Revised Groundwater Model Progress Report 01, Red Hill Bulk Fuel Storage Facility

JOINT BASE PEARL HARBOR-HICKAM, O‘AHU, HAWAI‘I

Administrative Order on Consent in the Matter of Red Hill Bulk Fuel Storage Facility, EPA Docket Number RCRA 7003-R9-2015-01 and DOH Docket Number 15-UST-EA-01, Attachment A, Statement of Work Section 6.2, Section 7.1.2, Section 7.2.2, and Section 7.3.2

July 1, 2022
Revision 00

Naval Facilities Engineering Systems Command

Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-17-D-1800, CTO N6274222F0106

~~For Red Hill AOC Party Use Only~~

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July 1, 2022
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ACRONYMS AND ABBREVIATIONS

3D	three-dimensional
AOC	Administrative Order on Consent
AOI	area of interest
bgs	below ground surface
CLN	Connected Linear Network
CSM	conceptual site model
DOH	Department of Health, State of Hawai‘i
DON; Navy	Department of the Navy, United States
EPA	Environmental Protection Agency, United States
EVS	Earth Volumetric Studio version 2022.4 (C Tech, Inc. www.ctech.com)
ft	foot/feet
GHB	general head boundary
GIK	Geologic Indicator Kriging
GWFM	groundwater flow model
IRR	Investigation and Remediation of Releases
LOI	local area of interest
msl	mean sea level
SME	subject matter expert
TPH	total petroleum hydrocarbon
WP	work plan

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1. Introduction

On March 25, 2020, the Navy submitted the Groundwater Flow Model (GWFM) Report to evaluate the flow of groundwater from beneath the Red Hill Storage Facility (the Facility), to address the goals and requirements of Statement of Work (SOW) Section 7.1 of the Administrative Order on Consent (AOC) In the Matter of Red Hill Bulk Fuel Storage Facility (EPA Docket No: 10 RCRA 7003-R9-2015-01; DOH Docket No: 15-UST-EA-01) (EPA Region 9 and DOH 2015). Among other things, the GWFM Report focused on the analysis of both the 2014 Tank 5 release and hypothetical future releases from the tank farm area, which was the focus of attention prior to November 2021. Also on March 25, 2020, the Navy submitted the related Investigation and Remediation of Releases (IRR) Report, to address the goals and requirements of AOC SOW Sections 6 and 7. (DON 2020) The GWFM Report used a multi-model approach to evaluate a variety of scenarios with the intention of bounding potential situations, with particular emphasis on the tank farm area.

Following submittal of the GWFM Report, several meetings were held among the Navy, Hawai'i Department of Health (DOH), and U.S. Environmental Protection Agency (EPA) (and other stakeholders in certain instances) to discuss various topics related to the GWFM and IRR Reports, including:

- Analytical testing
- Interpretation of total petroleum hydrocarbon (TPH) and other detections
- Water levels in the Red Hill area
- Soil vapor monitoring
- Petrophysical testing
- In-well and tracer testing
- Monitoring well network expansion and well design
- Comments on GWFM Report
- Geology
- Appropriate scale of Equivalent Porous Media approach
- May and November 2021 events
- Area of modeling interest
- Alternate methods to incorporate heterogeneity

On March 17, 2022, DOH and EPA formally transmitted a letter indicating the Regulators' "Disapproval of the Groundwater Flow Model Report" (EPA Region 9 and DOH 2022). The Regulators' letter contained 100 pages of commentary, including criticism of model conceptualization, construction, calibration, verification, and results; and some suggestions for future modeling efforts. The letter outlined eight key concerns, including: the need for improvements to the "detail and characteristics" of the "hydrostratigraphic units" underpinning the GWFM (key concern no. 1); the need to better represent "geologic heterogeneity" and other improvements to the "representations of the geologic system" (key concern no. 5); and the need to improve the models' "parameter ranges and other inputs" (key concern no. 7). Other portions of the Regulators' letter recommended one of the models (51e) as the best representation to use as a starting point, suggested revising the model layering and grid dimensions, and recommended focusing "near-term modeling efforts" within an area of interest (AOI) and in particular the Red Hill Ridge area. Based on these and related comments, the Navy understands that the geological conceptual site model (CSM) should be updated and the GWFM should be rebuilt with revised dimensions and parameters. Without extensive

changes, it is clear that the Regulators do not believe the Navy's provided GWFM fulfills the needs of the AOC.

To address these concerns, the Navy recommended a process and path forward in which the three Parties (the Navy, DOH, and EPA) and their technical subject matter experts (SMEs) could try to work together to develop a model or models that could suit the Parties' needs with sufficient detail to aid in site decision-making. During an early planning meeting held on May 8, 2022, the Navy presented the recommended modeling path forward and engaged the Parties' SMEs in evaluating and ranking the types of questions that modeling could potentially address, given the changed conditions that occurred in 2021, with particular focus on how the model can inform anticipated decision-making. Attachment 1 shows the Navy-proposed modeling process and ambitious schedule, which outlines a path in with the Parties could come together to agree upon technical modeling processes and parameters for each of four complicated modeling tasks related to: geological CSM development, groundwater flow modeling; vadose zone modeling; and contaminant fate and transport modeling. Attachment 2 summarizes the Party and SME discussions regarding some initial technical questions arising from the Regulators' letter, answers to which can help the Navy prepare an initial revised geological CSM and GWFM that the Parties could evaluate, revise, and hopefully come to agreement upon.

This Progress Report describes some of the progress that has been made since the Regulators' March 17. 2020 letter and indicates some of the next steps that the Navy recommends for developing a new model or models.

2. Revised Groundwater Flow Model Progress

Based on the feedback received from the Regulators and their SMEs, the Navy has begun to revise its geological CSM and perform some proof-of-concept analyses of potential GWFM improvements that may be implementable to address the concerns in the Regulators' letter.

2.1 GEOLOGICAL CSM UPDATES

The CSM, as described in the Navy's July 2018 CSM report (DON 2018b; 2019), is an evolving representation of the Red Hill area based on available data. As new data are obtained, the Red Hill CSM is meant to be refined and updated through an iterative process designed to promote collaboration between the Navy, regulatory agencies, and AOC SMEs. This iterative process was intended to ensure that the updated CSM adequately reflects current site-specific conditions and processes that affect groundwater flow and subsurface fate and transport processes.

The Navy initially generated a geological CSM using CTECH's Earth Volumetric Studio (EVS) software in 2018 and 2019. This model has since been significantly updated with additional information as described below.

2.1.1 Conceptual Site Model Features

The updated geological CSM encompasses both the vadose and the saturated zones and differentiates multiple soil and rock types, each with varying degrees of permeability: valley fill, saprolite, caprock, tuff, and basalt (pāhoehoe, massive a'ā, weathered a'ā clinker, unweathered a'ā clinker, and undifferentiated a'ā clinker in areas where historical references did not distinguish states of weathering). The 3D regional geologic model was developed to help visualize subsurface conditions and estimate the extent of geological materials, which forms a basis for the GWFM.

2.1.2 New Borings

Lithology from the following boring logs has been added to the CSM since the CSM report was first published in July 2018:

- RHMW01R
- RHMW12A
- RHMW14
- RHMW16
- RHMW19
- OWDFMW03A
- OWDFMW05A
- OWDFMW07A
- RHMW12
- RHMW13
- RHMW15
- RHMW16A
- OWDFMW02A
- OWDFMW04A
- OWDFMW06A
- OWDFMW08A

Boring logs from those basal aquifer wells completed since the IRR Report (which included boring logs completed up to its date of publication) are presented in Attachment 3.

Lithology from older boring logs in the Red Hill area were carried over from previous versions of the CSM and are included in this updated geological CSM. These older boring logs include:

- Borings from "Geology of the Red Hill Area" (Macdonald 1941)
- RHMW02 (DON 2005)
- RHMW04 (DON 2005)
- RHMW06 (DON 2015)
- RHMW08 (DON 2020)
- RHMW10 (DON 2020)
- Abandonment of Monitoring Well Summary Report (DON 2013)
- RHMW03 (DON 2005)
- RHMW05 (DON 2009)
- RHMW07 (DON 2015)
- RHMW09 (DON 2020)
- RHMW11 (DON 2020)

RHMW01 was not included because the log did not clearly differentiate the different types of basalt and more recent and more detailed information was available from nearby well RHMW01R.

2.1.3 Barrel Logs

Information from the "barrel logs" prepared during tank construction (DON 1943) was incorporated into the CSM. Attachment 4 presents the historical barrel logs. Although these logs are useful and describe the excavated surface of the cylindrical spaces mined for the tanks, there are limitations to the use of this information. The barrel logs provide relatively coarse descriptions of the subsurface materials; for example, while more recent boring logs distinguish between many types of basalt that can have drastically different transport properties (i.e., pāhoehoe, massive a'ā, weathered a'ā clinker, unweathered a'ā clinker), the barrel logs merely indicate that approximately 70% of the material was "rock" (leaving open the question whether a geologist was involved in the unattributed logging). Similarly, the barrel logs do not indicate whether "clinker" is weathered or unweathered, and this distinction can result in vastly different flow properties. Two of the logs indicate "loose rock," but do not explain how or whether that is distinguished from clinker, or whether the rock was loosened by the blasting out of the cavity. In addition, the relative percentage of the few material types described in the barrel logs are difficult to reconcile with the relative percentage of material types more carefully logged by geologists in area monitoring wells over recent decades. On the

other hand, the barrel logs, due mostly to the larger volumes they depict, do provide better indications of lava tubes in certain areas relatively far above the water table. Overall, the barrel logs provide some useful information over a larger volume, but unfortunately provide significantly less detail or precision than do the logs created by professional geologists from borings advanced at Red Hill in recent decades.

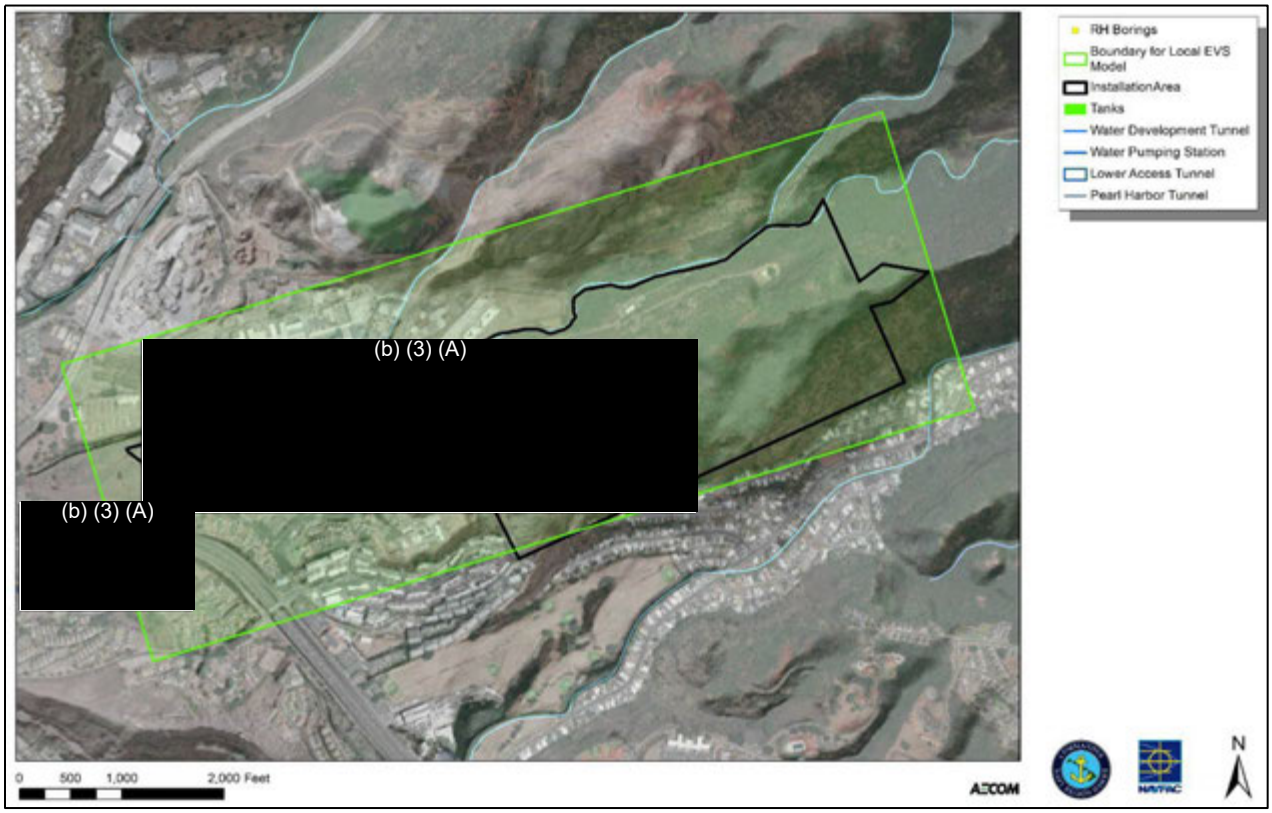
2.1.4 Seismic Study Results

The results of seismic surveys conducted in December 2018 were incorporated into the CSM. The surveys were conducted along nine transects in the Red Hill area to investigate stratigraphy and hydrogeologic boundaries beneath North Hālawa Valley, South Hālawa Valley, and Moanalua Valley (DON 2018a). Seismic survey results show the geometry and depth to key hydrostratigraphic boundaries within the upper 1,000 feet (ft) below ground surface (bgs). Key boundaries identified include the base of alluvium or top of saprolite, top of water-saturated (possibly perched) sediments, and the contact between saprolite and basalt. These lithologic boundaries were brought into the updated CSM.

2.1.5 Model Layering Refinement

The geological CSM is currently a local model that is being developed using the EVS software developed by CTech, Inc. The model is currently being developed within a rectangular area surrounding the Red Hill facilities and boundary (green area shown on Figure 1), based on boring log data from 55 locations. This potential "area of interest" (AOI) has been delineated in response to the regulators' letter and is offered as a starting point for consideration by the regulators and their SMEs.

