APPENDIX A

SUBSURFACE EXPLORATIONS
# APPENDIX A

## SUBSURFACE EXPLORATIONS

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1</td>
<td>GENERAL</td>
<td>A-1</td>
</tr>
<tr>
<td>A.2</td>
<td>DRILLING PROCEDURES</td>
<td>A-1</td>
</tr>
<tr>
<td>A.2.1</td>
<td>Rotary Core Drilling</td>
<td>A-1</td>
</tr>
<tr>
<td>A.2.2</td>
<td>Air-Rotary Drilling</td>
<td>A-2</td>
</tr>
<tr>
<td>A.2.3</td>
<td>Sonic Core Drilling</td>
<td>A-2</td>
</tr>
<tr>
<td>A.2.4</td>
<td>Bucket Auger Drilling</td>
<td>A-3</td>
</tr>
<tr>
<td>A.3</td>
<td>SAMPLING PROCEDURES</td>
<td>A-3</td>
</tr>
<tr>
<td>A.3.1</td>
<td>Modified California Sampler (MCS)</td>
<td>A-3</td>
</tr>
<tr>
<td>A.3.2</td>
<td>Sonic Core Samples</td>
<td>A-3</td>
</tr>
<tr>
<td>A.3.2.1</td>
<td>Traditional Sonic Core Sampling Method</td>
<td>A-3</td>
</tr>
<tr>
<td>A.3.2.2</td>
<td>Lexan Liner Sampling Method</td>
<td>A-4</td>
</tr>
<tr>
<td>A.3.2.3</td>
<td>Sonic Core Sample Handling</td>
<td>A-5</td>
</tr>
<tr>
<td>A.3.3</td>
<td>Rotary Core Samples</td>
<td>A-5</td>
</tr>
<tr>
<td>A.3.4</td>
<td>Grab Samples</td>
<td>A-5</td>
</tr>
<tr>
<td>A.4</td>
<td>ENVIRONMENTAL FIELD SCREENING FOR VOC’S</td>
<td>A-6</td>
</tr>
<tr>
<td>A.5</td>
<td>REVIEW AND CLASSIFICATION OF SAMPLES</td>
<td>A-6</td>
</tr>
<tr>
<td>A.5.1</td>
<td>Field Observations</td>
<td>A-6</td>
</tr>
<tr>
<td>A.5.2</td>
<td>Soil Classification System</td>
<td>A-6</td>
</tr>
<tr>
<td>A.5.3</td>
<td>Geologic Units and Descriptions</td>
<td>A-7</td>
</tr>
<tr>
<td>A.5.4</td>
<td>Boring Logs</td>
<td>A-7</td>
</tr>
<tr>
<td>A.6</td>
<td>PREVIOUS EXPLORATION LOGS</td>
<td>A-7</td>
</tr>
<tr>
<td>A.7</td>
<td>REFFERENCE</td>
<td>A-7</td>
</tr>
</tbody>
</table>
FIGURES

A-1 Soil Classification and Log Key (3 sheets)
A-2 Log of Boring B-1 (6 sheets)
A-3 Log of Boring B-2 (5 sheets)
A-4 Log of Boring B-3 (5 sheets)
A-5 Log of Boring B-4 (5 sheets)
A-6 Log of Boring B-5 (5 sheets)
A-7 Log of Boring B-6 (3 sheets)
A-8 Log of Boring B-7 (5 sheets)
A-9 Log of Boring B-8 (3 sheets)
A-10 Log of Boring B-9 (8 sheets)
A-11 Core Photographs Boring B-1 (5 sheets)
A-12 Core Photographs Boring B-7 (9 sheets)
A-13 Core Photographs Boring B-9 (8 sheets)
A-14 Previous IT Corporation Exploration Logs MW-5 through MW-7 (11 Sheets)
APPENDIX A

SUBSURFACE EXPLORATIONS

A.1 GENERAL

Shannon & Wilson performed geotechnical field explorations at nine (9) locations shown on Plate 1. The borings were completed to depths between 101.3 and 131.2 feet below the existing ground surface. In total, approximately 1,046 feet of drilling was performed for this project.

A description of the drilling methods and other field procedures used to perform the subsurface explorations is included in this appendix. Results of the explorations are included as Figures A-1 through A-10. Photographs of the rotary core samples are included as Figures A-11 through A-13.

A.2 DRILLING PROCEDURES

A.2.1 Rotary Core Drilling

Jet Drilling, Inc. of Signal Hill, California, provided and operated a truck-mounted CME 75 rotary drill rig to complete boring B-1 between November 25, 2011 and November 26, 2011. Gregg Drilling & Testing, Inc. of Signal Hill, California, provided and operated a truck-mounted CME 75 rotary drill rig to complete borings B-7 and B-9 between December 13, 2011 and December 20, 2011.

Jet Drilling used a double-tube coring system for the upper 67 feet of B-1. The coring was used to collect HQ (2.5-inch diameter) samples of soil and rock for testing. In this method, a core barrel was used to advance the boring and retrieve the samples. Fresh water was circulated through the hole as drilling progresses to cool the drill bit and flush cuttings. The soil and rock cuttings were collected in a tank at the ground surface.

The triple-tube core barrel used in the rotary core drilling method by Gregg Drilling consists of inner and outer barrels and a split inner core tube. The outer barrel rotates while the inner barrel and the inner split tube remain stationary. This system helps protect the core from the drilling fluid (mixture of soil/rock cuttings and water) and reduces the torsional forces transmitted to the core. In addition, the split inner tube allows for detailed visual analysis of the relatively undisturbed core. The system used by Gregg Drilling for this project was a HQ-3 system, where the core diameter is 2.5 inches and the borehole diameter is 3.77 inches.
To ream borings B-7 and B-9 for inclinometer installation, mud-rotary drilling was performed by Gregg Drilling using a CME-75 truck-mounted drill rig equipped with a 6-inch-diameter tri-cone bit. During the mud-rotary drilling, bentonite drilling mud was pumped out of a mud tank at the ground surface, down the N-sizes (2.8-inch OD) drill rods, out through the bit at the bottom of the borehole, up the annulus of the hole between the drill rods and the borehole, and back into the mud tank. The circulating drilling mud removed the cuttings generated by the drilling process from the hole, carrying them to the surface where they were screened and removed from the circulating drilling mud.

A.2.2 Air-Rotary Drilling

Air-rotary drilling methods were used to ream boring B-1 from 0 to 67.3 feet and then drill to 131.2 feet. The air-rotary drilling was performed by Jet Drilling using a truck-mounted, CME-75 drill rig equipped with a 4.275-inch O.D. tri-cone bit and AWJ-size (1.72-inch OD) drill rods. Single-rotary drilling methods were used. Direct-circulation air-rotary methods, using compressed air jetted through the threaded drill string and out the tri-cone bit. The return lifted the soil and rock cuttings and associated groundwater up through the annulus between the borehole wall and the drill steel to the surface, where they were discharged onto the paved ground surface.

A.2.3 Sonic Core Drilling

Boart Longyear of Upland, California, provided and operated a track-mounted rotosonic drill rig to complete borings B-6 and B-8 between December 12, 2011 and December 18, 2011. The sonic core drilling method uses high-frequency vibratory motion applied to the top of the drill column, along with down-pressure and rotation, to obtain nearly continuous core samples in soil and/or soft rock. Soil samples were obtained using 4.5-inch inside diameter (I.D.) core barrels. As the drill column was advanced into the ground, the core sample entered the core barrel. After advancing the core barrel a specific distance (termed a core “run”), the drill column and core barrel were then removed from the borehole, and the core sample was extracted from the core barrel into flexible plastic bags or hard Lexan (translucent plastic) liners. After retrieval of the core for a specific interval, a temporary casing was vibrated to the bottom of the sampled interval. The casing was then cleared of slough, and the next core sample was collected, starting at the bottom of the temporary casing.

Waste cuttings (slough) removed from the hole during the drilling process were collected in labeled 55-gallon drums for storage and disposal.
A.2.4 Bucket Auger Drilling

For borings B-2 through B-5, the subsurface conditions were explored with 24-inch-diameter, bucket-type drilling equipment. Caving and raveling of the boring walls occurred as indicated on the boring logs. The bucket auger holes were drilled uncased to the depths indicated on the logs. The soils and bedrock encountered were down-hole logged by our engineering geologists, and discrete grab samples were obtained for laboratory review and testing.

A.3 SAMPLING PROCEDURES

A.3.1 Modified California Sampler (MCS)

The Modified California Sampler (MCS) was driven 12 inches using a 140-pound hammer falling 30 inches for this project (MCS weights and drops sometimes vary) for boring B-1. For borings B-2 through B-5, the number of blows required to drive a MCS 12 inches with the Kelly bar including weight and drop are indicated on those boring logs. The MCS blow counts are not used for analyses given the typically poor correlation to Standard Penetration Test (SPT) N-values. However, the MCS blow count may be used as a relative measurement of density or consistency with other MCS samples within the borehole.

The MCS sampler has a larger outside diameter (3.25-inch) than an SPT sampler and is lined with a series of 1-inch-high, 2.5-inch diameter metal rings to contain a sample. Samples are 6 inches in length. The MCS samples were field classified and recorded on the logs by our field representative, sealed with plastic end caps and/or plastic liners, and returned to our laboratory for testing.

A.3.2 Sonic Core Samples

During each sampling run, the core barrel was extended 5 to 10 feet into the soil at the bottom of the borehole prior to extracting the core barrel from the hole. In some cases, runs less than 5 feet long were used because of very dense or hard conditions. Two methods of sonic core sampling were used for this project, as described in the following sections.

A.3.2.1 Traditional Sonic Core Sampling Method

During sonic core drilling, the soil core collected during a sampling run was extracted from the core barrel using a combination of gravity and vibration. The extracted soil was captured at the bottom of the core barrel into flexible plastic bags. Each bag contained about 0.5 to 4 feet of soil; therefore, multiple bags were required for each run. The filled bags were 6
inches in diameter. Cohesive, hard soil and bedrock were difficult to extract and often required the use of pressurized air inside the core barrel to force the soil out through the end of the core barrel. In this sonic core sampling method, the soil was disturbed through the coring and extraction process (e.g., fragmented cobbles and gravel, and distorted bedding planes).

After being retrieved from the sonic core, our field representative tied the sample bags at each end using plastic ties, knots, and/or tape to preserve the natural moisture content and integrity of the sample. Each bag was labeled with exploration and run number, and depth interval. The bags were sealed, placed in labeled wooden core boxes, and transported to our office for sorting, storage, and geologic logging.

A.3.2.2 Lexan Liner Sampling Method

Hard, Lexan (translucent plastic) liners were used to collect the soil samples in portions of the sonic core borings. In this method, 4-inch-diameter, Lexan liners with a wall thickness of about ¼ inch were inserted into the core barrel prior to each core run. The liners were typically 5 feet long. As the sonic coring equipment penetrated the soft rock at the bottom of the hole, the soft rock was pushed up into the liner inside the core barrel. Then the core barrel was removed from the hole and the liner was removed from the core barrel. This method was slower, but it generally resulted in samples that were less disturbed than the traditional method described above.

The Lexan liner sampling method was used in borings B-6 and B-8 for a predetermined depth range, coinciding with anticipated slide plane horizons. Above the Lexan liner sampling zone, flexible plastic bags were used as described above. The depth range of Lexan liner sampling is indicated on the exploration logs. In higher-strength, siliceous rock conditions, the Lexan liners were sometimes damaged due to the heat generated by the sonic coring method. In general, although some disturbance occurs during sampling (e.g., heat, vibration, heave), the sample fabric was found to be relatively intact inside the Lexan liners. In most runs, the apparent recovery length was often greater than 100 percent with the liners, possibly due to sample expansion induced by the sampling method.

The Shannon & Wilson field representative noted the soil conditions of each sample through the ends of the liner and then sealed the liners with plastic and duct tape to preserve the sample moisture content. The liners were sealed and transported to our office for sorting, storage, and geologic logging.
A.3.2.3 Sonic Core Sample Handling

Once at our office, sonic core samples (liners and bags) were sorted by exploration number and depth in a staging area. The soil cores were placed on a table, where they were opened and logged by a Shannon & Wilson geologist. The geologist also obtained grab samples of the soil at intervals where variable soil conditions were encountered. After geologic interpretation, the core bags and liners were temporarily re-sealed with tape, labeled with printed identification information, and stored in a warehouse for future review.

A.3.3 Rotary Core Samples

The 2.5-inch-diameter core samples obtained from the rotary core borings (B-1, B-7, and B-9) were photographed in the split (wet), visually examined by a geologist, and immediately placed into core boxes.

