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February 1, 2013

Mr. Jerry Wickham
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Subject: Investigation to Assess Non-Aqueous Phase Liquid at the Mission Valley Rock and Asphalt Plant Located at 7999 Athenour Way in Sunol, California Alameda County Case No. RO0000207 and GeoTracker Global ID T0600102092

Dear Mr. Wickham:

The attached report provides the results of the investigation that was conducted to assess non-aqueous phase liquid (NAPL) observed in well MW-11D located at 7999 Athenour Way, Sunol, California ("the Site"). The scope of the investigation was conducted in accordance with the work plan dated August 28, 2012. The work plan was prepared in response to the Alameda County Environmental Heath Services (ACEH) letter to Hanson dated June 21, 2012.

I declare, under penalty of perjury, that the information and/or recommendations contained in the attached report are true and correct to the best of my knowledge.

If you have any questions or comments concerning this report, please call me at (925) 244-6570 or Ron Goloubow of ARCADIS at (510) 596-9550.

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Subject:

Investigation to Assess Non-Aqueous Phase Liquid at the Mission Valley Rock and Asphalt Plant Located at 7999 Athenour Way in Sunol, California
Alameda County Case No. RO0000207 and GeoTracker Global ID T0600102092

Date:
February 1, 2013

Contact:
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Our ref:
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Dear Mr. Wickham:

In response to the Alameda County Environmental Health Services (ACEH) letter to Lehigh Hanson (Hanson) dated June 21, 2012 (ACEH letter), ARCADIS U.S. Inc. (ARCADIS) prepared a Work Plan dated August 28, 2012 on behalf of Hanson for the Mission Valley Rock and Asphalt plant located at 7999 Athenour Way, Sunol, California (the Site; Figure 1). This letter provides the data collected to respond to the ACEH letter that requested an assessment of the following four issues:

- Sources of the light non-aqueous phase liquid (LNAPL) recently observed in well MW-11D (other than the former diesel fuel underground storage tanks [USTs] to the north of the well).
- The possibility of a significant thickness of LNAPL in the gravel layer intersecting the screen interval for well MW-11D.
- The integrity of well MW-11D and its ability to prevent LNAPL from entering from shallow intervals above the screened interval.
- LNAPL thickness and a baildown test in well MW-11D.

The scope of the Work Plan included data collection, data analyses, and reporting activities for assessing these issues arising as a result of the LNAPL measured at well MW-11D in May 2012. The objectives of the field activities completed to fulfill the Work Plan were to assess the following:

- The potential sources of the LNAPL
- The vertical extent of the LNAPL
- The mobility of the LNAPL

Historically, LNAPL has been observed in “shallow and deep zone” groundwater monitoring wells at the Site. LNAPL has been measured during the groundwater monitoring events in groundwater monitoring wells MW-2, MW-3, MW-9D, and MW-11D (ARCADIS 2011; ARCADIS 2012). LNAPL thicknesses in those wells have ranged up to approximately 4 feet (well MW-2 in January 1999). However, data collected through 2010 have indicated that LNAPL thicknesses have decreased significantly over time, and an appreciable measurable amount of LNAPL had not been measured in any wells at the Site between 2002 and 2010 (ARCADIS 2011). The following table summarizes the occurrences of LNAPL in the four wells mentioned.

Well	Occurrence/measured thickness	Number of occurrences
MW-2	4.00 feet	1
	Less than 1 foot	13
	Not Detected	6 (including the last five measurements before well abandonment)
MW-3	Sheen	2
	Not Detected	35
MW-9D	Sheen	2
	Not Detected	16
MW-11D	0.61 foot	1
	Sheen	3
	“Observed”	2
	Not Detected	12

As part of the regulatory case closure process, a water level elevation survey was conducted at the Site in May 2012 (ARCADIS 2012) in response to comments provided by ACEH in an April 9, 2012 letter. During that water level elevation survey, approximately 0.61 foot of LNAPL was measured in well MW-11D. In addition, during two previous water level measurement events on December 24, 2010 and September 27, 2010, a “petroleum hydrocarbon-like liquid,” was observed on the water level probe; however, LNAPL thickness was not measured using an interface probe (ARCADIS 2011). As a result of the measurement of the LNAPL at well MW-11D, the ACEH requested additional investigation (the ACEH letter of June 21, 2012) and the following describes the field activities associated with the scope of work intended to provide the data necessary to respond to the ACEH letter.

Physical/Chemical Properties and Transmissivity of LNAPL in Well MW-11D

This portion of the subsurface investigation included the collection and analysis of samples of LNAPL and groundwater samples from well MW-11D, followed by baildown testing.

LNAPL and Groundwater Sampling and Results

ARCADIS and the subcontractor Confluence Environmental, Inc. (Confluence) mobilized to the Site on December 19, 2012 to collect an LNAPL and groundwater sample from monitoring well MW-11D. Prior to collection of the LNAPL and groundwater samples, the depth to LNAPL and depth to water within monitoring well MW-11D was measured using an oil-water interface probe. On December 19, 2012, the depth to product was 4.36 feet below ground surface (bgs) and the depth to water was 4.60 feet bgs. Based on these measurements, a product thickness of 0.24 foot was calculated.

Similarly, a groundwater elevation survey of several monitoring wells at the Site was conducted using an oil-water interface probe. The depth to water ranged from 2.62 feet bgs in monitoring well MW-9S to 6.82 feet bgs in monitoring well MW-12LF.The measured groundwater elevation ranged from 254.10 feet above mean sea level (msl) in monitoring well MW-10LF to 256.21 feet above msl in monitoring well MW-12D. A summary of the groundwater elevation survey results is presented in Table 1.

During the groundwater elevation survey conducted on December 19, 2012, a small amount of LNAPL was detected at monitoring wells MW-2S and MW-2D at a thickness of 0.04 and 0.06 foot, respectively. No LNAPL was detected in monitoring well MW-2M. In order to determine the persistence of LNAPL in these monitoring wells, the observed product was removed from each of the monitoring wells using a peristaltic pump and the return of LNAPL was measured the next day. On December 20, 2012, the thickness of LNAPL in monitoring well MW-2D was 0.02 foot, and there was no measurable amount of LNAPL in monitoring well MW-2S.

On December 19, 2012, a peristaltic pump was used to remove and collect approximately 150 milliliters (ml) of LNAPL from monitoring well MW-11D in laboratory-supplied glassware. The 150 ml represents the entire volume LNAPL that was measured in well MW-11D. Similarly, a sample of approximately 500 ml of groundwater was collected from monitoring well MW-11D. These LNAPL and groundwater samples were stored on ice and shipped under chain-of-custody procedure to PTS Laboratories Inc. (PTS), located in Santa Fe Springs, California, and analyzed for the “NAPL and Water Fluid Properties Package” that includes viscosity, density, and interfacial tension (three phase pairs: oil/water, oil/air, and water/air). In addition, the LNAPL sample was analyzed using PTS’s proprietary OILPRINT™ qualitative chromatography test to identify the type and potential source of the LNAPL and the degree of weathering.

The laboratory report for the analyses conducted on the LNAPL and groundwater sample are located in Attachment 1. In summary, the LNAPL source was described as a severely weathered diesel with degradation from bacterial action. The LNAPL sample appears to contain a small amount of gasoline fraction carbon, amounting to <1%. The majority of the remaining hydrocarbons are within the C_{10}-C_{18} range, with some heavier hydrocarbons. The results of the physical property tests confirmed this LNAPL was a weathered diesel fuel with a density of 0.88 grams/milliliter (g/ml) and a viscosity of 7.23 centipoise at 70˚F.

As provided in the conceptual site model (LFR 2007), the sources of LNAPL within monitoring MW-11D and the other monitoring wells at the Site are likely associated with the incidental releases that occurred during fueling operations and tank refilling at the former diesel USTs (Figure 2). Historically and recently, LNAPL has been observed in several monitoring wells surrounding these former USTs (MW-9D, MW-3, MW-2S, MW-2D, and MW-11D). The historical dewatering activities associated with the active mining operation at the site could have resulted in the transport of LNAPL in various directions from the former USTs (LFR 2007).

Baildown Testing of LNAPL Transmissivity in Well MW-11D

LNAPL transmissivity was measured by conducting baildown testing of the LNAPL at well MW-11D on December 19 and 20, 2012. Baildown testing consists of LNAPL removal and monitoring of LNAPL recovery in the test well over time immediately following removal, similar to a traditional aquifer slug test. The rate of LNAPL flow into the well during the recovery period of a baildown test is a function of LNAPL saturation, permeability of the surrounding formation to LNAPL, LNAPL physical properties, and the magnitude of the initial hydraulic gradient toward the well developed during LNAPL removal.

LNAPL baildown testing was conducted in accordance with the attached ARCADIS Standard Operation Procedure for LNAPL Baildown Testing (Attachment 2). Given the relatively small apparent thickness of product in well MW-11D, LNAPL was removed from the well manually using a peristaltic pump. During the first day of the baildown test, an oil-water interface probe was used after evacuation of the LNAPL from MW-11D to monitor the rate of LNAPL return. The measured depth to product and depth to water was recorded over 13-hour period (Table 2a). During that time, no more than 0.01 foot of LNAPL was measured within the well.

The second day of the baildown test (December 20, 2012) included evacuation of both LNAPL and groundwater from monitoring well MW-11D at an extraction rate of approximately 5 to 6 gallons per minute (gpm) using an electrical submersible pump. The depth to LNAPL and depth to water were measured at routine intervals using an oil-water interface probe until the depth to water was within 0.1 foot of the initial measurement. Two baildown tests were conducted in this manner (Table 2b). Each test lasted from approximately 50 to 80 minutes, and no measurable amount of LNAPL was detected in monitoring well MW-11D during this time. ARCADIS returned to the Site on January 14, 2013 and LNAPL was measured at a thickness of 0.01 foot at well MW11D using an interface probe.

The baildown test data (e.g., water level and LNAPL thickness recovery over time) were analyzed using American Petroleum Institute's (API's) baildown test evaluation spreadsheet to obtain estimates of LNAPL transmissivity. The API spreadsheet makes the necessary correction for LNAPL density and calculates transmissivity using guidelines developed by Bouwer and Rice (1976), Cooper and Jacob (1946), and Cooper Jr. et al. (1967) for adapting groundwater slug test analysis methods to LNAPL baildown testing.

