Div of Waste Management
and Radiation Control

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ENERGYSOLUTIONS

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Mr. Ty Howard, Director
Division of Waste Management and Radiation Control
P.O. Box 144880
Salt Lake City, UT 84114-4880

Subject: Submittal of Phase 1 Basal-Depth Aquifer Study Report

Dear Mr. Howard:

Attached is the *Phase 1 Basal-Depth Aquifer Study Report* for Energy*Solutions'* Clive Facility. This report provides the results and findings of a study of the basal-depth aquifer performed in accordance with the *Revised Phase 1 Basal-Depth Aquifer Study Plan* (November 12, 2019; CD19-0227). Field and laboratory investigations conducted to satisfy Study Plan objectives include the following:

- Logging a borehole to a depth of 617 feet below ground surface (bgs),
- Completion of a basal aquifer monitoring well to a total depth of 355 bgs,
- Collection of soils for geotechnical analysis,
- Determination of water content, bulk density, porosity, and particle-size distribution at selected intervals,
- Determination of vertical hydraulic conductivity of selected aquitard intervals,
- Aquifer testing to estimate the horizontal hydraulic conductivity of the basal-depth aquifer,
- Calculation of vertical gradients and an evaluation of the hydraulic relationship between the basal-depth aquifer and overlying shallow units, and
- Collection and analysis of a groundwater sample from the basal-depth aquifer.

The attached Report contains all field and laboratory documentation and data associated with the activities listed above.

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Energy*Solutions* will submit two (2) hard copies of the *Phase 1 Basal-Depth Aquifer Study Report* at a later date. Should you have any questions regarding this submission please feel free to contact me at (801) 303-0187.

Sincerely,

Robert W. Sobocinski
Groundwater Program Manager

cc: Don Verbica (DWMRC)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Phase 1 Basal-Depth Aquifer Study Report

Clive Disposal Facility

March 13, 2020

Prepared for:

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Abbreviations

%	percent
AWAL	American West Analytical Laboratories
bgs	below ground surface
cm/s	centimeters per second
CRT	constant rate test
DOE	Department of Energy
DWMRC	Division of Waste Management and Radiation Control
Facility	Energy*Solutions* Clive Facility
GEL	GEL Laboratories LLC
IGES	IGES geotechnical lab
K	hydraulic conductivity
mg/l	milligrams per liter
OD	outer diameter
ORP	oxidation reduction potential
pCi/l	picoCuries per liter
Study	Basal-Depth Aquifer Study
TDS	total dissolved solids
UAC	Utah Administrative Code
USCS	Unified Soil Classification System
U.S. EPA	United States Environmental Protection Agency

1.0 INTRODUCTION

This summary report presents findings for Phase 1 of the Basal-Depth Aquifer Study (Study) conducted at the Energy*Solutions* Clive Facility (Facility). Phase 1 of the Study was performed in accordance with the *Basal-Depth Aquifer Study Plan* (Energy*Solutions*, 2019 and Stantec, 2019), which was designed to understand the hydrogeologic and geologic characteristics of the basal-depth aquifer at the Facility where aquifer properties at basal-depths have not been extensively studied.

The hydrogeologic conditions of the first 100 feet below the Facility have already been well characterized since the State of Utah/Department of Energy VITRO Chemical Company project and original Envirocare of Utah licensing actions (Bingham Environmental, 1991 and Department of Energy [DOE] 1984a, 1984b). In addition, Energy*Solutions'* subsequent licensing and permitting activities have further characterized the subsurface beneath the Facility. These previous activities, coupled with long-term monitoring of the shallow, unconfined aquifer, have extensively captured the hydrogeologic conditions in the first 100 feet below ground surface (bgs). Based on the understanding of the hydrogeologic conditions in the first 100 feet, DOE and Energy*Solutions* assumed the conceptual model of the Facility includes similar stratigraphy below that first 100 feet.

Energy*Solutions* has been tasked by the Utah Division of Waste Management and Radiation Control (DWMRC) to validate this hydrogeologic conceptual model down to basal depths (i.e., log the subsurface geology/stratigraphy and characterize the deep aquifer) through the installation and sampling of a basal depth well. Data collected from Phase 1 of the Study are used to understand the characteristics of the subsurface hydrogeology at depths exceeding 100 feet bgs and inform Energy*Solutions* and DWMRC if development of subsequent Study phases are warranted. In addition to collection of basal-depth aquifer characteristic information, Phase 1 of the Study complies with the DWMRC Director's regulatory requirements.

1.1 SITE DESCRIPTION

The Facility is located near the eastern margin of the Great Salt Lake Desert, approximately 50 miles east of Wendover, Nevada and 80 miles west of Salt Lake City, Utah (**Figure 1**). Energy*Solutions* operates a low-level radioactive waste and mixed waste disposal facility and has been in operation since 1989. Work was performed at an uncontaminated background area of the Facility and media (soil and groundwater) encountered were not contaminated with hazardous or radiological substances.

1.2 GEOLOGY AND HYDROSTRATIGRAPHY

The surficial geology beneath the Facility consists of Quaternary Lacustrine (lakebed) deposits of ancient Lake Bonneville (Stephens, 1974). The upper 40 feet of lacustrine deposits consist of four hydrostratigraphic units including an upper silty clay/clayey silt (Unit 4), an upper silty sand (Unit 3), a middle silty clay (Unit 2), and a lower sand/silty sand (Unit 1).

The unsaturated zone beneath the facility includes Unit 4 and portions of Units 3 and 2. The shallow, unconfined groundwater system includes the saturated portions of Units 3 and 2. The confined aquifer occurs in Unit 1. Depths to groundwater typically range from 25 to 40 feet bgs beneath the Facility. Cross sections showing the four hydrostratigraphic units are presented in Figures 6, 9, and 10 of Bingham (1991).

A new monitoring well was installed beneath the well-characterized 100-foot-deep near-surface material where similar unconsolidated lake-bed sediments and alluvial valley fill were encountered (refer to Section 2.1).

2.0 SUMMARY OF FIELD WORK CONDUCTED

The objective of Phase 1 of the Study was to characterize the basal-depth aquifer. To collect Phase 1 data, a borehole was drilled; a basal-depth monitoring well was installed, developed, and sampled; and an aquifer test was conducted. DWMRC personnel observed the field data collection activities for the Study. Details regarding the data collection are discussed below.

2.1 BOREHOLE DRILLING AND GEOTECHNICAL SOIL SAMPLING

Between November 15 and December 5, 2019, one borehole was drilled by Cascade Drilling using the sonic drilling method. The borehole is located south of the Mixed Waste Cell (**Figure 2**) and upgradient of any historical or current disposal activities based on the shallow aquifer flow direction. Because creation of a detailed stratigraphic log is critical to characterizing the geology and hydrogeology at basal depths, particularly the stratigraphy below the first 100 feet, the sonic drilling method was selected as this method extracts a continuous core to the total depth of the boring.

A telescoping or step-down technique was used to advance the boring because the desired borehole depth scoped in the *Basal-Depth Aquifer Study Plan* was relatively deep (i.e., between 700 and 800 feet bgs*)*. Telescoping of the boring reduces friction, allowing the boring to be drilled deeper than if drilled without telescoping. The boring began with a 9-inch outer diameter (OD) casing drilled from ground surface to 157 feet bgs, telescoped down to a 8-inch OD casing from 157 feet to 337 feet bgs, and ended with a 7-inch OD casing from 337 feet to 615 feet bgs (the borehole total depth). The borehole was terminated at a depth shallower than the intended depth of 800 feet, because the sonic drill bit met refusal upon encountering a hard breccia layer at 607 to 615 feet bgs, which significantly reduced the drilling efficiency and risked damage of the drilling equipment.

Because the borehole termination depth was shallower than the scoped depth a meeting was held on December 9, 2019 with Energy*Solutions*, DWMRC, Stantec Consulting Services Inc. (Stantec)[1], and Cascade Drilling to evaluate adjustments to the planned borehole depth and effects on the planned monitoring well installation (refer to Section 2.2). During the meeting, all parties agreed to: (1) terminate the borehole at the depth achieved; and (2) screen the well at the deepest water-bearing bearing-zone encountered (approximately 330 to 350 feet bgs within the fine grained, wet, silty sand stratigraphy). This meeting was held in accordance with the *Basal-Depth Aquifer Study Plan.*

The collected continuous drill core was visually logged by a Stantec professional geologist licensed in the state of Utah using the Unified Soil Classification System (USCS) soil classification procedures and field descriptions including soil type, color, texture, bedding structures, and moisture content. The geologist also provided drilling and well installation oversight for the duration of the project. A copy of the borehole log is provided in **Appendix A** and photographs of the sonic core are provided in **Appendix B-1**.

[1] Stantec Consulting Services Inc. was retained by Energy*Solutions* to assist in the preparation and execution of Phase 1 of the Study.

The geologist identified 12 stratigraphically representative zones along the length of the drill core and collected one grab soil sample from each zone to measure grain-size distribution analysis (in accordance with ASTM D6913a). A summary of the representative zones is provided in **Table 2-1**. The samples were remitted by the geologist to Energy*Solutions* personnel for submission to IGES geotechnical lab (IGES). This analysis is used to determine particle size distribution and provide an indicator of material properties across the borehole area.

Additionally, the geologist identified depths where four undisturbed soil samples were collected in brass sleeves using a direct-push method to evaluate subsurface soil characteristics in an off-site laboratory. Specifically, two undisturbed samples were collected that could be representative of potential aquifer material (coarse-grained) and two undisturbed samples were collected that could be representative of potential aquitard (fine-grained) material. The sample depths were selected based on the geologist's professional judgement while logging the core utilizing the USCS. The samples were classified in the field as potential aquifers or potential aquitards. These samples were submitted to a local geotechnical laboratory (IGES) to measure porosity and bulk density. Additionally, the two undisturbed samples collected in the potential aquitard material also were submitted to IGES to measure vertical hydraulic conductivity. Geotechnical analytical results are presented in Section 3.1.

2.2 WELL INSTALLATION

Between December 10 and December 14, 2019, a deep well, designated I-1-700, was installed in the boring by Cascade Drilling with oversight provided by the Stantec geologist. Stantec recommended well construction details (i.e., installation depth, screen interval, and construction materials) to Energy*Solutions* based on discussions from the December 9, 2019 meeting with DWMRC and in accordance with the *Basal-Depth Aquifer Study Plan*. Energy*Solutions* submitted the recommendations in an email to DWMRC for approval, and DWMRC agreed with the recommended well construction in an email on December 10, 2019. The agreed upon well construction details were:

- Backfill the 617 feet deep boring with bentonite chips to a depth to accommodate a total well depth of approximately 350 feet bgs
- Install 0.020 stainless steel screen from 320 to 350 feet bgs, across what appears to be the most transmissive zone encountered during drilling (refer to borehole log in **Appendix A**)
- Install 10/20 sand pack around the well screen
- Install 3-inch diameter stainless steel casing
- Install an above-grade surface completion as outlined in the *Basal-Depth Aquifer Study Plan*

The well was installed to a total depth of 355 feet bgs with a 30-foot screen placed from 325-355 feet bgs. During well construction the well casing was suspended from the drill rig to 350 feet bgs, as specified in the bullet list above. However, after well construction was complete and the well casing was un-hooked from the drill rig the well settled an additional 5 feet, resulting in a total depth of 355 feet bgs. The well settlement was due to the weight of the stainless-steel casing used to construct the well. The interval from 350 to 355 feet consisted of the same fine grained, wet, silty sand stratigraphy as the proposed screened interval (320 to 350 feet) and was back-filled with filter pack sand prior to the well build, so the settlement did not affect the aquifer material screen interval. Once well construction was complete the inside of the

well casing was tagged with a weighted tape measure to verify a total depth at 355 feet bgs. The bottom of the well felt solid when tagged, indicating minor or no sediment inside the well after construction. The as-built well construction details include:

- 3-inch diameter stainless steel screen from 355 feet bgs to 325 feet bgs
- 3-inch diameter stainless steel casing from 325 feet bgs to 2.0 feet above ground surface
- 10/20 sand filter pack from 355 feet bgs to 319 feet bgs
- Fine-grained sand from 319 feet bgs to 314 feet bgs
- 3/8-inch bentonite chips from 314 feet bgs to 300 feet bgs
- Annular seal of bentonite grout from 300 feet bgs to 2 feet bgs
- Surface seal of concrete from 2 feet bgs to surface

A well construction diagram for I-1-700 is provided in **Appendix A** and photographs of well construction materials and well surface completion are provided in **Appendix B-2.**

2.3 MONITORING WELL DEVELOPMENT

Between January 14 and 15, 2020, I-1-700 was developed in accordance with the *Basal-Depth Aquifer Study Plan* by Cascade Drilling with oversight provided by a Stantec field technician. On January 14, 2020, the well was bailed, surged, bailed, and then pumped for 30 minutes at an average flow rate of 12.5 gallons per minute (gpm) using an electrical submersible pump installed to approximately mid-screen depth. The purge water was pumped directly to a 20,000-gallon capacity frac tank for storage (refer to photograph 11 in **Appendix B-2**). Purge water was monitored for water quality parameters pH, specific conductivity, turbidity, temperature and general appearance.

Development resumed January 15, 2020, with continued pumping of the well for an additional 1.8 hours at an average flow rate of 15 gpm. Water level measurements were collected during the pumping period and showed a 21.76-foot drop during the 1.8 hours of pumping. Development was stopped once the water parameters were stable and the final turbidity reading readings hovered in the low teens (refer to monitoring well development field forms provided in **Appendix A**). The purge water toward the end of the pumping period looked clear with no visible suspended solids. Approximately 2,058 gallons of water were purged during the two days of well development.

2.4 AQUIFER TEST AND GROUNDWATER SAMPLING

Between January 15 and 16, 2020, a 12-hour constant rate pumping test (i.e., aquifer test) was conducted for I-1-700 in accordance with the *Basal-Depth Aquifer Study Plan,* by the Stantec field technician and professional geologist, with pumping support provided by Cascade Drilling. On January 15, well development was completed, and the field technician installed pressure transducers in I-1-700 and in nearby observation wells I-1-100, I-1-50, and I-1-30 (refer to **Figure 2**). To accommodate the transducer the dedicated bladder pump in well I-1-30 was removed and placed in a plastic bag to keep the pump clean and contained. The pump was then delivered to the Energy*Solutions* security personnel to be placed in a warehouse storage area until it could be reinstalled after completion of the aquifer test.

SUMMARY OF FIELD WORK CONDUCTED

On January 16, 2020 the aquifer test was conducted. The pump in I-1-700 was turned on at 0750, pumped for 12 hours at an average flow rate of 15.4 gpm, and was shut off at 1950. During the aquifer test, water levels were recorded in the pumping well and the three nearby observation wells by the transducers and manually measured by the technician and geologist using electronic water-level sounders. The transducer in monitoring well I-1-100 stopped working during the aquifer test, therefore; manually recorded groundwater levels for this well were used in the aquifer test analysis (refer to Section 3.3).

During the 12 hours of pumping approximately 11,088 gallons of water were purged from the well and pumped directly to a 20,000-gallon capacity frac tank for storage. Aquifer test results are presented in Section 3.3.

During the aquifer test, Energy*Solutions* personnel collected groundwater samples and measured field parameters (i.e. pH, temperature, specific conductivity, oxidation reduction potential [ORP], and dissolved oxygen) in the discharge from I-1-700 in accordance with the *Basal-Depth Aquifer Study Plan*. The samples were collected using a valve installed in the pump discharge line (refer to photograph 11 in **Appendix B-2**).

Energy*Solutions* submitted the non-radiological parameter analyses samples to American West Analytical Laboratories (AWAL) and the radiological parameters analyses samples to GEL Laboratories LLC (GEL). At the time of groundwater collection, DWMRC personnel also collected splits of the groundwater samples for their own use. The groundwater sample field form is provided in **Appendix A** and sample results are presented in Section 3.4.

3.0 RESULTS

3.1 GEOTECHNICAL ANALYTICAL RESULTS

Soil descriptions and laboratory grain-distribution analysis results (in accordance with ASTM D6913a) of the disturbed grab samples collected from the stratigraphically representative zones are presented in **Table 3-1**. Depth intervals where the samples were collected are also presented in **Table 3-1**. Laboratory analyses indicate that the discrete samples collected from between 87 and 287 feet generally consist of sands with smaller fractions of gravels, silts, and/or clays. Samples collected from 337 to 592 feet include a higher percentage of fines (silt and clay) than those observed between 87 and 287 feet bgs.

Porosity and bulk density analyses were conducted for two undisturbed samples selected to be representative of aquifer material and the two undisturbed samples representative of aquitard material. Results are presented in **Table 3-2**. Porosity results for the aquifer samples are 33.5 percent (%) (I-1-700 247-248.5) and 47.2% (I-1-700 337-338.5). The higher porosity of the lower aquifer sample is likely due to the higher prevalence of fines (refer **Table 3-1**). Porosity values for the aquitard samples are 44.3% (I-1-700 297-298.5) and 49.1% (I-1-700).

Results of the vertical hydraulic conductivity (K) tests conducted on the two undisturbed samples representative of potential aquitard material were 0.074 and 0.011 feet per day (feet/day) (2.6×10^{-5} and 3.9×10^{-6} centimeters per second [cm/s]). The samples were collected from 297.5-298.0 feet bgs and 377.5-378.0 feet bgs, respectively (refer to **Table 3-2**). The geotechnical laboratory description for both samples is reddish-brown clayey sand. A copy of the geotechnical laboratory report is provided in **Appendix C**.

3.2 GROUNDWATER LEVELS AND VERTICAL HYDRAULIC GRADIENTS

Static groundwater levels were collected prior to the aquifer test on January 16, 2020, 32 days after I-1-700 was installed. In accordance with Energy*Solutions'* Groundwater Quality Discharge permit UGW450005, groundwater levels were corrected to freshwater equivalents prior to further interpretation and modeling. Corrected groundwater levels were used to calculate vertical hydraulic gradients (refer to Section 3.2.2) and model the hydraulic response to the aquifer pumping test (refer to Section 3.3.2).

3.2.1 Density Corrections

Due to the variable salinity of groundwater found beneath the Facility, density corrections were utilized to calculate fresh water equivalent heads (Post et al., 2007). Fresh water equivalent heads facilitate the

assessment of hydraulic gradients. The corrected densities were calculated utilizing the following equation:

$$h_{corr} = z + (p_{uncorr} \times SG_{well})$$

Where:
h_{corr} is the fresh water equivalent hydraulic head (feet amsl),
z is the elevation head of the mid-filter pack or mid-point of the saturated zone, whichever is lower (feet amsl),
p_{uncorr} is the uncorrected pressure head above point z (feet), and
SG_{well} is the specific gravity of the water in the well (unitless).

Measured static water levels and corrected and uncorrected heads are presented in **Table 3-3**. The magnitude of the density correction was greatest for I-1-700 because of the high groundwater specific gravity and long water column inside the well.

3.2.2 Vertical Hydraulic Gradients

Vertical hydraulic gradients between the collocated wells I-1-30, I-1-50, I-1-100, I-1-700 were calculated after converting saline water levels into fresh water equivalent heads (see Section 3.2).

Vertical gradients were calculated using the United States Environmental Protection Agency (U.S. EPA) Vertical Gradient Calculator (U.S. EPA, 2020). The calculator provides the mid-filter pack vertical gradient as well as the range of gradients, which account for well geometry and water level elevations, as applicable. A summary of gradient magnitudes and directions are provided in **Table 3-4**. All vertical gradients were upward immediately prior to the January 16, 2020 pumping test. The I-1-700 well has a hydraulic head that is higher than all collocated wells.

3.3 AQUIFER TEST RESULTS

3.3.1 Analysis Methods

Aquifer test data were analyzed using the software package AQTESOLV, version 4.0 Professional (Duffield, 2007). Groundwater level measurements were collected from the transducers as well as recorded manually by Stantec field personnel at I-1-700 (screened from 325-355 feet bgs), I-1-100 (screened from 90-100 feet bgs), I-1-50 (screened from 40-50 feet bgs), and I-1-30 (screened from 20-30 feet bgs) during the aquifer test.

Well I-1-30 showed no discernable response to the aquifer test, suggesting a limited hydraulic connection with the pumped aquifer. Well I-1-50 showed a slight reverse water-level fluctuation, which has been observed in aquifers and aquitards overlying pumped aquifers (Kim and Parizek, 1997).

Typical pumping responses were measured in wells I-1-700 and I-1-100. These two wells were selected to evaluate best fit hydraulic parameters using four different mathematical solutions including Hantush (1960), Neuman-Witherspoon (1969), and Cooper-Jacob (1946) for the constant rate test (CRT) pumping

period, and Theis (1935) for the recovery data. The following assumptions were applied for these methods of analysis (Duffield, 2007):

- The aquifer is confined or leaky confined, infinite areal extent, homogeneous, isotropic and of uniform thickness of 325 feet.
- For leaky aquifers, aquitards have infinite areal extent; uniform vertical hydraulic conductivity, storage coefficient, and uniform thickness; and flow in aquitards is vertical.
- For the Hantush method, the pumping and observation wells are partially penetrating, and diameter of pumping well is very small so that storage in the well can be neglected.
- For the Hantush method, the ratio of vertical to horizontal hydraulic conductivity (K_v/K_h) was assumed to be 0.1.
- Flow to the pumping well is unsteady; flow is horizontal and uniform in a vertical section through the axis of the well.
- Water is released from storage in an aquitard instantaneously with a decline of hydraulic head.
- Displacement is small relative to the saturated thickness of the aquifer.
- For the Neuman-Witherspoon method, aquitards are overlain or underlain by an infinite constant-head plane source.

During the aquifer test, the transducer in monitoring well I-1-100 stopped working during the pumping test; therefore, manually recorded groundwater levels were used in the analysis.

3.3.2 Analysis Results

Freshwater density corrections were applied to the measured groundwater levels due to the high and variable salinity observed locally. At I-1-700, freshwater equivalent drawdown is approximately 0.3 feet greater than the response in saline water. At I-1-100, the density correction was negligible. The AQTESOLV analytical results for the aquifer test are presented in **Appendix D**. Estimated hydraulic parameters from the pumping test analysis (including transmissivity, hydraulic conductivity, storativity, and specific yield) are presented in **Table 3-5**.

The maximum measured drawdown from the pumping test was 24.99 feet at I-1-700. The geometric mean for the estimated horizontal hydraulic conductivity in the basal aquifer is estimated to be 6.01 feet/day based on the results from I-1-100 and I-1-700. The average of the horizontal hydraulic conductivity estimates using different methods of analysis is 1.26 feet/day for I-1-700, and 28.72 feet/day for I-1-100 while the average value of storativity was estimated at 1.57×10^{-3} for I-1-700 and 6.81×10^{-3} for I-1-100.

Two of the four analysis methods applied at I-1-700 assumed the basal-depth aquifer is leaky confined (Hantush, 1960, and Neuman-Witherspoon, 1969). The relatively flat response near the end of pumping suggests a constant source of water is available, consistent with recharge (leakage) occurring during the test.

Three analyses were conducted to evaluate the pumping test response at I-1-100. Estimated hydraulic conductivity for I-1-100 is higher than I-1-700, suggesting the hydraulic conductivity at shallower depths is greater than the hydraulic conductivity near 325 feet bgs.

3.4 GROUNDWATER SAMPLE RESULTS

The groundwater sample from I-1-700 was analyzed for metals, radionuclides, and major ions at an off-site laboratory, and water quality parameters were measured in the field as provided in **Table 3-6**. The major cation is sodium and the major anion is chloride. Total dissolved solids (TDS) at basal depths are 65,400 milligrams per liter (mg/l), as compared to an average of 40,297 mg/l for shallow groundwater samples collected in 2018. As is the case for the Facility's shallow groundwater, the basal-depth groundwater is classified as Class IV – Saline Groundwater, due to the TDS concentration exceeding 10,000 mg/l (Utah Administrative Code R317-6-3, Ground Water Classes).

Total uranium (U) is 17.4 micrograms per liter (µg/l); isotopes U-233/234 and U-238 were detected and U-235-236 was not detected. Thorium isotopes were not detected. Gross alpha was not detected, though the analysis did not meet detection limit requirements due to low sample volume; sample volume was limited due to the analytical procedures (refer to the GEL analytical laboratory report provided in **Appendix E**). Gross beta is 495 picoCuries per liter (pCi/l). A copy of the AWAL and GEL groundwater analytical laboratory reports are provided in **Appendix E**.

The groundwater chemistry of I-1-700 is typical of deep groundwater isolated from recharge. Redox conditions are relatively reducing, based on the field ORP (i.e., Eh) measurement (refer to the groundwater sample field form provided in **Appendix A**) and the presence of dissolved iron and ammonia. Detected radiological and non-radiological constituents are naturally occurring.

4.0 SUMMARY AND CONCLUSIONS

In November and December 2019, a deep boring was drilled at the Facility to 617 feet bgs. The core extracted from the boring was logged and geotechnical soil samples were collected and analyzed. The boring was backfilled to 355 feet bgs and a 3-inch diameter well (I-1-700, screened across the observed most permeable zone from 325 to 355 feet bgs) was successfully constructed. Groundwater samples were collected and analyzed, and an aquifer test was conducted in January 2020.

From data collected during this Study, characteristics of the unconsolidated basal aquifer to 617 feet beneath the Facility were evaluated and several basal aquifer study data objectives outlined by DWMRC in their July 29, 2019 letter to Energy*Solutions* have been met. Visual inspection of the extracted core, geotechnical analysis results, aquifer test evaluation, and groundwater sampling results indicate the following:

- The zone of highest permeability (sandy silt) across the 617-foot-deep boring is located at 320 to 355 feet bgs. Horizontal hydraulic conductivity estimates from January 2020 aquifer tests are indicative of silt and silty sand material (**Table 3-5**), which correlate well with the stratigraphic boring log (**Appendix A**).
- Aquitard material is located both above and below the highest permeability interval, with the largest percentage of fine-grained material (up to 76.2%) located at deeper depths (**Table 3-1**). Much of the aquitard material was observed to be dense and dry (**Appendix A**).
- Low vertical hydraulic conductivities were measured in undisturbed samples collected from the identified aquitard zones above and below the I-1-700 screened interval, on the order of 10^{-5} cm/s in the upper and 10^{-6} cm/s in the lower aquitard zones (**Table 3-2**). These results are two to three orders of magnitude lower than horizontal hydraulic conductivity estimates of the aquifer test data analysis.
- The vertical hydraulic gradient, calculated using fresh water equivalent heads for I-1-700 and three nested wells, indicates an upward direction of vertical groundwater flow at the Facility.
- Poor water quality was measured in the groundwater samples collected from I-1-700 (screened from 325 to 355 feet bgs), notably a TDS concentration of 65,400 mg/l which is above the Utah Administrative Code 10,000 mg/l threshold for Class IV groundwater (UAC R317-6-3).

These results indicate limited connectivity between the shallow zones and the deeper basal aquifer at the Facility. Given the upward component of groundwater flow, low vertical hydraulic conductivity and observed dryness of the aquitard zones, and the lack of response in the 30 and 50 foot deep observation wells during the aquifer test, hydraulic communication from the shallow zones to the deeper basal aquifer under natural conditions is unlikely.

5.0 REFERENCES

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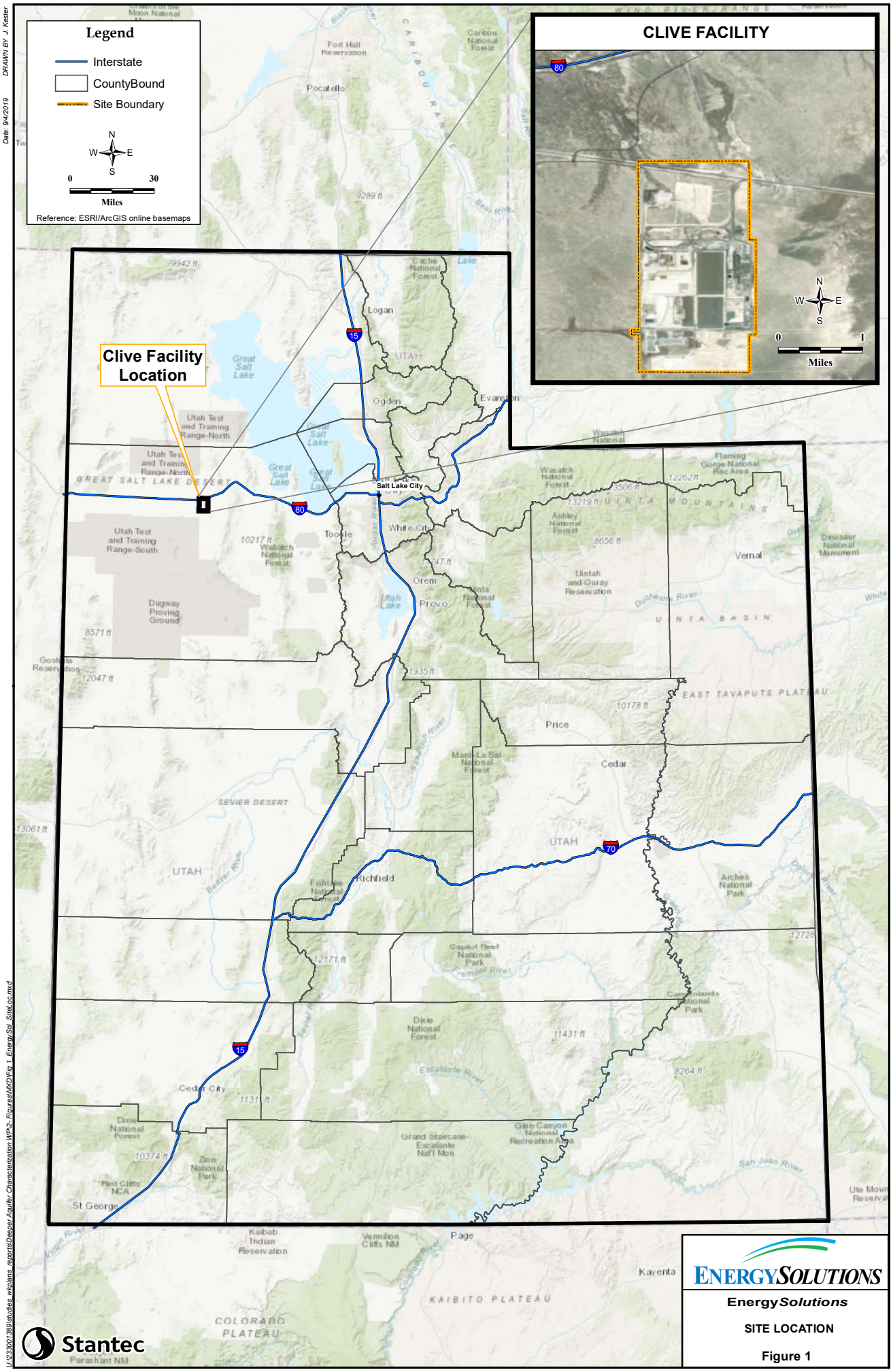
FIGURES



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Date: 9/4/2019

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ENERGYSOLUTIONS

EnergySolutions

SITE LOCATION

Figure 1

Legend

- I-1-700
- Existing Wells
- Mixed Waste Facility
- Site Boundary

Stantec

N
W E
S

0 170
Feet

Reference: ESRI/ArcGIS online world imagery

ENERGYSOLUTIONS

EnergySolutions

LOCATION OF
I -1-700

Figure 2

Date: 2/21/2020 DRAWN BY J. Kester

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TABLES

TABLE 2-1
SUMMARY OF STRATIGRAPHICALLY REPRESENTATIVE ZONES
PHASE 1 BASAL DEPTH AQUIFER STUDY
ENERGY*SOLUTIONS*, CLIVE, UTAH

Zone	Zone Depth Interval (feet bgs)		Generalized Soil Description	Corresponding Geotechnical Sample ID	Corresponding Sample Depth Interval (feet bgs)	
1	0	98.0	light brown silty sand	I-1-700 87-89	87.0	89.0
2	98.0	214.5	brown clayey/silty sand with gravel	I-1-700 107-109	107.0	109.0
3	214.5	239.0	brown poorly graded sand	I-1-700 227-229	227.0	229.0
4	239.0	267.0	brown silty sand with gravel	I-1-700 245-255	245.0	255.0
5	267.0	314.5	brown clayey/silty sand	I-1-700 282-287	282.0	287
6	314.5	355.0	grey silty sand / sandy silt	I-1-700 337-342	337.0	342.0
7	355.0	359.0	brown clayey/silt with gravel	I-1-700 356-359	356.0	359.0
8	359.0	515.5	brown silt/clay with sand[a]	I-1-700 367-369 [b]	367.0	369.0
8	359.0	515.5	brown clay with silt	I-1-700 430-432 [c]	430.0	432.0
8	359.0	515.5	brown clay with silt	I-1-700 505-507 [d]	505.0	507.0
9	515.5	534.0	brown silty sand	I-1-700 523-525	523.0	525.0
10	534.0	550.0	brown silty clay	I-1-700 542-544	542.0	544.0
11	550.0	577.0	light brown clayey/silty sand	I-1-700 570-572	570.0	572.0
12	577.0	607.0	dark brown clayey/silty sand	I-1-700 590-592	590.0	592.0

Notes
[a] Sand was observed in the upper portion of Zone 8, where geotechnical sample I-1-700 367-369 was collected.
[b] Sample collected is representative of upper portion of Zone 8.
[c] Sample collected is representative of mid portion of Zone 8.
[d] Sample collected is representative of lower portion of Zone 8.
bgs below ground surface
ID identification

TABLE 3-1
GEOTECHNICAL LABORATORY TEST RESULTS FOR DISTURBED SAMPLES
PHASE 1 BASAL DEPTH AQUIFER STUDY
ENERGY*SOLUTIONS*, CLIVE, UTAH

Sample ID	Depth Interval (ft bgs)		Geotechnical Laboratory Soil Description	Water Content (%) [1]	Coarse Fraction Water Content (%) [2]	Split Fraction Water Content (%) [3]	Gravel (%)	Sand (%)	Fines (%)	Comments
I-1-700 87-89	87.0	89.0	light brown silty sand	16.1	--	--	0.4%	69.9%	29.7%	
I-1-700 107-109	107.0	109.0	brown clayey sand with gravel	--	8.9	15.7	17.7%	70.2%	12.1%	
I-1-700 227-229	227.0	229.0	brown silty sand	--	7.9	39.1	0.4%	63.5%	36.1%	
I-1-700 245-255	245.0	255.0	brown silty sand with gravel	--	10.9	21.1	15.0%	68.5%	16.5%	Results are in nonconformance with Method D6913 because the minimum dry mass was not met.
I-1-700 282-287	282.0	287	brown clayey sand	--	15.3	28.1	12.8%	53.1%	34.1%	Results are in nonconformance with Method D6913 because the minimum dry mass was not met.
I-1-700 337-342	337.0	342.0	grey sandy silt	--	5.5	36.2	0.6%	44.1%	55.4%	
I-1-700 356-359	356.0	359.0	brownish grey clayey gravel with sand	--	6.3	17.4	27.8%	24.3%	47.9%	Results are in nonconformance with Method D6913 because the minimum dry mass was not met.
I-1-700 367-369	367.0	369.0	light brown clayey sand	30.1	--	--	5.4%	47.7%	46.9%	
I-1-700 430-432	430.0	432.0	brown clayey sand	28.3	--	--	7.4%	43.5%	49.1%	
I-1-700 505-507	505.0	507.0	brown clay with sand	--	4.0	22.9	2.4%	21.3%	76.2%	
I-1-700 523-525	523.0	525.0	brown silty sand	27.6	--	--	0.3%	55.1%	44.6%	
I-1-700 542-544	542.0	544.0	reddish brown sandy clay	25.0	--	--	0.1%	46.1%	53.8%	
I-1-700 570-572	570.0	572.0	light brown clayey sand	--	8.7	21.2	10.0%	40.7%	49.2%	Results are in nonconformance with Method D6913 because the minimum dry mass was not met.
I-1-700 590-592	590.0	592.0	dark brown silty sand	31.6	--	--	0.0%	57.5%	42.5%	

Notes
[1] Sample not split
[2] Coarse fraction of split sample (+3/8")
[3] Split fraction of split sample (-3/8")
ft bgs feet below ground surface
ID identification
% percent
-- not applicable

Laboratory method used:
ASTM D6913a Particle Size Distribution (Gradation) of Soils Using Sieve Analysis

TABLE 3-2
GEOTECHNICAL LABORATORY TEST RESULTS FOR UNDISTURBED SAMPLES
PHASE 1 BASAL DEPTH AQUIFER STUDY
ENERGY*SOLUTIONS*, CLIVE, UTAH

Sample ID	Depth Interval (feet bgs)		Sample Representative Material	Geotechnical Laboratory Soil Description	Water Content (%)	Dry Unit Weight (pcf)	Specific Gravity of Soil Solids ($G_{20°C}$)	Total Soil Porosity (%)	Vertical Hydraulic Conductivity (cm/s) [1]	Vertical Hydraulic Conductivity (feet/day) [1]
I-1-700 247-247.5	247.0	247.5			24.7	98.6				
I-1-700 247.5-248	247.5	248.0	aquifer	--	15.7	115.7	2.579	33.5	--	--
I-1-700 248-248.5	248.0	248.5			20	105.3				
I-1-700 297-297.5	297.0	297.5			31.4	89.4				
I-1-700 297.5-298	297.5	298.0	aquitard	reddish brown clayey sand	33.9	82.8	2.499 [2]	44.3	2.60E-05	7.40E-02
I-1-700 298-298.5	298.0	298.5			29	86.9				
I-1-700 337-337.5	337.0	337.5			25.3	90.1				
I-1-700 337.5-338	337.5	338.0	aquifer	--	46.9	72.7	2.390	47.2	--	--
I-1-700 338-338.5	338.0	338.5			43.8	73.1				
I-1-700 377-377.5	377.0	377.5			33	86.3				
I-1-700 377.5-378	377.5	378.0	aquitard	reddish brown clayey sand	34.3	85.7	2.631 [2]	49.1	3.90E-06	1.10E-02
I-1-700 378-378.5	378.0	378.5			39.2	80.8				

Notes
[1] Middle depth interval tube sample of three used for test specimen.
[2] Initial specific gravity test performed only on the middle depth sample. Reported value is the average specific gravity.

