MACTEC

COVER SHEET

FINAL DATA REPORT

GEOTECHNCIAL EXPLORATION AND TESTING
TURKEY POINT COL PROJECT
FLORIDA CITY, FLORIDA

October 6, 2008

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.
RALEIGH, NORTH CAROLINA

MACTEC PROJECT No. 6468-07-1950

Prepared For:

Bechtel Power Corporation
Subcontract No. 25409-102-HC4-CY00-00001

FINAL DATA REPORT Rev. 2
GEOTECHNICAL EXPLORATION AND TESTING

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VOLUME 1

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OVERVIEW

1.1 Introduction

MACTEC Engineering and Consulting, Inc. (MACTEC) was retained by Bechtel Power Corporation (Bechtel) to conduct the subsurface investigation and laboratory testing program to obtain information on subsurface materials and conditions for use in the preparation of the Combined Operating License (COL) Application for the FPL – Turkey Point Power Generating Station located in Florida City, Florida. The COL application, to be prepared by others, will be submitted to the U.S. Nuclear Regulatory Commission (NRC) for approval to locate a future nuclear electric power generation facility at the existing Turkey Point Site. A site location map is included as Figure 1.

MACTEC executed its services in accordance with Bechtel Subcontract No.25409-102-HC4-CY00-0001. The field work commenced on February 9, 2008 and drilling activities were substantially completed on May 30, 2008. Geophysical testing was completed on June 26, 2008.

The Scope of Work was defined in Exhibit "D" (current revision 4) of the Bechtel Subcontract and the technical requirements were defined in Bechtel Specification 25409-102-3PS-CY00-00001 Rev 002, dated April 9, 2008. The scope of work is briefly described below:

- Preparing and submitting a Quality Assurance Project Document, Work Plan, Environmental Protection Plan, and Health and Safety Plan.
- Obtaining permits necessary for performing the work.
- Furnishing the supervision, labor, equipment, tools, supplies, and materials necessary to perform the specified work at the locations specified by Bechtel.
- Providing geotechnical engineers and/or geologists in the field under the direction of qualified geotechnical engineers and/or geologists with experience in geotechnical investigations to oversee and log the investigation work.
- Providing a Site Manager responsible for oversight of all required field activities.
- Providing Quality Assurance (QA) observation of the field and laboratory work activities and submitting QA records.
- Locating work items by survey methods.
- Performing utility location survey prior to starting work
- Providing water to work areas for drilling and testing
- Performing Standard Penetration Tests (SPT) and obtaining samples using a split spoon sampler.
- Performing both HQ3 and PQ3 triple tube wire-line rock coring
- Performing SPT energy measurements.
- Obtaining undisturbed samples using standard pushed Shelby tubes, the Pitcher barrel sampler, and the Osterberg sampler.
- Collecting, labeling and transporting soil and rock core samples to a designated sample storage area.
- Transporting designated samples to appropriate laboratories for testing purposes.
- Backfilling drilled holes with cement/bentonite grout using the tremie method.
- Excavating and backfilling test pits and obtaining bulk samples.
- Installing ground water observation wells, performing field permeability tests, and obtaining water samples.

- Performing electrical Cone Penetrometer Tests (CPT) with down-hole seismic tests (if possible) and porewater pressure dissipation tests at selected locations.
- Performing down-hole geophysical logging.
- Performing down-hole acoustic televiewer logging.
- Performing suspension P-S logging.
- Performing down-hole velocity measurements
- Restoring the work areas.
- Performing laboratory testing on soil and rock samples.
- Preparing a Data Report containing the data generated by the subsurface investigation and laboratory testing activities.
- Performing all work under MACTEC's approved Safety Program.
- Performing all work in accordance with MACTEC's approved Environmental Protection Plan

Sampling and testing related to the geotechnical exploration are considered to be tasks that could affect design, construction or operation of safety-related systems, structures and components. This work was performed under a Quality Assurance program that meets the requirements of 10 CRF Part 50 Appendix B and 10 CFR 21 (Reporting of Defects and Noncompliance)

This Final Data Report generally describes the field and laboratory testing methods and presents the field data, and laboratory testing results completed for the site investigation area.

1.2 Personnel

MACTEC completed field work for this project under the direction of Bechtel's Site Coordinators, Mr. Jerry Lefevre, Mr. Linwood Bennett, and Mr. William Holtz. Site technical support was provided by Mr. Mike Klosterman, Mr. John Sturman, and Mr. Allen Shaw.

Primary MACTEC personnel and their responsibilities were as follows:

Stephen J. Criscenzo	Chief Engineer
J. Allan Tice	Senior Principal Engineer
G. Thomas McDaniel, P.E.	Project Principal Engineer
Scott Auger	Project Manager
Siesta Williams	Document Control
John Martin	Quality Assurance Representative
Matthew Cooke	Site Manager, Report Preparation
Daniel Haug	Site Coordinator
Michael Lear	Lead Geologist
Lise Bisson	Rig Geologist
Chris Burroughs	Rig Geologist
Oscar Rodriguez	Rig Engineer
Rodney Clark	Rig Geologist
Harry Lyatuu	Rig Engineer
Johnny Liles	Rig Geologist
Shaun Lehman	Rig Geologist
Stephen Woodham	Rig Engineer
Kimberly Charles-Smith	Principal Environmental Technician
Gautham Pillappa	Rig Engineer
Bryan Taylor	Rig Geologist

Steven E. Kiser, P.E.	SPT Hammer Energy Measurement – Charlotte
Jay Cerceo	SPT Hammer Energy Measurement - Charlotte
Michael Jones, PLS	Site Utility Survey
Mark Follis	Surveyor
Concepcion Barrios	Surveyor
Ananda Fowler	Surveyor
Jerald Johnson	Surveyor
Chris Lindstedt	Surveyor
Lee Brian Johnson	Laboratory Services Manager - Raleigh
Jianren Wang	Laboratory Services Manager - Atlanta
Michael Hamlet	Laboratory Services Manager - Charlotte
Jimmy Schiff	Report Preparation
Jim Howard	Report Preparation
William Grimes	Senior Geologist/Report Preparation
Steven Copley	Report Preparation
Bill Deobald	Report Preparation
Zeynep Ulker	Report Preparation

The organizations that conducted on-site work or laboratory testing of samples as part of this project are listed in Table 1.1.

1.3 Organization of Report

The organization of this report consists of a transmittal letter, table of contents, narrative text, tables, figures and appendices. The appendix documents containing project data submittals are further organized as follows:

Appendix A – Survey Report

Appendix B – Geotechnical Field Data
- Boring and Coring Logs with Core Photographs
- Test Pit Logs
- SPT Energy Measurement Reports

Appendix C – Cone Penetrometer Test Results
- CPT Data
- CPT Report
- CPT Calibration Report

Appendix D – Geophysical Test Data

Appendix E – Laboratory Test Data
- Section E.1 Index and Chemical Test Data Soils (Split Spoon)
- Section E.2 Strength Test Data, Rock (UC and UC with stress strain)

Appendix F – Soil Dynamic Laboratory Test (RCTS) Data

Appendix G – Groundwater Data

- Well Construction Permits
- Observation Well Records
- Well Development Records
- Well Sampling Records
- Laboratory Test Reports
- Slug Test Data

1.4 Quality Assurance

Quality-related activities conducted by MACTEC and its subcontractors during the work presented in this report were in accordance with the MACTEC Quality Assurance Manual and the MACTEC Quality Assurance Project Document. The MACTEC QA program complies with NQA-1 Subpart 2.2 and the requirements of 10 CFR 50 Appendix B.

SECTION 2
TEST METHODS

2.1 Surveying

The surveying in the power block area was conducted in two phases by MACTEC personnel, working under the direct supervision of Mr. Michael Jones, PLS, Land Surveyor, Florida License No. 4201. The first phase was to stake preliminary test locations based on initial coordinates provided by Bechtel, listed on Drawing No. 0-CY-0000-0001 issued for use on January 28, 2008. Later phases of surveying were performed to locate borings presented on subsequent revisions of Bechtel Drawing 0-CY-0000-0001 through Rev. 6, which was issued for use on April 11, 2008. Test locations were located in the field using Real Time Kinematic-Global Positioning Satellite (RTK-GPS) techniques. Wooden stakes tied with flagging and marked with the test-location designator were used to mark the surveyed locations. Prior to the start of testing, some test locations were relocated due to site conditions (water channels, topography) with concurrence of Bechtel personnel. Other borings were located at offsets from the staked location to accommodate additional testing/sampling at a given location, for example geophysical testing. The second phase of surveying was conducted after completion of testing. The surveyors returned to the site and determined as-built locations and ground surface elevations of the actual test locations using RTK-GPS survey techniques.

MACTEC used Trimble GPS System models 5700 and 5800 to locate test locations and collect field data and observations. In addition to the use of National Geodetic Survey control stations, MACTEC established two control points at the site to serve as reference for the surveys. To achieve project accuracy requirements, observations were made on two separate occasions at each test location. The independent observations captured at each test location were subsequently processed through Trimble Office Processing Software to determine final coordinate and elevation values. The field as-built locations were surveyed to establish the horizontal locations to the nearest 0.5 feet and the vertical locations were determined to the nearest 0.1 feet as outlined in the project Engineering Specifications, Section 2.0 Surveying Services.

The as-built survey locations are provided to Bechtel for their use in creating an as-built drawing of the exploration. The as-built survey locations were also used as input to final boring logs and other tables reporting locations. A complete copy of the survey report covering the as-built survey data for the project test locations can be found in Appendix A.

2.2 Utility Location

MACTEC surveyors under the direction of Mr. Michael Jones, PLS of MACTEC used preliminary survey locations and physical features to mark the locations planned for borings, wells, CPT probes and test pits. MACTEC personnel conducted sweeps within a 10-ft radius surrounding each boring location and or boring offset using geophysical induction with a Shond-Stedk Model GA-52CX magnetic locator. The intent was to locate any metallic underground utilities that would pose a risk to drilling personnel. No metallic underground utilities or energized lines were detected in the area of the geotechnical investigation. In addition to the magnetic induction survey, Florida Sunshine One Call was also notified at least one week in advance of drilling activities. Inquiries were made to FPL plant personnel to assist in underground utility locations. No underground utilities were reported in the project site by FPL and Florida Sunshine One Call.

2.3 Drilling Equipment/Methods

MACTEC mobilized the following drilling equipment to the site:

Drill Rig	Driller	Carrier Type	Owner	Hammer Serial Number	Auto Hammer	Rig Use
CME-55 LC	R. Banks	ATV	MACTEC	MEC-02	Yes	SPT, Core
CME-75	T. Warren/J. Warren	Truck	MACTEC	MEC-09	Yes	SPT, Core
CME-550	J. Warren	ATV	MACTEC	MEC-04	Yes	SPT, Core
CME 45c	D. Rhodes	Track	MACTEC	MEC-12	Yes	SPT, Core
CME-550	D. White/F. Cox	Marsh Buggy	MACTEC	893	Yes	SPT, Core, Well Installation
CME-550	L. Carter	ATV	MACTEC	MEC-03	Yes	SPT, Core
CME-55	Phillip Pitts	Marsh Buggy	MACTEC	MEC-425	Yes	SPT, Core, Well Installation
CME-550X	R. Landeros	ATV	MACTEC	MEC-05	Yes	SPT, UD, Core, Well Installation
CME-750	G. Bilbrey	ATV	Miller Drilling	07	Yes	SPT, Core
CME-550	R. White	ATV	Miller Drilling	M06	Yes	SPT, Core
Gus Pech Sonic	M. Martin	Truck	Miller Drilling	NA	No	Well Installation
Fugro CPT	A. Fonseca	Track	Fugro	NA	No	CPT

Each rig also had at least one support truck used to haul materials. Drilling water was provided on site by two water storage tanks fed by FPL on-site potable water utilities located adjacent to the office and support trailers. The drill rig at each boring location was provided drilling water using a flexible PVC pipe and rolled plastic tubing connected to the water storage tanks. Where boring locations were remote, a Marooka ATV water buggy was utilized to haul water to ATV drill rigs. Two water trucks were also used to haul and pump water to drill rigs.

Due to the soft surface soil conditions, access by the site drilling equipment and support vehicles to the soil boring locations was provided by constructing a geotextile reinforced, crushed limestone gravel roadway along the center line of the power block. Access to boring locations away from the gravel road was provided by laying timber mats to create a temporary roadway. The mats were removed after completion of each boring and re-used to construct other access roadways. The mats were moved using rough terrain fork lifts. Borings B-638, B-803 and B-804 were deleted from the program due to inaccessible conditions.

A Caterpillar D-6 bulldozer was used to smooth the ground at several boring locations and to maintain the gravel roadway.

Borings were generally advanced from the ground surface using mud rotary drilling techniques until encountering SPT refusal (defined as 50 blows for 0.5 feet or less of penetration) or to an approximate depth of 35 feet, whichever occurred first. SPT soil samples from the geotechnical borings were obtained at approximate 2.5-foot, 5-foot, and 10-foot intervals as described in Section 2.5.1. Once SPT refusal was encountered or an approximate depth of 35 feet was reached, a steel casing was set, and the holes were advanced using triple tube wire-line rock coring equipment and procedures described in ASTM D 2113. Rock coring was accomplished utilizing "HQ3" or "PQ3" sized core barrels with split inner-barrel liners. Additional SPT samples were collected between core runs (in zones of poor rock recovery) by advancement through the outer core barrel with the inner barrel removed. Three, four, and/or six-inch-diameter casings were used to stabilize the upper portions of borings as necessary. Multiple sized casings were typically set in borings advanced more than 100 feet below ground surface. Borings were advanced to a predetermined termination depth. All rigs utilized on this project for the collection of standard penetration testing (SPT) soil samples used automatic hammers. A summary of boring information is presented in Table 2.1. Geotechnical field data including boring logs, coring logs, core photographs, and test pit logs are included in Appendix B.

Ground water levels at the site are artificially maintained by variation of the water levels in the FPL cooling water canals which surround the investigation site. The groundwater levels at the borings locations were monitored during drilling operations and were generally near or above the existing ground surface. Due to the use of drilling fluid additives, the groundwater conditions observed in the geotechnical borings may not truly reflect the groundwater conditions at the project site.

Circulation of drill fluids was typically lost at the start of coring operations due to the porosity of the limestone formations encountered at the site. As a result large amounts of water were used to complete the borings. In borings that terminated at depths below the limestone units, circulation of drill fluids was typically regained by advancing steel casing through the limestone formations. Standard bentonite based drilling additives were used in borings not associated with observation well clusters. In geotechnical borings associated with observation wells, biodegradable drilling fluid additives such as "Revert" were used to complete the borings. Drilling fluid additives were used during rock coring procedures to reduce vibration of the drill tools and to prevent sand-locking of the core barrel due to the loss of circulation.

In borings where SPT measurements were collected, only side discharge type bits were used. Bit size varied depending on rod diameter, sampling type and depth. Flush jointed A-rods (AW, and AWJ) were used for any SPT boring that was advanced to less than 200 feet below ground surface (bgs). Flush jointed NWJ-rods, were used (from ground surface to the total depth of the boring) for any SPT boring that was advanced deeper than 200 feet bgs.

At selected locations and following review of the adjacent geotechnical boring by MACTEC and Bechtel, observation wells were installed by rotary wash drilling methods, rotosonic drilling methods, or in PQ3 size core holes. The borings were performed in accordance with section 5.1 of the Bechtel Specification. Each well consisted of PVC screen and riser pipe, steel centralizers, sand filter pack, bentonite chips or pellets and cement/bentonite grout. Protective metal well covers and concrete pads were placed at the surface. The well covers were painted with yellow rust preventative paint. Well screen intervals were assigned by Bechtel.

Cone penetration testing (CPT) was conducted by Fugro Consultants, Inc., a subcontractor to MACTEC. Fugro used a purpose-built approximate 20-ton capacity track-mounted cone penetration unit to complete the work. Each probe was advanced beginning at a depth of about

120 feet to the assigned termination depth or to cone refusal, which was the limit of the pushing capacity of the rig. CPT borings were advanced through HQ3-size core holes predrilled through the upper limestone layers as described in Section 2.8. At one location, an ATV drill rig was used to advance casing through hard zones, allowing the CPT to be performed to a depth of approximately 290 feet. Pore pressure dissipation testing was completed in selected CPT's at intervals determined by Bechtel.

The borings and the CPT probe locations were filled using a cement-bentonite grout prior to demobilizing from the site. The borings were grouted from the bottom of the boring by pumping the grout through a tremie pipe. A grout mixture was used to backfill the borings per Section 4.3 of the Specification. A stake or other marker was placed at each completed boring location for later survey use. Due to the porosity of the limestone formations we experienced severe loss of grout in to the formations. After discussion with Bechtel, the borehole abandonment procedure was modified through SDDR-12 to place a maximum of two grout volumes, allow the grout to set, fill the remaining open hole with bentonite chips to within a few feet of the ground surface, and then place grout until flush with the existing grade.

2.4 SPT Energy Measurements

SPT energy measurements were conducted for each of the drill rigs performing SPT soil sampling. Energy measurements were recorded during SPT sampling at the depth intervals shown on the SPT Energy Measurement reports in Appendix B. The length of the drill rod string, including the instrumented drill rod insert for each sample was generally 4 feet longer than the depth of the sample being collected.

The energy measurements were performed with a Pile Driving Analyzer (PDA) model PAK and calibrated accelerometers and strain gages. A section of drill rod two feet long and the same size as the drill rod used to advance the boring and instrumented with dedicated strain gages, was inserted at the top of the drill rod string immediately below the SPT automatic hammer. The inserted rod was also instrumented with two piezoresistive accelerometers that were bolted to the outside of the rod.

The work was conducted in general accordance with ASTM D 4633-05. The strain and acceleration signals were converted to force and velocity by the PDA, and the data was interpreted by the PDA according to the Case Method equation. The EFV method of energy calculation is recommended in ASTM Standard D 4633-05. The maximum energy transmitted to the drill rod string (as measured at the location of the strain gages and accelerometers) was calculated by the PDA using the EFV method equation, as shown below:

$$EFV = \int F(t) * V(t) * dt$$

Where: EFV = Transferred energy (EFV equation), or Energy of FV
F(t) = Calculated force at time t
V(t) = Calculated velocity at time t
dt = time differential (integral taken with respect to time)

The EFV equation, integrated over the complete wave event, measures the total energy content of the event using both force and velocity measurements. The EFV values associated with each blow were tabulated and averaged to obtain the average measured energy at each depth tested. The ratio of the average measured energy to the theoretical potential energy of the SPT system (140 lb weight with the specified 30 inch fall) is the energy transfer ratio (ETR).

