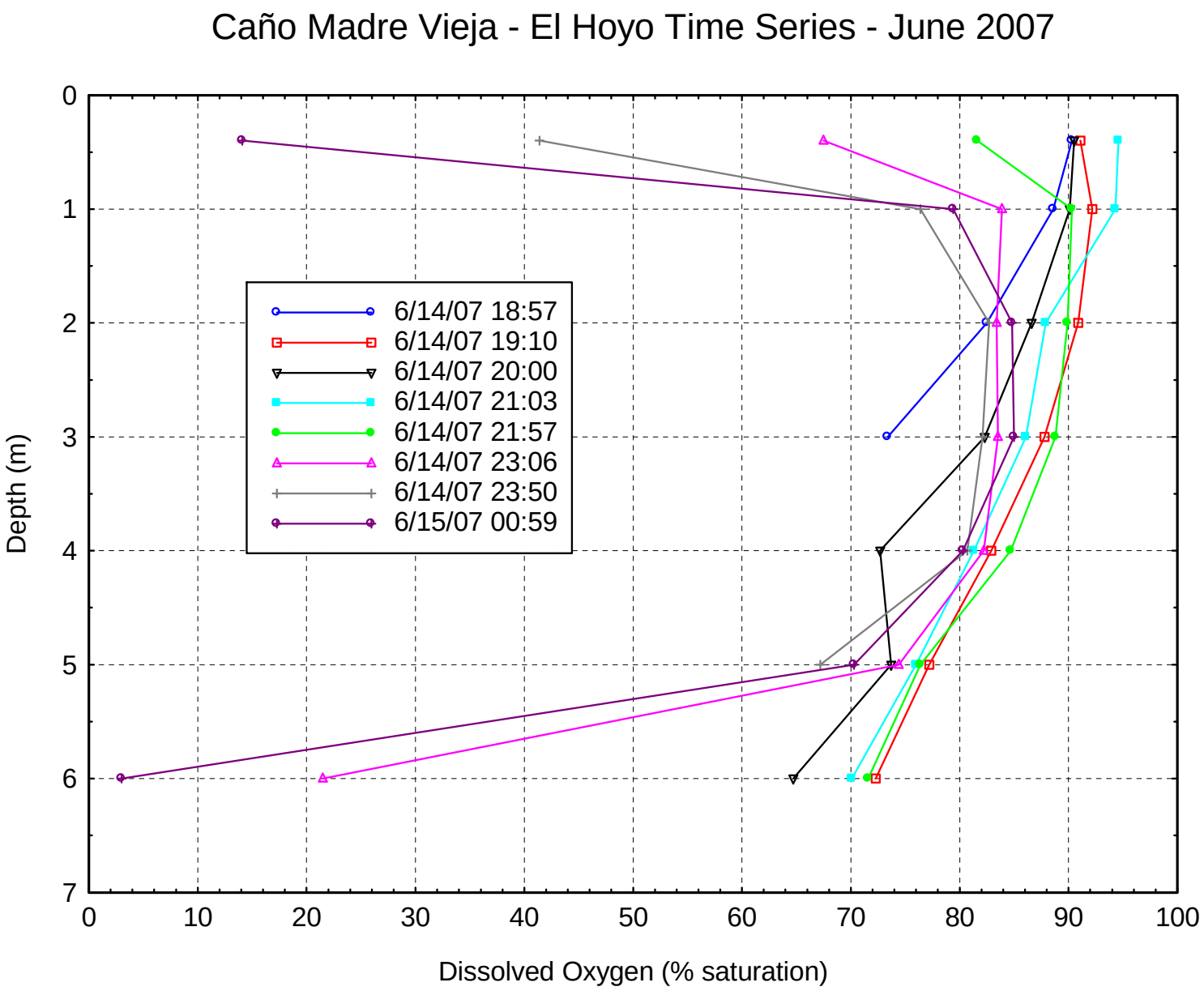
Caño Madre Vieja - El Hoyo Time Series - June 2007
Depth (m)
Dissolved Oxygen (% saturation)
0
1
2
3
4
5
6
7
0
10
20
30
40
50
60
70
80
90
100
6/14/07 18:57
6/14/07 19:10
6/14/07 20:00
6/14/07 21:03
6/14/07 21:57
6/14/07 23:06
6/14/07 23:50
6/15/07 00:59

Figura 16.