The data collected during the first day of baildown testing was used to populate the API evaluation spreadsheet (Attachment 3). The data from the baildown testing on the second day were not included because that methodology included the removal of both LNAPL and groundwater, as opposed to just removal of LNAPL, as suggested for use in the API evaluation spreadsheet. However, the results of the baildown testing on the second day (i.e., return of groundwater into the well but not LNAPL) support the findings of the first day and the results of the API evaluation spreadsheet. Due to the nature of the data (i.e., the minimal return of LNAPL into MW-11D during the baildown test of December 19, 2012), evaluation with the API spreadsheet yielded very low values for the LNAPL transmissivity. The average LNAPL transmissivity value, as calculated by the three methods mentioned above, was 0.02±0.01 square feet per day (ft^2/day). Guidance documents on LNAPL (ITRC 2009) suggest that LNAPL with a transmissivity of less than 0.1 ft^2/day indicates that appreciable quantities of LNAPL cannot be recovered and there is little migration risk.

The extracted LNAPL and other investigation-derived waste generated during the field activities, including decontamination or rinse water, were stored temporarily at the Site in labeled, Department of Transportation-approved 55 gallon drums until disposal.

CPT/ LIF Investigation to Characterize Extent of LNAPL

ARCADIS mobilized to the Site on January 14, 2013 with Gregg Drilling and Testing, Inc. (Gregg) to complete the advancement of one soil boring near existing well MW-11D using a cone penetrometer test (CPT) drilling rig equipped with a laser-induced fluorescence (LIF) tool.

The LIF system was used to screen for petroleum hydrocarbons in subsurface soils to assist in delineation of LNAPL in the vicinity of well MW-11D. Petroleum hydrocarbons contain compounds that fluoresce when excited by ultraviolet light (light at a specific wavelength generated from a laser). The LIF system uses a pulsed laser mounted internally within a probe that is pushed into the ground with a truck-mounted CPT rig. The laser causes certain aromatic petroleum hydrocarbons to fluoresce, the intensity of which is measured with an optical detector that is also located internal to the CPT probe. Soils impacted with petroleum hydrocarbons will exhibit fluorescence intensity that is proportional to the contaminant concentration, thus allowing the presence of LNAPL to be inferred. This drilling technology allows for the “real-time” collection of lithologic data as well as indicators for hydrocarbon-affected sediments.

CPT is performed simultaneously with the LIF system, and provides physical/electrical measurements of parameters from which lithology is inferred via an automated interpretation program. The CPT cone measures cone tip resistance and sleeve friction from which the corresponding lithologic profile (e.g., clay, sand, and silt) is interpreted.

Prior to initiating drilling activities, ARCADIS obtained a drilling permit (permit number 2012149) from the Zone 7 Water Agency. The location of the boring was marked out and a USA North utility clearance ticket was generated (ticket number 466269). Additionally, ARCADIS subcontracted with a private utility locator (Subdynamic Locating Services, Inc.) to identify the presence of public and private utilities in the vicinity of the boring location. Prior to advancement of the CPT/LIF, the boring location was hand augured to 5 feet bgs to ensure that a utility line was not present. At the time of the advancement of the boring, the groundwater level was approximately 4 feet bgs; therefore, there was a portion of the subsurface near the groundwater interface that could not be fully characterized using the CPT/LIF.

The CPT/LIF boring (LIF-1 as shown on Figure 2) was advanced approximately 2 feet northwest of monitoring well MW-11D. The CPT/LIF equipment was advanced to a depth of 36 feet bgs, in order to fully characterize the vertical extent of petroleum-impacted soils. The response from the CPT indicated the presence of clays and silt from 5 to 7 feet bgs underlain by lenses of sand and silty sand to 36 feet bgs (Attachment 4). Of note was the presence of two thin layers of consolidated sand or clayey sand at approximately 20 to 21 feet bgs. The silty gravel layer noted in the boring log (Attachment 5) of monitoring well MW-11D from approximately 13 to 21 feet bgs was not seen with the CPT in soil boring LIF-1.

The response from the LIF equipment indicated the potential presence of petroleum-impacted soil from approximately 8 to 26 feet bgs (Attachment 4). The greatest response from the LIF was at approximately 19 feet bgs. While the magnitude of the LIF response cannot be directly correlated to concentrations of various compounds in soil, generally, a greater LIF response indicates the potential for a greater concentration of petroleum hydrocarbons in soil.

The interval of greatest LIF response is consistent with the screened interval of well MW-11D (approximately 15.5 to 20.5 feet bgs). This screen interval is within the estimated potential vertical extent of petroleum hydrocarbons from 8 to 26 feet bgs, as determined by the LIF response. As indicted in the log for the LIF boring, there were thinner intervals that had a greater response to the LIF. These areas of greater LIF response are consistent with isolated intervals of petroleum hydrocarbons and not a large “pool” of LNAPL.

The distribution of the LIF responses against the known standard indicates that the soil is impacted with heavier-end petroleum, which is consistent with the results of the LNAPL laboratory analysis. The LIF results indicate that the vertical extent of the potentially petroleum-impacted soil is approximately 18 feet thick and lies beneath the current water table.

Soil boring LIF-1 was completed by injecting grout within the water column, up to equal level with the ground surface. A representative from the Zone 7 Water Agency was present to approve the boring completion.

Evaluation of the Integrity of Monitoring Well MW-11D

One concern raised by the ACEH was the integrity of MW-11D and its ability to prevent LNAPL from entering shallower intervals above the well screen. Based on the visual observations made of MW-11D at the time of these field activities, the integral structure of the monitoring well is in good condition. There are some signs of wear on the traffic-rated well box and other surficial portions of the well. However, the grouting associated with completing the seal within the subsurface and the PVC riser at the surface appeared to be in good condition. Based on the results for the LIF related to the screened interval of well MW-11D, and the integrity of the PVC riser, any movement of LNAPL within the annulus of MW-11D above the screened interval is not anticipated to migrate outward from MW-11D.

Recommendations

While the presence of LNAPL has been observed in monitoring well MW-11D, the assessment detailed herein indicates that the nature of the LNAPL is a highly weathered diesel with limited transmissivity (i.e., not mobile). Based on the high degree of microbial degradation identified within the LNAPL, it is anticipated that the original release of LNAPL occurred in the distant past. The anticipated source of the LNAPL is the former USTs; there is no indication that there is an ongoing source of LNAPL at the Site. Therefore, the mass of residual LNAPL remaining in the subsurface is expected to decrease with time and remain within the area it currently occupies.

The small values of LNAPL transmissivity calculated by the API worksheet indicate the potential for the residual LNAPL within the subsurface to be mobile is low. Based on this (and assuming the current site conditions remain the same), it is not anticipated that the LNAPL will move laterally within the subsurface and impact other areas of the Site.

The results of the LIF investigation indicate the vertical extent of potentially petroleum-impacted soil within this area is approximately 18 feet thick. The screen interval of monitoring well MW-11D lies within this vertical interval; therefore, it is not anticipated that LNAPL within MW-11D will move vertically to impact a new area. The integrity of monitoring well MW-11D remains intact. While there are some indications of needed repair to the well box and other surface features, there is no indication that the integrity of the subsurface construction has been compromised. Therefore, further migration of LNAPL through cracks or other imperfections in the well construction of MW-11D is not anticipated.

Given the nature and characteristics of the LNAPL in the vicinity of monitoring well MW-11D and the current site usage, ARCADIS recommends that the case be granted a letter of no further action related to the Alameda County Case No. RO0000207 and GeoTracker Global ID T0600102092. As part of the case closure process Hanson will prepare/conduct the following:

- A soil and groundwater management plan to provide methods for handling the petroleum hydrocarbon-affected soil and groundwater in this portion of the Site;

- A land use covenant to be recorded with the deed for the property that will document the presence of the LNAPL near well MW-11D and reference the soil and groundwater management plans; and

- Abandonment of the existing groundwater monitoring wells.

Closing

If you have questions regarding this letter or the project in general, please call me at 510.652.4500.

Sincerely,
ARCADIS U.S., Inc.

PROFESSIONAL GEOLOGIST
RONALD E. GOLOUBOW
No.8655
STATE OF CALIFORNIA
Expires Nov. 30, 2013

Ron Goloubow, P.G.
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Jennifer Nyman, ARCADIS
Fred Stanin, ARCADIS

Attachments:

Table 1. Groundwater Elevation Data (December 19, 2012)

Table 2a. MW-11D Product Baildown Test #1

Table 2b. MW-11D Product Baildown Test #2

Figure 1. Site Location Map

Figure 2. Site Plan

Attachment 1. Laboratory Analytical Results

Attachment 2. ARCADIS' Standard Operating Procedure for LNAPL Baildown Test, Rev. # 2, January 14, 2010

Attachment 3. American Petroleum Institute's Baildown Test - Transmissivity Evaluation Spreadsheet

Attachment 4. CPT and LIF Report

Attachment 5. Monitoring Well MW-11D Boring Log and Well Completion Details

References:

ARCADIS. 2011. Fourth Quarter 2010 Air Injection System and Groundwater Monitoring Report. March 18.

ARCADIS. 2012. Response to Alameda County Environmental Health Public Comments for Fuel Leak Case No. RO0000207 and GeoTracker Global ID T0600102092, Mission Valley Rock and Asphalt, 7999 Athenour Way, Sunol, CA 94586. June 1.