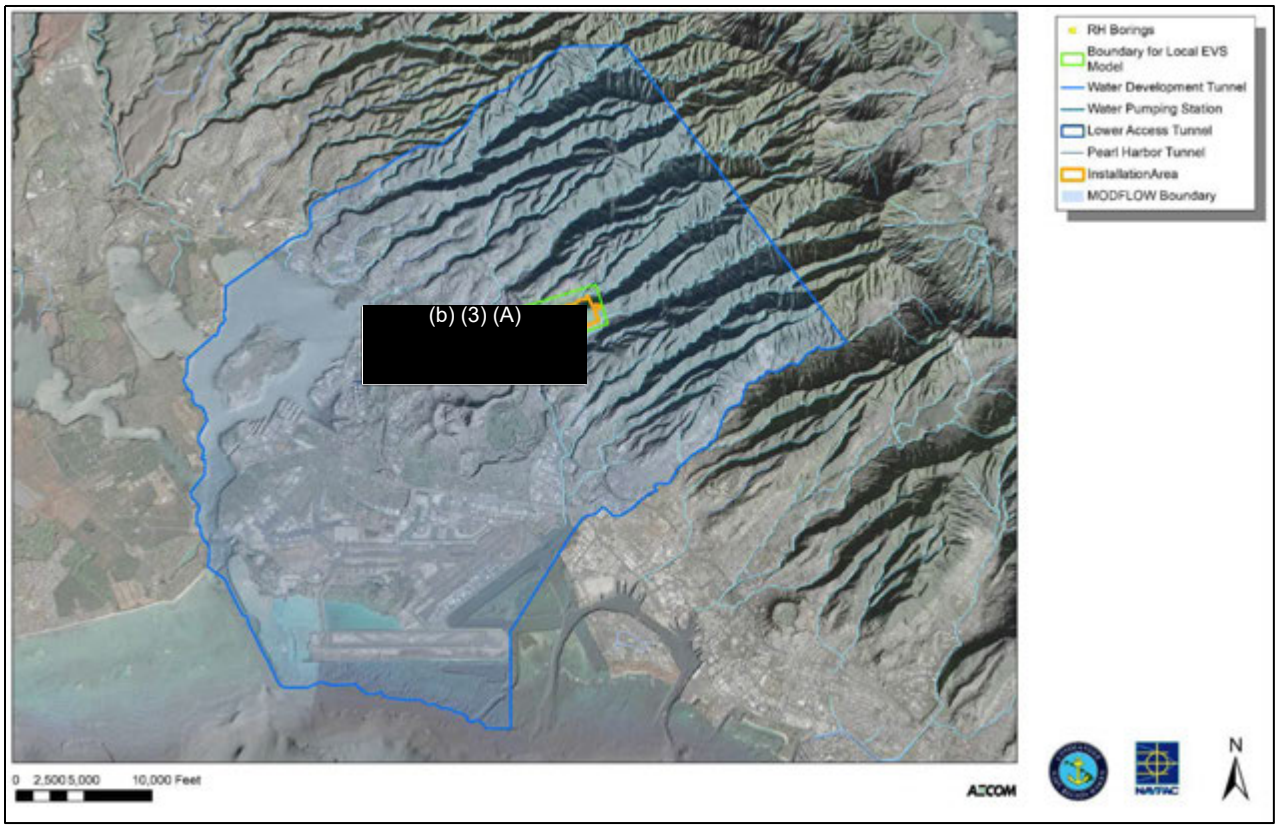
Figure 1: Geological CSM Area of Interest



The local model area was selected to encompass an area where a relatively dense sample data set is available (as compared to outlying areas away from Red Hill, where data is relatively scarce). The purpose of the

EVS model is to refine the legacy MODFLOW model developed in 2017. The local model area lies within the current MODFLOW model boundary, which is identified by the blue outline on Figure 2.

Figure 2: Existing MODFLOW Model Boundary



The input data set (55 boring logs) contains eight geological material types:

- Alluvium
- Saprolite
- Tuff
- Basalt, differentiated into the following subtypes:
  - Weathered a'ā clinker
  - Loose a'ā clinker
  - Undifferentiated a'ā clinker (where historical data do not indicate degrees of weathering)
  - Pāhoehoe
  - Massive a'ā

The model generation process uses three-dimensional (3D) interpolation, which is a process that provides estimations from sample data by the application of statistical algorithms that calculate ("model") new data at locations other than the input data points, so that a 3D field is created. The material types are calculated at "nodes" or points that are defined by the model setup, where a horizontal and vertical 3D "cell" size are provided to the EVS calculation program. The Red Hill input data are nonhierarchical and cannot be

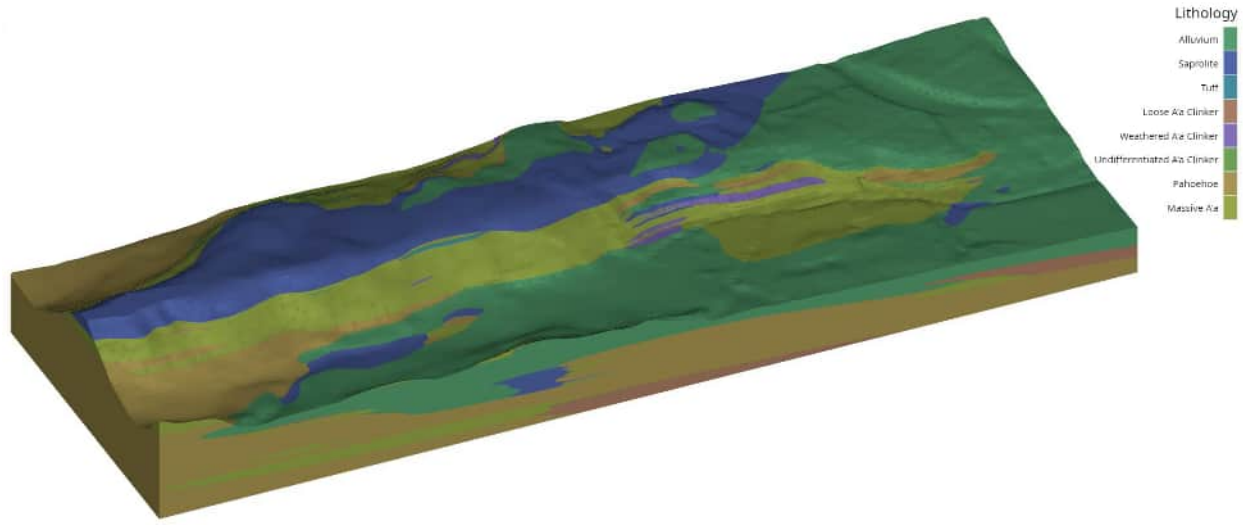
rendered as ordered stratigraphic layers; therefore, an interpolation technique called Geologic Indicator Kriging (GIK) is being employed to estimate lithologic materials by probability estimation. Indicator kriging is a non-parametric geostatistical method where the input values have been transformed into indicator threshold variables of 0 or 1, with results indicating the probability of a layer being above or below a threshold and where the output lithologic value is that which has the highest probability.

In an ideal scenario, the horizontal cell size would be the minimum distance between the samples, and the vertical cell size the minimum value of the material thicknesses; however, the chosen values must be a compromise dictated by the host machine's computational resources and required model resolution. The EVS GIK program provides typical kriging variables such as range, sill, nugget, semivariogram model type, vertical and horizontal anisotropy weightings, heading, and dip. These allow customizations appropriate for a geologic setting, where the values will be adjusted based on known constraints of the lithologic structures. For example, the horizontal extent of "massive aʻā" between two samples, at a given distance, must connect as expected from a flowing volcanic eruption, and therefore the interpolation parameters may need to be amended to generate such a connection. These choices contain a significant degree of subjectivity but are determined by professional judgement and knowledge of feasible geologic structures.

The certainty of the model results increases closer to the sample data; inversely, the uncertainty increases in areas where the input data are sparse. This may result in values that are not reasonable and must be amended. Because there are not any sample data in these locations, "artificial" constraining values must be introduced to modify the model to result in reasonable lithologic structures. These determinations require professional geologists' judgement based on knowledge of local and regional conditions.

Preliminary rendering of the local model (Figure 3), using the agreed upon regional dip direction of 213.6 degrees azimuth and dip magnitude of 2.9 degrees, and a horizontal to vertical ratio of 50 and horizontal anisotropy of 4, provides an initial rendition which may be amended and revised using alternate values for kriging parameters and with additional constraining points. This initial model is offered for consideration and evaluation by the Parties' SME and can be amended as warranted. The model is best investigated and evaluated "online" in three dimensions to better understand the modeled stratigraphy.

Figure 3: Initial Geological CSM Rendition



The EVS geologic CSM will be incorporated into a larger regional model that provides the necessary input for the MODFLOW modeling. This will be performed by using the legacy 2017 stratigraphic model,

comprising simple stratigraphic layers of alluvium, saprolite, and basalt, as input to a unified model. This may also incorporate refinement and differentiation of the general Basalt unit using the SISIM software, where all values of Basalt can be re-designated into the various types of basalt using a stochastic process. Incorporation into MODFLOW will be accomplished by sampling the EVS model at provided MODFLOW 3D cell centroid points, once the MODFLOW model dimensions have been agreed upon, and where these will be substituted with new values of Basalt and similar lithologies from the SISIM software results.

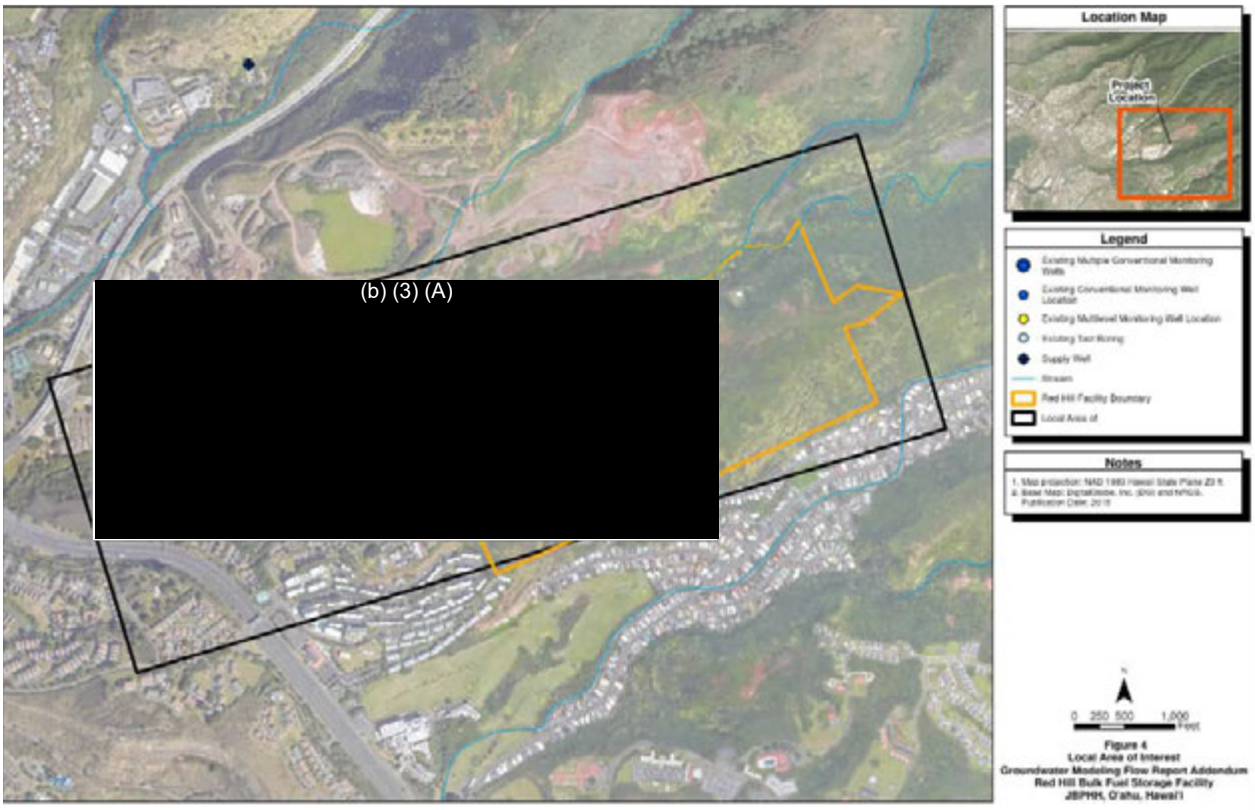
2.2 GROUNDWATER FLOW MODELING IMPROVEMENTS

The Navy has begun to address some of the initial, high-level comments in the Regulators' letter that must be addressed prior to completing the next stage of modeling and has performed some proof-of-concept modeling activities, as described below.

2.2.1 Area of Interest within the Monitoring Well Network

The Regulators' letter (and subsequent discussions) suggests giving particular focus to representation of heterogeneity and data within the AOI, which the Navy recommends be primarily in the area that is relatively data-rich with geological and hydrogeological information and which roughly corresponds to the existing monitoring well network shown on Figure 4 (this area is also referred to as the Local Area of Interest [LOI] on the figure). This AOI delineation is offered as a specific starting basis for consideration and refinement by the Parties' SMEs.

Figure 4: Potential Area of Interest



The area above will be referred to as the local numerical model. To the extent possible, boundaries for the local model will initially be established using existing information from the regional model.

The purpose for using a smaller model grid at this step includes, but is not limited to:

- Evaluation and calibration of important parameter matching (water table gradients, compartmentalization of water level trends in saturated units etc.) within a smaller and more highly discretized grid
- Evaluation of transient model simulations of aquifer stresses due to pumping (on/off)
- Evaluation of parameter scaling for important parameters that control transport, such as fracture correlation lengths, connections, and trends in direction
- Better constraining model input parameters (or range of parameters) for later extrapolation to the regional model
- Rapid forecasts using imposed conditions (e.g., hydraulic gradient magnitude and direction), without the effort required to develop a calibrated model
- Exploration of effects caused by heterogeneity, anisotropy, connectivity, and other hydrogeologic characteristics in a comparative context

2.2.2 Stochastic Generation Proof-of-Concept

The Regulators' letter suggested evaluating and implementing "alternative methods to represent subsurface heterogeneity", for example through the use of geostatistical methods that can be used to stochastically generate or differentiate the subtypes of basalt comprising the aquifer, conditioned on local stratigraphic data. This is a departure from previous modeling methods employed for the site that the Navy has begun to investigate. To investigate these methods, available geologic information that potentially controls flow and transport obtained from borings and barrel logs (e.g., fracture density, aperture, lengths) are being mapped and positioned at the appropriate location and depth. Stochastic methods can then be used to extrapolate the information within and across the local model domain (AOI), and potentially to the regional model.