Our field representative observed the coring process, logged the core, and noted the bedding, fractures and rock “quality”. Rock quality is typically conveyed in terms of the Rock Quality Designation (RQD), which is defined as the sum of the length of core pieces in a given core run that are greater than 4 inches in length divided by the total core run length. The percent recovery and RQD are represented graphically on the boring logs. Because of low recoveries in boring B-1 (using the double-tube method) for most of the runs, the values of RQD measured in the field were typically correspondingly low. The samples obtained from the rotary core method are assumed to be relatively undisturbed. Rock type, relative orientations of any bedding or discontinuities, and any other pertinent features were recorded and noted on the log of each boring. Selected sections of the core were removed for use in laboratory strength testing. The remaining soil core was stored in wood core boxes. The soil core was transported to our office.

A.3.4 Grab Samples

Grab samples are defined as soil samples that are “grabbed” from soil cuttings generated from the drilling process or directly from the side or bottom of the hole using a hand-operated tool. Grab samples were obtained as follows:

- During sonic core sample review, grab samples were removed from the sonic core bags or Lexan liners for laboratory testing purposes.
- Grab samples of disturbed soils were collected from the sidewall of each bucket auger hole, using hand tools or a trowel.
While other types of sampling (e.g., rock core sampling or penetration test sampling) represent a specific depth in the drilled hole, grab samples often have a less accurate depth because they are compiled from a depth range within a boring. The approximate sample depth was estimated and is noted on the exploration logs.

A.4 ENVIRONMENTAL FIELD SCREENING FOR VOC’S

Soil samples were field screened by the Shannon & Wilson field representative for contamination in accordance with Shannon & Wilson’s Field Inspector’s Guidelines. Field-screening methods consist of (a) visual observations, (b) photoionization detector (PID) measurements, (c) and/or olfactory observations. The PID was used to screen for the presence VOCs. If the field screening indicated potential soil contamination, an environmental sample was obtained and the sample submitted for chemical analytical testing.

The intent of PID monitoring is to evaluate the potential presence of contamination of soil and potential exposure to VOC in the breathing zone during drilling operations.

We also performed chemical testing on samples of the drill cutting and mud. The results of those tests are presented in Appendix D.

A.5 REVIEW AND CLASSIFICATION OF SAMPLES

A.5.1 Field Observations

The borings were observed by a Shannon & Wilson field representative, who collected, classified, stored, and transported soil samples; performed field screening; and prepared a detailed log of the exploration. In addition to examining and collecting soil samples, the field representatives also noted drill action, problems during drilling (e.g., heave, hole collapse, etc.), and other issues.

A.5.2 Soil Classification System

Soil classification for this project was based on ASTM D 2487, Standard Test Method for Classification of Soil for Engineering Purposes, and ASTM D 2488, Standard Recommended Practice for Description of Soils (Visual-Manual Procedure). The system is called the Unified Soil Classification System (USCS) and is summarized in Figure A-1.
A.5.3 Geologic Units and Descriptions

The geologic units as described in the report are used to maintain consistency when defining geology encountered in the borings throughout the project area. These geologic units are interpretive and are based on our review of existing geologic literature for the project area. The geologic unit designations for each soil layer are shown in the descriptions in the boring logs included in this appendix.

A.5.4 Boring Logs

A boring log is a written record of the subsurface conditions encountered in the exploration. It shows the soil layers encountered in the exploration and the rock or USCS symbol of each layer. The boring logs presented in this appendix include a numerical representation of the uncorrected blow counts measured in the penetration tests as well as the results of selected laboratory index tests (see Appendix C). Other information shown in the boring logs includes groundwater level measurements, horizontal coordinates, surface elevation, and types and depths of sampling. The sonic core logs include similar information except for blow counts (not applicable). In boreholes where downhole televiwer was performed, measured bedding and discontinuity attitudes are shown on the boring logs.

The review and completion of the final boring logs were performed by following a Quality Assurance/Quality Control (QA/QC) process developed by Shannon & Wilson. This program includes review of the soil samples by an experienced geologist after initial field observations are made, cross-checks with laboratory test results, and further cross-checks with developed geologic profiles. This detailed procedure is followed to assure consistency of the data presentation and to provide adequate QC for each exploration.

A.6 PREVIOUS EXPLORATION LOGS

The logs for explorations performed by others at the project site are included in this appendix as Figure A-14. The explorations were performed by IT Corporation between 1994 and 1995 in conjunction with the Site Investigation of the Whites Point Nike Missile Site (1996).

A.7 REFERENCE

Shannon & Wilson, Inc. (S&W), uses a soil classification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following page. Soil descriptions are based on visual-manual procedures (ASTM D 2488-93) unless otherwise noted.

**S&W CLASSIFICATION OF SOIL CONSTITUENTS**

- **MAJOR** constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (SAND).
- **Minor** constituents compose 12 to 50 percent of the soil and precede the major constituents (silty SAND). Minor constituents preceded by “slightly” compose 5 to 12 percent of the soil (slightly silty SAND).
- **Trace** constituents compose 0 to 5 percent of the soil (slightly silty SAND, trace of gravel).

**MOISTURE CONTENT DEFINITIONS**

- **Dry** Absence of moisture, dusty, dry to the touch
- **Moist** Damp but no visible water
- **Wet** Visible free water, from below water table

**ABBREVIATIONS**

- **ATD** At Time of Drilling
- **Elev.** Elevation
- **ft** feet
- **HSA** Hollow Stem Auger
- **ID** Inside Diameter
- **in** inches
- **lbs** pounds
- **Mon.** Monument cover
- **N** Blows for last two 6-inch increments
- **NA** Not Applicable or Not Available
- **OD** Outside Diameter
- **OVA** Organic Vapor Analyzer
- **PID** Photoionization Detector
- **ppm** parts per million
- **PVC** Polyvinyl Chloride
- **SS** Split Spoon sampler
- **SPT** Standard Penetration Test
- **USC** Unified Soil Classification
- **WLI** Water Level Indicator
- **MCS** Modified California Sampler
- **MnO** Manganese (II) Oxide

**GRAIN SIZE DEFINITIONS**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>SIEVE SIZE</th>
</tr>
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<tbody>
<tr>
<td>FINES</td>
<td>&lt; #200 (0.8 mm)</td>
</tr>
<tr>
<td>SAND*</td>
<td>#200 - #40 (0.4 mm)</td>
</tr>
<tr>
<td></td>
<td>#40 - #10 (2 mm)</td>
</tr>
<tr>
<td></td>
<td>#10 - #4 (5 mm)</td>
</tr>
<tr>
<td>GRAVEL*</td>
<td>#4 - 3/8 inch</td>
</tr>
<tr>
<td></td>
<td>3/8 - 3 inches</td>
</tr>
<tr>
<td>COBBLES</td>
<td>3 - 12 inches</td>
</tr>
<tr>
<td>BOULDERS</td>
<td>&gt; 12 inches</td>
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</table>

* Unless otherwise noted, sand and gravel, when present, range from fine to coarse in grain size.

**RELATIVE DENSITY / CONSISTENCY**

<table>
<thead>
<tr>
<th>COARSE-GRAINED SOILS</th>
<th>FINE-GRAINED/COHESIVE SOILS</th>
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<tbody>
<tr>
<td><strong>N, SPT.</strong> BLOWS/FT.</td>
<td><strong>RELATIVE DENSITY</strong></td>
</tr>
<tr>
<td>0 - 4</td>
<td>Very loose</td>
</tr>
<tr>
<td>4 - 10</td>
<td>Loose</td>
</tr>
<tr>
<td>10 - 30</td>
<td>Medium dense</td>
</tr>
<tr>
<td>30 - 50</td>
<td>Dense</td>
</tr>
<tr>
<td>Over 50</td>
<td>Very dense</td>
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</tbody>
</table>

**WELL AND OTHER SYMBOLS**

- **Cement/Concrete**
- **Asphalt or PVC Cap**
- **Bentonite Grout**
- **Cobbles**
- **Bentonite Seal**
- **Fill**
- **Slough**
- **Ash**
- **Silica Sand**
- **Bedrock**
- **2" ID, PVC Screen (0.020-inch Slot)**
- **Gravel**

White Point Landslide
San Pedro District
Los Angeles, California

**SOIL AND ROCK CLASSIFICATION AND LOG KEY**

August 2012 51-1-10052-011

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
## Unified Soil Classification System

(From ASTM D 2488-93 & 2487-93)

<table>
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<th>Major Divisions</th>
<th>Group/Graphic Symbol</th>
<th>Typical Description</th>
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<tbody>
<tr>
<td>Gravels (more than 50% of coarse fraction retained on No. 4 sieve)</td>
<td>Clean Gravels (less than 5% fines)</td>
<td>GW - Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines</td>
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<tr>
<td></td>
<td>Gravels with Fines (more than 12% fines)</td>
<td>GP - Poorly Graded Gravels, Gravel-Sand Mixtures, Little or No Fines</td>
</tr>
<tr>
<td></td>
<td>Sands (50% or more of coarse fraction passes the No. 4 sieve)</td>
<td>GM - Silty Gravels, Gravel-Sand-Silt Mixtures</td>
</tr>
<tr>
<td></td>
<td>Clean sands (less than 5% fines)</td>
<td>GC - Clayey Gravels, Gravel-Sand-Clay Mixtures</td>
</tr>
<tr>
<td></td>
<td>Sands with Fines (more than 12% fines)</td>
<td>SC - Clayey Sands, Sand-Silt Mixtures</td>
</tr>
<tr>
<td></td>
<td>Inorganic</td>
<td>ML - Inorganic Silts of Low to Medium Plasticity, Rock Flour, or Clayey Silts With Slight Plasticity</td>
</tr>
<tr>
<td></td>
<td>Organic</td>
<td>OL - Organic Silts and Organic Silty Clays of Low Plasticity</td>
</tr>
<tr>
<td></td>
<td>Inorganic</td>
<td>CL - Inorganic Clays of Low to Medium Plasticity, Gravely Clays, Sandy Clays, Silty Clays, Lean Clays</td>
</tr>
<tr>
<td></td>
<td>Organic</td>
<td>OL - Organic Silts and Organic Silty Clays of Low Plasticity</td>
</tr>
<tr>
<td></td>
<td>Inorganic</td>
<td>CH - Inorganic Clays of Medium to High Plasticity, Sandy Fat Clay, Gravelly Fat Clay</td>
</tr>
<tr>
<td></td>
<td>Organic</td>
<td>OH - Organic Clays of Medium to High Plasticity, Organic Silts</td>
</tr>
<tr>
<td></td>
<td>Inorganic</td>
<td>MH - Inorganic Silts, Mitaceous or Dilataneous Fine Sands or Silty Soils, Elastic Silt</td>
</tr>
<tr>
<td></td>
<td>Highly Organic Soils</td>
<td>Primarily organic matter, dark in color, and organic odor</td>
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</tbody>
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### Notes

1. Dual Symbols (symbols separated by a hyphen, i.e., SP-SM, slightly silty fine SAND) are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

2. Borderline symbols (symbols separated by a slash, i.e., CL/ML, silty CLAY/clayey SILT; GW/SW, sandy GRAVEL/gravelly SAND) indicate that the soil may fall into one of two possible basic groups.
### SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

#### Asphalts Paving

Stiff to very stiff, brownish-black (5YR 2/1), slightly sandy to sandy, silty CLAY; moist; scattered small ash blebs; (Qt) CH/CL.

#### Disturbed, stiff to very stiff, very pale orange (10YR 8/2) to mottled, pale yellowish-brown (10YR 6/2) and moderate yellowish-brown (10YR 5/4), clayey SILT to silty CLAY, moist; locally slightly fine to medium sandy, scattered to numerous silty clay clasts and ash blebs, scattered silt clasts at about 8.5 feet, disturbed fine sandstone seam at about 6.7 feet; (Qt) CL/ML.

#### SILTSTONE TO CLAYSTONE: Very low strength, very pale orange (10YR 8/2) to moderate yellowish-brown (10YR 5/4), interbedded, locally laminated; scattered highly fractured/disrupted layers, scattered warped layers and clasts, (Tma).

#### CLAYSTONE: Very low strength, mottled, moderate yellowish-brown (10YR 5/4) and dark yellowish-brown (10YR 6/6) and yellowish-brown (10YR 6/2) to grayish-orange (10YR 7/4) and dark yellowish-brown (10YR 6/6), interbedded with sillicous to clayey siltstone, scattered irregular/discontinuous fine-grained sandstone seams or zones, locally irregularly laminated, disturbed bedding; scattered ash beds; iron-oxide stained; highly weathered to completely weathered, (Tma).

#### SANDSTONE: Very low to low strength, moderate yellowish-brown (10YR 5/4) and pale yellowish-brown (10YR 6/2) to grayish-orange (10YR 7/4), fine-grained, scattered thin siltstone interbeds; locally highly fractured; iron-oxide stained; highly fractured at about 20 to 21.5 feet and 23 to 23.5 feet; moderately weathered to highly weathered (Tma).