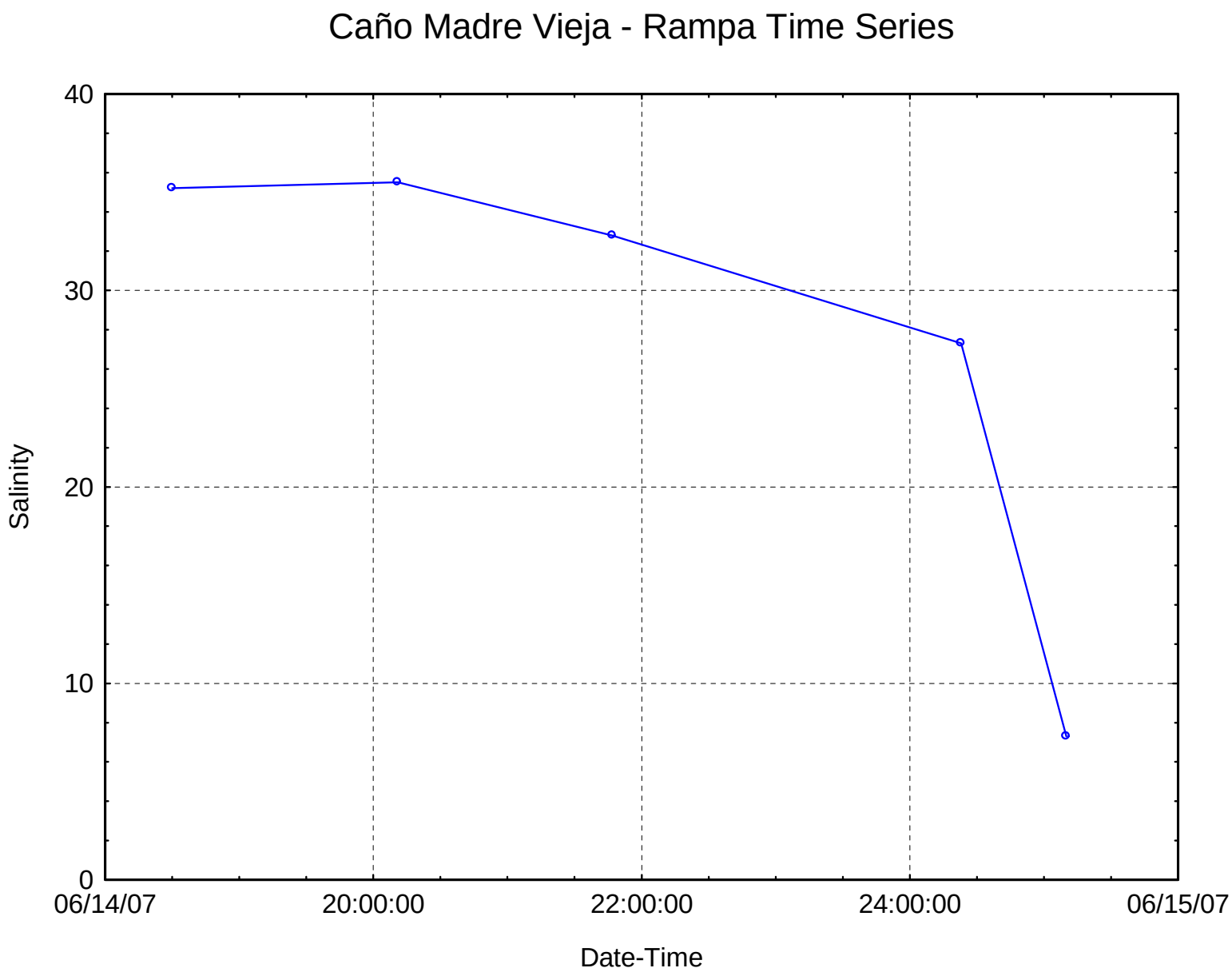
Caño Madre Vieja - Rampa Time Series
40
30
20
10
0
Salinity
06/14/07
20:00:00
22:00:00
24:00:00
06/15/07
Date-Time

Figura 17.