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Tables

Table 1
Groundwater Elevation Data (December 19, 2012)
Mission Valley Rock Company
Sunol, California

Well ID	Casing Diameter (inches)	Depth to Product (feet below TOC)	Depth to Water (feet below TOC)	Total Depth (feet below TOC)	Screened Interval (feet bgs)	Measuring Point Elevation (feet MSL)	Corrected Depth to Water (feet below TOC)	Groundwater Elevation (feet MSL)
MW-1	2	---	Not accessible	17.78	5.0 - 20.0	258.68	Not accessible	---
MW-2S	2	3.57	3.61	8.71	3.0-8.0	258.84	3.65	255.19
MW-2M	2	---	3.74	12.29	14.0-19.0	258.99	3.74	255.25
MW-2D	2	4.08	4.14	29.54	25.0-30.0	258.91	4.19	254.72
MW-3	2	---	4.85	14.70	5.0-20.0	259.08	4.85	254.23
MW-4S	2	---	Not accessible	8.35	3.0-8.0	259.14	Not accessible	---
MW-4D	2	---	Not accessible	23.38	17.0-22.0	259.22	Not accessible	---
MW-5S	2	---	Not measured	8.24	3.0-8.0	259.43	Not measured	---
MW-5D	2	---	Not measured	22.65	17.0-22.0	259.40	Not measured	---
MW-6S	2	---	4.52	15.00	5.0-15.0	258.75	4.52	254.23
MW-6D	2	---	4.56	29.15	24.5-29.5	259.27	4.56	254.71
MW-7S	2	---	3.12	8.48	5.0-8.0	258.84	3.12	255.72
MW-7D	2	---	3.77	23.61	20.0-25.0	258.80	3.77	255.03
MW-8	2	---	2.97	15.30	5.0-15.0	258.84	2.97	255.87
MW-9S	2	---	2.62	12.20	5.3-12.3	258.41	2.62	255.79
MW-9D	2	---	3.64	24.28	18.9-23.9	258.86	3.64	255.22
MW-9LF	2	---	3.76	39.11	33.3-38.3	258.94	3.76	255.18
MW-10S	2	---	5.08	9.58	4.8-9.8	260.67	5.08	255.59
MW-10D	2	---	5.73	19.38	15.5-20.5	260.64	5.73	254.91
MW-10LF	2	---	6.48	39.90	34.4-39.4	260.58	6.48	254.10
MW-11S	2	---	4.22	9.43	4.8-9.8	258.96	4.22	254.74
MW-11D	2	4.36	4.60	20.50	15.3-20.3	258.98	4.81	254.17
MW-11LF	2	---	4.70	39.41	32.8-37.8	259.01	4.70	254.31
MW-12S	2	---	6.79	11.04	4.6-11.6	262.69	6.79	255.90
MW-12D	2	---	6.49	19.70	16.0-21.0	262.70	6.49	256.21
MW-12LF	2	---	6.82	39.50	33.7-38.7	262.90	6.82	256.08
OXY-1S	2	---	Not measured	17	15-17	---	Not measured	---
OXY-1D	2	---	Not measured	32	30-32	---	Not measured	---
OXY-1LF	2	---	Not measured	44.5	42.5-44.5	---	Not measured	---

Notes:

1. Screened intervals are approximated. Screened interval in wells is lower than the measured total depth due to silting in the bottom of wells.
2. The measurement point for the above wells is the north side of the top of casing.
3. Groundwater Elevation = Measurement Point Elevation - Depth to Water.
4. TOC = Top of Casing
5. bgs = Below Ground Surface
6. MSL = Mean Sea Level

Table 2a
MW-11D Product Baildown Test #1
Mission Valley Rock Company
Sunol, California

Elapsed Time (minutes)	Depth to Product (feet below TOC)	Depth to Water (feet below TOC)	Product Thickness (feet)
1	---	4.51	0.00
2	---	4.51	0.00
3	---	4.50	0.00
4	---	4.48	0.00
5	---	4.46	0.00
6	---	4.45	0.00
7	---	4.44	0.00
8	---	4.44	0.00
9	4.43	4.44	0.01
10	4.43	4.44	0.01
11	4.42	4.43	0.01
14	4.41	4.42	0.01
17	4.41	4.42	0.01
22	4.40	4.41	0.01
27	4.40	4.41	0.01
32	4.40	4.41	0.01
42	4.39	4.40	0.01
52	4.39	4.40	0.01
62	4.39	4.40	0.01
72	4.38	4.39	0.01
82	4.38	4.39	0.01
92	4.38	4.39	0.01
107	4.38	4.39	0.01
137	4.38	4.39	0.01
266	4.33	4.34	0.01
301	4.33	4.34	0.01
828	4.23	4.24	0.01

Notes:

1. Screened intervals are approximated. Screened interval in wells is lower than the measured total depth due to silting in the bottom of wells.
2. The measurement point for the above wells is the north side of the top of casing.
3. Groundwater Elevation = Measurement Point Elevation - Depth to Water.
4. TOC = Top of Casing

Table 2b
MW-11D Product Baildown Test #2
Mission Valley Rock Company
Sunol, California

Elapsed Time (minutes)	Depth to Product (feet below TOC)	Depth to Water (feet below TOC)	Product Thickness (feet)
0.0	---	12.45	0.00
0.3	---	11.50	0.00
0.8	---	10.30	0.00
1.3	---	9.45	0.00
2.0	---	8.50	0.00
2.6	---	7.80	0.00
3.6	---	7.10	0.00
4.5	---	6.65	0.00
5.8	---	6.15	0.00
7.0	---	5.80	0.00
8.5	---	5.53	0.00
11.0	---	5.25	0.00
15.0	---	5.00	0.00
19.5	---	4.82	0.00
31.0	---	4.61	0.00
38.5	---	4.55	0.00
46.8	---	4.48	0.00
52.5	---	4.45	0.00
59.5	---	4.41	0.00
80.0	---	4.35	0.00
0.0	---	14.20	0.00
0.3	---	13.00	0.00
0.8	---	11.80	0.00
1.2	---	11.00	0.00
1.5	---	10.00	0.00
2.2	---	9.00	0.00
3.0	---	8.00	0.00
4.5	---	7.00	0.00
6.6	---	6.00	0.00
8.5	---	5.50	0.00
13.3	---	5.00	0.00
15.4	---	4.88	0.00
22.0	---	4.66	0.00
30.5	---	4.53	0.00
36.2	---	4.48	0.00
50.0	---	4.38	0.00

Notes:
1. Screened intervals are approximated. Screened interval in wells is lower than the measured total depth due to silting in the bottom of wells.
2. The measurement point for the above wells is the north side of the top of casing.
3. Groundwater Elevation = Measurement Point Elevation - Depth to Water.
4. TOC = Top of Casing

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Figures

HANSON AGGREGATES, 7999 ATHENOUR WAY, SUNOL, CALIFORNIA

SITE LOCATION MAP

ARCADIS

FIGURE 1

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Emeryville\ACT\EM009480\0012\DWG\EM009480 B06.dwg LAYOUT: 2 SAVED: 1/22/2013 10:27 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 2/1/2013 10:18 AM BY: REYES, ALEC
XREFS: IMAGES: PROJECTNAME: ----
Google Earth image August 2012.jpg

EXPLANATION:

MW-9S	Groundwater monitoring well (single completion; well cluster)
MW-7S/7D	Groundwater monitoring well (dual nested)
MW-2S/2M/2D	Groundwater monitoring well (triple nested)
MW-2	Abandoned groundwater monitoring well
TB-6	Grab groundwater sample location
SB-4	Temporary soil boring location
B-2	Sonic boring / grab groundwater
MIP-3	MIP boring / grab groundwater
OXY-1S	Air injection well (approximate location)
SG-1	Soil gas monitoring probe (approximate location)
LIF-1	CPT/LIF boring location

AST = Aboveground storage tank
UST = Underground storage tank
MIP = Membrane Interface Probe
CPT = Cone Penetrometer
LIF = Laser induced Fluorescence

HANSON AGGREGATES, SUNOL, CALIFORNIA

SITE PLAN

ARCADIS

FIGURE
2

ARCADIS

Attachments

Attachment 1

Laboratory Analytical Results

PTS Laboratories, Inc.

8100 Secura Way • Santa Fe Springs, CA 90670
Telephone (562) 347-2500 • Fax (562) 907-3610

January 8, 2013

Ron Goloubow
ARCADIS
2000 Powell Street, Suite 700
Emeryville, CA 94608

Re: PTS File No: 42958
Physical Properties Data
Hanson Aggregates; EM009480.0016

Dear Mr. Goloubow:

Please find enclosed report for Physical Properties analyses conducted upon the sample received from your Hanson Aggregates; EM009480.0016 project. All analyses were performed by applicable ASTM, EPA, or API methodologies. An electronic version of the report has previously been sent to your attention via the internet. The sample is currently in storage and will be retained for thirty days past completion of testing at no charge. Please note that the sample will be disposed of at that time. You may contact me regarding storage, disposal, or return of the sample.

PTS Laboratories appreciates the opportunity to be of service. If you have any questions or require additional information, please contact Rachel Spitz at (562) 347-2504.

Sincerely,
PTS Laboratories

For Rachel S

Michael Mark Brady, P.G.
District Manager

Encl.

PTS Laboratories

Project Name: Hanson Aggregates
Project Number: EM009480.0016

PTS File No: 42958
Client: ARCADIS

TEST PROGRAM - 20121221

FLUID ID	Date	Time	Fluid Type	Fluid Properties Pkg.	Fluid Cleaning	OILPRINT™ FSCOT		
Method:				ASTM D1481, 445, 971	Proprietary	IP 318/75M		
Date Received: 20121221								
MW-11D LNAPL	20121219	0900	LNAPL	X	X	X		
MW-11D WATER	20121219	1400	Water					
TOTALS:				1	1	1		

Laboratory Test Program Notes

Standard TAT for basic analysis is 10 business days.

Fluid Properties Package - LNAPL & Water: Includes dynamic viscosity and fluid density at three temperatures (70, 100, 130°F), surface tension for each fluid, and interfacial tensions (three phase pairs; oil/water, oil/air, and water/air (at ambient laboratory temperature)).