#### SILTSTONE: Very low strength, moderate yellowish-brown (10YR 5/4) to yellowish-gray (SY 7/2), scattered fine to medium-grained sandstone layers, thin-bedded, bedding dipping at about 10 to 15 degrees; very close to closely spaced joints, locally highly fractured; scattered ash

### LOG OF BORING B-1

<table>
<thead>
<tr>
<th>Elev., ft</th>
<th>Depth, ft.</th>
<th>Blow Count, (blows/ft)</th>
<th>GroundWater Samples</th>
<th>RQD/ Recovery, %</th>
<th>Ground Water Level ATD</th>
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<tbody>
<tr>
<td>120</td>
<td>10.5</td>
<td>21</td>
<td>19</td>
<td>23</td>
<td>17</td>
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<td>115</td>
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### LEGEND

- * Sample Not Recovered
- ▼ Ground Water Level ATD
- □ Modified California Sampler
- ▼ Rock Core

### NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
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3. USCS designation is based on visual-manual classification and selected lab testing.
**SOIL DESCRIPTION**

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

**SANDSTONE:** Low to high strength, gray-orange (10YR 7/4) to olive black (5Y 2/1), interbedded with siliciclastic siltstone, laminated to thin-bedded; moderately weathered to slightly weathered, (Tma).

Note: Description based on poor sample recovery.

**SILTSTONE:** Very low strength, gray-orange (10YR 7/4) to yellowish-gray (5Y 8/1), scattered clayey siltstone to claystone seams, laminated to thin-bedded, bedding dipping at 20 to 50 degrees; very close to closely spaced low to high angle joints locally infilled with gypsum; moderately weathered to slightly weathered, (Tma).

**SANDSTONE:** Very low to low strength, light olive gray (5Y 6/1), fine to medium-grained; scattered gypsum infilled joints; slightly weathered to fresh, (Tma).

**SILTSTONE:** Low strength, light olive gray (5Y 6/1), silicious, massive; wide spaced, iron-oxide stained fractures; slightly weathered to fresh, (Tma).

**CLAYSTONE:** Very low strength, light olive gray (5Y 6/1) and olive black (5Y 2/1), very thin bedded; close spaced, slickensided joints with offset bedding; cross-cut siltstone layers at 46.3 feet, fresh, (Tma).

**SANDSTONE:** Very low strength, light olive gray (5Y 6/1), fine to medium-grained, scattered syndepositionally disturbed layers of claystone and siltstone; scattered undulating iron-oxide stained fractures; slightly weathered to fresh, (Tma).

**SILTSTONE:** Very low strength, light olive gray (5Y 6/1) and olive black (5Y 2/1), interbedded clayey siltstone and silicious siltstone, laminated...
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

- No core recovery between 60 and 67.3 feet.

- Drilled without sampling from 67.3 to 131.2 feet.
- Petroleum odor at approximately 75 feet (tar smell from tar bed) with tar pieces in cuttings.

- Driller noted that tar bed ended at about 80 feet.

SOIL DESCRIPTION

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NOTES

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Cuttings became damp at about 109 feet.

- During short drilling delay at about 116 feet, water had accumulated in borehole.

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SOIL DESCRIPTION

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<table>
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<tr>
<th>Depth, ft</th>
<th>Symbol/Sketch</th>
<th>Samples</th>
<th>Attitude</th>
<th>Blow Count, (blows/ft)</th>
<th>RQD/Recovery, %</th>
<th>Ground Water</th>
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</table>

Notes -
1) Borehole advanced to 67.3 feet deep using continuous California Modified Sampler and HQ rock coring methods.
2) No core recovery at 60 to 67.3 feet deep.
3) Borehole advanced from 67.3 feet to 131.2 feet deep using air rotary methods. No samples were retrieved.
4) After reaching the bottom of hole, the borehole was flushed by allowing groundwater to accumulate in borehole and then forcing the water out by tiring on air supply. The procedure was done 10+ times. After standing for 1 hour, water level in borehole was measured at about 63.5 feet deep. The water level in the borehole could not be maintained above a depth of 44 feet during Acoustic Televiewer logging.
5) Hole was scanned with acoustic televiewer operated by Geovision upon completion of drilling.

LEGEND
- Sample Not Recovered
- Modified California Sampler
- Rock Core

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
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### Soil Description

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<thead>
<tr>
<th>Depth, ft</th>
<th>Description</th>
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<td>125</td>
<td>Stiff to very stiff, dark olive brown (2.5Y3/3, slightly gravelly to gravelly silty clay; moist; 2-5% angular fragments of siltstone and light brown sandstone; black oxidation halos around thin roots (1-2mm); mottling of carbonate and FeOx staining; (Qt) CL. -Percent of rock fragments increases to 5 - 10% -20 to 50% large rock fragments in matrix of silty clay.</td>
</tr>
<tr>
<td>115</td>
<td>Siltstone: White (2.5Y8/1) to pale yellow (5Y7/3), with thin interbeds of greenish gray (Gray6/5GY), clayey sand ranging from 1/8” to 1” thick; highly weathered (punky); soft; slightly moist; slightly reactive to dilute HCL (Tma). -Interbed of clayey sand -10” interbed of clayey sand</td>
</tr>
<tr>
<td>110</td>
<td>Silty Claystone: Olive yellow (2.5Y6/6) with FeOx and MnO motting with thin (&lt; 1”) interbeds of light blue-gray sandstone, (Tma).</td>
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<tr>
<td>105</td>
<td>Sandstone: Greenish gray (1Gley6/10Y); fine-grained; banding of FeOx and sulfur staining; upper contact irregular; local clayey sections (pods); moderately hard; moist, (Tma). -Thin (1/4&quot;) seam of very dark brown clayey sand at top of 10” horizon of orange brown, clayey siltsstone. Clayey Sandstone: light bluish gray with abundant sulfur staining in thin, roughly bedding-parallel banding, (Tma). -Sandstone grades to coarse grained across irregular contact. -Orange brown clayey siltsstone.</td>
</tr>
<tr>
<td>100</td>
<td>Claystone: Mottled olive brown (2.5Y5/6) and pale bluish gray; fractured; soft; moist; plastic, (Tma). -Clay grades to 20 - 30% sand and poorly sorted lenses and pods of coarse grained sand and local gravel to 1/4&quot;.</td>
</tr>
</tbody>
</table>

#### Notes
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3. USCS designation is based on visual-manual classification and selected lab testing.
4. Hammer Driving Weight and Drop: 0 to 25 ft- 4900 lbs, 25 to 50 ft- 3400 lbs, 50 to 75 ft-2200 lbs, 75 to 100 ft-1200 lbs. Add weight of stem below 100 feet.
CLAYEY SILTSTONE to SILTY CLAYSTONE: Yellowish-brown (10YR5/6); Top of unit marked by very dark brown horizon of MnO (?); staining about 1/4" thick; isolated, 1/2" - 3/4" elongate pods of light brown carbonate (?); very moist; plastic, (Tma).-Grades to fine- to medium-grained, clayey sandstone.

-Interbed of siliceous siltstone; dark gray (5Y4/1); laminated; very hard.

-1/4" to 1/2" stringers of gypsum cut bedding at low angles.
-1" interbed of pale bluish gray sandstone.
-Siltstone grades to very dark grayish brown (10YR3/2); siltstone with local cherty sections; moderately hard to hard.

-Bentonitic bed 1/4" to 3" thick; dark greenish gray (1Gley4/10Y) stringers of waxy clay, imbricated in matrix of light greenish gray (2Gley4/10G) waxy clay.

SILTSTONE: Very dark gray (10YR3/1); locally cherty with thin interbeds of pale bluish gray, fine-grained sandstone; moist; hard, (Tma).
-1" interbed of pale bluish gray sandstone; common, short, tight, gypsum-lined fractures oriented at high angles to bedding; some fractures with normal displacements of 1/2" or less.
-Series of 1/4" thick, pale bluish gray sandstone interbeds at top of sandy interval.

-Banded siltstone and sandstone.

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SOIL DESCRIPTION

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<th>Depth, ft</th>
<th>Elev., ft</th>
<th>Symbol/ Sketch</th>
<th>Samples</th>
<th>Attitude</th>
<th>Blow Count, (blows/ft)</th>
<th>RQD/ Recovery, %</th>
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- Thin sandstone interbed.
- 6" zone of very dark gray siltstone with cherty nodules.
- 1" thick interbed of pale bluish gray sandstone.
- Very dark grayish brown (10YR3/2) siltstone with cherty nodules; and local interbeds of greenish gray (1Gley5/5Y) sandstone; locally highly siliceous and hard with short (typically < 6"), double-terminating fractures filled with vitreous tar oriented at high angles to bedding; tar also occurs in 1/2" pods; no well-defined overall structure.
- 1/2" thick interbed of bluish-gray sandstone marks top of pale yellowish gray siliceous unit; vitreous tar common in pods and stringers up to 1/4" thick and 6 inches long.
- 12" horizon of pale bluish gray medium to coarse-grained sand of angular schist debris.
- Dark gray siltstone with greenish gray sandstone stringers; minor tar persists as fillings in few narrow, tight, double-terminating fractures less that three inches long.
- SANDSTONE to CLAYEY SANDSTONE: Bluish gray (2Gley5/1); very fine to fine grained, moderately hard; moist, (Tma).
- SILTSTONE: Very dark grayish brown (10YR3/2) siltstone to clayey siltstone; locally siliceous with thin interbeds of greenish gray, very fine-grained sandstone to siltstone; rare tar fillings in tight fractures; upper contact gradational, (Tma).
- Using crowds over next foot
- 12" horizon of medium- to coarse-grained, schist debris.
- 1/2" horizon of pale bluish-gray sandstone marks top of very dark grayish brown platy siltstone with grey sandstone interbeds; lightly fractured; light seepage along fractures.
- Water seepage into borehole.
- 2" normal offset of 2-3" section of massive clayey siltstone across tight, minor fault; underlying siltstone is tight, but with chaotic structure consisting of contorted bedding and isolated pods of different lithologies; probable soft sediment deformation
- Well-bedded dark gray siltstone with pale bluish-gray sandstone interbeds ranging from 1/8" to 1/2"; up to about 1" of normal displacement along fault that extends in boring from 73 to 77 feet; minor seepage along fault surface at several locations.

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SOIL DESCRIPTION

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-3" of normal displacement in 24" section of moderate brown claystone and pale bluish gray sandstone; locally fault has up to about 1/2" of soft brown silty clay gouge.

-3" thick horizon with elongated pods of pale brown carbonate(?)
-1 normal displacement in 1/2" interbed of bluish gray sandstone; fracture tight-no significant gouge thickness;

-1 interbed of bluish-gray sandstone in very dark grayish brown siltstone; base of clay horizon is highly polished; no striations; slightly wavy and discordant to bedding.
-Approximately 1" of normal displacement; very tight.

-Using core buckets and crowds
-Top of very dark brown to black, clayey siltstone.

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White Point Landslide
San Pedro District
Los Angeles, California

LOG OF BORING B-2

August 2012 51-1-10052-011

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A.3
Sheet 4 of 5
SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Symbol/Sketch</th>
<th>Samples</th>
<th>Blow Count, (blows/ft)</th>
<th>RQD, %</th>
<th>Recovery, %</th>
<th>Ground Water</th>
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</table>

- Schist debris unit about 18" thick
- Very dark grey siltstone
- 2" interbed of bluish-grey sandstone; 2" of normal displacement across fracture.
- 1/2" interbed of pale bluish gray sandstone.

BOTTOM OF BORING COMPLETED 12/02/2011

Notes:
1) Groundwater at 68 feet.
2) Hole visually logged to 112.5 feet.
3) Boring backfilled with tamped cuttings to 10 feet and concrete to surface.

LEGEND
* Sample Not Recovered  \( \sqrt{\) Ground Water Level ATD

NOTES
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SOIL DESCRIPTION

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Dark olive brown (2.5Y3/3), slightly gravelly to gravelly, silty CLAY; moist; 2-6% angular fragments of siltstone and light brown sandstone; (Qt) CL/CH.

- Grades less clay, 20% siltstone fragments typically ~1/8".

SILTSTONE: Light gray (5Y7/2) with fragments of greenish-gray (2Gley6/5BG) sandstone; soft; very highly weathered (Tma).

- Grades to clayey siltstone; less weathered; abundant sulfur staining and FeOx staining.
- Sandy interbed

CLAYEY SILTSTONE: Dark yellowish brown; banded; banding defined by subtle color variations, (Tma).

- 4" interbed of pale bluish-gray (2Gley5/5GB), very fine-grained, slightly silty sandstone; sulfur staining common sub-parallel to bedding.

- 6" horizon of dark yellowish-brown medium-grained sandstone of schist debris

- 36" interbed of olive brown (2.5Y4/4) siliceous siltstone with FeOx staining; persists as thin (2" typical) interbeds to 17 feet.