A platform for exploring the effects of geostatistical assumptions on groundwater flow is in development and is currently capable of producing data-conditioned stochastic simulations in two dimensions, with the ability to adjust grid cell size, anisotropy and direction, continuity length, and lithology proportions. An example showing the impact of changing the variogram anisotropy on simulation results is shown on Figure 5. The lithologic simulation tool will be improved so that it can be used to populate a three-dimensional grid suitable for translation to MODFLOW input files.

A proof-of-concept (POC) groundwater flow and particle-tracking simulation that incorporates a simplified stochastically-generated hydraulic conductivity field was developed using preliminary geostatistical parameters and local lithologic data. Model 51e from the GWFM Report was used to perform a particle-tracking simulation as a baseline for comparison, and its results are shown on Figure 6 for a condition where Red Hill Shaft and Halawa Shaft are both inactive. Lighter background shades of gray indicate more-permeable material (clinker beds), with darker shades representing lower-permeability basalt. Particles can be seen traveling west and southwest in fairly smooth trajectories, with different colors indicating the particles moving through different model layers. Particle start locations were selected for illustration only. The results of the POC stochastic model are shown on Figure 7, with high (clinker) and low (basalt) zonation developed from a series of two-dimensional sequential indicator simulations. These results are uncalibrated, preliminary, and merely intended to illustrate an example of possible changes resulting from the regulators' recommended approach. While the specific values displayed are not important for this proof of concept, the approach results in a dramatic change in particle travel direction resulting from a high-contrast permeability field, with particles channeled to the northwest. Based on the way flow appears to seek the high permeability cells, it is apparent that different simulations based on different stochastic generations could result in vastly different simulated results.

Figure 5: Initial Evaluation of the Effects of Variogram Anisotropy on Geostatistical Property Generation

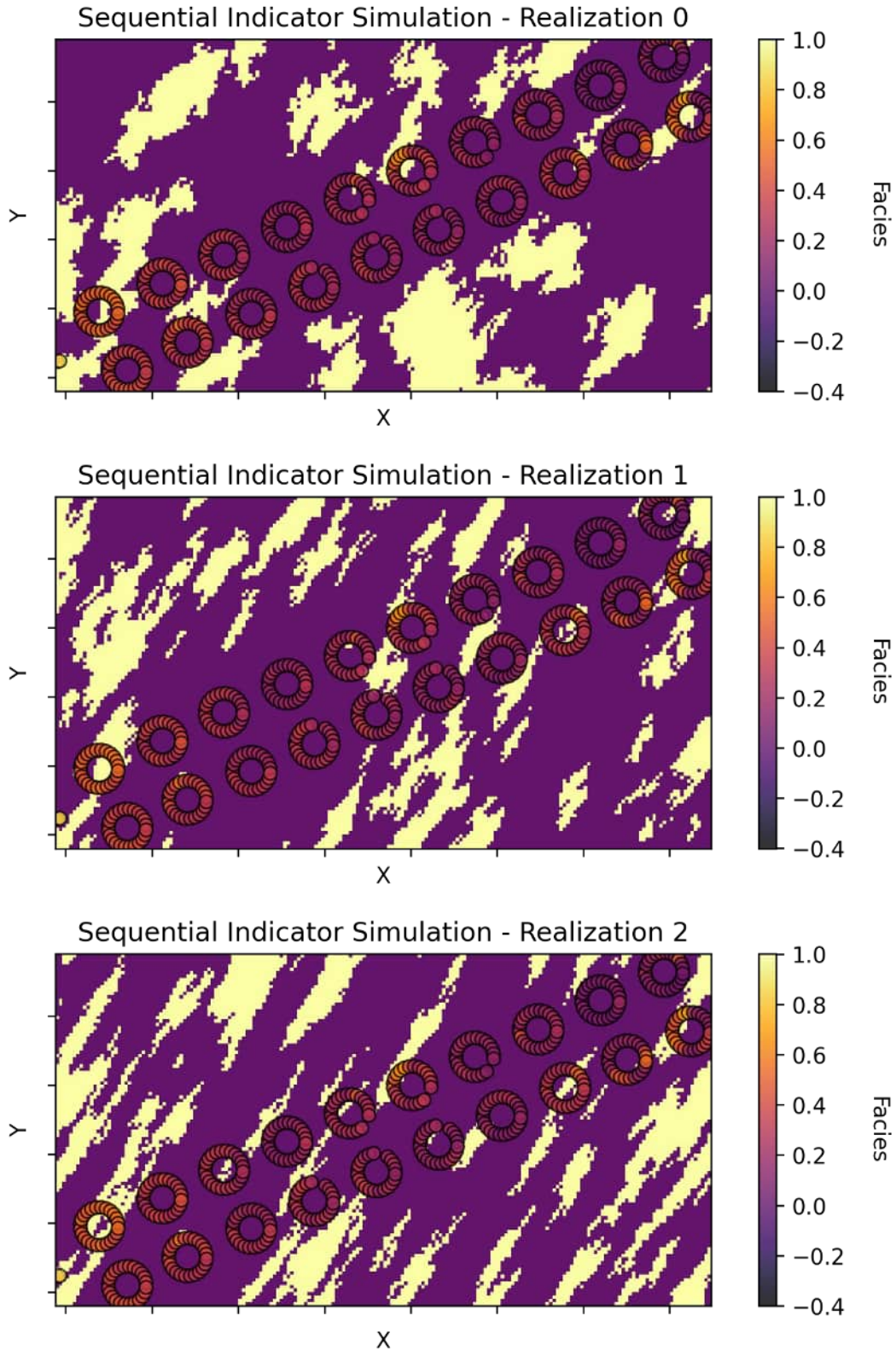


Figure 6: Particle Tracking Based on GWFM Report Model 51e

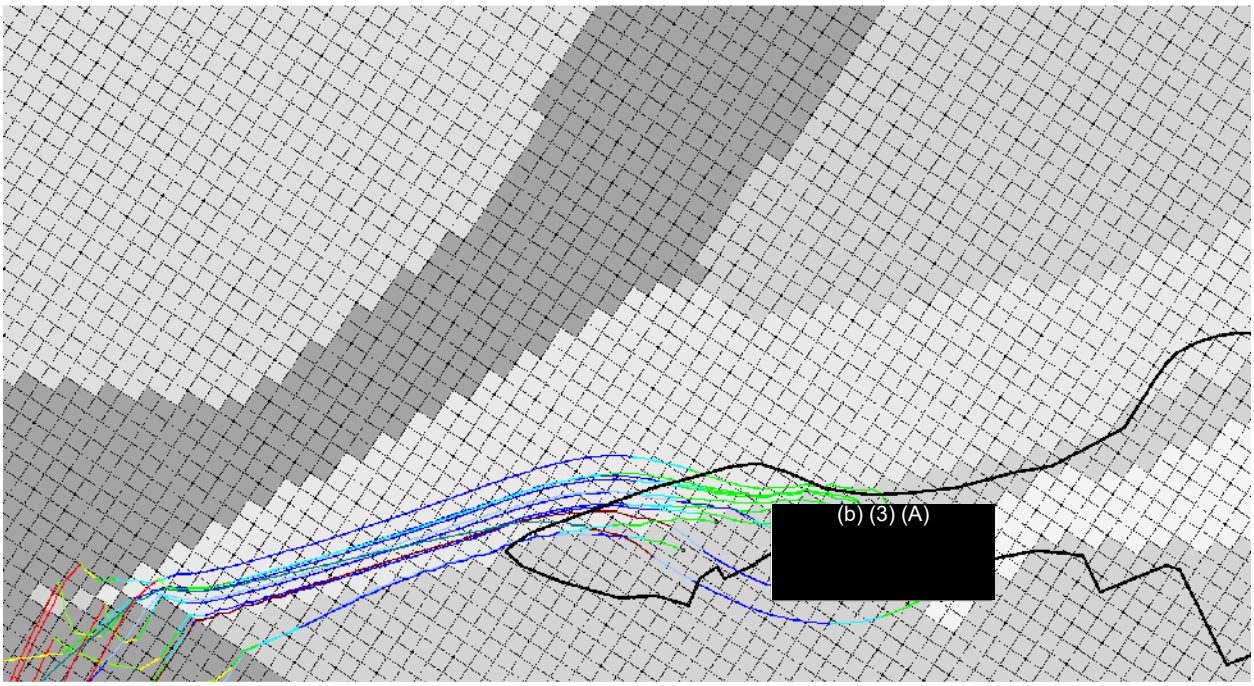
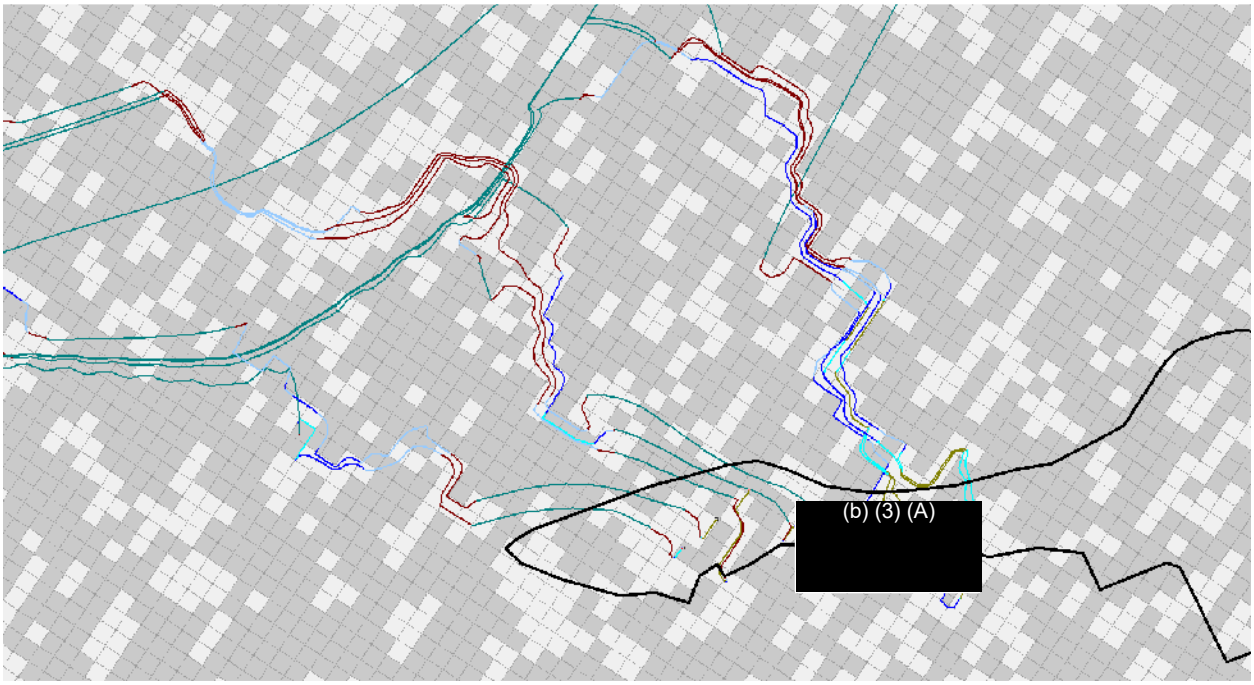


Figure 7: Particle Tracking for Proof-of-Concept Stochastic Generation Within Layer 4 of Model 51e



These preliminary simulations suggest that the current model grid may not be fine enough to capture details in high-permeability areas, if provisional estimates of variogram ranges are approximately correct. The blocky nature of the POC model's lithology suggests that the grid is too coarse to capture details that seem likely to influence local flow directions and additional tortuous pathways.

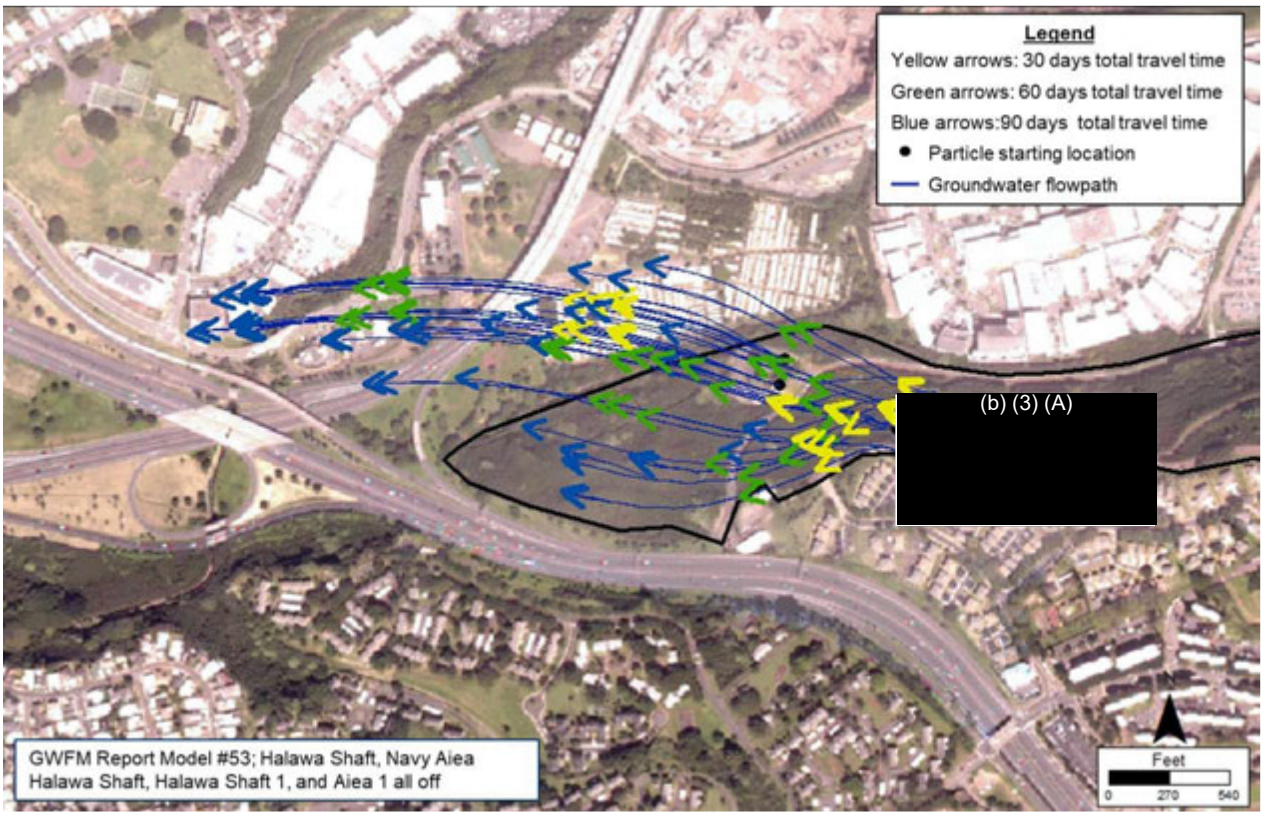
Once the overall parameters of the model and the geostatistics have been agreed upon, stochastic generation of the geological properties of the model cells can be conducted and evaluated. While this methodology could result in more realistic or plausible geological configurations, particular realizations may also result in inaccurate configurations, implausible geologic connections, or erroneous model results.