%	percent
--	not analyzed
bgs	below ground surface
cm/s	centimeters per second
ID	identification
pcf	pounds per cubic foot

Laboratory methods used:

ASTM D7263 Method B and D2216	Water Content and Unit Weight of Soil
ASTM D854	Specific Gravity of Soil Solids by Water Pycnometer
ASTM D5084 Method C	Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter

TABLE 3-3
JANUARY 2020 STATIC WATER LEVEL MEASUREMENTS AND ELEVATIONS
PHASE 1 BASAL DEPTH AQUIFER STUDY
ENERGY*SOLUTIONS,* CLIVE, UTAH

Well ID	Easting (feet) [1]	Northing (feet) [1]	Top of Protective Casing w/o Lid (feet amsl)	Water Level Date & Time	Depth to Water (feet)	Saline Water Elevation (feet amsl)	Specific Gravity	Fresh Water Groundwater Elevation (feet amsl)	Mid-Point of Filter Pack Elevation (feet amsl)	Mid-Point of Sat Zone Elevation (feet amsl)
I-1-30	1,194,196	7,420,901	4279.45	1/16/2020 07:51	28.85	4250.60	1.032	4250.73	4247.79	4253.67
I-1-50	1,194,193	7,420,900	4279.15	1/16/2020 07:53	28.65	4250.50	1.017	4250.78	4233.92	4243.05
I-1-100	1,194,194	7,420,897	4279.33	1/16/2020 07:54	29.17	4250.16	1.018	4251.35	4184.04	4217.2
I-1-700	1,194,218	7,420,924	4280.06	1/16/2020 07:50	31.40	4248.66	1.048	4263.33	3943.16	4087.44

Notes
[1] - State Plane Coordinates
amsl – above mean sea level
ID - identification
Sat - saturated
w/o - without

TABLE 3-4
VERTICAL HYDRAULIC GRADIENTS USING FRESH WATER EQUIVALENT HEADS
PHASE 1 BASAL DEPTH AQUIFER STUDY
ENERGY*SOLUTIONS*, CLIVE, UTAH

Upper Well	Lower Well	Midscreen Vertical Gradient	Vertical Gradient Ranges
I-1-30	I-1-50	+0.004	+0.002 to +0.023
	I-1-100	+0.010	+0.008 to +0.012
	I-1-700	+0.041	+0.038 to +0.045
I-1-50	I-1-100	+0.011	+0.009 to +0.016
	I-1-700	+0.043	+0.040 to +0.048
I-1-100	I-1-700	+0.050	+0.044 to +0.056

Note
positive (+) = upward gradient, negative (−) = downward gradient

TABLE 3-5

JANUARY 2020 AQUIFER TEST ESTIMATED HYDRAULIC PARAMETERS
PHASE 1 BASAL DEPTH AQUIFER STUDY
ENERGY*SOLUTIONS*, CLIVE, UTAH

Well ID	Tests	Analysis Method [1]	Aquifer Type	Transmissivity (ft^2/day)	Horizontal Hydraulic Conductivity (ft/day)	Storativity (-)	Average Horizontal Hydraulic Conductivity (ft/day)	Geometric Mean Horizontal Hydraulic Conductivity (ft/day)	Calculated Average for Storativity (-)
I-1-700 (screened from 325-355 feet bgs)	Pumping [2]	Hantush	Leaky Confined	45.51	0.14	1.91×10^{-5}	1.26	6.01	0.00157
		Neuman-Witherspon	Leaky Confined	48.08	0.15	0.004676			
		Cooper-Jacob	Confined	241.7	0.74	1.29×10^{-7}			
	Recovery	Theis-Recovery	Confined	1298.8	4.00	NA			
I-1-100 (screened from 90-100 feet bgs)	Pumping [2]	Hantush	Leaky Confined	1213.5	3.73	0.001335	28.72		0.00681
		Neuman-Witherspon	Leaky Confined	2492.9	7.67	0.0191			
		Cooper-Jacob	Confined	24300	74.77	2.354×10^{-10}			

Notes:
[1] Aquifer test data were analyzed using the software package AQTESOLV, version 4.0 Professional (Duffield, 2007).
[2] Constant pumping in well I-1-700 at an average rate of 15.4 gpm.
ft/day - feet per day
ft^2/day - feet squared per day
ID - identification
gpm - gallons per minute
NA - not applicable

TABLE 3-6

JANUARY 2020 I-1-700 GROUNDWATER SAMPLING RESULTS
PHASE 1 BASAL DEPTH AQUIFER STUDY
ENERGY*SOLUTIONS*, CLIVE, UTAH

Location Identification	**I-1-700**		
Date Collected	**1/16/2020**		
Screened Interval (depth bgs)	**335-355**		
Analyte/Methods (Units)			
Metals (mg/l)			
Calcium	773		
Iron, Dissolved	0.685		
Magnesium	794		
Potassium	507		
Sodium	23,200		
Metals (µg/l)			
Uranium	17.4		
Radionuclides (pCi/L)	Result	Uncertainty	MDA
K-40	478	±96.3	61.2
Th-228	0.136 U	±0.366	0.662
Th-230	0.228 U	±0.430	0.730
Th-232	0.0370 U	±0.252	0.501
U-233/234	13.6	±2.09	0.746
U-235/236	0.153 U	±0.351	0.557
U-238	6.39	±1.43	0.451
Gross Alpha	91.5 U	±112	189
Gross Beta	495	±157	248
Ra-226	2.71	±0.559	0.312
Ra-228	8.14	±1.80	1.78
Water Parameters (mg/l)			
Ammonia (as N)	0.189		
Bicarbonate (as CaCO3)	180		
Bromide	10.5		
Carbonate (as CaCO3)	<10.0		
Chloride	42,100		
Nitrate/Nitrite (as N)	0.134		
Sulfate	2,890		
Total Dissolved Solids	65,400		
Additional Water Parameters			
Conductivity (µmhos/cm)	111,000		
Ion Balance percent (%)	-5.30		
pH@ 25°C	7.04		
Field-measured Parameters			
pH	6.92		
Specific Conductivity (µmhos/cm)	95,800		
Temperature (^{o}C)	14.64		
Oxygen Reduction Potential (millivolts)	-275		
Dissolved Oxygen (mg/l)	0.30		
Specific Gravity (unitless)	1.048		

Notes:

bgs	below ground surface
°C	degrees Celsius
g/cm^3	grams per cubic centimeter
µg/l	micrograms per liter
µmhos/cm	micromhos per centimeter
mg/l	milligrams per liter
pCi/l	picocuries per liter
MDA	minimum detectable activity
U	Analyte was analyzed for but not detected above the MDA
K-40	Potassium 40
Th-228	Thorium 228
Th-230	Thorium 230
Th-232	Thorium 232
U-233/234	Uranium 233/234
U-235/236	Uranium 235/236
U-238	Uranium 238
Ra-226	Radium 226
Ra-228	Radium 228

APPENDICES

Appendix A BOREHOLE LOG, WELL BUILD DIAGRAM, AND FIELD FORMS

SOIL BORING / LITHOLOGY FORM

Stantec

Project No: 233001389 **Site ID:** Energy Solutions **Location ID:** I-1-700

Drill Date: 11/15/19 - 12/05/19 **Field Geologist/Personnel:** E. Yeager

Drilling Company/Driller: Cascade

SOIL BORING

Total Boring Depth (feet): 615.00

Depth Refusal: 615.00 on breccia

Borehole Diameter (inches): 9": 0-157 / 8": 157-337 / 7": 337-615

Borehole Angle Drilled: Vertical, 90° to surface

Borehole Azimuth *(degrees on compass)*: n/a

Cumulative Feet Drilled: 615.00

Drill Method: Sonic PS600T Track rig
sonic = sonic core

*C California Split Spoon Sampler (2.5" I.D.)
S Standard penetration test sampler
c Cuttings
▼ Elevation of ground water

BORING LOCATION

I-1-700 long: -113.1088
lat: 40.68129
elv: 4280.064
NAD83

I-1-30, 50, 100 nested wells

LOCATION DESCRIPTION nE of nested wells I-1-30, 50, 100

notes
11/15/19
WL meas. in I-1-30 @ 29.55 btoc

DEPTH (FEET)	% Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows (6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
0				na	na	Sonic	100	ML		silt with slight plasticity, ML, 10yR 7/3 very pale brown, stiff, dense, dry, iron oxide staining begins at 3.0 ft bgs	
							100	ML/CL SM		5-7 ft: interbedded silt and clay, ML/CL, 10yR 7/2 light gray, silt is stiff clay is soft, dry, iron oxide staining, bedding <1.0	
10							100	SC		inch thick. 7-17 ft: silty sand, SM, 10yR 6/4 light yellowish brown, fine grained, very loose, dry, iron oxide staining at 8-9.5 ft.	
							100	SM		11-13 ft: as above with low plasticity clayey sand, SC, soft. 17-20 ft: silty sand, SM slightly moist, stiff. 10yR 7/3 very pale brown, fine grained, Fe-ox staining.	
20							100	SM		20-25 ft: silty sand, SM, 10yR 6/4 light yellowish brown, fine grained, loose, dry, Fe-ox staining 24-25 ft.	
							100	CL		25-30 ft: silty clay, CL, 10yR 8/1 white, very soft, slightly moist, fine grained, medium plasticity	▽
30							100	SM/ML		30-37 ft: silty sand / sandy silt, SM/ML, 2.5y 8/1 white, fine grained, soft, loose, very moist, Fe-ox staining 30-30.5 ft	
							100	SM/ML SM		37-48 ft: silty sand, SM, 10yR 7/3 very pale brown, fine grained, soft, loose, very moist. Fe-ox staining throughout.	
40							100	SM			
50							80	SM		48-65 ft: silty sand as above but wet.	

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 - 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows(6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
50				na	na	SONIC	80	SM		see page 1	
							80	SM			
							80	SM		57-65 with angular, coarse sands	
							80	SM		and angular coarse gravel	
60							90	SM			
							90	SM		65-67: poorly graded sand, SP, fine grained flour sized, 10yR 6/3 pale brown,	
							90	SP		soft, loose, wet, Fe-ox staining	
							100	SM		67-70.5: silty sand, SM, 10yR 6/3 pale brown, fine grained with angular, coarse sands, soft, loose, wet	
70							100	SP SM		70.5-71: poorly graded sand, SP, fine grained flour sized, 2.5y 6/3 light yellowish brown	
							100	SM		71-77: silty sand, SM, 10yR 5/6 yellowish brown, fine grained with angular, coarse	
							100	SM		sand to gravel, soft, loose, wet	
							100	SP		77-81: poorly graded sand, SP, fine grained flour sized, 10yR 6/3 pale brown, soft,	
80							100	SP SM		loose, moist, Fe-ox staining 81-83: silty sand, SM, 10yR 6/3 pale brown,	
							100	SM ML		fine grained w/ angular coarse sands and gravel, moist ma. stiff, dense 83-87: silty/clayey sand with slight	
							100	ML		plasticity, ML, 10yR 7/3 very pale brown, with sub angular to subrounded sands and	
							100	SM		gravel, soft, sticky, wet. 87-93: silty sand, SM, 10yR 6/3 pale brown,	
90							100	SM		fine grained w/ angular coarse sands and gravel, loose, soft, wet	
							100	SM ML		93-97: silty/clayey sand with slight plasticity, ML, 10yR 7/4 very pale brown,	
							100	ML		with sub angular to subrounded sands and gravel, soft, sticky, wet	
							100	SM SW		97-98.5: silty sand, SM, 10yR 7/4 very pale brown, with subrounded coarse sands and gravel, wet. 98.5-99.5: well graded sand, SW, 10yR 5/4 yellowish brown, with rounded fine sized	
100										gravels, wet	

Grab sample for ASTM D6913a from 87-89 ft. bgs

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 - 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows (6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
100				na	na	Shelby	120	SM		99.5-107: Silty sand, SM, 7.5yr 6/6 reddish yellow, with subrounded coarse sand to coarse gravel, dense, moist.	
							120	SM			
							100	SM			
							100	SW		107-126: Well graded gravely sands, SW, 7.5yr 5/6 strong brown, gravel is fine to coarse sized and subrounded, loose, wet, Fe-ox staining from 123-126 ft.	
110							100	SW			
							100	SW			
							100	SW			
							100	SW			
120							100	SW			
							100	SW		126-127: clayey fine sand w/ slight plasticity, ML, 10yr 5/6 yellowish brown, soft, very loose, wet	
							100	ML			
							100	SM SW		127-128: Silty sand, SM, 10yr 5/6 yellowish brown, with subrounded fine sand, loose, soft, moist	
130							100	SW		128-137: Well graded gravely sand, SW, 10yr 5/4 yellowish brown, gravel is fine to coarse sized, subrounded to sub angular, loose, wet, Fe-ox staining from 136-137 ft.	
							100	SW			
							100	SW		137-139: Silty sand, SM, 10yr 5/4 yellowish brown, fine grained, wet, stiff.	
							100	SM		139-147: Silty sand, SM, 10yr 6/4 light yellowish brown, with subrounded coarse sand to coarse gravel, loose, wet, trace clay nodules through out.	
140							100	SM			
							100	SM			
							100	SM			
							100	SW		147-152: Well graded gravely sands, SW, 10yr 6/6 brownish yellow, subrounded coarse	
150											

Grabsample for ASTM D6913a from 107-109 ft. bgs

End of day WL = 27.9 ft. bgs
Drill casing @ 27.00
11/15/19

11/18/19
start of day WL = 26.49 ft bgs inside drill casing
@127 ft bgs

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 – 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

157 ft bgs end of 9" outer drill casing. Switch to 8". Drilling w/ water when driving casing to lubricate between 8" & 9" and remove cuttings.

@170 wet to slightly moist

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows (6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
150				na	na	SPIC	100	SW		sand to coarse gravel, loose, wet.	
							100	SM		152-157: silty sand, SM, 10 yr 5/6 yellowish brown, with subrounded coarse sand to coarse gravel, loose, wet	
							100	SM		157-160.5: well graded gravely sands, SW, 10 yr 5/6 yellowish brown, subrounded coarse sand to coarse gravel, loose, wet	
							100	SW			
160							100	SM		160.5-166: silty sand, SM 10 yr 5/6 yellowish brown, with trace subrounded coarse sand to coarse gravel, dense, wet.	
							100	SM		166-167: well graded gravely sands, SW, 10 yr 5/6 yellowish brown, sub rounded coarse sand to coarse gravel, loose, wet	
							100	SM SW			
							100	SM SW		167-169.5: silty sand, SM, 10 yr 4/6 dark yellowish brown, fine grained, moist, loose	
170							100	ML		169.5-170: well graded gravely sands, SW, 10 yr 5/6 yellowish brown, sub rounded coarse sand to fine gravel, loose, moist, Fe-ox staining.	
							100	ML		170-178: clayey fine sand with slight plasticity, ML, 7.5 yr 5/4 brown, with subangular coarse sized sand to coarse sized gravel, stiff, slightly moist.	
							100	ML			
							100	ML SW		178-180: well graded gravely sand, SW, 10 yr 5/6 yellowish brown, subrounded coarse sand to fine gravel, loose, wet.	
180							100	ML		180-188: clayey fine sand with slight plasticity, ML, 10 yr 5/6 yellowish brown, with subangular coarse sized sand to coarse sized gravel, stiff, moist.	
							100	ML			
							100	ML		some gravels are cemented. Drilling harder 177-188.	
							100	ML SW		188-190: well graded gravely sands, SW, 10 yr 5/6 yellowish brown, with subrounded coarse sand to fine gravel, loose, moist	
190							100	SM		190-194.5: silty sand, SM, 10 yr 5/6 yellowish brown, with subrounded coarse sand to coarse gravel, loose, moist.	
							100	SM SW		194.5-200: well graded gravely sands, SW 10 yr 5/6 yellowish brown, with subrounded coarse sand to coarse gravel, loose, moist	
							100	SW			
200							100	SW			

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 - 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows(6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
200				na	na	Sym/c	100	SM		200-203: silty sand, SM, 10YR 5/6 yellowish brown, with subrounded coarse sand to coarse gravel, loose, moist	
							100	SM SW		203-206: well graded sand, SW, 10YR 5/4 yellowish brown, with subrounded coarse sand to coarse gravel, loose, wet	
							100	SW SM		206-207: silty sand, SM, 10YR 5/6 yellowish brown, w/ subrounded coarse sand, dense, moist	
							100	SW SM		207-208: well graded sand, SW, 10YR 5/4 yellowish brown with rounded coarse sand to coarse gravel, loose, moist	
210							100	SM		208-213: silty sand, SM, 10YR 4/4 dark yellowish brown, w/ subrounded coarse	
							100	SM SW		sand to coarse gravel, dense 208-210, loose 210-213, moist. 213-214.5: well	
							100	SW SP		graded sand, SW, 10YR 6/4 light yellowish brown, w/ subrounded coarse sand to coarse gravel, loose, wet.	
							100	SP		214.5-227: poorly graded sand, SP, 10YR 4/4 dark yellowish brown, fine grained, loose, wet,	
220							100	SP		clean.	
							100	SP		no WL collected at end of day b/c drill	
							100	SP		casing is full of drill water to the surface. casing pulled back to 207ft bgs	
							95	SP		227-239: poorly graded sand, SP, 10YR 4/4 dark yellowish brown, fine grained, loose,	
230							95	SP		wet, clean.	
							95	SP			
							95	SP			
							100	SP SW		239-247: well graded gravely sand, SW,	
240							100	SW		10YR 5/4 yellowish brown, with subrounded coarse sand to coarse gravel, loose, wet,	
							100	SW		trace cementation and Fe-Ox staining from 241-242 ft. bgs.	
							100	SW			
										247-249.5 no recovery	
250											

Grab sample 227-229 ft for ASTM D6913a

11/18/19 ↑

11/19/19 ↓ start of day WL = 22.90 ft bgs inside drill casing at 217 ft w/ hole at 227 ft

Undisturbed sample 247-248.5 for ASTM D7263a, D2549, C127a sample rep. of aquifer material

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 - 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows(6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
250				na	na	Sonic	40	GW		249.5-252: well graded gravel-sand mix, GW, 10yR7/4 very pale brown, subrounded, wet	
							100	SW		252-257: Well graded sand, SW, 10yR5/6 yellowish brown, with subrounded coarse	
							100	SW		sand to coarse gravel, loose, wet	
							100	SM		257-259.5: silty sand, SM, 7.5yR 5/8 strong brown, loose, moist to wet, with subangular coarse gravel	
260							100	SM		259.5-264.5: silty sand, SM, 10yR 5/6 yellowish brown, with subrounded coarse sand and	
							100	SM GW		coarse gravel, soft, loose, wet - minor clay nodules 264.5-267: well graded gravel-sand mix, GW	
							100	GW		10yR5/6 yellowish brown, subrounded, wet	
							100	ML		267-274.5: clayey fine sand with slight plasticity, ML, 10yR5/6 yellowish brown,	
270							100	ML		dense, strong cementation throughout with broken cemented pieces gravel to	
							100	ML		cobble size, moist to wet. 274.5-277: silt, ML, 7.5yR5/6 strong brown, very hard, dense	
							100	ML		laminated, dry.	
							100	ML		277-284: clayey fine sand with slight plasticity, ML, 10yR 5/6 yellowish	
280							100	ML		brown. strong cementation throughout with broken cemented pieces gravel to	
							100	ML SM		cobble size, wet. 284-289: silty sand, SM, 7.5yR5/8	
							100	SM		strong brown, very hard, dense, dry. Loose from 286.5-287.	
							100	SM		289-297: silty sand, SM, 7.5yR 5/6 strong brown, very hard, dense, dry, moderate	
290							100	SM		to strong cementation throughout, with broken cemented pieces gravel	
							100	SM		size, Fe-OX staining throughout.	
							100	SM		no WL collected at end of day b/c drill casing is full of drill water to surface, casing pulled back to 287ft bgs.	
							100	ML CL		297-300: silt / silty clay, ML/CL, 10yR 7/2 light gray, laminated, coarse sand sized angular carbonate, dry,	
300										stiff, clay is medium plasticity. Wet at 299-299.5.	

Grab sample for ASTM D6913a from 245-255 ft. bgs

Grab sample for ASTM D6913a from 282-287 ft. bgs

undisturbed sample 297-298.5 for ASTM D7263a D8549 C127a, D5084a rep. of aquitard material 11/19/19 ↑

↓ 11/20/19 start of day WL = 20.9 ft bgs inside drill casing at 287 ft

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 - 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows(6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
300				NA	NA	Sonic	100	ML		300-307: sandy silt, ML, 7.5YR 5/4 brown, very hard, dense, moderate cementation	
							100	ML		throughout with broken cemented pieces coarse sand to coarse gravel in size, dry to moist	
							100	ML		with wet pockets.	
							90	SM		307-310: silty sand, SM, 10YR 5/6 yellowish brown, medium stiff, with rounded coarse gravel, wet Fe-ox staining.	
310							90	ML		310-314.5: sandy silt, ML, 10YR 5/6 yellowish brown, with subrounded coarse sized gravel, dry.	
							90	ML		very stiff.	
							90	SM		314.5-319: silty sand, SM, 10YR 4/3 brown,	
							100	SM		with subrounded to rounded coarse sand, dense, dry, with precipitate nodules (carbonate)	
320							100	SM		that are sub angular and gravel size.	
							100	SM		319-337: silty sand, SM, 10YR 5/2 grayish brown, fine grained, very loose,	
							100	SM		wet, minor precipitate grains coarse sand sized. From 324.5-331.0 Fe-ox staining	
							100	SM		and subrounded coarse gravel sized cemented pieces of both SM and Fe-ox	
							100	SM		material.	
330							100	SM		331-355: silty sand SM, 10YR 5/2	
							100	SM		grayish brown, fine grained, very loose,	
							100	SM		wet, clean	
							95	SM			
340							95	SM			
							95	SM			
							95	SM			
							100				
350											

337 ft bgs end of 8" outer drill casing. Switch to 7".

undisturbed sample 337-338.5 ft bgs for ASTM D7263 Sec 9.1, D854 A, C127 rep of aquifer material

Grab sample for ASTM D6913 from 337-342 ft. bgs

NO WL, end of dr Drill cas full of w ↑ 11/20

↓ 11/21 WL = 70 ft bgs inside drill cas pulled to 327' w/ bover at 337'.

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19-12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows(6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
350				na	na	Sonic	100	SM		see page 7	
							100	SM		355-356: sandy silt, ML, 7.5YR 5/6 strong brown, stiff, dense, dry. 356-357: silt with slight plasticity, ML, 2.5Y 8/2 pale yellow, minor cementation, dry, altered volcanic tuff?	
							100	ML		357-359: silt matrix as above w/ competent volcanics (tuff)	
							100	ML SM		359-359.5: silt, ML, 10YR 6/4 light yellowish brown, very dense, dry	
360							100	ML CL		359.5-361: silty sand / sandy silt, SM/ML, 2.5Y 5/3 light olive brown, wet.	
							100	CL ML		361-364: silty clay, 2.5Y 7/2 light gray, from soft at 361 to very stiff at 364, low plasticity, clasts fine gravel size of remolded silt, dry.	
							100	ML		364-371: sandy silt, ML, 2.5YR 6/6 olive yellow, fine grained, very dense, dry	
							100	ML			
370							100	ML		371-379: silt with slight plasticity, ML, 7.5YR 6/4 light brown, soft to stiff, dry.	
							100	ML			
							100	ML			
							100	ML CL		379-382: silty clay, CL, 7.5YR 7/4 pink, very soft, mod. plasticity, wet	
380							100	CL		382-384: competent volcanics with iron oxide staining, weak, white with black flecks (Mn precipitate)	
							100	Volcanic		same material as at 356-359 (tuff)	
							100	ML		384-387: silt, ML, 10YR 6/4 light yellowish brown, very dense, hard, dry.	
							100	ML		387-391: silt, ML, 7.5YR 5/6 strong brown, very dense, hard, dry	
390							100	ML		391-397: sandy silt, ML, 10YR 5/6 yellowish brown, very dense, hard, dry.	
							100	ML			
							100	ML			
							90	ML		397-412: sandy silt, ML, 2.5YR 6/3 light yellowish brown, very dense, hard, dry	
400											

Grab sample for ASTM D6913a from 356-359 ft bgs and 367-369 ft bgs

undisturbed sample 377-378.5 ft bgs for ASTM D7263Ba, D854a & C127a, D5084 & REP of aquitard material

no WL at end of day. Drill casing full of drill water. Casing @ 387', borehole @ 397' ↑ 11/21/19

11/22/19 morning WL = 16.1 ft bgs inside drill casing

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 - 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows (6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
400				na	na	Sonic	90	ML		see page 8	
							90	ML			
							90	ML			
							90	ML		wet @ 407-408 then dry again.	
410							90	ML			
							90	ML		412-417: clayey silt/fine sand with slight plasticity, ML, 7.5YR 5/6 strong brown, stiff, dry.	
							90	ML			
							100	ML		417-444: clayey silt/silt, ML, 7.5YR 5/6 strong brown, stiff, dry. slight plasticity in clayey silt zones.	
420							100	ML			
							100	ML		wet @ 423-423.5 then dry again	
							100	ML		wet @ 427.5-428.5 then dry again	
							100	ML			
430							100	ML			
							100	ML			
							100	ML			
							100	ML		wet @ 437-440 then dry again	
440							100	ML			
							100	ML		444-445: silt, ML, 2.5Y 7/3 pale yellow, dense, dry	
							100	ML		445-447.5: silt, ML, 5YR 5/6 yellowish red, dense, dry	
							90	ML		447.5-451: clayey silt with slight plasticity, 10YR 5/6 strong brown, dense, dry	
450											

Grab sample for ASTM D6913a from 430-432 ft bgs

no WL @ end of day. Drill casing @ 417' full of water

↑ 11/22/19

↓ 11/25/19 morning WL = 15.37 ft bgs inside drill casing.

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 - 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows (6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
450				↓ na	↓ na	SONIC	90	ML SM		small ash band at 451 ft. 451-453: silty sand, SM, 2.5y 5/2 grayish brown, dense moist	
		↓					90	SM-ML		453-462: silt, ML, 5y 7/3 pale yellow, very dense, dry	
							90	ML			
							100	ML			
460							100	ML		462-464: silt with slight plasticity, ML, 2.5y 6/3 light yellowish brown, stiff, with clay nodules	
							100	ML		and ash lenses, dry	
							100	ML		464.5-477: silt with fine sands and slight plasticity, 2.5y 6/3 light yellowish brown, very dense, dry	
							100	ML			
470							100	ML			
							100	ML			
							100	ML			
							100	ML		477-478.5: silt, ML, 5yr 5/8 yellowish red, very dense, dry, nodules of silt from above	
480							100	ML		477 zone included. 478.5-483: very fine sands laminated w/ clayey silts with slight plasticity, ML, sands are loose, clayey silts are soft, mod plasticity, dry, 7.5yr 5/4 brown	
							100	ML		483-491: sandy silt, ML, 7.5yr 4/6 strong brown, dense, dry	
							100	ML			
490							100	ML		491-496: silt, ML, 5yr 4/4 reddish brown, dense, dry	
							100	ML			
							90	ML SM/ML		496-500: silty sand/sandy silt, SM/ML, laminated, 2.5y 6/4 light yellowish brown,	
							90	SM/ML		dense to loose, dry	
500											

no WL @ end of day, drill casing full of water 11/25/19 ↑

11/26/19 ↓ WL = 16.85 ft bgs inside drill casing @ 457 ft w/ borehole @ 477 ft.

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19 - 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows(6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
500				na	na	Sonic	90	ML		500-504: silt, ML, 5YR 4/6 yellowish red, very dense, dry	
							90	ML/CL		504-507: silt/clay, ML/CL, laminated, 10YR 7/2 light gray. Clay is soft, medium plasticity, dry.	
							90	ML/CL			
							100	ML/CL		507-509: clayey fine sand, ML, 2.5Y 5/4 light olive brown, medium stiff, low plasticity, dry	
510							100	CL/SM		509-511: clay, CL, 5YR 4/6 yellowish red, hard, nonplastic, dense, dry	
							100	SM/CL		511-513: silty sand, SM, 2.5Y 5/3 light olive brown, loose, dry, fine grained. 513-513.5: clay (ash/tuff), CL, 2.5Y 8/1 white, soft, dry.	
							100	CL/ML		513.5-515.0: clay/silty clay, CL/ML, 2.5YR 2.5/8 dark red, hard, nonplastic, dry.	
							100	SM/ML		515-515.5: silty clay, CL, 5YR 5/6 yellowish red, soft, medium plasticity. layer of carbonate @ 515.5 appx 0.5" thick, dry.	
520							100	SM/ML		515.5-534: silty sand/sandy silt, SM/ML, 2.5Y 4/4 olive brown, fine grained, loose, dry.	
							100	SM/ML		slight plasticity	
							100	SM/ML			
530							100	SM/ML			
							100	SM/ML		534-537: silt, ML, 7.5YR 5/8 strong brown, very dense, dry.	
							100	ML			
							90	CL		537-546: silty clay, CL, 7.5Y 4/4 brown, soft, medium plasticity, dry.	
540							90	CL			
							90	CL			
							90	CL		546-550: silty clay, CL, 7.5Y 5/6 strong brown, hard, non plastic, dry.	
550							90	CL			

Grab sample for ASTM D6913a from 505-507 ft bgs

Grab sample for ASTM D6913a from 523-525 ft bgs

no WL @ end of clay. Casing at 460 ft borehole open to 537, full of drill water ↑ 11/26/19

↓ 12/02/19 WL = 17.35 ft bgs inside drill casing @ 457 ft w/ borehole @ 537 ft.

Grab sample for ASTM D6913a from 542-544 ft

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19- 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows (6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
550				na	na	Sample	90	ML		550-554: silt, ML, 7.5y 5/6 strong brown, with slight plasticity, dry, trace subrounded fine sized gravel	
							90	ML		554-557: silty/clayey fine sand with slight plasticity, ML, 10yR 4/4 dark yellowish brown, moist with trace subrounded fine sized gravel	
							90	ML			
							100	ML		557-559: silt, ML, 7.5yR 5/8 strong brown, very dense, dry.	
560							100	ML		559-561.5: clayey fine sand with slight plasticity, ML, 10yR 6/4 light yellowish brown, dry.	
							100	ML		561.5-577: sandy silt/silt, ML, 2.5y 6/4 light yellowish brown, very dense, dry. Carbonate precipitate from 562-566 ft.	
							100	ML			
							90	ML			
570							90	ML			
							90	ML		wet from 574-575 then dry again.	
							90	ML			
							80	SM		577-582: silty sand, SM, 10yR 5/6 yellowish brown, moist, with trace fine to coarse sized rounded gravel	
580							80	SM		582-585: silty/clayey fine sand, ML, 10yR 6/6 brownish yellow, slight plasticity, soft, wet, with subangular coarse sized gravel.	
							80	ML			
							80	ML/CL		585-587: silt/clay, ML/CL, 5yR 4/6 yellowish red, very hard dry.	
							90	SP/SW		587-589: poorly graded sand, SP, 10yR 4/3 brown, fine grained with rounded fine to coarse sized cobbles, loose, dry.	
590							90	SW		589-602.5: well graded sand, SW, fine grained, 10yR 3/3 dark brown, dry.	
							90	SW			
							90	SW		as above but wet 596-597	
							90	SW		598-598.5: clay lense, CL, 10yR 7/3 very pale brown, hard, dry. Wet from 598.5-600 inbetween clay lenses.	
600											

no WL @ end of day, casing full of drill water ↑ 12/02/19

↓ 12/03/19 WL = 9.3 ft bgs inside drill casing w/ borehole at 557 ft

Grab sample for ASTM D6913a from 570-572 ft.

Grab Sample for ASTM D6913a from 590-592 ft

no WL @ end of day, casing full of drill water ↑ 12/03/19

↓ 12/04/19 WL = at ground surface inside drill casing w/ borehole at 597 ft.

SOIL BORING / LITHOLOGY FORM *(Continued)*

Stantec

Drill Date: 11/15/19- 12/05/19 **Site ID:** Energy Solutions **Location ID:** I-1-700

no WL end of day.

↑ 12/04/19

↓ 12/05/19

DEPTH (FEET)	Grain Size % Gravel	% Sand	% Fines	Max. PID Reading (ppm)	Blows(6 in.)	Sample Type	Sample Recovery	USCS/ASTM Classification	Graphic Log	LITHOLOGIC DESCRIPTION (USCS name; color; size and angularity of each component or plasticity; density; moisture content; additional facts)	ELEVATION (FEET)
600				na	na	Bonic	90	SM/ML/CL		600-600.5: clay lense like 598-598.5 ft.	
							90	ML/CL		602.7-607: silt/clay, ML/CL, 7.5YR 4/6 strong brown, very dense, hard, dry.	
							90	ML/CL			
							50			607-615: Breccia with rock flour due to drilling. Rock flour wet from core barrel,	
610							50			not groundwater. strong, moderately hard. carbonate matrix	
							50			TD=615.00 ft. bgs	
										Borehole terminated at 615 ft. bgs w/in breccia. Would have	
620										to drill w/water and the potential	
										of getting stuck, decision made	
										w/ ES and State to end	
										borehole @ 615 ft. bgs.	
630											
640											
650											

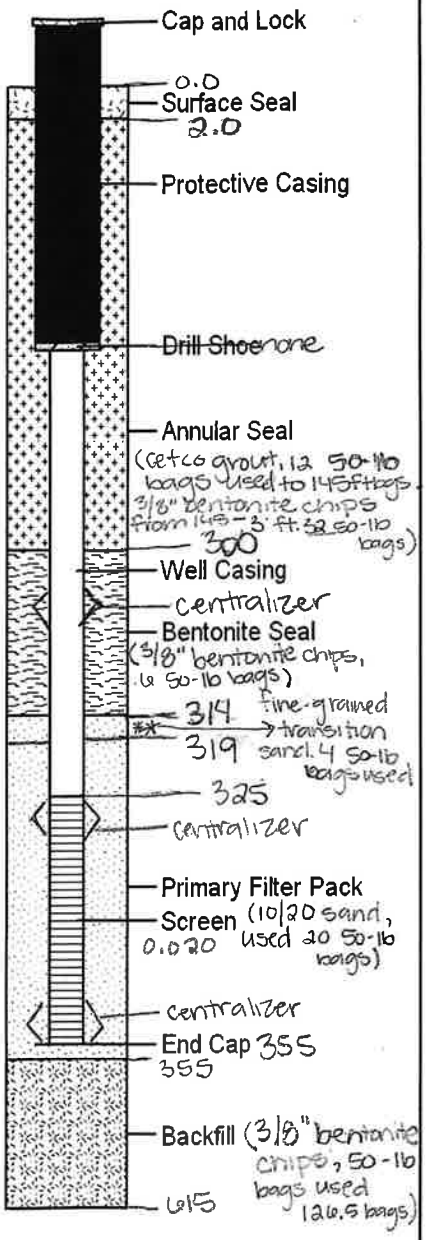
Project Name: ES deep aquifer drilling	Date Drilled: From 11/15/19 to 12/05/19	**Well ID**
Project Number: 233001389	Date Installed: From 12/10/19 to 12/14/19	I-1-700

Longitude: -113.1088 Latitude: 40.609129 Elevation: 4280.064 Datum: NAD83

Protective Casing: 1.9 BGS	3.9 AGS
Well Casing Top: ~~BGS~~	2.0 AGS
Well Casing Schedule: 40/80 Other: stainless steel	
Well Casing Diameter: 3.0 in	
Screen Joint: 325 (BGS)	
Screen Material: Stainless steel	Manufacturer: South Coast
Screen Type: mill slot	Slot Size: 0.020
End Cap Bottom: 355 (BGS)	
Borehole Bottom: 615 (BGS)	
Borehole Diameter: * see notes (BGS)	
Surface Seal (BGS): Top: 0.0	Bottom: 2.0
Surface Seal Material: concrete	
Annular Seal (BGS): Top: 2.0	Bottom: 300
Annular Space Seal Material: Cetco Grout / 3/8" bentonite chips 50-lb bags	
Primary Filter Pack: (BGS) Top: 314	Bottom: 355
Sand Size: 10/20 / fine-grained transition sand	Volume Added: ~8.6 Ft^3
Manufacturer: NFS 50-lb bags	Cap and Lock:
Protective Casing:	
Inside diameter:	
Drainage ports: none	
Backfilled with: 3/8" bentonite chips From: 615 to 355 (BGS)	
Drilling Method: Sonic PS600T track rig	
Drilling Fluids: Potable water	
Drilling Additives: (Describe) EZ mud	
Water level after completion: 32.5 BGS 34.5 TOC	
USCS Soil Classification @ Screen: Silty sand, fine grained	
GP GM GC GW SW SP (SM) SC ML MH CL CH Bed Rock	
Bedrock Classification: none	
Formation/Unit @ Screen: none	

*** Bentonite seal Top: 300 bottom: 314 used: 3/8" chips 6 50-lb bags

** 4



Well Drilled By	Well Installed By
Firm: Cascade Drilling	Firm: Cascade Drilling
Operator: Ryan Miller	Installer: Ryan Miller

Notes: * Borehole telescoped with: 9" casing 0-157 ft bgs, 8" casing: 157-337 ft bgs, 7" casing 337-615 ft bgs

All lengths and depths are recorded in feet unless otherwise stated.

Stantec

WELL DEVELOPMENT RECORD

Well Number: I-1-700

Job No. 233001389 Project Name: Energy Solutions Well dev. Page: 1 of 2

Date(s): 1/14/2020 + 1/15/2020 Comments: Notes prepared by Aaron Pittley

Developed by: Cascade Drilling + Stantec

Measuring Point (MP) of Well: TOCN

Screened Interval (ft bgs): 325-355

Filter Pack Interval (ft bgs): 319-355

Development Method: Bail, Surge, Pump

Starting H_2O Level (BMP): 31.85

Casing Stickup TOC (ft): 1.41

Casing Diameter (in ID): 3

Casing Volume (gal): 118.7

QUALITY ASSURANCE

Methods (describe)

Cleaning Equipment: NA

Development: 1.5" X 10' bailer, 3" dia rubber disc surge, 3" elec. sub, Pump

Disposal of Purge Water: Containerized on site

Instruments (indicate make, model, id.)

Water Level: Thermometer: Same as above

pH Meter: Aqua Troll 600/S/N 469079 Field Calibration: 1/14/20

Conductivity Meter: Same as above Field Calibration: 1/15/20

Turbidity Meter: Same as above Field Calibration:

Other: NA Field Calibration:

DEVELOPMENT MEASUREMENTS

Date/Time	Cumul. Vol. (gal)	Temp. (C)	Field EC (µS/cm)	Color	Turbidity	Other pH	Remarks
1/14/20, 0955	2	11.64	7479.40	Brown	1010.6	7.45	ORP -96.14 (Bailer)
1/14/20, 1120	10	13.54	30257.38	Brown	5311.2	7.26	ORP 11.22, Thick Water — silty sand
1/14/20, 1236	–	–	–	–	–	–	Started Surge — Total depth 358.00
1/14/20, 1310	–	–	–	–	–	–	Surge / Soft bottom — TD = 357.50
1/14/20, 1334	–	–	–	–	–	–	Continued Bailing
1/14/20, 1415	20	12.72	41893.10	Brown	721.3	7.20	DTW = 35.35, Less sand and fines
1/14/20, 1615	–	–	–	–	–	–	Pump installed at 345' — DTW = 31.85
1/14/20, 1625	–	–	–	–	–	–	Started Pump
1/14/20, 1626	–	–	–	–	–	–	7.79 gpm / DTW = 42.0[illegible]
1/14/20, 1630	–	–	–	–	–	–	8.4 gpm / DTW = 42.4[illegible]
1/14/20, 1632	–	–	–	–	–	–	Increased flow rate to 12 gpm / silty
1/14/20, 1635	105	12.39	73289.66	Brown	3198.73	7.03	DTW = 47.32, Flow 12.1 gpm / silty
1/14/20, 1640	165	12.60	79578.94	Brown	567.9	7.07	DTW = 47.57, Flow 12.1 gpm / silty
1/14/20, 1645	–	–	–	–	–	–	DTW = 47.85 –
1/14/20, 1650	285	12.81	79954.09	Brown	218.3	7.09	DTW = 48.01, Flow 12.4 gpm / silty
1/14/20, 1655	347	13.13	80839.43	Brown	167.5	7.08	DTW = 48.15, Flow 12.5 gpm / silty
1/14/20, 1657	377	–	–	–	–	–	Shut off pump

Total Discharge (gal): 372 Casing Volumes Purged: 3.1

Observations/Comments: Purge water becoming less turbid, continue pump purge on 1/15/20

Abbreviations:

BMP = below measuring point

BGS = below ground surface

Cumul. Vol. = cumulative volume removed

ID = inside diameter

C = Celsius

gal = gallons

ft = feet

in = inches

Filename: Well dev1.dwg

Stantec

WELL DEVELOPMENT RECORD

Well Number: I-1-700

Job No. 233001389 Project Name: Energy Solutions Well dev. Page: 2 of 2

Date(s): 1/15/2020 Comments: Notes: Produced by Aaron Pettley

Developed by: Cascade Drilling + Stantec

Measuring Point (MP) of Well: TOCN

Screened Interval (ft bgs): 325-355

Filter Pack Interval (ft bgs): 319-355

Development Method: Pump

Starting H_2O Level (BMP): 31.70

Casing Stickup TOC (ft): 1.41

Casing Diameter (in ID): 3

Casing Volume (gal): 118.7

QUALITY ASSURANCE

Methods (describe)

Cleaning Equipment: NA

Development: 3" electrical submersible pump

Disposal of Purge Water: Containerized onsite

Instruments (indicate make, model, id.)

Water Level: Thermometer: Same as above

pH Meter: Aqua Troll 600/SN 469079 Field Calibration: 1/15/20

Conductivity Meter: Same as above Field Calibration:

Turbidity Meter: Same as above Field Calibration:

Other: Field Calibration:

DEVELOPMENT MEASUREMENTS

Date/Time	Cumul. Vol. (gal)	Temp. (C)	Field EC (µS/cm)	Color	Turbidity	Other pH	Remarks
1/15/20, 0829	—	—	—	—	—	—	Started Pump
1/15/20, 0835	90	—	—	—	—	—	DTW = 51.40, Flow 18 gpm - Silty
1/15/20, 0845	240	14.04	77493.7	Brown	198.72	7.13	DTW = 51.79, Flow 15 gpm - Silty
1/15/20, 0851	324	—	—	—	—	—	DTW = 51.91, Flow 14 gpm
1/15/20, 0855	386	12.61	74180.41	Brown	239.92	7.13	DTW = 51.98, Flow 15.4 gpm - Silty
1/15/20, 0900	462	—	—	—	—	—	DTW = 52.15, Flow 15.2 gpm - Silty
1/15/20, 0910	613	13.44	79308.34	Slightly brown	104.8	7.13	DTW = 52.21, Flow 15.1 gpm - Cloudy
1/15/20, 0923	811	—	—	Slightly brown	—	—	DTW = 52.51, Flow 15.2 gpm - Cloudy
1/15/20, 0930	918	13.70	81912.45	Cloudy slight	30.7	7.16	DTW = 52.78, Flow 15.3 gpm - Slight cloudy
1/15/20, 0940	1072	—	—	—	—	—	DTW = 52.82, Flow 15.4 gpm
1/15/20, 0950	1226	13.70	83227.02	Clear	13.7	7.16	DTW = 53.01, Flow 15.4 gpm - Clear
1/15/20, 1000	1379	13.87	83757.80	Clear	11.3	7.14	DTW = 53.25, Flow 15.3 gpm - Clear
1/15/20, 1010	1532	—	—	—	—	—	DTW = 53.38, Flow 15.3 gpm
1/15/20, 1020	1686	14.00	83987.21	Clear	12.2	7.14	DTW = 53.46, Flow 15.4 gpm - Clear
1/15/20, 1023	—	—	—	—	—	—	Shut off pump -

Total Discharge (gal): 1686 + 372 = 2,058 Casing Volumes Purged: 17.3

Observations/Comments: Parameters became stable and water more clear

Abbreviations:

BMP = below measuring point

BGS = below ground surface

Cumul. Vol. = cumulative volume removed

ID = inside diameter

C = Celsius

gal = gallons

ft = feet

in = inches

Filename: Well-devel.dwg

Stantec

Groundwater Sampling Sheet
Energy*Solutions*
CL-EV-PR-004-F3 (Rev 2)

Groundwater Well No. or Sampling Point: I-1-700 Date: 1-16-20 Arrival Time: 14:20

Sampling Team Members: Team Leader: R SOBOCINSKI Assistant: J HILL

Stantec & GWMRC present

Description of Well Condition. (Note the condition of the well at the time of arrival, whether the well is secure (locked), general condition, note presence of cracks or any evidence of tampering.)