The average ETR measured for each rig used at the site ranged from 79.6% to 88.6% of the theoretical potential energy. These ETR values are within the range of typical values for automatic hammers. The ETR values (as percent of the theoretical value) are shown in Appendix B.

2.5 Sampling in Geotechnical Borings

2.5.1 Standard Penetration Test Sampling

SPT sampling in the geotechnical borings was generally conducted at 2.5-foot intervals from the ground surface to a depth of 15 feet. The SPT sampling interval below 15 feet was five feet to a depth of 100 feet. The SPT sampling interval below 100 feet was 10 feet. The equipment and methods used were in accordance with ASTM D 1586-99. The split barrel sampler was typically driven 1.5 feet in soil, with blows recorded for each 0.5-foot interval of penetration. The weight of the hammers used at the site ranged from 138.1 to 139.6 pounds, meeting the ASTM requirements. In very hard soils, driving was terminated after 50 blows were recorded for a 0.5-foot, or less, interval and the actual penetration recorded, (e.g., 50 blows / 0.3 feet). At selected locations where low penetration was encountered, the sampler was over-driven in attempt to collect additional sample.

The split barrel sampler was opened at the drill site and the recovered materials were visually described, classified, and photographed by MACTEC's rig geologist or engineer. A selected portion of the sample (typically the lower portion of the sample) was placed in a glass sample jar with a vapor-seal screw lid. In general, when more than one type of material was found in a sample, representative samples of each material were placed in separate jars and appropriately marked. Sample jars were labeled, placed in cardboard boxes, and transported to the on-site secure storage trailer at the end of each work day.

2.5.2 Rock Core Sampling

Rock coring in the geotechnical borings was generally conducted upon SPT refusal (50 blows for 0.5-feet or less of penetration) or when the boring reached an approximate depth of 35 feet. Rock recovered by the coring process, which was done according to ASTM D 2113-99, was carefully removed from the inner barrel and visually described by the rig geologist/engineer while in the split inner barrel liner. At that time the core recovery and Rock Quality Designation (RQD) were measured and the percent core recovery and RQD were calculated. Mechanical breaks were distinguished from natural breaks where possible. The core was photographed while in the split liner and then placed in appropriately marked wooden core boxes. The rock core was wrapped in 2-mil PVC plastic upon placement in the wooden core boxes, as recommended in ASTM D 5079, section 7.5.1 *Routine Care*, to preserve the moisture content of the rock core. The rig geologist/engineer placed foam spacers in the core box to stabilize the core laterally and wooden blocks were used to mark the ends of runs as needed. In-progress and completed core boxes were transported to the on-site secure storage trailers at the end of each work day.

Rock core samples from borings completed prior to or in progress during the NRC site visit, conducted February 26-27, 2008, were not wrapped in plastic. It was determined during the NRC's visit that measures described in ASTM D 5079, section 7.5.1, should be followed to preserve the moisture condition of the rock core.

Digital color photographs of the completed core boxes were taken at the site storage trailers, prior to removal of any core samples for potential testing. The core was wetted with a light water spray and a suitable scale was included in the photographs. After core photography was completed, selected samples from each core box were removed for potential laboratory testing. These samples were trimmed on site with a power rock saw, labeled, photographed, wrapped in vinylidene chloride plastic (saran wrap) and then wrapped in aluminum foil, and then coated with plastic microcrystalline wax as specified in ASTM D 5079 section 7.5.2 *Special Care*. The trimmed ends of the prepared samples were returned to their original position in the wooden core boxes and a piece of foam was placed where the rock core had been removed and noted as such. An inventory list of prepared samples was maintained at the site and provided to Bechtel for potential laboratory testing assignment.

2.5.3 Undisturbed Soil Sampling

Undisturbed soil samples were obtained from one borehole (B-630, as directed by Bechtel), in general accordance with ASTM D-1587, using standard pushed Shelby Tubes, Osterberg sampler, and Pitcher barrel sampler (USACE EM 1110-1-1804). The sampling method used at each interval was selected based on the subsurface conditions encountered during drilling in an effort to maximize sample quality and recovery.

A Pitcher barrel sampler was used for collection of undisturbed soil samples at depth intervals selected by Bechtel or when subsurface material was anticipated to be too dense or hard to allow satisfactory samples to be recovered by pushing the Shelby tube sampler. The Pitcher barrel sampler is a rotary sampler that drills the 3-inch diameter tube into the subsurface material.

The Osterberg tube sampler was used for collection of undisturbed soil samples at depth intervals when the subsurface material was anticipated to be very soft or loose. The Osterberg sampler is a hydraulically activated fixed piston sampler.

Any samples that were damaged were retained, capped and were noted as possibly disturbed samples. The undisturbed and disturbed samples were sealed at the top and bottom against moisture loss, labeled, and kept in an upright condition. Disturbed and undisturbed soil samples were transported to the climate-controlled on-site storage trailer following ASTM D 4220-95(2000) and stored vertically in specially prepared racks.

2.6 Boring Logs

The soil descriptions on the boring logs in Appendix B are based on the field descriptions (ASTM D 2488-00) by the rig geologist or engineer, modified according to ASTM D 2487-00 where lab test results are available. The rock core descriptions on the boring logs in Appendix B are based on the rig geologist's/engineer's description. The carbonate rock encountered at the site was classified according to Dunham's Classification of Carbonate Rocks (Dunham, R. J., 1962, Classification of Carbonate Rocks According to Depositional Texture: in *Classification of Carbonate Rocks: A Symposium*; Ham, W. E., ed.: American Association of Petroleum Geologists Memoir 1, p. 108-121).

For these sedimentary rocks, both hardness and induration were described by the rig geologist. The hardness descriptions were based on difficulty of breaking core pieces by manual or hammer means and are consistent with publications by the U. S. Army, U. S. Bureau of Reclamation and the text "Characteristics of Geologic Materials and Formations, A Field Guide for Geotechnical Engineers" by Hunt (CRC Press, 2006). Where SPT sampling was used in rock formations (because the rock was not sufficiently intact for standard coring methods), the hardness of the samples was described based on the SPT N-value. The N-value to hardness correlation was obtained from a published paper titled " Drilled Shaft Design and Construction in Florida" prepared by Bill C. McMahan, Jr., Independent Studies Project, University of Florida, dated August 18, 1988. A copy of the paper is located in Volume 1, in the Reference Section.

The boring logs in Appendix B were prepared using Version 8 of the computer program "gINT". On the boring logs, the strata breaks were delineated by a solid line where the changes between strata were distinctly visible in samples or based on drilling conditions and driller's feedback. A dashed line was used to infer a strata break in the zone between samples.

The geologic formations encountered in this geotechnical exploration were identified. In the project area, the geologic subsurface formations encountered from the surface include:

- Recent calcareous silts with varying levels of organic content locally referred to as **"Muck"** - When wet, this soil is soft to very soft and is generally considered to be unsuitable for construction. This layer was encountered from the surface to depths of typically three to five feet. The surface elevations for this strata ranged from 0.2 to -1.8 feet North American Vertical Datum of 1988 (NAVD88). The surface groundwater consists of sea water and its level was at or slightly above the ground surface elevation at time of drilling.

- **Miami Formation** – At the site, the Miami Formation is overlain by the organic calcareous silt (muck) layer except where the organic silt layer had been removed and replaced by granular fill for roadway access or overlain by canal excavation spoil materials. The Miami Formation is generally described as white, porous, sometimes sandy, fossiliferous, oolitic limestone (boundstone), locally cross-bedded and typically with locally interconnected vugs in-filled with overlying soils. The formation is mostly soft to medium hard throughout, but typically very hard at the base. The top of the Miami Formation was generally encountered between elevation -3 and -6 feet NAVD88. The Miami Formation is directly underlain by the Fort Thompson Formation.

  The formation was sampled by both Standard Penetration Testing (SPT) in its upper portions and rock coring near the base of the formation. The SPT samples generally were returned as silt-, sand-, and gravel-sized fragments broken from rock by the split-barrel sampler. The samples were interpreted as, and described as, a rock formation on the boring logs rather than as a granular material because, as observed in test pits, in the ground the formation appears as an intact mass. The rock hardness description was interpreted from the SPT "N" values as discussed previously in order to provide the limestone with a rock hardness description instead of the soil relative density designations.

- **Fort Thompson Formation** – The Fort Thompson Formation directly underlies the Miami Formation and the contact between these two formations is generally irregular. The Fort Thompson Formation is generally a more massive limestone (boundstone) than the Miami Formation. Its composition is variable, including the skeletal remains of coral, small solution cavities with translucent amber-colored re-crystallized calcite infill, fine grained fresh water limestone, sandy limestone with quartz sand interbeds, and shell molds and casts. These lithologies may alternate abruptly in thickness and lateral extent.

For the purpose of this report, the Fort Thompson Formation is divided into an Upper and Lower unit. The Upper Fort Thompson is generally coralline. The Lower Fort Thompson is generally a sandy limestone with uncemented sand interbeds and shell molds and casts. The contact between the Upper and Lower units of the formation has been identified for this study to be a layer of dark gray limestone having the characteristics of the Upper Fort Thompson that is generally up to 2 feet thick and is underlain by, typically, sandy limestone with shell molds and casts. The dark gray coloration was used as a marker for the base of the Upper unit. MACTEC did not subdivide the Fort Thompson into Upper and Lower units for borings where the marker was not discernible. The top of the Upper Fort Thompson Formation was generally encountered between elevation -23 and -33 feet NAVD88. The top of the Lower Fort Thompson was generally encountered between elevation -48 and -52 feet NAVD88. The Lower Fort Thompson Formation is directly underlain by the Tamiami Formation.

In zones of poor rock core recovery, the Fort Thompson Formation was occasionally sampled using the SPT. The SPT samples of this formation were returned as silt-, sand- and gravel-sized fragments broken from rock by the split-barrel sampler. The samples were interpreted as and described as a rock formation on the boring logs, rather than as a granular material. The rock hardness description was determined from the SPT "N" values as described in the discussion on the Miami Formation in order to provide the limestone with a rock hardness description instead of the soil relative density designations.

- **Tamiami Formation** – The Tamiami directly underlies the Lower Fort Thompson Formation. The Tamiami Formation generally consists of poorly graded and silty sand, locally with interlayered clayey sand, silt and lean clay. The top of the Tamiami Formation was generally encountered between elevation -113 and -117 feet NAVD88.

- **Hawthorn Group** – The Hawthorn Group directly underlies the Tamiami Formation. The top of the Hawthorn Group was generally encountered between elevation -215 and -224 feet NAVD88. The top of the Hawthorn Group is characterized by a "spike" in Gamma activity observed in the geophysical logs for the borings that were advanced deeper than 220 feet. The Gamma spike is likely related to the increase in phosphatic material associated with the Hawthorn Group. The Hawthorn was penetrated in only the deepest borings drilled for the project, B-601(DH), B-608(DH), B-610(DH), B-630, B-701(DH), B-708, and B710(DH). The Hawthorn generally consists of poorly graded and silty sand to about elevation -460 feet NAVD88, then changes to dolostone and limestone.

2.7 Sampling in Geotechnical Test Pits

Test pits were excavated using a rubber-tired backhoe at two locations identified by Bechtel. The Bechtel field representative selected the materials to be sampled. A MACTEC rig geologist collected the bulk samples. As approved by Bechtel, the bulk samples were placed in new 5-gallon plastic buckets with handles for carrying. Approximately ten buckets of each sampled material were obtained. Small portions of the samples were placed in glass jars and sealed for moisture retention. The backhoe was used to backfill the test pits using the excavated materials. The backfilled materials were placed into the excavation in the order in which they were removed, and tamped in-place using the backhoe. The rig geologist placed a stake at the test pit location for later survey location.

The buckets and jar samples were labeled and transported to the on-site storage area. The rig geologist prepared a Geotechnical Test Pit Log based on visual description of the excavated materials according to ASTM D 2488-06. The surveyed locations of the test pits are included in Appendix A. The Geotechnical Test Pit Logs are included in Appendix B.

2.8 Cone Penetrometer Testing

Cone Penetrometer Tests (CPT) were performed at four locations on the site. At location C-602, the initial attempt to perform the CPT was not successful due to equipment problems; the location was moved approximately 6 feet and reperformed as C-602A. This location was also used later for geophysical downhole velocity testing and identified for that purpose as B-640DHT.

The CPT tests were conducted using 15 cm^2 piezocones or seismic cones with the piezo transducer mounted in the U2 position (between the tip and sleeve). The specified probe depth was to 280 feet or to refusal. MACTEC utilized drill rigs to core and advance casing through the hard limestone formations to a depth of approximately 120 feet. CPT testing began at an approximate depth of 120 feet and extended to refusal depths of approximately 220 feet.

At location C-701, an ATV drill rig was used to advance casing through zones of CPT refusal. A multiple stage CPT sounding was performed to a depth of approximately 290 feet at this location. Seismic shear wave testing was attempted during the first CPT sounding at C-702. Due to the soft surficial muck layer, seismic shear wave testing was determined to not be feasible with the CPT rig. At depths designated by Bechtel in the four CPT borings, pore pressure dissipation measurements were performed at 24 locations. In our review of the CPT data, we noted that six of the pore pressure dissipations tests showed a continued increasing pore pressure rather than a dissipation. This could possibly have been caused by the drill rig continuing to apply load to the CPT rods due to settlement of the drill rig or its support mat in the soft surface soils. Results for all CPT testing are included in Appendix C.

2.9 Field Electrical Resistivity Testing

Field electrical testing was not assigned.

2.10 Geophysical Down-hole Testing

The geophysical down-hole testing was performed by GEOVision, the geophysical subcontractor. The results of the testing are presented in the GeoVision Report in Appendix D. The tests are briefly described below.

Down-hole geophysical testing and logging was performed in twelve borings in the power block area, including B-601(DH), B-604(DH), B-608(DH), B-610(DH), B-620(DH), B-640DHT, B-701(DH), B-704G(DH), B-708(DH), B-710G(DH), B-720G(DH), and B-740DHT. Borings designated as "G", for example "B-704G(DH)", were offset borings drilled adjacent the original staked geotechnical boring for geophysical testing. The suite of tests listed below was performed in each boring in accordance with the procedures listed below. Borings B-640DHT and B-740DHT were used only for downhole velocity testing. The location designated B-640DHT was the same location as earlier used for CPT testing designated as C-602A.

2.10.1 Natural Gamma (ASTM D 6274-98(04))

Gamma logs record the amount of natural gamma radiation emitted by the soil and rocks surrounding the boring. Natural gamma was recorded using two probes - one combined with the three arm caliper and one combined with the electrical logging tool. The dual measurements provided a quality check. The natural gamma data are qualitative and provide assistance in identifying strata changes.

2.10.2 Long and Short Normal Resistivity/Spontaneous Potential (ASTM D 5753-05)

Normal-resistivity logs record the electrical resistivity of the borehole environment and surrounding soil and water as measured by variably spaced potential electrodes on the logging probe. Spacing for potential electrodes is 16 inches for short-normal resistivity and 64 inches for long normal resistivity. Normal resistivity logs are affected by bed thickness, borehole diameter and borehole fluid, and can only be collected in water or mud filled open holes.

2.10.3 Three Arm Caliper (ASTM D 6167-97(04))

Caliper logs record borehole diameter with depth. Changes in borehole diameter are related to boring construction, such as casing or drilling bit size, and to fracturing or caving along the borehole wall. Because borehole diameter commonly affects log response, the caliper log can be useful in the analysis of other geophysical logs. Caliper with gamma logging is used to assist in the identification of strata changes.

2.10.4 Borehole Acoustic Televiewer Logging

Televiewer logging was conducted in accordance with GEOVison Procedure for using the Roberson Geologging Hi-Resolution Acoustic Televiewer (HIRAT) (Revision 1.0, dated 2/10/06) as included in the MACTEC Work Plan. The acoustic televiewer also determines bore-hole inclination and deviation from vertical by measuring amplitude and travel time of the reflected acoustic signal and produces a magnetically oriented photographic image of the acoustic reflectivity of the boring wall.

2.10.5 Suspension P-S Velocity Logging

Suspension P-S velocity logging was conducted in accordance with GEOVision procedure for OYO P-S Suspension Seismic Velocity Logging, Rev. 1.31) as contained in the MACTEC Work Plan. Measurements of compression (P) and shear (S) wave velocity were made at 1.6-foot intervals.

2.10.6 Downhole Velocity Logging

Downhole velocity logging to measure shear wave velocity was performed in B-640DHT and B-740DHT using methods described in GeoVision Procedure for Downhole Seismic Velocity Logging, Revision 1.1 which was approved by MACTEC and Bechtel as part of the MACTEC Downhole Velocity Logging Work Plan. The tests were performed to provide a second method of shear wave velocity measurement to compare to the P-S suspension logging. Logging was planned to be done to 150 feet below ground surface; however, in B-640DHT, curvature of the installed casing prevented passage of the probe beyond about 125 feet. The lesser depth was acceptable.

Downhole velocity testing is conducted in a borehole that has PVC casing installed with a grouted annulus. The PVC casing is pumped to remove water. An energy source is placed at the surface and a single receiver travels down the the cased borehole at 5-foot intervals. Energy from the source is transmitted down the soil/rock column from the surface to the receiver. Velocities are calculated from the first arrival travel time and depths. Results are presented as vertical profiles of velocity.

SECTION 3
SAMPLE STORAGE

Consistent with MACTEC's QAPD requirements, two on-site sample storage facilities were established. The sample storage facilities were lockable, temperature-controlled, sample storage trailers. The trailers were 40-foot long by 8-foot wide Mobile-Mini Open Bay Security Offices with high security door system and exterior security bars over each window. Racks were assembled to provide secure storage of undisturbed samples. The trailers were supported on timber cribbing and provided with hurricane tie down anchors. Electrical power was supplied to the site storage and office trailers by a diesel generator.

The sample storage trailers were provided with alarm systems which automatically telephoned selected MACTEC personnel who could respond if the temperature control systems failed or if electrical power was lost. This prevented the loss of temperature control in the trailers during periods when MACTEC personnel were not on site.