2.2.3 Additional Groundwater Flow Model Improvements

As discussed in the Aquifer Recovery Focus Group meetings held in December 2021 and January 2022, the Navy proceeded with emergency response simulations using several models from the GWFM Report as a starting point. Rapid simulations were performed to assess potential dissolved fuel migration directions and distances with Red Hill Shaft turned off (Figure 8). These simulations were refined as additional field data were collected. The simulations combined with particle-tracking results, field sampling results, and screening-level analytical transport modeling assisted the team with proposing additional monitoring locations. Preliminary order-of-magnitude fate and transport simulations were also performed with BIOSCREEN,[1] an EPA natural attenuation decision support system for dissolved hydrocarbons at controlled release sites. After preliminary forecasts were developed for the emergency response, the modeling team worked to develop a revised model, using Model 53 as the starting point (the regulators' letter would later suggest that Model 51e was the best starting point). The goal of the model revisions was to incorporate changes that would make the model better suited to simulate the November 20 release near Red Hill Shaft and eliminate some previous modeling assumptions that were conservative when the focus was on releases from the tank farm area. Some of these changes were identified during the emergency response action, while others were identified during informal feedback meetings that have been conducted.

[1] https://www.epa.gov/water-research/bioscreen-natural-attenuation-decision-support-system

Figure 8: Early Emergency Response Particle-Tracking Simulation Results



The following improvements have been incorporated into one or more draft models developed after delivery of the 2020 GWFM Report. Other potential improvements were tested and discarded when improvement was not observed. As recommended in the regulators' letter, further model development has begun using Model 51e as a starting point, but it is also possible that a new model grid may have to be built essentially from scratch to address some of the comments. In any case, the changes below are currently being incorporated into a revised model based on Model 51e.

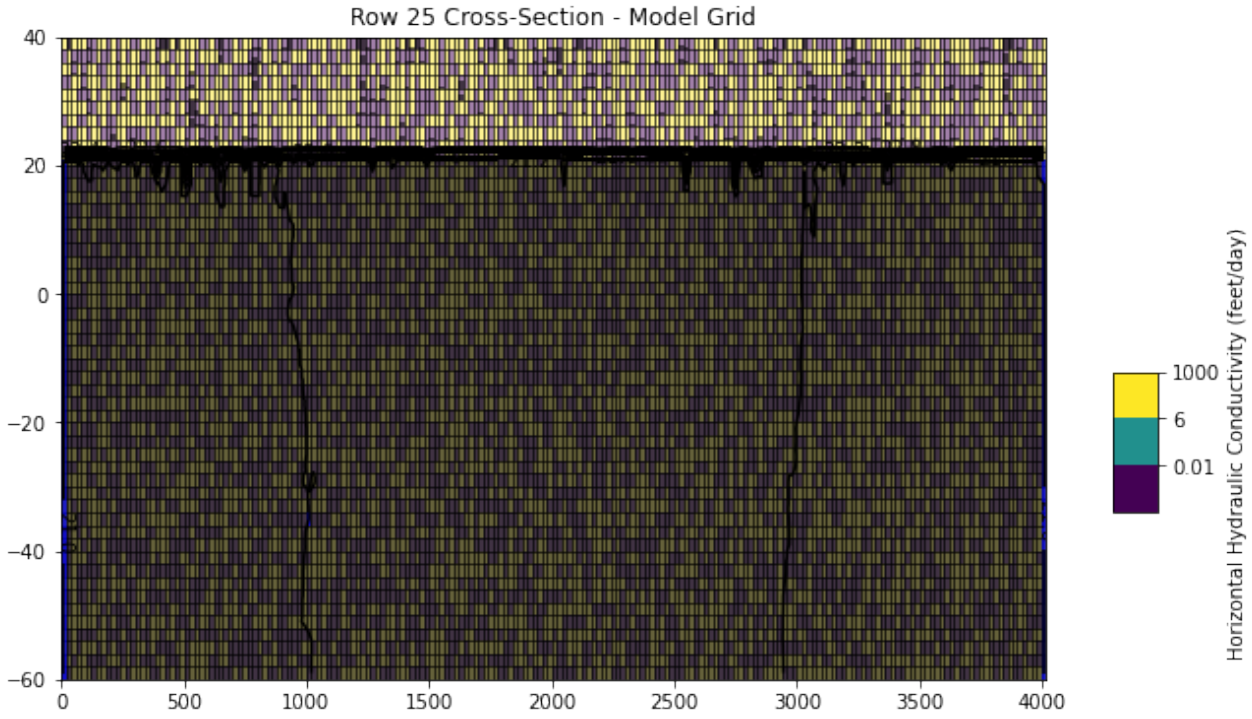
- The numerical representation of the Red Hill water development tunnel was updated to include both segments (east and west); the previous numerical representation (east segment only) was based on field observations of water production during tunnel construction, indicating little or no flow in the western segment, which was considered conservative with respect to potential releases near the tank farm, but may be less appropriate for the release near the shaft.
- Set the elevation of Red Hill water development tunnel Connected Linear Network (CLN) elevation to 5.1 ft to match the tunnel bottom elevation.
- Moved Red Hill Shaft calibration targets to the west end of the water development tunnel (near the pumps and instrumentation).
- Layer bottom adjustments in the water development tunnel vicinity to reduce numerical discontinuities and convergence difficulty.
- Added flux targets to Red Hill Shaft and Hālawa Shaft to ensure that historical pumping rates are not restricted by the simulated aquifer properties.
- Consolidated duplicate calibration targets.

- Increased conductance at the northwest and southeast general head boundary (GHB) heads.
- Consolidated duplicate GHB conditions.
- Turned on the vertical layer overlap function to allow cross-layer flows when geologic materials are adjacent in the physical system, but in different layers in the model.
- Reduced weight on a calibration target that concentrates flow at the east end of the water development tunnel.
- Reduced weight on the southeast flow calibration target to allow more deviation from the target value.
- Modified calibration target group weighting to emphasize match to pumping-response groupings.
- Removed layer elevation anomaly in southwest corner (anomaly is present in source data derived from Oki (2005).
- Removed interior no-flow cells and corrected bottom elevations.
- Reassigned incorrect zone numbers to better represent hydraulic property zonation.
- Updated Red Hill Shaft and Hālawa Shaft model cells to incorporate the very high specific yield of a tunnel.
- Revised groupings of head-difference targets to allow calibration on particular inter-well water-level relationships (e.g., grouping behavior of pumping responses) to begin to address compartmentalization concerns.
- Increased the number of pilot points used and added independent pilot point groups for each model layer representing basalt, to allow the autocalibration software to introduce additional heterogeneity and to better-represent vertical variation in permeability.

2.2.4 Next Steps

- Upon completion of EVS modeling, import the geologic architecture into MODFLOW.
- Build the local numerical model grid and assign appropriate hydrostratigraphic material types to each model cell by superimposing the EVS geologic framework onto the MODFLOW AOI grid.
- Determine boundary conditions for the localized flow model in collaboration with regulatory agencies and SMEs.
- Where basalt is present, populate AOI model cells with the material properties of clinker, pāhoehoe, and a'ā, using stochastic methods to develop small-scale heterogeneity.
- Recommend reasonable ranges of hydraulic parameters for the basalt aquifer and discuss and confirm with the Parties and their SMEs.
- Perform steady state and transient model simulations and compare with field observations.
- The lithologic simulation tool (Section 2.2.2) is being developed in parallel with another similar tool, a MODFLOW Box Model that creates a simple three-dimensional groundwater flow model, populates it with lithology-based permeabilities, runs the flow model and displays results, including horizontal and vertical slices that illustrate lithologic heterogeneity, groundwater contours, and where the aquifer is saturated (both the basal aquifer and perched zones). An example output image is presented on Figure 9 (note that the tool is still in development and the appearance of simulation output will likely change).

Figure 9: Sample Simplified Box Model Cross Section



3. In-Well and Tracer Testing Update

The Regulators' letter requested that the Navy acquire additional field data to support the evaluation of geological CSM and groundwater flow patterns. Recommendations included installing new wells, conducting in-well testing, and a tracer study. A series of meetings were held with the regulators to refine the scope and objectives of in-well testing in 2020 and 2021. The Navy provided a Draft Work Plan Outline in a Technical Working Group Meeting with EPA and DOH on July 16, 2021, proposing an in-well testing program designed to estimate the direction and velocity of groundwater flow at individual wells. Potential in-well testing methods include vertical profiling, borehole dilution testing, and colloidal borescope testing. The Regulators provided comments on the Draft WP Outline in August 2021.The latest Regulator SME meeting was held on February 4, 2022 and focused on how best to integrate Dr. Becker into the project as a third-party SME.

4. Well Permitting and Installation Updates

The following are updates on the status of sentinel and monitoring well permitting, access agreements, and installation.

- Current drilling and well installation efforts:
  - RHMW17 – a 4" conventional monitoring well has been installed across the basal piezometric surface located approximately 18–19 ft above mean sea level (msl). Well construction and well development are in progress.
  - RHP01 – Installation of a 2" conventional monitoring well is in progress.
  - RHP02 – a 2" conventional monitoring well is installed across the basal piezometric surface located approximately 18–19 ft msl. Well development has been completed and a dedicated low flow pump has been procured.

  - RHP03 – Installation of a 2" conventional monitoring well is in progress.
  - RHP04A – Installation of a 2" conventional monitoring well is in progress.
- Site access for upcoming wells:
  - Secured for proposed sentinel and monitoring wells inside the Facility boundary (RHMW18 (JJ), RHMWBB, and RHMWII).
  - In progress for proposed plume delineation wells RHP05, RHP06, and RHP08.
  - In progress for four proposed sentinel wells outside the Facility boundary.

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Attachment 1:
Navy-Proposed Modeling Schedule

~~For Red Hill AOC Party Use Only~~

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Proposed Modeling Schedule

	Start	*Duration (days)*	*Finish*
1) Geological Conceptual Site Model			
Initial Geological Conceptual Site Model (GCSM) meeting	Thursday, May 26, 2022	1	Thursday, May 26, 2022
Navy prepares initial GCSM model in EVS for Charrette	Friday, May 27, 2022	31	Sunday, June 26, 2022
GCSM Charrette - all parties agree upon all geological parameters throughout the model domain	Monday, June 27, 2022	4	Thursday, June 30, 2022
Navy completes GCSM in EVS	Friday, July 01, 2022	19	Tuesday, July 19, 2022
Navy Briefs Regulators on GCSM	Wednesday, July 20, 2022	1	Wednesday, July 20, 2022
Navy prepares CSM Addendum (Technical Memorandum)	Thursday, July 21, 2022	36	Thursday, August 25, 2022
2) Groundwater Flow Model			
Initial Groundwater Flow Model (GWFM) meeting	Tuesday, August 30, 2022	1	Tuesday, August 30, 2022
Navy prepares initial draft GWFM for Charrette	Wednesday, August 31, 2022	33	Sunday, October 02, 2022
GWFM Charrette - all parties agree upon all inputs (infrastructure and scenarios)	Monday, October 03, 2022	5	Friday, October 07, 2022
Navy completes, calibrates, and runs model scenarios	Saturday, October 08, 2022	30	Sunday, November 06, 2022
Navy Briefs Regulators on GWFM	Monday, November 07, 2022	1	Monday, November 07, 2022
Navy prepares GWFM Report Addendum	Tuesday, November 08, 2022	42	Monday, December 19, 2022
3) Vadose Zone Modeling			
Initial Vadose Zone Modeling (VZM) meeting	Tuesday, September 06, 2022	1	Tuesday, September 06, 2022
Navy prepares initial draft VZM for Charrette	Wednesday, September 07, 2022	28	Tuesday, October 04, 2022
VZM Charrette - all parties agree upon all inputs (infrastructure and scenarios)	Wednesday, October 05, 2022	4	Saturday, October 08, 2022
Navy completes, calibrates, and runs model scenarios	Sunday, October 09, 2022	29	Sunday, November 06, 2022
Navy Briefs Regulators on VZM	Monday, November 07, 2022	1	Monday, November 07, 2022
Navy prepares VZM Technical Memorandum	Tuesday, November 08, 2022	42	Monday, December 19, 2022
4) Groundwater Contaminant Fate and Transport			
Initial Groundwater Contaminant Fate and Transport (CF&T) meeting	Monday, December 26, 2022	1	Monday, December 26, 2022
Navy prepares initial draft CF&T Model for Charrette	Tuesday, December 27, 2022	45	Thursday, February 09, 2023
CF&T Charrette - all parties agree upon all inputs (infrastructure and scenarios)	Friday, February 10, 2023	5	Tuesday, February 14, 2023
Navy completes, calibrates, and runs model scenarios	Wednesday, February 15, 2023	61	Sunday, April 16, 2023
Navy Briefs Regulators on GWFM	Monday, April 17, 2023	1	Monday, April 17, 2023
Navy prepares CF&T Technical Memorandum	Tuesday, April 18, 2023	60	Friday, June 16, 2023

Note: all parties have not afreed to this process or schedule, which may therefore require revisions.