Y N In good condition?
Y N Is the well fully operational?
Y N Was the lock secure on arrival? — NA
Y N Evidence of tampering or vandalism?
Y N Are sandy or silty materials in the well?
Y N Standing water in or around the well?
Y N Cracks or breaks in the concrete or casings?
Y N Has the annual TD been determined?
Y N Has the annual pump/tubing inspection been performed? — NA
Y N Is the well in need of repairs?
Y N Is there a marked change in pumping rate? — NA

Weather Conditions

Wind Direction: East
Speed (est.): 0-5 mph
Cloud Cover: overcast
Temperature: 36 degrees F
Precip: Present Recent Rain Snow Other NA

General Comments/Problems:
mid-day cal check:
pH 7.0 7.04 at 18.06 °C
SC 47.6 48.5 at 16.55 °C
Specific Gravity: 1.048 Sample collection time: 1514

Pre--Sampling Groundwater Field Analysis Results. Temperature: F C Specific Conductivity: µmhos/cm

#	Pre-pH	Pre-Temp	Pre-SC	Pre-Eh	Pre-Diss O	Appearance of Groundwater
1	6.91	14.63	95.6	-266	0.32	clear
2	6.92	14.64	95.7	-171	0.31	clear
3	6.92	14.64	95.8	-275	0.30	clear

Well Information: for 2-inch well — Purge Volume Formula: V_p (gal) = 0.5 gal/ft x ($Depth_{TD}$ - $Depth_{H2O}$)

Depth to well bottom (D_{TD}): 358.' TOC
Survey factor for DTW probe: NA
Calculated purge volume:
Total purge volume:

Depth to groundwater (D_{H2O}): pumping, started at 30.62' TOC
Adjusted D_{H2O}: NA
Time pump on: NA Time pump off: NA
1st flow rate of purge: gallons/minute
2nd flow rate of purge: gallons/minute

Analytical laboratories and delivery information: Rad Lab: BEL Chem Lab: ANAL
Delivery Time/Date:
Delivery Time/Date:

Collection Order		Minimum Vol/ Container	Collection Order		Minimum Vol/ Container
1 NA	a. Volatile Organics	3x40ml/glass	5 X	e. Cations	500 ml plastic
2 NA	b. Semi-VOCs	2x500ml/amber glass	6 X	f. Anions	500 ml plastic
3 X	c. Metals/Inorgs	500 ml plastic	7 X	g. Radiologics	~~3.5~~ 2.0 gallons plastic
4 X	d. TDS, TSS	500 ml plastic	8 NA	h. Others (describe)	

Sampling Team Leader's Initials: RWA Others: JH

Note: Bob Sobocinski with EnergySolutions verified via email on 02/25/2020 the units for the pre-sampling field analysis:
Temp - Celsius
SC - mhos/cm
EH - millivolts
Diss O - mg/l

Appendix B PHOTOGRAPHS

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 1

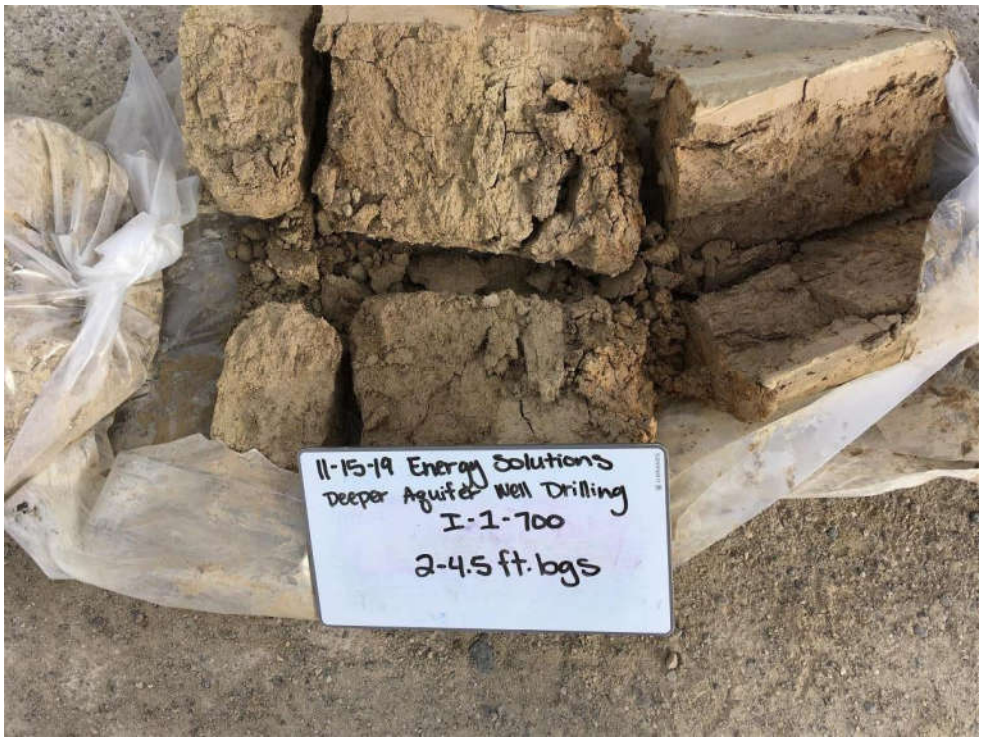
Drilling Date:
11/15/2019

Comments:
0 - 2 ft bgs

Photograph ID: 2

Drilling Date:
11/15/2019

Comments:
2 - 4.5 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 3

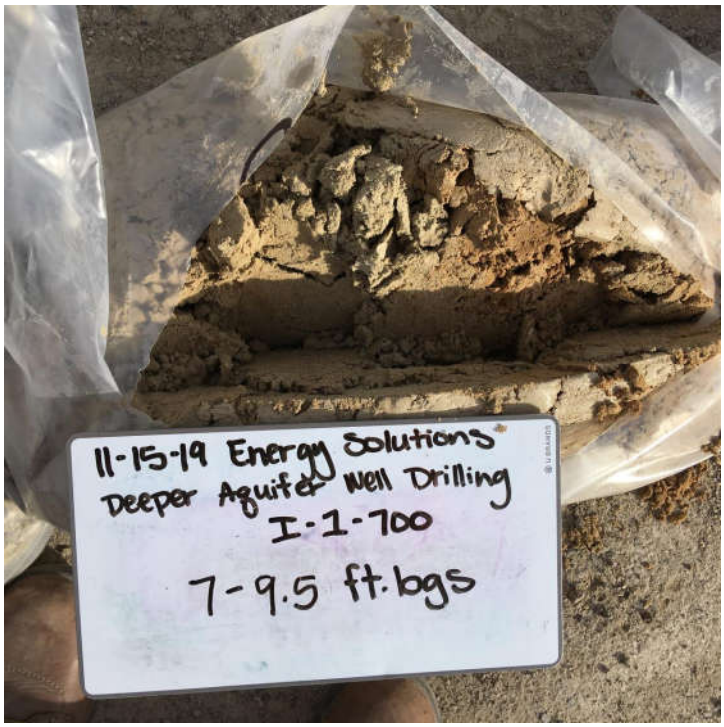
Drilling Date:
11/15/2019

Comments:
4.5 - 7 ft bgs

Photograph ID: 4

Drilling Date:
11/15/2019

Comments:
7 - 9.5 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 5

Drilling Date:
11/15/2019

Comments:
9.5 - 12 ft bgs

Photograph ID: 6

Drilling Date:
11/15/2019

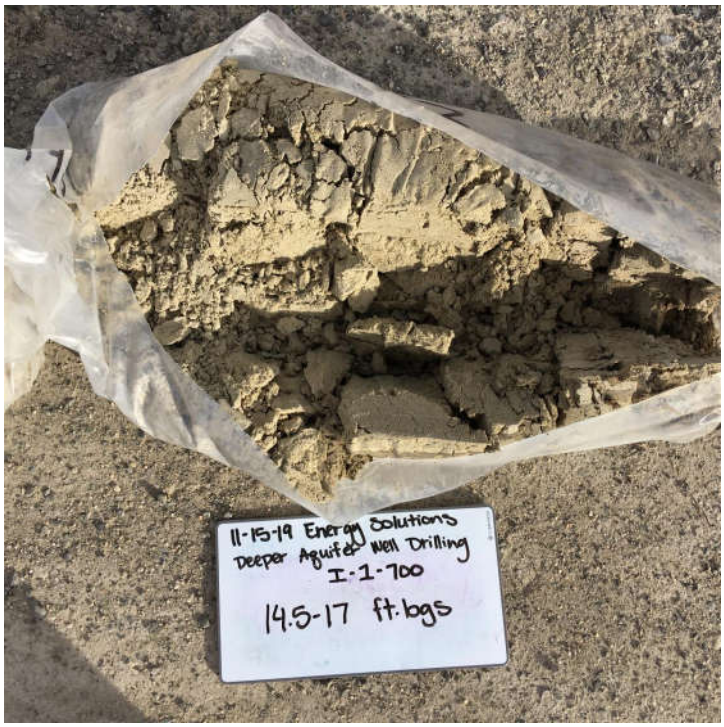
Comments:
12 - 14.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 7

Drilling Date:
11/15/2019

Comments:
14.5 - 17 ft bgs



Photograph ID: 8

Drilling Date:
11/15/2019

Comments:
17 - 19.5 ft bgs

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 9

Drilling Date:
11/15/2019

Comments:
19.5 - 22 ft bgs

Photograph ID: 10

Drilling Date:
11/15/2019

Comments:
22 - 24.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 11

Drilling Date:
11/15/2019

Comments:
24.5 - 27 ft bgs

Photograph ID: 12

Drilling Date:
11/15/2019

Comments:
27 - 29.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 13

Drilling Date:
11/15/2019

Comments:
29.5 - 32 ft bgs

Photograph ID: 14

Drilling Date:
11/15/2019

Comments:
32 - 34.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 15

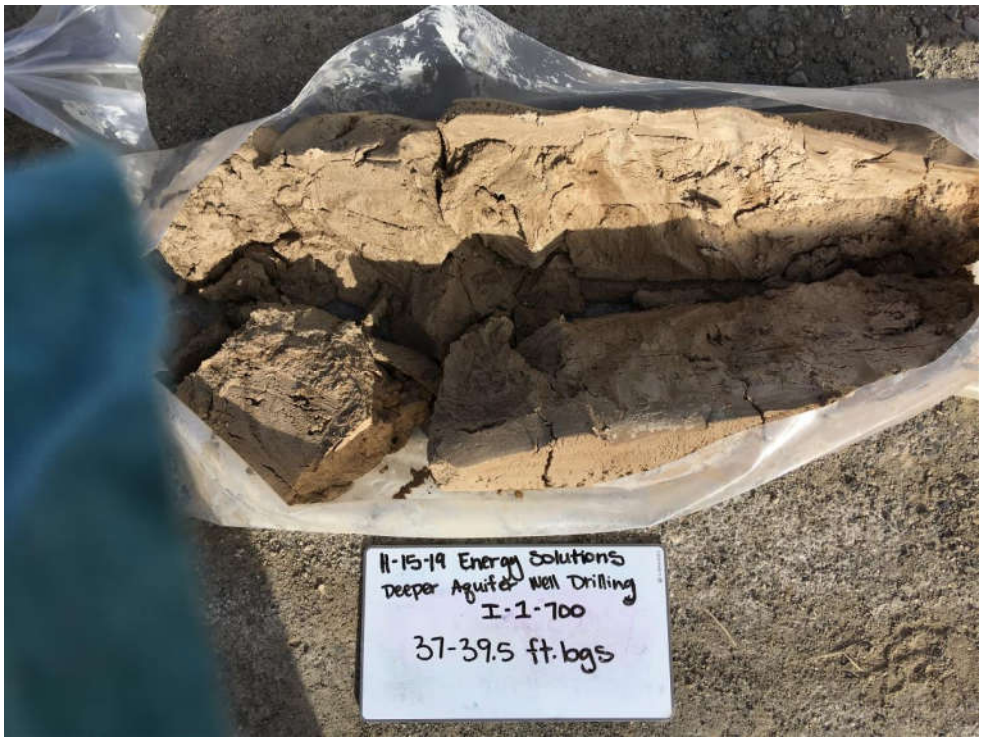
Drilling Date:
11/15/2019

Comments:
34.5 - 37 ft bgs

Photograph ID: 16

Drilling Date:
11/15/2019

Comments:
37 - 39.5 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 17

Drilling Date:
11/15/2019

Comments:
39.5 - 42 ft bgs

Photograph ID: 18

Drilling Date:
11/15/2019

Comments:
42 - 44.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 19

Drilling Date:
11/15/2019

Comments:
44.5 - 47 ft bgs

Photograph ID: 20

Drilling Date:
11/15/2019

Comments:
47 - 49.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 21

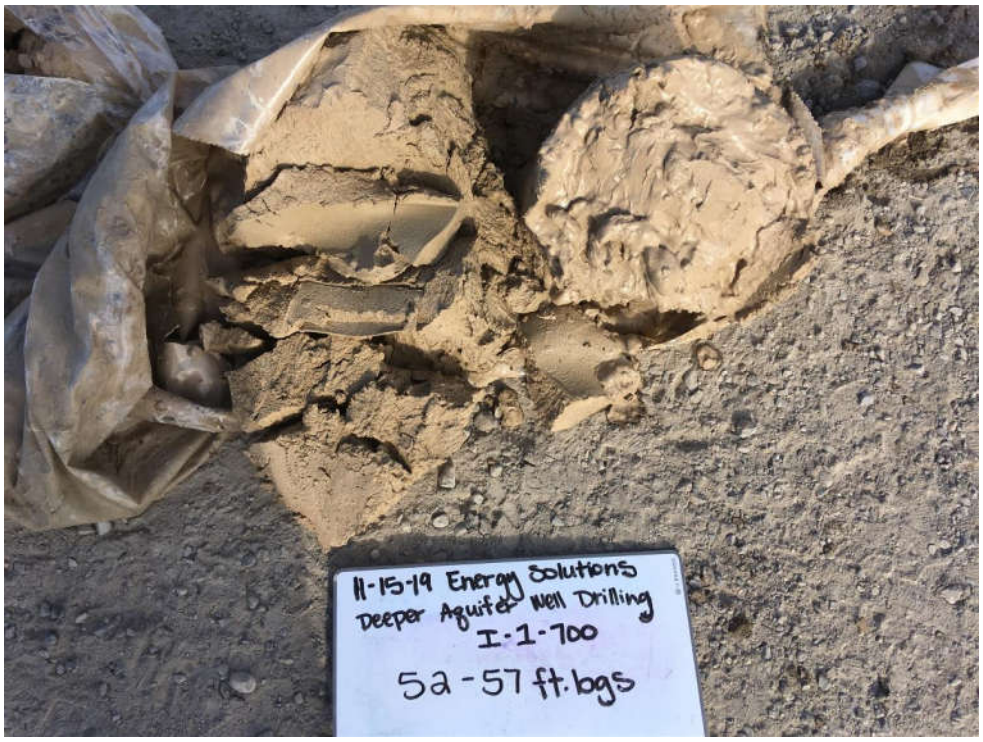
Drilling Date:
11/15/2019

Comments:
49.5 - 52 ft bgs

Photograph ID: 22

Drilling Date:
11/15/2019

Comments:
52 - 57 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 23

Drilling Date:
11/15/2019

Comments:
57 - 59.5 ft bgs

Photograph ID: 24

Drilling Date:
11/15/2019

Comments:
59.5 - 62 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 25

Drilling Date:
11/15/2019

Comments:
62 - 64.5 ft bgs

Photograph ID: 26

Drilling Date:
11/15/2019

Comments:
64.5 - 67 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 27

Drilling Date:
11/15/2019

Comments:
67 - 69.5 ft bgs

Photograph ID: 28

Drilling Date:
11/15/2019

Comments:
69.5 - 71 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 29

Drilling Date:
11/15/2019

Comments:
71 - 77 ft bgs

Photograph ID: 30

Drilling Date:
11/15/2019

Comments:
77 - 79.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 31

Drilling Date:
11/15/2019

Comments:
79.5 - 82 ft bgs

Photograph ID: 32

Drilling Date:
11/15/2019

Comments:
82 - 84.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 33

Drilling Date:
11/15/2019

Comments:
84.5 - 87 ft bgs

Photograph ID: 34

Drilling Date:
11/15/2019

Comments:
87 - 89.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 35

Drilling Date:
11/15/2019

Comments:
89.5 - 92 ft bgs

Photograph ID: 36

Drilling Date:
11/15/2019

Comments:
92 - 94.5 ft bgs

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 37

Drilling Date:
11/15/2019

Comments:
94.5 - 97 ft bgs

Photograph ID: 38

Drilling Date:
11/15/2019

Comments:
97 - 99.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 39

Drilling Date:
11/15/2019

Comments:
99.5 - 102 ft bgs

Photograph ID: 40

Drilling Date:
11/15/2019

Comments:
102 - 104.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 41

Drilling Date:
11/15/2019

Comments:
104.5 - 107 ft bgs

Photograph ID: 42

Drilling Date:
11/15/2019

Comments:
107 - 109.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 43

Drilling Date:
11/15/2019

Comments:
109 - 112.5 ft bgs

Photograph ID: 44

Drilling Date:
11/15/2019

Comments:
112 - 114.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 45

Drilling Date:
11/15/2019

Comments:
114.5 - 117 ft bgs

Photograph ID: 46

Drilling Date:
11/15/2019

Comments:
117 - 119.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 47

Drilling Date:
11/15/2019

Comments:
119.5 - 122 ft bgs

Photograph ID: 48

Drilling Date:
11/15/2019

Comments:
122 - 124.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 49

Drilling Date:
11/18/2019

Comments:
124.5 - 127 ft bgs

Photograph ID: 50

Drilling Date:
11/18/2019

Comments:
127 - 129.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 51

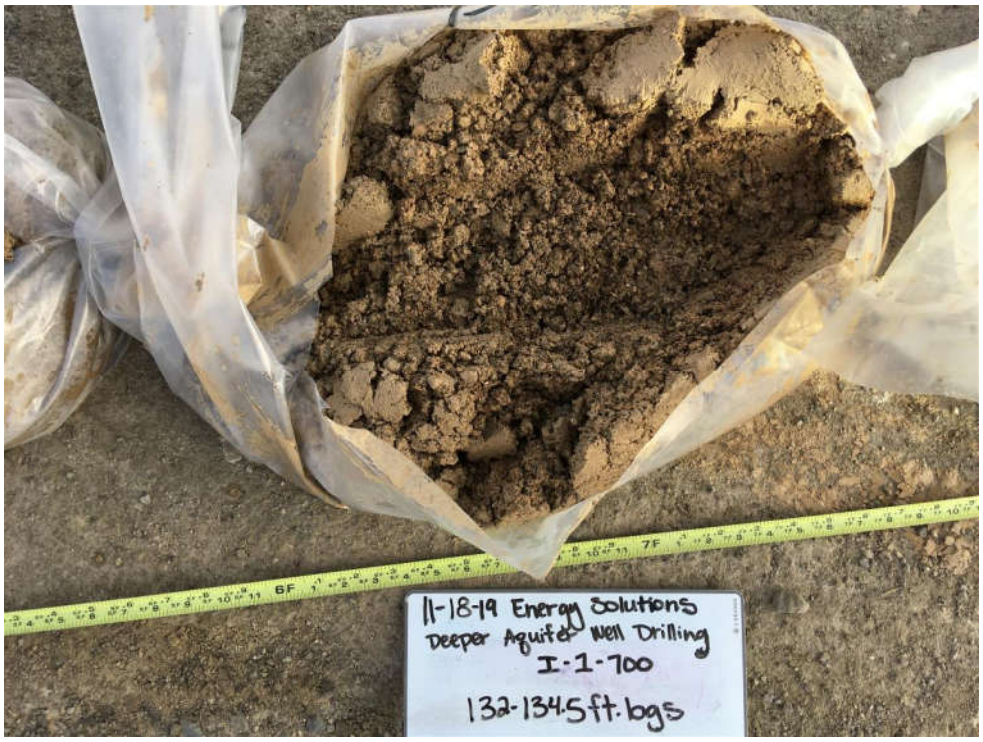
Drilling Date:
11/18/2019

Comments:
129.5 - 132 ft bgs

Photograph ID: 52

Drilling Date:
11/18/2019

Comments:
132 - 134.5 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 53

Drilling Date:
11/18/2019

Comments:
134.5 - 137 ft bgs

Photograph ID: 54

Drilling Date:
11/18/2019

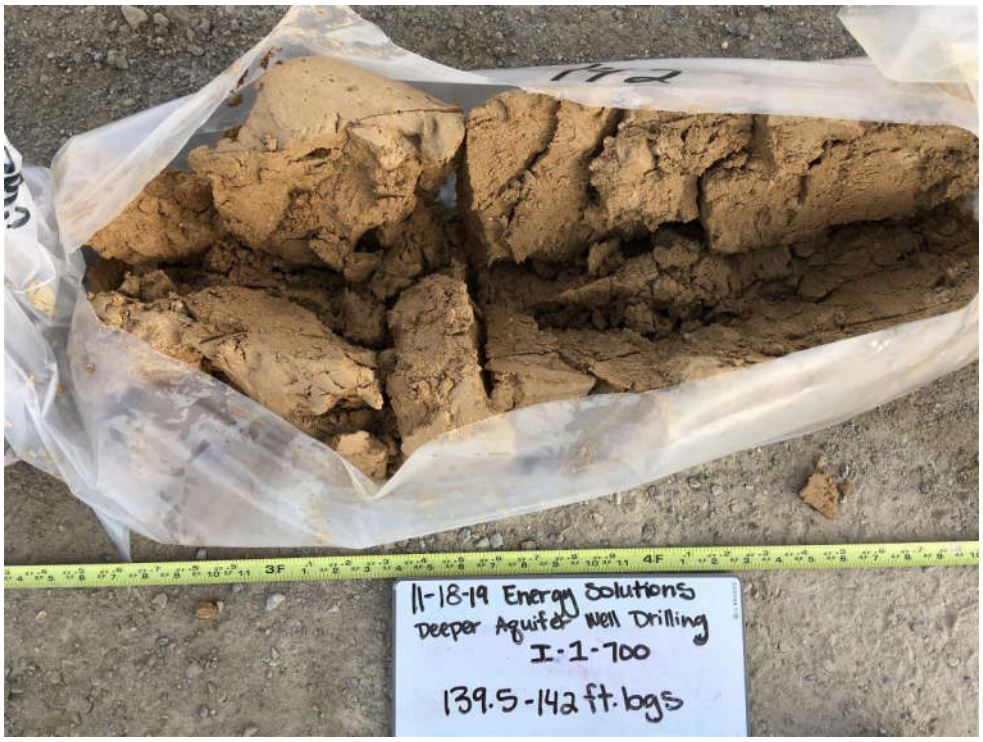
Comments:
137 - 139.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 55

Drilling Date:
11/18/2019

Comments:
139.5 - 142 ft bgs



Photograph ID: 56

Drilling Date:
11/18/2019

Comments:
142 - 144.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 57

Drilling Date:
11/18/2019

Comments:
144.5 - 147 ft bgs

Photograph ID: 58

Drilling Date:
11/18/2019

Comments:
147 - 149.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 59

Drilling Date:
11/18/2019

Comments:
149.5 - 152 ft bgs

Photograph ID: 60

Drilling Date:
11/18/2019

Comments:
152 - 154.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 61

Drilling Date:
11/18/2019

Comments:
154.5 - 157 ft bgs

Photograph ID: 62

Drilling Date:
11/18/2019

Comments:
157 - 159.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 63

Drilling Date:
11/18/2019

Comments:
159.5 - 162 ft bgs

Photograph ID: 64

Drilling Date:
11/18/2019

Comments:
162 - 164.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 65

Drilling Date:
11/18/2019

Comments:
164.5 - 167 ft bgs

Photograph ID: 66

Drilling Date:
11/18/2019

Comments:
167 - 169.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 67

Drilling Date:
11/18/2019

Comments:
169.5 - 172 ft bgs

Photograph ID: 68

Drilling Date:
11/18/2019

Comments:
172 - 174.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 69

Drilling Date:
11/18/2019

Comments:
174.5 - 177 ft bgs

Photograph ID: 70

Drilling Date:
11/18/2019

Comments:
177 - 179.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 71

Drilling Date:
11/18/2019

Comments:
179.5 - 182 ft bgs; bag broke, sample fell out

Photograph ID: 72

Drilling Date:
11/18/2019

Comments:
182 - 184.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 73

Drilling Date:
11/18/2019

Comments:
184.5 - 187 ft bgs

Photograph ID: 74

Drilling Date:
11/18/2019

Comments:
187 - 189.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 75

Drilling Date:
11/18/2019

Comments:
189.5 - 192 ft bgs

Photograph ID: 76

Drilling Date:
11/18/2019

Comments:
192 - 194.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 77

Drilling Date:
11/18/2019

Comments:
194.5 - 197 ft bgs

Photograph ID: 78

Drilling Date:
11/18/2019

Comments:
197 - 199.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 79

Drilling Date:
11/18/2019

Comments:
199.5 - 202 ft bgs

Photograph ID: 80

Drilling Date:
11/18/2019

Comments:
202 - 204.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 81

Drilling Date:
11/18/2019

Comments:
204.5 - 207 ft bgs

Photograph ID: 82

Drilling Date:
11/18/2019

Comments:
207 - 209.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 83

Drilling Date:
11/18/2019

Comments:
209.5 - 212 ft bgs

Photograph ID: 84

Drilling Date:
11/18/2019

Comments:
212 - 214.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 85

Drilling Date:
11/18/2019

Comments:
214.5 - 217 ft bgs

Photograph ID: 86

Drilling Date:
11/18/2019

Comments:
217 - 219.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 87

Drilling Date:
11/18/2019

Comments:
219.5 - 222 ft bgs

Photograph ID: 88

Drilling Date:
11/18/2019

Comments:
222 - 224.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 89

Drilling Date:
11/18/2019

Comments:
224.5 - 227 ft bgs

Photograph ID: 90

Drilling Date:
11/19/2019

Comments:
227 - 229.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 91

Drilling Date:
11/19/2019

Comments:
229.5 - 232 ft bgs

Photograph ID: 92

Drilling Date:
11/19/2019

Comments:
232 - 234.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 93

Drilling Date:
11/19/2019

Comments:
234.5 - 237 ft bgs

Photograph ID: 94

Drilling Date:
11/19/2019

Comments:
237 - 239.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 95

Drilling Date:
11/19/2019

Comments:
239.5 - 242 ft bgs

Photograph ID: 96

Drilling Date:
11/19/2019

Comments:
242 - 244.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 97

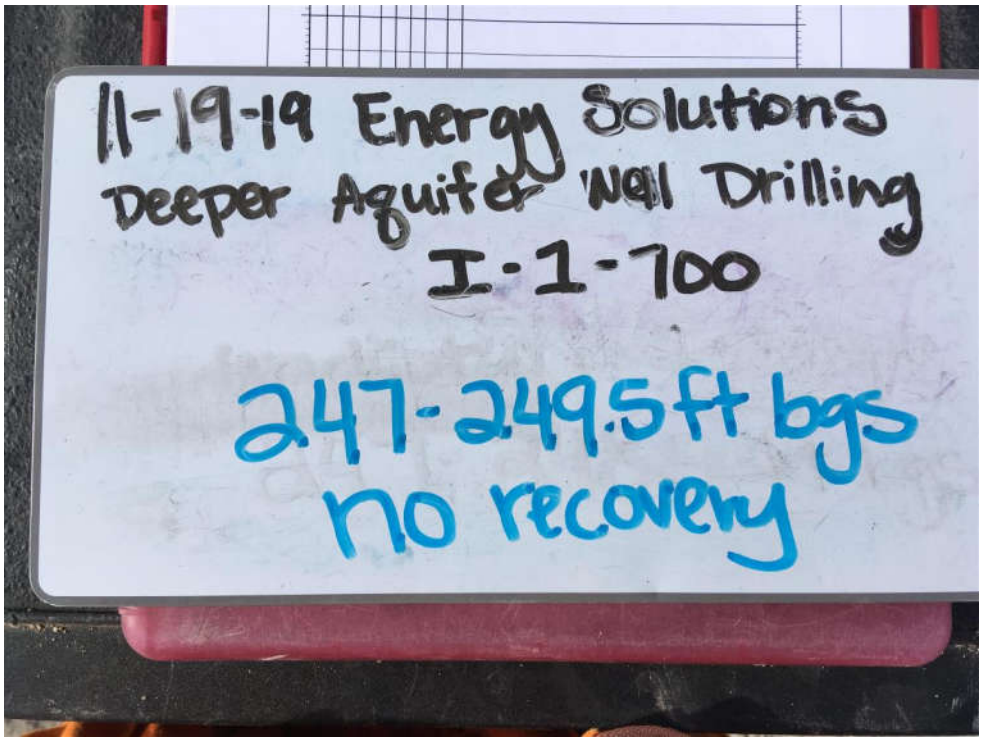
Drilling Date:
11/19/2019

Comments:
244.5 - 247 ft bgs

Photograph ID: 98

Drilling Date:
11/19/2019

Comments:
247 - 249.5 ft bgs - No Recovery



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 99

Drilling Date:
11/19/2019

Comments:
249.5 - 252 ft bgs

Photograph ID: 100

Drilling Date:
11/19/2019

Comments:
252 - 254.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 101

Drilling Date:
11/19/2019

Comments:
254.5 - 257 ft bgs

Photograph ID: 102

Drilling Date:
11/19/2019

Comments:
257 - 259.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 103

Drilling Date:
11/19/2019

Comments:
259.5 - 262 ft bgs

Photograph ID: 104

Drilling Date:
11/19/2019

Comments:
262 - 264.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 105

Drilling Date:
11/19/2019

Comments:
264.5 - 267 ft bgs

Photograph ID: 106

Drilling Date:
11/19/2019

Comments:
267 - 269.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 107

Drilling Date:
11/19/2019

Comments:
269.5 - 272 ft bgs

Photograph ID: 108

Drilling Date:
11/19/2019

Comments:
272 - 274.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 109

Drilling Date:
11/19/2019

Comments:
274.5 - 277 ft bgs

Photograph ID: 110

Drilling Date:
11/19/2019

Comments:
277 - 279.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 111

Drilling Date:
11/19/2019

Comments:
279.5 - 282 ft bgs

Photograph ID: 112

Drilling Date:
11/19/2019

Comments:
282 - 284.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 113

Drilling Date:
11/19/2019

Comments:
284.5 - 287 ft bgs

Photograph ID: 114

Drilling Date:
11/19/2019

Comments:
287 - 289.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 115

Drilling Date:
11/19/2019

Comments:
289.5 - 292 ft bgs

Photograph ID: 116

Drilling Date:
11/19/2019

Comments:
292 - 294.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 117

Drilling Date:
11/19/2019

Comments:
294.5 - 297 ft bgs

Photograph ID: 118

Drilling Date:
11/20/2019

Comments:
297 - 299.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 119

Drilling Date:
11/20/2019

Comments:
299.5 - 302 ft bgs

Photograph ID: 120

Drilling Date:
11/20/2019

Comments:
302 - 304.5 ft bgs

Stantec

Photographic Log

Client:	EnergySolutions, LLC	**Project:**	Basal Aquifer Characterization Drilling
Site Name:	Clive Facility	**Site Location:**	I-1-700

Photograph ID: 121

Drilling Date:
11/20/2019

Comments:
304.5 - 307 ft bgs

Photograph ID: 122

Drilling Date:
11/20/2019

Comments:
307 - 309.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 123

Drilling Date:
11/20/2019

Comments:
309.5 - 312 ft bgs

Photograph ID: 124

Drilling Date:
11/20/2019

Comments:
312 - 314.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 125

Drilling Date:
11/20/2019

Comments:
314.5 - 317 ft bgs

Photograph ID: 126

Drilling Date:
11/20/2019

Comments:
317 - 319.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 127

Drilling Date:
11/20/2019

Comments:
319.5 - 322 ft bgs

Photograph ID: 128

Drilling Date:
11/20/2019

Comments:
322 - 324.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 129

Drilling Date:
11/20/2019

Comments:
324.5 - 327 ft bgs

Photograph ID: 130

Drilling Date:
11/20/2019

Comments:
327 - 329.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 131

Drilling Date:
11/20/2019

Comments:
329.5 - 332 ft bgs

Photograph ID: 132

Drilling Date:
11/20/2019

Comments:
332 - 334.5 ft bgs

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 133

Drilling Date:
11/20/2019

Comments:
334.5 - 337 ft bgs

Photograph ID: 134

Drilling Date:
11/21/2019

Comments:
337 - 339.5 ft bgs

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 135

Drilling Date:
11/21/2019

Comments:
339.5 - 342 ft bgs

Photograph ID: 136

Drilling Date:
11/21/2019

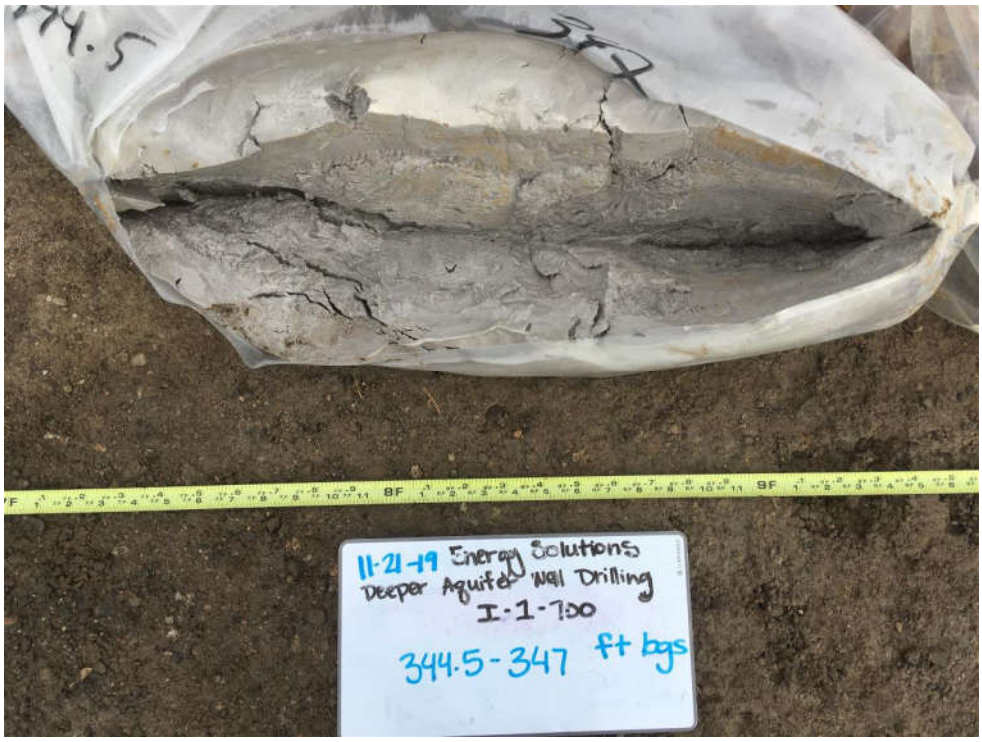
Comments:
342 - 344.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 137

Drilling Date:
11/21/2019

Comments:
344.5 - 347 ft bgs



Photograph ID: 138

Drilling Date:
11/21/2019

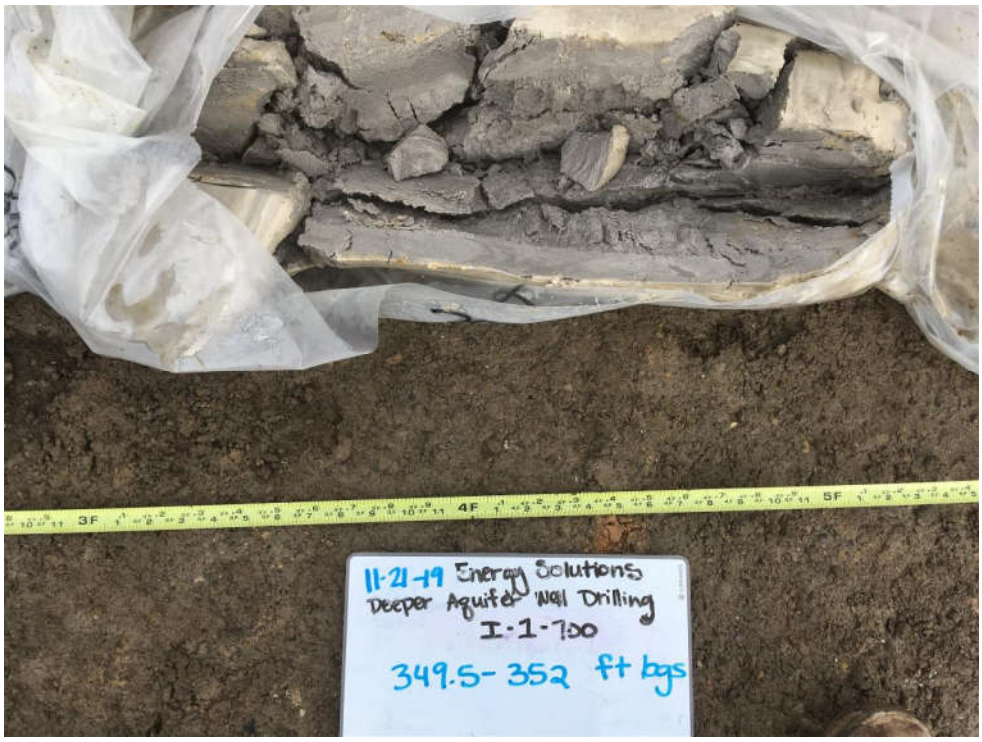
Comments:
347 - 349.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 139

Drilling Date:
11/21/2019

Comments:
349.5 - 352 ft bgs



Photograph ID: 140

Drilling Date:
11/21/2019

Comments:
352 - 354.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 141

Drilling Date:
11/21/2019

Comments:
354.5 - 357 ft bgs

Photograph ID: 142

Drilling Date:
11/21/2019

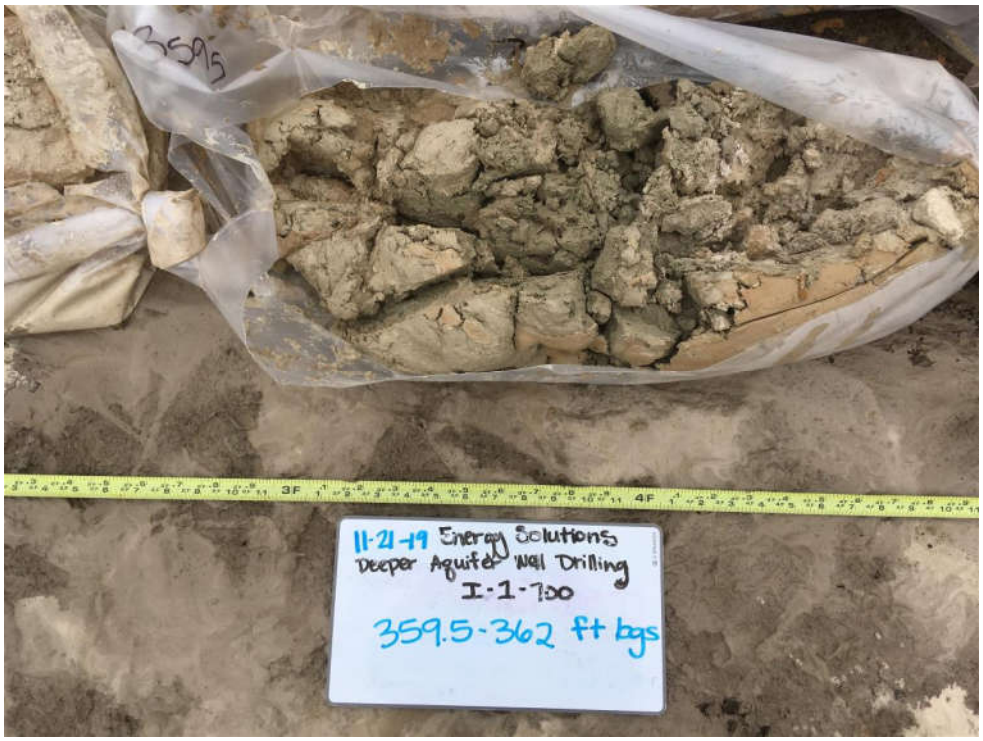
Comments:
357 - 359.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 143

Drilling Date:
11/21/2019

Comments:
359.5 - 362 ft bgs



Photograph ID: 144

Drilling Date:
11/21/2019

Comments:
362 - 364.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 145

Drilling Date:
11/21/2019

Comments:
364.5 - 367 ft bgs

Photograph ID: 146

Drilling Date:
11/21/2019

Comments:
367 - 369.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 147

Drilling Date:
11/21/2019

Comments:
369.5 - 372 ft bgs

Photograph ID: 148

Drilling Date:
11/21/2019

Comments:
372 - 374.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 149

Drilling Date:
11/21/2019

Comments:
374.5 - 377 ft bgs

Photograph ID: 150

Drilling Date:
11/21/2019

Comments:
377 - 379.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 151

Drilling Date:
11/21/2019

Comments:
379.5 - 382 ft bgs

Photograph ID: 152

Drilling Date:
11/21/2019

Comments:
382 - 384.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 153

Drilling Date:
11/21/2019

Comments:
384.5 - 387 ft bgs

Photograph ID: 154

Drilling Date:
11/21/2019

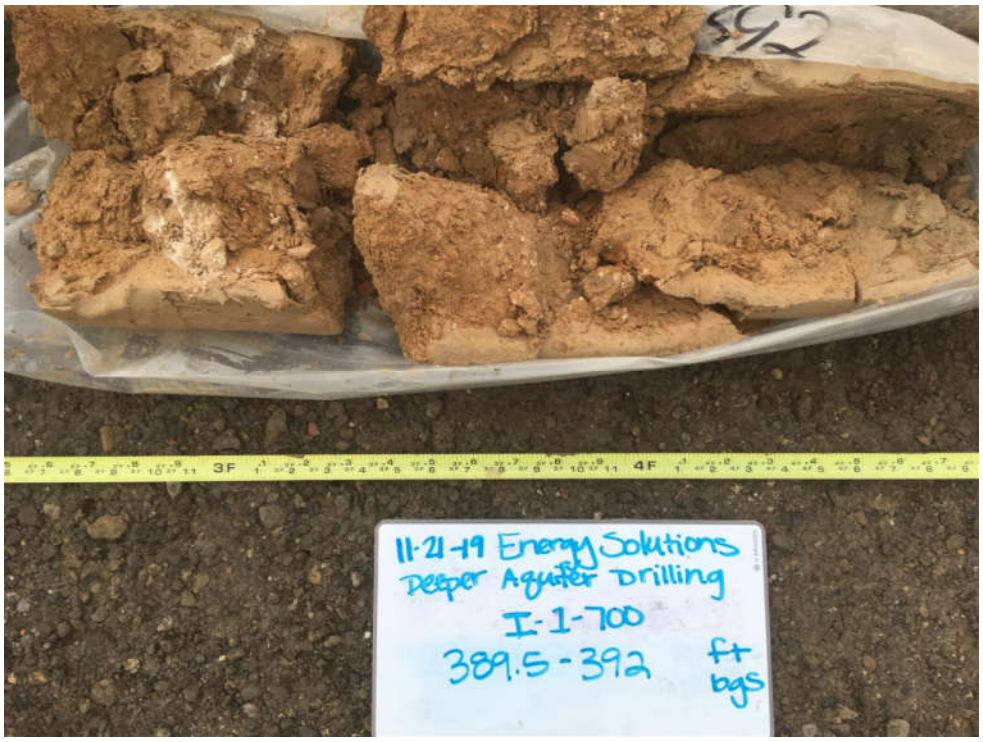
Comments:
387 - 389.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 155

Drilling Date:
11/21/2019

Comments:
389.5 - 392 ft bgs



Photograph ID: 156

Drilling Date:
11/21/2019

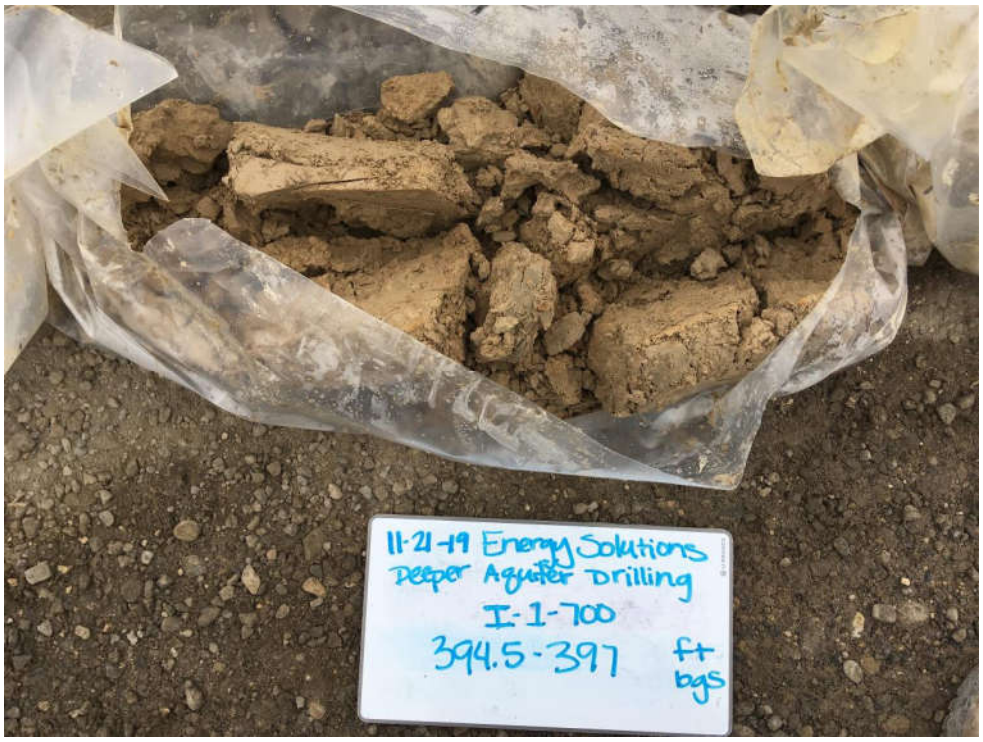
Comments:
392 - 394.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 157