Samples were transported daily from the field to the sample storage trailers by the rig geologists/engineers and drill crews. The SPT and bulk samples were transported in accordance with ASTM D 4220-95(2000), for Group B samples. The SPT samples were transported in their compartmentalized cardboard box, each labeled to show the contents therein. The bulk test pit samples were sealed in 5-gallon plastic buckets. The UD samples were handled as Group C samples under ASTM D 4220-95(2000). The UD samples were sealed and stored vertically in specially fabricated UD sample racks. The rock cores were transported in accordance with ASTM D 5079-02, in their wooden core boxes, kept horizontal, and each labeled to show the contents. Rock core samples prepared for potential laboratory testing were stored in appropriately labeled wooden core boxes and stacked separately from the geotechnical boring core boxes.

A sample inventory log was kept at the sample storage facility. All samples entering the storage facility were logged in by the rig geologist/engineer or lead geologist. A chain-of-custody form was completed for samples removed from the facility.

The custody of the samples remaining on site was turned over to FPL for long term storage at the completion of our geotechnical exploration services. The transfer of custody of these remaining samples occurred during the period of June 24, 2008 through July 2, 2008. An FPL Chain-of-Custody form was completed for the samples removed from MACTEC's on-site sample storage facilities. FPL was provided with a copy of the sample inventory log which indicates that the samples were transferred to FPL for long term storage.

SECTION 4
LABORATORY TESTING – GEOTECHNICAL

Soil laboratory testing was conducted on approximately 178 disturbed (split-spoon), seven undisturbed (tube) and two bulk samples (from test pits) obtained during the subsurface investigation. In addition 88 selected rock core samples were tested for unconfined compressive strength, and two of these were tested with stress-strain measurements. The testing was performed in accordance with the current ASTM standards or other standards where applicable. The samples to be tested and the tests to be performed were selected by Bechtel engineers. The original assignment sheet was supplemented with additional tests as the investigation progressed. The added tests were written in red ink to distinguish them from previously assigned tests. Updated versions of the Assignment sheet were issued on the dates listed below.

- Geotechnical Lab Test Assignment No. 1 – 2/29/08
- Geotechnical Lab Test Assignment No. 2 – 3/13/08
- Geotechnical Lab Test Assignment No. 3 – 3/25/08
- Geotechnical Lab Test Assignment No. 4 – 4/11/08
- Geotechnical Lab Test Assignment No. 5 – 4/24/08
- Geotechnical Lab Test Assignment No. 6 – 5/2/08
- Geotechnical Lab Test Assignment No. 7 – 5/5/08
- Geotechnical Lab Test Assignment No. 8 – 5/8/08
- Geotechnical Lab Test Assignment No. 9 – 5/15/08
- Geotechnical Lab Test Assignment No. 11 – 5/19/08
- Geotechnical Lab Test Assignment No. 12 – 5/20/08
- Geotechnical Lab Test Assignment No. 10 – 5/23/08
- Geotechnical Lab Test Assignment No. 13 – 6/30/08
- Geotechnical Lab Test Assignment No. 14 – 8/8/08

Samples assigned for laboratory testing were removed from the site secure storage area, and their removal was documented on the sample inventory lists. Chains of Custody were completed by the persons removing the samples. The SPT and bulk samples were packaged and transported via commercial carrier following ASTM D 4220-95(2000) methods for Group B samples. The UD samples were transported in vertical racks by MACTEC personnel in a cushioned van or truck following methods in ASTM D 4220-95(2000) for Group C samples. The Special Care rock core samples were carefully packed into sturdy transport containers, placed in cushioned vans or trucks and transported by MACTEC personnel following guidance in ASTM D 5079-02.

Testing of soil specimens was contingent upon the receipt of soil samples, laboratory assignment sheets and authorization for testing. In some cases commencement of testing was deferred until all three of these items were received by the laboratory performing the test.

Occasionally, the quantity of material was insufficient to perform the assigned testing. These occurrences were brought to the attention of Bechtel, and either a replacement sample was assigned, or the testing was cancelled altogether.

Because of the generally weak character of the rock, preparation of the rock cores for unconfined compressive strength testing required special considerations. After discussions with Bechtel, it was agreed through SDDR 29 that attempting to trim ends and sides to meet the dimensional tolerance requirements of ASTM D 4543-08 would have a high potential risk of sample damage.

The rock cores were trimmed to length and then capped for testing. The actual dimensions were recorded on lab test forms.

Also, because of the fragility of the rock and the porosity of the limestone, attaching strain gages for determination of stress-strain characteristics was not possible for most samples. Of the 88 samples tested, only two samples were found acceptable for strain gage attachment. Strength test results for rock cores are presented in Appendix E.2.

Except as described in following paragraphs, the laboratory testing was conducted in MACTEC's laboratories in Raleigh, North Carolina, Charlotte, North Carolina and Atlanta, Georgia; Soil index tests were conducted in the Raleigh lab, carbonate content tests were performed in the Atlanta lab and rock strength tests were conducted in the Charlotte lab.

Chemical testing for pH, sulfates and chlorides on selected soil samples was done by Test-America in Earth City, Missouri, a subcontractor to MACTEC. In all, 15 soil samples were identified by Bechtel engineers for soil chemical testing and a portion of each jar sample was divided and submitted to TestAmerica for moisture content, pH, sulfate and chloride testing.

Resonant Column Torsional Shear (RCTS) testing of seven selected undisturbed soil samples from B-630 was conducted by Fugro Consultants, Inc. in Houston, Texas (subcontractor to MACTEC) under the technical direction of Dr. K.H. Stokoe of the University of Texas. Undisturbed sample tubes were X-rayed prior to testing.

Consolidated undrained (CU) Triaxial Shear testing of an undisturbed soil sample from Boring B-630 was also performed by Fugro Consultants, Inc. in Houston, Texas.

In order to evaluate the effect of compaction energy on the near surface Miami Formation, particle size distribution tests were performed on samples in the following conditions:

1. As obtained from the test pit excavations for TP-701 and TP-601
2. As prepared for ASTM D 1557-07, but before compaction testing
3. After ASTM D 1557-07 compaction testing

The results indicate that there was some crushing of the material due to the compaction effort. The results of the particle size distribution tests are presented in Appendix E.1

MACTEC transported specified soil and rock core samples selected by Bechtel for Kd testing to the MACTEC Raleigh Office laboratory. The Raleigh laboratory prepared the samples for shipment to Argonne laboratories, Inc. by crushing and sieving the samples to obtain the required weight of material having the specified grain sizes (1cm and 1mm). The prepared samples were shipped to Argonne Laboratories for Kd Testing. The Kd testing performed by Argonne Laboratories was performed for Bechtel and is not provided in this report.

The tests that were assigned and performed, identified by their ASTM standard or other procedure, are shown in the following sections.

4.1 Identification Tests

- Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass - ASTM D 2216-05
- Specific Gravity of Soil Solids by Water Pycnometer - ASTM D 854-06
- Particle-Size Analysis of Soils - ASTM D 422-63 (2002)e1 (for analysis including hydrometer)
- Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis - ASTM D 6913-(2004)e1 (for analysis not including hydrometer)
- Liquid Limit, Plastic Limit, and Plasticity Index of Soils - ASTM D 4318-05
- Moisture, Ash, and Organic Matter of Peat and Other Organic Soils - ASTM D 2974-07a
- Unit Weight (sections 5.7-5.9, 8.1 and 11.3.2 of ASTM D 5084-03)
- Classification of Soils for Engineering Purposes (Unified Soil Classification System) – ASTM D 2487-06
- Description and Identification of Soils (Visual-Manual Procedure) – ASTM D 2488-06
- Rapid Determination of Carbonate Content of Soils – ASTM D 4373-02

Note that grain size distribution data for specimens tested in accordance with ASTM D 6913-2004 are reported to the nearest whole number whereas those with assigned hydrometer tests performed in accordance with ASTM D 422-63 are reported to one decimal place.

4.2 Compaction and Strength Tests

- Laboratory Compaction Characteristics of Soil Using Modified Effort – ASTM D 1557-07
- CBR (California Bearing Ratio) of Laboratory-Compacted Soils - ASTM D 1883-05
- LBR (Florida Lime Rock Bearing Ratio) of Laboratory-Compacted Soils –Florida Method FM-5-515

4.3 Shear Strength Tests

- Unconfined Compressive Strength Testing of Intact Rock Core Samples- ASTM D 7012-07
- Consolidated Undrained Triaxial Shear Testing of Undisturbed Soil Samples – ASTM D 4767-04

4.4 Modulus and Damping Tests (Resonant Column/Torsional Shear [RCTS])

- Test Procedures and Calibration Documentation Associated with the RCTS and URC Tests at the University of Texas at Austin, DCN: UTSD RCTS GR06-4, April 25, 2006, Geotechnical Engineering Center, University of Texas, Austin, Texas.

4.5 Chemical Testing of Soil

- pH – EPA Standard SW 846 9045D
- Chloride- EPA Standard SW 846 9056 / EPA Method 300.0 (EPA-600/4-79-020)
- Sulfate- EPA Standard SW 846 8056 / EPA Method 300.0 (EPA-600/4-79-020)

4.6 Reporting

Except for the RCTS tests, the geotechnical laboratory test reports, consisting of individual test data and results sheets as required by the testing standard, are contained in Appendix E. Summaries of the test results are shown in Tables 4.1 through 4.3. Appendix E, Section E.1 contains the results of laboratory testing on soil samples. Appendix E, Section E.2 contains the results of laboratory testing on rock samples.

The RCTS tests, including the data and documentation of review and approval by Dr. K. H. Stokoe, are presented in Appendix F. The presentation of the reports by Fugro assigned Appendix labels A through G to the test reports.

SECTION 5
WATER SAMPLING, FIELD AND LABORATORY TESTING

5.1 Well Installation

MACTEC and MACTEC's subcontractor, Miller Drilling, installed ten observation well pairs within the power block and surrounding areas of the site as part of this project. Prior to initiating drilling activities for the observation wells, MACTEC submitted a State of Florida Permit Application to Construct a Well for each of the observation wells and received approval to construct these wells. Copies of the approved permits are included in Appendix G. Each well pair consisted of an observation well screened in the Miami Formation (well identification contains the suffix "U") and an observation well screened near the base of the Fort Thompson Formation (well identification contains the suffix "L"). MACTEC installed two, deep monitoring wells (OW-606-D and OW-706-D) which were screened below the Fort Thompson Formation in the Tamiami Formation. All observation wells were installed per the applicable portions of Sections 5.2 and 5.3 of the Bechtel Specification, and all well installation activities were completed under the supervision of Mr. Phillip Pitts, a licensed water-well driller in the State of Florida (License No. 11035). A total of 22 observation wells were installed during this project. The well-construction details are shown in Observation Well Installation Records in Appendix G. Pertinent information for the observation wells installed at the site is shown in Table 5.1.

The observation well depths and screen intervals were specified by Bechtel's hydrogeologist after review of adjacent borehole records, and geophysical logs where appropriate. Borings for the observation wells were advanced using mud rotary drilling techniques with a nominal 6-inch outside diameter, PQ3 wireline coring techniques with a nominal 5-inch outside diameter, and rotosonic techniques with a nominal 7-inch outside diameter. The drilling contractor used "Revert", a biodegradable drilling fluid additive, during borehole advancement for the observation wells and the associated geotechnical borings at each well cluster. MACTEC did not collect soil samples from the boreholes for the wells because these boreholes were adjacent to geotechnical borings, from which samples were collected.

Borehole depths shown on the borehole logs indicate the total depth drilled and sampled. Due to small amounts of drill spoil at the base of the drill bit, or due to the sampler advancing beyond the augered depth, the total depth shown on the borehole log may be slightly greater than the well depth reported on the companion well installation record.

Upon reaching the designated depth for a well, machine-slotted PVC casing connected to solid PVC was set, and a 12/20 silica sand pack and bentonite seal were placed in the wells. A cement/bentonite grout mixture was emplaced from the top of the bentonite seal to the ground surface in each borehole by the tremie method. The drilling contractor used the grout mix specified in Section 4.13 of the Specification.

After well installation activities were completed, MACTEC surveyors determined the location, the elevation of the marked top-of-well-casing, and the elevation of the concrete pad installed around the well. These data are included on the well installation records. The water-depth measurements are referenced to the marked point on top of the PVC casing. The survey data was also used along with measurements of the well sections to calculate elevations for the various components of the observations wells (bentonite seal, filter pack, screened interval, etc.).

The wells were capped with a lockable steel well cover extending approximately three feet above grade. A concrete pad, approximately two feet square and six inches thick, was installed around each well cover per Section 5.3.5 of the Bechtel Specification.

5.2 Water-Level Measurements

MACTEC representatives measured the depth to the water table in each well at various times related to development, in-situ testing and water quality sampling using an electric water-level meter. Depth measurements were referenced to the marked top of the PVC casing. These water levels are shown on the various field forms in Appendix G. Additionally, MACTEC installed data loggers and telemetry units at each of the observation well locations. These data loggers will record water-table elevations over a two-year period as part of a long-term monitoring program established for the site. The results of this monitoring program will be provided in data reports submitted under separate cover.

5.3 Well Development

After well installation was completed, MACTEC developed each well using a submersible pump, in accordance with Section 5.3.6 of the Bechtel Specification. A minimum of ten saturated borehole volumes were removed from each well during the development process. During the development process, MACTEC cycled the pump off and on to create a surge effect in the well. The wells were considered developed when the pumped water was relatively clear and free of suspended sediment in accordance with the Specification. MACTEC measured field indicator parameters during well development using a Horiba U22 and Hach turbidity meter, and recorded this information on well development records. Copies of the well development records are included in Appendix G.

5.4 Well Purging and Sampling

In accordance with Bechtel Laboratory Assignment No. 12, MACTEC purged and sampled observation wells OW-606L, -606U, -621L, -621U, -706L, -706U, -721L, -721U, -735U, -802U, -805U, and -809U using a submersible pump that was set approximately one to two feet above the bottom of the well. MACTEC purged each well until field-measured indicator parameters of water quality "stabilized" and until at least three well volumes were purged. Using a Horiba U22 equipped with a flow-through cell and a HACH turbidity meter, MACTEC measured the following field-indicator parameters in accordance with ASTM D 6452-99 (2005):

- Temperature
- pH
- Electrical conductivity (specific conductance)
- Turbidity
- Oxidation-reduction potential (redox)
- Dissolved oxygen

MACTEC calibrated the Horiba and Hach meters at least daily during well purging activities and recorded this information in field notebooks. Stabilization of field parameters was based on three consecutive measurements showing values with the following criteria, made at intervals not less than one-half well volume or five minutes, whichever was greater, unless directed otherwise by Bechtel:

- pH: ±0.1 pH units
- Dissolved oxygen: ±0.3 mg/liter
- Electrical conductivity: ±3 percent
- Oxidation-reduction potential: ±10 mv
- Turbidity ±1 nephelometric turbidity unit (NTU), or ±10 percent if greater than 10 NTUs

The pumping rate during field-indicator parameter measurement collection and sample collection was kept low enough to minimize sample turbidity, sample aeration, bubble formation, and turbulent filling of the sample containers. The purging method used was consistent with "purging based on fixed volume combined with indicator parameter stabilization" as described in ASTM D 6452-99. In accordance with Section 5.5.4 of the Bechtel Specification, the final field-indicator parameter readings are summarized in Table 5.2. Well sampling record sheets are included in Appendix G.

5.5 Laboratory Testing of Groundwater Samples

MACTEC filled the laboratory-provided sample containers with groundwater directly from the tubing attached to the pump. The containers were placed in a cooler with ice, and the cooler was delivered by overnight courier to the TestAmerica Laboratories, Inc. in Earth City, Missouri under chain-of-custody. TestAmerica tested the groundwater samples for the following parameters according to the current methods cited in "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020 using the methods cited:

- Total dissolved solids -- EPA Method 160.1
- Inorganic ions (bromide, chloride, fluoride, sulfate) -- EPA Method 300.0
- Cations (calcium, iron, magnesium, manganese, potassium, silica, silicon, and sodium) -- EPA 6020C
- Alkalinity (bicarbonate/carbonate) -- EPA Method 310.1.
- Nitrogen as Ammonia -- EPA Method 350.1.
- Nitrate/nitrite -- EPA Method 300.0
- Cation/anion balance -- Laboratory standard procedure

Section 5.5.5 of the Bechtel Specification indicated testing for cations by EPA Method 200 and nitrate and nitrite by EPA Method 353.1. Prior to submitting the groundwater samples to TestAmerica, MACTEC submitted Supplier Deviation Disposition Request (SDDR) No. 41 requesting the use of Methods 6020C for cations and 300.0 for nitrate/nitrite. Bechtel approved the use of these methods through the acceptance of SDDR No. 41 on May 28, 2008. Silica is not a cation; therefore, TestAmerica used Method 6020 to test for silicon, and calculated the resulting silica content based on the assumption that all of the silicon was silica.

Also, the Specification listed cation/anion balance as a laboratory report item. TestAmerica reported the ion balance difference as a %, using Standard Method 18 1030F.

During laboratory testing, the results of matrix spike and matrix spike duplicate (MS/MSD) samples were commonly outside of the established quality control (QC) limits. TestAmerica indicated that matrix interference was likely the cause of poor MS/MSD recoveries. According to TestAmerica, the MS/MSD samples are prepared prior to testing, with no known range of analyte concentrations in the samples. Therefore, high concentrations of target analytes in the samples could interfere with MS/MSD recoveries. Additionally, the majority of the samples with poor MS/MSD recoveries required dilutions to bring the results into the calibration range of the machine. Therefore, these spiked amounts, added prior to any knowledge of actual sample concentrations, were likely diluted out of the final results (i.e. the dilution resulted in elevated method detection limits and quantitation limits that could not detect the spiked amount). MS/MSD recoveries for those analytes not requiring high dilutions and not impacted by matrix interference show acceptable recovery values. Additionally, the results of laboratory control samples were within QC limits and demonstrate the Method performance. Therefore, the data generated is deemed to be reliable.