PTS File No: 42958
Client: ARCADIS

PTS Laboratories

VISCOSITY, DENSITY, and SPECIFIC GRAVITY DATA

(METHODOLOGY: ASTM D445, ASTM D1481, API RP40)

PROJECT NAME: Hanson Aggregates
PROJECT NO: EM009480.0016

SAMPLE ID	MATRIX	TEMPERATURE, °F	SPECIFIC GRAVITY	DENSITY, g/cc	VISCOSITY	
					centistokes	centipoise
MW-11D WATER	Water	70	1.000	0.9980	1.02	1.02
		100	1.001	0.9939	0.717	0.713
		130	1.000	0.9859	0.514	0.506
MW-11D LNAPL	NAPL	70	0.8776	0.8758	8.26	7.23
		100	0.8721	0.8660	4.95	4.29
		130	0.8636	0.8515	3.30	2.81

PTS File No: 42958

Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: DuNuoy Method - ASTM D971)

PROJECT NAME: Hanson Aggregates

PROJECT NO: EM009480.0016

PHASE PAIR		TEMPERATURE, °F	INTERFACIAL TENSION, Dynes/centimeter
SAMPLE ID / PHASE	SAMPLE ID / PHASE		
MW-11D WATER	Air	70.7	61.8
MW-11D LNAPL	Air	70.9	24.1
MW-11D WATER	MW-11D LNAPL	70.9	16.3

QUALITY CONTROL DATA

PHASE PAIR:	DIWATER / AIR
TEMPERATURE, °F:	70.7
IFT, MEASURED:	72.4
IFT, PUBLISHED:	72.5
RPD:	-0.11

PTS File No: 42958
Client: ARCADIS
Project Name: Hanson Aggregates
Project No: EM009480.0016
Date: January 3, 2013

Hydrocarbon Characterization

Introduction

An LNAPL sample identified as MW-11D was received for hydrocarbon characterization.

Conclusions

The sample can be clearly identified as a severely weathered diesel. Degradation from bacterial action has removed all traces of normal paraffin compounds. It contains a small amount of gasoline fraction (C_4 – C_9) amounting to probably less than 1 percent. The bulk of the hydrocarbons lie in the C_{10} – C_{18} fraction with a few percent of heavier components out to C_{24}. This is a typical hydrocarbon distribution for most diesels. The presence of large isoprenoid peaks (pristine and phytane) suggests that the diesel was derived from a modestly paraffinic crude oil.

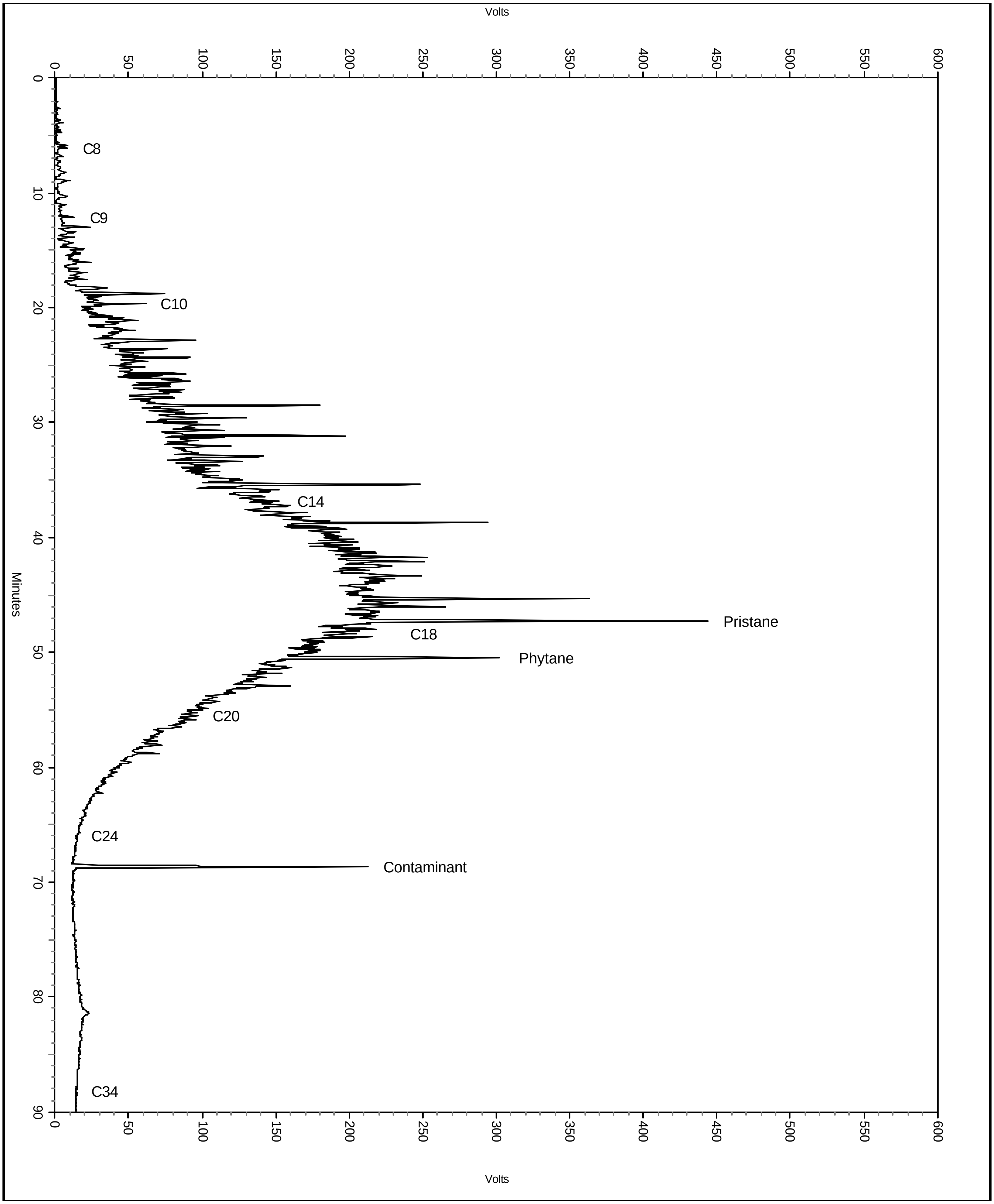
Analyses and Discussion

The sample was analyzed by OILPRINT^{TM} to obtain information on the detailed hydrocarbon composition of the C_2 – C_{34} fraction. The data are presented in Figure 1. This is a reduced scale copy of the chromatogram with some peak identities added.

L.W. Slentz

PTS File No.: 42958 FIGURE 1

Sample ID: MW-11D LNAPL_537



PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

COMPANY: ARCADIS

ADDRESS: 2000 POWELL ST #700 | CITY: EMERYVILLE | ZIP CODE:

PROJECT MANAGER: CAITLIN BELL

PROJECT NAME: HANSON AGGREGATES | PHONE NUMBER: 857-488-0490

PROJECT NUMBER: EM009480.0016 | FAX NUMBER:

SITE LOCATION: SUNOL, CA

SAMPLER SIGNATURE: Caitlin Bell

PO#:

TURNAROUND TIME: 24 HOURS ☐ 48 HOURS ☐ 72 HOURS ☐ 5 DAYS ☐ NORMAL ☒ OTHER: ______

SAMPLE INTEGRITY (CHECK): INTACT ✓ ON ICE ✓

PTS QUOTE NO.: 12-146

PTS FILE: 42958

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	OIL PRINT	COMMENTS
MW-11D LNAPL	12/19/12	0900								X												X	2°C
MW-11D WATER	12/19/12	1400								X													

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Caitlin Bell	[signature]		
COMPANY: ARCADIS	COMPANY: PTS	COMPANY:	COMPANY:
DATE: 12/19/12 TIME: 1600	DATE: 12/21/12 TIME: 1413	DATE: TIME:	DATE: TIME:

ARCADIS

Attachment 2

ARCADIS' Standard Operating Procedure for LNAPL Baildown Test, Rev. # 2, January 14, 2010

Imagine the result

Standard Operating Procedure for LNAPL Baildown Test

Rev. # 2

Rev. Date: January 14, 2010

Approval Signatures

Prepared by: ______________________ Date: January 14, 2010

Jonathon J. Smith

Reviewed by: ______________________ Date: January 14, 2010

Brad W. Koons, P.E.

I. Scope and Application

The objective of this Standard Operating Procedure (SOP) is to establish uniform procedures for conducting rising-head light non-aqueous-phase liquid (LNAPL) baildown tests to evaluate LNAPL conductivity (K_n) in the subsurface at a specific well location. The data generated from the LNAPL baildown test can be used, along with other site data, to evaluate LNAPL mobility and recoverability at a site. This SOP describes the equipment, field procedures, materials and documentation procedures necessary to determine LNAPL conductivity. The details within this SOP should be used in conjunction with project work plans.

This SOP applies to task orders and projects associated with ARCADIS. This SOP may be modified, as required, depending on site-specific conditions, equipment limitations or limitations imposed by the procedure. The ultimate procedure employed will be documented in the appropriate project work plans or reports. If changes to the testing procedures are required due to unanticipated field conditions, the changes will be discussed with the project manager as soon as practicable and documented in the project report.

II. Personnel Qualifications

Only qualified ARCADIS-related personnel will conduct LNAPL baildown tests. ARCADIS field sampling personnel will have sufficient "hands-on" experience necessary to successfully complete the LNAPL baildown test field work. Training requirements for conducting LNAPL baildown tests include reviewing this SOP and other applicable SOPs and/or guidance documents, instrument calibration training, and health and safety training.

ARCADIS field sampling personnel will have completed current company-required health and safety training (e.g., 40-hour Hazardous Waste Operations training, site-specific training, first aid and cardiopulmonary resuscitation (CPR) training), as needed.