Drilling Date:
11/22/2019

Comments:
394.5 - 397 ft bgs



Photograph ID: 158

Drilling Date:
11/22/2019

Comments:
397 - 399.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 159

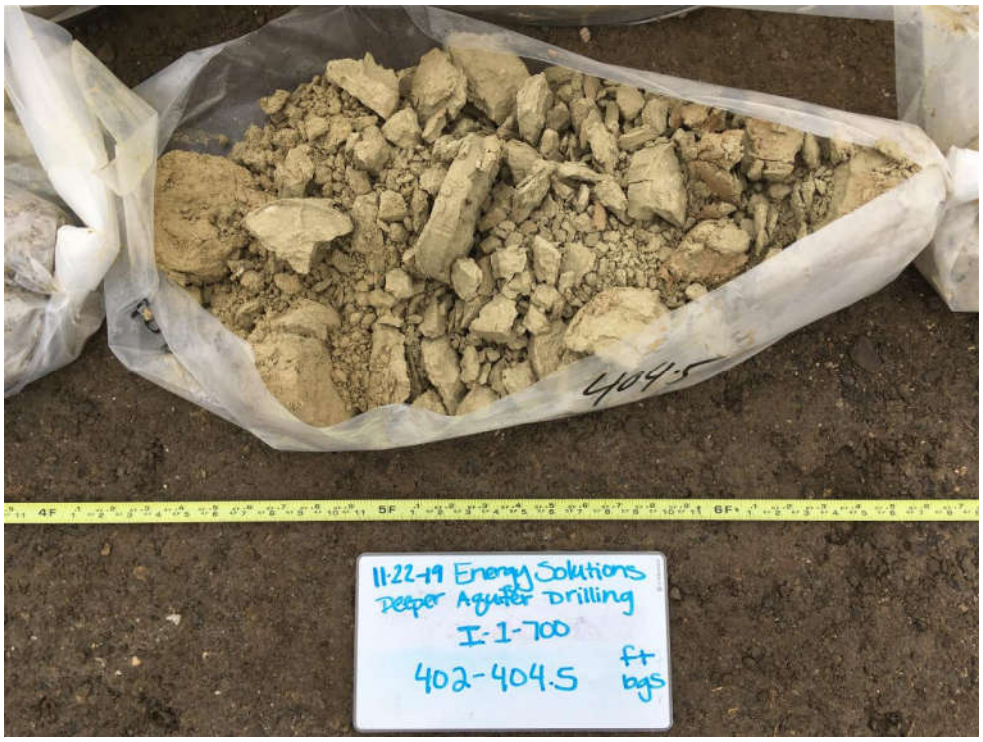
Drilling Date:
11/22/2019

Comments:
399.5 - 402 ft bgs

Photograph ID: 160

Drilling Date:
11/22/2019

Comments:
402 - 404.5 ft bgs

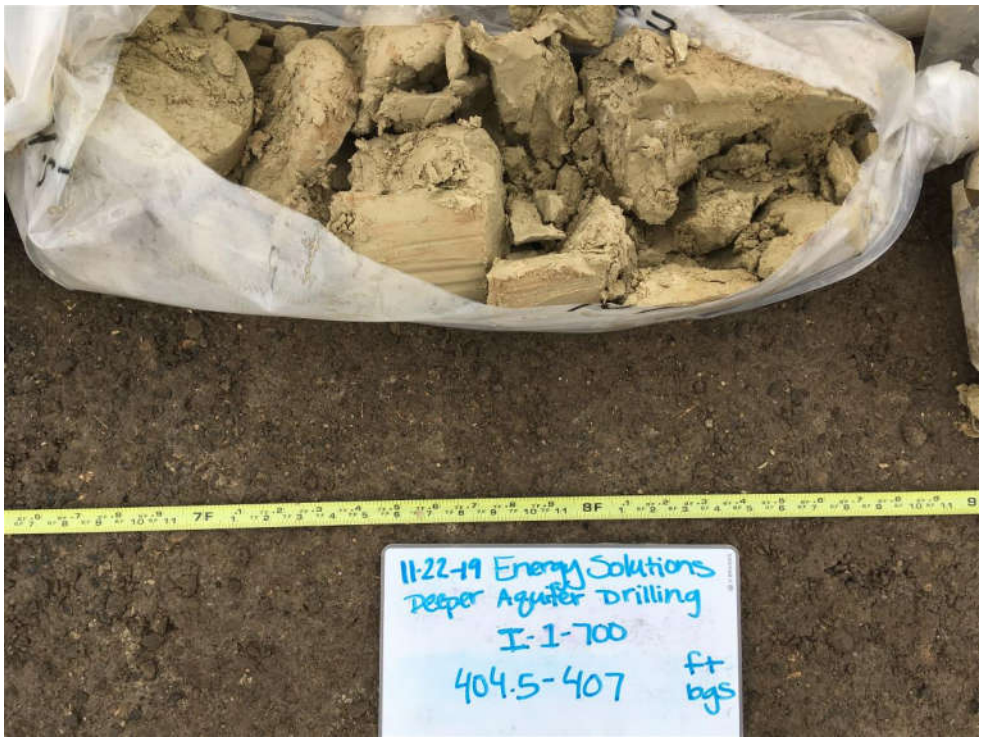


Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 161

Drilling Date:
11/22/2019

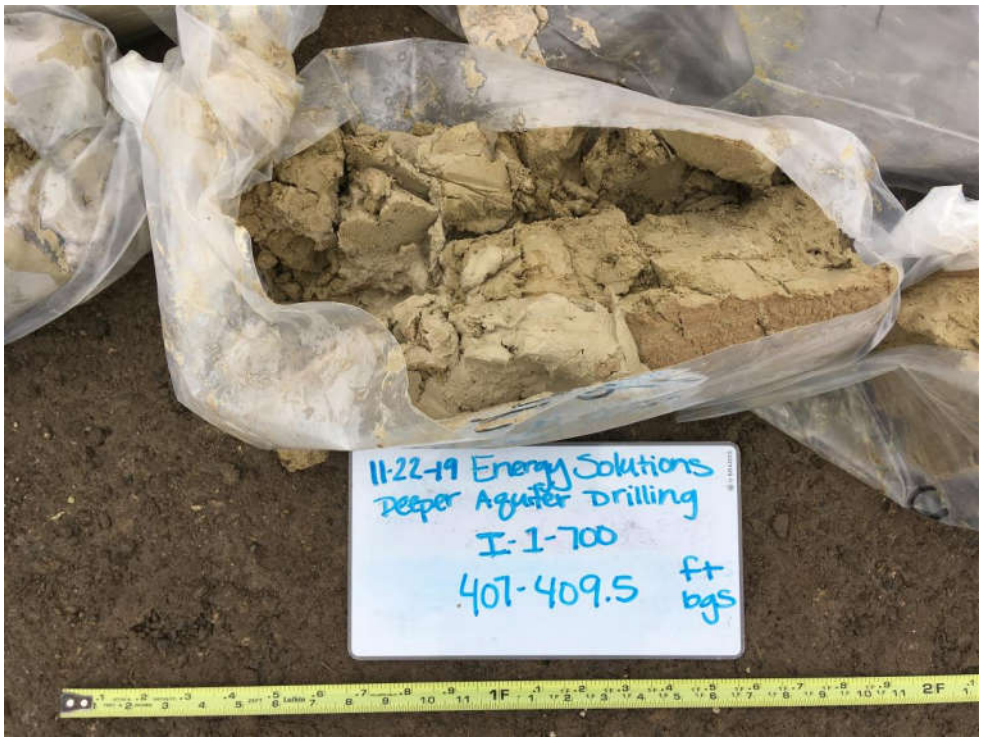
Comments:
404.5 - 407 ft bgs



Photograph ID: 162

Drilling Date:
11/22/2019

Comments:
407 - 409.5 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 163

Drilling Date:
11/22/2019

Comments:
409.5 - 212 ft bgs

Photograph ID: 164

Drilling Date:
11/22/2019

Comments:
412- 414.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 165

Drilling Date:
11/22/2019

Comments:
414.5 - 417 ft bgs

Photograph ID: 166

Drilling Date:
11/22/2019

Comments:
417 - 419.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 167

Drilling Date:
11/22/2019

Comments:
419.5 - 422 ft bgs

Photograph ID: 168

Drilling Date:
11/22/2019

Comments:
422 - 424.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 169

Drilling Date:
11/22/2019

Comments:
424.5 - 427 ft bgs

Photograph ID: 170

Drilling Date:
11/22/2019

Comments:
427 - 429.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 171

Drilling Date:
11/22/2019

Comments:
429.5 - 432 ft bgs

Photograph ID: 172

Drilling Date:
11/22/2019

Comments:
432 - 434.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 173

Drilling Date:
11/22/2019

Comments:
434.5 - 437 ft bgs

Photograph ID: 174

Drilling Date:
11/25/2019

Comments:
437 - 440 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 175

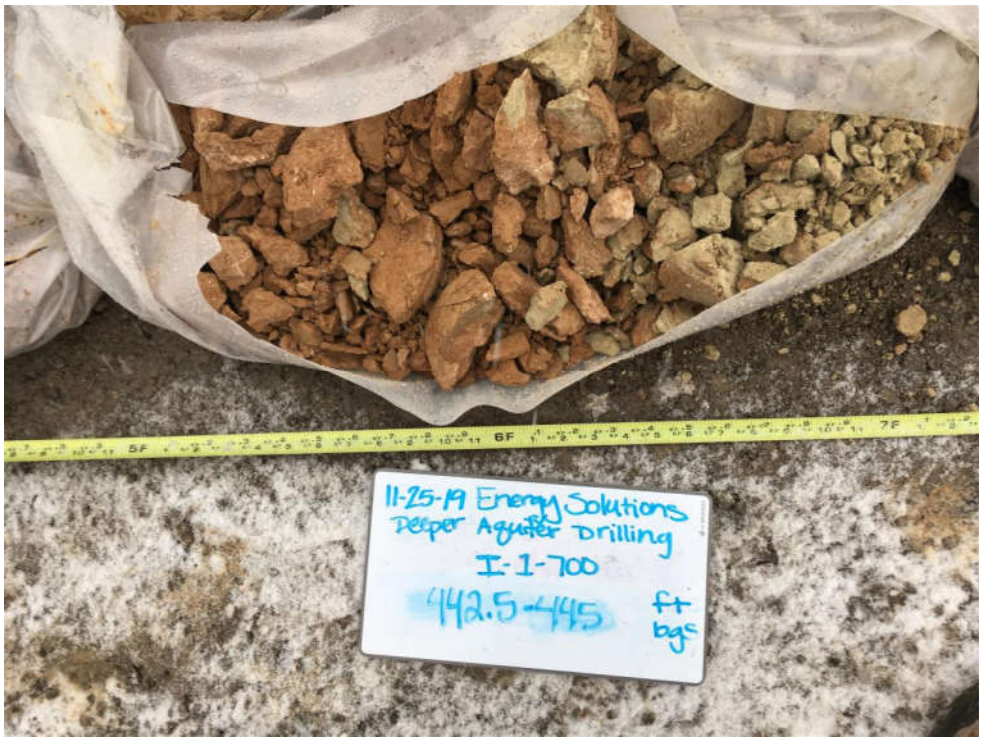
Drilling Date:
11/25/2019

Comments:
440 - 442.5 ft bgs

Photograph ID: 176

Drilling Date:
11/25/2019

Comments:
442.5 - 445 ft bs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 177

Drilling Date:
11/25/2019

Comments:
445 - 447.5 ft bgs

Photograph ID: 178

Drilling Date:
11/25/2019

Comments:
447.5 - 450 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 179

Drilling Date:
11/25/2019

Comments:
450 - 452 ft bgs

Photograph ID: 180

Drilling Date:
11/25/2019

Comments:
452 - 454.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 181

Drilling Date:
11/25/2019

Comments:
454.5 - 457 ft bgs

Photograph ID: 182

Drilling Date:
11/25/2019

Comments:
457 - 460 ft bgs

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 183

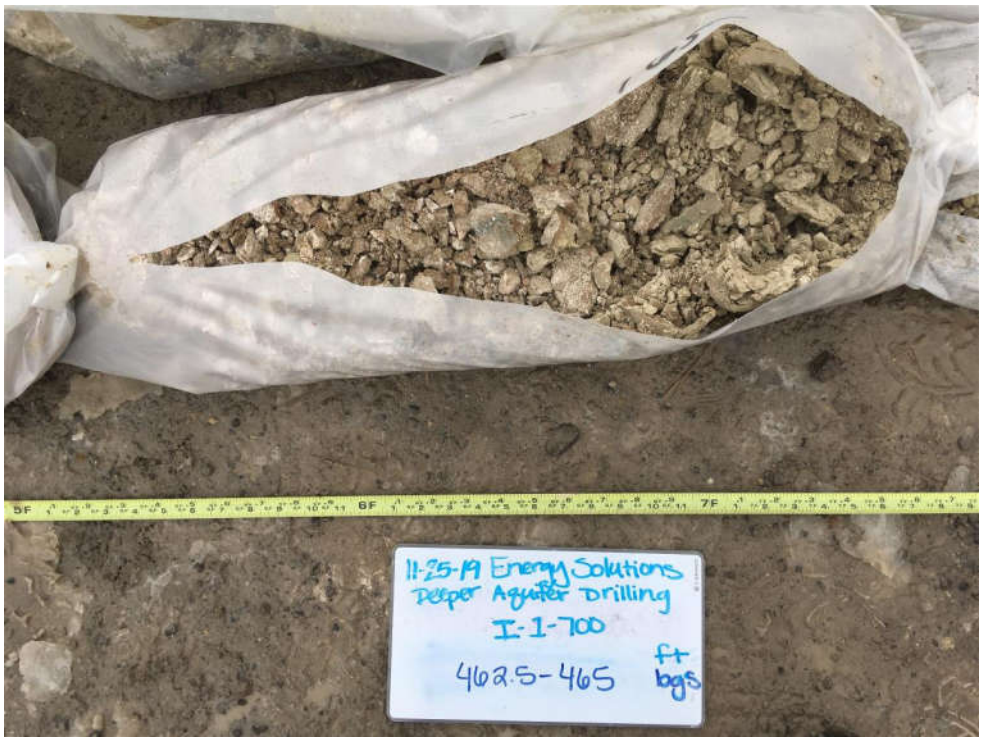
Drilling Date:
11/25/2019

Comments:
460 - 462.5 ft bgs

Photograph ID: 184

Drilling Date:
11/25/2019

Comments:
462.5 - 465 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 185

Drilling Date:
11/25/2019

Comments:
465 - 467.5 ft bgs

Photograph ID: 186

Drilling Date:
11/25/2019

Comments:
467.5 - 470 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 187

Drilling Date:
11/26/2019

Comments:
470 - 472 ft bgs

Photograph ID: 188

Drilling Date:
11/26/2019

Comments:
472 - 474.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 189

Drilling Date:
11/26/2019

Comments:
474.5 - 477 ft bgs

Photograph ID: 190

Drilling Date:
11/26/2019

Comments:
477 - 479 ft bgs

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 191

Drilling Date:
11/26/2019

Comments:
479 - 481.5 ft bgs

Photograph ID: 192

Drilling Date:
11/26/2019

Comments:
481.5 - 484 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 193

Drilling Date:
11/26/2019

Comments:
484 - 486.5 ft bgs

Photograph ID: 194

Drilling Date:
11/26/2019

Comments:
486.5 - 489 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 195

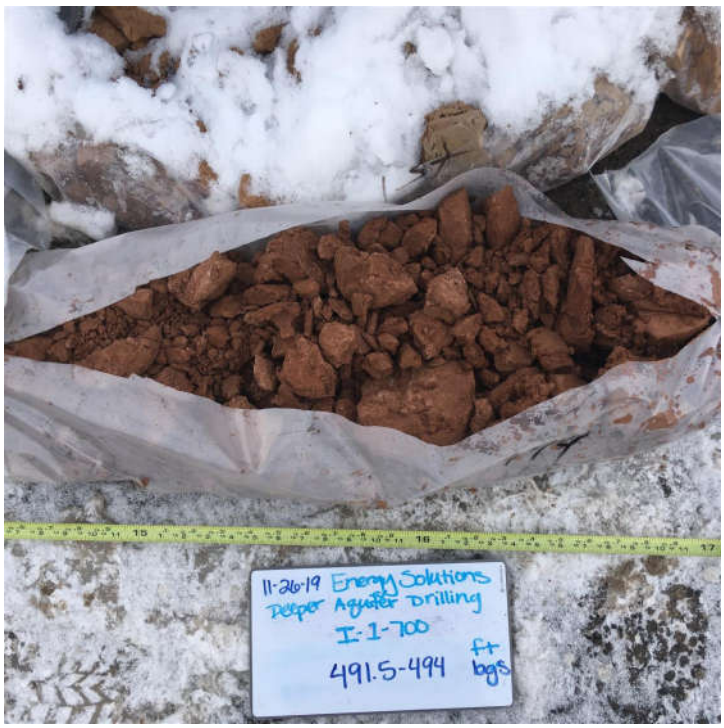
Drilling Date:
11/26/2019

Comments:
489 - 491.5 ft bgs

Photograph ID: 196

Drilling Date:
11/26/2019

Comments:
491.5 - 494 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 197

Drilling Date:
11/26/2019

Comments:
494 - 497 ft bgs

Photograph ID: 198

Drilling Date:
11/26/2019

Comments:
497 - 499.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 199

Drilling Date:
11/26/2019

Comments:
499.5 - 502 ft bgs

Photograph ID: 200

Drilling Date:
11/26/2019

Comments:
502 - 504.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 201

Drilling Date:
11/26/2019

Comments:
504.5 - 507 ft bgs

Photograph ID: 202

Drilling Date:
11/26/2019

Comments:
507 - 510 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 203

Drilling Date:
11/26/2019

Comments:
510 - 512.5 ft bgs

Photograph ID: 204

Drilling Date:
11/26/2019

Comments:
512.5 - 515 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 205

Drilling Date:
11/26/2019

Comments:
515 - 517.5 ft bgs

Photograph ID: 206

Drilling Date:
11/26/2019

Comments:
517.5 - 520 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 207

Drilling Date:
11/26/2019

Comments:
520 - 522.5 ft bgs

Photograph ID: 208

Drilling Date:
11/26/2019

Comments:
522.5 - 525 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 209

Drilling Date:
11/26/2019

Comments:
525 - 527 ft bgs

Photograph ID: 210

Drilling Date:
11/26/2019

Comments:
527 - 529.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 211

Drilling Date:
11/26/2019

Comments:
529.5 - 532 ft bgs

Photograph ID: 212

Drilling Date:
11/26/2019

Comments:
532 - 534.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 213

Drilling Date:
11/26/2019

Comments:
534.5 - 537 ft bgs

Photograph ID: 214

Drilling Date:
12/2/2019

Comments:
537 - 539.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 215

Drilling Date:
12/2/2019

Comments:
539.5 - 542 ft bgs

Photograph ID: 216

Drilling Date:
12/2/2019

Comments:
542 - 544.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 217

Drilling Date:
12/2/2019

Comments:
544.5 - 547 ft bgs

Photograph ID: 218

Drilling Date:
12/2/2019

Comments:
547 - 549.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 219

Drilling Date:
12/2/2019

Comments:
549.5 - 552 ft bgs

Photograph ID: 220

Drilling Date:
12/2/2019

Comments:
552 - 554.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 221

Drilling Date:
12/2/2019

Comments:
554.5 - 557 ft bgs

Photograph ID: 222

Drilling Date:
12/3/2019

Comments:
557 - 559.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 223

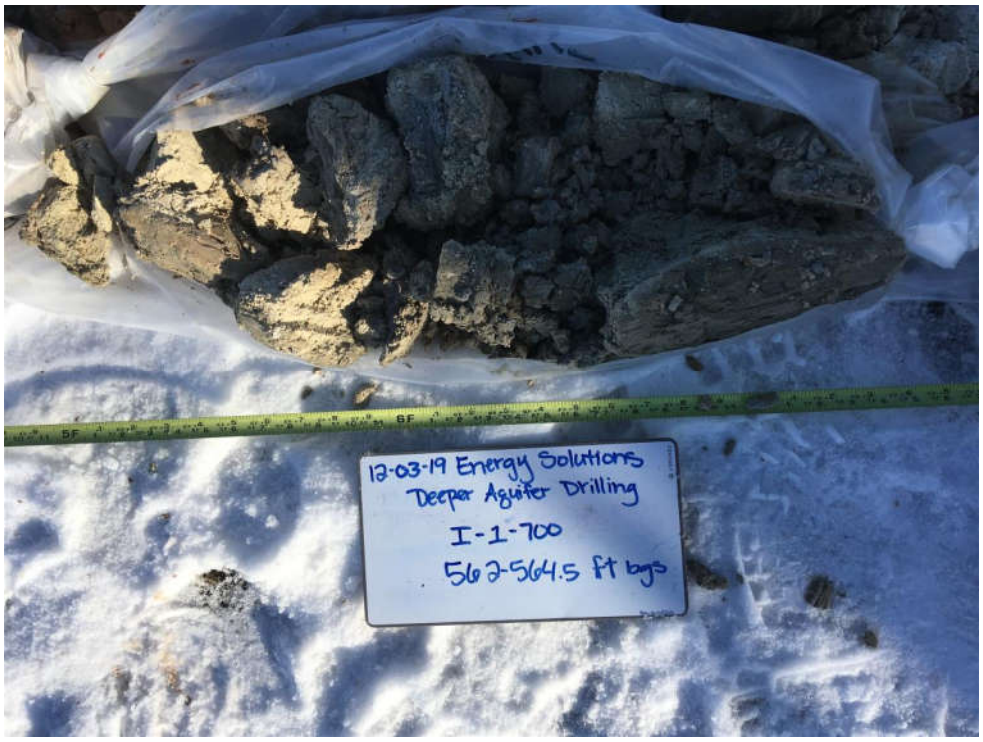
Drilling Date:
12/3/2019

Comments:
559.5 - 562 ft bgs

Photograph ID: 224

Drilling Date:
12/3/2019

Comments:
562 - 564.5 ft bgs



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 225

Drilling Date:
12/3/2019

Comments:
564.5 - 567 ft bgs

Photograph ID: 226

Drilling Date:
12/3/2019

Comments:
567 - 569.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 227

Drilling Date:
12/3/2019

Comments:
569.5 - 572 ft bgs

Photograph ID: 228

Drilling Date:
12/3/2019

Comments:
572 - 574.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 229

Drilling Date:
12/3/2019

Comments:
574.5 - 577 ft bgs

Photograph ID: 230

Drilling Date:
12/3/2019

Comments:
577 - 579.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 231

Drilling Date:
12/3/2019

Comments:
579.5 - 582 ft bgs

Photograph ID: 232

Drilling Date:
12/3/2019

Comments:
582 - 584.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 233

Drilling Date:
12/3/2019

Comments:
584.5 - 587 ft bgs

Photograph ID: 234

Drilling Date:
12/3/2019

Comments:
587 - 589.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 235

Drilling Date:
12/3/2019

Comments:
589.5 - 592 ft bgs

Photograph ID: 236

Drilling Date:
12/3/2019

Comments:
592 - 594.5 ft bgs

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 237

Drilling Date:
12/3/2019

Comments:
594.5 - 597 ft bgs

Photograph ID: 238

Drilling Date:
12/4/2019

Comments:
597 - 599.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 239

Drilling Date:
12/4/2019

Comments:
599.5 - 602 ft bgs

Photograph ID: 240

Drilling Date:
12/4/2019

Comments:
602 - 604.5 ft bgs

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 241

Drilling Date:
12/4/2019

Comments:
604.5 - 607 ft bgs

Photograph ID: 242

Drilling Date:
12/5/2019

Comments:
607 - 615 ft bgs;
Breccia/Rock flour

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 1

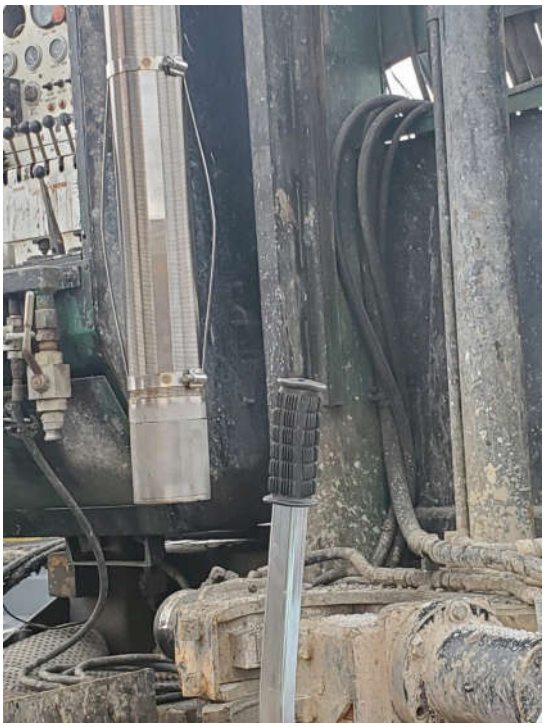
Drilling Date:
11/26/2019

Comments:
Sonic drill rig and support truck set up on I-1-700. Core laid down under tarps covered by snow.

Photograph ID: 2

Drilling Date:
1/31/2020

Comments:
End cap placed at bottom of well screen prior to lowering down borehole.



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 3

Drilling Date:
12/12/2019

Comments:
Stainless steel well screen specifics.

Photograph ID: 4

Drilling Date:
12/12/2019

Comments:
Stainless steel well blank casing specifics.

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 5

Drilling Date:
12/12/2019

Comments:
Stainless steel well blank casing laid out for well build installation.

Photograph ID: 6

Drilling Date:
12/12/2019

Comments:
Sand used for filter pack around screen.

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 7

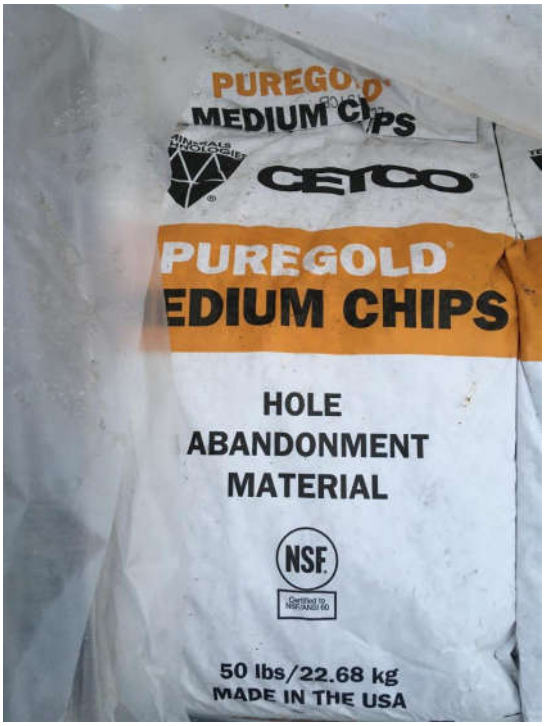
Drilling Date:
12/12/2019

Comments:
Sand used for filter pack around screen.

Photograph ID: 8

Drilling Date:
12/12/2019

Comments:
Bentonite chips used for bentonite seal.



Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 9

Drilling Date:
12/13/2019

Comments:
Grout used for annular seal.

Photograph ID: 10

Drilling Date:
12/13/2019

Comments:
Concrete used for surface seal.

Stantec

Photographic Log

Client:	**EnergySolutions, LLC**	**Project:**	**Basal Aquifer Characterization Drilling**
Site Name:	**Clive Facility**	**Site Location:**	**I-1-700**

Photograph ID: 11

Drilling Date:
1/16/2020

Comments:
Surface completion of I-1-700 (photo taken during well development set up)

Appendix C GEOTECHNICAL LABORATORY REPORT

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

© IGES 2004, 2020

Project: **EnergySolutions**
No: **M03271-001**
Location: Basal Aquifer Investigation
Date: 1/10/2020
By: BF/EH/KK

Sample Info.	Boring No.	I-1-700	I-1-700	I-1-700	I-1-700	I-1-700	I-1-700	I-1-700	I-1-700
	Sample:								
	Depth (ft.):	247.0-247.5	247.5-248.0	248.0-248.5	297.0-297.5	297.5-298.0	298.0-298.5	337.0-337.5	337.5-338.0
Unit Weight Info.	Sample height, H (in)	5.402	5.838	5.433	5.939	3.018	5.948	5.124	5.031
	Sample diameter, D (in)	2.424	2.417	2.398	2.441	2.432	2.432	2.383	2.378
	Sample volume, V (ft^3)	0.0144	0.0155	0.0142	0.0161	0.0081	0.0160	0.0132	0.0129
	Mass rings + wet soil (g)	1010.32	1145.56	1021.85	1061.63	1165.19	1015.51	955.73	904.34
	Mass rings/tare (g)	205.18	204.31	207.97	204.47	757.31	202.42	279.00	278.36
	Moist soil, Ws (g)	805.14	941.25	813.88	857.16	407.88	813.09	676.73	625.98
	Moist unit wt., γ_m (pcf)	123.03	133.87	126.36	117.49	110.83	112.11	112.81	106.73
Water Content	Wet soil + tare (g)	356.47	470.32	385.11	402.79	329.56	362.35	391.51	345.68
	Dry soil + tare (g)	309.94	423.99	341.49	336.78	278.54	309.66	336.89	274.06
	Tare (g)	121.93	128.51	123.63	126.68	127.94	127.97	120.75	121.26
Water Content, w (%)		**24.7**	**15.7**	**20.0**	**31.4**	**33.9**	**29.0**	**25.3**	**46.9**
Dry Unit Wt., γ_d (pcf)		**98.6**	**115.7**	**105.3**	**89.4**	**82.8**	**86.9**	**90.1**	**72.7**

Comments:

Water observed leaking from the tube sample.

Water observed leaking from the tube sample.

Entered by:_____

Reviewed:_____

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

© IGES 2004, 2020

Project: **EnergySolutions**
No: **M03271-001**
Location: Basal Aquifer Investigation
Date: 1/10/2020
By: BF/EH/KK

Sample Info.	Boring No.	I-1-700	I-1-700	I-1-700	I-1-700				
	Sample:								
	Depth (ft.):	338.0-338.5	377.0-377.5	377.5-378.0	378.0-378.5				
Unit Weight Info.	Sample height, H (in)	5.491	2.726	2.929	5.890				
	Sample diameter, D (in)	2.388	2.400	2.404	2.398				
	Sample volume, V (ft^3)	0.0142	0.0071	0.0077	0.0154				
	Mass rings + wet soil (g)	957.82	371.42	1158.90	785.75				
	Mass rings/tare (g)	278.93	0.00	757.31	0.00				
	Moist soil, Ws (g)	678.89	371.42	401.59	785.75				
	Moist unit wt., γ_m (pcf)	105.16	114.74	115.08	112.53				
Water Content	Wet soil + tare (g)	382.09	362.31	314.75	356.51				
	Dry soil + tare (g)	308.47	327.00	262.99	291.27				
	Tare (g)	140.36	219.88	112.21	125.04				
Water Content, w (%)		**43.8**	**33.0**	**34.3**	**39.2**				
Dry Unit Wt., γ_d (pcf)		**73.1**	**86.3**	**85.7**	**80.8**				

Entered by:_____

Reviewed:_____

Specific Gravity of Soil Solids by Water Pycnometer

(ASTM D854)

© IGES 2005, 2020

Project: **EnergySolutions**
No: **M03271-001**
Location: Basal Aquifer Investigation
Date: 1/13/2020
By: BF

Drill hole / Sample:	I-1-700	I-1-700	I-1-700	I-1-700	I-1-700	I-1-700
Sample:						
Depth (ft)	247.0-248.5	297.5-298.0	297.0-298.5	337.0-338.5	377.5-378.0	377.0-378.5
Engineering Classification	Not req.	Not req.	Not req.	Not req.	Not req.	Not req.
Method	A	A	A	A	A	A
Material passing No. 4 sieve, P (%)	100	100	100	100	100	100
Pycnometer No.	7	3	8	3	5	5
Mass of pycnometer (g)	169.53	170.54	166.67	170.57	168.65	168.65
Mass of pycnometer, soil, and water, $M_{\rho\, ws,t}$ (g)	725.43	714.08	712.18	695.21	710.2	695.25
Temperature, T_t (°C)	21.1	20.6	21.1	20.8	20.6	20.8
Mass of pycnometer and water at test temperature, $M_{pw,t}$ (g)	668.14	669.31	665.36	669.29	667.31	667.29
Mass of tare + dry soil (g)	419.96	484.86	410.46	377.72	400.16	369.23
Mass of tare (g)	326.41	410.39	332.29	333.15	330.85	324.16
Mass of soil, M_s (g)	93.55	74.47	78.17	44.57	69.31	45.07
Specific gravity of soil solids at test temperature, G_t	2.580	2.508	2.493	2.390	2.623	2.634
Temperature coefficient, K	0.99977	0.99987	0.99977	0.99983	0.99987	0.99983
Specific gravity of soil solids at 20°C, $G_{20°C}$	**2.579**	**2.508**	**2.493**	**2.390**	**2.623**	**2.633**
Apparent specific gravity of solids retained on No. 4, $G_{1@20°C}$						
Average specific gravity at 20°C, $G_{avg\,@20°C}$						

Comments:

Initial specific gravity test performed only on the middle depth interval sample. Average specific gravity value is 2.499

Initial specific gravity test performed only on the middle depth interval sample. Average specific gravity value is 2.631

Entered by:_____

Reviewed by:_____

Porosity of Soil

© IGES 2007, 2020

Project: **EnergySolutions**
No: **M03271-001**
Location: Basal Aquifer Investigation
Date: 1/13/2020
By: EH/KK/BF

Sample Info.	Boring No.	I-1-700	I-1-700	I-1-700	I-1-700				
	Sample:								
	Depth (ft.):	247.0-248.5	297.0-298.5	337.0-338.5	377.0-378.5				
Unit Weight Data	Sample height, H (in)	16.673	14.905	15.646	11.545				
	Sample diameter, D (in)	2.413	2.435	2.383	2.401				
	Mass rings + wet soil (g)	3177.73	3242.33	2817.89	2316.07				
	Mass rings/tare (g)	617.46	1164.20	836.29	757.31				
	Moist soil, Ws (g)	2560.27	2078.13	1981.60	1558.76				
	Moist unit wt., γ_m (pcf)	127.9	114.1	108.2	113.6				
Water Content	Wet soil + tare (g)	1211.90	1094.70	1119.28	1033.57				
	Dry soil + tare (g)	1075.42	924.98	919.42	881.26				
	Tare (g)	374.07	382.59	382.37	457.13				
	Water content (%)	19.5	31.3	37.2	35.9				
Specific gravity of solids, Gs		2.579	2.499	2.390	2.631				
Void ratio, e		0.504	0.796	0.892	0.964				
Porosity, n		0.335	0.443	0.472	0.491				
Total Soil Porosity, n (%)		**33.5**	**44.3**	**47.2**	**49.1**				
Water Porosity, n_w (%)		**33.4**	**43.5**	**47.0**	**48.1**				
Air Porosity, n_a (%)		**0.1**	**0.8**	**0.2**	**1.0**				

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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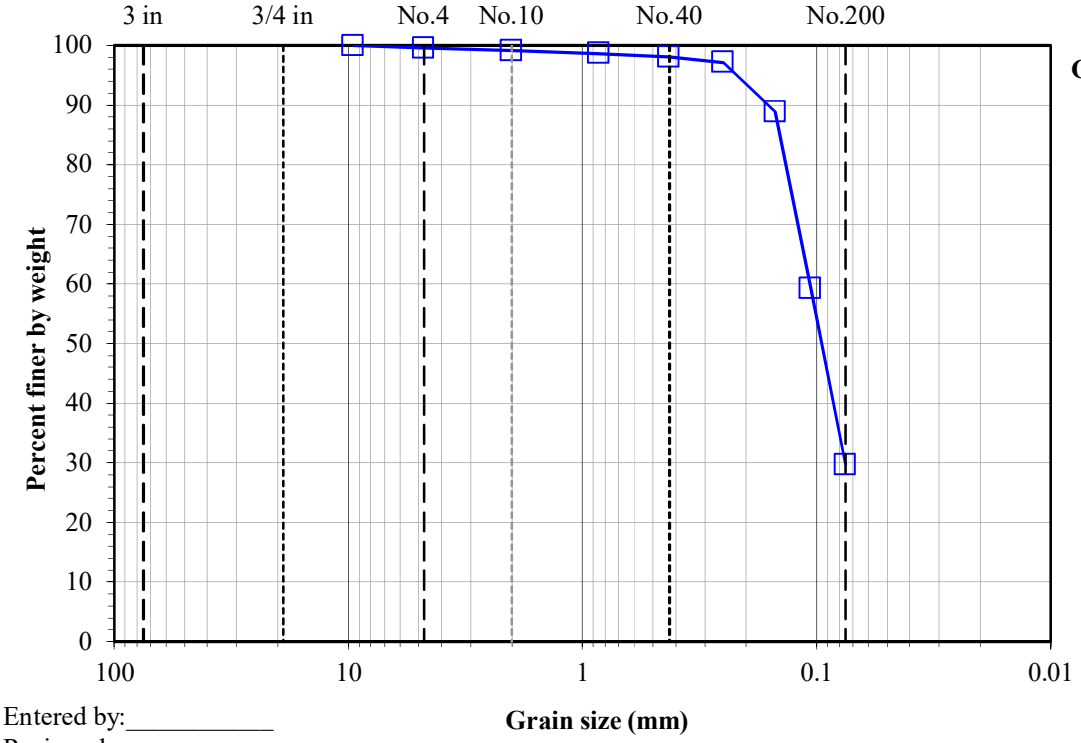
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/26/2019
By: BF

Boring No.: I-1-700
Sample:
Depth: 87-89'
Description: Light brown silty sand

	Moist	Dry
Split:	No	
Total sample wt. (g):	222.08	191.31
	-	
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	350.61
Dry soil + tare (g):	-	319.84
Tare (g):	-	128.53
Water content (%):	0.0	16.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
1"	-	25	-
3/4"	-	19	-
3/8"	-	9.5	100.0
No.4	0.82	4.75	99.6
No.10	1.68	2	99.1
No.20	2.64	0.85	98.6
No.40	3.70	0.425	98.1
No.60	5.48	0.25	97.1
No.100	21.35	0.15	88.8
No.140	78.00	0.106	59.2
No.200	134.50	0.075	29.7



Gravel (%): 0.4
Sand (%): 69.9
Fines (%): 29.7

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

© IGES 2004, 2020

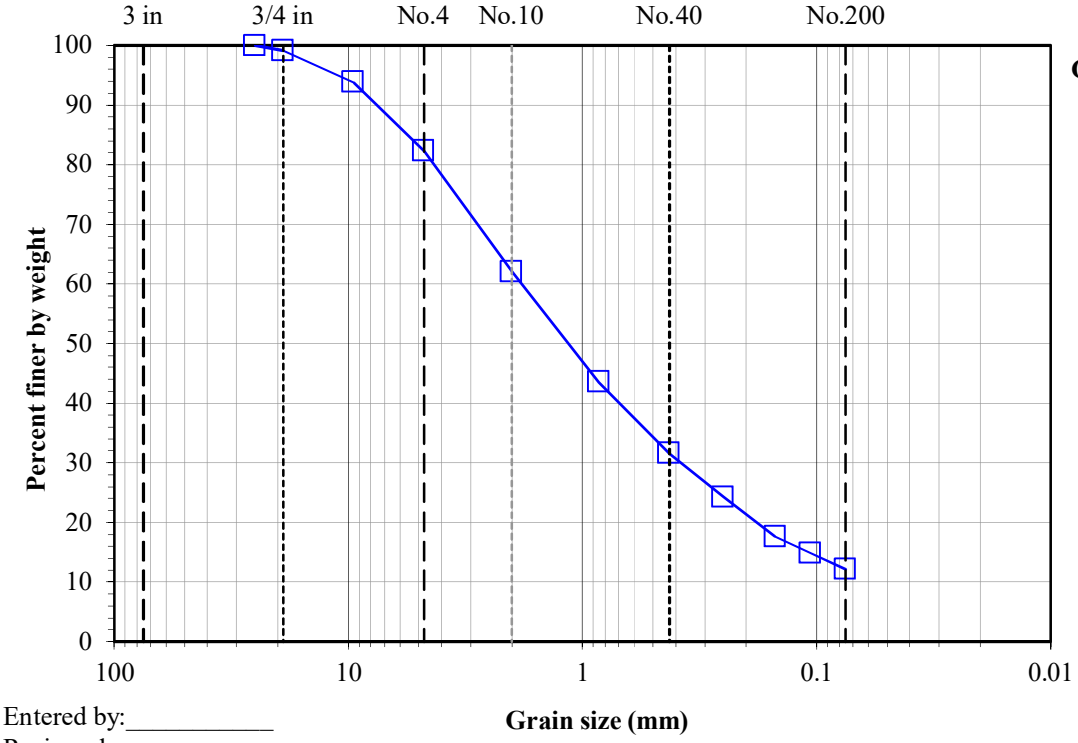
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/26/2019
By: BF

Boring No.: I-1-700
Sample:
Depth: 107-109'
Description: Brown clayey sand with gravel

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	2562.54	2222.37
+3/8" Coarse fraction (g):	149.21	136.95
-3/8" Split fraction (g):	290.49	251.02
Split fraction:	0.938	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	331.15	414.97
Dry soil + tare (g):	314.51	375.50
Tare (g):	128.58	124.48
Water content (%):	8.9	15.7

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	-	
1"	-	25	100.0	
3/4"	20.08	19	99.1	
3/8"	136.95	9.5	93.8	←Split
No.4	30.88	4.75	82.3	
No.10	85.09	2	62.0	
No.20	134.68	0.85	43.5	
No.40	166.66	0.425	31.5	
No.60	186.16	0.25	24.2	
No.100	203.91	0.15	17.6	
No.140	211.43	0.106	14.8	
No.200	218.62	0.075	12.1	