The holding time for the total dissolved solid (TDS) tests for the groundwater samples collected from observation wells OW-735U and OW-809U was exceeded. The test method states that these analyses need to be conducted as soon as possible. The tests were run within the hold time, but the results exceeded the standard operating procedure (SOP) limit of 200 milligrams, which is referenced in Method 160.1. Because the samples had to be diluted and tested again, TestAmerica had to flag the samples as being run outside of the hold time. However, the samples were immediately placed into an iced-cooler chest upon collection and were subsequently refrigerated upon receipt by TestAmerica until analysis. Based on these preservation techniques, biological decomposition of the samples should have been minimal. Therefore, the exceedance of the hold time is not considered to have adversely affected the quality of the data. Additional TDS testing of other samples collected from the site exhibited similar concentrations of TDS and are used as supporting evidence that the result for OW-735U is reliable.

Review of the test results for OW-621U, OW-706L, and OW-809U identified TDS concentrations that were significantly lower than the summed analyte totals. Review by TestAmerica did not identify an error in calculations or measurements, and a source for the difference could not be determined. The TDS results for samples OW-621U, OW-706L, and OW-809U are not considered valid and should not be used for calculations or relied upon for decision making purposes. Table 5.3 has been annotated to note that these results have been rejected.

TestAmerica detected silicon and silica in the method blank associated with the groundwater sample collected from observation well OW-621L, and chloride in the groundwater samples collected from observation wells OW-621L, OW-802U, and OW-805U at estimated concentrations below the respective quantitation limits. TestAmerica detected iron in the method blank associated with groundwater samples collected from observation wells OW-606U, OW-606L, OW-621U, OW-706U, OW-706L, OW-721U, OW-721L, OW-735U, and OW-809U at estimated concentrations below the respective quantitation limits. Because the results reported for these analytes in the corresponding groundwater samples were significantly higher (typically greater than 10x the blank amount) and because these reported values are similar to others reported for the site without method blank contamination, MACTEC concludes that these data should be used with caution. The exception is the iron result for the groundwater sample collected from observation well OW-606L, which was detected at a concentration less than 4x that reported for the associated method blank. Based on guidance from the US EPA in *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 540-R-04-004), MACTEC recommends qualifying this result as non-detect at the quantitation limit of 50 μg/L.

The laboratory test results for ground-water chemistry are summarized on Table 5.3 and copies of the laboratory test reports are included in Appendix G.

5.6 In-Situ Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing was conducted in observation wells OW-606U and L, OW-621U and L, OW-636U and L, OW-706U and L, OW-721U and L, OW-735U and L, OW-802U and L, OW-805U and L, OW-809U and L, and OW-812U and L following methods in Section 5.3.7.1 of the Bechtel Specification and as assigned by Bechtel. The testing used procedures described in Section 8 of ASTM D 4044-96 (2002). The test procedure is commonly termed the slug test method. Slug testing involves establishing a static water level, lowering a solid cylinder into the well to cause an increase of water level in the well and monitoring the time rate for the well water level to return to the pre-test static level. This method is commonly called the "falling head" method. After stabilization of the water level due to the falling head test, the slug is rapidly removed to create a lowering of the water level in the well, and the time rate for water to recover to the pre-test static level is recorded. This method is commonly called the "rising head" method. Electronic transducers and data loggers are used for measuring the water levels and times during the test. The rising and lowering of the static water level can also be achieved using a pump or pneumatic methods if the hydraulic conductivity of the aquifer surrounding the well is high enough that traditional slug methods do not create a significant change in head such that a response curve can be generated. MACTEC used pneumatic and traditional solid slug methods during this investigation, in accordance with Section 5.3.7.1 of the Specification. Based on the use of pneumatic methods for inducing the head changes in wells OW-606U, OW-621U, OW-636U, OW-636L, OW-802U, OW-802L, OW-805U, OW-805L, OW-812U, and OW-812L, falling head tests were conducted at these locations. Bechtel approved the use of rising head tests only for these wells in their acceptance of SDDR 40 on June 11, 2008.

Water-level measurements were collected on a logarithmic cycle throughout the slug tests using In-situ Level Troll 700 data loggers. At the completion of each slug test, water-level measurements were downloaded from the data loggers. These data were imported into AQTESOLV™ for Windows version 4.5 and evaluated using either the Butler, KGS, McElwee-Zenner, or Springer-Gelhar methods. Due to the rapid recovery of these wells, analysis of the data needed to be conducted using a method designed for highly permeable materials.

The Butler method, which accounts for oscillatory water-level response sometimes observed in aquifers of high hydraulic conductivity, is based on the following assumptions:

- Aquifer has infinite areal extent
- Test well is partially penetrating
- Aquifer is confined
- Aquifer is homogeneous and of uniform thickness
- Flow is quasi-steady state
- Volume of water, V, is injected into or discharged from the well instantaneously

The KGS method was developed for an overdamped slug test in both confined and unconfined aquifers for fully or partially penetrating wells. The KGS method is based on the following assumptions:

- Aquifer has infinite areal extent
- Aquifer potentiometric surface is initially horizontal
- Aquifer is confined or unconfined
- Water is released instantaneously from storage with decline of hydraulic head
- Aquifer is homogeneous and of uniform thickness
- Test and observation wells are fully or partially penetrating
- Flow is unsteady
- Volume of water, V, is injected into or discharged from the well instantaneously

storage with decline of hydraulic head | discharged from the well instantaneously

The McElwee-Zenner method was developed for a single-well slug test in a homogeneous confined aquifer that accounts for the complete range of water-level responses from overdamped to underdamped (oscillatory). The McElwee-Zenner method is based on the following assumptions:

- Aquifer has infinite areal extent
- Aquifer is homogeneous and of uniform thickness
- Test well is partially penetrating
- Flow is quasi-steady state
- Aquifer is confined
- Volume of water, V, is injected into or discharged from the well instantaneously

The Springer-Gelhar method was developed for a slug test in a homogeneous, anisotropic unconfined aquifer and accounts for the oscillatory waster-level responses sometimes observed in aquifers of high hydraulic conductivity. The Springer-Gelhar method is based on the following assumptions:

- Aquifer has infinite areal extent
- Aquifer is homogeneous and of uniform thickness
- Test well is fully or partially penetrating
- Flow is quasi-steady state
- Aquifer is unconfined
- Volume of water, V, is injected into or discharged from the well instantaneously

Based on these methods, values of hydraulic conductivity were calculated for each slug test conducted.

A summary of the slug test results is provided in Table 5.4. The software output plots used to analyze the slug test data are included in Appendix G.

Based on the results of the slug test analyses, hydraulic conductivity estimates for the wells completed in the Miami Formation (the "U" wells) ranged from approximately 4.5 to 319 feet per day, and estimates for the wells completed in the Fort Thompson Formation (the "L" wells) ranged from approximately 1 to 109 feet per day. These values are different than the results for these rock units published by the U.S. Geological Survey in *Hydrogeology of the Surficial Aquifer System, Dade County, Florida* (USGS; 1991, Water-Resources Investigations Report 90-4108). The results of aquifer tests conducted by the USGS identified estimated hydraulic conductivities for the Miami Formation that ranged from 29,000 to 42,000 feet per day. Estimates for the Fort Thompson Formation ranged from 450 to greater than 55,000 feet per day, with most estimates on the order of ten thousands of feet per day.

One potential explanation for the low hydraulic conductivity estimates from the slug tests is due to well construction techniques. All of MACTEC's wells were completed as screened wells with a sand filter installed in the annulus between the screen and borehole walls. All of the USGS wells referenced in WRIR 90-4108 were completed as open-hole wells. Typical sand filters would have a much lower hydraulic conductivity than reported for the surrounding aquifer materials. The sand filter likely controlled the flow rate of groundwater into the wells during slug testing. Therefore, the hydraulic conductivity results presented in Table 5.4 are likely biased low, and are not considered representative of the hydrogeologic units.

FINAL DATA REPORT Rev. 2
GEOTECHNICAL EXPLORATION AND TESTING

TURKEY POINT COL PROJECT
FLORIDA CITY, FLORIDA

October 6, 2008

VOLUME 1
Tables

Prepared By:

MACTEC Engineering and Consulting, Inc.
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MACTEC Project No. 6468-07-1950

Prepared For:

Bechtel Power Corporation
Subcontract No. 25409-102-HC4-CY00-00001

TABLE 1.1
ORGANIZATIONS PERFORMING WORK AT THE SITE OR IN THE LABORATORY

Organization	Function
MACTEC Engineering and Consulting, Inc.	• Underground Utility Clearance • Surveying of borings, observation wells, CPT locations, test pits and geophysical test locations • Geotechnical soil borings with SPT tests • Undisturbed Sampling • Boring Abandonment • Bulk Sampling • Geotechnical Laboratory Testing for Soil samples • SPT Energy Measurement on Drill Rig • Well Installation • Water Sampling • Slug Testing • Aquifer Pumping Test • Logging of Soil Borings • Site Coordination
Fugro Consultants, Inc.	• Field CPT Testing • RCTS Testing • Direct shear testing
STL Laboratories (Test America)	• Chemical Testing for Soil and Water samples
Miller Drilling, Inc.	• Geotechnical soil borings with SPT tests • Undisturbed Sampling
GEOVision	• Downhole geophysical logging • P-S suspension logging
University of Texas Austin/Dr. Stokoe	• Review of RCTS Test results

TABLE 2.1
TESTING SUMMARY - Borings - Cone Penetrometer - Test Pits
Turkey Point COL Project
MACTEC Project Number 6468071950

Boring Number	Boring Type				Equipment		Depth		As-Built Coordinates/Elevations			In-Situ Testing						
	SPT	Core	UD Tubes	CPT	Drill Rig	Hammer ID	Proposed (ft)	Actual (ft)	Northing (US ft)	Easting (US ft)	Ground Surface Elevation (ft)	P-S Suspension	Deviation	Natural Gamma	Resistivity	Caliper	Spontaneous Potential	Down Hole Velocity Logging
B-601(DH)	X	X			CME-75 (CLT)	MEC-09	400	419.2	396,967.9	876,642.9	-1.4	X	X	X	X	X	X	
B-602	X	X			CME-45C (RAL)	MEC-12	200	204.1	397,019.6	876,594.1	-1.4							
B-603	X	X			CME-550 (ATL)	MEC-03	150	151.2	397,018.4	876,697.0	-1.4							
B-604(DH)	X	X			CME-550X (ATL)	MEC-05	150	165.0	396,915.9	876,591.6	-1.5	X	X	X	X	X	X	
B-605	X	X			CME-550 (ATL)	MEC-03	200	201.0	396,916.8	876,694.1	-1.7							
B-606	X	X			CME-550 (ATL)	MEC-03	150	151.2	396,958.9	876,738.0	-1.4							
B-607	X	X			CME-550 (ATL)	MEC-03	150	152.5	396,830.0	876,644.2	-1.5							
B-608(DH)	X	X			CME-550X (ATL)	MEC-05	250	265.4	396,829.5	876,735.9	-1.5	X	X	X	X	X	X	
B-609	X	X			CME-550 (ATL)	MEC-03	150	150.7	396,762.5	876,689.0	-1.5							
B-610(DH)	X	X			CME-750 (Miller)	07	250	269.0	397,084.2	876,644.4	-1.4	X						
B-611	X	X			CME-550 (CLT)	MEC-04	150	151.5	397,086.7	876,735.0	-1.5							
B-612	X	X			CME-550 (ATL)	MEC-03	125	125.1	397,085.5	876,869.1	-1.5							
B-613	X	X			CME-550 (Miller)	M06	150	150.2	397,162.2	876,809.4	-1.4							
B-614	X	X			CME-550 (Miller)	M06	125	128.0	397,204.1	876,870.7	-1.5							
B-615	X	X			CME-55 LC (RAL)	MEC-02	150	150.6	397,167.4	876,761.8	-1.5							
B-616	X	X			CME-550 (ATL)	MEC-03	125	125.0	397,207.9	876,723.7	-1.2							
B-617	X	X			CME-550 (ATL)	MEC-03	125	126.1	397,288.1	876,721.7	-1.4							
B-618	X	X			CME-45C (RAL)	MEC-12	150	154.7	397,207.6	876,643.1	-1.4							
B-619	X	X			CME-45C (RAL)	MEC-12	125	128.7	397,293.9	876,653.7	-1.7							
B-620(DH)	X	X			CME-750 (Miller)	07	200	215.0	397,394.9	876,648.3	-1.5	X	X	X	X	X	X	
B-621	X	X			CME-55 LC (RAL)	MEC-02	100	126.5	397,367.6	876,949.3	0.2							
B-622	X	X			CME-55 LC (RAL)	MEC-02	100	100.2	397,421.2	876,810.7	0.2							
B-623	X	X			CME-55 LC (RAL)	MEC-02	100	100.2	397,422.6	876,523.2	-1.3							
B-624	X	X			CME-550 (ATL)	MEC-03	100	103.2	397,327.1	876,514.1	-1.4							
B-625	X	X			CME-550 (Miller)	M06	125	126.7	397,106.5	876,960.5	-1.4							
B-626	X	X			CME-550 (Miller)	M06	100	100.6	396,874.5	876,857.2	-1.6							
B-627	X	X			CME-550 (ATL)	MEC-03	100	102.0	396,835.2	876,332.9	-1.3							
B-628	X	X			CME-750 (Miller)	07	125	127.9	397,072.9	876,473.2	-1.5							
B-629	X	X			CME-550 (ATL)	MEC-03	100	100.3	396,971.9	876,346.1	-1.1							
B-630	X	X	X		CME-550X (ATL)	MEC-05	280	294.0	396,871.5	876,462.1	-1.5							
B-631	X	X			CME-550 (Miller)	M06	100	100.8	396,655.1	876,514.1	-1.2							
B-632	X	X			CME-550 (Miller)	M06	100	100.3	396,432.4	876,737.0	-1.6							
B-633	X	X			CME-55 Marsh Buggy	MEC-425	100	100.4	396,113.3	876,993.9	-1.5							
B-634	X	X			CME-550 Marsh Buggy	893	125	127.5	395,758.2	876,677.2	-0.7							
B-635	X	X			CME-550 Marsh Buggy	893	125	128.5	395,770.9	876,798.2	-0.9							
B-636	X	X			CME-55 Marsh Buggy	MEC-425	125	126.0	395,714.8	877,193.2	-1.1							
B-637	X	X			CME-55 Marsh Buggy	MEC-425	150	150.0	395,693.1	877,310.3	-0.2							
B-639	X	X			CME-550 (ATL)	MEC-03	100	102.6	396,963.5	876,998.2	-1.4							
B-640(DHT)/C-602A				X	CME-750 (Miller) / Fugro CPT Track Rig	07	150	150.0	397,116.6	876,528.3	-0.3							X
B-701(DH)	X	X			CME-750 (Miller)	07	600	615.5	396,976.1	875,792.3	-1.1	X	X	X	X	X	X	
B-702	X	X			CME-550 (Miller)	M06	200	202.5	397,017.9	875,745.9	-1.2							
B-703	X	X			CME-550 (Miller)	M06	150	150.0	397,018.1	875,846.1	-1.3							
B-704(DH)	X	X			CME-750 (Miller)	07	150	151.5	396,930.7	875,741.7	-1.4							
B-704G(DH)	X	X			CME-550X (ATL)	MEC-05	200	163.5	396,938.6	875,749.0	-1.3	X	X	X	X	X	X	
B-705	X	X			CME-550X (ATL)	MEC-05	200	200.0	396,919.2	875,846.4	-1.3							
B-706	X	X			CME-750 (Miller)	07	150	151.9	396,962.5	875,885.3	-1.2							
B-707	X	X			CME-550 (Miller)	M06	150	152.0	396,828.8	875,790.8	-1.8							
B-708(DH)	X	X			CME-750 (Miller)	07	250	266.5	396,829.7	875,885.7	-1.4	X	X	X	X	X	X	
B-709	X	X			CME-550X (ATL)	MEC-05	150	150.0	396,760.5	875,840.6	-1.3							
B-710(DH)	X	X			CME-75 (CLT)	MEC-09	250	250.9	397,086.9	875,792.9	-1.3							

Prepared By [signature] 8/19-08
Checked By ZHU 8-19-08

TABLE 2.1
TESTING SUMMARY - Borings - Cone Penetrometer - Test Pits
Turkey Point COL Project
MACTEC Project Number 6468071950