Driller using coring bucket and crowds

- 12" interbed of clayey sandstone of schist debris with nodules and thin lenses of siliceous siltstone.

- 1/2" interbed of clayey sandstone.

- 12" interbed of siliceous siltstone; moderately to highly fractured; locally fractures are backfilled with clay and crushed rock; larger zone of crushed rock clearly bounded by distinct fracture surface at 23.8 feet; overall fracture ranges from about 1/4" to 3" wide and is tightly backfilled with clay and crushed rock; isolated fragments of siliceous

**LEGEND**

* Sample Not Recovered  
▼ Ground Water Level ATD  
★ Environmental Sample Obtained  
★ Modified California Sampler  
Grab Sample

**NOTES**

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<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Symbol/ Sketch</th>
<th>RQD, %</th>
<th>Ground Water Level ATD</th>
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</tbody>
</table>

**CLAYEY SILTSTONE:** Light olive brown (2.5YS/6); thin interbeds of siliceous siltstone, (Tma).
- Thin interbed of clayey sand.
- 18" interbed of medium- to coarse-grained sandstone of schist debris with isolated nodules of siliceous siltstone and pale bluish-gray, clayey sandstone.
- Improvement in overall rock quality.

**CLAYEY SILTSTONE:** Moderate brown; gypsum stringers in fractures and pervasive FeOx staining; massive, (Tma).

**SILTSTONE:** Dark yellowish brown (10YR3/4); laminated; 1-2" interbeds of siliceous siltstone at intervals of 12-18"; abundant gypsum along parting surfaces and in tight fractures; fractures typically restricted to interbeds, (Tma).
- 2" thick, fractured, siliceous interbed with vitreous tar fillings in fractures.

**CLAYEY SANDSTONE to SANDY SILTSTONE:** Dark greenish gray (1Gye4.5GY); fine- to medium-grained; consists of angular schist debris; hard; slightly moist; locally heavily stained with FeOx; Gypsum common in fractures; massive, (Tma).
- Large nodule of dark grayish-brown siliceous siltstone on NW side of boring; fractured; vitreous tar fillings in fractures; extends to 36-5 feet and slightly less than 1/2 way around the boring with few siliceous nodules on opposite boring wall; tar occurs in SE wall of boring in few short, tight fractures.

**SILICEOUS SILTSTONE:** Very dark grayish brown (10YR3/2); fractures up to 1/2" wide filled with hard, vitreous tar; most fractures much smaller, (Tma).

**SANDSTONE:** Dark grayish brown to gray mottled with FeOx staining; fine-grained; medium- to coarse-grained; schist debris, (Tma).

**SILTSTONE:** Very dark brown; 1/4" interbeds of pale bluish-gray sandstone, (Tma).

**CLAYEY SANDSTONE:** Pale bluish-gray; very fine-grained; massive; soft; moist, (Tma).

**CLAYEY SILTSTONE:** Very dark grayish brown (10YR3/1); thin interbeds of pale bluish gray sandstone and pale brown siliceous siltstone; overall moderately hard; slightly moist, (Tma).
- 1/2" interbed of pale bluish gray sandstone

**SILICEOUS SILTSTONE:** Very dark gray (10YR3/1); highly fractured; seepage pervasive along fractures, (Tma).

---

**NOTES**

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. Hammer Driving Weight and Drop: 0 to 25 ft.- 4900 lbs, 25 to 50 ft.- 3400 lbs, 50 to 75 ft.-2200 lbs, 75 to 100 ft.-1200 lbs. Add weight of stem below 100 feet.
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

- Chaotic assemblage of dark brown siltstone, siliceous siltstone; and bluish-gray, fine- to coarse-grained schist debris; lithologies mixed, but unit is very dense overall; units appear to be juxtaposed across high-angle fractures that are difficult to trace.
  - Soft clay gouge fills fracture in hard, clayey siltstone; fracture can be traced over about 18", surface striated at N20E.
  - Minor seepage
  - Shear in clayey siltstone; striated at S72W.

CLAYEY SILTSTONE: pale gray to pale brown; upper surface planar, polished, and locally mullioned; can be traced approximately 1/2 way around the hole; shear at upper surface clearly truncates bedding in overlying material, (Tma).

- Grades downward into pale bluish-gray siltstone; remains sheared and fractured, but with less mixing of lithologies than in overlying unit.
  - 2" interbed of pale brown clayey siltstone; continuous around boring; generally well bedded below with beds 1/4" to 3"; most sandstone beds
  - ~1 thick with clay intervals 1/4" to 1" thick.
  - Less well bedded but overall hard and indurated; beds present are truncated, rotated to discordant angles or contorted; probably soft sediment deformation as opposed to clear post-depositional disturbance noted above.
  - Planar surface on top of clayey siltstone interbed; slight seepage along surface; striated at S44W; appears generally parallel to bedding.

CLAYEY SILTSTONE: with pale bluish gray sandstone interbeds.

Upper surface polished, wavy; continuous around hole; occurs below thin zone of crushed rock, (Tma).

- Well-defined, 8' interval of clayey siltstone; truncated with 3" of normal displacement across zone of fractures that ranges from a single discrete surface to a zone 3 to 4 inches wide; individual fractures have soft gouge of clay and crushed rock.

CLAYSTONE: Moderate brown with few interbeds of pale bluish-gray sandstone, (Tma).

- 2" normal displacement of 1" sandstone interbed across polished planar shear surface; shear can be traced 1/2 way around hole; striated at N54W.
  - Polished and striated at S43W parting surface in bedded clayey siltstone.
  - Siltstone grades to sandy.
  - 8" horizon with abundant thin siliceous beds and nodules.

CLAYEY SILTSTONE: Dark olive gray (5Y3/2); thin sandstone interbeds, (Tma).

- 2" normal displacement of thin sandstone interbed across thin shear.
  - Clayey siltstone grades massive with only remnants of bedding expressed as short lenses and pods of sandstone; perversely sheared and fractured; seepage long fractures and from sandy materials.

- Well-defined bedding truncated against striated shear surface.

- 3" of normal displacement of 6 thick interbed of cemented, bluish-gray sandstone in clayey siltstone; displacement occurs across zone of
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. Hammer Driving Weight and Drop: 0 to 25 ft.; 4900 lbs, 25 to 50 ft.; 3400 lbs, 50 to 75 ft.; 2200 lbs, 75 to 100 ft.; 1200 lbs. Add weight of stem below 100 feet.

White Point Landslide
San Pedro District
Los Angeles, California

LOG OF BORING B-3

August 2012
51-1-10052-011

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
FIG. A.4
Sheet 4 of 5

REV 3
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

- Fracture in clayey siltstone.
  - Chaotic mixture of fine- to medium-grained, greenish gray sand and very dark gray siltstone supported in matrix of dark greenish gray sandstone.

- Samples collected at 105, 111.5 and 115 ft. The surface of the sampler developed a greenish patina on drying after one of these samples. Specific note was not made during drilling; however, the reaction was discussed during a phone call shortly after.
  - Driller using crowds with digging bucket.

SANDY SILTSTONE: Greenish gray; fine-grained with fragments of siltstone; isolated carbonized plant(?) fragments; overall very hard, (Tma).

SILTSTONE: Very dark grayish brown (10YR3/2) with thin interbeds of greenish gray (2Gley6/5BG) very fine-grained sandstone to siltstone; moderately hard, (Tma).

- Boring not logged below 111.5 feet due to groundwater.

BOTTOM OF BORING COMPLETED 12/06/2011

Notes:
1) Groundwater at 48 feet.
2) Hole visually logged to 111.5 feet.
3) Boring converted to 8-inch-diameter, schedule 80 groundwater well.

LEGEND
- Sample Not Recovered
 E Environmental Sample Obtained
 Modified California Sampler
 Grab Sample

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. Hammer Driving Weight and Drop: 0 to 25 ft.- 4900 lbs, 25 to 50 ft.- 3400 lbs, 50 to 75 ft.- 2200 lbs, 75 to 100 ft.- 1200 lbs. Add weight of stem below 100 feet.

White Point Landslide
San Pedro District
Los Angeles, California

LOG OF BORING B-3

August 2012
51-1-10052-011

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
FIG. A.4
Sheet 5 of 5
**SOIL DESCRIPTION**

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Elev., ft</th>
<th>Soil Type/Description</th>
<th>Blow Count (blows/ft)</th>
<th>Attitude</th>
<th>RQD/Recovery, %</th>
<th>Ground Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Soft to stiff, very dark grayish brown (10YR3/2), slightly gravelly to gravelly,</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>silty CLAY; moist; 2-5% angular fragments of siltstone ranging up to ~1&quot; with</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/4&quot; - 1/2&quot; most common; (Qt) CL/CH.</td>
<td>1</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>5</td>
<td>-Grades brownish yellow (10YR6/6); angular fragments to 6 inches.</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>125</td>
<td>SANDSTONE: Greenish gray (1Gley5/10Y); fine- to medium-grained; highly fractured;</td>
<td>1</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>soft; moist carbonate and sulfur staining common as filling in fractures subparallel</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>to bedding, (Tma).</td>
<td>1</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>130</td>
<td>CLAYEY SILTSTONE: Dark brown; moderately hard; moist; several thin siliceous beds in</td>
<td>1</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>upper 10 inches; siliceous beds are fractured and locally displaced, (Tma).</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-3&quot; interbed of pale yellowish gray clay and carbonate; deeply weathered</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-12&quot; sandstone interbed; orange brown; medium- to coarse-grained;</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>siliceous inclusions up to about 6 inches long.</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Siliceous interbeds grade more common; 1&quot; interbeds occur typically every 6 inches</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-2&quot; interbed of pale gray sandstone.</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-12&quot; interbed of medium- to coarse-grained sandstone to clayey sandstone of schist</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>debris.</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Grades into bedded unit consisting of approximately 40% siliceous siltstone;</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% pale brown claystone; and 50% medium grained sandstone of schist debris; beds</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>typically range 1/2&quot; to 3&quot; and are lenticular and discontinuous.</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1/4&quot; interbed of dark brown clayey sand; continuous around boring.</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-South side of boring exposes moderate yellowish brown sandy siltstone; north side</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>of boring is very hard, highly fractured siliceous siltstone; thick MnO staining</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>common along fractures; local</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES**

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. Hammer Driving Weight and Drop: 0 to 25 ft.: 4900 lbs, 25 to 50 ft.: 3400 lbs, 50 to
   75 ft.: 2200 lbs, 75 to 100 ft.: 1200 lbs. Add weight of stem below 100 feet.
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

- Accumulations of tar in fractures; no evidence of fractures or fault between units; thin bed of clayey sand overlies contact without offset. - Gypsum and MnO filling in fractures up to ~1/4” wide.

- Clayey Siltstone: Moderate yellowish brown; banding defined by subtle variations in color and lithology; moderately hard; few high-angle fractures filled with MnO staining; local gypsum; top marked by 1/2” interbed of pale yellow brown to pale yellow gray sandy clay, (Tma).
  - Siliceous nodule 8” thick and 24” long.
  - 1/2” interbed of medium-grained clayey sand.
  - 1/2” interbed of very clayey siltstone, abundant gypsum along bedding in siltstone

- Sandstone: Pale olive (5Y6/3), very fine-grained; hard; slightly moist; few fractures with MnO coating; upper contact abrupt; planar with strong concentration of gypsum; local light motting of FeOx, (Tma).
  - Grades to dark yellowish brown to very dark grayish brown (10YR3/2); gypsum common along fractures and bedding planes; thin, spotty staining of vitreous tar on parting surfaces.
  - 1” siliceous interbeded
  - 10” interbed of siliceous siltstone
  - 10 - 15% coarse-grained sand sized schist fragments distributed uniformly in groundmass of dark grayish-brown siltstone
  - 1-3” interbed of pale bluish gray, fine- to very coarse-grained sandstone; offset 1/2 in several places across very tight fractures that cannot be traced more than a few inches.
  - 6-12” interbed of siliceous siltstone.
  - Very dark brown clayey siltstone with 1/8”-1/4” interbeds of very fine-grained, grayish green sandstone spaced at 1” - 3” intervals; very dense; no significant fractures.
  - Thin sandstone interbeded.
  - Siltstone grades lighter brown; sandstone interbeds increase to thicknesses of ~3”.

- 2” siliceous siltstone interbeded.

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
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3. UCSC designation is based on visual-manual classification and selected lab testing.
4. Hammer Driving Weight and Drop: 0 to 25 ft.: 4900 lbs, 25 to 50 ft.: 3400 lbs, 50 to 75 ft.: 2200 lbs, 75 to 100 ft.: 1200 lbs. Add weight of stem below 100 feet.
SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

<table>
<thead>
<tr>
<th>Depth, ft.</th>
<th>Sym/ Sketch</th>
<th>Samples</th>
<th>Blow Count, (blows/ft)</th>
<th>RQD/ Recovery, %</th>
<th>Ground Water Depth, ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>51.0</td>
<td></td>
<td>15</td>
<td></td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

-2" interbed of bluish-gray (2Gley5/10b), medium- to coarse-grained sandstone of schist debris.