Gravel (%): 17.7
Sand (%): 70.2
Fines (%): 12.1

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

© IGES 2004, 2020

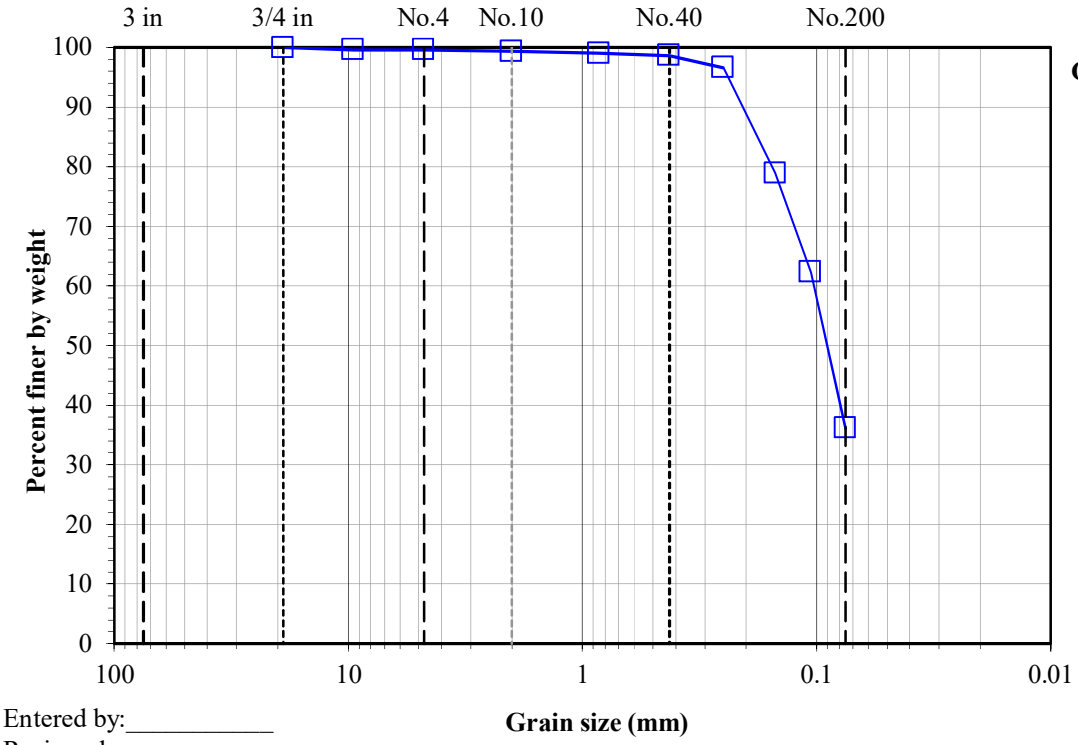
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/24/2019
By: BF

Boring No.: I-1-700
Sample:
Depth: 227-229'
Description: Brown silty sand

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	2183.34	1571.47
+3/8" Coarse fraction (g):	7.01	6.50
-3/8" Split fraction (g):	310.06	222.96
Split fraction:	0.996	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	136.68	436.92
Dry soil + tare (g):	136.08	349.82
Tare (g):	128.50	126.86
Water content (%):	7.9	39.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	-	
1"	-	25	-	
3/4"	-	19	100.0	
3/8"	6.50	9.5	99.6	←Split
No.4	-	4.75	99.6	
No.10	0.54	2	99.3	
No.20	1.26	0.85	99.0	
No.40	2.18	0.425	98.6	
No.60	6.72	0.25	96.6	
No.100	46.27	0.15	78.9	
No.140	83.41	0.106	62.3	
No.200	142.11	0.075	36.1	



Gravel (%): 0.4
Sand (%): 63.5
Fines (%): 36.1

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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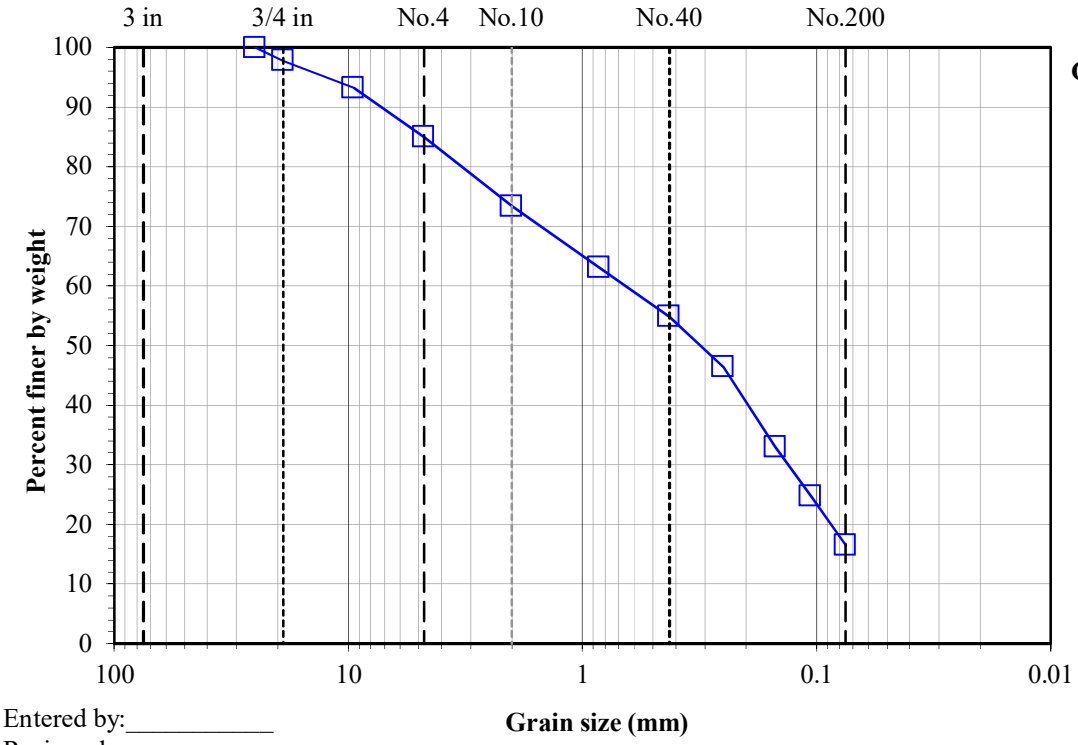
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/24/2019
By: BSS

Boring No.: I-1-700
Sample:
Depth: 245-255'
Description: Brown silty sand with gravel

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	1961.20	1628.46
+3/8" Coarse fraction (g):	122.19	110.18
-3/8" Split fraction (g):	443.22	365.92
Split fraction:	0.932	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	380.30	571.90
Dry soil + tare (g):	364.95	494.60
Tare (g):	224.10	128.68
Water content (%):	10.9	21.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	-	
1"	-	25	100.0	
3/4"	35.88	19	97.8	
3/8"	110.18	9.5	93.2	←Split
No.4	32.42	4.75	85.0	
No.10	77.93	2	73.4	
No.20	118.12	0.85	63.1	
No.40	150.71	0.425	54.8	
No.60	183.78	0.25	46.4	
No.100	236.50	0.15	33.0	
No.140	268.67	0.106	24.8	
No.200	301.12	0.075	16.5	



Gravel (%): 15.0
Sand (%): 68.5
Fines (%): 16.5

Comments:
These results are in nonconformance with Method D6913 because the minimum dry mass was not met.

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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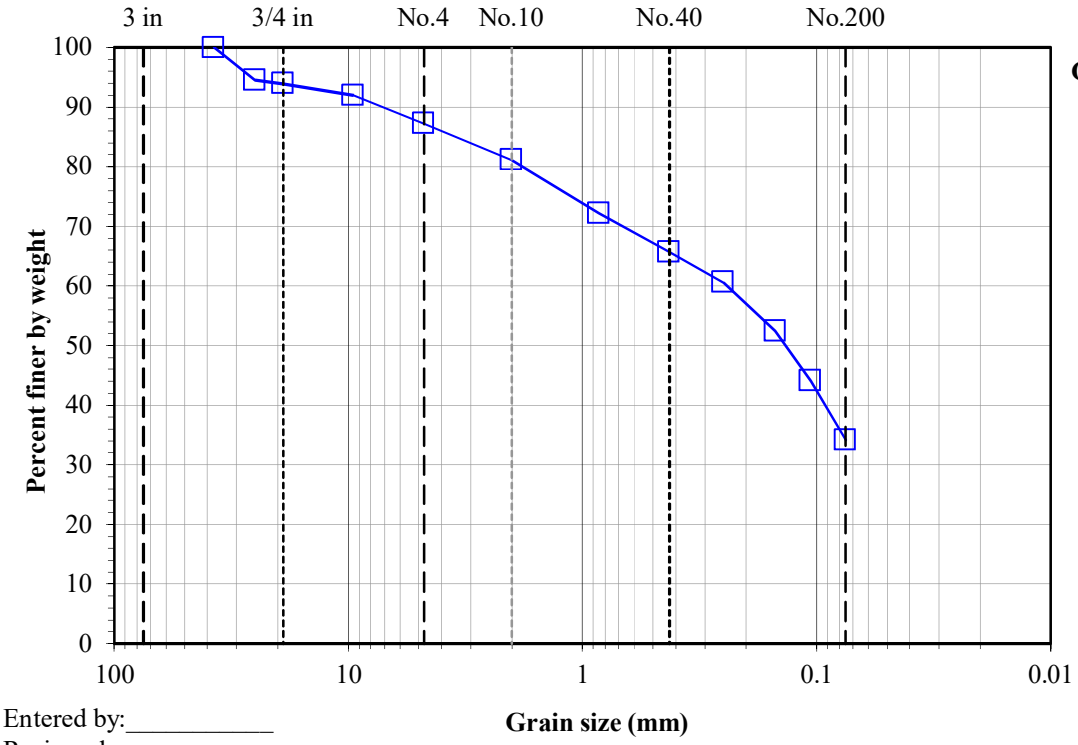
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/24/2019
By: BSS

Boring No.: I-1-700
Sample:
Depth: 282-287'
Description: Brown clayey sand

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	2120.08	1668.44
+3/8" Coarse fraction (g):	155.00	134.41
-3/8" Split fraction (g):	505.63	394.72
Split fraction:	0.919	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	304.94	627.29
Dry soil + tare (g):	280.84	516.38
Tare (g):	123.56	121.66
Water content (%):	15.3	28.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
1"	90.93	25	94.6	
3/4"	100.72	19	94.0	
3/8"	134.41	9.5	91.9	←Split
No.4	20.27	4.75	87.2	
No.10	46.43	2	81.1	
No.20	84.76	0.85	72.2	
No.40	112.72	0.425	65.7	
No.60	134.66	0.25	60.6	
No.100	169.71	0.15	52.4	
No.140	205.65	0.106	44.0	
No.200	248.25	0.075	34.1	



Gravel (%): 12.8
Sand (%): 53.1
Fines (%): 34.1

Comments:
These results are in nonconformance with Method D6913 because the minimum dry mass was not met.

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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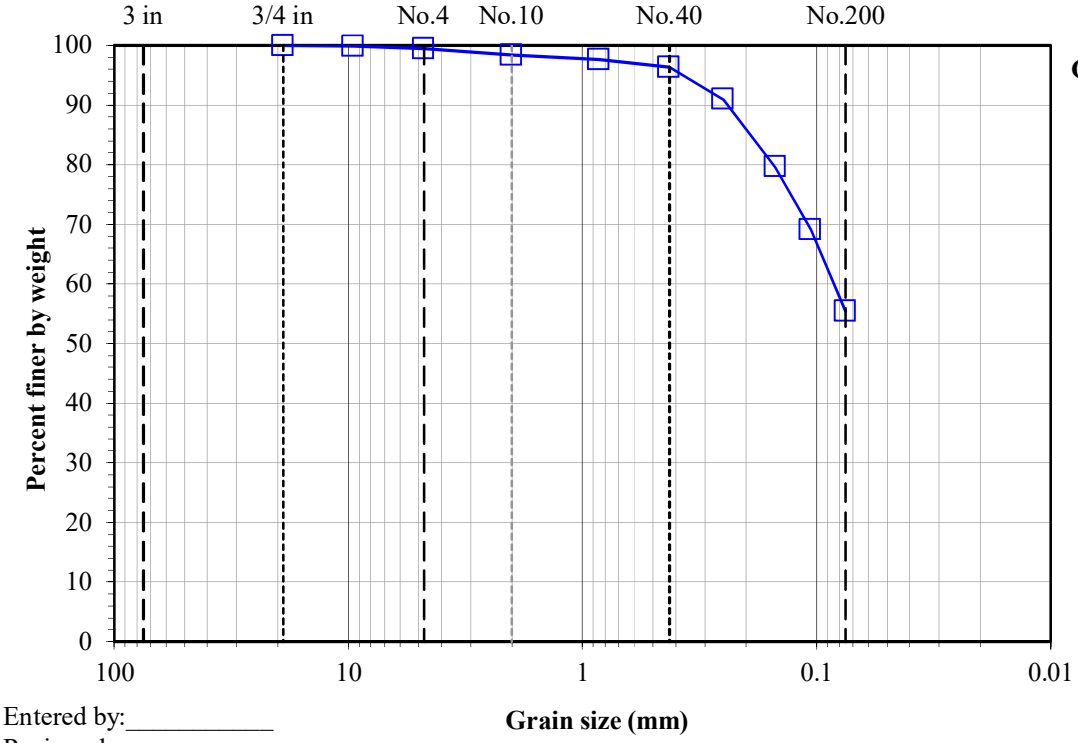
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/24/2019
By: BSS

Boring No.: I-1-700
Sample:
Depth: 337-342'
Description: Grey sandy silt

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	1669.7	1226.26
+3/8" Coarse fraction (g):	1.53	1.45
-3/8" Split fraction (g):	438.32	321.82
Split fraction:	0.999	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	129.52	559.45
Dry soil + tare (g):	129.44	442.95
Tare (g):	127.99	121.13
Water content (%):	5.5	36.2

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	-	
1"	-	25	-	
3/4"	-	19	100.0	
3/8"	1.45	9.5	99.9	←Split
No.4	1.44	4.75	99.4	
No.10	4.95	2	98.3	
No.20	7.25	0.85	97.6	
No.40	11.47	0.425	96.3	
No.60	28.85	0.25	90.9	
No.100	65.36	0.15	79.6	
No.140	99.19	0.106	69.1	
No.200	143.39	0.075	55.4	



Gravel (%): 0.6
Sand (%): 44.1
Fines (%): 55.4

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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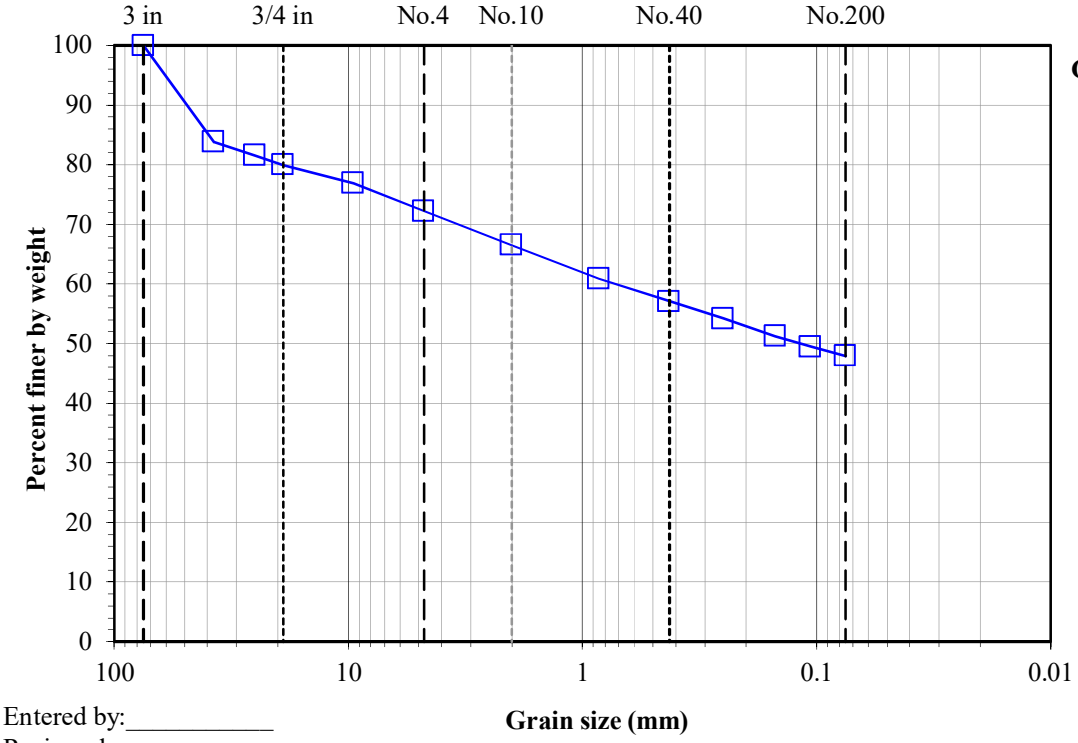
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/27/2019
By: BSS

Boring No.: I-1-700
Sample:
Depth: 356-359'
Description: Brownish grey clayey gravel with sand

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	1812.4	1578.55
+3/8" Coarse fraction (g):	388.41	365.36
-3/8" Split fraction (g):	344.29	293.32
Split fraction:	0.769	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	556.94	471.52
Dry soil + tare (g):	531.45	420.55
Tare (g):	127.36	127.23
Water content (%):	6.3	17.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	255.62	37.5	83.8	
1"	290.99	25	81.6	
3/4"	316.64	19	79.9	
3/8"	365.36	9.5	76.9	←Split
No.4	17.72	4.75	72.2	
No.10	39.59	2	66.5	
No.20	61.00	0.85	60.9	
No.40	75.73	0.425	57.0	
No.60	86.62	0.25	54.2	
No.100	97.89	0.15	51.2	
No.140	104.54	0.106	49.5	
No.200	110.43	0.075	47.9	



Gravel (%): 27.8
Sand (%): 24.3
Fines (%): 47.9

Comments:
These results are in nonconformance with Method D6913 because the minimum dry mass was not met.

Entered by:_____
Reviewed:_____

Z:\PROJECTS\M03271_Energy_Solutions\001_Basal_Aquifer\[GSDv2.xlsm]7

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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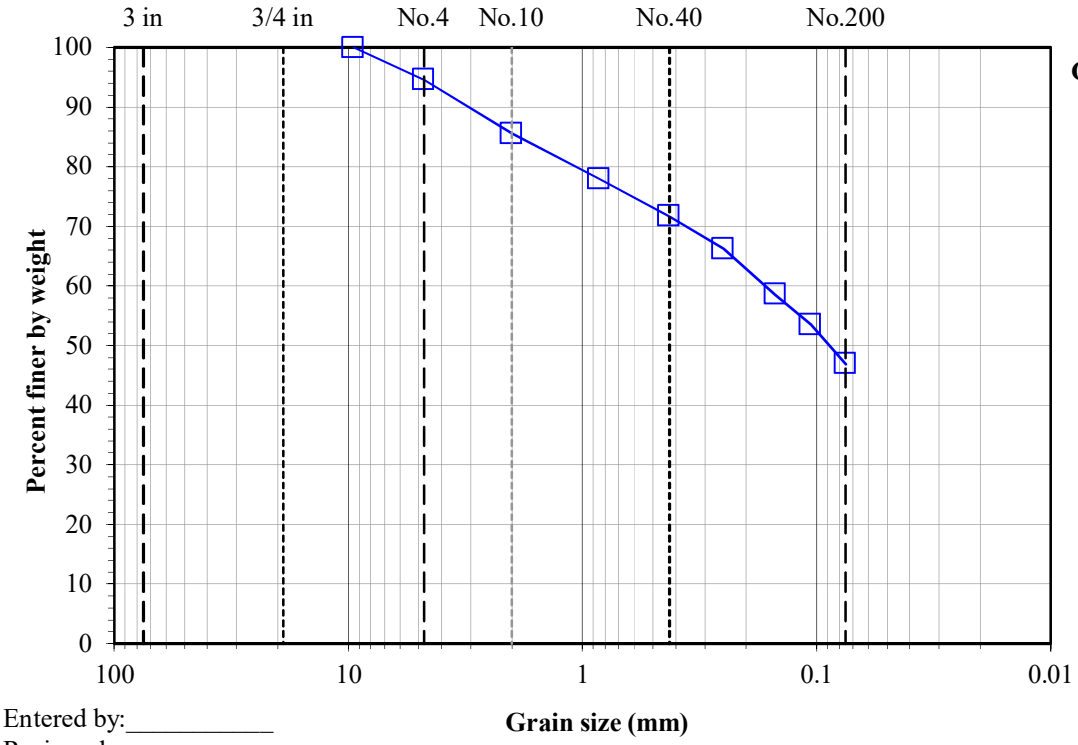
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/26/2019
By: BF

Boring No.: I-1-700
Sample:
Depth: 367-369'
Description: Light brown clayey sand

	Moist	Dry
Split:	No	
Total sample wt. (g):	236.16	181.55
	-	
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	363.07
Dry soil + tare (g):	-	308.46
Tare (g):	-	126.91
Water content (%):	0.0	30.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
1"	-	25	-
3/4"	-	19	-
3/8"	-	9.5	100.0
No.4	9.86	4.75	94.6
No.10	26.19	2	85.6
No.20	39.97	0.85	78.0
No.40	51.38	0.425	71.7
No.60	61.30	0.25	66.2
No.100	75.20	0.15	58.6
No.140	84.44	0.106	53.5
No.200	96.38	0.075	46.9



Gravel (%): 5.4
Sand (%): 47.7
Fines (%): 46.9

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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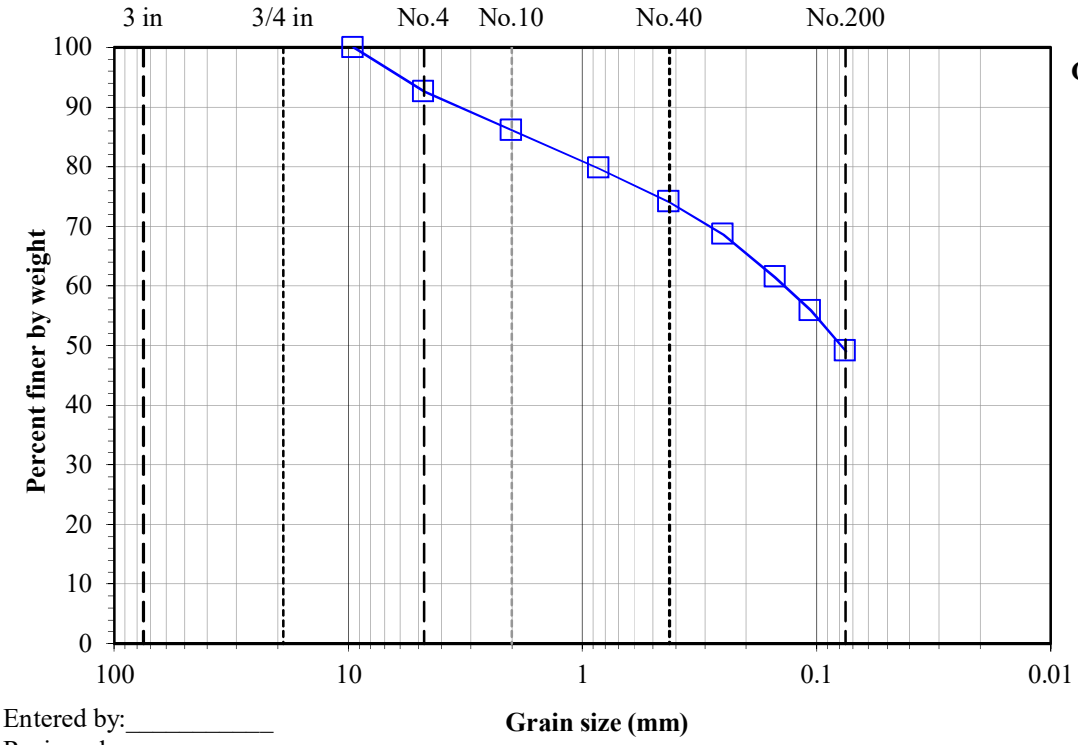
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/26/2019
By: BF

Boring No.: I-1-700
Sample:
Depth: 430-432'
Description: Brown clayey sand

	Moist	Dry
Split:	No	
Total sample wt. (g):	244.32	190.36
	-	
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	367.31
Dry soil + tare (g):	-	313.35
Tare (g):	-	122.99
Water content (%):	0.0	28.3

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
1"	-	25	-
3/4"	-	19	-
3/8"	-	9.5	100.0
No.4	14.04	4.75	92.6
No.10	26.54	2	86.1
No.20	38.63	0.85	79.7
No.40	49.41	0.425	74.0
No.60	59.79	0.25	68.6
No.100	73.38	0.15	61.5
No.140	84.09	0.106	55.8
No.200	96.90	0.075	49.1



Gravel (%): 7.4
Sand (%): 43.5
Fines (%): 49.1

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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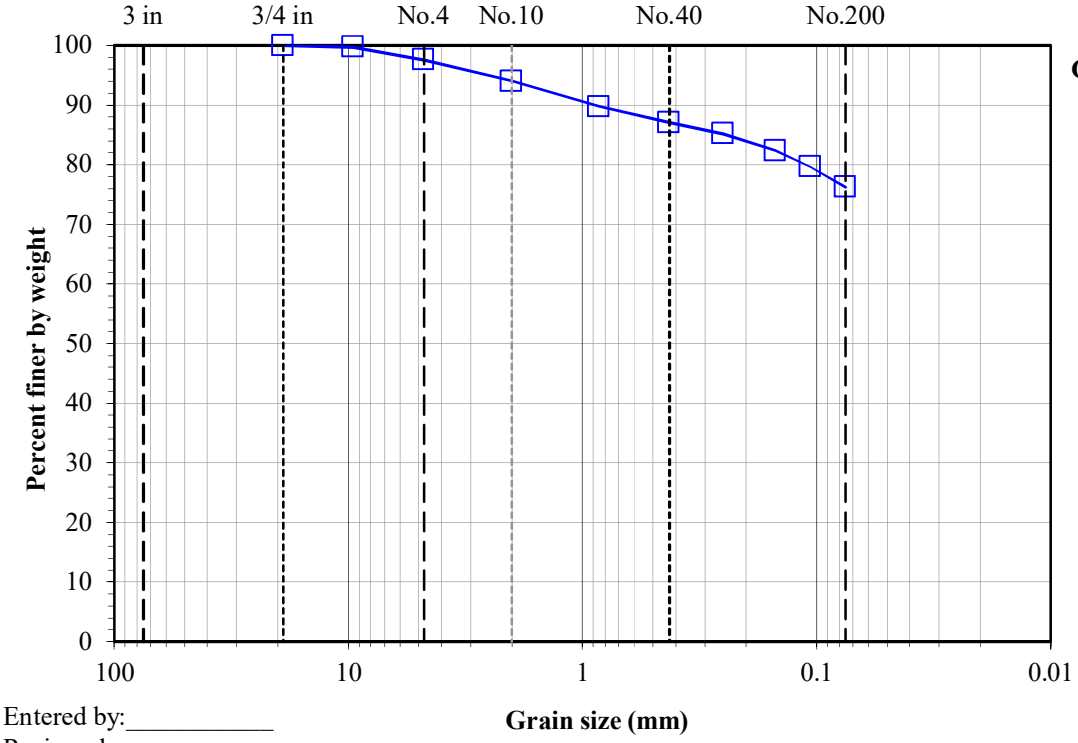
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/27/2019
By: JAB

Boring No.: I-1-700
Sample:
Depth: 505-507'
Description: Brown clay with sand

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	1181.22	961.79
+3/8" Coarse fraction (g):	2.77	2.66
-3/8" Split fraction (g):	189.62	154.33
Split fraction:	0.997	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	127.31	316.49
Dry soil + tare (g):	127.20	281.20
Tare (g):	124.46	126.87
Water content (%):	4.0	22.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	-	
1"	-	25	-	
3/4"	-	19	100.0	
3/8"	2.66	9.5	99.7	←Split
No.4	3.32	4.75	97.6	
No.10	8.91	2	94.0	
No.20	15.48	0.85	89.7	
No.40	19.62	0.425	87.0	
No.60	22.53	0.25	85.2	
No.100	26.91	0.15	82.3	
No.140	31.07	0.106	79.6	
No.200	36.35	0.075	76.2	



Gravel (%): 2.4
Sand (%): 21.3
Fines (%): 76.2

Entered by:_____
Reviewed:_____

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

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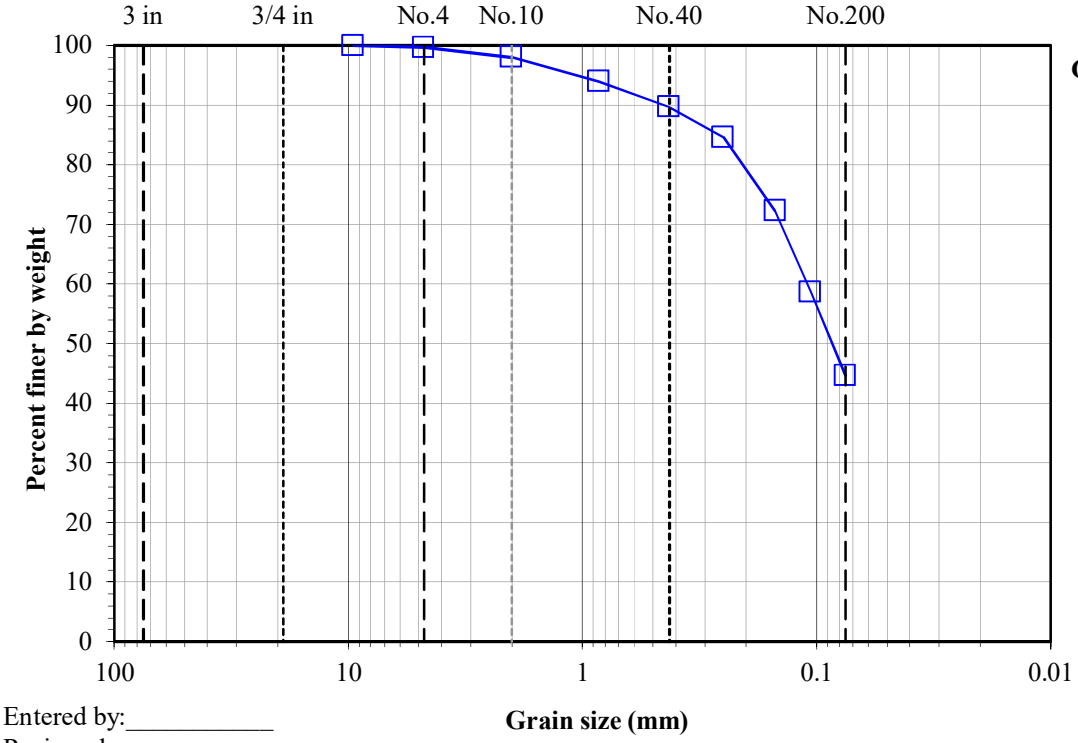
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/27/2019
By: JAB

Boring No.: I-1-700
Sample:
Depth: 523-525'
Description: Brown silty sand

	Moist	Dry
Split:	No	
Total sample wt. (g):	226.43	177.39
	-	
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	345.04
Dry soil + tare (g):	-	296.00
Tare (g):	-	118.61
Water content (%):	0.0	27.6

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
1"	-	25	-
3/4"	-	19	-
3/8"	-	9.5	100.0
No.4	0.61	4.75	99.7
No.10	3.58	2	98.0
No.20	10.75	0.85	93.9
No.40	18.31	0.425	89.7
No.60	27.36	0.25	84.6
No.100	49.19	0.15	72.3
No.140	73.35	0.106	58.7
No.200	98.28	0.075	44.6



Gravel (%): 0.3
Sand (%): 55.1
Fines (%): 44.6

Entered by:_____
Reviewed:_____

Z:\PROJECTS\M03271_Energy_Solutions\001_Basal_Aquifer\[GSDv2.xlsm]11

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

© IGES 2004, 2020

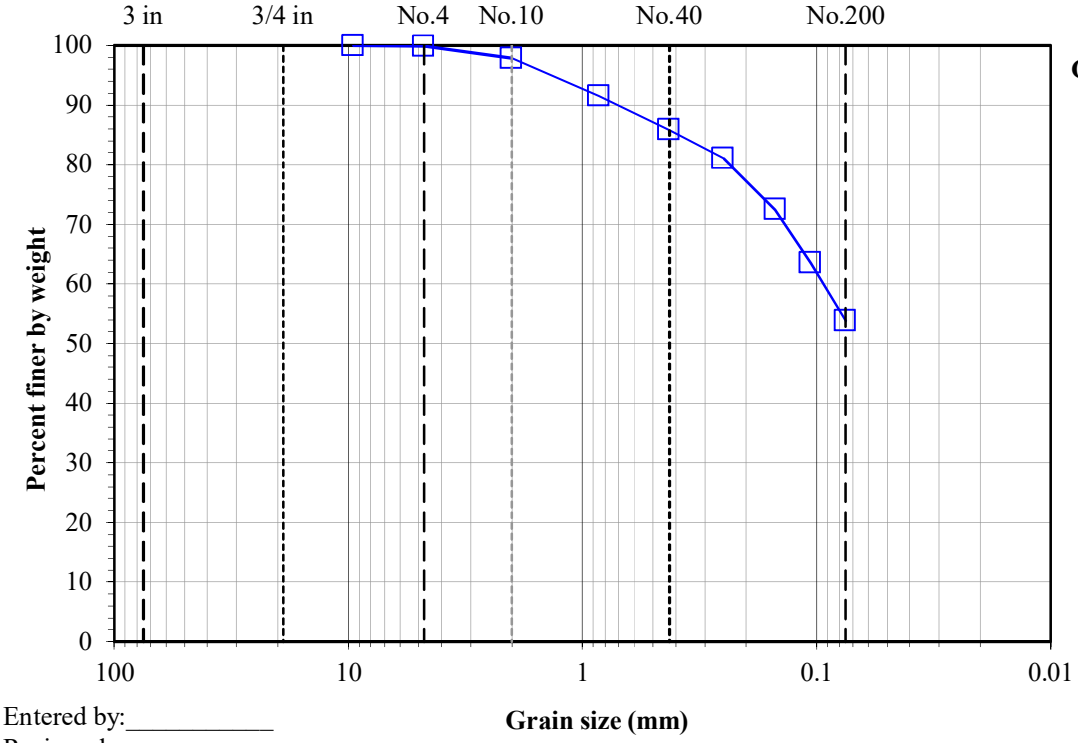
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/27/2019
By: JAB

Boring No.: I-1-700
Sample:
Depth: 542-544'
Description: Reddish brown sandy clay

	Moist	Dry
Split:	No	
Total sample wt. (g):	197.26	157.81
	-	
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	338.74
Dry soil + tare (g):	-	299.29
Tare (g):	-	141.48
Water content (%):	0.0	25.0

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
1"	-	25	-
3/4"	-	19	-
3/8"	-	9.5	100.0
No.4	0.21	4.75	99.9
No.10	3.42	2	97.8
No.20	13.38	0.85	91.5
No.40	22.35	0.425	85.8
No.60	29.88	0.25	81.1
No.100	43.48	0.15	72.4
No.140	57.62	0.106	63.5
No.200	72.89	0.075	53.8



Gravel (%): 0.1
Sand (%): 46.1
Fines (%): 53.8

Entered by:_____
Reviewed:_____

Z:\PROJECTS\M03271_Energy_Solutions\001_Basal_Aquifer\[GSDv2.xlsm]12

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

© IGES 2004, 2020

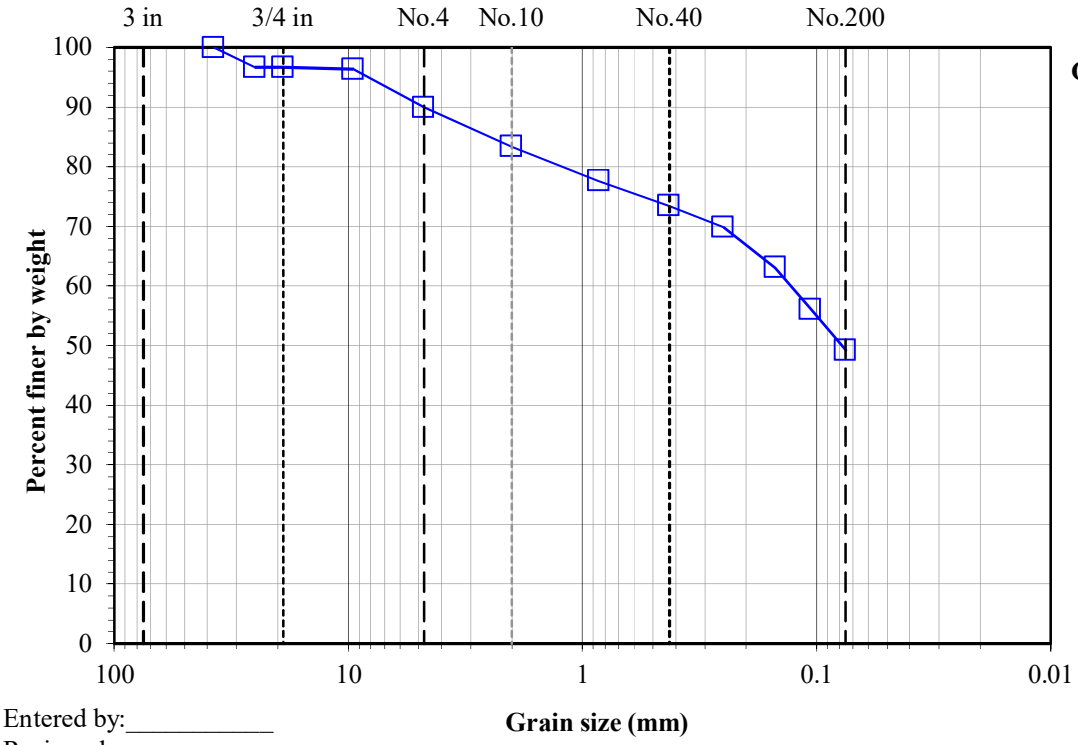
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/27/2019
By: JAB

Boring No.: I-1-700
Sample:
Depth: 570-572'
Description: Light brown clayey sand

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	1060.98	878.51
+3/8" Coarse fraction (g):	35.05	32.23
-3/8" Split fraction (g):	170.18	140.38
Split fraction:	0.963	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	163.59	298.26
Dry soil + tare (g):	160.71	268.46
Tare (g):	127.74	128.08
Water content (%):	8.7	21.2

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
1"	29.54	25	96.6	
3/4"	29.54	19	96.6	
3/8"	32.23	9.5	96.3	←Split
No.4	9.29	4.75	90.0	
No.10	18.87	2	83.4	
No.20	27.32	0.85	77.6	
No.40	33.38	0.425	73.4	
No.60	38.62	0.25	69.8	
No.100	48.50	0.15	63.0	
No.140	58.70	0.106	56.1	
No.200	68.61	0.075	49.2	



Gravel (%): 10.0
Sand (%): 40.7
Fines (%): 49.2

Comments:
These results are in nonconformance with Method D6913 because the minimum dry mass was not met.

Entered by:_____
Reviewed:_____

Z:\PROJECTS\M03271_Energy_Solutions\001_Basal_Aquifer\[GSDv2.xlsm]13

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

© IGES 2004, 2020

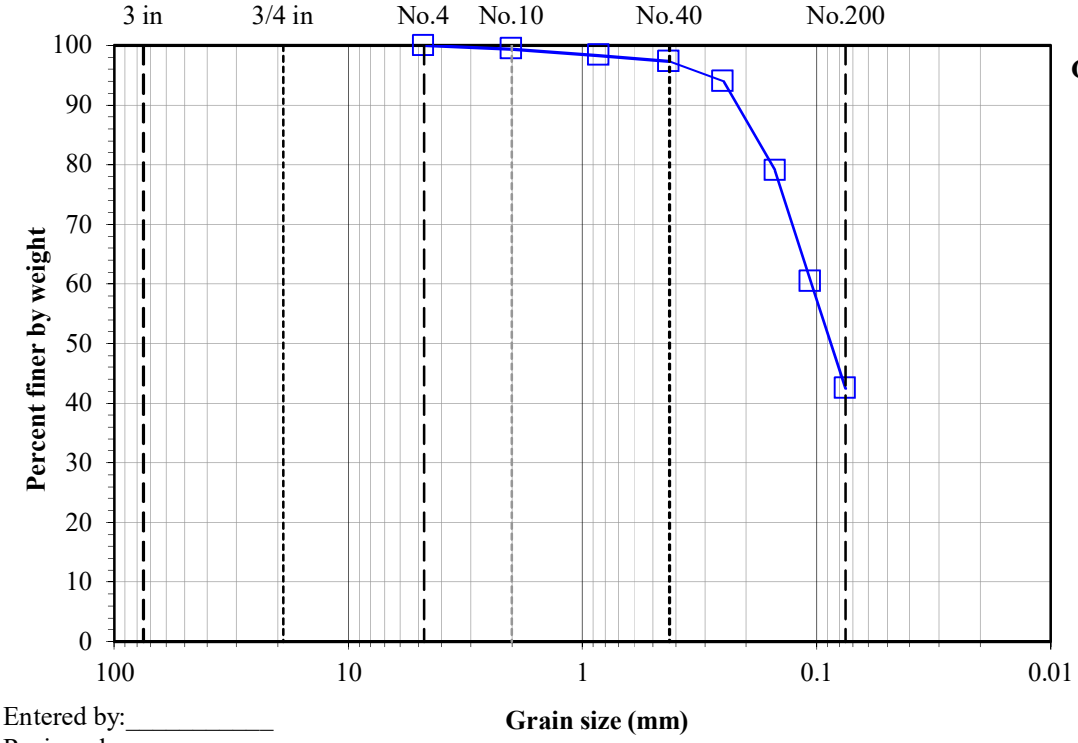
Project: EnergySolutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 12/30/2019
By: BF

Boring No.: I-1-700
Sample:
Depth: 590-592'
Description: Dark brown silty sand

	Moist	Dry
Split:	No	
Total sample wt. (g):	252.15	191.55
	-	
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	375.69
Dry soil + tare (g):	-	315.09
Tare (g):	-	123.54
Water content (%):	0.0	31.6

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
1"	-	25	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	100.0
No.10	1.22	2	99.4
No.20	3.24	0.85	98.3
No.40	5.21	0.425	97.3
No.60	11.53	0.25	94.0
No.100	40.15	0.15	79.0
No.140	75.82	0.106	60.4
No.200	110.22	0.075	42.5



Gravel (%): 0.0
Sand (%): 57.5
Fines (%): 42.5

Entered by:_____
Reviewed:_____

Z:\PROJECTS\M03271_Energy_Solutions\001_Basal_Aquifer\[GSDv2.xlsm]14

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

© IGES 2005, 2020

Project: Energy Solutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 1/9/2020
By: EH

Boring No.: I-1-700
Sample:
Depth: 297.5-298.0'
Sample Description: Reddish brown clayey sand
Sample Type: Undisturbed

	Initial (o)	Final (f)
Sample Height, H (in)	3.018	2.988
Sample Diameter, D (in)	2.432	2.370
Sample Length, L (cm)	7.666	7.590
Sample Area, A (cm^2)	29.970	28.462
Sample Volume, V (cm^3)	229.74	216.02
Wt. Rings + Wet Soil (g)	1165.19	422.20
Wt. Rings (g)	757.31	0
Wet Unit Wt., γ_m (pcf)	110.8	122.0
Wet Soil + Tare (g)	329.56	539.89
Dry Soil + Tare (g)	278.54	428.50
Tare (g)	127.94	139.76
Weight of solids, Ws (g)	304.67	304.67
Water Content, w (%)	33.88	38.58
Dry Unit Wt, γ_d (pcf)	82.8	88.0
Void ratio, e	0.89	0.97
Saturation (%)	95.3	100 [a]
Average K[b] (cm/sec)	**2.6E-05**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20ºC

Gs	2.508	Determined
Cell No.	2	
Station No.	3	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	60	
Effective vert. consolidation stress (psi)	60	

	Initial (o)	Final (f)
B value	0.76	0.94
External Burette (cm^3)	6.30	34.20
Cell Pressure (psi)	0.0	90.0
Backpressure bottom (psi)	30.0	
Backpressure top (psi)	30.0	
System volume coefficient (cm^3/psi)	0.158	
System volume change (cm^3)	14.18	`
Net sample volume change (cm^3)	-13.72	
Bottom burette ground length, l_b (cm)	82.25	
Top burette ground length, l_t (cm)	81.95	
Burette area, a (cm^2)	0.197	
Conversion, reading to cm head (cm/rd)	5.076	

Start Date and Time: 1/8/20 10:11

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (ºC)	Visc. Ratio R_T	K[b] (cm/sec)
60.0	1.32 1.55	8.64 8.40	37.46	35.07	2.9E-05	23.5 23.5	0.92	2.7E-05
60.0	1.55 1.77	8.40 8.20	35.07	32.94	2.7E-05	23.5 23.5	0.92	2.5E-05
60.0	1.77 1.96	8.20 8.00	32.94	30.96	2.7E-05	23.5 23.5	0.92	2.5E-05
60.0	1.96 2.15	8.00 7.81	30.96	29.03	2.8E-05	23.5 23.5	0.92	2.6E-05
60.0	2.15 2.33	7.81 7.62	29.03	27.15	2.9E-05	23.5 23.5	0.92	2.7E-05
60.0	2.33 2.50	7.62 7.46	27.15	25.48	2.8E-05	23.5 23.5	0.92	2.6E-05

Comments:
Middle depth interval tube sample of three used for test specimen. The maximum Skempton's B-value of 0.94 was determined on subsequent B-checks with no increase. It is assumed that the test specimen was saturated.