Boring Number	Boring Type				Equipment		Depth		As-Built Coordinates/Elevations			In-Situ Testing						
	SPT	Core	CPT	Test Pit	Drill Rig	Hammer ID	Proposed (ft)	Actual (ft)	Northing (US ft)	Easting (US ft)	Ground Surface Elevation (ft)	P-S Suspension	Deviation	Natural Gamma	Resistivity	Caliper	Spontaneous Potential	Down Hole Velocity Logging
B-710(DH)R	X				CME-550 (CLT)	MEC-04	15	15.0	397,087.2	875,781.9	-1.3							
B-710G(DH)					CME-550X (ATL)	MEC-05	265	273.5	397,075.1	875,792.2	-1.4	X	X	X	X	X	X	
B-711	X	X			CME-750 (Miller)	07	150	151.7	397,085.6	875,884.8	-1.1							
B-712	X	X			CME-55 LC (RAL)	MEC-02	125	128.3	397,082.1	876,022.1	-1.1							
B-713	X	X			CME-550 (ATL)	MEC-03	150	152.5	397,179.3	875,959.0	-1.1							
B-714	X	X			CME-550 (Miller)	M06	125	125.6	397,258.7	876,020.6	-1.0							
B-715	X	X			CME-550 (Miller)	M06	150	150.1	397,259.2	875,908.5	-0.9							
B-716	X	X			CME-55 LC (RAL)	MEC-02	125	126.6	397,214.3	875,872.7	-1.1							
B-717	X	X			CME-550 (ATL)	MEC-03	125	127.2	397,287.0	875,873.1	-1.1							
B-718	X	X			CME-550 (ATL)	MEC-03	150	150.8	397,190.9	875,792.6	-1.2							
B-719	X	X			CME-55 LC (RAL)	MEC-02	125	126.7	397,293.2	875,791.3	-1.1							
B-720(DH)	X	X			CME-550X (ATL)	MEC-05	200	204.9	397,396.7	875,791.1	-0.9							
B-720G(DH)					CME-55 Marsh Buggy	MEC-425	215	220.8	397,385.2	875,794.0	-1.1	X	X	X	X	X	X	
B-721	X	X			CME-550 (ATL)	MEC-03	100	127.4	397,338.0	876,120.1	-1.5							
B-722	X	X			CME-550 (ATL)	MEC-03	100	103.2	397,434.2	875,979.6	-1.0							
B-723	X	X			CME-550 (Miller)	M06	100	100.6	397,421.2	875,675.4	-1.0							
B-724	X	X			CME-550 (Miller)	M06	100	100.0	397,325.5	875,663.2	-0.7							
B-725	X	X			CME-550 (Miller)	M06	125	126.6	397,099.8	876,111.2	-1.0							
B-726	X	X			CME-550 (Miller)	M06	100	100.5	396,875.6	876,003.9	-1.4							
B-727	X	X			CME-550 (Miller)	M06	100	100.9	397,117.7	875,666.1	-1.3							
B-728	X	X			CME-550 (Miller)	M06	125	126.6	397,070.5	875,620.1	-1.4							
B-729	X	X			CME-550 (Miller)	M06	100	100.9	396,970.7	875,493.4	-1.2							
B-730	X	X			CME-550 (ATL)	MEC-03	100	103.2	396,868.0	875,621.0	-1.0							
B-731	X	X			CME-550 (ATL)	MEC-03	100	103.2	396,645.6	875,423.1	-1.5							
B-732	X	X			CME-750 (Miller)	07	100	104.5	396,412.1	875,682.4	-1.0							
B-733	X	X			CME-550 (ATL)	MEC-03	100	103.5	396,117.5	875,897.5	-1.0							
B-734	X	X			CME-45C (RAL)	MEC-12	125	130.0	395,833.2	875,546.3	-0.6							
B-735	X	X			CME-45C (RAL)	MEC-12	125	128.0	395,824.7	875,689.4	-0.8							
B-736	X	X			CME-45C (RAL)	MEC-12	125	125.0	395,808.5	876,107.1	-0.5							
B-737	X	X			CME-550 Marsh Buggy	893	150	153.3	395,803.7	876,237.8	-0.6							
B-738	X	X			CME-45C (RAL)	MEC-12	100	101.2	397,728.1	875,607.3	0.1							
B-739	X	X			CME-750 (Miller)	07	100	101.0	396,962.9	876,149.6	-1.6							
B-740(DHT)					CME-550 (Miller)	M06	150	150.0	397137.2*	875841.7*	-0.8							X
B-802	X	X			CME-550 Marsh Buggy	893	125	128.5	398,817.1	876,265.7	-1.5							
B-805	X	X			CME-55 Marsh Buggy	MEC-425	125	125.3	396,883.0	877,239.5	-1.6							
B-806	X	X			CME-550 Marsh Buggy	893	125	127.4	395,288.3	877,237.4	-0.4							
B-807	X	X			CME-550 Marsh Buggy	893	125	128.5	395,277.5	875,987.8	-0.7							
B-808	X	X			CME-550 Marsh Buggy	893	125	126.4	396,204.9	875,331.8	-1.0							
B-809	X	X			CME-550 Marsh Buggy	893	125	124.5	397,028.0	875,151.3	-1.3							
B-810	X	X			CME-550 Marsh Buggy	893	125	127.0	397,806.7	875,012.4	-1.2							
B-811	X	X			CME-550 (Miller)	M06	125	127.3	398,325.2	874,953.8	-1.4							
B-812	X	X			CME-550 Marsh Buggy	893	125	128.7	398,913.2	875,043.1	-1.4							
B-813	X	X			CME-550 Marsh Buggy	893	125	126.5	399,047.6	876,097.3	-1.3							
B-814	X	X			CME-550 (Miller)	M06	125	153.2	399,138.9	877,404.8	9.0							
C-601			X		Fugro CPT Track Rig	NA	120-220	120-226	397,129.8	876,361.3	-0.1							
C-602**			X		Fugro CPT Track Rig	NA	120-220	120-222	397,115.6	876,534.6	-0.5							
C-701			X		Fugro CPT Track Rig	NA	120-220	120-290	397,100.2	875,839.3	-1.4							
C-702			X		Fugro CPT Track Rig	NA	120-220	120-221	397,149.4	876,042.2	0.3							
TP-601				X	Back Hoe	NA	NA	5.2	397,105.6	876,035.8	-1.4							
TP-701				X	Back Hoe	NA	NA	5.0	396,988.2	875,508.5	-1.4							

*Location adjacent to PVC pipe in hole.

**C-602 abandoned; redone as C-602A at B-640(DHT) location.

TABLE 4.1
SUMMARY OF SOIL LABORATORY INDEX AND CLASSIFICATION TEST RESULTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Prepared By ZHU 8-19-08
Checked By [illegible] 8-19-08

Boring Number	Sample Number	Depth (ft)	Gravel (%)	Sand (%)	Fines (%)	Silt (%)	0.005 mm Clay (%)	USCS Symbol (1)	Natural Moisture (%)	LL	PI	G_s
B-601(DH)	601-3	5.3-6.8	39	38	23			GM				
B-601(DH)	601-5	9.7-11.2	59	40	1			GP				
B-601(DH)	601-6	12.5-14	54	36	10			GP-GM				
B-601(DH)	601-8	21.4-22.9	59.5	23.3	17.2	10.4	6.8	GM				
B-601(DH)	601-10B	122-122.7	1	81	18			SM				
B-601(DH)	601-11	128.3-129.8	0.0	75.5	24.5	14.4	10.1	SM				
B-601(DH)	601-14	158.4-159.9	0	40	60			CL		24	10	
B-601(DH)	601-16	178.4-179.9	0	40	60			ML		22	2	
B-601(DH)	601-18	198.4-199.9	0	33	67			CL		25	13	
B-601(DH)	601-19	208.4-209.9	0	28	72			CL		34	13	
B-601(DH)	601-23	248.4-249.9	0	80	20			SM				2.70
B-601(DH)	601-28	298.4-299.9	0.0	84.7	15.3	7.3	8.0	SM				
B-601(DH)	601-32	338.4-339.2	0.0	82.5	17.5	10.2	7.3	SM				
B-601(DH)	601-34	358.4-358.9	0	85	15			SM				
B-601(DH)	601-36	378.4-379.1	0	87	13			SM				
B-601(DH)	601-38	398.4-399.2	0.0	84.1	15.9	7.6	8.3	SM				
B-601(DH)	601-39	418.4-419.2	0	88	12			SP-SM				
B-602	602-3	4.8-6.3	47	37	16			GM				
B-602	602-9	122.6-124.1	0.6	79.1	20.3	11.9	8.4	SM				
B-602	602-11	142.5-144	0	67	33			SM				
B-602	602-13	162.6-164.1	0	40	60			ML				
B-602	602-16	192.6-194.1	0.0	34.9	65.1	54.7	10.4	ML				
B-602	602-17	202.6-204.1	0	24	76			ML				
B-603	603-3	5-6.5	44	38	18			GM				
B-603	603-5	10-11.5	60	22	18			GM				
B-603	603-8	120.5-122	5.3	33.3	61.4	49.0	12.4	ML				
B-603	603-10	131.7-133.2	6	65	29			SM				
B-603	603-11	136.4-137.9	1.5	85.7	12.8	7.8	5.0	SM				
B-603	603-14	149.7-151.2	0	58	42			SM				
B-604(DH)	604-4	8.5-10	52.0	34.1	13.9	7.5	6.4	GM				
B-604(DH)	604-9	28.5-30	43	39	18			GM				
B-604(DH)	604-13	138.5-140	1	70	29			SM				
B-604(DH)	604-15	163.5-165	0.0	37.4	62.6	52.8	9.8	ML				
B-605	605-4	7.5-9	43	45	12			SP-SM				
B-605	605-6	12.5-14	34	53	13			SM				
B-605	605-8	20-21.5	0	90	10			SP-SM				
B-605	605-10	30-31.5	59	27	14			GM				

TABLE 4.1
SUMMARY OF SOIL LABORATORY INDEX AND CLASSIFICATION TEST RESULTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Prepared By ZHU 8-19-08
Checked By [illegible] 8-19-08

Boring Number	Sample Number	Depth (ft)	Gravel (%)	Sand (%)	Fines (%)	Silt (%)	0.005 mm Clay (%)	USCS Symbol (1)	Natural Moisture (%)	LL	PI	G_s
B-605	605-12	119.9-121.4	0.0	48.1	51.9	37.1	14.8	ML				
B-605	605-15	131.4-132.9	0	64	36			SM				2.67
B-605	605-18	144.9-146.4	0.0	57.8	42.2	32.8	9.4	SM				
B-605	605-20	154.9-156.4	0	58	42			SM				
B-605	605-22	164.5-166	0.0	40.0	60.0	48.1	11.9	ML				
B-605	605-24	174.5-176	0	40	60			ML				
B-605	605-26	184.5-186	0.0	38.5	61.5	47.9	13.6	ML				
B-605	605-27	189.5-191	0	42	58			ML				
B-605	605-28	194.5-196	0	40	60			CL-ML		24	5	
B-605	605-29	199.5-201	0.0	30.3	69.7	54.7	15.0	ML				
B-606	606-8	119.4-121.9	2.1	78.4	19.5	8.9	10.6	SM				
B-606	606-9	129.7-131.2	0.4	60.6	39.0	28.3	10.7	SM				
B-606	606-11	149.7-151.2	0	59	41			SM				
B-607	607-3	5-6.5	32	46	22			SM				
B-607	607-6	12.5-14	33	48	19			SM				
B-607	607-9	129.5-131	0.4	68.9	30.7	16.3	14.4	SM				
B-607	607-10	139.5-141	0	70	30			SC-SM		18	4	
B-607	607-12	151-152.5	0.0	55.3	44.7	35.0	9.7	SM				
B-608(DH)	608-7	18.5-20	49	37	14			GM				
B-608(DH)	608-11	117.8-119.3	0	84	16			SM				
B-608(DH)	608-12	128-129.5	0	77	23			SM				
B-608(DH)	608-14	148-149.5	0	90	10			SP-SM		NV	NP	
B-608(DH)	608-17	178-179.5	0	42	58			ML		24	2	
B-608(DH)	608-22	228-229.3	0	62	38			SM		21	3	
B-608(DH)	608-24	248.9-250.4	0	75	25			SM				
B-609	609-3	5-6.5	35	42	23			SM				
B-610(DH)	610-4	7.5-9	35	43	22			SM				
B-610(DH)	610-8	116-117.5	5.3	82.7	12.0	4.3	7.7	SP-SM				
B-610(DH)	610-10	132.5-134	9	60	31			SM				
B-611	611-4	7.5-9.0	42	39	19			GM				
B-614	614-3	5.1-6.6	0	59	41			SM				
B-614	614-7	14.6-16.1	0	73	27			SM				
B-614	614-11	116.4-117.9	35.3	50.4	14.3	7.7	6.6	SM				
B-614	614-12	126.5-128	0	75	25			SM				

TABLE 4.1
SUMMARY OF SOIL LABORATORY INDEX AND CLASSIFICATION TEST RESULTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Prepared By ZHU 8-19-08
Checked By [illegible] 8-19-08

Boring Number	Sample Number	Depth (ft)	Gravel (%)	Sand (%)	Fines (%)	Silt (%)	0.005 mm Clay (%)	USCS Symbol (1)	Natural Moisture (%)	LL	PI	G_s
B-616	616-9	24.5-26	42	48	10			SW-SM				
B-616	616-12	123.5-125	13	69	18			SM				
B-619	619-4	7.1-8.6	50	37	13			GM				
B-619	619-6	12.1-13.6	51	38	11			GP-GM				
B-619	619-8	121.6-123.1	0.3	78.2	21.5	11.0	10.5	SM				
B-620(DH)	620-3	5-6.5	39	43	18			SM				
B-620(DH)	620-5	10.5-11.5	59.1	29.3	11.6	5.6	6.0	GP-GM				
B-620(DH)	620-8	19.5-21.0	13	76	11			SP-SM				
B-620(DH)	620-10	120.5-122	51	31	18			GM				
B-621	621-4	7.5-9	43	38	19			GM				
B-621	621-8	18.5-20	51	29	20			GM				
B-621	621-11	115.3-116.8	0.0	90.6	9.4	3.2	6.2	SP-SM				
B-621	621-12	125-126.5	0.0	76.1	23.9	13.1	10.8	SM				
B-625	625-3	5.1-6.6	38	47	15			SM				
B-625	625-6	12.5-14	0.0	69.0	31.0	16.9	14.1	SM				
B-625	625-7	15.2-16.4	62	34	4			GW				
B-625	625-8	120.4-121.3	2.3	63.3	34.4	28.5	5.9	SM				
B-625	625-9	125.2-126.7	1.8	71.9	26.3	16.8	9.5	SM				
B-630	UD-2	129.5-132	0.0	76.5	23.5	13.8	9.7	SM	32.5	25	1	
B-630	UD-8	161.5-163.1	0.0	36.5	63.5	55.6	7.9	ML	31.4	26	2	
B-630	UD-13	188.5-191	0.0	47.3	52.7	43.5	9.2	ML	30.0	22	3	
B-630	UD-16	208.5-211	0.0	21.3	78.7	60.9	17.8	CL	29.8	34	10	
B-630	UD-19	228.5-231	0.0	47.6	52.4	47.6	4.8	ML	23.6	24	3	
B-630	UD-23	258.5-261	0.0	79.6	20.4	14.8	5.6	SC-SM	22.7	20	5	
B-630	UD-27	291.5-294	0.0	76.1	23.9	16.4	7.5	SM	22.1	23	3	
B-701(DH)	701-1	0-1.5	0	55	45			SM	INS	INS		
B-701(DH)	701-2B	2.9-4	46	35	19			GM				
B-701(DH)	701-3	5.6-6.6	0	60	40			SM				
B-701(DH)	701-6	12.5-14	67	25	8			GP-GM				
B-701(DH)	701-8	115.5-117	8	79	13			SM				
B-701(DH)	701-9	122.7-124.2	12.1	67.5	20.4	11.0	9.4	SM				
B-701(DH)	701-10	127.5-129	5	66	29			SM				
B-701(DH)	701-12	147.5-149	0	57	43			SM		23	1	

TABLE 4.1
SUMMARY OF SOIL LABORATORY INDEX AND CLASSIFICATION TEST RESULTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Prepared By ZHU 8-19-08
Checked By [signature] 8-19-08

Boring Number	Sample Number	Depth (ft)	Gravel (%)	Sand (%)	Fines (%)	Silt (%)	0.005 mm Clay (%)	USCS Symbol (1)	Natural Moisture (%)	LL	PI	G_s
B-701(DH)	701-15	172.5-174	0	38	62			ML		22	3	
B-701(DH)	701-18	197.6-199.1	0	31	69			ML		25	3	
B-701(DH)	701-19	207.6-209.1	0	74	26			SM		29	5	
B-701(DH)	701-20	217.5-219	0	69	31			SM		25	3	
B-701(DH)	701-22	237.5-239	0	56	44			SC-SM		21	17	
B-701(DH)	701-28	297.5-299	0.0	85.5	14.5	5.3	9.2	SM				2.68
B-701(DH)	701-33	347.5-348.9	0	89	11			SP-SM		NV	NP	
B-701(DH)	701-38	397.5-398.8	0	94	6			SP-SM		NV	NP	
B-701(DH)	701-39	407.5-409	0	89	11			SP-SM		NV	NP	
B-701(DH)	701-41	427.5-428.9	0	89	11			SP-SM		NV	NP	
B-702	702-3	5.1-6.6	31	48	21			SM				
B-702	702-7	14.7-16.2	45.2	42.7	12.1	5.8	6.3	GP-GM				
B-702	702-10	31.0-32.5	36	55	9			SP-SM				
B-702	702-12	119.2-120.7	21	67	12			SP-SM				
B-702	702-21	176.2-177.7	0.0	31.8	68.2	56.4	11.8	ML				
B-702	702-23	196.2-197.7	0	28	72			ML		22	2	
B-703	703-3	5.2-6.7	58	30	12			GP-GM				
B-703	703-6	12.3-13.8	3	88	9			SP-SM				
B-703	703-9	118.6-120.1	0.0	91.2	8.8	1.5	7.3	SP-SM				
B-703	703-10	123.8-125.3	0	77	23			SM				2.66
B-703	703-12	133.5-135	0.2	74.6	25.2	14.2	11.0	SM				
B-703	703-14	143.5-145	0	62	38			SC-SM		24	5	
B-703	703-15	148.5-150	0.0	81.3	18.7	8.9	9.8	SM				
B-704(DH)	704-4	7.4-8.9	37	40	23			SM				
B-704(DH)	704-10	28.5-30	14	69	17			SM				
B-704(DH)	704-15	123-124.5	57	33	10			GW-GM				
B-704(DH)	704-16	128-129.5	7	67	26			SM				
B-704(DH)	704-17	133-134.5	10.1	61.8	28.1	16.5	11.6	SM				
B-704(DH)	704-18	138-139.5	11	60	29			SM				
B-704(DH)	704-21	150-151.5	0.0	58.0	42.0	31.6	10.4	SM				
B-705	705-4	7.5-9	71	18	11			GP-GM				
B-705	705-8	18.5-20	58	25	17			GM				
B-705	705-11	33.5-35	36	24	40			GM				
B-705	705-14	128.5-130	0.0	70.0	30.0	15.8	14.2	SM				
B-705	705-16	138.5-140	0	71	29			SM				2.67
B-705	705-18	148.5-150	0.0	59.0	41.0	31.2	9.8	SM				
B-705	705-23	173.5-175	0	41	59			ML				

TABLE 4.1
SUMMARY OF SOIL LABORATORY INDEX AND CLASSIFICATION TEST RESULTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Prepared By ZHU 8-19-08
Checked By [signature] 8-19-08