~~For Red Hill AOC Party Use Only~~

Attachment 2:
Summary of Party Discussions

~~For Red Hill AOC Party Use Only~~

~~For Red Hill AOC Party Use Only~~

Category	Question List	Can it be Modeled?	Priority	Required?	Govt Comments	Regulators Comments (as interpretted from the meeting on 5/9/22)	Minor notes added 5/17/22	Tonkin Comments
Capture/remediation	Will the groundwater model accurately forecast contaminant fate and transport now and in the future?	Maybe	3	No	Response should be driven by data and professional judgement.	Unlikely to be highly accurate. We want the model to be characteristic, representative, and useful. Should not strive for point by point accuracy because that won't happen. Maybe reword this to "can the model represent the main characteristics of rate and directions of flow" and maybe should be a higher priority.		In this setting, a fully deterministic model cannot be constructed. So the modeling should (a) capture the salient FEPs, and (b) provide realistic outputs that collectively span the plausible range of outcomes, so that decisions can be made. Some choices in model design may be possible to be made "conservatively" but most should be based on best-estimates and ranges.
	How do we determine if Red Hill Shaft's capture zone requires optimization?	Yes	4	Yes	Dependent upon P-well field data and professional judgement	Seems reasonable. P-well data will help us understand more than we do now. In general, we need to understand what recovery has happened since releases.		Capture (containment) and remediation are two different though overlapping goals. Capture/containment is an objctive to minimize impacts to other potential receptors, and to provide time for attenuation of degradable constituents. But this system cannot be fully "flushed", so there will always be contaminants present. But over time the threat they pose diminishes fairly quickly assuming no new releases.
	What are the prospects for capturing all fuel from the aquifer?	Maybe		No				
	Where should additional monitoring wells be installed?	Yes		No	Professional judgement has already determined where additional wells are being placed	Agree that the model is appropriate for this type of use. We need to be more open in terms of the fact that the model might tell us something new, and use that new information. We are in a difficult situation because we are placing wells without an accurate model. Answer of "no" chosen due to the interest of time, but modeling should be used after the fact to validate locations and/or assist in placement of additional monitoring locations.		
	Where do we expect to place extraction wells in order to capture the rest of the plume that is not captured by Red Hill Shaft?	Yes		Yes	It is not yet clear that there is a risk-driving plume to capture (OWDF, RHMW15, and RHMW5, the nearest wells don't appear to be impacted. This may be a data driven question.	Where does the water come from that is produced in the shaft? Maybe we should think of this as the zone of contribution to RHS.		This is a regulatory decision. In some states, efforts are made to intercept and recover contamination even when it is also being recovered by a treated water source (e.g., NYS) to reduce the burden on the water supplier. In other states, this is not done.
Confirmation	Can the rate and direction of contamination from its release point to surrounding receptors be accurately forecasted?	Yes		Yes	Outcome will take time - well into 2024	Ties in with earlier question.		The response here seems to contradict ROW 2 above. Between the two responses, I think that modeling can provide a great deal of insight into rates, and a fair amount of insight into directions. Taken together, this can support appropriate decisions about mitigating strategies. Modeling is excellent for quantifying decisions made in a CSM, via comparison with field data, as demonstrated in 2021.
	What are the uncertainties in the capture zone analyses and existing groundwater flow models?	Maybe		Maybe		Agree this should not be a focus right now. Need to focus on CSM. At some point need to answer this question. Question that it can be modeled, but only certain aspects. A "maybe" for column E. There is no way to get around continually comparing the model to field data. If you can't model it, then you are stuck with field testing, so if it CAN be modeled, that would be ideal. To be assessed perhaps as a discussion once the models are constructed and preliminary capture zones are assessed.		there are two broad categories of uncertianty - aleotoric and epistemic: the former is truly "random", and the latter may have some underlying non-randomness and therefore can be improved by more knowledge. Modeling can accomplish two things: (a) it can evaluate the effects of alteotoric uncertainty, though it can not do much to reduce this; and (b) it can help us understand what aspects of the system produce substantial epistemic uncertainty so we can try to learn more about those FEPs. There is some overlap between these uncertainties, but modeling can help in both cases. Example - the basalts may be represented probabilistically, for convenience, however there IS structure to them, they are not actually random. If we improve knowledge of the structure, then we would have a stratified random representation, which would be better than purely random. We want to improve understanding of how uncertainty plays out at RHBSF
	How do we confirm the effectiveness of capture?	No/Maybe		No		Rows 7-10 are just part of the modeling process.		Agreed with column G. Confirming the extent of capture or containment is a multi-lines-of-evidence effort based on field data (water levels, gradients, mass fluxes, etc) and modeling. But overall, the "confirmation" should fall back mostly on field data.
	How do we confirm that the groundwater models are representative?	No		No		Maybe most important to confirm and continually corroborate the model with data		Not "maybe" but definitely. But there is a time-lag on getting sufficient data to corroborate the model. So, we will need to proceed with what we have, and deal with the fact we have a fair amount of (as noted above) epistemic uncertainty at this time, and recognize that. THis will hopefully be addressed as we get more data. Until then, we have to do the best we can.
Geologic characterization	What are the migration pathways in the vadose zone?	Maybe		Yes		Rephrase it to "what are the migration mechanisms and rates" and "yes" cor columns C and E. It is a question of where it is going to hit the water table/ how the volume and rate of release impacts where the water table is hit.		Agree with column G edits.
	What geological structures can potentially influence groundwater and contaminant transport toward surrounding receptors?	Yes	1	Yes	Govt acknowledges RA request to incorporate barrel logs and apply geostatistics to surrounding area. How do we accomplish this specifically?	Agree		Ok
Groundwater flow/particle tracking	What are the groundwater flow patterns?	Yes	1	Yes		Agree		Ok
	How do the dissolved constituents travel in the groundwater under current conditions?	Yes		Yes	Data including EAL exceedances answers this question	Copy to 13 as well. Groudnwater chemistry work can give good insight about flow direction.		Ok. Note we need a framework for using the geochem fruitfully.
	How effective is the Red Hill Shaft capture zone?	Yes	1	Yes	Outcome will take time - well into 2024	Identify a target zone and answer are we able to capture it? If we don't have optimal capture zone, do work to optimize it. Can't wait until 2024 to optimize capture zone.		Agree with column G edits.
	What are the rates and directions of groundwater flow at the Facility; and how effective is capture of a fuel plume by Red Hill Shaft?	Yes	1	Yes		Overlapping question. Should be priority 1.		Agree with column G edits.
	What will the effects of RHS operation (5 MGD) be on groundwater flow, under differing operation conditions for other supply wells?	Yes	3	Maybe	Will regulators accept field tests and a CSM to answer this question?	A bit puzzled by this question. Need clarification. The bigger question is how important is the modeling vs the gathering of more data. If the model agrees with the field data, then it is useful. Can contamination make its way to Halawa shaft? What is the zone of contribution to Hawala Shaft?		Futher note to that in column G: we need to understand this, in order to understand the capture zone because the capture zone arises from and is caused by the change in the flow field due to pumping of RHS. So, this has to be a "yes" in Column E, otherwise we are saying we cannot model capture.
	What is the target area of treatment/impact within the saturated zone?	Maybe		No		See this as more of a data driven thing that gets passed through the model. Need to define area of impact.		Futher note to that in column G: agreed, we need to define the target area first, which is data-driven, and then evaluate through a combination of modeling and field data.

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Category	Question List	Can it be Modeled?	Priority	Required?	Govt Comments	Regulators Comments (as interpretted from the meeting on 5/9/22)	Minor notes added 5/17/22	Tonkin Comments
	Could contaminated groundwater enter the stream environment?	Yes				With the curent MODFLOW effort it would be difficult to model the stream to basal interactions. The stream may be interacting with a perched zone. Perhaps fulfill this need with fieldwork to determine if seeps are observed discharging into the stream. This may have already been investigated by the EPA via weepholes and no readings were observed. This could be more of a chemical question? Perhaps water dating could be utilized? Ultimately this is not a question for modeling but other investigative avenues.		Agreed with column G edits. Modeling could provide some "scenario" type of simulations, but ultimately this is best determined via field work - the USGS has performed many such studies at Hanford, and in the mid-west, to name a few.
	What drinking water or other receptors are near potential migration paths?	Yes	2			Does this need to take vadose zone transport into account? This is something that needs to be modeled in regards to the basal, but also might need to be thought about in terms of vadose zone transport for determining longevity of potential risk, distal transport and the source terms.		This does involve both dissolved and product migration, at this site.
Model scenarios	What will the effects of RHS operation be on product migration?	Yes/Maybe				Difficult but also one of the most important questions that needs to be answered. So is this something that can be determined as a long term goal? Perhaps after P-wells are installed? Concern is that we still have the potential for another large release, so knowing what would happen from a larger release is something that needs to be addressed. What do we mean with "not at this time"? Perhaps we can follow up on this?		I suspect RHS operation will only affect product migration close-by, where the induced gradients are sufficient Beyond that distance, product will do its own thing. Perhaps modeling could be used to estimate where those two different regimes would transition to help guide monitoring.
	What will the effects of RHS operation be on extents of the dissolved constituents?	Yes	3		Meant from a transport perspective rather than a bioremediation perspective.	One of the complications is that we are pumping at half the rate of operations from municipal pumping (approx 9MGD 12hrs/day). This could necessitate transient assessments. During a release this would be particularly important.	I thought they said that this may be out of the scope. This is where G.D. Beckett commented that the list of defenciencies should be used as our 'questions to be answered'.	The F&T model should be able to answer this, if the underlying flow fields are fairly reliable and representative.
	What is the projected Red Hill Shaft capture zone when Red Hill Shaft **is pumping but**, Aiea Halawa Shaft, and BWS Halawa Shaft are not pumping?	Yes	2		Outcome will take time - well into 2024	Make this a priority 2. Note that the capture zone is zero if no one is pumping. Note that NAPL migration might also be impacted when migration is not happening (a dispersion question? A diffusion question?). Even when shafts are not actively being pumped they still could act as a conduit for transport in some ways but not in other ways (depending on the connected porespace). These ancillary questions may not be something that we can model, but need to be kept in mind. Could this be something like surface water transport of LNAPL but with multiple release points in the shaft. How do we treat transport just with the tunnel being there.	RHS acts as a strange conduit even while not pumping, drawing water from the east and flowing out of the western end of a 2,000 ft tunnel.	The basic answer to column B is "YES", and it is necessary that this be achieved by the modeling. However the comments under G and H are also relevant.
	What is the projected Red Hill Shaft capture zone when Red Hill Shaft is pumping at varying pumping rates while Aiea Halawa Shaft and BWS Halawa Shaft are off?	Yes		Yes	Outcome will take time - well into 2024			
	Is redistribution of pumping threatening seawater upconing/intrusion?	Yes			This would likely require a different model	Could be evaluated afterwards or secondarily with primary modeling efforts if determined necessary by the group. Chlorides may be able to be addressed in a different way. Understanding groundwater flow is the primary goal. This is more of a question that should be directed to CWRM to determine if it is important for oversight of the facility or production wells.		Not sure this requires a different model exactly: this is more of a water resource management decision, EXCEPT to the extent that some of the local geochem may result from upconing or more complex pathways. For the current AOC modeling, this isnt needed but later an active saltwater condition could be represented to evaluate this, with minimal other changes to the model structure.
Plume tracking	Where is the free product in the vadose zone?	Yes		Maybe	Would require multiphase model and time			Agreed
	How will fuel interact with and move through the vadose zone?	Yes		Maybe	Would require multiphase model and time			Agreed
	Where did the product enter the saturated zone?	Yes		Maybe	Would require multiphase model and time			Agreed
	How will the product travel along the groundwater surface?	Yes/Maybe		Yes	Outcome will take time - well into 2024			Agreed
	What dissolved constituents are present in the aquifer?	Maybe		Maybe	Data will answer this question			Agreed
	What is the biodegredation rate at the site?	No		No	Bench tests may answer this question			Agreed
Spill Assessment	What was the quantities, location, fuel type(s) and times frames of fuel released (2014-present) for releases within the footprint of the tank farm as identified by the AOC?	No			It should be noted that this is an important question and needs addressing. The purpose of this question list is to identify the specific questions that need to be incorporated directly into the flow modeling so that these questions can be assessed with the tool that this model aims to provide	All of the product questions are potential scenarios to cooberate the CSM. Last year's events support some aspects of the CSM and disproved aspects of the CSM in other ways (holding capacity?). There is a huge benefit to marrying field efforts with modeling efforts, but that may benefit the effort. The groundwater model specifically does not call for plume or vadose modeling and is more of a means to addressing the concerns of Section 7 after construction.		This falls under the epistemic uncertainty framework at this time. This information is best obtained via interviews, surveys, investigations, and then the best estimate thus obtained may be used as a source term in modeling. The modeling can then provide feedback on the potential reliability of this independent estimate and how consistent it is with other aspects of the CSM.
Additional Questions	Could we treat the basal like the vadose in terms of composition?					The goal is to incorporate as much detailed geology as we can now so that the important flow conditions are included in the transport system.		The basalt representation should be developed at a reasonable EPM scale that can provide a basis for parameterizing both the vadose and saturated zone systems. This is fundamental to the overall project objectives.
	Can we go directly from a groundwater flow model to a transport?					Hopefully by incorporating the complexities we think early it will us to better understand the transport later.		It should be anticipated that this will be somewhat iterative and not a linear flow-to-transport transition.
	What is the process for addressing releases. Is it possible with this particular modeling task or is another model structure necessary?	No				To be discussed at a future multiday meeting if determined appropriate. It is good to try to get on the same page but we need to keep the eye on the ball on what is expected from a regulatory perspective. We need to understand the aquifer system better than before so as to better understand transport that could be an issue of scaling. Specific quantitative definiciencies need to be addressed in the models. However it is approached is not the problem for RAs but making sure the deficiencies are addressed is what really matters from a metrics perspective.		Column C should read "Maybe", so both C and E are maybe.