Entered by:_____
Reviewed:_____

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

© IGES 2005, 2020

Project: Energy Solutions
No: M03271-001
Location: Basal Aquifer Investigation
Date: 1/9/2020
By: EH

Boring No.: I-1-700
Sample:
Depth: 377.5-378.0'
Sample Description: Reddish brown clayey sand
Sample Type: Undisturbed

	Initial (o)	Final (f)
Sample Height, H (in)	2.929	2.877
Sample Diameter, D (in)	2.404	2.296
Sample Length, L (cm)	7.440	7.308
Sample Area, A (cm^2)	29.284	26.716
Sample Volume, V (cm^3)	217.86	195.24
Wt. Rings + Wet Soil (g)	1158.9	404.58
Wt. Rings (g)	757.31	0
Wet Unit Wt., γ_m (pcf)	115.1	129.4
Wet Soil + Tare (g)	314.75	524.72
Dry Soil + Tare (g)	262.99	419.81
Tare (g)	112.21	122.86
Weight of solids, Ws (g)	298.96	298.96
Water Content, w (%)	34.33	35.33
Dry Unit Wt, γ_d (pcf)	85.7	95.6
Void ratio, e	0.82	0.88
Saturation (%)	100.0	100 [a]
Average K[b] (cm/sec)	**3.9E-06**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20ºC

Gs	2.493	Determined
Cell No.	1	
Station No.	6	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	60	
Effective vert. consolidation stress (psi)	60	

	Initial (o)	Final (f)
B value	0.76	0.96
External Burette (cm^3)	13.30	49.40
Cell Pressure (psi)	0.0	90.0

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.150
System volume change (cm^3)	13.48
Net sample volume change (cm^3)	-22.62
Bottom burette ground length, l_b (cm)	82.05
Top burette ground length, l_t (cm)	82
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

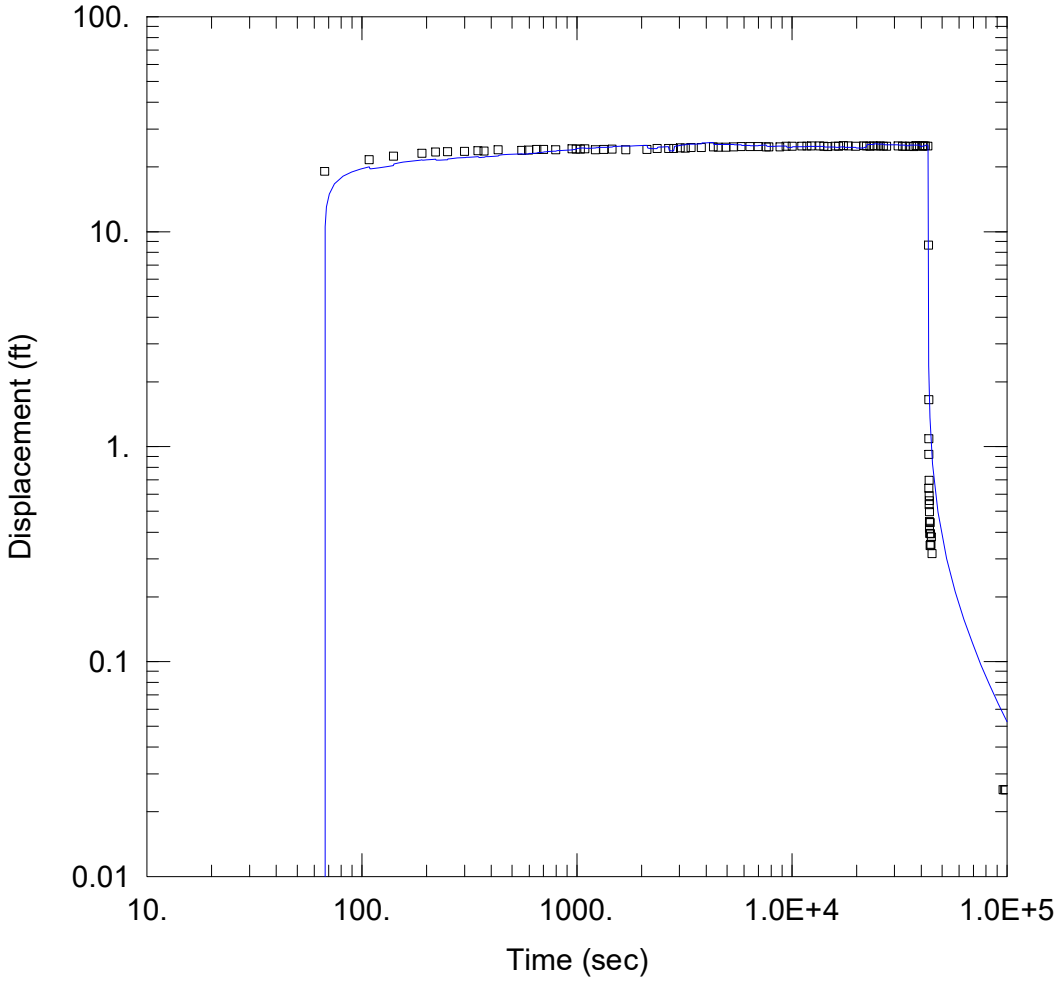
Start Date and Time: 1/8/20 10:11

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (ºC)	Visc. Ratio R_T	K[b] (cm/sec)
180.0	0.16 0.31	9.84 9.72	49.19	47.82	4.2E-06	23.6 23.6	0.92	3.9E-06
180.0	0.31 0.45	9.72 9.60	47.82	46.50	4.2E-06	23.6 23.6	0.92	3.8E-06
180.0	0.45 0.59	9.60 9.48	46.50	45.18	4.3E-06	23.6 23.6	0.92	4.0E-06
180.0	0.59 0.73	9.48 9.37	45.18	43.91	4.3E-06	23.6 23.6	0.92	3.9E-06
180.0	0.73 0.86	9.37 9.26	43.91	42.69	4.2E-06	23.6 23.6	0.92	3.9E-06
180.0	0.86 0.99	9.26 9.15	42.69	41.47	4.3E-06	23.6 23.6	0.92	4.0E-06

Comments:
Middle depth interval tube sample of three used for test specimen.

Entered by:_____
Reviewed:_____

Appendix D AQTESOLV ANALYTICAL RESULTS



WELL TEST ANALYSIS

Data Set: C:\...\I-1-700_Hantush_leakyconfined_pump.aqt
Date: 02/28/20 Time: 13:14:26

PROJECT INFORMATION

Client: EnergySolns
Project: 233001389
Test Date: 1-16-2020

AQUIFER DATA

Saturated Thickness: 325. ft
Aquitard Thickness (b'): 1. ft
Anisotropy Ratio (Kz/Kr): 0.1
Aquitard Thickness (b"): 1. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
I-1-700	1194214.7	7420935.3

Observation Wells

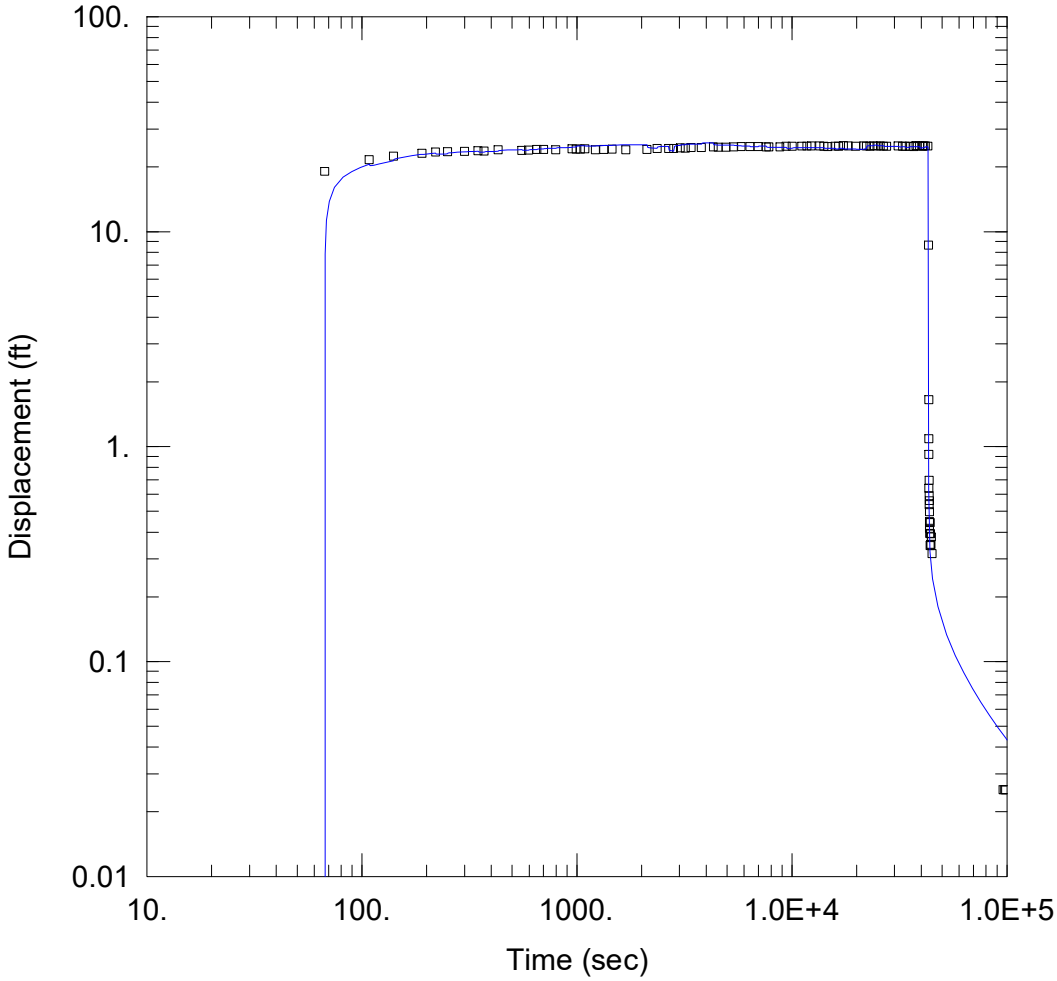
Well Name	X (ft)	Y (ft)
▫ I-1-700	1194214.7	7420935.3

SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush

T = 45.51 ft^2/day
r/B' = 0.1
r/B" = 0.

S = 1.91E-5
ß' = 0.1
ß" = 1.85



WELL TEST ANALYSIS

Data Set: C:\...\I-1-700_Neuman_leakyconfined_pump.aqt
Date: 02/28/20 Time: 13:24:29

PROJECT INFORMATION

Client: EnergySolns
Project: 233001389
Test Date: 1-16-2020

AQUIFER DATA

Saturated Thickness: 325. ft
Aquitard Thickness (b'): 1. ft
Anisotropy Ratio (Kz/Kr): 0.1
Aquitard Thickness (b"): 1. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
I-1-700	1194214.7	7420935.3

Observation Wells

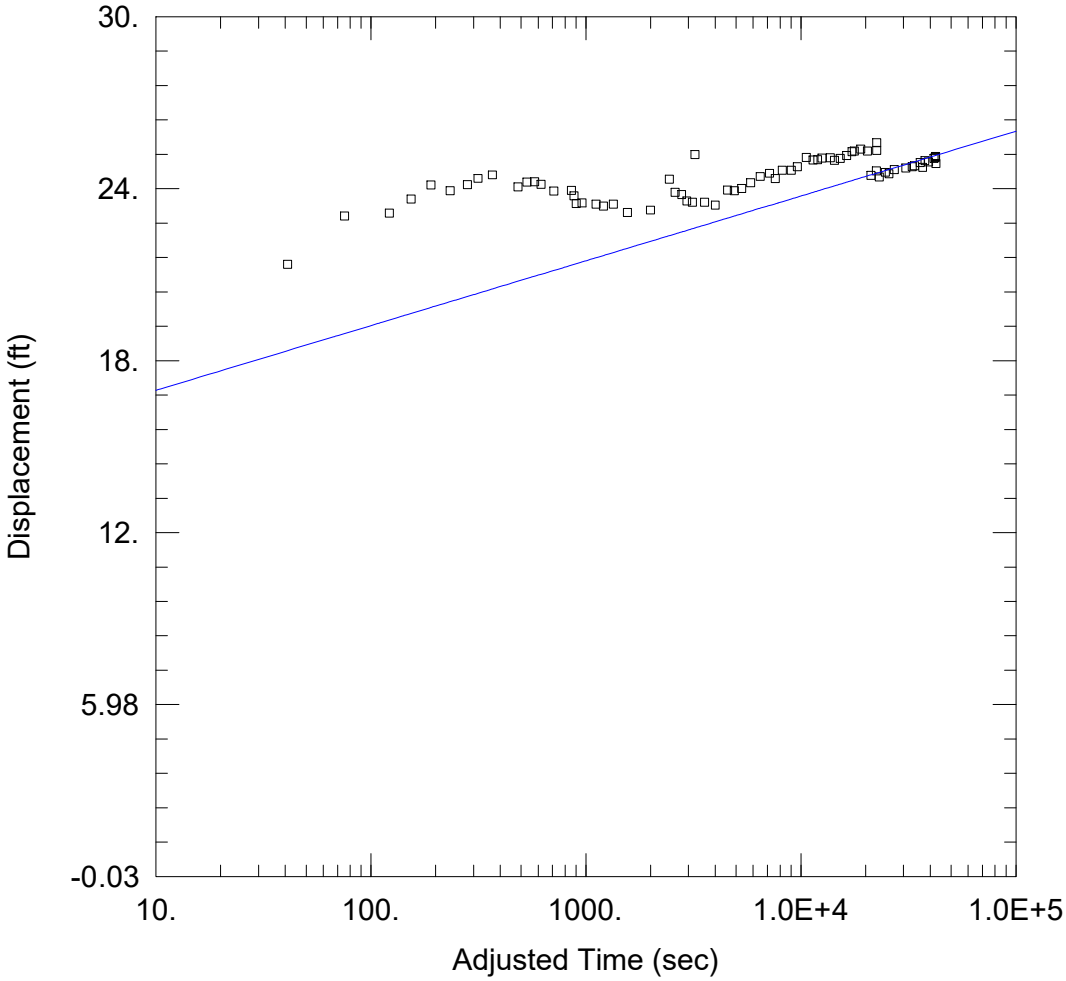
Well Name	X (ft)	Y (ft)
▫ I-1-700	1194214.7	7420935.3

SOLUTION

Aquifer Model: Leaky
Solution Method: Neuman-Witherspoon

T = 48.08 ft^2/day
r/B = 0.1
T2 = 3065.6 ft^2/day

S = 0.004676
ß = 0.1148
S2 = 1.259E-5



WELL TEST ANALYSIS

Data Set: \...\I-1-700_CooperJacob_confined_pump.aqt
Date: 02/28/20 Time: 12:02:10

PROJECT INFORMATION

Client: EnergySolns
Project: 233001389
Test Date: 1-16-2020

AQUIFER DATA

Saturated Thickness: 325. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
I-1-700	1194214.7	7420935.3

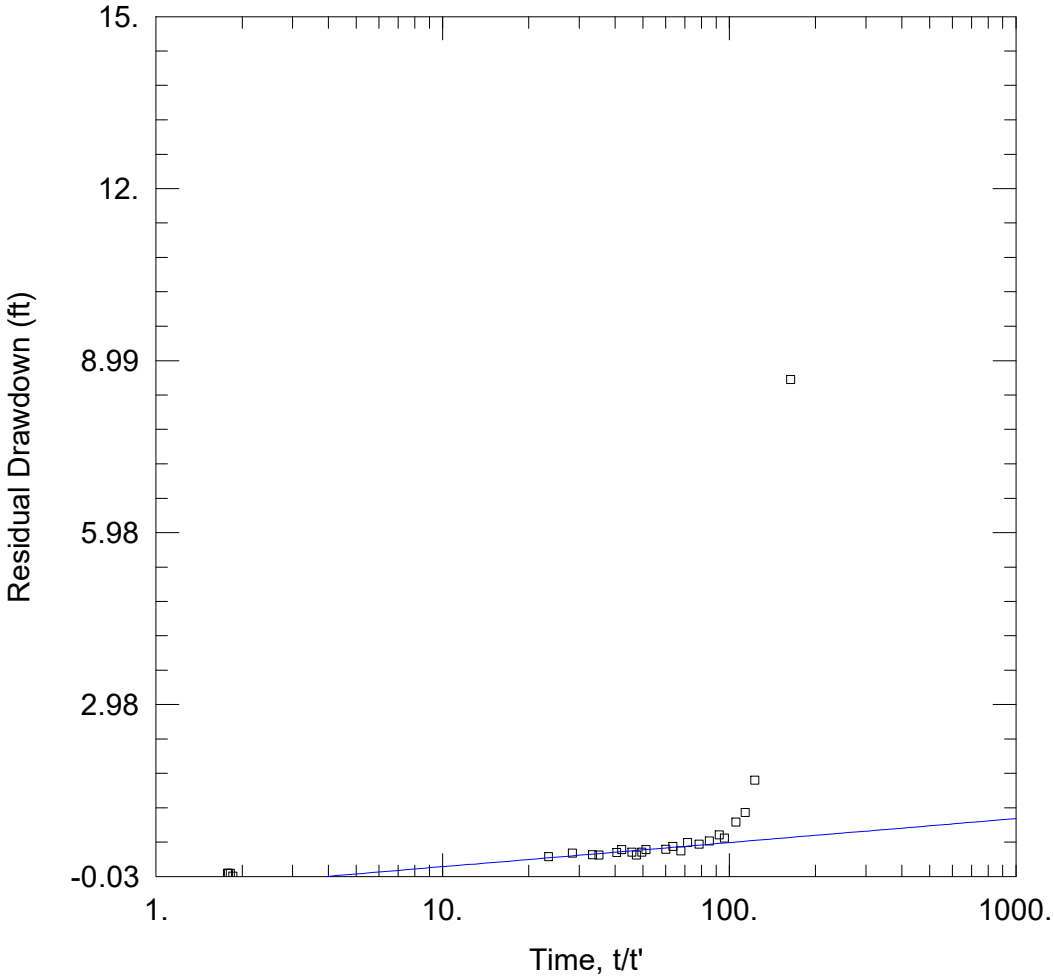
Observation Wells

Well Name	X (ft)	Y (ft)
▫ I-1-700	1194214.7	7420935.3

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 241.7 ft^2/day S = 1.292E-7



WELL TEST ANALYSIS

Data Set: \...\I-1-700_Theis_confined_recovery.aqt
Date: 02/28/20 Time: 11:59:37

PROJECT INFORMATION

Client: EnergySolns
Project: 233001389
Test Date: 1-16-2020

AQUIFER DATA

Saturated Thickness: 325. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
I-1-700	1194214.7	7420935.3

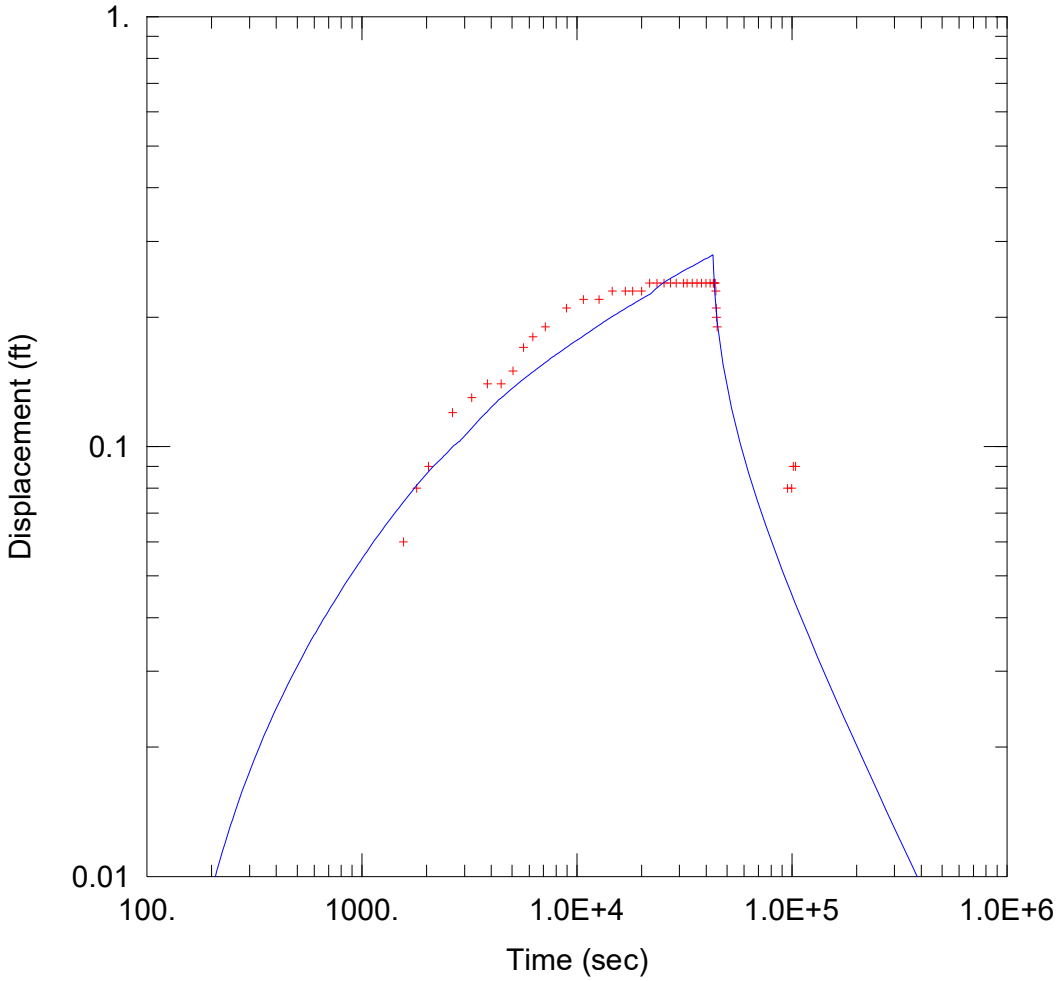
Observation Wells

Well Name	X (ft)	Y (ft)
▫ I-1-700	1194214.7	7420935.3

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 1298.8 ft^2/day S/S' = 4.621



WELL TEST ANALYSIS

Data Set: C:\...\I-1-700_Hantush_leakyconfined_obs.aqt
Date: 02/28/20 Time: 13:10:33

PROJECT INFORMATION

Client: EnergySolns
Project: 233001389
Test Date: 1-16-2020

AQUIFER DATA

Saturated Thickness: 325. ft
Aquitard Thickness (b'): 1. ft
Anisotropy Ratio (Kz/Kr): 0.1
Aquitard Thickness (b"): 1. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
I-1-700	1194214.7	7420935.3

Observation Wells

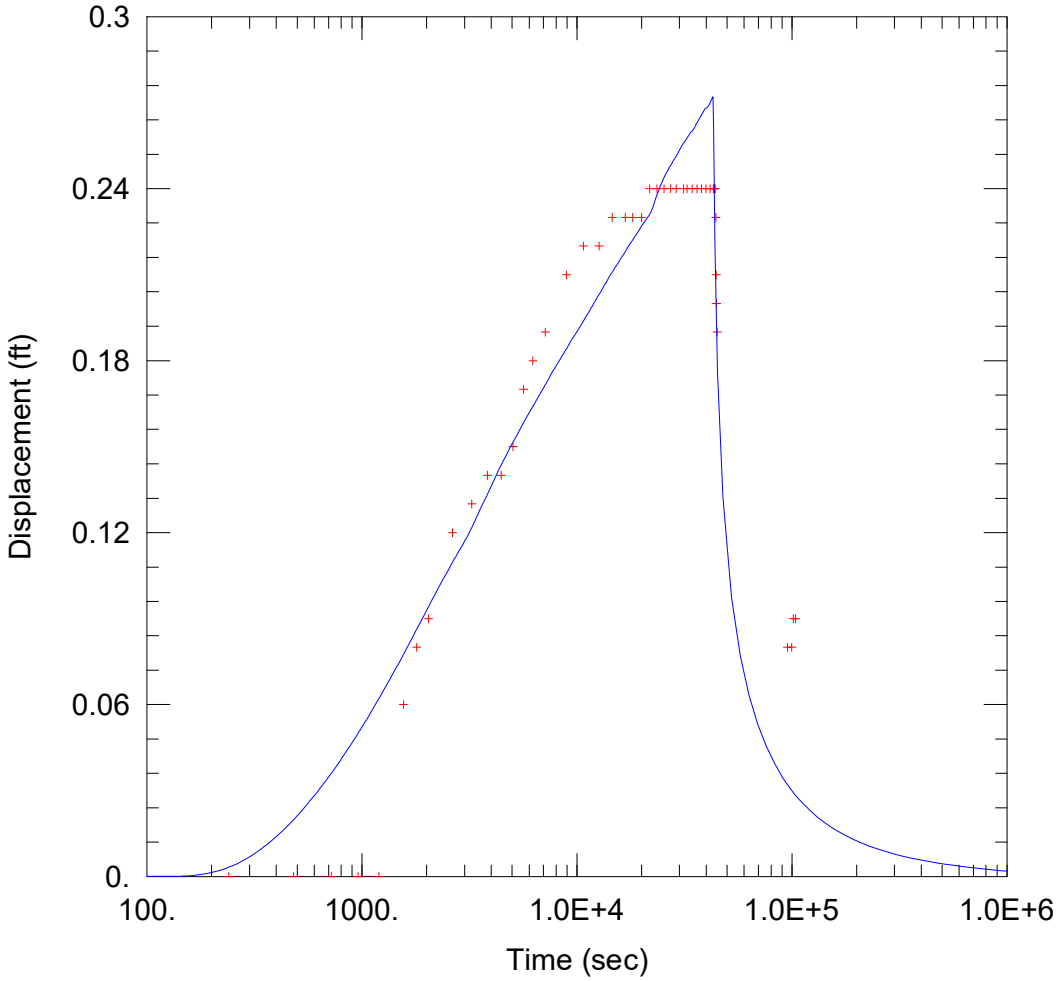
Well Name	X (ft)	Y (ft)
+ I-1-100	1194186.5	7420897.9

SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush

T = 1213.5 ft^2/day
r/B' = 0.1
r/B" = 0.

S = 0.001335
ß' = 0.1
ß" = 1.85



WELL TEST ANALYSIS

Data Set: C:\...\I-1-700_Neuman_leakyconfined_obs.aqt
Date: 02/28/20 Time: 13:21:35

PROJECT INFORMATION

Client: EnergySolns
Project: 233001389
Test Date: 1-16-2020

AQUIFER DATA

Saturated Thickness: 325. ft
Aquitard Thickness (b'): 1. ft
Anisotropy Ratio (Kz/Kr): 0.1
Aquitard Thickness (b"): 1. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
I-1-700	1194214.7	7420935.3

Observation Wells

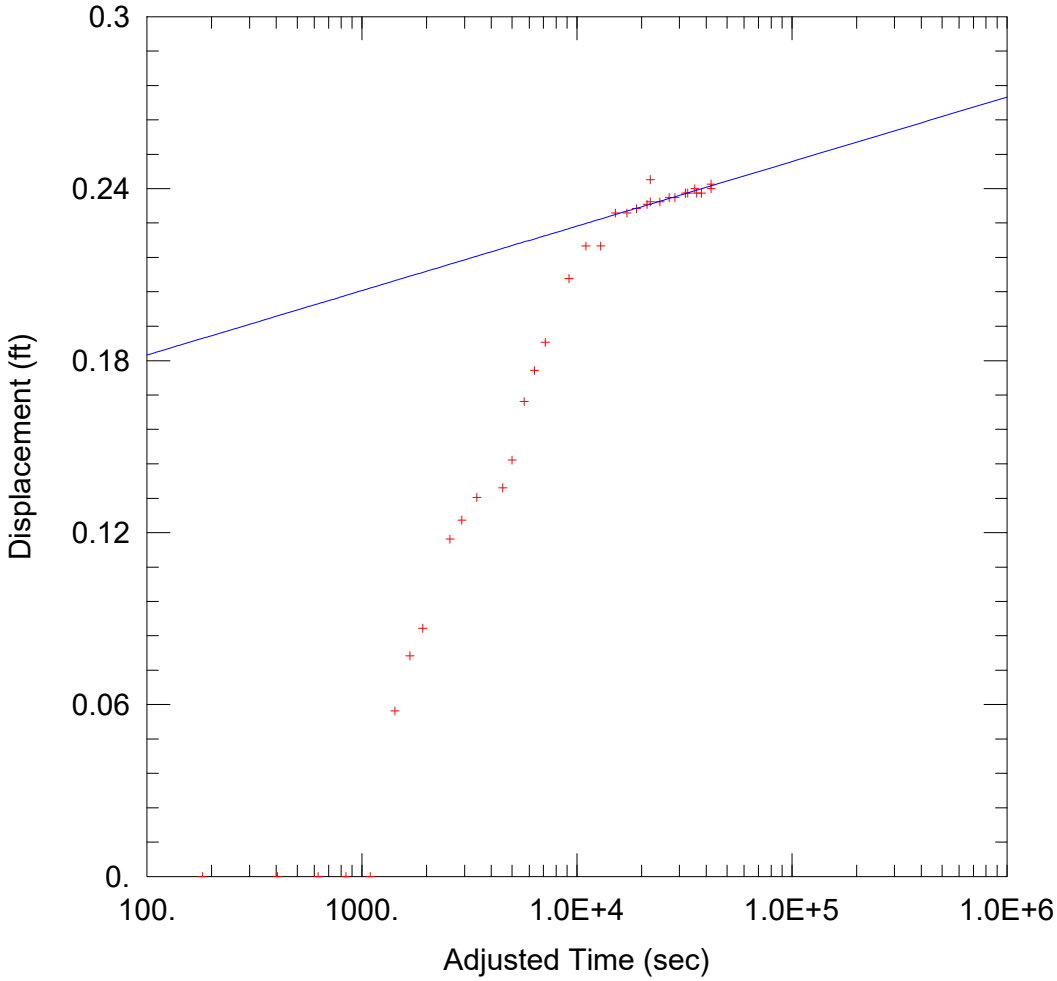
Well Name	X (ft)	Y (ft)
+ I-1-100	1194186.5	7420897.9

SOLUTION

Aquifer Model: Leaky
Solution Method: Neuman-Witherspoon

T = 2492.9 ft^2/day
r/B = 0.1
T2 = 8.64E+9 ft^2/day

S = 0.0191
ß = 0.1148
S2 = 1.0E-10



WELL TEST ANALYSIS

Data Set: \...\I-1-700_CooperJacob_confined_obs.aqt
Date: 02/28/20 Time: 12:01:38

PROJECT INFORMATION

Client: EnergySolns
Project: 233001389
Test Date: 1-16-2020

AQUIFER DATA

Saturated Thickness: 325. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
I-1-700	1194214.7	7420935.3

Observation Wells

Well Name	X (ft)	Y (ft)
+ I-1-100	1194186.5	7420897.9

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 2.43E+4 ft^2/day S = 2.354E-10

Appendix E GROUNDWATER ANALYTICAL LABORATORY REPORTS

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171
F 843.766.1178

gel.com

February 12, 2020

Mr. Jared Stark
EnergySolutions, LLC.
299 South Main Street, Suite 1700
Salt Lake City, Utah 84111

Re: EUI-11 Environmental Monitoring-Rad
Work Order: 502174
SDG: EUI-11350

Purchase Order:20-EUI-11
Chain of Custody:65534

Dear Mr. Stark:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on January 24, 2020. Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

This original data report has been prepared and reviewed in accordance with GEL's standard operating procedures. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843)556-8171 extension 4453.

Sincerely,

Edith M. Kent

Edith Kent
Project Manager

Enclosures

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Case Narrative

Case Narrative
for
EnergySolutions LLC (693694)
SDG: EUI-11350
Work Order: 502174

February 11, 2020

Laboratory Identification:

GEL Laboratories LLC
2040 Savage Road
Charleston, South Carolina 29407
(843) 556-8171

PO

20-EUI-11

Summary

Sample Receipt

The sample arrived at GEL Laboratories LLC, Charleston, South Carolina on January 24, 2020 for analysis.

The samples associated with Chain of Custody 65534 were received at a temperature of 2 degrees C. The samples were analyzed for Metals and Radiochemistry parameters.

Sample Identification

The laboratory received the following sample:

Laboratory Identification	Sample Description
502174001	I-1-700 011720-01

Items of Note

There are no items to note.

Case Narrative

Sample analyses were conducted using methodology as outlined in GEL Laboratories, LLC (GEL) Standard Operating Procedures. Any technical or administrative problems during analysis, data review, and reduction are contained in the analytical case narratives in the enclosed data package.

Edith Kent
Project Manager

GEL Laboratories LLC PO Box 30712 Charleston, SC 29417 2040 Savage Road Charleston, SC 29407 P 843.556.8171 F 843.766.1178 www.gel.com

Chain of Custody and Supporting Documentation

ENERGYSOLUTIONS

EC-0101E

Revision 1

CHAIN OF CUSTODY

Date: 1/17/2020

COC Number: 65534

Custody Holder: Jason Hill

SamplingTeam Jason Hill

Sample Dates: 1/16/2020

ORIGINAL

Field Log Book Page No.(s): N/A

Remarks: Offsite Radiological Analysis (GEL)

Stn/Loc	SampleID	Description	Date	Time	Relinquished To COC	Received From COC	Transfer Initial/Date/Time
	011720-01	I-1-700	1/16/2020	15:14			

Transfer to W.O. 502174 EMK | ~~01-24-08:55~~ ~~01~~ 01-24-2020 | 08:55 EMK 01/21/2020

JASON Hill | **Relinquished By (print/sign):**

JERROD ANDRESEN | **Received By (print/sign):** 01/23/2020 **Date/Time:**

JERROD ANDRESEN | **Relinquished By (print/sign):**

Zac Wardman | **Received By (print/sign):** 1/24/20 855 **Date/Time:**

Relinquished By (print/sign): **Received By (print/sign):** **Date/Time:**

Relinquished By (print/sign): **Received By (print/sign):** **Date/Time:**

ANALYTICAL REQUEST

ENERGYSOLUTIONS

Work Order: EUI-11350/502174

EnergySolutions COC: 65534 Date 1/17/2020

Laboratory: General Engineering Laboratories PO: 2020 EUI-11

Requested By: Jason Hill Include Data Package: ☑

Report To: Tim Orton ORIGINAL

Turn-around-time:

AutoID	Sample ID:	Description	Sample Date	Sample Time
086356	011720-01	I-1-700	1/16/2020	15:14

Requested Analysis for this sample: Gamma Spectrometry, Gross Alpha/Beta, Ra-226, Ra-228, Th-228,230,232, ~~U-Isotn~~ U-233/234,235/236,238

Additional Instructions/Commen

Please analyze Gamma Spectrometry for K-40 only.

Also, please report all results to Robert Sobocinski (rwsobocinski@energysolutions.com)
jbh (jhill, 1/17/2020 9:51:55 AM) (jhill, 1/17/2020 9:53:11 AM) (jandresen, 1/23/2020 10:55:10 AM)

Signature: Date: 01/23/2020

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

Client: CARE	**SDG/AR/COC/Work Order:** 502174
Received By: George McAbee	**Date Received:** 1/24/2020
Carrier and Tracking Number	Circle Applicable: FedEx Express FedEx Ground UPS Field Services Courier Other 7759395 8582

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?	✓		Hazard Class Shipped: UN#: 2910 If UN2910, Is the Radioactive Shipment Survey Compliant? Yes ✓ No___
B) Did the client designate the samples are to be received as radioactive?	✓		COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?	✓		Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: Wet Ice Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 2°C
4	Daily check performed and passed on IR temperature gun?	✓			**Temperature Device Serial #:** 122-19 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
6	Samples requiring chemical preservation at proper pH?	✓	✓		Sample ID's and Containers Affected: Metals If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___ (If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___ (If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?			✓	
13	COC form is properly signed in relinquished/received sections?	✓			Circle Applicable: Not relinquished Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials EMM Date 1/27/2020 Page ___ of ___

GL-CHL-SR-001 Rev 6

Laboratory Certifications

List of current GEL Certifications as of 11 February 2020

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−30
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

Metals Analysis

Case Narrative

Metals
Technical Case Narrative
EnergySolutions LLC
SDG #: EUI-11350
Work Order #: 502174

Product: **Determination of Metals by ICP-MS**
Analytical Method: EPA 200.8
Analytical Procedure: GL-MA-E-014 REV# 33
Analytical Batch: 1962589

Preparation Method: EPA 200.2
Preparation Procedure: GL-MA-E-016 REV# 18
Preparation Batch: 1962588

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
502174001	I-1-700 011720-01
1204483525	Method Blank (MB)**ICP-MS**
1204483526	Laboratory Control Sample (LCS)
1204483529	502174001(I-1-700 011720-01L) Serial Dilution (SD)
1204483527	502174001(I-1-700 011720-01D) Sample Duplicate (DUP)
1204483528	502174001(I-1-700 011720-01S) Matrix Spike (MS)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Calibration Information

ICSA/ICSAB Statement
For the ICP-MS analysis, the ICSA solution contains analyte concentrations which are verified trace impurities indigenous to the purchased standard.

Technical Information

Sample Dilutions
Dilutions may be required for many reasons, including to minimize matrix interferences or to bring over range target analyte concentrations into the linear calibration range. Per the SOP, sample 502174001 (I-1-700 011720-01) was diluted due to internal standard recoveries outside the acceptable control limits.