Boring Number	Sample Number	Depth (ft)	Gravel (%)	Sand (%)	Fines (%)	Silt (%)	0.005 mm Clay (%)	USCS Symbol (1)	Natural Moisture (%)	LL	PI	G_s
B-705	705-24	178.5-180	0.0	33.4	66.6	53.3	13.3	ML				
B-705	705-27	193.5-195	1	32	67			ML				
B-706	706-2	3.1-4.6	15	39	46			SM				
B-706	706-4	8-9.5	2.0	49.4	48.6	22.7	25.9	SC				
B-706	706-5	10.5-12.9				(Note: samples 706-5 and 706-7 were combined)						2.73
B-706	706-6	12.9-14.4	61	31	8			GP-GM				
B-706	706-7	15.7-16.0				(Note: samples 706-5 and 706-7 were combined)						2.73
B-706	706-9	115.8-117.3	5.5	84.4	10.1	3.9	6.2	SP-SM				2.66
B-706	706-11	125.9-127.4	6	68	26			SM				
B-706	706-13	135.4-136.9	1.8	49.2	49.0	34.0	15.0	SM				
B-706	706-15	145.4-146.9	45	39	16			GM				
B-707	707-6	12.5-14	0	92	8			SP-SM				
B-707	707-10	108.8-110.3	0	70	30			SM				
B-707	707-14	125.3-126.8	1.9	64.1	34.0	20.4	13.6	SM				
B-707	707-16	135.5-137	0	69	31			SM				
B-707	707-18	145.5-147	0.5	53.6	45.9	35.5	10.4	SM				
B-708 (DH)	708-3	5.0-6.5	22	53	25			SM				
B-708 (DH)	708-6	13-14.5	58	36	6			GP-GM				
B-711	711-3	5-6.5	47	34	19			GM				
B-711	711-5	9.9-11.4	67	25	8			GP-GM				
B-711	711-9	24-25.5	46	48	6			SW-SM				
B-711	711-11	120.5-122	0.0	46.9	53.1	44.1	9.0	ML				
B-711	711-12	130.2-131.7	0	67	33			SM				
B-711	711-14	150.2-151.7	12.5	69.1	18.4	8.5	9.9	SM				
B-715	715-3	5-6.5	36	43	21			SM				
B-715	715-5	10-11.5	57	29	14			GM				
B-715	715-8	21.7-23.2	43	37	20			GM				
B-715	715-10	118.4-119.9	21	69	10			SP-SM				
						3.4	5.9					
B-715	715-11	128.1-129.6	27.7	51.7	20.6	14.0	6.6	SM				
B-715	715-13	148.6-150.1	0	58	42			SM				
B-720 (DH)	720-3	6-7.5	31	49	20			SM				
B-720 (DH)	720-6	13.5-15	59	31	10			GP-GM				
B-720 (DH)	720-8	23.5-25	25	37	38			SM				
B-720 (DH)	720-10	118.4-119.9	0.0	92.0	8.0	1.6	6.4	SP-SM				

TABLE 4.1
SUMMARY OF SOIL LABORATORY INDEX AND CLASSIFICATION TEST RESULTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Prepared By ZHU 8-19-08
Checked By [signature] 8-19-08

Boring Number	Sample Number	Depth (ft)	Gravel (%)	Sand (%)	Fines (%)	Silt (%)	0.005 mm Clay (%)	USCS Symbol (1)	Natural Moisture (%)	LL	PI	G_s
B-720 (DH)	720-12	138.4-139.9	0.1	65.4	34.5	26.0	8.5	SM				
B-720 (DH)	720-13	148.4-149.9	0	60	40			SM				
B-720 (DH)	720-14	158.4-159.9	1	38	61			ML				
B-730	730-3	3.9-5.4	6	59	35			SM				
B-730	730-5	8.6-10.1	42.2	29.6	28.2	11.0	17.2	GM				
B-730	730-8	19.6-21.1	51	36	13			GM				
B-737	737-3	5-6.5	34	42	24			SM				
B-737	737-5	10-11.5	42	33	25			GM				
B-737	737-8	18.6-20.1	55	31	14			GM				
B-737	737-14B	112.7-113.3	32	46	22			SM				
B-737	737-15	121.8-123.3	2.8	74.0	23.2	14.4	8.8	SM				
B-737	737-17	141.8-143.3	0	64	36			SM				

(1) USCS classifications are visual, except where Liquid Limit and Plasticity Index values were available.
INS = Insufficient sample available to perform assigned test.
LL= Liquid Limit, PI = Plasticity Index, G_s = Specific Gravity
Shaded cells indicate that information was not obtained.

Prepared By: ZHU Date: 8/9-08
Checked By: JA Date: 8-19-08

TABLE 4.2
SUMMARY OF SOIL TEST RESULTS
FOR TEST PITS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Test Pit Number	Sample Depth (ft.)	USCS Symbol	Particle Size Analysis			Specific Gravity	Moisture-Density(1)		LBR	CBR			
			Gravel (%)	Sand (%)	Fines (%)		Max. Dry Density (pcf)	Optimum Moisture (%)	(%)	Molded Density (pcf)	Molded Moisture (%)	Soaked CBR (0.10")	Soaked CBR (0.20")
TP-601	3.2-5	SP-SM	42	46	12		106.5	16.3	112	103.0	15.9	66.5	63.9
										104.5	16.5	69.1	65.8
										107.5	16.9	67.3	78.9
TP-701	3-4.5	SM	39	44	17	2.73	106.9	17.4	129	96.1	16.2	22.2	20.9
										96.8	16.5	24.9	21.2
										105.5	16.4	58.9	61.4

(1) Moisture/density testing performed in accordance with ASTM D 1557-02 (Modified Proctor).

LBR= Limerock Bearing Ratio , CBR = California Bearing Ratio

Prepared By [signature] 7-24-08
Checked By EHU 7/24/08

TABLE 4.3
SUMMARY OF LABORATORY TEST RESULTS - ROCK
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Boring Number	Run Number	Sample ID	Sample Top Depth (feet)	Sample Length (L) (inches)	Sample Diameter (D) (inches)	L/D Ratio	Unit Weight (pcf) (1)	Moisture Content (%)	Type of Break (2)	Unconfined Compressive Strength (psi)(3)	Young's Modulus (ksi x1000)	Specific Gravity
B-601(DH)	Run 3	601DH-CS-01	39.9	7.19	3.26	2.2	140.6	4.3	COL	4823		
B-601(DH)	Run 4	601DH-CS-02	43.5	7.06	3.26	2.2	130.4	8.4	C	2384		
B-601(DH)	Run 5	601DH-CS-03	50.2	7.19	3.25	2.2	120.4	12.0	S	1962		
B-601(DH)	Run 6	601DH-CS-04	52.0	7.28	3.26	2.2	114.4	17.0	S	1559		
B-601(DH)	Run 9	601DH-CS-05	66.7	7.19	3.27	2.2	119.3	14.2	S	1197		
B-601(DH)	Run 14	601DH-CS-06	92.9	7.26	3.25	2.2	115.5	12.7	S	938		
B-601(DH)	Run 14	601DH-CS-07	94.3	7.14	3.24	2.2	102.0	14.1	S	812		
B-601(DH)	Run 15	601DH-CS-08	99.7	7.16	3.23	2.2	112.9	13.4	S	413(5)		
B-602	Run 10	602-CS-01	52.2	4.94	2.37	2.1	110.8	15.8	S	883		
B-602	Run 10	602-CS-02	54.4	5.31	2.40	N/A	94.1	23.2	N/A	(4)		
B-602	Run 16	602-CS-03	79.5	5.04	2.40	2.1	139.8	6.2	S	3665		
B-604(DH)	Run 4	604DH-CS-01	49.8	5.19	2.40	2.2	126.0	12.1	C	4012		
B-604(DH)	Run 4	604DH-CS-02	50.6	5.07	2.40	2.1	123.2	12.1	S	3175		
B-604(DH)	Run 10	604DH-CS-03	80.2	5.03	2.40	2.1	133.5	7.9	S	3183		
B-606	Run 7	606-CS-01	32.0	5.35	2.39	2.2	124.4	11.4	S	1764		
B-606	Run 8	606-CS-02	33.5	5.15	2.40	2.2	114.7	11.9	S	772		
B-606	Run 12	606-CS-04	52.2	5.29	2.40	2.2	144.0	5.6	S	4991		
B-606	Run 18	606-CS-05	74.3	5.25	2.38	2.2	132.1	7.7	S	2188		
B-606	Run 19	606-CS-06	80.1	5.03	2.39	2.1	125.0	8.9	S	2752		
B-607	Run 3	607-CS-01	25.7	5.21	2.39	N/A	103.9	10.6	N/A	(4)		2.65
B-607	Run 5	607-CS-02	33.9	4.92	2.39	2.1	112.1	13.0	S	1559		
B-607	Run 6	607-CS-03	40.7	4.95	2.39	2.1	120.5	10.5	S	1963		
B-607	Run 8	607-CS-04	50.4	4.98	2.39	2.1	123.8	11.8	S	3266		
B-607	Run 10	607-CS-05	58.6	4.98	2.38	2.1	133.9	9.4	S	1418(5)		
B-607	Run 19	607-CS-06	99.7	5.02	2.37	2.1	110.1	13.6	S	350		

Prepared By [handwritten initials] 7-24-08
Checked By ZHU 7/24/08

TABLE 4.3
SUMMARY OF LABORATORY TEST RESULTS - ROCK
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Boring Number	Run Number	Sample ID	Sample Top Depth (feet)	Sample Length (L) (inches)	Sample Diameter (D) (inches)	L/D Ratio	Unit Weight (pcf) (1)	Moisture Content (%)	Type of Break (2)	Unconfined Compressive Strength (psi)(3)	Young's Modulus (ksi x1000)	Specific Gravity
B-608(DH)	Run 2	608DH-CS-01	41.3	5.17	2.40	2.2	144.2	4.2	C	5416		
B-608(DH)	Run 3	608DH-CS-02	42.9	5.11	2.41	2.1	142.1	4.4	C	4160		
B-608(DH)	Run 15	608DH-CS-03	105.2	5.06	2.39	2.1	101.5	18.5	S	430		
B-609	Run 1	609-CS-01	29.0	5.24	2.40	2.2	111.4	10.5	S	416		
B-609	Run 1	609-CS-02	30.1	4.99	2.41	2.1	109.4	15.8	S	1494		
B-609	Run 6	609-CS-04	50.1	5.28	2.40	2.2	126.0	10.8	S	2551		
B-609	Run 16	609-CS-06	79.6	5.16	2.38	2.2	127.8	7.9	S	1865		
B-609	Run 22	609-CS-07	101.9	5.20	2.39	2.2	110.3	13.2	S	587		
B-610(DH)	Run 3	610DH-CS-01	27.6	5.12	2.40	2.1	112.7	16.6	S	1239		
B-610(DH)	Run 3	610DH-CS-02	29.6	4.97	2.39	2.1	107.9	20.0	S	1446		
B-610(DH)	Run 7	610DH-CS-04	49.9	5.27	2.41	2.2	125.0	12.4	S	2038	3.7	
B-610(DH)	Run 13	610DH-CS-05	77.6	5.24	2.40	2.2	130.9	8.8	S	3000		
B-611	Run 1	611-CS-01	28.7	5.07	2.39	2.1	120.6	11.9	S	1480		
B-611	Run 3	611-CS-02	36.6	5.36	2.39	2.2	125.1	9.7	S	2806		
B-611	Run 5	611-CS-03	43.7	5.20	2.40	2.2	136.5	5.8	S	3603		
B-611	Run 10	611-CS-05	68.7	5.10	2.39	2.1	142.5	4.1	S	2471		
B-611	Run 15	611-CS-07	92.9	5.30	2.39	N/A	107.1	13.0	N/A	(4)		
B-611	Run 18	611-CS-09	108.7	5.16	2.39	N/A	96.2	22.7	N/A	(4)		
B-614	Run 5	614-CS-02	52.1	5.08	2.40	2.1	122.7	12.9	S	3550		
B-614	Run 11	614-CS-04	83.1	5.06	2.39	2.1	110.8	17.3	S	990		
B-616	Run 2	616-CS-01	36.1	5.01	2.39	2.1	106.2	12.9	S	1050		
B-616	Run 6	616-CS-04	61.2	5.15	2.40	2.1	122.8	10.5	C/S	2245		
B-619	Run 4	619-CS-01	29.0	4.77	2.39	2.0	108.4	20.6	S	935		
B-619	Run 8	619-CS-02	49.4	4.90	2.40	2.0	134.4	6.8	C/S	4413		
B-620(DH)	Run 5	620DH-CS-02	40.6	4.71	2.40	2.0	125.5	11.1	S	2556		
B-620(DH)	Run 6	620DH-CS-03	51.2	5.02	2.41	2.2	122.7	13.7	S	2487	2.9	

Prepared By [signature] 7-24-08
Checked By ZHU 7/24/08

TABLE 4.3
SUMMARY OF LABORATORY TEST RESULTS - ROCK
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Boring Number	Run Number	Sample ID	Sample Top Depth (feet)	Sample Length (L) (inches)	Sample Diameter (D) (inches)	L/D Ratio	Unit Weight (pcf) (1)	Moisture Content (%)	Type of Break (2)	Unconfined Compressive Strength (psi)(3)	Young's Modulus (ksi x1000)	Specific Gravity
B-620(DH)	Run 8	620DH-CS-04	61.6	5.25	2.41	2.2	125.5	8.6	S	1356		
B-621	Run 4	621-CS-01	43.8	5.15	2.40	2.2	131.1	7.1	S	3178		
B-621	Run 17	621-CS-04	107.3	5.26	2.40	2.2	96.3	17.9	S	443		
B-701(DH)	Run 3	701DH-CS-01	26.4	7.34	3.26	2.3	104.2	11.7	S	309		
B-701(DH)	Run 6	701DH-CS-02	42.3	7.03	3.24	2.2	141.7	7.1	COL	5665		
B-701(DH)	Run 8	701DH-CS-03	51.8	7.10	3.24	2.2	131.4	8.2	C	2323		
B-701(DH)	Run 10	701DH-CS-04	60.8	7.17	3.26	2.2	133.5	10.1	S	2921		
B-701(DH)	Run 10	701DH-CS-05	62.2	7.14	3.26	2.2	123.0	6.7	S	172		
B-701(DH)	Run 12	701DH-CS-06	74.3	7.20	3.25	2.2	137.7	7.6	S	2099		
B-701(DH)	Run 24	701DH-CS-07	467.7	5.20	2.36	2.2	108.8	20.4	C/S	94		
B-701(DH)	Run 28	701DH-CS-08	487.4	5.18	2.33	2.2	113.8	17.7	C/S	18		
B-701(DH)	Run 32	701DH-CS-10	509.0	3.36	2.37	NA	105.7	20.2	NA	NA		
B-701(DH)	Run 42	701DH-CS-14	556.4	5.11	2.36	2.2	99.9	24.4	C/S	310		
B-701(DH)	Run 51	701DH-CS-17	601.8	4.24	2.35	NA	107.6	19.7	NA	NA		
B-702	Run 8	702-CS-01	70.1	5.26	2.40	2.2	143.7	3.1	S	2976		
B-702	Run 8	702-CS-02	72.0	5.11	2.39	2.1	138.5	6.9	S	2251		
B-702	Run 11	702-CS-03	86.9	5.17	2.39	2.2	133.7	5.5	S	1364		
B-702	Run 14	702-CS-04	102.2	5.17	2.39	NA	104.4	12.5	NA	(4)		
B-708(DH)	Run 3	708DH-CS-01	37.8	5.08	2.40	2.1	134.6	6.3	C	3924		
B-708(DH)	Run 6	708DH-CS-04	50.7	5.24	2.40	2.2	138.8	6.4	S	4414		
B-708(DH)	Run 8	708DH-CS-06	61.4	5.29	2.40	2.2	138.6	5.7	S	4230		
B-708(DH)	Run 16	708DH-CS-07	102.2	5.38	2.39	NA	97.2	12.9	NA	(4)		
B-711	Run 1	711-CS-01	34.1	4.99	2.39	2.1	108.1	14.1	S	907		
B-711	Run 2	711-CS-02	35.6	4.94	2.40	2.1	105.2	13.0	S	1417		
B-711	Run 5	711-CS-03	50.9	4.98	2.39	2.1	135.3	7.3	C/S	4051		
B-711	Run 6	711-CS-04	59.5	5.10	2.39	2.1	132.6	9.0	S	3129		2.68
B-711	Run 7	711-CS-05	60.7	4.98	2.39	2.1	138.9	6.6	S	3194		

Prepared By ___ 7-24-08
Checked By ZHU 7/24/08

TABLE 4.3
SUMMARY OF LABORATORY TEST RESULTS - ROCK
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Boring Number	Run Number	Sample ID	Sample Top Depth (feet)	Sample Length (L) (inches)	Sample Diameter (D) (inches)	L/D Ratio	Unit Weight (pcf) (1)	Moisture Content (%)	Type of Break (2)	Unconfined Compressive Strength (psi)(3)	Young's Modulus (ksi x1000)	Specific Gravity
B-711	Run 7	711-CS-06	62.0	4.90	2.40	2.0	142.5	5.5	C/S	5031		
B-711	Run 12	711-CS-07	86.7	4.95	2.40	2.1	133.0	7.8	S	1133		
B-711	Run 15	711-CS-08	102.0	5.01	2.40	2.1	99.2	15.0	S	378		
B-711	Run 15	711-CS-09	104.0	4.97	2.39	2.1	102.9	14.4	S	367		
B-715	Run 2	715-CS-01	32.8	5.16	2.36	2.2	130.1	4.5	S	2173		
B-715	Run 4	715-CS-03	42.0	5.15	2.36	2.2	133.7	14.2	S	5831		
B-715	Run 7	715-CS-05	55.4	5.19	2.36	2.2	138.1	8.6	C/S	4062		
B-715	Run 13	715-CS-07	88.0	4.97	2.36	2.1	148.7	3.0	C/S	3485		
B-737	Run 3	737-CS-01	42.7	5.18	2.37	2.2	151.4	3.3	S	7800		
B-737	Run 3	737-CS-02	44.3	5.17	2.36	2.2	149.8	4.0	COL	5112		

(1) Dry Unit Weight. To determine Wet Unit Weight, multiply Dry Unit Weight by 1+Moisture Content (in decimal form).
(2) Types of Breaks: COL=Columnar; C=Cone; S=Shear; C/S=Cone/Shear
(3) Due to core conditions, it was not feasable to meet preparation methodology and dimensional tolerances of ASTM 4543. Cores were capped gypsum compound for testing. Load direction approximately perpendicular to general bedding.
(4) Unable to perform test due to core breaking during capping procedure.
(5) Test duration was less than 2 minutes due to a compressive load at failure that was less than anticipated.
(6) Reported results represent average of values obtained from three trials.
(7) Shaded cells indicate that information not obtained.
NA = Not Applicable

TABLE 4.4
SUMMARY OF COMPRESSIVE STRENGTH AND ELASTIC MODULI OF INTACT ROCK CORE - ASTM D 7012-07
Turkey Point COL Project
MACTEC Job No. 6468-07-1950