Attachment 3:
Boring Logs and Well Construction Details

Boring Log Source Publications

Well/Boring ID	Source Publication
Red Hill Groundwater Monitoring Network Borings (2001-2021)	
RHMW01 (installed as B-V1D)	Department of the Navy (DON). 2002. *Red Hill Bulk Fuel Storage Facility Investigation Report (Final) for Fleet Industrial Supply Center (FISC), Oahu, Hawaii.* Prepared by AMEC Earth & Environmental, Inc., Huntsville, AL. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. August.
RHMW02 RHMW03 RHMW04	Department of the Navy (DON). 2007. *Red Hill Bulk Fuel Storage Facility Final Technical Report, Pearl Harbor, Hawaii.* Prepared by TEC, Inc. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. August.
RHMW05	Internal Navy report
RHMW06 RHMW07	Department of the Navy (DON). 2015. *Draft Monitoring Well Installation Report, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Hawaii.* Prepared by Battelle, Columbus, OH; and Parsons, South Jordan, UT. JBPHH HI: Naval Facilities Engineering Command, Hawaii. March.
RHMW08 RHMW09	Department of the Navy (DON). 2017. *Groundwater Flow Model Progress Report 01, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; April 5, 2017, Revision 00.* Prepared by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
RHMW10	Department of the Navy (DON). 2017. *Groundwater Flow Model Progress Report 02, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; August 4, 2017, Revision 00.* Prepared by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
RHMW11	Department of the Navy (DON). 2018. *Technical Memorandum, Testing and Verification of Packer Integrity at RHMW11, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; February 9, 2018.* JBPHH HI: Naval Facilities Engineering Command, Hawaii. February.
RhMW12 RHMW13	DON, Department of the Navy (DON). 2020. *Investigation and Remediation of Releases Report, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; March 25, 2020, Revision 00.* Prepared by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
RHMW14 RHTB01	Department of the Navy (DON). 2019. *Groundwater Model Progress Report 08, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; August 5, 2019, Revision 00.* Prepared by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
RHMW15	Department of the Navy (DON). 2019. *Groundwater Model Progress Report 09, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; December 5, 2019, Revision 00.* Prepared by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
HDMW2253-03 (Hālawa Deep Monitor Well)	Commission on Water Resource Management (CWRM). 2001. *Well Completion Report, Oahu (Hālawa) Deep Monitor Well 2253-03.* State of Hawaii Department of Land and Natural Resources. October 11.
OWDFMW01 (installed as MW08)	Department of the Navy (DON). 2000. *Remedial Investigation Phase II, Red Hill Oily Waste Disposal Facility, Hālawa, Oahu, Hawaii.* Prepared by Earth Tech, Inc., Honolulu, HI. Volume I, Technical Report. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. September.

Well/Boring ID	Source Publication
Oily Waste Disposal Facility Site Investigation Basal Monitoring Well Borings (2021)	
OWDFMW02A OWDFMW03A OWDFMW04A OWDFMW05A OWDFMW06A OWDFMW07A OWDFMW08A	Not previously published
Red Hill Fire Suppression and Ventilation System Study Borings (2012-2013)	
B-1 – B-13	Pacific Geotechnical Engineers, Inc. (PGE). *0 to 35% Design, FY15 DLA MILCON P-205, Red Hill Fire Suppression and Ventilation System, Joint Base Pearl Harbor-Hickam, Red Hill Fuel Storage Facility, Hawaii PGE Job No.* 3773-008, 3773-006.
URS Drilling Logs (Abandonment Reports) (2012-2013)	
B-01 – B-10	Pacific Geotechnical Engineers, Inc. (PGE). *0 to 35% Design, FY15 DLA MILCON P-205, Red Hill Fire Suppression and Ventilation System, Joint Base Pearl Harbor-Hickam, Red Hill Fuel Storage Facility, Hawaii PGE Job No.* 3773-008, 3773-006.

XH-29

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

333 Federal Building
Honolulu, Hawaii

February 26, 1941

Captain H F Bruns
Public Works Office
Pearl Harbor, T H

Dear Captain Bruns:

Attached is a report by Dr. Macdonald re the geology of the Red Hill underground oil fuel storage project and the amount of rock recoverable for concrete aggregate. Both Dr. Macdonald and I have been in constant touch with the engineers and drillers and have rendered advice to Lt. Powell, Messrs. Peters and Rankin, and others as the work progressed. This report is a record of the structure of the Red Hill area. We will stand by for further assistance in case new problems arise.

You will be interested to know that the U. S. Army has encountered water with a 46-foot head in Aliamanu Crater in the basalts of the Red Hill spur about one-half mile seaward of the storage project construction camp. Except for this well, there is no other draft on the water in the Red Hill artesian area. The development of a large supply of water from a shaft sunk at an appropriate place in one of the tunnels of the storage project will be a relatively simple matter with the present excavating equipment on the job. It seems a propitious time to replace the Aiea artesian wells and surface pumping station with a bomb-proof Maui-type well.

We will be glad to designate the site for such a well at any time.

Yours truly,

(b) (6)
Geologist in Charge
Hawaiian Ground-Water Investigations

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Geology of the Red Hill and Waimalu areas, Oahu, in relation to the Underground Fuel Storage Project of the U.S. Navy

By

(b) (6)

Assistant Geologist
U. S. Geological Survey

February 21, 1941

Geology of the Red Hill area

The rocks of the Red Hill area have been examined both in the field and in the laboratory. Cleared sections along coordinates 27, 36, 49, and 62 have been mapped in detail, and the diamond-drill cores from borings 1, 2-B, 3, 4, 6, 7, 8, and 9 have been studied and fully described. They are plotted on the attached sections.

General geologic conditions as affecting construction

The region lies on the southwest flank of the eroded Koolau volcano, and the rocks are lava flows from that volcano. All are basalt in composition. Two types of lava flows are present, and are known respectively by the names aa, and pahoehoe. Aa flows are generally dense in their central part, but contain a gradually increasing number of bubble-holes, or vesicles, as the top and bottom of the flow is approached. At the top, and often at the base of aa flows, is found a layer of fragmental material known as clinker. The fragments in the clinker range from a fraction of an inch to many feet in diameter, but most of them are less than two feet. They are more or less cemented and welded together, and are frequently partly decomposed by the action of circulating ground water. For convenience, the dense part of the aa flow will be referred to in this report as aa, in order to distinguish that part of the lava flow from the clinker.

Pahoehoe flows are typically frothy, with abundant bubble-holes; the local term pukapuka rock is descriptive of this rock. The pahoehoe flows are fed by lava moving through tubes in the interior of the flow, most of them only a foot or two across but a few reaching diameters of tens of feet. Sometimes the liquid lava drains away from these tubes leaving them partly or entirely empty. Many small lava tubes of this sort are exposed in the pahoehoe lavas along the southeast wall of South Halawa Gulch, and one about 7 feet in diameter was encountered in shaft 4 on Red Hill.

The lava flows form sheets 3 to 50 feet thick, with very irregular tops and bottoms, sloping gently southwestward. Many of them thin toward the southwest, as shown on the accompanying longitudinal sections. The lavas moved down the slope toward the southwest as relatively narrow streams. Their continuity along the ridge is therefore greater than across the ridge. Many flows thicken or thin rapidly across the ridge, and some pinch out altogether. These conditions are shown on the accompanying geologic sections.

Decomposition of the lava flows is largely confined to a zone at the surface. The rocks are softened by surface weathering to a depth of 40 to 60 feet. Below this depth, the clinker layers are often partly decomposed by water moving through them. Very slight weathering has been observed on the buried top of a few flows, and some pahoehoe flows show a slight reddening due to the oxidation of the iron in the rock. A few inches of soil, baked to natural brick by the heat of the overlying lava, were encountered at an elevation of 255 feet in drill hole 8. Otherwise, the rocks in this area are generally fresh and unaltered.

All of these rock types stand well without support in small tunnels. But it is difficult to predict their behavior in an arch of wide span. No such arch has ever been excavated in Hawaii. Judging from their physical appearance, the aa should stand best, the pahoehoe next best, and the clinker least well of the three types. Thick flows of aa will probably stand better than thin flows. All of these flows are broken by vertical joints, or planes of separation, which divide them into a large number of separate blocks. The principal joints in the thicker aa flows average from 6 to 10 feet apart, but most of the blocks of this dimension are further broken by smaller joints between the major ones. It is thus very unlikely that any single solid lava flow would act as a cantilever beam over any considerable span. The various blocks do, however, key into one another, and should break to a self-supporting arch if permitted to do so. This arch must, of course, be lined to prevent movement of any of the blocks, which might cause their unkeying and collapse, or the equilibrium of the arch.

The vertical distribution of the various types of lavas is shown in the accompanying geologic sections. Aa is more abundant than pahoehoe in the upper part of the sections, but pahoehoe becomes more abundant near the base. The upper two-thirds of the tank excavations will be largely in aa lava and clinker; the lower one-third will be largely in pahoehoe. The arch of tank 1 will probably be largely in aa, which should stand well, but a layer of clinker will probably be encountered near the top of the arch. The uppermost part of the arch may enter a pahoehoe flow. The arch of tank 2 will encounter a smaller percentage of aa and a larger amount of pahoehoe than tank 1.

Rock for use in concrete aggregate

It is probable that neither the pahoehoe nor the clinker can be used in concrete aggregate. The clinker is apt to be partly decomposed and softened, and therefore undesirable for this purpose. Some larger blocks in the clinker may be useable. The pahoehoe in general does not crush well for use in aggregate. Some of this may be useable, but should not be considered in an estimate of the available rock for this purpose. The aa, particularly the dense phases of the thicker flows, is the only material which can be assumed with confidence to be suitable for aggregate. This material will be similar in all respects to that now being quarried on the northwest side of South Halawa Gulch. It has a more or less well defined platyness owing to flowage while the lava was congealing, and much of it will break with a somewhat splintery fracture.

To obtain an estimate of the amount of rock available for concrete aggregate, the approximate percentages of aa, clinker, and pahoehoe encountered in four of the drill holes has been determined.

Hole 1, nearly between shafts 1 and 2, shows for the upper 133 feet of the shaft below the crown of the arch, 80 percent aa, 8 percent clinker, and 12 percent pahoehoe. The percentage of aa in this drill hole is considerably higher than average, and not over half of it is useable for aggregate.

Hole 9, about 200 feet south of shaft 2, for the same distance below the crown of the arch, shows 51 percent aa, 32 percent clinker, and 17 percent pahoehoe. For the entire depth of hole 9, below the level of the crown of the arch, the percentages are: 48 percent aa, 15 percent clinker, and 37 percent pahoehoe. This hole is more typical than is hole 1.

Drill hole 2, from an altitude of 348 feet to the bottom of the hole, shows: 62 percent aa, 21 percent clinker, and 17 percent pahoehoe. Drill hole 7, from an altitude of 368 feet to the bottom of the hole, shows: 62 percent aa, 31 percent clinker, and 7 percent pahoehoe. The section just below the bottom of these two holes undoubtedly contains a higher proportion of pahoehoe than in the section penetrated by the holes.

The percentage of the aa useable in concrete aggregate can only be estimated. An approximation may be reached by assuming that the percentage will be the same as the percent of core recovery. The following tables indicate cored intervals in suitable material, and the percentage of core recovered in each.

Hole 1

Interval		Core recovered	
Depth (feet)	Length (feet)	Feet	Percent
102.7-132.4	29.7	13.0	44
142.8-159.0	16.2	8.2	50
167.8-179.5	11.7	7.0	60
191.4-237.0	45.6	12.2	53
Average			52

Hole 9

Hole 9

Interval		Core recovered	
Depth (feet)	Length (feet)	Feet	Percent
101-111	10.0	8.1	81.0
130-151	21.0	6.3	30.0
155-177.5	22.5	11.4	50.6
190-201	11.0	8.0	72.7
225-275	50.0	20.6	41.2
332-345	13.0	6.0	46.1
Average			53.6

Fifty percent therefore appears a ~~safe~~ conservative estimate of the proportion of the aa suitable for aggregate.

Applying these percentages to the previous figures on the amount of aa penetrated by the respective drill holes, the following amounts are obtained:

In hole 1, for the upper 133 feet of the shaft below the crown of the arch, approximately 40 percent of the material penetrated would be of good quality for aggregate. This estimate is probably considerably higher than that available in the average.

In hole 9, for the upper 133 feet of the shaft below the crown of the arch, approximately 25.5 percent of the material penetrated would be of good quality for aggregate, and for the entire depth of the hole below the level of the crown of the arch approximately 24 percent of the material penetrated would be of good quality for aggregate.

Inasmuch as some of the other material may also be useable, there should be little doubt of obtaining at least 25 percent of useable rock from the total volume removed in excavating for the tanks. A more critical problem appears to be that of segregating the suitable material from the unsuitable without either too great expense or too great a loss of suitable material.

Water conditions in excavations

Northeast of Aliamanu cone the excavations will be in permeable lavas, but will lie entirely above the water table. Perched water was not encountered in any of the drill holes. Probably the only water encountered in the workings will be the small amount of water which is continually seeping downward through the rocks toward the water table.

The pipe-line tunnel will start at Pearl Harbor in tuff and continue in it for a mile or more toward Red Hill. The tuff is impermeable, but water can move along the numerous bedding planes and fractures in it. The altitude of the zone of saturation in the tuff is 46 feet in the well being drilled at Aliamanu Ammunition depot. The water table may slope steeply toward Pearl Harbor, in which case the pipe-line tunnel will be above the saturated zone most of the way to Red Hill. However, it is not anticipated that sufficient ground water will be encountered to make excavation difficult unless a buried ridge of Koolau basalt or other permeable rock such as gravel supplied by the Red Hill basin is encountered below the level of the artesian head, which may be as high as 46 feet. The probability of encountering such a ridge does not seem great.