III. Equipment List

Equipment and materials used for conducting the LNAPL baildown tests may include, but are not limited to, the following:

- appropriate personal protective equipment (PPE), as specified in the site Health and Safety Plan (HASP)
- equipment decontamination supplies
- photoionization detector (PID) (see ARCADIS SOP: Photoionization Detector Air Monitoring and Field Screening)
- plastic sheeting
- oil absorbent pads
- stopwatch
- polypropylene rope
- clean disposable bailers
- oil-specific skimmer pump
- vacuum truck
- plastic bucket with lid
- plastic beakers or graduated cylinders (appropriately sized for anticipated NAPL/water recovery volume)
- Calculator
- appropriate field logs/forms
- oil-water interface probe (see ARCADIS SOP: Water Level Measurement)
- data logger and transducer
- white masking tape

- measuring tape with gradation in hundredths of a foot
- indelible ink pen
- monitoring well keys
- bolt cutters
- monitoring well locks
- field log book or PDA or field (computer) notebook

IV. Cautions and Procedure Considerations

Wells containing LNAPL for baildown testing should be selected based on project-specific objectives and a review of historical site data. It is good practice to select several baildown test wells to bracket the range of observed historical apparent LNAPL thickness measurements and LNAPL mobility/recoverability conditions across a given area. As a rule of thumb, apparent LNAPL thicknesses in wells used for baildown tests should be greater than or equal to the borehole diameter (Lundy and Parcher, 2007). Additional guidelines for selecting appropriate wells for LNAPL baildown testing include:

- Select wells located near the interior and exterior portions of the LNAPL plume(s)
- Select wells located in a variety of geologic materials, as feasible
- Consider the position of wells relative to groundwater and LNAPL flow direction
- Consider the potential of wells to exhibit different equilibrated apparent LNAPL thicknesses
- Select wells which contain different types of LNAPL, if present

In addition, understanding the areas affected by recent remediation efforts should be considered because these areas may not be representative of static subsurface conditions. Also, ARCADIS field sampling personnel must be aware of historical fluid levels as they compare to the conditions at the time of testing (i.e., the smear zone).

If higher LNAPL recovery rates are expected, larger diameter wells (4- to 6-inch-diameter casings) are generally preferred. The increased area of the wellbore seepage face for larger diameter wells will provide information that is applicable to a larger, more representative volume of aquifer material. However, if the expected recovery rate is low, smaller diameter wells are often preferred because the volume of the borehole is smaller relative to the formation recovery capacity. Further discussion on accounting for the well filter pack is presented in *A Protocol for Performing Field Tasks and Follow-up Analytical Evaluation for LNAPL Transmissivity using Well Baildown Procedures* (Beckett and Lyverse, 2002).

ARCADIS project personnel must confirm that the test wells have been properly developed. This cannot be overemphasized, as incomplete well development results in underestimates of LNAPL transmissivity (T_n) and LNAPL conductivity (K_n). See the ARCADIS SOP titled *Monitoring Well Development* for additional details.

ARCADIS field sampling personnel must verify that the air/LNAPL and LNAPL/groundwater interfaces occur within the screen interval. At a minimum, the piezometric head elevation in the well should occur below the top of the screen.

ARCADIS field sampling personnel will choose the most appropriate technique to evacuate the LNAPL from the well. These techniques include:

- **Manual bailer** — A 1¾-inch-diameter bailer will be used for 2-inch-diameter wells. For 4-inch-diameter wells, a 3-inch-diameter bailer will be used for LNAPL recovery. ARCADIS highly recommends using product recovery cups, which attach to the bottom of the bailer and maximize the surface area for LNAPL recovery (For example, the Superbailer™, manufactured by EON Products, Inc. has this feature built-in). This will allow for more complete LNAPL removal and more accurate recovery measurements.

- **Pumping** — LNAPL removal can be accomplished by using an oil-specific skimmer pump that operates at a pumping rate which exceeds the LNAPL recharge capacity. For shallow wells (< 25 feet below ground surface), a peristaltic pump may also be a useful, effective and appropriate mode of LNAPL removal.

- **Vacuum Truck** — If large LNAPL volumes are to be removed or extremely rapid recovery rates are anticipated, LNAPL removal can be accomplished using a vacuum truck. The vacuum extraction line is to be outfitted with a small-diameter stinger attachment that will be extended down the well and an in-line site glass to observe extracted fluid color for determination of whether LNAPL or groundwater is being extracted. Begin pumping at the LNAPL/air interface and slowly move the stinger tube downward to extract LNAPL. When groundwater recovery is observed indicating that the LNAPL has been evacuated withdraw the stinger tube and begin fluid level measurements.

Follow the sequential steps below for each baildown test well. Data collection is generally manual using an interface probe, although a data logger can also be used as long as it can sense either the fluid interfaces or the head change only with respect to LNAPL. Before performing an LNAPL baildown test, allow monitoring well water and LNAPL levels to equilibrate with atmospheric pressure. Gauge fluid levels periodically for 5 to 10 minutes to monitor changes in head. Monitoring wells without vents (flush mounts) may require more time to equilibrate with atmospheric pressure following well cap removal.

ARCADIS recommends taking LNAPL measurements initially in one-minute intervals and then adjusting the frequency of measurements thereafter, based on site-specific conditions. The rate of LNAPL recovery will usually slow over time unless the zone of interest is highly conductive. Once the rate of recovery is slow enough, a new baildown test can be initiated at another location, returning to take periodic measurements at the initial test well. Continue this process as long as it is viable based on soil characteristics, field logistics, well locations and data collection needs. Real-time examination of the data curves is the best indicator of data sufficiency. A plot of the change in LNAPL thickness over time may exhibit up to three theoretical segments:

1) initial steep segment that could reflect filter pack drainage

2) main production segment where the formation LNAPL gradient to the wells controls recovery

3) third segment where the diminishing formation LNAPL gradient produces a flatter recovery curve

Repeatedly introducing the oil-water interface indicator may alter the fluid-level measurements. Avoid splashing the probe into the water table or lowering the probe too far beyond the LNAPL-water interface depth. To avoid introducing surface soil or other material into the monitoring well, stage downhole equipment on a clean and dry working surface.

Two field personnel are recommended to adequately perform this test, one person to collect the data and one person to record the data.

V. Health and Safety Considerations

Overall, the Loss Prevention System™ (LPS) tools and the site-specific HASP will be used to guide the performance of LNAPL baildown tests in a safe manner without incident. A Job Safety Analysis (JSA) will be prepared for LNAPL baildown tests. The following specific health and safety issues must be considered when conducting LNAPL baildown tests:

- Monitoring for volatile organic compounds (VOCs) in the monitoring well head space must be conducted with a PID and recorded in the field logbook prior to initiating the LNAPL baildown test. PID readings will be compared to action levels established in the site HASP for appropriate action.

- Appropriate PPE must be worn to avoid contact with LNAPL during the baildown test.

- LNAPL removed from the test well must be managed with caution to avoid igniting the LNAPL material. LNAPL characteristics must be reviewed in the JSA, which will be prepared and reviewed by the project team prior to implementing the baildown test.

- LNAPL generated during the baildown test must be properly managed in accordance with facility and applicable regulatory requirements.

- Well covers must be carefully removed to avoid potential contact with insects or animals nesting in the well casings.

VI. Procedure

Specific procedures for conducting LNAPL baildown tests are presented below:

1. Identify site, well number, date and time on the LNAPL Baildown Test Log and field logbook or PDA, along with other appropriate LNAPL baildown testing information. An example LNAPL Baildown Test Log is provided in Attachment 1 to this SOP.

2. Place clean plastic sheeting and several oil absorbent pads on the ground next to the well.

3. Unlock and open the monitoring well cover while standing upwind from the well.

4. Measure the concentration of detectible organics present in the worker breathing zone immediately after opening the well using a PID. If the PID reading(s) exceed the thresholds provided in the HASP, take appropriate actions per the HASP. After monitoring the worker breathing zone, proceed to

monitor the well head space with the PID and record the PID reading in the field logbook.

5. Prepare a test log to record LNAPL recovery data. Initially, data should be collected very frequently. As time progresses and the LNAPL recovery rate slows, less frequent measurements will be required. In most cases, initial measurement increments of 1 minute are sufficient, with subsequent measurements farther apart as appropriate, based on observed rate of recovery during the first few readings. If LNAPL recovery rates are high, data should be collected more frequently. For lower LNAPL recovery rates, time intervals between measurements can be increased.

6. It is important to monitor rapid LNAPL recovery at a higher frequency, again as indicated by the observed recovery data.

7. Secure one end of the rope to the bailer and the other end to the well casing using a bowline knot.

8. Before beginning the baildown testing, measure and record static fluid levels using the oil/ water interface probe (i.e., depth to LNAPL and depth to groundwater) and document the well construction details. Using the conversion chart at the bottom of the test log, the measured LNAPL thickness and the well diameter, calculate and record the initial LNAPL volume in the well. Gauge fluid levels periodically for 5 to 10 minutes to monitor changes in head. Do not begin the test until the well has equilibrated. Ideally, one person will be responsible for lowering the bailer into the well and recording time intervals in the log, and another person will be responsible for lowering the water-level probe into the well and measuring and communicating water-level depths to the person recording information in the log.

9. To begin baildown testing, slowly lower the bailer or equivalent into the well until it is just below the LNAPL-water interface.

10. Set stopwatch. Wait to start the stopwatch until immediately after LNAPL removal is finished.

11. Evacuate LNAPL from the well by gently bailing, pumping, or vacuum recovery as described in Section IV above while minimizing water production. One of the assumptions employed in the analysis of the baildown test data is that the LNAPL is removed from the well instantaneously. Thus, it is important to avoid spending excessive amounts of time (more than 5 minutes) removing LNAPL from the well.

12. Record the time at which LNAPL removal is complete (or removed to the maximum practical extent) as the test start time. Begin measuring the elapsed time, starting with this point. Monitor depth to LNAPL and depth to water at the appropriate intervals, as discussed above (5). Measure fluid levels to the nearest hundredth of a foot with the oil-water interface probe and record, along with the corresponding time reading in minutes and seconds.

13. Transfer the LNAPL and groundwater evacuated from the well into an appropriately sized beaker or graduated cylinder. Record the volumes of LNAPL and groundwater on the Baildown Test Log (Attachment 1). If an LNAPL/water emulsion was formed during fluid recovery, allow time for LNAPL/water separation and make note of the observed emulsification.

14. Two to eight hours of data collection is usually sufficient. However, faster LNAPL recovery need not be monitored for extended periods, and slow recovering wells may benefit from follow-up readings the next day.

15. Place all LNAPL and groundwater collected during the test into an appropriate container for proper waste management.

16. Decontaminate the oil-water level indicator with a non-phosphate detergent and water scrub, a tap water rinse, a reagent grade methanol rinse, a second tap water rinse, a second methanol rinse, a third tap water rinse, and a triple rinse with distilled water (see SOP titled *Field Equipment Decontamination*).