Analyte	502174
	001
Uranium	5X

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Qualifier Definition Report
for

CARE009 EnergySolutions LLC (693694)

Client SDG: EUI-11350 GEL Work Order: 502174

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this data report:

Signature: **Name: Edmund Frampton**

Date: 04 FEB 2020 **Title: Team Leader**

Sample Data Summary

METALS
−1−
INORGANICS ANALYSIS DATA PACKAGE

SDG No: EUI−11350 **METHOD TYPE:** EPA

SAMPLE ID: 502174001 **CLIENT ID:** I−1−700 011720−01

CONTRACT: CARE EUI−11

MATRIX: Water **DATE RECEIVED** 24−JAN−20 **LEVEL:** Low

CAS No	Analyte	Result	Units	C	Qual	M*	MDL	DF	Inst ID	Analytical Run
7440−61−1	Uranium	17.4	ug/L			MS	0.335	5	ICPMS12	200131−1

***Analytical Methods:**

MS EPA 200.8

Quality Control Summary

METALS
−2a−
Initial and Continuing Calibration Verification

SDG No: EUI−11350

Contract: CARE EUI−11 **Lab Code:** GEL

Instrument ID: ICPMS12

Sample ID	Analyte	Result	Units	True Value	Units	% Recovery	Acceptance Window (%R)	M*	Analysis Date/Time	Run Number
ICV01										
	Uranium	47.3	ug/L	50	ug/L	94.6	90.0 − 110.0	MS	31−JAN−20 14:03	200131−1
CCV01										
	Uranium	47.8	ug/L	50	ug/L	95.5	90.0 − 110.0	MS	31−JAN−20 14:11	200131−1
CCV02										
	Uranium	47.3	ug/L	50	ug/L	94.6	90.0 − 110.0	MS	31−JAN−20 14:24	200131−1

***Analytical Methods:**

MS EPA 200.8

METALS
−2b−
CRDL Standard for ICP & ICPMS

SDG No: EUI−11350

Contract: CARE EUI−11 **Lab Code:** GEL

Instrument ID: ICPMS12

Sample ID	Analyte	Result	Units	True Value	Units	% Recovery	Advisory Limits (%R)	M*	Analysis Date/Time	Run Number
CRDL01										
	Uranium	.2	ug/L	.2	ug/L	100	70.0 − 130.0	MS	31−JAN−20 14:06	200131−1

***Analytical Methods:**

MS **EPA 200.8**

Metals
−3a−
Initial and Continuing Calibration Blank Summary

SDG No.: EUI−11350

Contract: CARE EUI−11

Lab Code: GEL

Sample ID	Analyte	Result ug/L	Acceptance	Conc Qual	MDL	RDL	Matrix	M*	Analysis Date/Time	Run
ICB01										
	Uranium	0.067	+/−.2	U	0.067	0.2	LIQ	MS	31−JAN−20 14:04	200131−1
CCB01										
	Uranium	0.067	+/−.2	U	0.067	0.2	LIQ	MS	31−JAN−20 14:13	200131−1
CCB02										
	Uranium	0.067	+/−.2	U	0.067	0.2	LIQ	MS	31−JAN−20 14:25	200131−1

***Analytical Methods:**

MS **EPA 200.8**

METALS
−3b−
PREPARATION BLANK SUMMARY

SDG NO. EUI−11350

Contract: CARE EUI−11

Matrix: Water

Sample ID	Analyte	Result	Units	Acceptance Window	Conc Qual	M*	MDL	RDL
1204483525								
	Uranium	0.0670	ug/L	+/−0.2	U	MS	0.0670	0.200

***Analytical Methods:**

MS EPA 200.8

METALS
−4−
Interference Check Sample

SDG No: EUI−11350

Contract: CARE EUI−11 **Lab Code:** GEL

Instrument: ICPMS12

Sample ID	Analyte	Result	Units	True Value	Units	% Recovery	Acceptance Window (%R)	Analysis Date/Time	Run Number
ICSA01									
	Uranium	0.014	ug/L					31−JAN−20 14:08	200131−1
ICSAB01									
	Uranium	19.5	ug/L	20	ug/L	97.4	80.0 − 120.0	31−JAN−20 14:09	200131−1

METALS
−5a−

Matrix Spike Summary

SDG NO. EUI−11350 **Client ID** I−1−700 011720−01S

Contract: CARE EUI−11 **Level:** Low

Matrix: WATER **% Solids:**

Sample ID: 502174001 **Spike ID:** 1204483528

Analyte	Units	Acceptance Limit	Spiked Result	C	Sample Result	C	Spike Added	% Recovery	Qual	M*
Uranium	ug/L	75−125	68.3		17.4		50.0	102		MS

***Analytical Methods:**

MS **EPA 200.8**

Metals
−6−
Duplicate Sample Summary

SDG No.: EUI−11350 **Lab Code:** GEL

Contract: CARE EUI−11 **Client ID:** I−1−700 011720−01D

Matrix: WATER **Level:** Low

Sample ID: 502174001 **Duplicate ID:** 1204483527 **Percent Solids for Dup:** N/A

Analyte	Units	Acceptance Limit	Sample Result	C	Duplicate Result	C	RPD	Qual	M*
Uranium	ug/L	+/−20%	17.4		18.4		5.74		MS

***Analytical Methods:**
MS EPA 200.8

METALS
–7–
Laboratory Control Sample Summary

SDG NO. EUI–11350

Contract: CARE EUI–11

Aqueous LCS Source: Inorganic Ventures **Solid LCS Source:**

Sample ID	Analyte	Units	True Value	Result	C	% Recovery	Acceptance Limit	M*
1204483526								
	Uranium	ug/L	50.0	49.4		98.9	85–115	MS

***Analytical Methods:**

MS **EPA 200.8**

METALS
–9–
Serial Dilution Sample Summary

SDG NO. EUI–11350 **Client ID** I–1–700 011720–01L

Contract: CARE EUI–11

Matrix: LIQUID **Level:** Low

Sample ID: 502174001 **Serial Dilution ID:** 1204483529

Analyte	Initial Value ug/L	C	Serial Value ug/L	C	% Difference	Qual	Acceptance Limit	M*
Uranium	3.47		3.45		.576			MS

***Analytical Methods:**

MS **EPA 200.8**

METALS
−13−
SAMPLE PREPARATION SUMMARY

SDG No: EUI−11350 **Method Type:** MS

Contract: CARE EUI−11 **Lab Code:** GEL

Sample ID	Client ID	Sample Type	Matrix	Prep Date	Initial Sample Size	Final Sample Volume	Percent Solids
Batch Number	1962588						
1204483525	MB for batch 1962588	MB	W	30−JAN−20	50mL	50mL	
1204483526	LCS for batch 1962588	LCS	W	30−JAN−20	50mL	50mL	
1204483528	I−1−700 011720−01S	MS	W	30−JAN−20	50mL	50mL	
1204483527	I−1−700 011720−01D	DUP	W	30−JAN−20	50mL	50mL	
502174001	I−1−700 011720−01	SAMPLE	W	30−JAN−20	50mL	50mL	

Metals
-14-
Analysis Run Log

Contract: CARE EUI-11

Lab Code : GEL

Client Sdg: EUI-11350

Inst Name: ICPMS12

Instrument Type: MS

Start Date: 31-JAN-20

End Date: 31-JAN-20

Data File: 200131-1

Samp ID	D/F	Run Time	U
S0.0	1	13:58:32	X
S10	1	14:00:09	X
S100	1	14:01:46	X
ICV01	1	14:03:21	X
ICB01	1	14:04:58	X
CRDL01	1	14:06:34	X
ICSA01	1	14:08:11	X
ICSAB01	1	14:09:47	X
CCV01	1	14:11:25	X
CCB01	1	14:13:02	X
1204483525	1	14:14:40	X
1204483526	1	14:16:17	X
502174001	5	14:17:54	X
1204483527	5	14:19:30	X
1204483528	5	14:21:06	X
1204483529	25	14:22:42	X
CCV02	1	14:24:21	X
CCB02	1	14:25:57	X

Standards

METALS
−10−
Instrument Detection Limits

SDG NO. EUI−11350

Contract: CARE EUI−11 **Lab Code: GEL** **MDL** **Effective Date:** 16−APR−17

Instrument(s): ICPMS12 **Verified on:** 31−JAN−2020

ICP/MS	Analyte	Wavelength (nm)	MDL ug/L	RDL ug/L
LIQUID	Uranium		0.067	0.2

METALS
−12−
Linear Ranges

SDG NO. EUI−11350

Contract: CARE EUI−11 **Lab Code: GEL**

Instrument ID ICPMS12

Analyte	Integration Time (msec)	LDR	Units	Effective Date
Uranium	1000	5000	ug/L	01−AUG−17

Raw Data

ICPMS #12 Daily Performance

Sample ID: Sample
Sample Date/Time: Friday, January 31, 2020 10:16:26
Sample Description:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\Daily 2.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\default4\Sample.580
Mass Calibration File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\MassCal\default2.tun
Dual Detector Mode: Pulse
Acquisition Date/Time&Time Zone: Friday, January 31, 2020 10:16:26 Eastern Standard Time
Number of Replicates: 5

Summary

	Analyte	Mass	Meas. Intens. Mean	Net Intens. Mean	Net Intens. SD	Net Intens. RSD
	Be	9.0	51713.1	51713.060	1054.533	2.0
	Mg	24.0	103587.1	103587.112	2390.861	2.3
	Co	58.9	68934.9	68934.880	2393.442	3.5
	Rh	102.9	38755.3	38755.303	448.958	1.2
	In	114.9	249189.4	249189.398	4499.056	1.8
	Pb	208.0	108077.4	108077.418	2570.774	2.4
⌈>	Ba	137.9	236465.6	236465.620	4185.334	1.8
⌊	Ba++	69.0	2831.0	0.012	0.000	0.6
⌈>	Ce	139.9	256536.2	256536.162	6581.448	2.6
⌊	CeO	155.9	4375.8	0.017	0.001	5.9
	Bkgd	220.0	0.2	0.200	0.112	55.9

Current Conditions

C Val	Description
0.96	Nebulizer Gas Flow STD/KED [NEB]
1.20	Auxiliary Gas Flow
18.00	Plasma Gas Flow
-12.00	Deflector Voltage
1600.00	ICP RF Power
-1525.00	Analog Stage Voltage
800.00	Pulse Stage Voltage
0.00	Quadrupole Rod Offset STD [QRO]
-16.00	Cell Rod Offset STD [CRO]
8.00	Discriminator Threshold
-12.00	Cell Entrance/Exit Voltage STD
0.00	RPa
0.45	RPq
0.96	DRC Mode NEB
-9.00	DRC Mode QRO
-2.00	DRC Mode CRO
-7.00	DRC Mode Cell Entrance/Exit Voltage
0.60	Cell Gas A
200.00	Axial Field Voltage
-16.00	KED Mode CRO
-12.50	KED Mode QRO
-9.00	KED Mode Cell Entrance Voltage
-31.00	KED Mode Cell Exit Voltage
3.00	KED Cell Gas A
0.00	KED RPa
0.25	KED RPq
475.00	KED Mode Axial Field Voltage

Current Autolens Data

Analyte	Mass	Num of Pts	DAC Value	Maximum Intensity
Be	9.012	41	-13.5	34020.5
Mg	23.985	41	-14.5	169728.3
In	114.904	41	-11.5	135178.6
Ce	139.905	41	-10.0	87078.6
Pb	207.977	41	-6.5	54993.6
U	238.050	41	-7.0	91767.8

ICPMS #12 Instrument Tuning Report

Analyte	Exact Mass	Meas. Mass	Mass DAC	Res DAC	Meas. Pk. Width
Be	9.0	9.0	1640	2060	0.714
Mg	24.0	24.0	4629	2068	0.665
Mg	25.0	25.0	4813	2065	0.675
Mg	26.0	26.0	5026	2065	0.686
Co	58.9	58.9	11597	2062	0.710
Rh	102.9	102.9	20382	2065	0.724
In	114.9	114.9	22774	2064	0.726
Ce	139.9	139.9	27775	2065	0.739
Pb	206.0	206.0	40982	2069	0.698
Pb	207.0	207.0	41195	2070	0.705
Pb	208.0	208.0	41385	2065	0.729
U	238.1	238.0	47395	2065	0.748

Report Date/Time: Friday, January 31, 2020 10:06:38

ICPMS #12 - Summary Report

Sample ID: Cal Blank
Sample Date/Time: Friday, January 31, 2020 13:58:32
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\Cal Blank.731

Concentration Results

Summary

Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>Lu	175		**ug/L**		952701.526	
U	238		**ug/L**		29.000	

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	

QC Calculated Values

Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>	Lu	175					
	U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: Standard 1
Sample Date/Time: Friday, January 31, 2020 14:00:09
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\Standard 1.732

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		896076.707	896076.707
	U	238	**10.000**	**ug/L**	0.567	209214.886	0.233

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175					
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: Standard 2
Sample Date/Time: Friday, January 31, 2020 14:01:46
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\Standard 2.733

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		925992.276	925992.276
	U	238	**100.039**	**ug/L**	1.457	2250794.791	2.431

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175					
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 1
Sample Date/Time: Friday, January 31, 2020 14:03:21
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 1.734

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		871435.623	871435.623
	U	238	**47.291**	**ug/L**	2.312	1001542.868	1.149

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		91.47			
		U	238	94.583				

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 2
Sample Date/Time: Friday, January 31, 2020 14:04:58
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 2.735

Concentration Results

Summary

Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>Lu	175		**ug/L**		947985.272	947985.272
U	238	**0.010**	**ug/L**	9.173	248.669	0.000

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>	Lu	175		99.50			
	U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 3
Sample Date/Time: Friday, January 31, 2020 14:06:34
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 3.736

Concentration Results

Summary

Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>Lu	175		**ug/L**		835333.195	835333.195
U	238	**0.200**	**ug/L**	1.473	4078.916	0.005

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>	Lu	175		87.68			
	U	238	99.847				

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 4
Sample Date/Time: Friday, January 31, 2020 14:08:11
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 4.737

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		724920.967	724920.967
	U	238	**0.014**	**ug/L**	9.427	268.003	0.000

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		76.09			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 5
Sample Date/Time: Friday, January 31, 2020 14:09:47
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 5.738

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		725859.312	725859.312
	U	238	**19.481**	**ug/L**	2.217	343591.874	0.473

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		76.19			
		U	238	97.406				

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 6
Sample Date/Time: Friday, January 31, 2020 14:11:25
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 6.739

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		797012.107	797012.107
	U	238	**47.751**	**ug/L**	0.415	925001.909	1.161

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		83.66			
		U	238	95.502				

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 7
Sample Date/Time: Friday, January 31, 2020 14:13:02
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 7.740

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		834209.795	834209.795
	U	238	**0.006**	**ug/L**	4.338	139.001	0.000

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		87.56			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: 1204483525
Sample Date/Time: Friday, January 31, 2020 14:14:40
Sample Type: Sample
Sample Description: CARE 200.8 MB
Number of Replicates: 3
Batch ID: 1962589|1|baj
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\1204483525.741

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		857726.557	857726.557
	U	238	**0.004**	**ug/L**	1.266	101.334	0.000

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		90.03			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: 1204483526
Sample Date/Time: Friday, January 31, 2020 14:16:17
Sample Type: Sample
Sample Description: CARE 200.8 LCS
Number of Replicates: 3
Batch ID: 1962589|1|baj
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\1204483526.742

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		886084.003	886084.003
	U	238	**49.439**	**ug/L**	2.530	1064894.867	1.202

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		93.01			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: 502174001
Sample Date/Time: Friday, January 31, 2020 14:17:54
Sample Type: Sample
Sample Description: CARE 200.8
Number of Replicates: 3
Batch ID: 1962589|5|baj
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\502174001.743

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		576087.730	576087.730
	U	238	**3.470**	**ug/L**	1.520	48590.852	0.084

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		60.47			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: 1204483527
Sample Date/Time: Friday, January 31, 2020 14:19:30
Sample Type: Sample
Sample Description: CARE 200.8 DUP
Number of Replicates: 3
Batch ID: 1962589|5|baj
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\1204483527.744

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		587095.442	587095.442
	U	238	**3.675**	**ug/L**	2.225	52438.072	0.089

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		61.62			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: 1204483528
Sample Date/Time: Friday, January 31, 2020 14:21:06
Sample Type: Sample
Sample Description: CARE 200.8 MS
Number of Replicates: 3
Batch ID: 1962589|5|baj
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\1204483528.745

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		587636.851	587636.851
	U	238	**13.655**	**ug/L**	0.474	195041.584	0.332

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		61.68			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: 1204483529
Sample Date/Time: Friday, January 31, 2020 14:22:42
Sample Type: Sample
Sample Description: CARE 200.8 SDILT
Number of Replicates: 3
Batch ID: 1962589|25|baj
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\1204483529.746

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		880726.867	880726.867
	U	238	**0.690**	**ug/L**	1.382	14798.330	0.017

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		92.45			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 6
Sample Date/Time: Friday, January 31, 2020 14:24:21
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 6.747

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		1014388.816	1014388.816
	U	238	**47.309**	**ug/L**	2.227	1166250.605	1.150

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		106.47			
		U	238	94.618				

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

ICPMS #12 - Summary Report

Sample ID: QC Std 7
Sample Date/Time: Friday, January 31, 2020 14:25:57
Sample Type: Sample
Sample Description:
Number of Replicates: 3
Batch ID:
Method File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\Method\200.8 u.mth
Dataset File: C:\Users\Public\Documents\PerkinElmer Syngistix\ICPMS\DataSet\200128\QC Std 7.748

Concentration Results

Summary

	Analyte	Mass	**Conc. Mean**	**Report Unit**	Conc. RSD	Meas. Intens. Mean	Net Intens. Mean
>	Lu	175		**ug/L**		967064.818	967064.818
	U	238	**0.006**	**ug/L**	6.177	175.334	0.000

Calibration

Analyte	Mass	Curve Type	Correlation Coefficient
Lu	175	Linear Thru Zero	
U	238	Linear Thru Zero	1.0000

QC Calculated Values

	Inte	Analyte	Mass	QC Std % Recovery	Int Std % Recovery	Spike % Reco	Dilution % D	Duplicate Rel. % Difference
>		Lu	175		101.51			
		U	238					

QC Out of Limits

Measurement Type	Analyte	Mass	Out of Limits Message

QC Action

QC Action Line: No QC action taken

Miscellaneous

Prep Logbook

Sample Preparation for Total Recoverable Elements by EPA Method 200.2

Batch ID: **1962588**
Analyst: Ridge Gleaton
Method: EPA 200.2
Lab SOP: GL-MA-E-016 REV# 18
Instrument: Metals Manual Instrument

Type	Sample Id	Description	Serial Number	Spike Amount	Spike Units
LCS	1204483526	ICP-MS spiking soluiton A	UI191025-A	.25	mL
LCS	1204483526	ICP-MS spiking solution B	UI191025-B	.25	mL
MS	1204483528	ICP-MS spiking soluiton A	UI191025-A	.25	mL
MS	1204483528	ICP-MS spiking solution B	UI191025-B	.25	mL

Sample ID	Prep Date	Matrix	Initial Volume (mL)	Hot Block Stop Date (date)	Final Volume (mL)	Prep Factor (mL/mL)	pH Check
1204483525 MB	30-JAN-2020 09:50:58	Water	50	01/30/20 13:50	50	1	<2
1204483526 LCS	30-JAN-2020 09:50:58	Water	50	01/30/20 13:50	50	1	<2
502174001	30-JAN-2020 09:50:58	Water	50	01/30/20 13:50	50	1	<2
1204483529 SDILT (502174001)	30-JAN-2020 09:50:58	Water	50	01/30/20 13:50	50	1	<2
1204483527 DUP (502174001)	30-JAN-2020 09:50:58	Water	50	01/30/20 13:50	50	1	<2
1204483528 MS (502174001)	30-JAN-2020 09:50:58	Water	50	01/30/20 13:50	50	1	<2

Reagent/Solvent Lot ID	Description	Amount
200120	HYDROCHLORIC ACID	.5 mL
3011870	Concentrated Nitric Acid	1 mL

Comments:
Block Temperature (90-95C): 94 C
Temperature within limits (Y/N)?: y
Thermometer ID: 118840
Hot Block ID: 14
Digestion tube lot #: 1906257

Standard Logbook

Serial ID:	UI190415-09	**Open/Reference Date:**	15-APR-19	**Amount :**	250 mL
Name:	ICP-MS CRDL Master #1	**Received:**	15-APR-19	**Catalog Number :**	090014-MC-02
Type:	Source Material	**Expires:**	15-APR-20	**Lot Number :**	10091735-1
Employee:	Paul Boyd			**Solvent :**	+/- 0.5% IN 2% HNO3
Supplier:	02SI				
Description:	ICPMS CRDL Master Soln #1				
Comments:	None				

Analyte	Concentration	Analyte	Concentration
Aluminum	50 mg/L	Arsenic	5 mg/L
Barium	4 mg/L	Beryllium	.5 mg/L
Boron	15 mg/L	Cadmium	1 mg/L
Calcium	200 mg/L	Chromium	30 mg/L
Cobalt	1 mg/L	Copper	2 mg/L
Iron	100 mg/L	Lead	2 mg/L
Lithium	10 mg/L	Magnesium	30 mg/L
Manganese	5 mg/L	Nickel	2 mg/L
Phosphorous	50 mg/L	Potassium	300 mg/L
Selenium	5 mg/L	Sodium	250 mg/L
Strontium	10 mg/L	Thallium	2 mg/L
Thorium	2 mg/L	Uranium	.2 mg/L
Vanadium	20 mg/L	Zinc	20 mg/L

Serial ID:	UI190415-10	**Open/Reference Date:**	15-APR-19	**Amount :**	250 mL
Name:	ICP-MS CRDL Master #2	**Received:**	15-APR-19	**Catalog Number :**	160044-11-02
Type:	Source Material	**Expires:**	15-APR-20	**Lot Number :**	10091735-2
Employee:	Paul Boyd			**Solvent :**	+/- 0.5% IN 2% HNO3
Supplier:	02SI				
Description:	ICPMS CRDL Soln #2				
Comments:	None				

Analyte	Concentration	Analyte	Concentration
Antimony	3 mg/L	Molybdenum	1 mg/L
Silver	1 mg/L	Tin	5 mg/L
Titanium	10 mg/L	Tungsten	5 mg/L
Zirconium	2 mg/L		

Serial ID:	UI191025-A	**Open/Reference Date:**	13-NOV-19	**Catalog Number :**	GEL-12A
Name:	ICP-MS SPIKE A	**Received:**	25-OCT-19	**Lot Number :**	N2-MEB673694
Type:	Source Material	**Expires:**	25-OCT-20		
Employee:	Edmund Frampton				
Supplier:	Inorganic Ventures				
Description:	ICP-MS spiking soluiton A				
Comments:	None				

Analyte	Concentration	Analyte	Concentration

Analyte	Concentration	Analyte	Concentration
Antimony	10 mg/L	Hafnium	10 mg/L
Molybdenum	10 mg/L	Tantalum	10 mg/L
Tin	10 mg/L	Titanium	10 mg/L
Tungsten	10 mg/L	Zirconium	10 mg/L

Serial ID: UI191025-B **Open/Reference Date:** 13-NOV-19 **Catalog Number :** GEL-12B
Name: ICP-MS SPIKE B **Received:** 25-OCT-19 **Lot Number :** N2-MEB673693
Type: Source Material **Expires:** 25-OCT-20
Employee: Edmund Frampton
Supplier: Inorganic Ventures
Description: ICP-MS spiking solution B
Comments: None

Analyte	Concentration	Analyte	Concentration
Aluminum	400 mg/L	Arsenic	10 mg/L
Barium	10 mg/L	Beryllium	10 mg/L
Bismuth	10 mg/L	Boron	20 mg/L
Cadmium	10 mg/L	Calcium	400 mg/L
Cesium	10 mg/L	Chromium	10 mg/L
Cobalt	10 mg/L	Copper	10 mg/L
Iron	400 mg/L	Lead	10 mg/L
Lithium	10 mg/L	Magnesium	400 mg/L
Manganese	10 mg/L	Nickel	10 mg/L
Phosphorous	400 mg/L	Potassium	400 mg/L
Rhenium	10 mg/L	Rhodium	10 mg/L
Selenium	10 mg/L	Silver	10 mg/L
Sodium	400 mg/L	Strontium	10 mg/L
Thallium	10 mg/L	Thorium	10 mg/L
Uranium	10 mg/L	Uranium-235	.072 mg/L
Uranium-238	9.928 mg/L	Vanadium	10 mg/L
Zinc	10 mg/L		

Serial ID: UI191102-07 **Open/Reference Date:** 02-NOV-19 **Amount :** 250 mL
Name: ICP-MS ICV/CCV Master B **Received:** 02-NOV-19 **Catalog Number :** 160054-02-03
Type: Source Material **Expires:** 02-NOV-20 **Lot Number :** 10066767-11
Employee: Paul Boyd **Solvent :** 2% HNO3 100 cm2
Supplier: 02SI
Description: ICPMS ICV/CCV Soln B - 20ppm
Comments: None

Analyte	Concentration	Analyte	Concentration
Arsenic	20 mg/L	Barium	20 mg/L
Beryllium	20 mg/L	Boron	40 mg/L
Cadmium	20 mg/L	Chromium	20 mg/L
Cobalt	20 mg/L	Copper	20 mg/L

Analyte	Concentration	Analyte	Concentration
Lead	20 mg/L	Lithium	20 mg/L
Manganese	20 mg/L	Nickel	20 mg/L
Selenium	20 mg/L	Strontium	20 mg/L
Thallium	20 mg/L	Thorium	20 mg/L
Uranium	20 mg/L	Vanadium	20 mg/L
Zinc	20 mg/L		

Serial ID: UI191102-09 **Open/Reference Date:** 02-NOV-19 **Amount :** 250 mL
Name: ICP-MS ICV/CCV Master A **Received:** 02-NOV-19 **Catalog Number :** 160055-01-03
Type: Source Material **Expires:** 02-NOV-20 **Lot Number :** 10066767-12
Employee: Paul Boyd **Solvent :** 2% HNO3 100 cm2
Supplier: 02SI
Description: ICPMS ICV/CCV SOLN A - 2000ppm
Comments: None

Analyte	Concentration	Analyte	Concentration
Aluminum	2020 mg/L	Calcium	2000 mg/L
Iron	2000 mg/L	Magnesium	2000 mg/L
Phosphorous	2000 mg/L	Potassium	2000 mg/L
Sodium	2000 mg/L		

Serial ID: UI191112-03 **Open/Reference Date:** 12-NOV-19 **Catalog Number :** 060074-05-01
Name: ICPMS Tungsten - 10mg/L S **Received:** 12-NOV-19 **Lot Number :** 10070573-10
Type: Source Material **Expires:** 12-NOV-20 **Solvent :** 2% HNO3 + Tr HF
Employee: Paul Boyd
Supplier: O2SI
Description: ICPMS Tungsten standard SPIKE - 10mg/L
Comments: None

Analyte	Concentration	Analyte	Concentration
Tungsten	10 mg/L		

Serial ID: UI191204-08 **Open/Reference Date:** 04-DEC-19 **Amount :** 250 mL
Name: ICP-MS ICV/CCV Master C **Received:** 04-DEC-19 **Catalog Number :** ZGEL-107-500
Type: Source Material **Expires:** 30-OCT-20 **Lot Number :** 52-274CR
Employee: Paul Boyd **Solvent :** 2% HNO3/Tr. Tart Acid/ Tr. HF 100
Supplier: Spex
Description: ICPMS ICV/CCV Soln C - 20ppm
Comments: None

Analyte	Concentration	Analyte	Concentration
Antimony	20 mg/L	Molybdenum	20 mg/L
Silver	20 mg/L	Tin	20 mg/L
Titanium	20 mg/L	Tungsten	20 mg/L

Analyte	Concentration	Analyte	Concentration
Zirconium	20 mg/L		

Serial ID: UI191218-12
Name: ICP-MS ICSAB Master B
Type: Source Material
Employee: Paul Boyd
Supplier: 02SI
Description: ICPMS ICSAB Master B
Comments: None

Open/Reference Date: 18-DEC-19
Received: 18-DEC-19
Expires: 18-DEC-20

Amount : 250 mL
Catalog Number : 160033-02-02
Lot Number : 10069799-9
Solvent : +/- 2.0% in 2% HNO3

Analyte	Concentration	Analyte	Concentration
Arsenic	2 mg/L	Barium	2 mg/L
Beryllium	2 mg/L	Boron	2 mg/L
Cadmium	2 mg/L	Chromium	2 mg/L
Cobalt	2 mg/L	Copper	2 mg/L
Lead	2 mg/L	Lithium	2 mg/L
Manganese	2 mg/L	Nickel	2 mg/L
Selenium	2 mg/L	Strontium	2 mg/L
Thallium	2 mg/L	Thorium	2 mg/L
Uranium	2 mg/L	Vanadium	2 mg/L
Zinc	2 mg/L		

Serial ID: UI191218-13
Name: ICP-MS ICSAB Master C
Type: Source Material
Employee: Paul Boyd
Supplier: 02SI
Description: ICPMS ICSAB Master C
Comments: None

Open/Reference Date: 18-DEC-19
Received: 18-DEC-19
Expires: 18-DEC-20

Amount : 250 mL
Catalog Number : 160033-03-02
Lot Number : 10069799-10
Solvent : +/- 2.0% in 2% HNO3 + tr HF

Analyte	Concentration	Analyte	Concentration
Antimony	2 mg/L	Silver	2 mg/L
Tin	2 mg/L	Tungsten	2 mg/L
Zirconium	2 mg/L		

Serial ID: UI3001438-11
Name: ICP-MS ICSA Master A Nex
Type: Source Material
Employee: Paul Boyd
Supplier: 02SI
Description: ICP-MS ICSA Master A NEXION
Comments: None

Open/Reference Date: 02-NOV-19
Received: 02-NOV-19
Expires: 02-NOV-20

Amount : 1000 mL
Catalog Number : 60013-01-01LNexion
Lot Number : 10065549-13
Solvent : 5% HNO3 + Tr HF

Analyte	Concentration	Analyte	Concentration

Analyte	Concentration	Analyte	Concentration
Aluminum	1000 mg/L	Calcium	1000 mg/L
Carbon	2000 mg/L	Chloride	10000 mg/L
Iron	1000 mg/L	Magnesium	1000 mg/L
Molybdenum	20 mg/L	Phosphorous	1000 mg/L
Potassium	1000 mg/L	Sodium	1000 mg/L
Sulfur	1000 mg/L	Titanium	20 mg/L

Serial ID: UMS191203-01 **Open/Reference Date:** 03-DEC-19 **Amount :** 250 mL
Name: ICPMSCalSPIKEB **Received:** 03-DEC-19 **Catalog Number :** ZGEL-100-250
Type: Source Material **Expires:** 30-NOV-20 **Lot Number :** 8-124AB
Employee: Paul Boyd
Supplier: SPEX
Description: ICPMS Calibration Standard Solution B
Comments: None

Analyte	Concentration	Analyte	Concentration
Arsenic	10 mg/L	Barium	10 mg/L
Beryllium	10 mg/L	Boron	20 mg/L
Cadmium	10 mg/L	Chromium	10 mg/L
Cobalt	10 mg/L	Copper	10 mg/L
Lead	10 mg/L	Lithium	10 mg/L
Manganese	10 mg/L	Nickel	10 mg/L
Selenium	10 mg/L	Silver	10 mg/L
Strontium	10 mg/L	Thallium	10 mg/L
Thorium	10 mg/L	Uranium	10 mg/L
Vanadium	10 mg/L	Zinc	10 mg/L

Serial ID: UMS191203-02 **Open/Reference Date:** 03-DEC-19 **Catalog Number :** ZGEL-102-250
Name: ICPMSCalSPIKEA **Received:** 03-DEC-19 **Lot Number :** 8-126AB
Type: Source Material **Expires:** 30-NOV-20
Employee: Paul Boyd
Supplier: SPEX
Description: ICPMS Calibration Standard Solution A
Comments: None

Analyte	Concentration	Analyte	Concentration
Aluminum	1000 mg/L	Calcium	1000 mg/L
Iron	1000 mg/L	Magnesium	1000 mg/L
Phosphorous	1000 mg/L	Potassium	1000 mg/L
Sodium	1000 mg/L		

Standard Logbook

Serial ID: UMS191203-03 **Open/Reference Date:** 03-DEC-19 **Amount :** 250 ml
Name: ICPMSCalSPIKEC **Received:** 03-DEC-19 **Catalog Number :** ZGEL-101-250
Type: Source Material **Expires:** 30-NOV-20 **Lot Number :** 8-125AB
Employee: Paul Boyd
Supplier: SPEX
Description: ICPMS Calibration Standard Solution C
Comments: None

Analyte	Concentration	Analyte	Concentration
Antimony	10 mg/L	Molybdenum	10 mg/L
Tin	10 mg/L	Titanium	10 mg/L
Zirconium	10 mg/L		

Serial ID: WMS200131-04 **Open/Reference Date:** 31-JAN-20 **Amount :** 50 mL
Name: ICPMS Cal Standard 100 **Received:** 31-JAN-20 **Balance Id :** 4025216
Type: Working **Expires:** 01-FEB-20 **Pipet Id :** 3541598
Employee: Paul Boyd **Solvent :** 2%HNO3/1%HCl -3032237
Supplier: GEL
Description: ICPMS Calibration Standard (100 ppb)
Comments: None

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UI191112-03	Tungsten	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Arsenic	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Barium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Beryllium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Boron	20 mg/L	5 mL	500 mL	200 ug/l
UMS191203-01	Cadmium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Chromium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Cobalt	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Copper	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Lead	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Lithium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Manganese	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Nickel	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Selenium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Silver	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Strontium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Thallium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Thorium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Uranium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Vanadium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-01	Zinc	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-02	Aluminum	1000 mg/L	5 mL	500 mL	10000 ug/l
UMS191203-02	Calcium	1000 mg/L	5 mL	500 mL	10000 ug/l
UMS191203-02	Iron	1000 mg/L	5 mL	500 mL	10000 ug/l
UMS191203-02	Magnesium	1000 mg/L	5 mL	500 mL	10000 ug/l

Standard Logbook

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UMS191203-02	Phosphorous	1000 mg/L	5 mL	500 mL	10000 ug/l
UMS191203-02	Potassium	1000 mg/L	5 mL	500 mL	10000 ug/l
UMS191203-02	Sodium	1000 mg/L	5 mL	500 mL	10000 ug/l
UMS191203-03	Antimony	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-03	Molybdenum	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-03	Tin	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-03	Titanium	10 mg/L	5 mL	500 mL	100 ug/l
UMS191203-03	Zirconium	10 mg/L	5 mL	500 mL	100 ug/l

Serial ID: WMS200131-04A **Open/Reference Date:** 31-JAN-20 **Balance Id :** 4025216
Name: ICPMS Cal Standard 10 **Received:** 31-JAN-20 **Pipet Id :** 3541598
Type: Working **Expires:** 01-FEB-20 **Solvent :** 2%HNO3/1%HCl -3032237
Employee: Paul Boyd
Supplier: GEL
Description: ICPMS Calibration Standard (10 ppb)
Comments: None

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
WMS200131-04	Aluminum	10000 ug/l	50 mL	500 mL	1000 ug/l
WMS200131-04	Antimony	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Arsenic	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Barium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Beryllium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Boron	200 ug/l	50 mL	500 mL	20 ug/l
WMS200131-04	Cadmium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Calcium	10000 ug/l	50 mL	500 mL	1000 ug/l
WMS200131-04	Chromium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Cobalt	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Copper	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Iron	10000 ug/l	50 mL	500 mL	1000 ug/l
WMS200131-04	Lead	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Lithium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Magnesium	10000 ug/l	50 mL	500 mL	1000 ug/l
WMS200131-04	Manganese	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Molybdenum	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Nickel	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Phosphorous	10000 ug/l	50 mL	500 mL	1000 ug/l
WMS200131-04	Potassium	10000 ug/l	50 mL	500 mL	1000 ug/l
WMS200131-04	Selenium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Silver	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Sodium	10000 ug/l	50 mL	500 mL	1000 ug/l
WMS200131-04	Strontium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Thallium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Thorium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Tin	100 ug/l	50 mL	500 mL	10 ug/l

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
WMS200131-04	Titanium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Tungsten	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Uranium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Vanadium	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Zinc	100 ug/l	50 mL	500 mL	10 ug/l
WMS200131-04	Zirconium	100 ug/l	50 mL	500 mL	10 ug/l

Serial ID: WMS200131-05 **Open/Reference Date:** 31-JAN-20 **Balance Id :** BAL216
Name: ICPMS ICV **Received:** 31-JAN-20 **Pipet Id :** 3541598
Type: Working **Expires:** 01-FEB-20 **Solvent :** 2%HNO3/1%HCl -3032237
Employee: Paul Boyd
Supplier: GEL
Description: ICPMS ICV
Comments: None

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UI191102-07	Arsenic	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Barium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Beryllium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Boron	40 mg/L	2.5 mL	1000 mL	100 ug/L
UI191102-07	Cadmium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Chromium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Cobalt	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Copper	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Lead	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Lithium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Manganese	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Nickel	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Selenium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Strontium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Thallium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Thorium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Uranium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Vanadium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-07	Zinc	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191102-09	Aluminum	2020 mg/L	2.5 mL	1000 mL	5050 ug/L
UI191102-09	Calcium	2000 mg/L	2.5 mL	1000 mL	5000 ug/L
UI191102-09	Iron	2000 mg/L	2.5 mL	1000 mL	5000 ug/L
UI191102-09	Magnesium	2000 mg/L	2.5 mL	1000 mL	5000 ug/L
UI191102-09	Phosphorous	2000 mg/L	2.5 mL	1000 mL	5000 ug/L
UI191102-09	Potassium	2000 mg/L	2.5 mL	1000 mL	5000 ug/L
UI191102-09	Sodium	2000 mg/L	2.5 mL	1000 mL	5000 ug/L
UI191204-08	Antimony	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191204-08	Molybdenum	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191204-08	Silver	20 mg/L	2.5 mL	1000 mL	50 ug/L

Standard Logbook

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UI191204-08	Tin	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191204-08	Titanium	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191204-08	Tungsten	20 mg/L	2.5 mL	1000 mL	50 ug/L
UI191204-08	Zirconium	20 mg/L	2.5 mL	1000 mL	50 ug/L

Serial ID: WMS200131-06 **Open/Reference Date:** 31-JAN-20 **Balance Id :** BAL216
Name: ICPMS CRDL **Received:** 31-JAN-20 **Pipet Id :** 3820544
Type: Working **Expires:** 01-FEB-20 **Solvent :** 2%HNO3/1%HCl - 3032237
Employee: Paul Boyd
Supplier: GEL
Description: ICPMS CRDL
Comments: None

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UI190415-09	Aluminum	50 mg/L	.5 mL	500 mL	50 ug/L
UI190415-09	Arsenic	5 mg/L	.5 mL	500 mL	5 ug/L
UI190415-09	Barium	4 mg/L	.5 mL	500 mL	4 ug/L
UI190415-09	Beryllium	.5 mg/L	.5 mL	500 mL	.5 ug/L
UI190415-09	Boron	15 mg/L	.5 mL	500 mL	15 ug/L
UI190415-09	Cadmium	1 mg/L	.5 mL	500 mL	1 ug/L
UI190415-09	Calcium	200 mg/L	.5 mL	500 mL	200 ug/L
UI190415-09	Chromium	30 mg/L	.5 mL	500 mL	10 ug/L
UI190415-09	Cobalt	1 mg/L	.5 mL	500 mL	1 ug/L
UI190415-09	Copper	2 mg/L	.5 mL	500 mL	2 ug/L
UI190415-09	Iron	100 mg/L	.5 mL	500 mL	100 ug/L
UI190415-09	Lead	2 mg/L	.5 mL	500 mL	2 ug/L
UI190415-09	Lithium	10 mg/L	.5 mL	500 mL	10 ug/L
UI190415-09	Magnesium	30 mg/L	.5 mL	500 mL	30 ug/L
UI190415-09	Manganese	5 mg/L	.5 mL	500 mL	5 ug/L
UI190415-09	Nickel	2 mg/L	.5 mL	500 mL	2 ug/L
UI190415-09	Phosphorous	50 mg/L	.5 mL	500 mL	50 ug/L
UI190415-09	Potassium	300 mg/L	.5 mL	500 mL	300 ug/L
UI190415-09	Selenium	5 mg/L	.5 mL	500 mL	5 ug/L
UI190415-09	Sodium	250 mg/L	.5 mL	500 mL	250 ug/L
UI190415-09	Strontium	10 mg/L	.5 mL	500 mL	10 ug/L
UI190415-09	Thallium	2 mg/L	.5 mL	500 mL	2 ug/L
UI190415-09	Thorium	2 mg/L	.5 mL	500 mL	2 ug/L
UI190415-09	Uranium	.2 mg/L	.5 mL	500 mL	.2 ug/L
UI190415-09	Vanadium	20 mg/L	.5 mL	500 mL	20 ug/L
UI190415-09	Zinc	20 mg/L	.5 mL	500 mL	20 ug/L
UI190415-10	Antimony	3 mg/L	.5 mL	500 mL	3 ug/L
UI190415-10	Molybdenum	1 mg/L	.5 mL	500 mL	1 ug/L
UI190415-10	Silver	1 mg/L	.5 mL	500 mL	1 ug/L
UI190415-10	Tin	5 mg/L	.5 mL	500 mL	5 ug/L
UI190415-10	Titanium	10 mg/L	.5 mL	500 mL	10 ug/L

Standard Logbook

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UI190415-10	Tungsten	5 mg/L	.5 mL	500 mL	5 ug/L
UI190415-10	Zirconium	2 mg/L	.5 mL	500 mL	10 ug/L

Serial ID: WMS200131-20 **Open/Reference Date:** 31-JAN-20 **Balance Id :** BAL216
Name: ICPMS ICSA **Received:** 31-JAN-20 **Lot Number :** 1064482
Type: Working **Expires:** 01-FEB-20 **Pipet Id :** 3541598
Employee: Paul Boyd **Solvent :** 2%HNO3/1%HCl -3032237
Supplier: GEL
Description: ICPMS ICSA NexION
Comments: None

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UI3001438-11	Aluminum	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Calcium	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Carbon	2000 mg/L	25 mL	250 mL	200000 ug/L
UI3001438-11	Chloride	10000 mg/L	25 mL	250 mL	1000000 ug/L
UI3001438-11	Iron	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Magnesium	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Molybdenum	20 mg/L	25 mL	250 mL	2000 ug/L
UI3001438-11	Phosphorous	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Potassium	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Sodium	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Sulfur	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Titanium	20 mg/L	25 mL	250 mL	2000 ug/L

Serial ID: WMS200131-21 **Open/Reference Date:** 31-JAN-20 **Balance Id :** BAL216
Name: ICPMS ICSAB **Received:** 31-JAN-20 **Pipet Id :** 1758088
Type: Working **Expires:** 01-FEB-20 **Solvent :** 2%HNO3/1%HCl -3032237
Employee: Paul Boyd
Supplier: GEL
Description: ICPMS ICSAB NexION
Comments: None

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UI191218-12	Arsenic	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Barium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Beryllium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Boron	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Cadmium	2 mg/L	2.5 mL	250 mL	20.804 ug/L
UI191218-12	Chromium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Cobalt	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Copper	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Lead	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Lithium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Manganese	2 mg/L	2.5 mL	250 mL	26.141 ug/L

Standard Logbook

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
UI191218-12	Nickel	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Selenium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Strontium	2 mg/L	2.5 mL	250 mL	23.162 ug/L
UI191218-12	Thallium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Thorium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Uranium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Vanadium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-12	Zinc	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-13	Antimony	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-13	Silver	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-13	Tin	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-13	Tungsten	2 mg/L	2.5 mL	250 mL	20 ug/L
UI191218-13	Zirconium	2 mg/L	2.5 mL	250 mL	20 ug/L
UI3001438-11	Aluminum	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Calcium	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Carbon	2000 mg/L	25 mL	250 mL	200000 ug/L
UI3001438-11	Chloride	10000 mg/L	25 mL	250 mL	1000000 ug/L
UI3001438-11	Iron	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Magnesium	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Molybdenum	20 mg/L	25 mL	250 mL	2000 ug/L
UI3001438-11	Phosphorous	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Potassium	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Sodium	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Sulfur	1000 mg/L	25 mL	250 mL	100000 ug/L
UI3001438-11	Titanium	20 mg/L	25 mL	250 mL	2000 ug/L

Serial ID: 191217 **Open/Reference Date:** 30-DEC-19 **Lot Number :** 2019092697
Name: I-HCL **Received:** 17-DEC-19
Type: Reagent/Solvent **Expires:** 17-DEC-21
Employee: Edmund Frampton
Supplier: VWR
Description: HYDROCHLORIC ACID
Comments: None

Serial ID: 200120 **Open/Reference Date:** 20-JAN-20 **Lot Number :** 2019111458
Name: I-HCL **Received:** 20-JAN-20
Type: Reagent/Solvent **Expires:** 20-JAN-22
Employee: Edmund Frampton
Supplier: VWR
Description: HYDROCHLORIC ACID
Comments: None

Standard Logbook

Serial ID: 3000723 **Open/Reference Date:** **Lot Number :** 0000226537
Name: I-HNO3 **Received:** 31-OCT-19
Type: Reagent/Solvent **Expires:** 31-OCT-21
Employee: Edmund Frampton
Supplier: VWR - BDH Chemicals
Description: Concentrated Nitric Acid
Comments: None

Serial ID: 3011870 **Open/Reference Date:** 10-DEC-19 **Lot Number :** 2019100718
Name: I-HNO3 **Received:** 26-NOV-19
Type: Reagent/Solvent **Expires:** 26-NOV-21
Employee: Hannah Hatherly
Supplier: VWR - BDH Chemicals
Description: Concentrated Nitric Acid
Comments: None

Serial ID: 3032237 **Open/Reference Date:** 20-JAN-20 **Solvent :** Type I Water
Name: B-2%HNO3/1%HCl-ICPMS **Received:** 20-JAN-20
Type: Reagent/Solvent **Expires:** 03-FEB-20
Employee: Paul Boyd
Supplier: GEL
Description: 2%HNO3/1%HCl Solution (Type I Water)
Comments: None

Parent Material	Analyte	Parent Conc.	Aliquot	Final Vol.	Final Conc.
191217	I-HCL	36.5-38.0	80 mL	8 l	N/A
3000723	I-HNO3	68.0-70.0%	160 mL	8 l	N/A

Radiological Analysis

Case Narrative

Radiochemistry
Technical Case Narrative
EnergySolutions LLC
SDG #: EUI-11350
Work Order #: 502174

Product: **Alphaspec Th-228, 230, 232, Liquid**
Analytical Method: DOE EML HASL-300, Th-01-RC Modified
Analytical Procedure: GL-RAD-A-038 REV# 18
Analytical Batch: 1962978

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
502174001	I-1-700 011720-01
1204484437	Method Blank (MB)
1204484438	502174001(I-1-700 011720-01) Sample Duplicate (DUP)
1204484439	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Recounts
Samples 1204484438 (I-1-700 011720-01DUP) and 502174001 (I-1-700 011720-01) were given additional clean-up steps and recounted in order to remove suspected interferences. The recounts are reported.