Geology of the Waimalu area

The geology of the Waimalu area has been studied in the same manner as that of the Red Hill area. Cleared lines down the southeast wall of Waimalu Gulch along coordinates 0 + 35, 10 + 99.57, and 25 + 72.46 have been mapped in detail, and drill cores from diamond drill holes on these lines have been studied and described.

The rock types are the same as those at Red Hill. Aa lava and clinker are predominant in the upper part of the section, but pahoehoe lava is the dominant type in the lower part. The distribution of the various rock types is shown in the accompanying geologic sections.

Descriptions of

diamond-drill cores from

Red Hill and Waimalu areas, Oahu

1. USGS No.: Oahu T 19; US Navy No.: Halawa No. 1.
2. Location: Red Hill
3. Location determined by:
4. Longitude: (b) (3) (A)
5. Latitude:
6. Owner: US Navy
7. Driller: J M Heizer
8. Started: Aug. 31, 1940.
9. Completed: Sept. 16, 1940.
10. Altitude: 467.2
11. Depth: 237
12. Diameter: 1½ inches
13. Casing: 30.3 feet
14. Purpose: to determine nature of rock, in connection with underground fuel storage project.
15. Salt content when completed:
16. Head:
17. Geologic formations penetrated:

0.0 - 47.3	---	Highly decomposed aa
47.3 - 66.9	---	AA; with feldspar phenocrysts
66.9 - 74.7	---	Aa
74.7 - 94.5	---	Aa
94.5 - 101.5	---	Pahoehoe
101.5 - 137.8	---	Aa
137.8 - 142.8	---	Pahoehoe
142.8 - 166.±	---	Aa
166.± - 181.7	---	Aa
181.7 - 191.4	---	Pahoehoe
191.4 - 237.0	---	Aa (maybe flow top at 209')

Core			Description
Depth (feet)	Length (inches)	Texture	
0.0 - 19.7	0		No core
19.7 - 20.0	3	Dense	Highly decomposed aa
20.0 - 30.2	0		No core
30.2 - 32.2	11	Dense	Medium gray, sparingly vesicular, non-porphyritic aa; partly decomposed.
32.2 - 47.3	0		No core. Log says "firm red soil." Probably decomposed aa
47.3 - 50.2	20	Dense	Medium gray, sparingly vesicular aa, with a very few small phenocrysts of feldspar
50.2 - 58.1	82	Do	Like above
58.1 - 61.8	46	Do	Like above
61.8 - 66.9	40	Do	Like above
66.9 - 74.7	21	Vesicular	Like above, but sparingly to moderately vesicular and somewhat clinkery, & dark gray
74.7 - 80.0	13	Dense	Sparingly vesicular, medium grey, non-porphyritic aa
80.0 - 82.8	24	Do	Like above
82.8 - 86.4	31	Do	Like above
86.4 - 91.8	34	Do	Like above; lower 11" are somewhat clinkery and darker gray
91.8 - 94.5	10	Vesicular	Like above
94.5 -101.5	46	Do	Highly to moderately vesicular dark gray non-porphyritic pahoehoe
101.5 -102.7	8	Dense	Medium gray sparingly vesicular aa with scattered small phenocrysts of feldspar and a few of olivine
102.7 -113.1	26	Do	Like above. Lower 10" moderately vesicular

Core			Description
Depth (feet)	Length (inches)	Texture	
113.1 - 121.7	83	Do	Like above. Sparingly vesicular
121.7 - 126.5	47	Do	Like above. A 12" clinkery streak 16" below top
126.5- 128.4	23	Do	Like above
128.4 - 132.4	48	Do	Like above
132.4 - 137.8	40	Do	Like above. Lower 6" clinkery
137.8 - 142.8	39	Vesicular	Highly to moderately vesicular pahoehoe, with small phenocrysts of feldspar and a few of olivine; partly reddened
142.8 - 151.1	29	Do	Moderately to sparingly vesicular medium gray aa, with scattered small phenocrysts of feldspar and a few of olivine
151.1 - 155.0	31	Do	Like above
155.0 - 159.0	39	Dense	Medium gray sparingly vesicular aa, with a few phenocrysts of feldspar
159.0 - 167.8	40	Do	Like above. Lower 9" clinkery
167.8 - 175.6	48	Vesicular	Moderately to sparingly vesicular aa, like above but non-porphyritic
175.6 - 179.5	36	Dense	Like above, but sparingly vesicular
179.5 - 181.7	3	Vesicular	Clinker; fresh
181.7 - 191.4	27	Dense	Sparingly vesicular medium gray pahoehoe, with a few phenocrysts of feldspar
191.4 - 196.5	25	Do	Sparingly to moderately vesicular medium gray, non-porphyritic aa
196.5- 200.0	33	Do	Like above
200.0 - 204.0	37	Do	Like above
204.0 - 206.6	16	Do	Like above
206.6 - 225.4	112	Do	Like above; upper 10" clinkery; may be top of new flow but probably inter-flow clinker

Core			Description
Depth (feet)	Length (inches)	Texture	
225.4 - 229.5	40	Do	Like above
229.5 - 237.0	31	Do	Like above; lower 6" clinkery

1. USGS No.: Oahu T 20; US Navy No.: Halawa No. 2B
2. Location: Red Hill
3. Location determined by:
4. Longitude: (b) (3) (A)
5. Latitude:
6. Owner: US Navy
7. Driller: 0.0 - 190.3, W M Mullin; 190.3 - 295.0, J M Heizer
8. Started: Oct. 25, 1940
9. Completed: Oct. 31, 1940
10. Altitude: 539.5
11. Depth: 295.0
12. Diameter: 1½ inches
13. Casing:
14. Purpose: To determine nature of rock, in connection with underground fuel storage project.
15. Salt content when completed:
16. Head:
17. Geologic formations penetrated:

0.0 - 190.3	---	Partly cable drilled; the remainder diamond drilled by W M Mullin: cores too badly messed up to be of use
190.3 - 205.5	---	Aa, sparingly vesicular, upper part non-porphyritic, lower part with a few feldspar phenocrysts
205.5 - 210.9	---	Clinker
210.9 - 225.0	---	Aa, with rare phenocrysts of olivine and feldspar
225.0 - 233.2	---	Clinker
233.2 - 257.0	---	Aa
257.0 - 265.2	---	Aa, clinkery
265.2 - 277.0	---	Aa
277.0 - 295.0	---	Pahoehoe

Core			Description
Depth (feet)	Length (inches)	Texture	
0.0 - 190.3	0		No core
190.3 - 196.7	16	Dense	Sparingly vesicular, medium gray, nonporphyritic aa, locally slightly clinkery
196.7 - 199.3	24	Do	Like above
199.3 - 204.7	64	Do	Like above. A very few small phenocrysts of feldspar
204.7 - 205.5	8	Do	Like above
205.5 - 210.9	2	Permeable?	A piece of hard gray aa like above, probably base of flow; rest probably clinker. Log says "clinker."
210.9 - 221.3	97	Dense	Medium-gray, sparingly to moderately vesicular aa, with rare small phenocrysts of olivine and feldspar
221.3 - 225.0	30	Do	Like above
225.0 - 233.2	5	Permeable	As clinker
233.2 - 242.0	27	Do	Dark gray sparingly to moderately vesicular aa, clinkery, with rare phenocrysts of olivine and feldspar
242.0 - 244.4	24	Dense	Medium to dark gray, sparingly vesicular nonporphyritic aa
244.4 - 248.7	50	Do	Like above, but with a single phenocrysts of olivine
248.7 - 256.0	89	Do	Like above; nonporphyritic
256.0 - 257.0	11	Do	Like above
257.0 - 265.2	12	Permeable	Broken, clinkery aa, medium-gray, nonporphyriti
265.2 - 269.3	39	Dense	Medium-gray, sparingly to moderately vesicular aa, with a few very small phenocrysts of feldspar, none of them over 1mm long

269.3 - 271.9	29	Do	Like above
271.9 - 277.0	16	Do	Like above
277.0 - 289.0	26	Permeable	Highly vesicular, medium to dark gray nonporphyritic pahoehoe
289.0 - 295.0	47	Do	like above

1. USGS No.: Oahu T 21; US Navy No.: Halawa No. 3
2. Location: Red Hill
3. Location determined by:
4. Longitude: (b) (3) (A)
5. Latitude:
6. Owner: US Navy
7. Driller: J M Heizer
8. Started: Sept. 30, 1940
9. Completed: Oct. 7, 1940
10. Altitude: 609.09
11. Depth: 328.2
12. Diameter:
13. Casing:
14. Purpose: to determine nature of rock, in connection with underground fuel storage project
15. Salt content when completed:
16. Head:
17. Geologic formations penetrated:

83.6 - 99.2	---	Aa
99.2 - 114.2	---	Clinker
114.2 - 144.2	---	Aa
144.2 - 146.±	---	Clinker
146.± - 175.	---	Aa
175. - 206.±	---	Aa
206.± - 274.5	---	Aa
274.5 - 276.2	---	Pahoehoe
276.2 - 284.±	---	Aa
284.± - 328.2	---	Pahoehoe

Core			Description
Depth (feet)	Length (inches)	Texture	
0.0 - 83.6	0		No core. Upper part of hole percussion drilled
83.6 - 88.4	.57	Dense	Sparingly vesicular medium gray aa, with scattered small phenocrysts of feldspar
88.4- 99.2	118	Do	Like above
99.2 - 101.0	11	Do	Immature soil, derived from decomposed clinker
101.0 - 114.2	0		No core. Log says "soft." Probably clinker
114.2 - 120.4	68	Dense	Medium gray sparingly vesicular aa, with scattered phenocrysts of feldspar and a few of olivine
120.4 - 125.4	58	Do	Like above
125.4 - 134.2	35	Do	Upper 22" like above but partly reddened; lower 13" clinker
134.2 - 137.1	6	Vesicular	Clinkery aa
137.1 - 144.2	4	Do	Like above
144.2 - 145 ±	6	Dense	Clinker, reddened and decomposed
145 ± - 148.7	39	Do	Medium gray sparingly vesicular non-porphyritic aa; upper 8" clinkery
148.7 - 154.0	55	Do	Like above
154.0 - 158.8	50	Do	Like above
158.8 - 162.7	49	Do	Like above
162.7 - 167.9	62	Do	Like above
167.9 - 175.9	40	Do	Like above, except lower 7" like below
175.9 - 186.7	40	Vesicular	Medium gray moderately to sparingly vesicular aa with scattered small phenocrysts of feldspar: locally clinkery

Core		Texture	Description
Depth (feet)	Length (inches)		
186.7 - 197.1	96	Dense	Like above, but sparingly vesicular
197.1 - 205.1	96	Do	Like above
205.1 - 209.6	58	Vesicular	Like above; lower 20" clinkery
209.6 - 214.5	20	Vesicular	Moderately vesicular medium grey aa, non-porphyritic; upper 6" clinkery
214.5 - 219.0	30	Dense	Like above; sparingly to moderately vesicular
219.0 - 226.6	50	Do	Like above
226.6 - 234.3	36	Do	Like above
234.3 - 244.2	33	Do	Like above; lower 10" clinkery
244.2 - 247.2	25	Do	Like above
247.2 - 252.3	52	Do	Like above
252.3 - 256.2	31	Do	Like above; 8" clinkery streak 8" above base
256.2 - 261.5	37	Dense	Like above
261.5 - 264.5	24	Do	Like above
264.5 - 266.5	20	Do	Like above
266.5 - 276.2	91	Variable	Upper 73 inches like above; lower 18" dark gray moderately to highly vesicular pahoehoe
276.2 - 287.5	59	Do	Upper 37" medium gray moderately to sparingly vesicular aa; lower 22" dark gray highly vesicular pahoehoe
287.5 - 302.2	17	Vesicular	Pahoehoe, like above
302.2 - 309.1	44	Do	Like above
309.1 - 320.5	35	Do	Like above
320.5 - 323.2	19	Do	Like above

1. USGS No.: Oahu T 22; US Navy No.: Halawa No.4
2. Location: Red Hill
3. Location determined by:
4. Longitude: (b) (3) (A)
5. Latitude:
6. Owner: US Navy
7. Driller: J N Heizer
8. Started: Sept. 17, 1940
9. Completed: Sept. 28, 1940
10. Altitude: 708.81
11. Depth: 3751'
12. Diameter: 1½ inches
13. Casing:
14. Purpose: to determine nature of rock, in connection with underground fuel storage project
15. Salt content when completed:
16. Head:
- . Geologic formations penetrated:

0.0 - 132.0	---	No core. Cable drilled
132.0 - 159.0	---	Aa
159.0 - 175.0	---	Pahoehoe
175.0 - 190.0	---	Aa
190.0 - 240.0	---	Aa
240.0 - 255.0	---	Aa with olivine
255.0 - 298.0	---	Pahoehoe
298.0 - 327.5	---	Aa
327.5 - 375.1	---	Pahoehoe

Core			Description
Depth (feet)	Length (inches)	Texture	
0.0 - 132.0	0		No core. Cable drilled
132.0 - 140.1	18	Dense	Medium gray, sparingly to moderately vesicular, non-porphyritic aa; locally clinkery
140.1 - 149.2	28	Do	Like above; more or less clinkery; white zeolites deposited on surface of clinker
149.2 - 156.4	82	Do	Like above; sparingly vesicular
156.4 - 159.0	26	Do	Like above
159.0 - 166.2	47	Vesicular	Highly vesicular medium gray pahoehoe, reddened in upper part
166.2 - 175.0	57	Do	Like above
175.0 - 179.7	16	Dense	Medium gray sparingly vesicular aa, with a few small phenocrysts of feldspar
179.7 - 189.8	110	Do	Like above
189.8 - 199.9	51	Do	Like above, but not porphyritic; upper 2" porphyritic, next 2" clinkery
199.9 - 207.5	37	Do	Like above; 5" clinker streak 6" above base
207.5 - 210.6	8½	Do	Like above; clinkery
210.6 - 222.6	58	Do	Like above; locally clinkery
222.6 - 229.3	65	Do	Like above
229.3 - 240.0	52	Do	Like above
240.0 - 246.1	31	Do	Like above; upper 9" clinkery; with a few phenocrysts of olivine
246.1 - 250.2	38	Do	Like above