17. Secure the monitoring well prior to leaving by replacing the well cap and/or cover and locking it.

VII. Waste Management

Rinse water, PPE and other waste materials generated during equipment decontamination must be placed in appropriate containers and labeled. Containerized waste will be disposed of in a manner consistent with appropriate waste management procedures for investigation-derived waste.

VIII. Data Recording and Management

ARCADIS field sampling personnel will record data using the LNAPL Baildown Test Log (Attachment 1). All information relevant to the test data beyond the items identified in the Baildown Test Log will be recorded using the field logbook, PDA or field computer. Field equipment decontamination activities and waste management activities will be recorded in the field logbook. Records generated as a result of implementing this SOP will be controlled and maintained in the project record files in accordance with client-specific requirements.

IX. Quality Assurance/Quality Control

ARCADIS project personnel will review the data set collected during the LNAPL baildown test in the field to determine whether or not the data are reasonable given site-specific conditions. For example, if the data indicates that LNAPL recovery is very rapid in a very low-permeability soil type, this may indicate that there are problems with the data set. If the data are questionable, the field equipment must be checked to confirm it is working properly and the test will be repeated, if possible. Depending on data quality objectives, a duplicate LNAPL baildown test may be conducted as a quality control check 48 hours after the initial test, assuming water levels and apparent LNAPL thicknesses have returned to static conditions.

Any issues that may affect the data must be recorded in the field log book so that analysts can consider those issues when processing the data.

X. References

Beckett, G.D. and Lyverse, M.A. 2002. *A Protocol for Performing Field Tasks and Follow-up Analytical Evaluation for LNAPL Transmissivity using Well Baildown Procedures, August 2002.*

Lundy, D. and Parcher, M. 2007. *Assessment of LNAPL Volume, Mobility and Recoverability for Recovery Systems: Design and Risk-Based Corrective Action. National Ground Water Association Short Course, November 2007.*

ARCADIS SOPs Referenced Herein:

Field Equipment Decontamination, Revision No.1, April, 2009.

Monitoring Well Development, Revision No.2, March, 2008.

Photoionization Detector Air Monitoring and Field Screening, Revision No. 0, July, 2003.

Water Level Measurement, Revision No. 1, March, 2004.

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Attachment 1: LNAPL BAILDOWN TEST LOG

LNAPL Baildown Test Standard Operating Procedure

Site Name		Test Well ID	
Date and Time In		Date and Time Out	
Personnel		Weather	

Well Construction Details

Top of Casing Elevation (ft amsl)		Screen Slot Size (in)	
Total Well Depth (ft)		Filter Pack Type	
Depth to Top of Screen (ft)		Depth to Bottom of Screen (ft)	
Well Casing Diameter (in)		Borehole Diameter (in)	

Initial Test Conditions

Static Depth to LNAPL (ft)		Test Date	
Static Depth to Water (ft)		Start Time	
LNAPL Thickness (ft)		Initial LNAPL Volume in Well (gal)	

LNAPL Removal Information

LNAPL Removal Method/Equipment		Time LNAPL Removal Begins	
Volume of LNAPL Removed (gal)		Time LNAPL Removal is Completed	
Volume of Groundwater Removed (gal)			

Baildown Test Data

Elapsed Time (min)	Depth to LNAPL (ft)	Depth to Water (ft)	Observations

(Modified after Beckett and Lyverse, 2002)

Well Casing Volumes	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
(Gal./Ft.)	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Attachment 3

American Petroleum Institute's Baildown Test - Transmissivity Evaluation Spreadsheet

API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

Reset

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

Unconfined

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)

0.02

Standard Deviation (ft^2/d)

0.01

Coefficient of Variation

0.72

Well Designation:	MW-11D	Beckett and Lyverse (2002)
Date:	19-Dec-12	

Ground Surface Elev (ft msl)	259.3	Enter These Data
Top of Casing Elev (ft msl)	259.0	
Well Casing Radius, r_c (ft):	0.083	r_{e1}
Well Radius, r_w (ft):	0.500	
LNAPL Specific Yield, S_y:	0.175	
LNAPL Density Ratio, ρ_r:	0.880	
Top of Screen (ft bgs):	0.0	
Bottom of Screen (ft bgs):	0.0	
LNAPL Baildown Vol. (gal.):	0.0	
Effective Radius, r_{e3} (ft):	0.222	Calculated Parameters
Effective Radius, r_{e2} (ft):	#NUM!	
Initial Casing LNAPL Vol. (gal.):	0.04	
Initial Filter LNAPL Vol. (gal.):	0.24	

Drawdown Adjustment (ft)
-0.13

Enter Data Here

	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)
Initial Fluid Levels:	0	4.36	4.6	4.65	4.89	4.68					0.24	
Enter Test Data:	1.0	4.51	4.51	4.80	4.80	4.80	0.28				0.00	
	2.0	4.51	4.51	4.80	4.80	4.80	0.28	1.5	0.000	0.28	0.00	0.222
	3.0	4.50	4.50	4.79	4.79	4.79	0.27	2.5	0.000	0.27	0.00	0.222
	4.0	4.48	4.48	4.77	4.77	4.77	0.25	3.5	0.000	0.26	0.00	0.222
	5.0	4.46	4.46	4.75	4.75	4.75	0.23	4.5	0.000	0.24	0.00	0.222
	6.0	4.45	4.45	4.74	4.74	4.74	0.22	5.5	0.000	0.22	0.00	0.222
	7.0	4.44	4.44	4.73	4.73	4.73	0.21	6.5	0.000	0.21	0.00	0.222
	8.0	4.44	4.44	4.73	4.73	4.73	0.21	7.5	0.000	0.21	0.00	0.222
	9.0	4.43	4.44	4.72	4.73	4.72	0.20	8.5	2.238	0.20	0.01	0.222
	10.0	4.43	4.44	4.72	4.73	4.72	0.20	9.5	0.000	0.20	0.01	0.222
	11.0	4.42	4.43	4.71	4.72	4.71	0.19	10.5	0.000	0.19	0.01	0.222
	14.0	4.41	4.42	4.70	4.71	4.70	0.18	12.5	0.000	0.19	0.01	0.222
	17.0	4.41	4.42	4.70	4.71	4.70	0.18	15.5	0.000	0.18	0.01	0.222
	22.0	4.4	4.41	4.69	4.70	4.69	0.17	19.5	0.000	0.17	0.01	0.222
	27.0	4.4	4.41	4.69	4.70	4.69	0.17	24.5	0.000	0.17	0.01	0.222
	32.0	4.4	4.41	4.69	4.70	4.69	0.17	29.5	0.000	0.17	0.01	0.222
	42.0	4.39	4.40	4.68	4.69	4.68	0.16	37.0	0.000	0.16	0.01	0.222
	52.0	4.39	4.40	4.68	4.69	4.68	0.16	47.0	0.000	0.16	0.01	0.222
	62.0	4.39	4.40	4.68	4.69	4.68	0.16	57.0	0.000	0.16	0.01	0.222
	72.0	4.38	4.39	4.67	4.68	4.67	0.15	67.0	0.000	0.15	0.01	0.222
	82.0	4.38	4.39	4.67	4.68	4.67	0.15	77.0	0.000	0.15	0.01	0.222
	92.0	4.38	4.39	4.67	4.68	4.67	0.15	87.0	0.000	0.15	0.01	0.222
	107.0	4.38	4.39	4.67	4.68	4.67	0.15	99.5	0.000	0.15	0.01	0.222
	137.00	4.38	4.39	4.67	4.68	4.67	0.15	122.0	0.000	0.15	0.01	0.222
	266.00	4.33	4.34	4.62	4.63	4.62	0.10	201.5	0.000	0.12	0.01	0.222
	301.00	4.33	4.34	4.62	4.63	4.62	0.10	283.5	0.000	0.10	0.01	0.222
	828.00	4.23	4.24	4.52	4.53	4.52	0.00	564.5	0.000	0.05	0.01	0.222

Generalized Bouwer and Rice (1976)

Well Designation:	MW-11D
Date:	19-Dec-12

$$T_n = \frac{r_e^{\,2}\ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

Enter early time cut-off for least-squares model fit

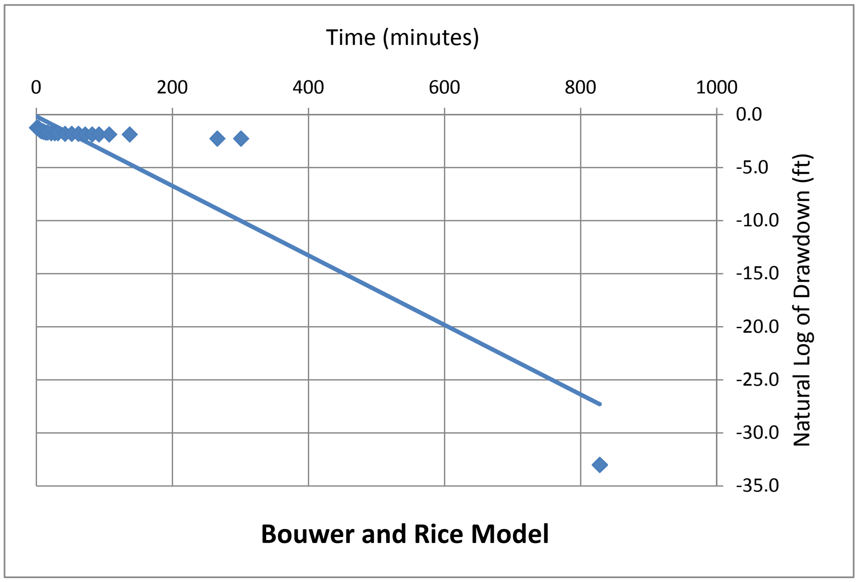
$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.00 +/- 0.00 ft^2/d