Prepared by: ZHU 7/24/08
Reviewed by: [signature] 7/24/08

SAMPLE ID	AS RECEIVED MOISTURE CONTENT	SPECIMEN DIAMETER (INCH)	SPECIMEN HEIGHT (INCH)	L/D Ratio	DIMENSIONAL REQUIREMENTS	DRY UNIT WEIGHT (pcf)	TEST DURATION (TIME TO FAILURE IN MINUTES : SECONDS)	Strain Rate (in/min)	UNCONFINED COMPRESSIVE STRENGTH, (PSI)	TYPE OF BREAK	MOE (ksi x 1000)
B-610 (DH) CS-04 49.9'-50.7'	12.4%	2.41	5.27	2.2	See Note (1)	125.0	2:46	0.03	2,038	SHEAR	3.7
B-620 (DH) CS-03 51.2'-52.0'	13.7%	2.41	5.02	2.1	See Note (1)	122.7	11:00	0.03	2,487	SHEAR	2.9

Note (1): Because of core conditions, preparation according to ASTM D 4543 and achieving dimensional tolerances of ASTM D 4543 was not feasible. Cores were capped for testing
Note (2): Material Type: Limestone
Note (3): Confining Pressure: None
Note (4): Laboratory Temperature During Testing was 23.9 degrees Celsius
Note (5): Load Direction approximately perpendicular to general bedding.
Note (6): See individual test sheets for more information.
Note (7): Due to higher than anticipated loads, compressive testing had to be completed using a higher capacity testing frame.
MOE = Modulus of Elasticity

MACTEC ENGINEERING AND CONSULTING, INC.
RALEIGH, NC

TABLE 4.5
SUMMARY OF LABORATORY TEST RESULTS - CARBONATE CONTENT
ASTM D 4373-02
TURKEY POINT COL
MACTEC PROJECT NO. 6468-07-1950

Prepared By [signature] 7-25-08
Checked By ZHU 7-25-08

Boring No.	Sample No.	Depth (ft.)	Calcite Equivalent (%)
B-601 (DH)	601DH-5	9.7-11.2	93
B-601 (DH)	601DH-18	198.4-199.9	29
B-601 (DH)	601DH-23	248.4-249.9	21
B-603	603-3	5.0-6.5	90
B-603	603-5	10.0-11.5	92
B-603	603-8	120.5-122.0	19
B-603	603-11	136.4-137.9	40
B-605	605-4	7.5-9.0	89
B-605	605-12	119.9-121.4	27
B-605	605-15	131.4-132.9	30
B-605	605-18	144.9-146.4	24
B-605	605-26	184.5-186.0	24
B-605	605-28	194.5-196.0	27
B-607	607-3	5.0-6.5	89
B-607	607-CS-03	25.7-26.5	78*
B-607	607-CS-19	99.7-100.5	81*
B-607	607-9	129.5-131.0	19
B-608 (DH)	608DH-CS-03	105.2-106.0	78*
B-608 (DH)	608DH-17	178.0-179.5	22
B-608 (DH)	608DH-22	228.0-229.5	34
B-619	619-6	12.1-13.6	91
B-619	619-8	121.6-123.1	12
B-701 (DH)	701DH-3	5.1-6.6	92
B-701 (DH)	701DH-CS-02	42.3-43.4	93*
B-701 (DH)	701DH-22	237.5-239.0	20
B-701 (DH)	701DH-CS-07	467.7-468.5	87
B-701 (DH)	701DH-CS-10	509.0-509.8	93
B-701 (DH)	701DH-CS-17	601.8-602.6	78
B-703	703-6	12.3-13.8	89
B-703	703-9 R	118.6-120.1	12
B-703	703-15	148.5-150.0	20

TABLE 4.5
SUMMARY OF LABORATORY TEST RESULTS - CARBONATE CONTENT
ASTM D 4373-02
TURKEY POINT COL
MACTEC PROJECT NO. 6468-07-1950

Prepared By [signature] 7-25-08
Checked By ZHU 7-25-08

Boring No.	Sample No.	Depth (ft.)	Calcite Equivalent (%)
B-704 (DH)	704DH-15	123.0-124.5	12
B-704 (DH)	704DH-21	150.0-151.5	18
B-705	705-4	7.5-9.0	92
B-705	705-14	128.5-130.0	20
B-705	705-24	178.5-180.0	24
B-706	706-2	3.1-4.6	86
B-706	706-6	12.9-14.4	92
B-706	706-11	125.9-127.4	21
B-706	706-15	145.0-146.9	17
B-707	707-6	12.5-14.0	92
B-707	707-14	125.3-126.8	20
B-707	707-18	145.5-147.0	18
B-711	711-3	5.0-6.5	95
B-711	711-CS-01	34.1-34.9	93*
B-711	711-CS-05	60.7-61.5	68*
B-711	711-CS-09	104-104.8	83*
B-711	711-11	120.5-122.0	11
B-715	715-CS-01	32.8-33.6	92*
B-730	730-3	3.9-5.4	91
B-730	730-8	19.6-21.1	89
TP-601	601-1	3.2-5.0	89
TP-701	701-1	3.0-4.5	92

*Value shown is the average of three separate tests.

Prepared By: ZHU Date: 7-25-08
Checked By: WSL Date: 7-25-08

TABLE 4.6
SUMMARY OF SOIL
CHEMICAL TEST RESULTS
FPL-TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Sample Identification			Natural Moisture (%)	pH SW 846 9045D	Chloride (mg/kg) SW 846 9056(2)	Sulfate (mg/kg) SW 846 8056(3)
Boring No.	Sample Number	Depth (feet)				
B-601(DH)	601-8	21.4	11.5	8.9	6790	953
B-603	603-3	5.0	18.2	8.4	5430	780
B-605	605-20	154.9	22.2	8.3	5190	1180
B-607	607-10	139.5	19.5	8.4	4490	1140
B-701(DH)	701-1	0	65.4	7.4	70400	7590
B-701(DH)	701-3	5	16.7	8.5	5050	551
B-701(DH)	701-8	115.5	25.6	8.5	4290	560
B-701(DH)	701-12	147.5	30.2	8.3	6960	993
B-703	703-10	123.8	22.1	8.4	4730	974
B-704 (DH)	704-16	128	14.8	8.7	7020	914
B-705	705-11	33.5	19.8	8.7	2540	461
B-706	706-2	3.1	21.4	8.3	8830	1190
B-711	711-12	130.2	21.1	8.3	4430	806
B-715	715-3	5	12.3	8.8	3250	334
B-715	715-11	128.1	26.0	8.4	6090	957

NOTES:
(1) Tests performed by TESTAMERICA - St. Louis, MO
(2) SW 846 9056/EPA Method 300.0 (EPA-600 / 4-79-020)
(3) SW 846 8056/EPA Method 300.0 (EPA-600 / 4-79-020)

Prepared By: ZHU Date: 8-19-08
Checked By: [signature] Date: 8-19-08

TABLE 4.7
SUMMARY OF CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Borehole	Sample No.	Sample Depth (ft)	USCS[1]	Gradation			Atterberg Limits [2]		Initial Dry Unit Weight (pcf)	Initial Moisture Content (%)	Triaxial Test Data [3]			
				Sand (%)	Silt (%)	Clay (%)	LL (%)	PI (%)			c (ksf)	φ (°)	c' (ksf)	φ' (°)
B-630	UD 12	178.9	ML	33.0	55.7	11.3	21	1	88.7	30.1	1.88	14	1.7	20
									87.9	31.8				
									87.2	32.2				

Notes: (1) USCS = Unified Soil Classification System
(2) LL=Liquid Limit, PI= Plasticity Index
(3) φ = Total stress internal friction angle; c = Total stress cohesion intercept
φ' = Effective stress internal friction angle; c' = Effective stress cohesion intercept

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RALEIGH, NC

TABLE 5.1
SUMMARY OF OBSERVATION WELL DATA
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Well Number	Drilling Method	Borehole Depth (ft)	Well Depth (ft)	Screen Interval (ft bgs)	Coordinates		TOC Elevation	Pad Elevation	Height of Casing (ft ags)	Well Diameter (I.D. in.)	Testing	
					Northing	Easting					Slug Testing	Sampling for Chemistry
OW-606D	Rotary wash	137.0	136.0	125 - 135	396962.8	876712.9	1.6	-1.6	3.2	2		
OW-606L	Rotosonic	110.0	108.0	97 - 107	396979.9	876732.6	1.3	-1.5	2.8	2	✓	✓
OW-606U	Rotosonic	30.2	29.0	18 -28	396938.0	876734.8	1.4	-1.8	3.2	2	✓	✓
OW-621L	Rotosonic	110.0	109.6	98.6 - 108.6	397364.5	876970.0	3.1	0.1	3.0	2	✓	✓
OW-621U	Rotosonic	30.0	28.4	17.4 - 27.4	397375.8	876930.0	3.9	0.6	3.3	2	✓	✓
OW-636L	Rotary wash	111.0	108.1	97.1 - 107.1	395290.8	877257.2	3.0	-0.4	3.4	2	✓	
OW-636U	Rotary wash	29.8	28.0	17 - 27	395285.8	877215.7	2.8	-0.6	3.4	2	✓	
OW-706D	Rotary wash	138.4	135.1	123.8 - 133.8	396960.1	875864.4	2.2	-1.1	3.3	2		
OW-706L	Rotary wash	112.0	111.0	100 - 110	396978.2	875904.6	2.2	-1.0	3.2	2	✓	✓
OW-706U	Rotary wash	29.0	28.0	17 - 27	396940.1	875895.7	1.7	-1.5	3.2	2	✓	✓
OW-721L	Rotary wash	109.0	107.0	96 - 106	397321.5	876120.3	2.0	-1.2	3.2	2	✓	✓
OW-721U	Rotary wash	26.0	25.0	14 - 24	397361.2	876121.4	2.0	-1.1	3.1	2	✓	✓
OW-735L	Rotary wash	110.0	107.9	96.9 - 106.9	395824.3	875669.6	2.7	-0.7	3.4	2	✓	
OW-735U	Rotary wash	28.0	27.0	16 - 26	395823.3	875709.2	2.8	-0.5	3.3	2	✓	✓
OW-802L	Rock coring	110.0	109.0	98 - 108	398817.1	876265.7	2.1	-1.2	3.3	2	✓	
OW-802U	Rotary wash	27.0	26.0	15 - 25	398820.2	876243.7	2.2	-1.2	3.4	2	✓	✓
OW-805L	Rock coring	97.0	96.0	85 - 95	396883.0	877239.5	2.2	-1.5	3.7	2	✓	
OW-805U	Rotary wash	30.0	29.0	18 - 28	396842.8	877240.9	1.2	-1.6	2.8	2	✓	✓
OW-809L	Rotary wash	110.0	106.5	95.5 - 105.5	397007.9	875152.3	2.4	-0.9	3.3	2	✓	
OW-809U	Rotary wash	27.0	26.0	15 - 25	397045.8	875152.4	2.5	-0.7	3.2	2	✓	✓
OW-812L	Rotary wash	109.0	108.0	97 - 107	398892.8	875045.5	2.1	-1.2	3.3	2	✓	
OW-812U	Rotary wash	27.0	26.0	15 - 25	398933.9	875043.5	2.2	-0.8	3.0	2	✓	

ft bgs = feet below ground surface
ft ags = feet above ground surface
Northings and Eastings provided in US feet (NAD83)
Elevations in feet (NAVD88)

Prepared by: wsr Date: 7-23-08

Checked by: CBS Date: 7/23/08

TABLE 5.2
SUMARY OF GROUNDWATER FIELD MEASUREMENTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Well ID	Sample Date	Temperature (°C)	pH (S.U.)	Dissolved Oxygen (mg/L)	Specific Conductivity (mS/cm)	Turbidity (NTU)	O.R.P. (mV)
OW-606L	5/28/2008	28.29	7.08	9.92	52.8	0.77	-370
OW-606U	5/28/2008	28.71	6.84	1.66	66.9	0.34	-344
OW-621L	6/4/2008	27.80	7.06	1.66	>99.9	0.21	-349
OW-621U	5/29/2008	27.82	7.08	0.05	91.0	2.91	-351
OW-706L	5/29/2008	29.61	6.83	1.49	46.4	0.20	-351
OW-706U	5/29/2008	30.85	6.65	1.13	76.6	0.83	-392
OW-721L	5/28/2008	28.56	6.76	1.18	74.3	7.55	-370
OW-721U	5/28/2008	28.92	7.10	10.6	53.1	0.36	-364
OW-735U	5/27/2008	29.47	7.00	0.02	86.6	0.92	-360
OW-802U	6/5/2008	28.27	6.80	1.90	82.8	0.48	-322
OW-805U	6/5/2008	28.26	7.10	1.19	60.9	0.32	-346
OW-809U	5/27/2008	30.82	6.98	0.01	83.9	0.97	-371

Observation wells purged in accordance with ASTM D 6452-99. Field parameters reported for the final stablization reading.

Prepared by: WSC Date: 7-23-08

Checked by: CBS Date: 7/25/08

TABLE 5.3
SUMMARY OF GROUNDWATER TEST RESULTS
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

Analytical Method →		160.1	6020C								300.0						310.1 - Alkalinity		SM 18 2320B	350.1	SM18 1030F & API
Constituent →		TDS	Calcium	Iron	Magnesium	Manganese	Potassium	Silica	Silicon	Sodium	Bromide	Chloride	Fluoride	Sulfate	Nitrate	Nitrite	Bicarbonate	Carbonate	Total Alkalinity	Ammonia*	Ion Balance Difference
Well ID	Date Collected	mg/L	µg/L								mg/L						mg/L		mg/L	µg/L	%
OW-606L	5/28/2008	49,100	632,000 N	<50U	1,880,000 N	39.1	549,000 N	2,630	<250,000 N	15,100,000 N	62.5	29,600	<20.0	3,860	<0.20	<200	8.2	<5.0	165	1,580	3.2
OW-606U	5/28/2008	43,100	535,000 N	318 NB	1,730,000 N	35.4	525,000 N	729	<250,000 N	14,400,000 N	56.6	27,900	<20.0	3,470	<0.20	<200	7.8	<5.0	155	844	2.7
OW-621L	6/4/2008	52,800	574,000 N	<50,000 N	1,960,000 N	<2,000 N	586,000 N	133,000 JB	62,100 JBN	16,300,000 N	65.9	31,300 B	<20.0	3,610	<0.20	<200	181	<5.0	181	1,300	2.8
OW-621U	5/29/2008	19400[R]	492,000 N	453 NB	1,600,000 N	36.8	476,000 N	637	<250,000 N	13,100,000 N	50.6	25,500	<1.0	3,210	<4.0	<200	9.4	<5.0	189	588	2.7
OW-706L	5/29/2008	17400[R]	413,000 N	531 NB	1,170,000 N	8.3	327,000 N	7,560	<250,000 N	9,440,000 N	37.7 J	19,100	<1.0	2,280	<4.0	<200	9.6	<5.0	191	611	4.0
OW-706U	5/29/2008	40,500	725,000 N	178 NB	2,150,000 N	43.5	658,000 N	1,840	<250,000 N	17,500,000 N	70.5	33,300	<1.0	3,850	<4.0	<200	10.2	<5.0	204	2,090	1.1
OW-721L	5/28/2008	54,600	667,000 N	362 NB	2,020,000 N	46.2	587,000 N	3,170	<250,000 N	16,300,000 N	64.9	31,100	<20.0	3,990	<0.20	<200	9.0	<5.0	180	1,820	1.7
OW-721U	5/28/2008	45,400	603,000 N	329 NB	1,890,000 N	58.1	569,000 N	848	<250,000 N	15,400,000 N	60.1	29,900	<20.0	3,860	<0.20	<200	8.2	<5.0	164	1,680	2.8
OW-735U	5/27/2008	40,200[1]	749,000 N	133 NB	2,140,000 N	32.7	655,000 N	<250	<250,000 N	17,700,000 N	262	37,500	<20.0	4,090	<4.0	<200	179	<5.0	179	2,150	6.7
OW-802U	6/5/2008	53,900	579,000 N	<50,000 N	1,980,000 N	<2,000 N	586,000 N	143,000 J	66,700 JN	16,400,000 N	65.1	31,600 B	<20.0	3,720	<0.20	<200	178	<5.0	178	1,400	3.0
OW-805U	6/5/2008	45,700	447,000 N	<50,000 N	1,570,000 N	<2,000 N	493,000 N	107,000 J	49,900 JN	13,200,000 N	53.6	27,600 B	<20.0	3,070	<0.20	<200	177	<5.0	177	548	6.9
OW-809U	5/27/2008	34,800[1R]	704,000 N	158 NB	2,040,000 N	28.1	607,000 N	<250	<250,000 N	16,700,000 N	241 J	35,900	<1.0	4,050	<4.0	<200	177	<5.0	177	2,210	7.4

* = Test conducted on Nitrogen, as Ammonia.

< # = Indicates analyte not detected at or above the method detection limit.

<50U = Indicates analyte detected in the associated method blank at a concentration between the method detection limit and quantitation limit. Based on EPA 540-R-04-004, this result has been flagged as "non-detect" at the quantitation limit.

N = Spiked analyte recovery is outside stated control limits. Method performance confirmed using Laboratory Control Spike sample results.

J = Estimated result. Result is less than the reporting limit.

B = Method blank contamination. The associated method blank contains the target analyte at a reportable level. These data should be used with caution.

[1] = Because the initial results exceeded the SOP limits for this test, the samples were diluted and re-analyzed. Re-analysis was conducted out of hold time.

[R] = indicates result has been rejected during data review process (see Section 5.5 for discussion). These results are not considered valid and should not be used.