SILTSTONE: very dark grayish brown (10YR3/2) with dark bluish gray (2Gley4/10b) sandstone interbeds of medium- to coarse-grained schist debris; bedding discontinuous; common offsets range from 1/8" to 1/4"; fractures associated with offsets are very tight and cannot be traced more than an inch or two beyond the offset bed; overall unit is very tight; local contortions in bedding appear likely to be soft sediment deformation, (Tma).

- Siliceous siltstone interbed
  - Bedding uniform and banded
  - Sandstone interbed
- 10 interbed of siliceous siltstone; fractured; moderate seepage along fractures.

- Thin sandstone interbed
  - Fracture in siltstone; undetermined offset.

- Contorted bedding; mixed lithologies; overall unit is very tight; probable soft sediment deformation.

- Thin sandstone interbed; minor offsets; fractures cannot be traced into adjacent siltstone.
  - Intersecting fractures in siltstone.

- 6" bluish gray sandstone offset an undetermined amount along steep-dipping fracture.

- Bottom of 10" interbed of bluish gray sandstone.
**SOIL DESCRIPTION**

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Elevation, ft</th>
<th>Symbol/Sketch</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 - 80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 - 85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>85 - 90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 - 95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95 - 95.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Bluish gray sandstone interbed.
- 18" interbed of dark gray siliceous siltstone; highly fractured.
- Strong water flow with numerous streams extending more than six inches into boring; cumulative flow approximates a garden hose on full.
- Polished fracture offsets light grayish blue sandstone.
- Siltstone very dark gray (2.5Y4/1); waxy texture.

**NOTES**

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. Hammer Driving Weight and Drop: 0 to 25 ft: 4900 lbs, 25 to 50 ft: 3400 lbs, 50 to 75 ft: 2200 lbs, 75 to 100 ft: 1200 lbs. Add weight of stem below 100 feet.

**REFERENCES**

White Point Landslide
San Pedro District
Los Angeles, California

**LOG OF BORING B-4**

August 2012

51-1-10052-011

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. A.5
Sheet 4 of 5
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Elev., ft</th>
<th>Symbol/Sketch</th>
<th>Samples</th>
<th>Attitude</th>
<th>Blow Count, (blows/ft)</th>
<th>RQD/Recovery., %</th>
<th>Ground Water Level ATD</th>
</tr>
</thead>
<tbody>
<tr>
<td>101.3</td>
<td>0</td>
<td></td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1) Groundwater at 55 feet.
2) Hole visually logged to 80 feet.
3) Boring backfilled with soils cuttings.

LEGEND

- Sample Not Recovered
- Ground Water Level ATD
- Environmental Sample Obtained
- Modified California Sampler
- Grab Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
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4. Hammer Driving Weight and Drop: 0 to 25 ft.: 4900 lbs, 25 to 50 ft.: 3400 lbs, 50 to 75 ft.: 2200 lbs, 75 to 100 ft.: 1200 lbs. Add weight of stem below 100 feet.
**SOIL DESCRIPTION**

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Soil Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-120</td>
<td>Stiff to very stiff, very dark grayish brown (10YR3/2), slightly gravelly to gravelly, sandy silty CLAY; moist; 2-5% angular fragments of pale yellow siltstone to 1/4&quot;; (Qt) CH.</td>
<td></td>
</tr>
<tr>
<td>120-115</td>
<td>-Grades to clay with isolated rock fragments to 6&quot;; very stiff, moist.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-% rock fragments increases to 10 to 20%</td>
<td></td>
</tr>
<tr>
<td>115-110</td>
<td>-Fragments to 4&quot; common.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILTSTONE to CLAYEY SILTSTONE: light yellow brown to brownish yellow (10YR6/4-6) with mottling of greenish gray (1Gley6/5GY); abundant carbonate and gypsum in thin veins; local MnO staining on fracture surfaces, (Tma)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SANDSTONE: Pale greenish gray to yellowish-brown (10YR5/8); very fine-grained; sulfur and FeOx staining common along fractures sub-parallel to bedding, (Tma).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Increased Iron Oxide motting.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-4&quot; interbed of grayish yellow, medium- to coarse-grained sandstone immediately underlain by 8&quot; interbed of yellowish brown siltstone.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILTSTONE: Moderate yellow brown; massive; upper contact irregular; overlain by 4&quot; horizon of medium- to coarse-grained sandstone, (Tma).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CLAYEY SILTSTONE: Mottled olive (5Y5/4) to greenish gray (1Gley6/10Y); laminated; stiff; moist; FeOx staining along bedding, (Tma).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-36&quot; interbed of clayey siltstone with sand.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES**

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. Hammer Driving Weight and Drop: 0 to 25 ft.- 4900 lbs, 25 to 50 ft.- 3400 lbs, 50 to 75 ft.-2200 lbs, 75 to 100 ft.-1200 lbs. Add weight of stem below 100 feet.

**LOG OF BORING B-5**

White Point Landslide
San Pedro District
Los Angeles, California

August 2012

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A.6
Sheet 1 of 5
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

-1" interbed of siliceous siltstone

-Grades sandy with siliceous nodules.

-18-inch interbed of siliceous siltstone; moderate yellowish brown; very hard; short, tight (<1/16"), subvertical fractures filled with MnO.

-Siliceous siltstone persists in clayey siltstone as thin, discontinuous beds and nodules; gypsum locally along bedding.

-2" interbed of yellowish-brown silty claystone, with gypsum accumulation along bedding.

SANDSTONE: Mottled dark yellow brown to very dark gray; thinly interbedded (1-2"), gypsum occurs as 1/8" stringers along bedding and less commonly in narrow fractures, (Tma).

-1/4" to 1" horizon of brownish yellow (10YR6/8) to yellow (2.5Y7/8), waxy clay; large gypsum crystals common within clay and along contacts; base of unit is polished and roughly planar with faint striations and possible milliols oriented downdip; overlies moderate brown clayey siltstone; interbedded with silicious siltstone in thin beds and modules.

-% siliceous beds increases.

-2" interbed of medium- to coarse-grained clayey sandstone; continuous around hole.

SILTSTONE and SILICEOUS SILTSTONE: Very dark grayish brown (2.5Y3/2) to dark brown (7.5YR3/4); strong FeOx staining and pervasive gypsum; hard; highly fractured; fractures commonly diluted to 1/16"; locally up to 1/4"; single, well defined fracture extends from 40 to 44 feet and ranges from nearly indistinguishable to a 4-inch-wide cavity backfilled with crushed rock and clayey sand, (Tma).

-Isolated pods of gray, coarse-grained, clayey sandstone of schist debris.

-Polished, planar surface with thin film coating of clay in otherwise very hard, fractured siliceous shale; subtle striations (SS0W); siltstone much less fractured below.

-2" interbed of pale brown, clayey siltstone; continuous around hole; siltstone significantly less siliceous below with bluish gray, 1" interbeds.
### SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

#### Depth, ft

<table>
<thead>
<tr>
<th>Elev., ft</th>
<th>Soil Type</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>50</td>
<td>-</td>
<td>Light seepage; 1&quot; of normal displacement across tight fracture.</td>
</tr>
<tr>
<td>55</td>
<td>-</td>
<td>1&quot; of fine-grained sandstone; few steep-dipping, short, tight fractures filled with vitreous tar.</td>
</tr>
<tr>
<td>60</td>
<td>-</td>
<td>Nodules of siliceous siltstone; tar-filled fractures persist.</td>
</tr>
<tr>
<td>65</td>
<td>-</td>
<td>12&quot; horizon with pods of bluish-gray, medium-grained sandstone.</td>
</tr>
<tr>
<td>70</td>
<td>-</td>
<td>SILICEOUS SILTSTONE: grayish-brown; massive; very hard; tar filled fractures.</td>
</tr>
<tr>
<td>75</td>
<td>-</td>
<td>SANDSTONE: Pale gray, coarse-grained; clayey; mainly schist debris; very dense; upper contact gradational, (Tma).</td>
</tr>
<tr>
<td>80</td>
<td>-</td>
<td>Siltstone grades to very dark grayish brown (10YR3/2); 2&quot; interbed of pale bluish-gray sandstone; light seepage; 1&quot; of normal displacement across tight fracture.</td>
</tr>
</tbody>
</table>

#### Refer to KEY for explanation of symbols, codes, abbreviations and definitions.

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4. Hammer Driving Weight and Drop: 0 to 25 ft.: 4900 lbs, 25 to 50 ft.: 3400 lbs, 50 to 75 ft.: 2200 lbs, 75 to 100 ft.: 1200 lbs. Add weight of stem below 100 feet.
### SOIL DESCRIPTION

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<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Elevation, ft</th>
<th>Symbol/ Sketch</th>
<th>Samples</th>
<th>Attitude</th>
<th>Blow Count, (blows/ft)</th>
<th>RQD/ Recovery, %</th>
<th>Ground Water</th>
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</table>

SANDSTONE: Dark greenish gray (1Gley3/10Y); very fine- to medium-grained; local sections of coarse-grained schist debris; locally very well-cemented, (Tma).

SILTSTONE: Dark gray; thin interbeds of pale blue sandstone, (Tma).

- 4" interbed of very well cemented, pale blue sandstone; slightly fractured with light seepage; basal contact on underlying siltstone is planar and polished with a thin film of clay; no striations noted.

- Grades coarser-grained, better cemented.

SILTSTONE: Dark gray; thin interbeds of pale blue sandstone, (Tma).

- 10" interbed of very well cemented sandstone; dark bluish gray (2Gley4/10B); medium- to coarse-grained; schist debris.
- Tight fracture with strong seepage (est. ~1/2 gal/min)
- Thin sandstone interbed
- Thin sandstone interbed continuous around hole.

- Contorted bedding including sequences of siltstone, sandstone and a 6" thick section of siliceous siltstone deformed into very tight folds; included in a section about 3 feet thick with clear bounding surfaces above and below; bounding surfaces are continuous around the hole without offset or other disruption; overall unit is very tight and dense.

SILTSTONE: Dark gray; thin interbeds of pale blue sandstone; attitude on uppermost thin sandstone interbed, (Tma).

- Fracture with 2° normal displacement.
- Fracture with 6° of normal displacement; underlying material consists mainly of massive dark gray siltstone with disseminated schist debris; local sections of contorted bedding; very tight overall.

- Numerous fractures in otherwise massive siltstone, striations oriented at S80E.
- Excavated to 95 feet and logged downhole to 75 feet on 12/14/2011 - deepened to 121 feet and downhole log resumed on 12/15/2011. Water standing at 83 feet @ 7AM on 12-15-2011.

- Bucket Auger
- Modified California Sampler
- Grab Sample

#### LEGEND
- Sample Not Recovered
- Ground Water Level ATD
- Environmental Sample Obtained
- Modified California Sampler
- Grab Sample

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SOIL DESCRIPTION

SILICEOUS SILTSTONE: grayish-brown; massive; very hard, (Tma).

SILTSTONE: Dark gray; thin interbeds of pale blue sandstone, (Tma).-1" interbed of pale bluish-gray sandstone.-Siltstone grades clayey; several thin sandstone interbeds.

-1" siliceous interbed.
-1" siliceous interbed.

-1/2" normal offset of 3" interbed of bluish gray sandstone across tight fracture with polished surface.

SILTY SANDSTONE: Very dark gray (2.5Y3/1); very fine-grained; moderately hard; thin interbeds of greenish gray (1G5/5Y) fine-grained sandstone and rare, thin interbeds of very dark gray (5Y3/1) clay, (Tma).

Greenish patina on sampler-Thin sandstone interbeds 1/4" thick.

SILTSTONE: Dark gray with disseminated, coarse-grained schist debris, (Tma).

CLAYEY SILTSTONE: Dark olive gray (5Y3/2); moderately hard; slightly to moderately plastic, (Tma).

BOTTOM OF BORING- COMPLETED 12/15/2011
Notes: 1) Groundwater encountered during drilling at approximately 80 feet. 2) Hole visually logged to 116 feet. 3) Boring converted to inclinometer casing, installed 3.34 inclinometer casing with Ao = 230; casing secured to south boring wall; backfilled with 3/8 gravel to within 5.5 feet of surface. Surface completion using slurry and 2'x2' box.