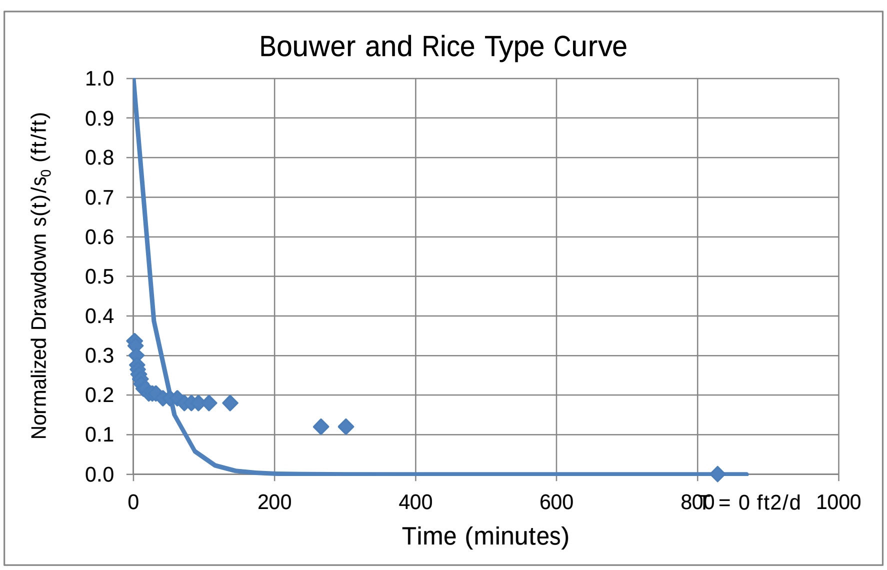
L_e/r_e
1.1
C
0.84
R/r_e
1.07

J-Ratio
-20.000

Coef. Of Variation
0.09



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-11D
Date:	19-Dec-12

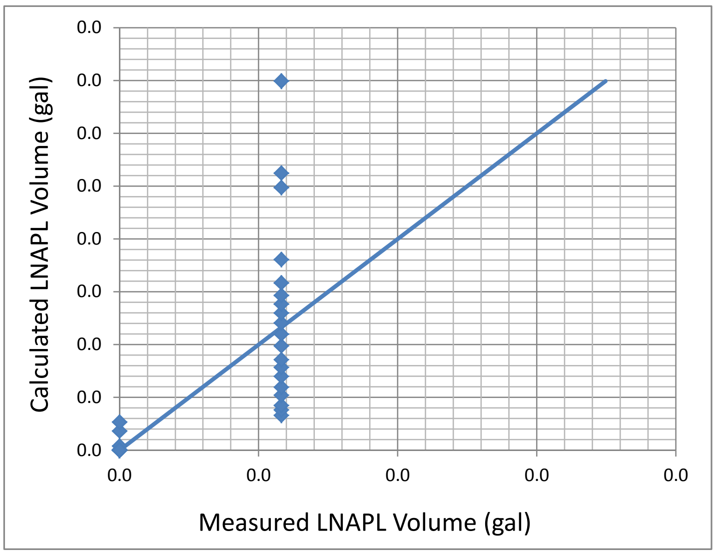
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

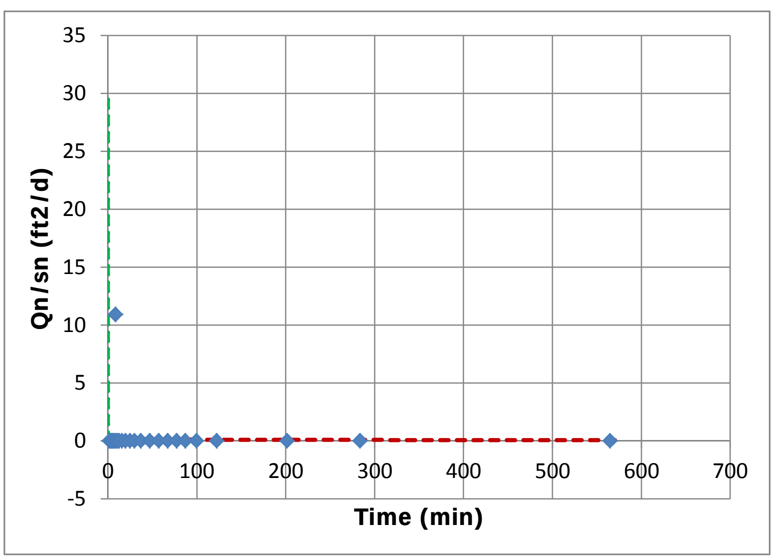
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Time Adjustment (min):	0	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.037	<-- Minimize this using "Solver"
	0.004	<-- Working S_n
Trial T_n (ft^2/d):	0.024	<-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.02**





Height

30

ARCADIS

Attachment 4

CPT and LIF Report

GREGG DRILLING & TESTING, INC.
GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

January 16, 2013

Arcadis
Attn: Caitlin Bell

Subject: CPT Site Investigation
Hanson Aggregates
Sunol, California
GREGG Project Number: 13-009MA

Dear Ms. Bell:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☐
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	UVOST Laser Induced Fluorescence	(UVOST)	☒
5	Groundwater Sampling	(GWS)	☐
6	Soil Sampling	(SS)	☐
7	Vapor Sampling	(VS)	☐
8	Pressuremeter Testing	(PMT)	☐
9	Vane Shear Testing	(VST)	☐
10	Dilatometer Testing	(DMT)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (925) 313-5800.

Sincerely,
GREGG Drilling & Testing, Inc.

Mary Walden
Operations Manager

950 Howe Rd • Martinez, California 94553 • (925) 313-5800 • FAX (925) 313-0302
www.greggdrilling.com

Cone Penetration Test Sounding Summary

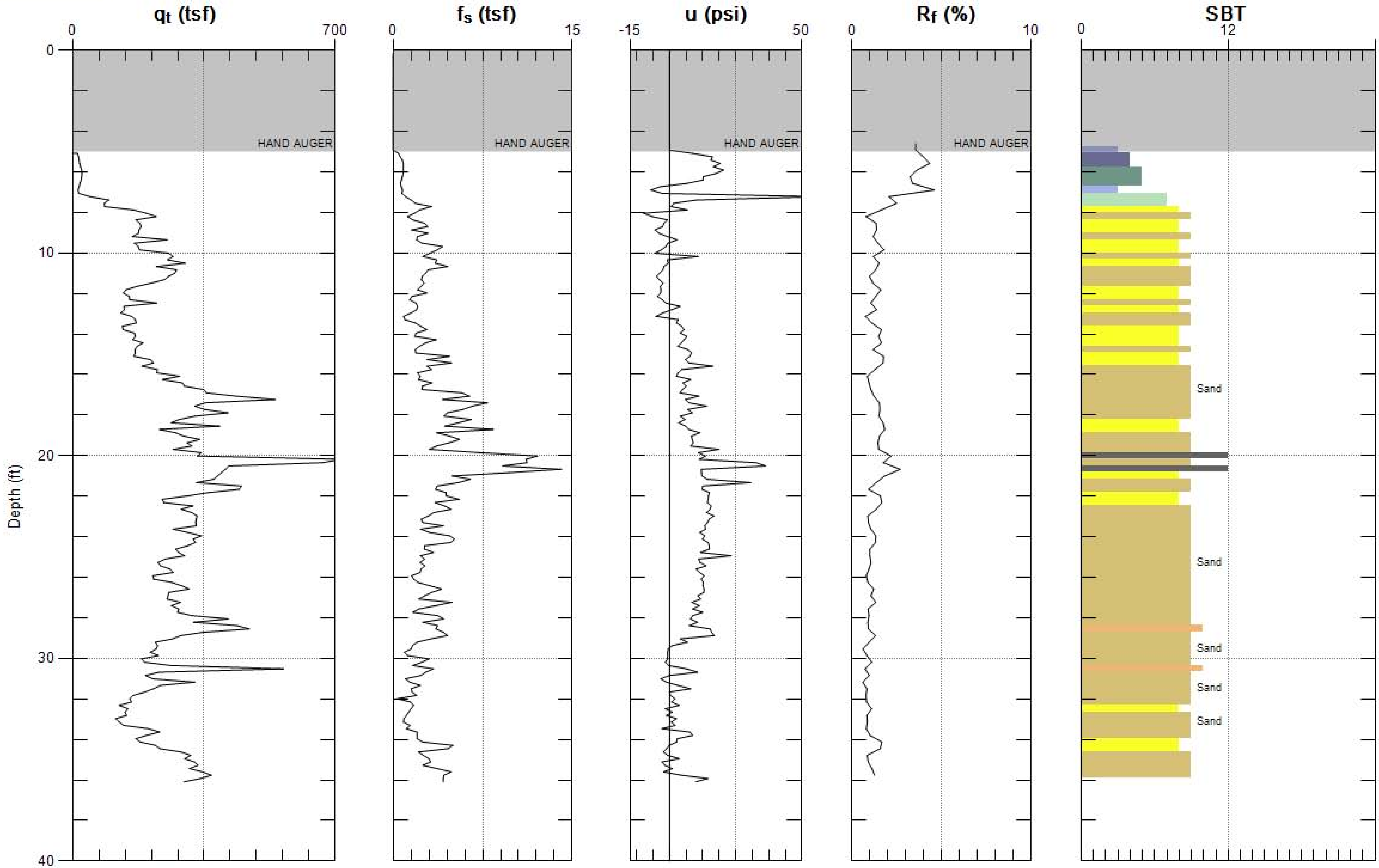
-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
LIF-1	1/14/13	36	-	-	-