Prepared by: GWSU Date: 10-3-08

Checked by: RAK Date: 10/3/08

TABLE 5.4
IN-SITU RECOVERY TESTING SUMMARY (ASTM D 4044-96(02))
TURKEY POINT COL PROJECT
MACTEC PROJECT NO. 6468-07-1950

						Falling Head Test Results in ft/day[1]				Rising Head Test Results in ft/day[1]			
Slug Test ID	Test Date	Borehole Depth (ft bgs)	TOC Elevation (ft NAVD 88)	Filter-Pack Interval (ft bgs)	Screen Interval (ft bgs)	Butler	KGS	McElwee-Zenner	Springer-Gelhar	Butler	KGS	McElwee-Zenner	Springer-Gelhar
OW-606 U	5/20/2008	30.17	1.4	15-30.17	18 -28	*Falling head test not conducted due to pneumatic testing method*					9.80E+01		1.35E+02
OW-606 U Test 2	5/20/2008	30.17	1.4	15-30.17	18 -28	*Falling head test not conducted due to pneumatic testing method*					9.20E+01		1.23E+02
OW-606 L	5/18/2008	109.00	1.3	92.8-109	97 - 107	1.20E+02		1.18E+02		3.02E+01	3.50E+01		
OW-606 L	5/20/2008	109.00	1.3	92.8-109	97 - 107	*Falling head test not conducted due to pneumatic testing method*				6.74E+01		6.61E+01	
OW-621 U	5/20/2008	30.00	3.9	14.4-30	17.4 - 27.4	*Falling head test not conducted due to pneumatic testing method*					9.44E+01		6.89E+01
OW-621 L	5/17/2008	110.00	3.1	95-110	98.6 - 108.6	9.16E+01	7.13E+01			3.11E+01	3.33E+01		
OW-621 L Test 2	5/17/2008	110.00	3.1	95-110	98.6 - 108.6	Falling Head test not conducted				3.57E+01	3.04E+01		
OW-621 L	5/20/2008	110.00	3.1	95-110	98.6 - 108.6	*Falling head test not conducted due to pneumatic testing method*				1.67E+01	1.66E+01		
OW-636 U	5/21/2008	29.80	3	12.8-29.8	17 - 27	*Falling head test not conducted due to pneumatic testing method*					5.73E+01		5.06E+01
OW-636 U Test 2	5/21/2008	29.80	3	12.8-29.8	17 - 27	*Falling head test not conducted due to pneumatic testing method*					7.93E+01		6.43E+01
OW-636 L	5/21/2008	111.00	2.8	93.5-111	97.1 - 107.1	*Falling head test not conducted due to pneumatic testing method*				1.01E+01	1.06E+01		
OW-636 L Test 2	5/21/2008	111.00	2.8	93.5-111	97.1 - 107.1	*Falling head test not conducted due to pneumatic testing method*				9.43E+00	1.00E+01		
OW-706 U	5/16/2008	29.00	1.7	13.4-29	17 - 27		6.42E+00		8.38E+01		3.12E+01		3.03E+01
OW-706 U	5/20/2008	29.00	1.7	13.4-29	17 - 27	*Falling head test not conducted due to pneumatic testing method*					7.61E+01		7.02E+01
OW-706 L	5/16/2008	112.00	2.2	96.85-112	100 - 110	2.12E+01	2.19E+01			2.42E+01	2.60E+01		
OW-721 U	5/15/2008	26.00	2	9.9-26	14 - 24		4.55E+01		4.55E+01		3.25E+01		2.70E+01
OW-721 U	5/20/2008	26.00	2	9.9-26	14 - 24	*Falling head test not conducted due to pneumatic testing method*					3.25E+01		2.44E+01
OW-721 L	5/15/2008	109.00	2	92-109	96 - 106	2.73E+00	1.13E+00			1.16E+01	2.91E+00		
OW-721 L	5/20/2008	109.00	2	92-109	96 - 106	*Falling head test not conducted due to pneumatic testing method*				2.84E+00	1.33E+00		
OW-735 U	5/15/2008	28.00	2.8	12-16	16 - 26		1.10E+02		3.19E+02		8.47E+01		5.82E+01
OW-735 U	5/20/2008	28.00	2.8	12-16	16 - 26	*Falling head test not conducted due to pneumatic testing method*					7.07E+01		8.02E+01
OW-735L	5/15/2008	110.00	2.7	92.3-110	96.9 - 106.9	4.91E+01	2.06E+01			4.20E+01	3.21E+01		
OW-802 U	5/20/2008	27.00	2.2	10-17	15 - 25	*Falling head test not conducted due to pneumatic testing method*					4.11E+01		3.19E+01
OW-802 L	5/20/2008	110.00	2.1	93-110	98 - 108	*Falling head test not conducted due to pneumatic testing method*				2.33E+01	3.10E+01		
OW-805 U	6/6/2008	30.00	1.2	13-17	18 - 28	*Falling head test not conducted due to pneumatic testing method*				1.36E+02	1.02E+02		1.07E+02
OW-805 L	6/6/2008	97.00	2.2	80-97	85 - 95	*Falling head test not conducted due to pneumatic testing method*				5.27E+00	5.94E+00		
OW-809 U	5/15/2008	27.00	2.5	12.6-27	15 - 25		1.03E+02		9.12E+01		8.23E+01		6.07E+01
OW-809 U	5/20/2008	27.00	2.5	12.6-27	15 - 25	*Falling head test not conducted due to pneumatic testing method*					3.59E+01		2.69E+01
OW-809 L	5/15/2008	110.00	2.4	91-110	95.5 - 105.5	1.04E+02	1.09E+02			3.34E+01	3.66E+01		
OW-812 U	5/20/2008	27.00	2.2	11-27	15 - 25	*Falling head test not conducted due to pneumatic testing method*					3.12E+01		2.45E+01
OW-812 L	5/20/2008	109.00	2.1	94-109	97 - 107	*Falling head test not conducted due to pneumatic testing method*				2.10E+01	2.12E+01		

ft bgs = feet below ground surface
ft NAVD 88 = feet relative to North American Vertical Datum of 1988
Slug tests conducted in accordance with ASTM D 4044-96 (2002)
Indicates test not analyzed by the referenced method
[1] = Hydraulic conductivity estimates determined from slug tests analyses are likely biased low, and are not representative of the hydrogeologic units tested. (Please see discussion in text Section 5.6).

Prepared by: WSG Date: 10-8-08
Checked by: [signature] Date: 10/8/08

MACTEC Engineering and Consulting, Inc.
Raleigh, NC

FINAL DATA REPORT Rev. 2
GEOTECHNICAL EXPLORATION AND TESTING

TURKEY POINT COL PROJECT
FLORIDA CITY, FLORIDA

October 6, 2008

VOLUME 1
Figures

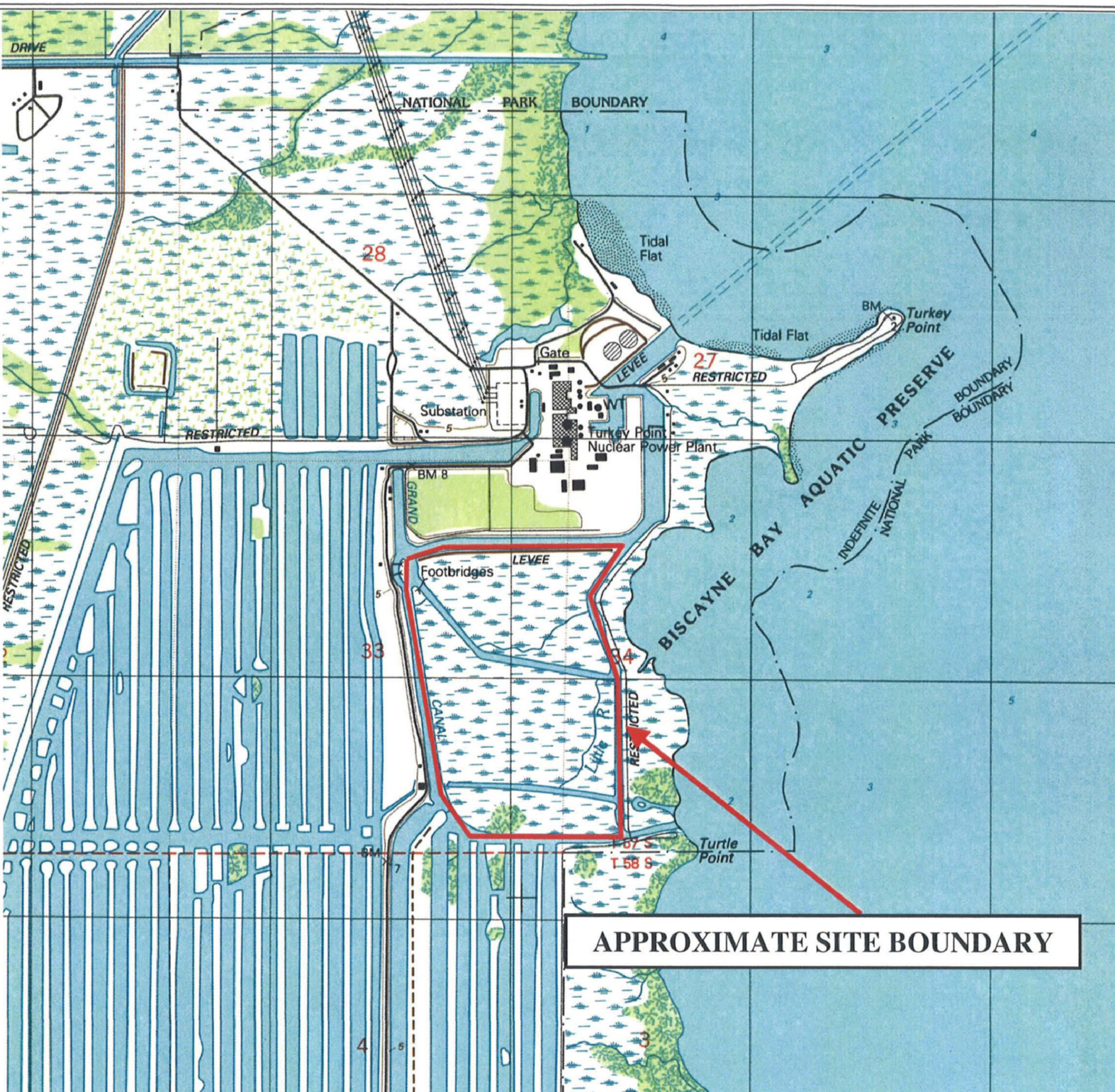
Prepared By:

MACTEC Engineering and Consulting, Inc.
Raleigh, North Carolina

MACTEC Project No. 6468-07-1950

Prepared For:

Bechtel Power Corporation
Subcontract No. 25409-102-HC4-CY00-00001



ARSENICKER KEYS, FLA.

1997

NIMA 4934 IV NE–SERIES V847

QUADRANGLE LOCATION

NORTH

NOTE: SITE LOCATION IS APPROXIMATE

MACTEC

MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

SITE VICINITY MAP
TURKEY POINT COL PROJECT
FLORIDA CITY, FLORIDA

DRAWN:	WSG	DATE:	MAY 2008	FIGURE
ENG CHECK:	WBO	SCALE:	1 : 24000	1
APPROVAL:	AJ	JOB:	6468-07-1950	

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DRILLED SHAFT DESIGN

AND

CONSTRUCTION IN FLORIDA

BY:

BILL C. MCMAHAN, JR.

INDEPENDENT STUDY PROJECT

UNIVERSITY OF FLORIDA

August 18, 1988

Note: Only relevant portions of this report are presented.

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DRILLED SHAFT DESIGN AND CONSTRUCTION IN FLORIDA

1.0 Overview

Drilled shafts have been used throughout the the world in applications requiring moderate to high tension, compression or lateral capacities. Drilled shafts may be comparatively more expensive (on a unit cost basis) than other deep foundation systems. However, in many instances, the total foundation costs associated with driven pile or other deep foundation systems may exceed those for the drilled shaft foundation. The key factors which affect cost effectiveness of drilled shaft foundations are the type and magnitude of structural loads, the depth of suitable bearing strata, and construction related considerations.

Drilled shafts are desirable when it is necessary to support high tension and compression loads. In many instances one drilled shaft can replace an entire pile cap of lower capacity piles. For instance a single 3- to 4-foot diameter shaft rock socketed into the Florida Limestone Formation may safely carry 1,000 to 2,000 kips (or more) in compression and 500 to 1,000 kips in tension. The same compression loads would require five to ten 200 kip piles. Ten to twenty piles would be required to provide 500 to 100 kips tension capacity. Drilled shafts can also provide significant lateral capacity thereby reducing the number of foundation elements required. The reduction of foundation members and the elimination of the pile cap (in some applications) usually results in cost savings and better production rates.

Design and construction of drilled shafts in Florida varies significantly across the state. In some parts of the state, drilled shafts are designed based on a combination of sidewall shear (rock socket shear) and end bearing resistance. In other portions of the state, soil and groundwater conditions preclude consideration of shaft end bearing capacity. The remainder of this paper presents drilled shaft design and construction techniques used by Law Engineering in Tampa, Florida. A case study for a recent project is also presented.

2.0 Case Study: Drilled Shafts in Tampa

2.1 Background

A new convention center in Tampa is being founded on a combination of drilled shafts and driven prestressed concrete piles. The foundation system includes 1,500 piles and 70 shafts. Planned drilled shaft capacities range from 200 to 2,000 kips. Three- to four-foot diameter shafts with 10- to 30-foot rock socket lengths are being installed. The driven pile system is more cost effective in this application; however, drilled shafts are required to minimize vibrations adjacent a 54-inch diameter force main which lies near the building perimeter.

The convention center site is located next to the Hillsborough River in Downtown Tampa. The site was dredge filled many years ago, and significant deposits of bay bottom silts and clays underlie the generally sandy dredge fill. A geotechnical exploration at the site included standard penetration test borings both on land and over water. A rock coring program was also conducted to obtain core samples of more competent zones of the limestone formation. The generalized subsurface profile is presented on Figure 1. Detailed discussions of Geology in the Tampa area are presented in other publications (McMahan 88, Stone 87). However, a brief discussion of the subsurface conditions at the convention center site is presented below.

2.2 Subsurface Conditions

The profile consists of 15 to 20 feet of sands, underlain by bay bottom silts and clays which overlie the limestone formation. The formation is characterized as variably indurated sandy calcareous clays and silts with occasional thin layers of chert. Standard penetration resistance (N-values) in the more cemented lenses range from 50 blows/foot to 50 blows/inch. Less cemented, more earthen zones exhibit typical standard penetration resistances less than 50 blows/ft.

Direct inspection of limestone cuts indicate that the Tampa Limestone Formation has slots, pits, and voids, which are filled with very soft soils. The anomalies in the limestone formation are represented on the borings as zones which exhibit N-values less than 1 blow/foot or drilling fluid losses. The voids and slots are generally concentrated within the upper portion of the formation and generally discontinuous. The primary and secondary porosity of the limestone formation result in a relatively pervious formation. In fact, the limestone formation is part of the Floridian aquifer.

2.3 Shaft Design

2.3.1 Overview of Design Approaches

Moderate to high capacity drilled shafts in Tampa are founded in the Tampa Limestone Formation. The shaft capacity is based only on sidewall shear. End bearing is neglected because shafts in Tampa are installed using wet methods of construction. Since the shaft bottom is not available for inspection, the engineer cannot be certain that the shaft excavation is thoroughly cleaned prior to concreting the shaft. Therefore, end bearing resistance is neglected from capacity calculations, but it is considered as a redundant design feature (i.e., an extra factor of safety).

There are at least two alternative design methods used to predict shaft capacity, and both neglect endbearing affects. One approach uses strain compatibility (load transfer) analytical techniques, and the other uses and allowable average sidewall shear strength values. In each method, special considerations are made which account for the variability and inhomogeneity of the bearing stratum.

The first step in shaft capacity design typically includes performing standard penetration soil test borings across the site, selecting an area of the site which exhibits typical subsurface conditions, and performing pilot borings (timed drilling using a Nx tricone roller bit) adjacent to typical standard penetration test borings. The pilot borings give a more comprehensive view of rock quality versus depth. The drill rates obtained, however, are strongly influenced by the drill rig characteristics, the crowd down pressure, and the condition and dimensions of the drilling equipment. For these reasons, pilot borings are typically correlated to N-values for each specific project and drill rig.

Semi-empirical correlations have been developed between load transfer strength parameters and N-values. A similar correlation has been developed between N-values and allowable sidewall shear values. Both correlations have been load test verified. Typical correlations are presented on Table 1.

When the strain compatibility approach is used, the pilot boring information obtained at each shaft location is evaluated using a load transfer/strain compatibility computer program. Shaft socket length is determined based on design shaft loads. Load transfer functions required as input into the computer program are developed using the N-value correlations. The advantages of the strain compatibility approach is that both capacity and settlement estimates are generated. Furthermore, the strain compatibility method accounts for the layered limestone strata, with differing load transfer characteristics. The prime disadvantage of the approach is that its use in the field during construction is limited because access to a computer is limited.

When the allowable sidewall shear approach is used, a representative shear value is selected based on N-values and correlated to drilling time. A minimum drilling time representing the allowable shear value is selected and each pilot boring is evaluated by assuming that no side wall shear transfer occurs in zones exhibiting drill rates less than the target drilling time. Additionally, no shear transfer is considered in

TABLE 1: N-VALUE SHEAR PARAMETER CORRELATION

MATERIAL	LOAD TRANSFER PARAMETERS		AVERAGE ALLOWABLE SHEAR
Soft limestone (10 < N < 20)	Peak shear strength	5 ksf	3 ksf
	Residual shear strength	0.5 ksf	
	Movement to mobilize peak shear	0.2 in.	
Medium limestone (20 < N < 50)	Peak shear strength	10 ksf	5 ksf
	Residual shear strength	1 ksf	
	Movement to mobilize peak shear	0.2 in.	
Hard limestone (50 < N < 50/3")	Peak shear strength	20 ksf	7.5 ksf
	Residual shear strength	2 ksf	
	Movement to mobilize peak shear	0.1 in.	
Very hard limestone (50/3" < N)	Peak shear strength	30 ksf	10 ksf
	Residual shear strength	3 ksf	
	Movement to mobilize peak shear	0.1 in.	

the sandy overburden soils. All zones exhibiting timed drill rates greater than the target drill time are assigned the allowable sidewall shear value.

The design procedures outlined above are sometimes verified using reduced scale or full scale load tests. However, most small jobs omit the very expensive load test program and conservative design parameters are assumed to increase the level of comfort.

2.3.2 Design Approach: Convention Center Test Shafts

The test shaft socket lengths and capacities were determined using the allowable sidewall shear approach and were compared against the capacity based on the strain compatibility method of analysis. Both approaches yielded similar capacity shafts for a given socket length. The strain compatibility approach yielded slightly more conservative capacities. However, since, the allowable sidewall shear approach is less complex, this design method was implemented in order to facilitate field inspection.

2.3.2.1 Design of Test Shaft #1 and Reaction Shafts

Reaction shafts were selected in production pier locations and were sized to carry approximately 450 tons of tension. They were drilled to depths of approximately 40 and 42 feet below existing grade (tip elevations approximately +54.5 and +52.0 feet