LEGEND
* Sample Not Recovered  \(\text{V} \) Ground Water Level ATD
E Environmental Sample Obtained
\(\text{H} \) Modified California Sampler
Grab Sample

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<th>Samples</th>
<th>Attitude</th>
<th>Blow Count, (blows/ft)</th>
<th>Ground Water</th>
<th>RQD/Recovery, %</th>
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<thead>
<tr>
<th>Depth, ft</th>
<th>Elev., ft</th>
<th>Soil Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td></td>
<td>Interlaminated, CLAYEY SILTSTONE, SANDSTONE (fine), and CLAYSTONE: Very low strength with medium strength silicified seams; olive-black (SY 2/1) siltstone, medium bluish-gray (5B 5/1) sandstone, and brownish-gray (5YR 4/1) claystone; abundant organics, scattered gypsum stringers; fresh; (Tma).</td>
<td></td>
</tr>
<tr>
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<td></td>
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<td>-Silicified fine sandstone above 41 feet, interlaminated below.</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td>-Silicified fine sandstone seams at 53 feet.</td>
</tr>
<tr>
<td>60</td>
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<td></td>
<td>-Fine to coarse sandstone between 55 and 56 feet.</td>
</tr>
<tr>
<td>65</td>
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<td>Intermixed, CLAYEY SILTSTONE and SANDSTONE (fine): Low strength, fresh, (Tma).</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
<td>CLAYSTONE: Very low strength, dark green-gray (5G 4/1), scattered fine sandstone seams, fresh, (Tma).</td>
<td></td>
</tr>
<tr>
<td>75</td>
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<td>-Increasing fine sandstone seams (green-gray 5G 6/1) below 64 feet.</td>
<td></td>
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<tr>
<td>80</td>
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<td>CLAYEY SILTSTONE (fine sandy): Low strength, brownish-gray (5YR 4/1), bedded, scattered fine sandstone seams, fresh, (Tma).</td>
<td></td>
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<tr>
<td>85</td>
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<td>-Diced and broken texture between 73 and 76 feet.</td>
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<tr>
<td>90</td>
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<td>Intermixed, BENTONITE and CLAYEY SILTSTONE: Very low strength, medium gray (SN 5) bentonite and olive-gray (5Y 4/1) siltstone, contorted texture with scattered sandstone layers, slightly weathered, (Tma).</td>
<td></td>
</tr>
</tbody>
</table>

*Sample Not Recovered

Soil Core (as in Sonic Core Borings)

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<th>Symbo</th>
<th>Sketch</th>
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<th>Blows</th>
<th>RQD/Recovery, %</th>
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**NOTES**

1. Boring converted to groundwater well.
Asphalt Paving

Note - Borehole was advanced to about 4.5 feet using mud rotary drilling methods to allow for the insertion of the core barrel. No samples were collected.

Brownish gray (5YR 4/1) to mottled dark yellowish brown (10YR 4/2) and dark yellowish orange (10YR 6/6), clayey SILT to siltly CLAY; moist; scattered clayey silt clasts, scattered to numerous nodules; (Qt) CL/ML.

CLAYEY SILTSTONE: Very low strength, mottled greenish gray (5G 6/1) and dark yellowish orange (10YR 6/6), completely weathered, (Tma).  

SILTSTONE: Very low strength, moderate yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/2) to dark yellowish orange (10YR 6/6) and greenish gray (5G 6/1), laminated to thin-bedded, interbedded with clayey siltstone and fine-grained sandstone; bedding horizontal to dipping to 10 degrees, sandstone locally very low to low strength; medium to wide spaced fractures with iron-oxide coatings, moderately to highly weathered, (Tma).

SILICIOUS SILTSTONE: Low to medium high strength, light bluish gray (5B 7/1), interbedded with fine-grained sandstone; very close spaced, low to high angle irregular rough joints; slightly to moderately weathered, (Tma).

SILTSTONE: Very low to low strength, moderate yellowish brown (10Yr 5/4), pale yellowish brown (10YR 6/2) and greenish gray (5Gy 6/1), laminated to thin-bedded, interbedded with scattered clayey siltstone and sandstone layers, bedding dipping at about 10 to 50 degrees; very close to closely spaced fractures, locally infilled with tar or gypsum; iron-oxide stained, highly weathered to slightly weathered, (Tma).
SOIL/ROCK DESCRIPTION

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- Gypsum fracture in fillings between 30 and 41 feet.

- Tar infilling in joints between 32 and 32.5 feet.

SANDSTONE: Very low strength, pale yellowish brown (10YR 6/2), fine-grained; highly fractured (closed) with tar infilling; sulfur; moderately weathered, (Tma).

SILTSTONE: Very low to low strength, medium gray (N5) and olive black (5Y 2/1), laminated to thin-bedded, interbedded with clayey siltstone, sandstone, and scattered claystone layers, planar bedded to chaotic with clasts of siltstone and sandstone, bedding dipping at about 30 to 60 degrees; very close to medium spaced, low to high angle joints with numerous slickenside, scattered shear zones; iron-oxide staining above about 44 feet; slightly weathered to fresh, (Tma).

-Shear at 45.5 feet.

-Slickensided shears between 48 and 62 feet.

NOTES
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White Point Landslide
San Pedro District
Los Angeles, California

LOG OF BORING B-7

August 2012
51-1-10052-011
SILICIOUS SILTSTONE: High strength, light brownish gray (5YR 6/1), laminated; bedding dipping at about 80 degrees; close spaced rough fractures; fresh, (Tma).

SILTSTONE: Very low to low strength; medium gray (N5) and brownish black (5YR 2/1); chaotic (syndepositional) bedding with clayey siltstone and fine to medium-grained sandstone; very close to medium spaced fractures; fresh, (Tma).

SANDSTONE: Very low to moderate strength, medium gray (N5), fine-grained, chaotic bedded with siltstone and clayey siltstone clasts; very close to closely spaced fractures, scattered shear zones; fresh, (Tma).

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

NOTES
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**SOIL/ROCK DESCRIPTION**

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---

**SILTSTONE:** Very low to low strength, brownish gray (5YR 4/1) and medium gray (N5), laminated to thin-bedded, interbedded with clayey siltstone and fine to medium-grained sandstone, planar bedding dipping at about 10 to 20 degrees to chaotic (syndepositional) bedding with flame structures and clasts of sandstone and siltstone; very close to medium spaced fractures locally with slickensides or striations; fresh, (Tma).

- Bentonite seam at 87.7 feet.

**SANDSTONE:** Very low to low strength, medium gray (N5) and brownish gray (5YR 4/1), fine-grained, interbedded to mixed (chaotic) with siltstone; medium spaced joints; fresh, (Tma).

**SILTSTONE:** Very low to low strength, brownish gray (5YR 4/1) and medium gray (N5), chaotic bedded with clayey siltstone and fine to medium-grained sandstone; close to medium spaced fractures; fresh, (Tma).

---

**NOTES**

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3. USCS designation is based on visual-manual classification and selected lab testing.
CLAYEY SILTSTONE: Very low strength, brownish gray (5YR 4/1), laminated to thin-bedded, bedding dipping at about 20 degrees; close spaced fractures; fresh, (Tma).

SILICIOUS SILTSTONE: Low to medium high strength, light brownish gray (5YR 6/1), laminated, dipping at about 20 degrees, very closely spaced fractures locally coated with tar; fresh, (Tma).

SILTSTONE: Very low to low strength, brownish gray (5YR 4/1) and medium gray (5Y) laminated to thin-bedded, bedding dipping at about 20 degrees, bedding locally offset, interbedded with clayey siltstone and fine to medium-grained sandstone; very close to widely spaced fractures locally infilled with tar, locally striated; fresh, (Tma).

BOTTOM OF BORING COMPLETED 12/14/2011

Notes:
1) Hole was drilled using HQ3 rotary coring drilling methods to about 117 feet deep.
2) The borehole was inspected using an optical televIEWer operated by Geovision.
3) The borehole was then reamed to about 6 inches diameter to 118 feet using mud rotary drilling methods with 2 sizes of tri-cone bits to allow installation of 3.34 inch O.D. inclinometer casing.
### SOIL/ROCK DESCRIPTION
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<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>Olive Gray (5Y 3/2), gravelly, silty CLAY; moist; abundant roots, abundant dark yellow-orange (10YR 6/6) silt clasts, highly weathered; (Qt).</td>
</tr>
<tr>
<td>120</td>
<td>SILTSTONE: Low strength, moderate yellowish-brown (10YR 5/4) to dark yellowish-brown (10YR 4/2), fine sandy, scattered manganese-oxide staining, caliche pockets, and silicified zones, weathered, (Tma).</td>
</tr>
<tr>
<td>115</td>
<td>Interbedded, SANDSTONE (fine) and SILTSTONE (fine sandy): Low strength with medium strength silicified zones, yellowish-gray (5Y 7/2) sandstone and moderate yellowish-brown (10YR 5/4) siltstone, scattered silicified zones, slightly weathered, (Tma).</td>
</tr>
<tr>
<td>110</td>
<td>- Medium strength, silicified sandstone (yellowish-gray 5Y 7/2) between 11.5 and 13.5 feet.</td>
</tr>
<tr>
<td>105</td>
<td>- Becomes clayey below 15 feet.</td>
</tr>
<tr>
<td>100</td>
<td>Interbedded, CLAYSTONE and CLAYEY SILTSTONE: Very low strength, moderate yellowish-brown (10YR 5/4), scattered sandstone seams, scattered manganese-oxide staining, slightly weathered, (Tma).</td>
</tr>
<tr>
<td>95</td>
<td>- Fine to medium sandstone seam (gray blue 5PB 5/2) at 19 feet.</td>
</tr>
<tr>
<td>90</td>
<td>- Sheared, with clayey sandstone stringers between 26.5 and 27.0 feet.</td>
</tr>
<tr>
<td>85</td>
<td>- Abundant gypsum stringers below 27 feet.</td>
</tr>
<tr>
<td>80</td>
<td>- Abundant organics and organic-rich seams between 28 and 31 feet.</td>
</tr>
<tr>
<td>75</td>
<td>- Color change to brownish-gray (5YR 4/1) between 31 and 32 feet.</td>
</tr>
<tr>
<td>70</td>
<td>- Fine sandstone seam, medium bluish-gray (5B 5/1), between 34 and 35 feet.</td>
</tr>
<tr>
<td>65</td>
<td>SANDSTONE: Medium strength to low strength, medium bluish-gray (5B 5/1), fine to medium sand and silicified at top, fine sand toward top.</td>
</tr>
</tbody>
</table>

---

**NOTES**

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### SOIL/ROCK DESCRIPTION

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<table>
<thead>
<tr>
<th>Depth, ft.</th>
<th>Elevation, ft.</th>
<th>Symbol/Sketch</th>
<th>Samples</th>
<th>Blow Count, (blows/ft)</th>
<th>Ground Water</th>
<th>RQD, % Recovery</th>
<th>Ground Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.0</td>
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<tr>
<td>58.5</td>
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</tr>
</tbody>
</table>

- **bottom, fresh, (Tma).**
  - Interbedded, SILTSTONE and CLAYSTONE: Very low to low strength, olive gray (5Y 4/1) to olive black (5Y 2/1) abundant organic-rich seams, scattered fine sandy seams, fresh, (Tma).
  - Silicious fine sandstone seam (olive gray 5Y 4/1) between 44.0 and 44.5 feet.
  - Fine to coarse sandy (blueschist grains) claystone from 46 to 47.5 feet.
  - Organic-rich with abundant fine sand stringers below 48 feet.

- **CLAYEY SANDSTONE: Very low strength with medium strength silicified zones; dark green-gray (5GY 4/1) to medium bluish-gray (5B 5/1), massive to faintly bedded, abundant angular clasts (rip-ups) of brownish black (5YR 2/1) clayey, organic-rich siltstone; fresh; (Tma).**

- **Interbedded, CLAYEY SILTSTONE and CLAYSTONE: Very low strength, olive gray (5Y 4/1), abundant olive black (5Y 2/1) organic-rich layers, scattered fine sandstone (medium gray SN5) seams, fresh, (Tma).**
  - Fine sandstone (medium gray SN5) seam at 62 feet.
  - Sheared and contorted texture with scattered fine to coarse sandstone pockets between 63.5 and 64.5 feet.
  - Scattered fine to coarse sandy pockets at 67.5 feet.
  - Slightly silicified at 68.5 feet.

- **Switch from plastic tube-bags (0 to 76 feet) to Lexan liners (78 to 110 feet).**

#### LEGEND

- Sample Not Recovered
- Soil Core (as in Sonic Core Borings)

#### NOTES

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SOIL/ROCK DESCRIPTION

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<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Symbol/ Sketch</th>
<th>Samples</th>
<th>Attitude</th>
<th>Blow Count, (blows/ft)</th>
<th>ROQ/ Recovery, %</th>
<th>Ground Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>81.5</td>
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<td>88.0</td>
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<td>90.3</td>
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<tr>
<td>91.0</td>
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<tr>
<td>93.0</td>
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<td>94.0</td>
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<td>95.5</td>
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<tr>
<td>98.0</td>
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<tr>
<td>100.0</td>
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<tr>
<td>102.0</td>
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</tr>
</tbody>
</table>

- Fine to medium sandy (medium bluish gray 5B 5/1) below 80 feet.