GREGG

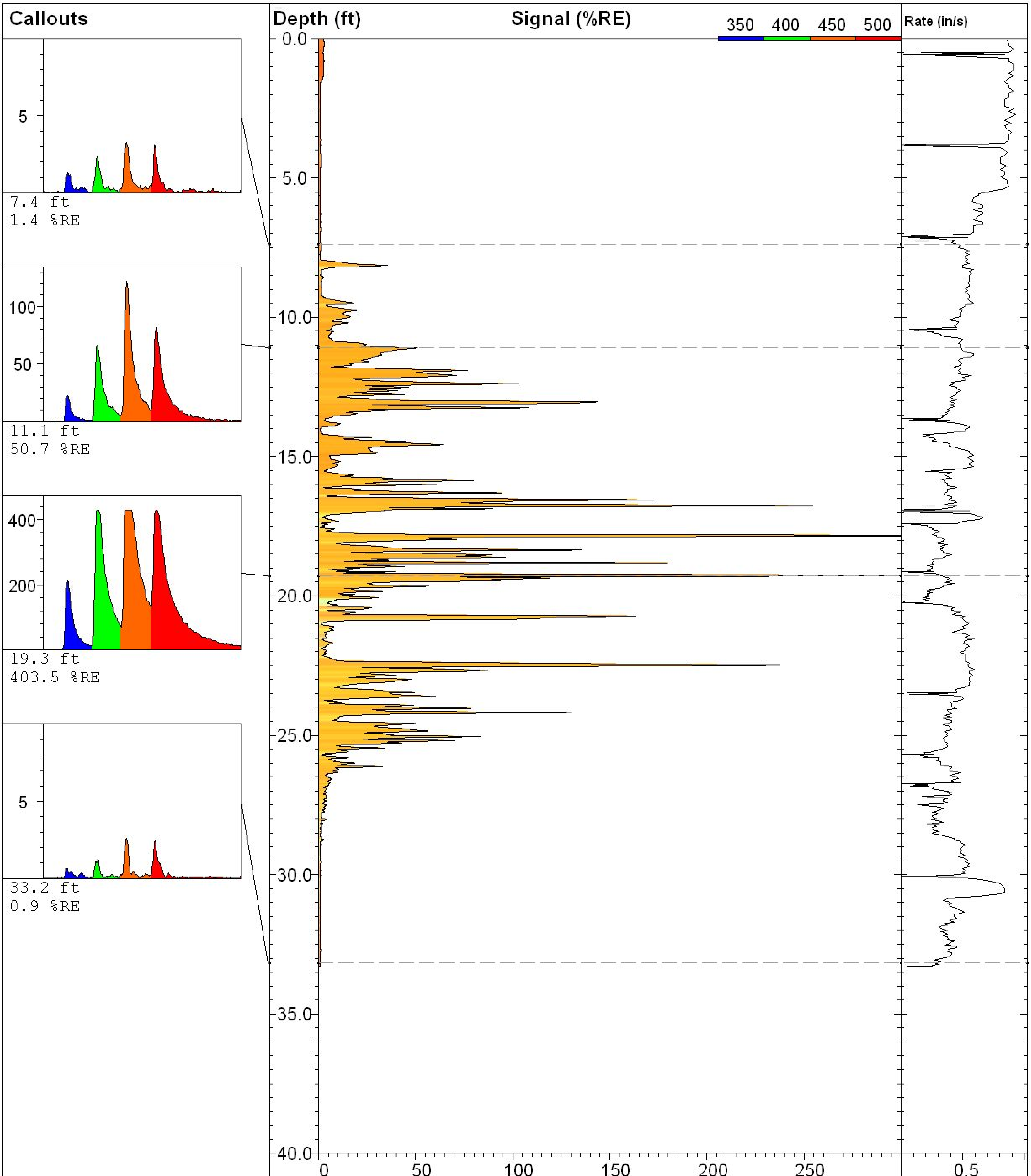
ARCADIS

Site: HANSON AGGREGATES | Engineer: C.BELL
Sounding: LIF-1 | Date: 1/14/2013 09:51



Max. Depth: 36.089 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)



www.greggdrilling.com

LIF-1

UVOST By Dakota
www.DakotaTechnologies.com

Site: **Hanson Aggregates**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **33.28 ft**
Client: **Arcadis**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **403.5 % @ 19.26 ft**
Job: **13-009MA**	*Operator/Unit:* **D. Tidwell/UVOST1009**	*Date & Time:* **2013-01-14 10:03 PST**

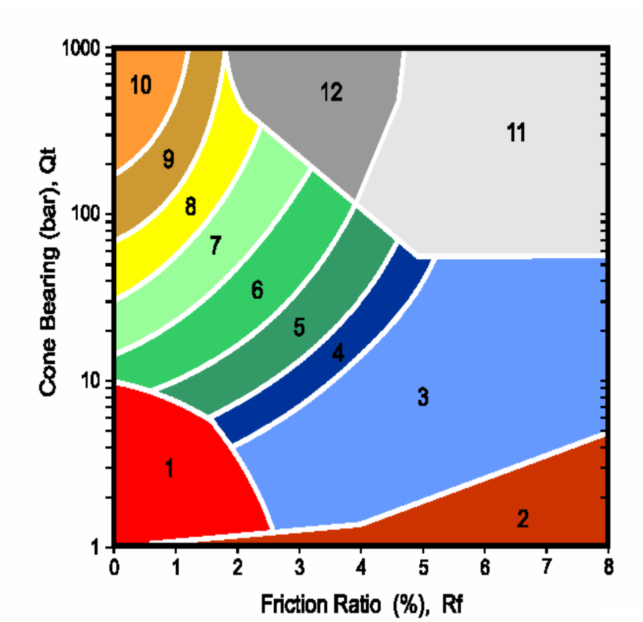
Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected from your site are presented in graphical form in the attached report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings extending greater than 50 feet, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. do not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and do not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



(After Robertson, et al., 1986)

ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT

Bibliography

Lunne, T., Robertson, P.K. and Powell, J.J.M., "Cone Penetration Testing in Geotechnical Practice" E & FN Spon. ISBN 0 419 23750, 1997

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Robertson, P.K., Sully, J., Woeller, D.J., Lunne, T., Powell, J.J.M., and Gillespie, D.J., "Guidelines for Estimating Consolidation Parameters in Soils from Piezocone Tests", Canadian Geotechnical Journal, Vol. 29, No. 4, August 1992, pp. 539-550.

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Campanella, R.G. and I. Weemees, "Development and Use of An Electrical Resistivity Cone for Groundwater Contamination Studies", Canadian Geotechnical Journal, Vol. 27 No. 5, 1990 pp. 557-567.

DeGroot, D.J. and A.J. Lutenegger, "Reliability of Soil Gas Sampling and Characterization Techniques", International Site Characterization Conference - Atlanta, 1998.

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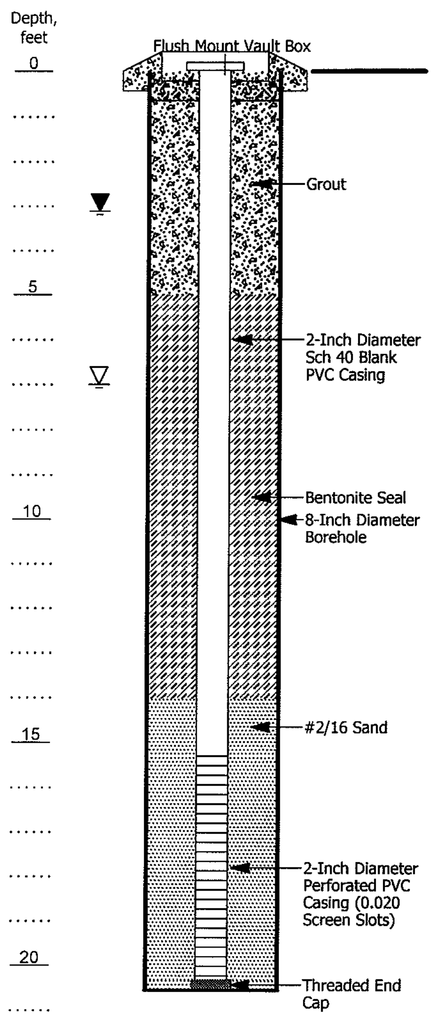
Zemo, D.A., T.A. Delfino, J.D. Gallinatti, V.A. Baker and L.R. Hilpert, "Field Comparison of Analytical Results from Discrete-Depth Groundwater Samplers" BAT EnviroProbe and QED HydroPunch, Sixth national Outdoor Action Conference, Las Vegas, Nevada Proceedings, 1992, pp 299-312.

Copies of ASTM Standards are available through www.astm.org

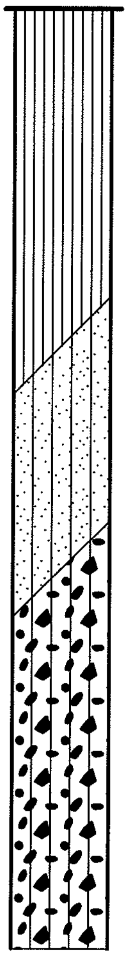
Attachment 5

Monitoring Well MW-11D Boring Log and Well Completion Details

WELL CONSTRUCTION | LITHOLOGY | SAMPLING DATA



Graphic Log



Visual Description

Silt with Sand (ML), Dark Gray (10YR 4/1), dry, with fine-grained sand, trace fine-grained subangular gravel (5, 20, 70, 5)

Silty Sand with Gravel (SM), Dark Gray (10YR 4/0), wet, with fine to coarse grained subangular gravel, fine-to medium-grained sand, silt, clay (20, 55, 15, 10), slight petroleum hydrocarbon odor

Silty Gravel (GM), Dark Gray (10YR 4/0), wet, fine-to coarse-grained subrounded gravel, fine-to medium-grained sand, silt, clay (70, 10, 15, 5), slight petroleum hydrocarbon sheen

Bottom of boring at approximately 21 feet

Sampling Data

Recovery	Blows per 6 in.	PID (ppm)
	37/50	50
	24/18	35
	50	100

Well Permit Number: 26066
Date Well Drilled: 4/28/06
Drilling Company: Gregg Drilling
Driller: JT
Sampling Method: Split Spoon
LFR Geologist: Jason Triolo

EXPLANATION

- Clay (CL/CH)
- Silt (ML/MH)
- Sand (SP/SW)
- Gravel (GP/GW)
- Modified California Sampler
- Shading indicates sample recovery; black bar to left indicates sample collected for analytical purposes.
- ∇ Water level at time of drilling
- ▼ Static Water Level

(Gravel, Sand, Silt, Clay) (70, 15, 10, 5)

WELL CONSTRUCTION AND LITHOLOGY FOR WELL MW-11D

LFR LEVINE•FRICKE
001-09480-00

Mission Valley

7/3/06 JST/DLB

ENVR SOIL+WELL 001-09480-00 HANSON MISSION VALLEY.GPJ 7/10/06