Product: **Alphaspec U-233/234, 235/236, 238, Liquid**
Analytical Method: DOE EML HASL-300, U-02-RC Modified
Analytical Procedure: GL-RAD-A-011 REV# 27
Analytical Batch: 1962983

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
502174001	I-1-700 011720-01
1204484441	Method Blank (MB)
1204484442	502174001(I-1-700 011720-01) Sample Duplicate (DUP)
1204484443	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Duplication Criteria between QC Sample and Duplicate Sample
The Sample and the Duplicate, (See Below), did not meet the relative percent difference requirement; however, they do meet the relative error ratio requirement with the value listed below.

Sample	Analyte	Value
1204484442 (I-1-700 011720-01DUP)	Uranium-233/234	RPD 27.6* (0.00%-20.00%) RER 1.63 (0-3)

Product: **Gammaspec, Gamma, K-40**
Analytical Method: DOE EML HASL-300
Analytical Procedure: GL-RAD-A-013 REV# 27
Analytical Batch: 1962483

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
502174001	I-1-700 011720-01
1204483327	Method Blank (MB)
1204483328	502174001(I-1-700 011720-01) Sample Duplicate (DUP)
1204483329	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

Product: **GFPC Ra228, Liquid**
Analytical Method: EPA 904.0/SW846 9320 Modified
Analytical Procedure: GL-RAD-A-009 REV# 17
Analytical Batch: 1962818

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
502174001	I-1-700 011720-01

1204484083	Method Blank (MB)
1204484084	502174001(I-1-700 011720-01) Sample Duplicate (DUP)
1204484085	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

Product: **GFPC Gross A/B, Liquid**
Analytical Method: EPA 900.0/SW846 9310
Analytical Procedure: GL-RAD-A-001 REV# 20
Analytical Batch: 1962821

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
502174001	I-1-700 011720-01
1204484086	Method Blank (MB)
1204484087	502174001(I-1-700 011720-01) Sample Duplicate (DUP)
1204484088	502174001(I-1-700 011720-01) Matrix Spike (MS)
1204484089	502174001(I-1-700 011720-01) Matrix Spike Duplicate (MSD)
1204484090	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Preparation Information

Aliquot Reduced
aliquot volumes were reduced due to the sample matrix.

Quality Control (QC) Information

RDL Met
The blank (See Below) did not meet the detection limit due to keeping the blank volume consistent with the other sample aliquots.

Sample	Analyte	Value
1204484086 (MB)	ALPHA	Result -45.6 < MDA 86.3 > RDL 5 pCi/L
	BETA	Result -8.1 < MDA 151 > RDL 5 pCi/L

Samples (See Below) did not meet the required detection limits due to low sample volume. No more volume could be used due to not exceeding the maximum net weight limit of the calibration curve. The samples counted for 500 minutes.

Sample	Analyte	Value
1204484087 (I-1-700 011720-01DUP)	ALPHA	Result 142 < MDA 249 > RDL 5 pCi/L
502174001 (I-1-700 011720-01)	ALPHA	Result 91.5 < MDA 189 > RDL 5 pCi/L

Technical Information

Gross Alpha/Beta Preparation Information
High hygroscopic salt content in evaporated samples can cause the sample mass to fluctuate due to moisture absorption. To minimize this interference, the salts are converted to oxides by heating the sample under a flame until a dull red color is obtained. The conversion to oxides stabilizes the sample weight and ensures that proper alpha/beta efficiencies are assigned for each sample. Volatile radioisotopes of carbon, hydrogen, technetium, polonium and cesium may be lost during sample heating.

Product: **Lucas Cell, Ra226, Liquid**
Analytical Method: EPA 903.1 Modified
Analytical Procedure: GL-RAD-A-008 REV# 15
Analytical Batch: 1962720

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
502174001	I-1-700 011720-01
1204483826	Method Blank (MB)
1204483827	502174001(I-1-700 011720-01) Sample Duplicate (DUP)
1204483828	502174001(I-1-700 011720-01) Matrix Spike (MS)
1204483829	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Duplication Criteria between QC Sample and Duplicate Sample
The Sample and the Duplicate, (See Below), did not meet the relative percent difference requirement; however, they do meet the relative error ratio requirement with the value listed below.

Sample	Analyte	Value
1204483827 (I-1-700 011720-01DUP)	Radium-226	RPD 41.8* (0.00%-20.00%) RER 2.38 (0-3)

Technical Information

Recounts
Sample 1204483826 (MB) was recounted due to a suspected blank false positive. The recount is reported.

Miscellaneous Information

Additional Comments
The matrix spike, 1204483828 (I-1-700 011720-01MS), aliquot was reduced to conserve sample volume.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Qualifier Definition Report
for

CARE009 EnergySolutions LLC (693694)

Client SDG: EUI-11350 GEL Work Order: 502174

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria
** Analyte is a Tracer compound
U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this data report:

Signature: Heather M. McCarty **Name: Heather McCarty**

Date: 12 FEB 2020 **Title: Analyst II**

Sample Data Summary

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: February 11, 2020

Company :	EnergySolutions, LLC.
Address :	299 South Main Street, Suite 1700
	Salt Lake City, Utah 84111
Contact:	Mr. Jared Stark
Project:	EUI-11 Environmental Monitoring-Rad

Client Sample ID:	I-1-700 011720-01	Project:	CARE EUI-11
Sample ID:	502174001	Client ID:	CARE009
Matrix:	Water		
Collect Date:	16-JAN-20 15:14		
Receive Date:	24-JAN-20		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Th-228, 230, 232, Liquid "As Received"													
Thorium-228	U	0.136	+/-0.366	0.662	1.00	pCi/L			HAKB	02/03/20	0803	1962978	1
Thorium-230	U	0.228	+/-0.430	0.730	1.00	pCi/L							
Thorium-232	U	0.0370	+/-0.252	0.501	1.00	pCi/L							
Alphaspec U-233/234, 235/236, 238, Liquid "As Received"													
Uranium-233/234		13.6	+/-2.09	0.746	1.00	pCi/L			HAKB	01/28/20	1208	1962983	2
Uranium-235/236	U	0.153	+/-0.351	0.557	1.00	pCi/L							
Uranium-238		6.39	+/-1.43	0.451	1.00	pCi/L							
Rad Gamma Spec Analysis													
Gammaspec, Gamma, K-40 "As Received"													
Potassium-40		478	+/-96.3	61.2		pCi/L			RYH1	01/25/20	1716	1962483	3
Rad Gas Flow Proportional Counting													
GFPC Gross A/B, Liquid "As Received"													
Alpha	U	91.5	+/-112	189	5.00	pCi/L			JXC9	02/05/20	1906	1962821	4
Beta		495	+/-157	248	5.00	pCi/L							
GFPC Ra228, Liquid "As Received"													
Radium-228		8.14	+/-1.80	1.78	3.00	pCi/L			JXK3	02/05/20	0940	1962818	5
Rad Radium-226													
Lucas Cell, Ra226, Liquid "As Received"													
Radium-226		2.71	+/-0.559	0.312	1.00	pCi/L			MXH8	02/10/20	1212	1962720	6

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Th-01-RC Modified	
2	DOE EML HASL-300, U-02-RC Modified	
3	DOE EML HASL-300	
4	EPA 900.0/SW846 9310	
5	EPA 904.0/SW846 9320 Modified	
6	EPA 903.1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Thorium-229 Tracer	Alphaspec Th-228, 230, 232, Liquid "As Received"			59.9	(15%-125%)
Uranium-232 Tracer	Alphaspec U-233/234, 235/236, 238, Liquid "As Received"			86.9	(15%-125%)
Barium-133 Tracer	GFPC Ra228, Liquid "As Received"			69.6	(15%-125%)

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: February 11, 2020

Company :	EnergySolutions, LLC.
Address :	299 South Main Street, Suite 1700
	Salt Lake City, Utah 84111
Contact:	Mr. Jared Stark
Project:	EUI-11 Environmental Monitoring-Rad

Client Sample ID:	I-1-700 011720-01	Project:	CARE EUI-11
Sample ID:	502174001	Client ID:	CARE009

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

Quality Control Summary

GEL LABORATORIES LLC

2040 Savage Road Charleston, SC 29407 - (843) 556-8171 - www.gel.com

QC Summary

Report Date: February 11, 2020

EnergySolutions, LLC.
299 South Main Street, Suite 1700
Salt Lake City, Utah

Contact: Mr. Jared Stark

Workorder: 502174

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Rad Alpha Spec										
Batch 1962978										
QC1204484438 502174001 DUP										
Thorium-228	U	0.136	U	0.153	pCi/L	N/A		N/A	HAKB	02/03/20 08:03
	Uncertainty	+/-0.366		+/-0.354						
Thorium-230	U	0.228	U	0.535	pCi/L	N/A		N/A		
	Uncertainty	+/-0.430		+/-0.504						
Thorium-232	U	0.0370	U	0.0561	pCi/L	N/A		N/A		
	Uncertainty	+/-0.252		+/-0.242						
QC1204484439 LCS										
Thorium-228				21.5	pCi/L					01/29/20 12:49
	Uncertainty			+/-2.30						
Thorium-230				2.44	pCi/L			(75%-125%)		
	Uncertainty			+/-0.822						
Thorium-232	19.9			20.5	pCi/L		103	(75%-125%)		
	Uncertainty			+/-2.24						
QC1204484437 MB										
Thorium-228			U	0.137	pCi/L					01/29/20 12:49
	Uncertainty			+/-0.409						
Thorium-230			U	0.313	pCi/L					
	Uncertainty			+/-0.424						
Thorium-232			U	0.0827	pCi/L					
	Uncertainty			+/-0.311						
Batch 1962983										
QC1204484442 502174001 DUP										
Uranium-233/234		13.6		10.3	pCi/L	27.6*		(0%-20%)	HAKB	01/28/20 12:08
	Uncertainty	+/-2.09		+/-2.14						
Uranium-235/236	U	0.153	U	0.317	pCi/L	N/A		N/A		
	Uncertainty	+/-0.351		+/-0.560						
Uranium-238		6.39		5.67	pCi/L	11.9		(0%-20%)		
	Uncertainty	+/-1.43		+/-1.59						

QC Summary

Workorder: **502174**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Rad Alpha Spec										
Batch 1962983										
QC1204484443 LCS										
Uranium-233/234				26.2	pCi/L				HAKB	01/28/20 12:08
	Uncertainty			+/-4.36						
Uranium-235/236				2.09	pCi/L					
	Uncertainty			+/-1.52						
Uranium-238	27.3			28.3	pCi/L		104	(75%-125%)		
	Uncertainty			+/-4.55						
QC1204484441 MB										
Uranium-233/234			U	0.163	pCi/L					01/28/20 12:08
	Uncertainty			+/-0.346						
Uranium-235/236			U	-0.0206	pCi/L					
	Uncertainty			+/-0.178						
Uranium-238			U	-0.0833	pCi/L					
	Uncertainty			+/-0.158						
Rad Gamma Spec										
Batch 1962483										
QC1204483328 502174001 DUP										
Potassium-40		478		561	pCi/L	16		(0%-20%)	RYH1	01/26/20 06:20
	Uncertainty	+/-96.3		+/-89.9						
QC1204483329 LCS										
Americium-241	1.09E+05			1.20E+05	pCi/L		110	(75%-125%)		01/26/20 07:18
	Uncertainty			+/-4010						
Cesium-137	39600			40300	pCi/L		102	(75%-125%)		
	Uncertainty			+/-858						
Cobalt-60	27000			28200	pCi/L		104	(75%-125%)		
	Uncertainty			+/-855						
Potassium-40			U	300	pCi/L					
	Uncertainty			+/-478						
QC1204483327 MB										
Potassium-40			U	4.30	pCi/L					01/25/20 17:17
	Uncertainty			+/-47.9						

QC Summary

Workorder: **502174**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Rad Gas Flow										
Batch 1962818										
QC1204484084 502174001 DUP										
Radium-228		8.14		9.97	pCi/L	20.2		(0% - 100%)	JXK3	02/05/20 09:40
	Uncertainty	+/-1.80		+/-2.23						
QC1204484085 LCS										
Radium-228	58.9			57.8	pCi/L		98.1	(75%-125%)		02/05/20 09:40
	Uncertainty			+/-3.86						
QC1204484083 MB										
Radium-228			U	0.186	pCi/L					02/05/20 09:40
	Uncertainty			+/-0.658						
Batch 1962821										
QC1204484087 502174001 DUP										
Alpha	U	91.5	U	142	pCi/L	N/A		N/A	JXC9	02/05/20 19:07
	Uncertainty	+/-112		+/-150						
Beta		495		472	pCi/L	4.94		(0% - 100%)		
	Uncertainty	+/-157		+/-128						
QC1204484090 LCS										
Alpha	12500			11700	pCi/L		93.5	(75%-125%)		02/05/20 17:10
	Uncertainty			+/-1160						
Beta	45000			48500	pCi/L		108	(75%-125%)		
	Uncertainty			+/-1700						
QC1204484086 MB										
Alpha			U	-45.6	pCi/L					02/05/20 19:07
	Uncertainty			+/-37.8						
Beta			U	-8.10	pCi/L					
	Uncertainty			+/-86.6						
QC1204484088 502174001 MS										
Alpha	12500 U	91.5		9470	pCi/L		75.6	(75%-125%)		02/05/20 17:10
	Uncertainty	+/-112		+/-1820						
Beta	45000	495		47400	pCi/L		104	(75%-125%)		
	Uncertainty	+/-157		+/-1760						
QC1204484089 502174001 MSD										
Alpha	12500 U	91.5		9980	pCi/L	5.21	79.6	(0%-20%)		02/05/20 17:10
	Uncertainty	+/-112		+/-1880						
Beta	45000	495		46300	pCi/L	2.19	102	(0%-20%)		
	Uncertainty	+/-157		+/-1730						

QC Summary

Workorder: **502174**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Rad Ra-226											
Batch 1962720											
QC1204483827 502174001 DUP											
Radium-226		2.71		4.14	pCi/L	41.8*		(0%-20%)	MXH8	02/10/20	12:12
	Uncertainty	+/-0.559		+/-0.689							
QC1204483829 LCS											
Radium-226	27.1			27.9	pCi/L		103	(75%-125%)		02/10/20	12:43
	Uncertainty			+/-1.72							
QC1204483826 MB											
Radium-226			U	0.180	pCi/L					02/10/20	13:44
	Uncertainty			+/-0.167							
QC1204483828 502174001 MS											
Radium-226	135	2.71		130	pCi/L		94.1	(75%-125%)		02/10/20	12:12
	Uncertainty	+/-0.559		+/-9.77							

Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

The Qualifiers in this report are defined as follows:

- ** Analyte is a Tracer compound
- < Result is less than value reported
- > Result is greater than value reported
- BD Results are either below the MDC or tracer recovery is low
- FA Failed analysis.
- H Analytical holding time was exceeded
- J See case narrative for an explanation
- J Value is estimated
- K Analyte present. Reported value may be biased high. Actual value is expected to be lower.
- L Analyte present. Reported value may be biased low. Actual value is expected to be higher.
- M M if above MDC and less than LLD
- M REMP Result > MDC/CL and < RDL
- N/A RPD or %Recovery limits do not apply.
- N1 See case narrative
- ND Analyte concentration is not detected above the detection limit
- NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
- R Sample results are rejected
- U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
- UI Gamma Spectroscopy--Uncertain identification

QC Summary

Workorder: **502174**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

UJ	Gamma Spectroscopy--Uncertain identification
UL	Not considered detected. The associated number is the reported concentration, which may be inaccurate due to a low bias.
X	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
Y	Other specific qualifiers were required to properly define the results. Consult case narrative.
^	RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.
h	Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

American West
ANALYTICAL LABORATORIES

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Bob Sobocinski
EnergySolutions
423 West 300 South, Suite 200
Salt Lake City, UT 84101

RE: Basal Aquifer Invest. / LARW / 76115

Dear Bob Sobocinski: Lab Set ID: 2001375

American West Analytical Laboratories received sample(s) on 1/16/2020 for the analyses presented in the following report.

American West Analytical Laboratories (AWAL) is accredited by The National Environmental Laboratory Accreditation Program (NELAP) in Utah and Texas; and is state accredited in Colorado, Idaho, New Mexico, Wyoming, and Missouri.

All analyses were performed in accordance to the NELAP protocols unless noted otherwise. Accreditation scope documents are available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

Thank You,

Approved by: Jose G. Rocha
Digitally signed by Jose G. Rocha
DN: cn=Jose G. Rocha, o=American West Analytical Laboratories, ou=UT00031, email=jose@awal-labs.com, c=US
Date: 2020.02.04 15:16:09 -07'00'

Laboratory Director or designee

All analyses applicable to the CWA, SDWA, and RCRA are performed in accordance to NELAC protocols. Pertinent sampling information is located on the attached COC. Confidential Business Information: This report is provided for the exclusive use of the addressee. Privileges of subsequent use of the name of this company or any member of its staff, or reproduction of this report in connection with the advertisement, promotion or sale of any product or process, or in connection with the re-publication of this report for any purpose other than for the addressee will be granted only on contact. This company accepts no responsibility except for the due performance of inspection and/or analysis in good faith and according to the rules of the trade and of science.

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Inorganic Case Narrative

Client: EnergySolutions
Contact: Bob Sobocinski
Project: Basal Aquifer Invest. / LARW / 76115
Lab Set ID: 2001375

Sample Receipt Information:

Date of Receipt: 1/16/2020
Date of Collection: 1/16/2020
Sample Condition: Intact
C-O-C Discrepancies: None

Holding Time and Preservation Requirements: The analysis and preparation of all samples were performed within the method holding times. All samples were properly preserved.

Preparation Requirements: The samples were analyzed following the methods stated on the analytical reports.

Analytical QC Requirements: All instrument calibration requirements were met. All calibration checks were within control limits.

Batch QC Requirements: MB, LCS, MS, MSD, RPD, DUP:

Method Blank (MB): No target analytes were above the reporting limit, indicating that the procedure was free from contamination.

Laboratory Control Sample (LCS): The LCS results were within the control limits. This indicates that the method is in control.

Matrix Spike / Matrix Spike Duplicate (MS/MSD): All percent recoveries and RPDs (Relative Percent Differences) were inside established limits, with the following exceptions:

Sample ID	Analyte	QC	Explanation
2001375-001A	Calcium	MS/MSD	High analyte concentration
2001375-001A	Magnesium	MSD	High analyte concentration
2001375-001A	Potassium	MS/MSD	High analyte concentration
2001375-001A	Sodium	MS/MSD	High analyte concentration
2001375-001C	Ammonia	MS/MSD	Sample matrix interference

Duplicate (DUP): The parameters that require a duplicate analysis had RPDs inside the control limits.

Corrective Action: None required.

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INORGANIC ANALYTICAL REPORT

Client: EnergySolutions **Contact:** Bob Sobocinski
Project: Basal Aquifer Invest. / LARW / 76115
Lab Sample ID: 2001375-001
Client Sample ID: I-1-700
Collection Date: 1/16/2020 1514h
Received Date: 1/16/2020 1733h

Analytical Results DISSOLVED METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Calcium	mg/L	1/17/2020 1128h	1/31/2020 1644h	SW6010D	50.0	**773**	[2]
Iron	mg/L	2/3/2020 1053h	2/3/2020 1828h	SW6010D	0.100	**0.685**	
Magnesium	mg/L	1/17/2020 1128h	1/31/2020 1644h	SW6010D	50.0	**794**	[2]
Potassium	mg/L	1/17/2020 1128h	1/31/2020 1644h	SW6010D	50.0	**507**	[2]
Sodium	mg/L	1/17/2020 1128h	1/31/2020 1627h	SW6010D	1,000	**23,200**	[2]

[2] - *Analyte concentration is too high for accurate matrix spike recovery and/or RPD.*

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

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INORGANIC ANALYTICAL REPORT

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: EnergySolutions **Contact:** Bob Sobocinski
Project: Basal Aquifer Invest. / LARW / 76115
Lab Sample ID: 2001375-001
Client Sample ID: I-1-700
Collection Date: 1/16/2020 1514h
Received Date: 1/16/2020 1733h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Ammonia (as N)	mg/L	1/22/2020 825h	1/22/2020 1358h	E350.1	0.0500	**0.189**	[1]
Bicarbonate (as CaCO3)	mg/L		1/20/2020 526h	SM2320B	10.0	**180**	
Bromide	mg/L		1/24/2020 851h	E300.0	10.0	**10.5**	
Carbonate (as CaCO3)	mg/L		1/20/2020 526h	SM2320B	10.0	< 10.0	
Chloride	mg/L		1/27/2020 855h	SM4500-Cl-E	5,000	**42,100**	
Conductivity	µmhos/cm		1/17/2020 521h	SM2510B	2.00	**111,000**	
Ion Balance	%		1/31/2020 1704h	Calc.	-100	**-5.30**	
Nitrate/Nitrite (as N)	mg/L		1/23/2020 1033h	E353.2	0.100	**0.134**	
pH @ 25° C	pH Units		1/16/2020 2004h	SM4500-H+B	1.00	**7.04**	
Sulfate	mg/L		1/17/2020 649h	SM4500-SO4-E	500	**2,890**	
Total Dissolved Solids	mg/L		1/17/2020 1140h	SM2540C	500	**65,400**	

[1] - *Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.*

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Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: ME
QC Type: LCS

Analyte		Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID:	**LCS-67528**	Date Analyzed:	01/31/2020 1610h											
Test Code:	6010D-DIS	Date Prepared:	01/17/2020 1128h											
Calcium		10.2	mg/L	SW6010D	0.146	1.00	10.00	0	102	80 - 120				
Magnesium		10.3	mg/L	SW6010D	0.0876	1.00	10.00	0	103	80 - 120				
Potassium		10.5	mg/L	SW6010D	0.194	1.00	10.00	0	105	80 - 120				
Sodium		10.5	mg/L	SW6010D	0.154	1.00	10.00	0	105	80 - 120				
Lab Sample ID:	**LCS-67868**	Date Analyzed:	02/03/2020 1825h											
Test Code:	6010D-DIS	Date Prepared:	02/03/2020 1053h											
Iron		1.07	mg/L	SW6010D	0.0961	0.100	1.000	0	107	80 - 120				

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: ME
QC Type: MBLK

Analyte		Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID:	**MB-67528**	Date Analyzed:	01/31/2020 1607h											
Test Code:	6010D-DIS	Date Prepared:	01/17/2020 1128h											
Calcium		< 1.00	mg/L	SW6010D	0.146	1.00								
Magnesium		< 1.00	mg/L	SW6010D	0.0876	1.00								
Potassium		< 1.00	mg/L	SW6010D	0.194	1.00								
Sodium		< 1.00	mg/L	SW6010D	0.154	1.00								
Lab Sample ID:	**MB-67868**	Date Analyzed:	02/03/2020 1822h											
Test Code:	6010D-DIS	Date Prepared:	02/03/2020 1053h											
Iron		< 0.100	mg/L	SW6010D	0.0961	0.100								

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: ME
QC Type: MS

Analyte		Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID:	**2001375-001AMS**	Date Analyzed:	01/31/2020 1630h											
Test Code:	6010D-DIS	Date Prepared:	01/17/2020 1128h											
Sodium		22,700	mg/L	SW6010D	154	1,000	10.00	23200	-4,620	75 - 125				[2]
Lab Sample ID:	**2001375-001AMS**	Date Analyzed:	01/31/2020 1653h											
Test Code:	6010D-DIS	Date Prepared:	01/17/2020 1128h											
Calcium		791	mg/L	SW6010D	7.30	50.0	10.00	773	171	75 - 125				[2]
Magnesium		804	mg/L	SW6010D	4.38	50.0	10.00	794	104	75 - 125				
Potassium		542	mg/L	SW6010D	9.70	50.0	10.00	507	356	75 - 125				[2]
Lab Sample ID:	**2001375-001AMS**	Date Analyzed:	02/03/2020 1836h											
Test Code:	6010D-DIS	Date Prepared:	02/03/2020 1053h											
Iron		1.53	mg/L	SW6010D	0.0961	0.100	1.000	0.685	84.8	75 - 125				

[2] - *Analyte concentration is too high for accurate matrix spike recovery and/or RPD.*

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Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: ME
QC Type: MSD

Analyte		Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID:	**2001375-001AMSD**	Date Analyzed:	01/31/2020 1633h											
Test Code:	6010D-DIS	Date Prepared:	01/17/2020 1128h											
Sodium		22,900	mg/L	SW6010D	154	1,000	10.00	23200	-3,290	75 - 125	22700	0.581	20	[2]
Lab Sample ID:	**2001375-001AMSD**	Date Analyzed:	01/31/2020 1656h											
Test Code:	6010D-DIS	Date Prepared:	01/17/2020 1128h											
Calcium		776	mg/L	SW6010D	7.30	50.0	10.00	773	22.9	75 - 125	791	1.89	20	[2]
Magnesium		789	mg/L	SW6010D	4.38	50.0	10.00	794	-53.0	75 - 125	804	1.97	20	[2]
Potassium		536	mg/L	SW6010D	9.70	50.0	10.00	507	290	75 - 125	542	1.22	20	[2]
Lab Sample ID:	**2001375-001AMSD**	Date Analyzed:	02/03/2020 1839h											
Test Code:	6010D-DIS	Date Prepared:	02/03/2020 1053h											
Iron		1.60	mg/L	SW6010D	0.0961	0.100	1.000	0.685	91.4	75 - 125	1.53	4.21	20	

[2] - *Analyte concentration is too high for accurate matrix spike recovery and/or RPD.*

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QA Officer

QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: WC
QC Type: DUP

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: 2001375-001BDUP Date Analyzed: 01/17/2020 521h Test Code: COND-W-2510B													
Conductivity	111,000	µmhos/cm	SM2510B	0.500	2.00					111000	0.0901	5	
Lab Sample ID: 2001375-001BDUP Date Analyzed: 01/16/2020 2004h Test Code: PH-4500H+B													
pH @ 25° C	7.06	pH Units	SM4500-H+B	1.00	1.00					7.04	0.284	5	
Lab Sample ID: 2001375-001BDUP Date Analyzed: 01/17/2020 1140h Test Code: TDS-W-2540C													
Total Dissolved Solids	67,900	mg/L	SM2540C	400	500					65400	3.75	5	

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Jose Rocha
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QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: WC
QC Type: LCS

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: LCS-R134947 Date Analyzed: 01/23/2020 1404h Test Code: 300.0-W													
Bromide	5.22	mg/L	E300.0	0.138	0.500	5.000	0	104	90 - 110				
Lab Sample ID: LCS-R134733 Date Analyzed: 01/20/2020 526h Test Code: ALK-W-2320B													
Alkalinity (as CaCO3)	245	mg/L	SM2320B	1.32	10.0	250.0	0	98.0	90 - 110				
Lab Sample ID: LCS-R135024 Date Analyzed: 01/27/2020 853h Test Code: CL-W-4500CLE													
Chloride	9.80	mg/L	SM4500-Cl-E	1.06	5.00	10.00	0	98.0	90 - 110				
Lab Sample ID: LCS-R134656 Date Analyzed: 01/17/2020 521h Test Code: COND-W-2510B													
Conductivity	996	µmhos/cm	SM2510B	0.500	2.00	1,000	0	99.6	98 - 102				
Lab Sample ID: LCS-67627 Date Analyzed: 01/22/2020 1318h Test Code: NH3-W-350.1 Date Prepared: 01/22/2020 825h													
Ammonia (as N)	9.11	mg/L	E350.1	0.0492	0.0500	10.00	0	91.1	90 - 110				
Lab Sample ID: LCS-R134902 Date Analyzed: 01/23/2020 1031h Test Code: NO2/NO3-W-353.2													
Nitrate/Nitrite (as N)	1.02	mg/L	E353.2	0.00494	0.0100	1.000	0	102	90 - 110				
Lab Sample ID: LCS-R134652 Date Analyzed: 01/16/2020 2004h Test Code: PH-4500H+B													
pH @ 25° C	9.02	pH Units	SM4500-H+B	1.00	1.00	9.000	0	100	98 - 102				
Lab Sample ID: LCS-R134661 Date Analyzed: 01/17/2020 649h Test Code: SO4-W-4500SO4E													
Sulfate	971	mg/L	SM4500-SO4-E	123	250	1,000	0	97.1	90 - 110				

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Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: WC
QC Type: LCS

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: LCS-R134764 Date Analyzed: 01/17/2020 1140h													
Test Code: TDS-W-2540C													
Total Dissolved Solids	188	mg/L	SM2540C	8.00	10.0	205.0	0	91.7	80 - 120				

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: WC
QC Type: LCSD

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: LCSD-R135024	Date Analyzed:	01/27/2020 854h											
Test Code: CL-W-4500CLE													
Chloride	9.67	mg/L	SM4500-Cl-E	1.06	5.00	10.00	0	96.7	90 - 110	9.8	1.32	10	

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QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: WC
QC Type: MBLK

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: MB-R134947 Date Analyzed: 01/23/2020 1347h													
Test Code: 300.0-W													
Bromide	< 0.500	mg/L	E300.0	0.138	0.500								
Lab Sample ID: MB-R134733 Date Analyzed: 01/20/2020 526h													
Test Code: ALK-W-2320B													
Bicarbonate (as CaCO3)	< 10.0	mg/L	SM2320B	1.32	10.0								
Carbonate (as CaCO3)	< 10.0	mg/L	SM2320B	1.32	10.0								
Lab Sample ID: MB-R135024 Date Analyzed: 01/27/2020 852h													
Test Code: CL-W-4500CLE													
Chloride	< 5.00	mg/L	SM4500-Cl-E	1.06	5.00								
Lab Sample ID: MB-R134656 Date Analyzed: 01/17/2020 521h													
Test Code: COND-W-2510B													
Conductivity	< 2.00	µmhos/cm	SM2510B	0.500	2.00								
Lab Sample ID: MB-67627 Date Analyzed: 01/22/2020 1318h													
Test Code: NH3-W-350.1 Date Prepared: 01/22/2020 825h													
Ammonia (as N)	< 0.0500	mg/L	E350.1	0.0492	0.0500								
Lab Sample ID: MB-R134902 Date Analyzed: 01/23/2020 1030h													
Test Code: NO2/NO3-W-353.2													
Nitrate/Nitrite (as N)	< 0.0100	mg/L	E353.2	0.00494	0.0100								
Lab Sample ID: MB-R134661 Date Analyzed: 01/17/2020 649h													
Test Code: SO4-W-4500SO4E													
Sulfate	< 5.00	mg/L	SM4500-SO4-E	2.46	5.00								

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QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: WC
QC Type: MBLK

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: MB-R134764	Date Analyzed:	01/17/2020 1140h											
Test Code: TDS-W-2540C													
Total Dissolved Solids	< 10.0	mg/L	SM2540C	8.00	10.0								

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QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: WC
QC Type: MS

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: 2001375-001BMS Date Analyzed: 01/24/2020 911h Test Code: 300.0-W													
Bromide	114	mg/L	E300.0	2.76	10.0	100.0	10.5	103	90 - 110				
Lab Sample ID: 2001375-001BMS Date Analyzed: 01/20/2020 526h Test Code: ALK-W-2320B													
Alkalinity (as CaCO3)	280	mg/L	SM2320B	1.32	10.0	100.0	180	100	80 - 120				
Lab Sample ID: 2001375-001BMS Date Analyzed: 01/27/2020 927h Test Code: CL-W-4500CLE													
Chloride	52,500	mg/L	SM4500-Cl-E	1,060	5,000	10,000	42100	104	90 - 110				
Lab Sample ID: 2001375-001CMS Date Analyzed: 01/22/2020 1359h Test Code: NH3-W-350.1 Date Prepared: 01/22/2020 825h													
Ammonia (as N)	12.8	mg/L	E350.1	0.0492	0.0500	10.00	0.189	126	90 - 110				[1]
Lab Sample ID: 2001375-001CMS Date Analyzed: 01/23/2020 1035h Test Code: NO2/NO3-W-353.2													
Nitrate/Nitrite (as N)	10.5	mg/L	E353.2	0.0494	0.100	10.00	0.134	103	90 - 110				
Lab Sample ID: 2001375-001BMS Date Analyzed: 01/17/2020 649h Test Code: SO4-W-4500SO4E													
Sulfate	3,890	mg/L	SM4500-SO4-E	246	500	1,000	2890	99.5	80 - 120				

[1] - *Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.*

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QC SUMMARY REPORT

Client: EnergySolutions
Lab Set ID: 2001375
Project: Basal Aquifer Invest. / LARW / 76115

Contact: Bob Sobocinski
Dept: WC
QC Type: MSD

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: 2001375-001BMSD Date Analyzed: 01/24/2020 927h Test Code: 300.0-W													
Bromide	116	mg/L	E300.0	2.76	10.0	100.0	10.5	105	90 - 110	114	1.78	20	
Lab Sample ID: 2001375-001BMSD Date Analyzed: 01/20/2020 526h Test Code: ALK-W-2320B													
Alkalinity (as CaCO3)	284	mg/L	SM2320B	1.32	10.0	100.0	180	104	80 - 120	280	1.42	10	
Lab Sample ID: 2001375-001BMSD Date Analyzed: 01/27/2020 858h Test Code: CL-W-4500CLE													
Chloride	52,400	mg/L	SM4500-Cl-E	1,060	5,000	10,000	42100	103	90 - 110	52500	0.248	10	
Lab Sample ID: 2001375-001CMSD Date Analyzed: 01/22/2020 1359h Test Code: NH3-W-350.1 Date Prepared: 01/22/2020 825h													
Ammonia (as N)	12.0	mg/L	E350.1	0.0492	0.0500	10.00	0.189	118	90 - 110	12.8	6.45	10	[1]
Lab Sample ID: 2001375-001CMSD Date Analyzed: 01/23/2020 1036h Test Code: NO2/NO3-W-353.2													
Nitrate/Nitrite (as N)	10.5	mg/L	E353.2	0.0494	0.100	10.00	0.134	104	90 - 110	10.5	0.572	10	
Lab Sample ID: 2001375-001BMSD Date Analyzed: 01/17/2020 649h Test Code: SO4-W-4500SO4E													
Sulfate	3,870	mg/L	SM4500-SO4-E	246	500	1,000	2890	97.7	80 - 120	3890	0.485	10	

[1] - *Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.*

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American West Analytical Laboratories

Rpt Emailed: D
ECA100

WORK ORDER Summary

Work Order: **2001375**

Client: EnergySolutions
Due Date: 1/30/2020

Client ID: ENE050 **Contact:** Bob Sobocinski

Project: **Basal Aquifer Invest. / LARW / 76115** **QC Level:** III WO Type: Project

Comments: QC 3 - No Chromatograms; LARW, EDD. See Client required PQLs for 6020.; Include GWPL Summary with final report (if there are any analytes over the limits.);

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
2001375-001A	I-1-700	1/16/2020 1514h	1/16/2020 1733h	3005A-DIS-PR	Aqueous		DF - dis met/hg	1
				6010D-DIS *5 SEL Analytes: CA FE MG K NA*			DF - dis met/hg	
2001375-001B				300.0-W *1 SEL Analytes: BR*			DF - wc	
				ALK-W-2320B *2 SEL Analytes: ALKB ALKC*			DF - wc	
				CL-W-4500CLE			DF - wc	
				COND-W-2510B			DF - wc	
				IONBALANCE *1 SEL Analytes: BALANCE*			DF - wc	
				PH-4500H+B			DF - wc	
				SO4-W-4500SO4E			DF - wc	
				TDS-W-2540C			DF - wc	
2001375-001C				NH3-W-350.1			DF - nh3 / no2/no3	
				NH3-W-PR			DF - nh3 / no2/no3	
				NO2/NO3-W-353.2			DF - nh3 / no2/no3	

Printed: 01/16/20 17:44 LABORATORY CHECK: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ LUO ☐ HOK HOK HOK COC Emailed

ENERGYSOLUTIONS

CHAIN OF CUSTODY RECORD/LAB WORK REQUEST, Revision 0
CL-EV-PR-004 F1

76115
CL-EV-PR-004 F1

This is our standard LARW suite plus ammonium & NO2/NO3.

Chain of Custody Number 2001375
Cooler Number NA
Page 1 of 1
Air Bill No.

Event BASAL AQUIFER INVEST.

Laboratory ANAL

EnergySolutions
Phone (801) 649-2000 Fax (801) 413-5646
Contact: Robert Sobocinski
Please email reports to:
rwsobocinski@energysolutions.com ~~and amccandless@energysolutions.com~~

Project LARW 11e.(2) Mixed Waste (circle one)

Samplers Signatures J HILL / R SOBOCINSKI

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[a]	Sampling Technique[b]	Volatile Organic Compounds	Semi-Volatile Organic Compounds, Pesticides, Herbicides	Total PCBs, Dioxins/Furans	Dissolved Metals ~~or Total Metals Sb, As, Ba, Be, Cd, Cr, Cu, Fe, Pb, Hg, Mo, Ni, Se, Ag, Tl, V, Zn~~	Major Cation and Anions Br, Ca, Mg, K, Na, HCO_3, CO_3, Cl, ~~F, NO_2~~, NO_3-NO_2, SO_4 AND AMMONIUM	pH, SC, TDS, and ~~TSS~~ ION BALANCE	Cyanide, Sulfide	Carbon-14, Iodine-129, Tc-99, and Tritium	Gross β, Total U, Be-7, Cd-109, Co-60, Mn-54, K-40, Ra-226 & 228, Sr-90, Np-237, Th-230 & 232, Iso-U		
	NA	I-1-700	NA	1/16/20	1514	WG	SP	NA	NA	NA	X	X	X	NA	NA	NA	NA	NA
		NA		NA	NA	NA	NA				NA	NA	NA					

Analyses Requested

Laboratory Use Only

SAMPLES WERE:
1 Shipped or hand delivered
Notes:
2 Ambient or Chilled
Notes:
3 Temperature 3.5
4 Received Broken/Leaking (Improperly Sealed) Y N
Notes:
5 Properly Preserved Y N
Notes:
6 Received Within Holding Times Y N
Notes:

COC Tape Was:
1 Present on Outer Package Y N NA
2 Unbroken on Outer Package Y N NA
3 Present on Sample Y N NA
4 Unbroken on Sample Y N NA
Notes:

Discrepancies Between Sample Labels and COC Record? Y N
Notes:

a **Matrix:**
SO-Soil
SE-Sediment
WS-Surface Water
WG-Groundwater
LF-Product
AA-Air
SW-Wipe
EP/TCLP-Leachate
EQ-Trip Blank
Equipment Blanks
WW-Wastewater

b **Sampling Technique**
C-Composite
G-Grab
HA-Hand Auger
CN-Cone Penetrometer
BP-Bladder Pump
SP-Submersible Pump
B-Bailer

SPECIAL INSTRUCTIONS:
none

Relinquished by	Received by	Date	Time
Robert Sobocinski	Vaylmas	1/16/20	1733

Relinquished by	Received by	Time

Energy Solutions

LARW Analytes (3/2019)

Dissolved Metals:

Calcium
Iron
Magnesium
Potassium
Sodium

Inorganics:

Bromide
Bicarbonate
Carbonate
Chloride
Conductivity
Ion Balance
pH
Sulfate
TDS

Lab Set ID: 2001375

pH Lot #: 6179

Preservation Check Sheet

Sample Set Extension and pH

Analysis	Preservative	-001																	
Ammonia	pH <2 H_2SO_4	yes																	
COD	pH <2 H_2SO_4	↑																	
Cyanide	pH >12 NaOH																		
Metals	pH <2 HNO_3	yes																	
NO_2/NO_3	pH <2 H_2SO_4	yes																	
O & G	pH <2 HCL	↑																	
Phenols	pH <2 H_2SO_4																		
Sulfide	pH >9 NaOH, Zn Acetate																		
TKN	pH <2 H_2SO_4																		
T PO_4	pH <2 H_2SO_4																		
Cr VI+	pH >9 $(NH_4)_2SO_4$																		

Procedure:

1) Pour a small amount of sample in the sample lid
2) Pour sample from lid gently over wide range pH paper
3) **Do Not** dip the pH paper in the sample bottle or lid
4) If sample is not preserved, properly list its extension and receiving pH in the appropriate column above
5) Flag COC, notify client if requested
6) Place client conversation on COC
7) Samples may be adjusted

Frequency: All samples requiring preservation

* The sample required additional preservative upon receipt.

\+ The sample was received unpreserved.

▲ The sample was received unpreserved and therefore preserved upon receipt.

\# The sample pH was unadjustable to a pH < 2 due to the sample matrix.

• The sample pH was unadjustable to a pH > ____ due to the sample matrix interference.