- SANDSTONE: Very low strength, light bluish-gray (5B 7/1), fine to medium grained, scattered angular clasts (rip-ups) of clayey siltstone, fresh, (Tma).

- CLAYEY SILTSTONE grading to CLAYSTONE: Low strength, olive-gray (5Y 4/1) to brownish black (5YR 2/1), thickly laminated (varved?), fresh, (Tma).

- Becomes claystone below 43 feet.

- SILTSTONE: Low strength with medium strength silicified zones, brownish-gray (5YR 4/1) to brownish-black (5YR 2/1), mostly broken texture with angular silicified fragments in fine sandy silt matrix, scattered bedding, scattered tar clasts, fresh, (Tma).

- Bedded clayey silt seam between 87.5 and 88 feet.

- CLAYEY SILTSTONE: Very low strength, brownish-gray (5YR 4/1), contorted texture, scattered siltstone layers, abundant layers with angular silicified siltstone clasts, fresh, (Tma).

- Siltstone layer with abundant angular silicicous clasts between 89.5 and 90.0 feet.

- Abundant angular silicicous clasts between 91 and 92 feet.

- SILICIOUS SILTSTONE BRECCIA and SILTSTONE: Very low strength with medium strength silicified clasts, brownish-gray (5YR 4/1) to grayish-black (N2), abundant tar pockets, abundant medium to high strength silicified, angular fragments in low strength slightly clayey siltstone matrix, massive (no observable bedding or foliation), fresh, (Tma).

- Soft, organic-rich, slightly clayey silt seam from 96.5 to 97.0 feet.

- Wet, angular silicicous brecciated gravel seam between 97 and 98 feet.

- CLAYSTONE: Low strength, brownish-black (5YR 2/1), slightly fine to medium sandy, faintly bedded to massive, fresh, (Tma).

- Massive with 5 to 10 percent suspended fine to coarse sand between 100.5 and 101.5 feet.

- SILTSTONE: Very low strength, brownish-black (5YR 2/1), faintly bedded at 5 to 20 degrees with fine sand seams, fresh, (Tma).

- Diced texture with high strength, angular silicified siltstone clasts between 103.5 and 104.0 feet.

- CLAYSTONE: Low strength, olive black (5Y 2/1), faintly bedded, scattered contorted texture, scattered fine sand seams, fresh, (Tma).

BOTTOM OF BORING
COMPLETED 12/18/2011

Notes:
1. Sonic core was collected into plastic bags to about 78 feet to the bottom of the hole. Lexan tubing was then used from 78 feet to the bottom of the hole.
2. A piezometer well was installed in the borehole at the end of the drilling. During well construction, sand filter material was placed to inside the drill casing and packed in between the well casing and drill casing. When the casing was pulled up, the well casing was pulled up also. When the well casing was finally freed, the well casing had been pulled up from the planned bottom of casing at 105 feet to about 101 feet deep.

LEGEND

* Sample Not Recovered
☑ Soil Core (as in Sonic Core Borings)

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<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Elev., ft</th>
<th>Symbols/Sketch</th>
<th>Attitude</th>
<th>Blow Count, (blows/ft)</th>
<th>Ground Water</th>
<th>Samples</th>
<th>RQD/Recovery, %</th>
<th>ROQ/Recovery, %</th>
<th>Ground Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>1.0</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark gray, slightly silty clayey, silty gravelly SAND; moist; abundant organics; (Qt) SM.</td>
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<td></td>
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<td></td>
<td>- Note - Borehole advanced to 3 feet with tri-cone bit in preparation for rock coring. No samples were collected.</td>
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</tr>
<tr>
<td>120</td>
<td>3.0</td>
<td></td>
<td></td>
<td>Brownish gray (5YR 4/1) to mottled dark yellowish brown (10YR 4/2) and grayish orange (10YR 7/4), trace of gravel to gravelly, slightly sandy to sandy, silty CLAY; moist; scattered to numerous siltstone clasts; (Qt) CL.</td>
<td></td>
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</tr>
<tr>
<td>115</td>
<td>7.2</td>
<td></td>
<td></td>
<td>SILTSTONE: Very low strength, mottled, very pale orange (10YR 8/2), pale yellowish brown (10YR 6/2) and light gray (N6), relic thin bedded; highly fractured, locally sheared; highly to completely weathered; (Tma).</td>
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<td></td>
<td>- shear zone between 7.8 and 9.0 feet.</td>
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</tr>
<tr>
<td>115</td>
<td>9.2</td>
<td></td>
<td></td>
<td>SILTSTONE: Very low to low strength, pale yellowish brown (10YR 6/2) and moderate yellowish brown (10YR 5/4), with zones of light gray (N 7) and light bluish gray (SB 7/1), laminated to thin-bedded, interbedded with fine to medium-grained sandstone, bedding dipping at about 5 to 15 degrees, locally chaotic bedded; scattered thin shear zones, scattered highly fractured zones, medium to wide spaced tight joints with manganese oxide coating, local gypsum infill in fractures and along bedding planes; iron-oxide stained, moderately to highly weathered; (Tma).</td>
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<td>-2&quot; bentonite seam (10YR 8/2) at 10.2 feet.</td>
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</tr>
<tr>
<td>115</td>
<td>14.0</td>
<td></td>
<td></td>
<td>- Silicious from 14.0 to 14.5 feet.</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

NOTES

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<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Elev., ft</th>
<th>RQD/ Recovery, %</th>
<th>Ground Water</th>
<th>Samples</th>
<th>Blow Count, (blows/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1.50</td>
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<td>2.00</td>
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</tr>
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</tr>
<tr>
<td>4.00</td>
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</tr>
</tbody>
</table>

- Bentonite seam at 17.7 feet.
- Thinly bedded, silty sandstone seam between 17.8 and 18.8 feet.
- Bentonite seam at 19.5 feet.
- Several moderate yellowish brown (10YR 5/4), 2- to 3-inch sandstone seams between 21 and 23 feet.

**NOTES**

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Contorted bedding and 40-degree shear zone between 30 and 31 feet.

Abundant sandstone pockets and gypsum stringers between 31 and 33 feet.

**SILICIOUS SILTSTONE:** Low to moderate strength, light bluish gray (5B 7/1) and grayish orange (10 YR 7/4), irregular interbeds of fine-grained sandstone, scattered very low strength seams; very close to closely spaced fractures coated with iron-oxide staining and locally infilled with tar and gypsum; slightly to moderately weathered, (Tma).

**SILTSTONE:** Very low to low strength, dusky yellowish brown (10YR 2/2) and moderate yellowish brown (10YR 6/4), laminated to thin-bedded, interbedded with clayey siltstone, claystone, and fine to medium-grained sandstone, bedding dipping at about 20 degrees, scattered pale yellowish brown nodules; close spaced fractures infilled with gypsum; moderately weathered, (Tma).

**SANDSTONE:** Very low to low strength, light greenish gray (5GY 8/1), fine-grained, laminated to medium bedded, interbedded with siltstone laminae below about 40.5 feet with irregular bedding; medium spaced joints, locally fractures sealed with tar and gypsum; sulfur locally present; fresh, (Tma).

**CLAYSTONE:** Very low to low strength, brownish black (5YR 2/1) to olive gray (5Y 4/1), laminated to thin-bedded, interbedded with clayey siltstone and fine-grained sandstone, bedding dipping at about 10 to 20 degrees, scattered very pale orange nodules; scattered gypsum infill along bedding planes up to 3/8 inch thick; fresh, (Tma).

**CLAYEY SILTSTONE:** Very low to low strength, brownish black (5YR 2/1) to olive black (5Y 2/1) and light gray (N7), interbedded with siltstone and fine to medium-grained sandstone, laminated to thin-bedded, bedding dipping at about 10 degrees, scattered sandstone layers with chaotic soft sediment deformed claystone and siltstone clasts and warped discontinuous layers, scattered to locally numerous
SOIL/ROCK DESCRIPTION

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Very pale orange nodules; locally very closely spaced fractures infilled with gypsum, locally highly fractured zones with slickensides; slightly weathered to fresh, locally moderately weathered, (Tma).

-Sandstone seam (moderate bluish gray, 5B 5/1) from 47.5 to 48.5 feet.

-Fine to medium sandstone with claystone frip-up clasts form 49.4 to 50.0 feet.

Interbedded SANDSTONE and SANDY SILTSTONE: Very low to low strength, locally moderate strength, brownish black (5YR 2/1) and light gray (7N), laminated to thin-bedded, interbedded with clayey siltstone and fine to medium-grained sandstone, bedding dipping at about 10 to 30 degrees, scattered chaotic soft sediment deformed zones, irregular contacts along chaotic sandstone interbeds, scattered grayish orange nodules; fresh, (Tma).

- Contorted, soft-sediment deformation between 56.2 and 58.4 feet.
**SOIL/ROCK DESCRIPTION**

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<table>
<thead>
<tr>
<th>Depth, ft</th>
<th>Symbol/Sketch</th>
<th>Samples</th>
<th>Blow Count, (blows/ft)</th>
<th>RQD/Recovery, %</th>
<th>Ground Water</th>
<th>Depth, ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>60.8</td>
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</tr>
<tr>
<td>65.8</td>
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</table>

**CLAYEY SILTSTONE:** Very low to low strength, brownish black (5YR 2/1) and light gray (N7), laminated to thin-bedded, interbedded with siltstone and fine-grained sandstone, bedding generally dipping at about 10 degrees, bedding locally warped, scattered grayish orange nodules; medium to wide spaced slickensided joints, locally with offset layers; fresh, (Tma).

**SILTSTONE:** Low strength, brownish gray (5YR 4/1) and light gray (N7), interbedded with fine to medium-grained sandstone, laminated to thin-bedded, bedding dipping at about 5 to 10 degrees, becoming chaotic to intermixed; fresh, (Tma).

**CLAYEY SILTSTONE:** Very low to low strength, brownish gray (5YR 4/1) and light gray (N7), interbedded with siltstone, claystone and fine-grained sandstone, laminated to thin-bedded with scattered chaotic bedded sections, bedding generally dipping at about 10 degrees, scattered grayish orange nodules; wide spaced slickensided and striated joints; fresh, (Tma).

- Contorted, soft-sediment deformation between 70.5 and 72 feet.

---

**NOTES**

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
SOIL/ROCK DESCRIPTION

- Soft sediment deformation from 76.5 to 78 feet.

- Core loss from 84.3 to 85 feet.

SILTSTONE: Very low to low strength, brownish gray (5YR 4/1) and light gray (N7), laminated to thin-bedded, interbedded with clayey siltstone, claystone, and fine-grained sandstone, bedding dipping at about 10 degrees; fresh, (Tma).

CLAYEY SILTSTONE: Very low to low strength, locally moderate strength, brownish gray (SYR 4/1) and light gray (N7) seams, interbedded with claystone, siltstone and fine-grained sandstone, laminated to thin-bedded, bedding dipping at about 10 degrees, locally chaotic bedded, scattered grayish orange nodules; close to widely spaced joints with slickensides; fresh, (Tma).

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
**SOIL/ROCK DESCRIPTION**

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

<table>
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<th>Depth, ft</th>
<th>Type</th>
<th>Description</th>
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<tr>
<td>115 ft</td>
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<td>SANDSTONE: Low strength, light gray (N7) and light olive gray (5Y 6/1), fine to medium-grained, with folded seams and ripped up clasts of clayey siltstone and claystone; fresh, (Tma).</td>
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<tr>
<td>94.8 ft</td>
<td></td>
<td>CLAYEY SILTSTONE: Very low to low strength, dark yellowish brown (10YR 4/2) with light gray (N7) seams, interbedded with siltstone and fine-grained sandstone, thin-bedded to laminated, bedding dipping at about 5 to 10 degrees; wide spaced joints locally slickensided; fresh, (Tma).</td>
</tr>
</tbody>
</table>

- Low angle (<5 degrees), soft slickensided clay seam from 96.3 to 96.5 feet.
- Bentonite seam with abundant slickensides between 96.7 and 97 feet.
- Silicious siltstone between 97 and 97.5 feet.

---

**LEGEND**

- Sample Not Recovered
- Rock Core Sample

**NOTES**

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
**SOIL/ROCK DESCRIPTION**

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

<table>
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<th>Depth, ft</th>
<th>Elev., ft</th>
<th>Symbol/ Sketch</th>
<th>Samples</th>
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<th>RQD/ Recovery, %</th>
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**SANDSTONE:** Very low to low strength, greenish gray (5G 6/1) and dark yellowish brown (10YR 4/2), fine to medium-grained (fining upwards), scattered to locally numerous clayey siltstone rip up clasts; clasts locally slickensided internally; fresh, (Tma).

**SILTSTONE:** Very low to low strength, dark yellowish brown (10YR 4/2), slightly fine sandy to fine sandy; medium spaced joints with slickensides; fresh, (Tma).

**SANDSTONE:** Very low to low strength, light gray (N7), fine to medium-grained, scattered to locally numerous rip up clasts of siltstone and claystone; close to medium spaced, low to high angle joints with striations; fresh, (Tma).

**SILTSTONE:** Very low to low strength, dark yellowish brown (10YR 4/2) to brownish gray (5YR 4/1), scattered to locally numerous rip up clasts of sandstone and siltstone, and soft sediment deformed chaotic bedded zones; scattered planar joints with striations; fresh, (Tma).

**BOTTOM OF BORING COMPLETED 12/20/2011**

Notes:

1) Hole was drilled using HQ3 rotary coring drilling methods to 117 feet.
2) Borehole was inspected using an optical televiwer operated by Geovision. The borehole was then reamed to about 6 inches diameter to a depth of 120 feet using mud rotary drilling methods with 2 sizes of tri-cone bits to allow installation of 3.34 inch O.D. inclinometer casing.

**NOTES**

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2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

---

**LOG OF BORING B-9**

August 2012

White Point Landslide
San Pedro District
Los Angeles, California

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A.10
Sheet 8 of 8
TRAFFIC BARRIER
4" DIAMETER STEEL POST

LOCKING WELL COVER

WELL PAD

GROUND SURFACE

CONCRETE CAP SEAL

4" DIAMETER SCHEDULE 80 PVC BLANK WELL CASING

GROUNDWATER MEASURED AT 12.40'
(10-21-94)

GROUT/CEMENT
(42 BAGS CEMENT)
(4 BAGS BENTONITE)

BENTONITE SEAL
1/2" BENTONITE PELLETS (2 BUCKETS)

CENTRALIZERS (STAINLESS STEEL)
AT 48', 88', 108 & 128'

GROUNDWATER ENCOUNTERED DURING DRILLING AT 110'

#12 SRI SILICA SAND (29 BAGS)

4" INSIDE DIAMETER, 0.02" CONTINUOUS SLOT STAINLESS STEEL WELL SCREEN

2' SILT TRAP (STAINLESS STEEL)

NOTE: NOT TO SCALE

MW-5 MONITORING WELL DETAILS

PREPARED FOR
MARTIN MARIETTA ENERGY SYSTEMS, INC.
OAK RIDGE, TENNESSEE

INTERNATIONAL TECHNOLOGY CORPORATION
Very dark grayish brown (10YR 3/2) silicified SANDSTONE, dry, highly fractured.

Siliceous SANDSTONE, fine grained.

Very dark grayish brown (10YR 3/2) SANDSTONE, dry, fine grain, with occasional SHALE bed.

Less SANDSTONE, slightly more SHALE.

Very dark grayish brown (10YR 3/2) SHALE, dry, thinly bedded.

Very dark grayish brown (10YR 3/2) interbedded SANDSTONE/SHALE beds, dry to damp, very fine grained SANDSTONE.

At 105', damp.

Very dark grayish brown (10YR 3/2) SANDSTONE, damp, occasional thin SHALE bed showing.

Groundwater encountered at 110' during drilling. At 110', very dark grayish brown (10YR 3/2) interbedded SANDSTONE/SHALE, wet.

Note: Groundwater under pressure.

Some as above, SHALE/SANDSTONE interbeds, wet.

Very dark grayish brown (10YR 3/2) interbedded thin SHALE/SANDSTONE, moist, SANDSTONE is very fine to line, SHALE is highly fractured, some chert fragments showing.

At 128', less SHALE, more SANDSTONE, damp to moist.

Very dark grayish brown (10YR 3/2) SANDSTONE, with occasional SHALE interbeds, moist, thin bedded SHALE units.

TOTAL DEPTH = 154.0 FEET
MW-6 Monitoring Well Details
Prepared for
Martin Marietta Energy Systems, Inc.
Oak Ridge, Tennessee

NOTE. NOT TO SCALE.
## Monitoring Well No. MW-6

**Coordinates:** Not surveyed

**Field Engineer:** G. Casal
**Date Began:** 01-08-94

**Edited By:** G. Casal
**Date Finished:** 01-08-94

**Checked By:** J. Zhao
**Ground Surface:** El. Not meas.

### Description

- **Loose, yellowish brown (10YR 5/4) Silt Sand with trace of clay, dry, numerous roots, grasses-organic matter.** At 5', less organics.
  - At 5', damp.

- **Bedrock – Monterey Formation, Alhambra Shale Member:** Interbeds SANDSTONE/SILTSTONE/CLAYSTONE, brown (10YR 5/3) damp, very fine grained SANDSTONE.

- **Dense brown (10YR 5/3) SANDSTONE with CLAYSTONE interbeds, damp, 70% SANDSTONE/30% CLAYSTONE, SANDSTONE very fine to fine grained.**

- **Dense, brownish yellow (10YR 8/8) SANDSTONE, dry to damp, very fine grain.**

- **Dense, brownish yellow (10YR 8/8) interbedded SANDSTONE with SILTSTONE, damp, numerous calcite crystals showing.**

- **Dense, dark yellowish brown (10YR 4/4) CLAYSTONE/SANDSTONE interbeds, damp, very fine grain.**
  - At 35', strong cementation, very dark gray (10YR 3/1) SHALE, dry, very hard drilling, some calcite (fracture filling) present.

- **Dense, dark yellowish brown (10YR 4/8) SANDSTONE, dry to damp, very fine grain.**
  - At 43', damp to moist.
  - At 44', dry.
  - From 44-46', occasional SHALE/SILTSTONE interbeds showing.

- **Dark grayish brown (10YR 4/2) SANDSTONE, dry to damp, very fine grain, traces of SILTSTONE fragments showing.**
  - At 55', dark grayish brown (10YR 4/2) SHALE interbeds within SANDSTONE, dry, strong cementation, thin beds.
  - Very dark grayish brown (10YR 3/2) SANDSTONE, dry, very fine grain.
  - At 62', SHALE showing within SANDSTONE, dry, strong cementation.

- **At 65', very dark grayish brown (10YR 3/2) SANDSTONE, dry, very fine grain.**
  - Trace of SHALE at 66'/trace at 71.'
At 75', very dark grayish brown (10YR 3/2) SANDSTONE, dry, tints of SHALE interbedded within SANDSTONE.

At 80', very dark gray (10YR 3/1) SHALE, dry, strong cementation, very hard drilling.
At 82', very dark gray (10YR 3/1) SANDSTONE, dry to damp, very fine to fine grain.

At 90', very dark gray (10YR 3/1) SANDSTONE, dry, very fine grain.

At 95', very dark gray (10YR 3/1) interbedded SANDSTONE/CLAYSTONE, damp to moist, very fine grain.
At 100', very dark gray (10YR 3/1) interbedded SANDSTONE/CLAYSTONE, very fine grain.

At 110', very dark gray (10YR 3/1) CLAYSTONE/SANDSTONE interbeds, moist.
At 115', dark grayish brown (10YR 4/2) SANDSTONE, dry, fine grain.
At 117', very dark gray (10YR 3/1) SHALE, very dry, strong cementation.

Very dark grayish brown (10YR 3/2) strong cemented SANDSTONE interbedded with very fine grained SHALE, dry, thinly bedded, few calcite fragments (fracture filling).

Groundwater measured at 128.14' (10-21-94).
Loose SHALE, more SANDSTONE, dry, very hard drilling.
Groundwater encountered at 130' during drilling.

At 135', dark brown (10YR 3/3) strong cemented SANDSTONE with occasional SHALE interbeds, dry, few calcite fragments—fracture filling.
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**MONITORING WELL NO. MW-7**

**COORDINATES**
- N. Not surveyed
- E. Not surveyed

**FIELD ENGINEER**: O. Cash, **DATE BEGAN**: 1-14-81
**EDITED BY**: O. Cash, **DATE FINISHED**: 1-16-81
**CHECKED BY**: J. Thomas, **GROUND SURFACE EL.**: Not measured

**DESCRIPTION**
- Fil: loose, light gray (10YR 7/3) GRAVELS (road bed) dry, coarse
- CLAYEY SAND, dry, numerous rock fragments.
- At 2', Aluminum-medium dense, very dark grayish brown (10YR 3/2)
- CLAYEY SAND, dry, numerous rock fragments.
- At 9', CLAYEY SAND, dry.

**At 6', color change to dark grayish brown (10YR 4/2) CLAYEY SAND,**
- Dry, numerous gravels, comp to 6,
- Brown (10YR 4/3) CLAYEY SAND, comp to medium grained,
- Numerous gravels, rock fragments.

**At 8', Bedrock - Monterey Formation, Altered Shale Member,**
- Brown (10YR 5/3) Interbedded SANDSTONE/SILTSTONE, SANDSTONE is
- Dry, fine grain, SILTSTONE is dry to damp, thinly bedded.
- Numerous SILTSTONE fragments at 12'.
- At 13', light brownish gray (10YR 8/2) silicified SANDSTONE, very dry.
- At 15', brown (10YR 3/3) SANDSTONE, dry, few SILTSTONE fragments.

**At 22', dark grayish brown (10YR 4/2) SANDSTONE, dry to comp, very
- fine grain.

**At 26', some CLAYSTONE showing within SANDSTONE.**

**Color change to dark gray (10YR 4/1).**

**At 26', dark gray (10YR 4/3) SANDSTONE/SILTSTONE/CLAYSTONE interbeds,**
- Damp, very fine grain.
- Dark gray (7.5YR 4/1-) SANDSTONE/CLAYSTONE interbeds, damp,
- Very fine grained SANDSTONE.
- Dark gray (7.5YR 4/1-) SANDSTONE with occasional CLAYSTONE
- Interbeds, damp, very fine grain.

**Less CLAYSTONE, more SANDSTONE.**

**Very dark grayish brown (10YR 3/2) SANDSTONE, comp, very fine
- grain.**

**At 53', dark brown (10YR 4/3) silicified SANDSTONE, dry, visible
- layering, fractured.**

**At 54', slight color change to brown (10YR 5/3) silicified SANDSTONE,**
- Dry, few chart fragments.
- From 53-55', few CLAYSTONE layers showing.

**At 62', interbedded brown (10YR 4/3) SANDSTONE with brown
- (10YR 5/3) CLAYSTONE, very fine to fine grained SANDSTONE.**

**At 65', 60% SANDSTONE/40% CLAYSTONE.**

**At 68', slightly more SANDSTONE (75%)/CLAYSTONE (25%).**

*PROJECT NO. 406733*

*CLIENT: MARTIN MARIETTA ENERGY SYSTEMS, INC.*

*SEE LEGEND FOR LOGS AND TEXT PITS FOR EXPLANATION OF SYMBOLS AND TERMS*
### Monitoring Well No. MW-7

**Coordinates**
- Not surveyed

**Field Engineer**
- G. Cash

**Date Began**
- 1-06-94

**Edited By**
- G. Cash

**Date Finished**
- 1-06-94

**Checked By**
- J. Phala

**Ground Surface El.**
- Not given

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- **Well Details**
  - **Drilled:** 140 ft
  - **Frac:** N/A

- **Pumping Test Results**
  - **TUB:** N/A
  - **TRIP:** N/A
  - **HDR:** N/A
  - **HQS:** N/A

**Legend:**
- See legend for logs and test pits for explanation of symbols and terms.

**Project No.**
- 408733

**Client:**
- Martin Marietta Energy Systems, Inc.

**International Technology Corporation**

**Previous IT Corporation Exploration Logs**

**Shannon & Wilson, Inc.**
- Geological and Environmental Consultants

**Sheet 10 of 11**
**MONITORING WELL NO. MW-7**

**COORDINATES**
- U. Not surveyed
- F. Not surveyed

**FIELD ENGINEER**  G. Cash  **DATE BEGAN**  1-06-94
**EDITED BY**  G. Cash  **DATE FINISHED**  1-06-94
**CHECKED BY**  J. Zhang  **GROUND SURFACE EL. Not meas.**

**DESCRIPTION**
- 140 ft: Very dark gray brown (10YR 3/2) SANDSTONE, strong cementation, fine to medium grained.
- Few SHALE fragments at 144 ft.
- Very dark gray (10YR 3/2) SANDSTONE with SHALE interbeds, strong cementation in SANDSTONE. SHALE is thinly bedded.
- At 150 ft, SANDSTONE/SHALE interbeds.

**TOTAL DEPTH = 150.0 FEET**

---

**PROJECT NO. 409733**

**CLIENT:** MARTIN MARIETTA ENERGY SYSTEMS, INC.

**See legend for logs and test pits for explanation of symbols and terms**

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**Previous IT Corporation Exploration Logs**