Core			Description
Depth (feet)	Length (inches)	Texture	
250.2 - 254.2	34	Do	Like above
254.2 - 255.0	9	Do	Like above
255.0 - 285.0	42	Vesicular	Highly vesicular dark gray pahoehoe; reddened in its upper part
285.0 - 297.0	75	Do	Like above
297.0 - 298.0	5	Do	Like above
298.0 - 303.9	37	Dense	Sparingly to moderately vesicular, medium gray, non-porphyritic aa
303.9 - 327.5	28	Do	Like above
327.5 - 342.1	79	Vesicular	Highly vesicular, dark gray pahoehoe
342.1 - 358.6	81	Do	Like above
358.6 - 375.1	43	Do	Like above

1. USGS No.: Oahu T 24; US Navy No.: Halawa No.6
2. Location: Red Hill
3. Location determined by:
4. Longitude: (b) (3) (A)
5. Latitude:
6. Owner: US Navy
7. Driller: J M Heizer
8. Started: Oct. 9, 1940
9. Completed: Oct. 15, 1940
10. Altitude: 522,
11. Depth: 235
12. Diameter: 1½ inches
13. Casing: 92.8
14. Purpose: to determine nature of rock, in connection with underground fuel storage project
15. Salt content when completed:
16. Head:
17. Geologic formation penetrated:

0.0 - 46.1	---	No core. Cable drilled
46.1 - 52.8	---	Aa
52.8 - 92.8	---	Clinker
92.8 - 120 ±	---	Aa
120 ± - 126.0	---	Pahoehoe
126.0 - 145.0	---	Clinker
145.0 - 166.±	---	Aa (with feldspar)
166.± - 175.0	---	Aa (with olivine)
175.0 - 182.6	---	Clinker
182.6 - 198.±	---	Aa
198.± - 201.6	---	Clinker
201.6 - 217.0	---	Aa
217.0 - 235.0	---	Pahoehoe

Depth (feet)	Core Length (inches)	Texture	Description
0.0 - 46.1	0		No core. Cable drilled
46.1 - 52.8	47	Dense	Medium gray, sparingly vesicular, non-porphyritic aa; locally clinkery; partly decomposed by weathering
52.8 - 56.0	0		No core
56.0 - 56.7	7	Do	Partly decomposed clinker
56.7 - 92.8	0		No core. Log says "soft." Probably clinker
92.8 - 99.2	62	Dense	Sparingly vesicular to almost non-vesicular, medium gray aa, with scattered small phenocrysts of feldspar
99.2 - 106.1	74	Do	Like above
106.1 - 121.2	103	Do	Like above. Lower 9" like below but aa. Appears to grade down into under-lying pahoehoe.
121.2 - 126.0	53	Vesicular	Dark gray highly vesicular pahoehoe
126.0 - 129.5	14	Dense	Clinker
129.5 - 134.1	30	Do	Do
134.1 - 145.0	20	Do	Upper 15" like above. Lower 5" like below
145.0 - 150.0	60	Do	Sparingly vesicular medium gray aa, with scattered small phenocrysts of feldspar
150.0 - 160.2	120	Do	Like above
160.2 - 163.0	25	Do	Like above
163.0 - 171.3	80	Do	Upper 24" like above; next 26" clinker; lower 30" medium gray sparingly vesicular aa, with scattered small phenocrysts of feldspar and a few of olivine
171.3 - 175.0	14	Do	Upper 6" like above; lower 8" clinker

175.0 - 180.0	0		No core. Probably clinker
180.0 - 181.2	10	Pervious?	Clinker
181.2 - 182.6	0		No core. Log says "soft." Probably clinker
182.6 - 192.2	108	Dense	Medium gray, sparingly vesicular, non-porphyritic aa
192.2 - 199.2	72	Do	Like above. Lower ol2" clinkery
199.2 - 201.6	5	Pervious?	Clinker
201.6 - 204.9	32	Dense	Dark gray, sparingly to moderately vesicular aa, with a few rare phenocrysts of olivine
204.9 - 208.5	35	DD	Like above, but medium gray.
208.5 - 217.0	97	Do	Like above
217.0 - 235	43	Vesicular	Medium to dark gray, highly vesicular pahoehoe; reddened throughout upper part

1. U.S.G.S. No.: Oahu T 25; U.S. Navy No. Halawa No. 7.

2. Location: Red Hill

3. Location determined by:

4. Longitude: (b) (3) (A)

5. Latitude:

6. Owner: U.S. Navy

7. Driller: J.M. Heiger

8. Started: Nov. 1, 1940

9. Completed: Nov. 8, 1940

10. Altitude: 476.3

11. Depth: 242.0

12. Diameter: 1½ inches

13. Casing:

14. Purpose: To determine nature of rock, in connection with underground fuel storage project

15. Salt content when completed:

16. Head:

17. Geologic formations penetrated:

0.0 - 98.9	---	Percussion drilled
98.9 - 101.2	---	Clinker
101.2 - 112.0	---	Aa, with feldspar phenocrysts
112.0 - 121.0	---	Clinker
121.0 - 130.0	---	Aa, nonporphyritic
130.0 - 146.4	---	Clinker
146.4 - 162.0	---	Aa, nonporphyritic
162.0 - 170.1	---	Clinker
170.1 - 203.0	---	Aa, with feldspar phenocrysts
203.0 - 207.0	---	Clinker
207.0 - 219.5	---	Aa, nonporphyritic
219.5 - 224.5	---	Clinker
224.5 - 232.0	---	Aa, with phenocrysts of ¼ olivine
232.0 - 242.0	---	Pahoehoe

Depth (feet)	Core Length (inches)	Texture	Description
0 - 98.9	0		No core. Percussion drilled.
98.9 - 101.2	6	Clinkery	Medium-gray, clinkeryaaa, with a few small phenocrysts of feldspar.
101.2 - 109.1	76	Variable	Aa like above; upper 16" sparingly vesicular, next 25" moderately vesicular and locally clinkery, lower 35" sparingly vesicular.
109.1 - 112.0	21	Dense	Like above, sparingly vesicular.
112.0 - 121.4	9	Clinkery	Upper 7" like above, clinkery; lower 2" like below.
121.4 - 127.1	72	Variable	Medium-gray nonporphyritic aa; upper 26" moderately vesicular, lower 46" sparingly vesicular
127.1 - 130.0	24	Dense	Like above, sparingly vesicular
130.0 - 133.2	7	Clinkery	Like above, clinkery
133.2 - 136.6	6	Do	Do
136.6 - 141.2	6	Do	Do
141.2 - 146.4	7	Do	Do
146.4 - 148.8	24	Dense	Medium-gray, sparingly vesicular, nonporphyritic aa
148.8 - 151.8	20	Do	Do
151.8 - 156.8	50	Do	Do
156.8 -161.2	51	Do	Do
161.2 - 162.0	9	Do	Like above, but a few small feldspar phenocrysts
162.0 - 170.1	5	Clinker	Reddened, loose clinker. Probably highly permeable
170.1 - 174.1	36	Vesicular	Medium-gray aa, with scattered small phenocrysts of feldspar; moderately vesicular, and upper 14" clinkery.

174.1- 184.1	120	Dense	Like above; moderately to springly vesicular
184.1- 193.2	110	Do	Like above, moderately to sparingly vesicular
193.2- 203.0	116	Do	Like above
203.0- 206.1	2	Clinkery	Like above, but clinkery
206.1- 208.8	10	Do	Upper 3" loose, reddened clinker; lower 7" slightly reddened nonporphyritic sparingly vesicular aa
208.8- 211.7	20	Dense	Like above
211.7- 214.8	36	Do	Medium-gray sparingly vesicular nonporphyritic aa
214.8- 219.5	55	Do	Like above
219.5- 224.5	13	Clinkery	Upper 7" loose reddened clinker; lower 6" medium to dark gray moderately to sparingly vesicular aa with scattered phenocrysts of olivine from 1 to 3 mm across
224.5- 228.4	31	Dense	Like above, sparingly vesicular
228.4- 232.0	34	Do	Like above
232.0- 242.0	18	Vesicular	Highly vesicular, medium to dark gray, nonporphyritic pahoehoe

1. U.S.G.S. No.: Oahu T 26; U.S. Navy No.: Halawa No. 8.
2. Location: Red Hill
3. Location determined by:
4. Longitude: (b) (3) (A)
5. Latitude:
6. Owner: U.S. Navy
7. Driller: J M Heizer
8. Started: Nov. 9, 1940.
9. Completed: Nov. 14, 1940
10. Altitude: 431.8
11. Depth: 203.5 feet
12. Diameter: $1\frac{1}{2}$ inches
13. Casing: 106.4 feet
14. Purpose: To determine nature of rock, in connection with underground fuel storage project
15. Salt content when completed:
16. Head:
17. Geologic formations penetrated:

0.0 - 106.4	---	Percussion drilled
106.4 - 125 ±	---	Aa, nonporphyritic
125 ± - 134.2	---	Clinker
134.2 - 177.±	---	Aa, with phenocrysts of feldspar & olivine
177.± - 178.±	---	Red baked soil
178.± - 180.0	---	Clinkery aa
180.0 - 188.5	---	Aa, nonporphyritic
188.5 - 197.±	---	Clinker
197.± - 203.5	---	Aa, with feldspar phenocrysts

Core			Description
Depth (feet)	Length (inches)	Texture	
0.0 - 106.4	0		No core. Percussion drilled.
106.4 - 127.0	91	Dense	Medium-gray sparingly vesicular nonporphyritic aa; lower 15" are firmly cemented clinker, with probably low permeability.
127.0 - 129.0	0		No core. Probably clinker like below.
129.0 - 130.0	7	Permeable	Loose, fresh, aa clinker.
130.0 - 134.2	0		No core. Probably clinker like above.
134.2 - 143.6	20	Permeable(?)	Dark gray, locally clinkery aa, like below.
143.6 - 150.8	21	Permeable(?)	DO
150.8 - 154.1	38	Dense	Sparingly vesicular, medium gray aa, with moderately abundant small phenocrysts of feldspar and a few of olivine.
154.1 - 160.2	71	Do	Like above.
160.2 - 167.5	87	Do	Like above.
167.5 - 171.0	39	Do	Like above; locally clinkery.
171.0 - 180.0	54	Do	Upper 33" like above, with last 7" somewhat reddened and clinkery; next 3" dense, well-indurated baked red soil; remainder is clinkery aa like below, upper 3" reddened.
180.0 - 187.0	90	Dense	Medium-gray sparingly vesicular aa, essentially nonporphyritic, but with a very few small phenocrysts of feldspar.
187.0 - 198.1	28	Dense	Upper 20" like abve; next 4" clinker; lower 4" like below.
198.1 - 203.5	63	Do	Medium-gray sparingly and locall moderately vesicular aa, locally clinkery, with small phenocrysts of feldspar.

1. U.S.G.S. No.: Oahu T 27 ; U.S. Navy No: Halawa No. 9.

2. Location: Red Hill

3. Location determined by:

4. Longitude: 157° 54' 1.2" .

5. Latitude: 21° 22' 22.8".

6. Owner: U.S. Navy

7. Driller: W M Mullin

8. Started: Nov. 7, 1940 ~~(?)~~

9. Completed: Nov. 15, 1940

10. Altitude: 462 feet

11. Depth: 370'.

12. Diameter: 1 inch

13. Casing:

14. Purpose: To determine nature of rock, in connection with underground fuel storage project.

15. Salt content when completed:

16. Head:

17. Geologic formations penetrated:

0	- 35	---	No core
35	- 40	---	Aa, nonporphyritic
40	- 42	---	Clinkery aa
42	- 47	---	Aa, nonporphyritic
47	- 55	---	Clinker
55	- 78	---	Aa, with small phenocrysts of feldspar and a few of olivine
78	- 90	---	Clinker
90	- 108	---	Aa, nonporphyritic
108	- 130	---	~~Clinker~~ Pahoehoe
130	- 138 ±	---	Clinker
138 ±	- 151	---	Aa, nonporphyritic
151	- 155	---	Clinker
155	- 177.5	---	Aa, with phenocryst of feldspar & Olivine
177.5	- 185 ±	---	Clinker
185 ±	- 203 ±	---	Aa with phenocryst s of feldspar
203 ±	- 225	---	Clinker
225	- 273 ±	---	Aa, nonporphyritic
273 ±	- 325 ±	---	Pahoehoe
325 ±	- 345	---	Aa, with very few small feldspar phenocrysts
345	- 370	---	Pahoehoe, with phenocrsts of feldspar and olivine

Core			Description
Depth (feet)	Length (inches)	Texture	
0 - 35 ±	0		No core. Percussion drilled(?) Driller's appears to have kept no log for this hole!
35 ± - 40	34	Dense	Medium-gray, sparingly vesicular nonporphyritic aa
40 - 42 ±	11	Permeable?	Clinkery aa
42± - 47 ±	37	Dense	Medium-gray sparingly vesicular nonporphyritic aa
47 ± - 53	7	Dense?	Clinker, but rotted and well indurated
53 - 55	15	Do	Like above
55 - 63	85	Dense	Medium-gray sparingly vesicular aa, with scattered small phenocrysts of feldspar
63 - 73	92	Do	Like above, plus a very few olivine phenocrysts
73 - 78	60	Do	Like above. Note--core is marked wrong! This 5' interval contains 75" of recovered core!
78 - 84	42	Permeable(?)	Upper ½ is clinker: lower ½ aa and clinkery aa
84 - 90	33	Permeable	Clinker, partly decomposed, with abundant white clay-like material (montmorillonite?)
90 -101	81	Dense	Sparingly to moderately vesicular, medium-gray, nonporphyritic aa; lower 9" clinkery
101 -111	93	Variable	Upper 75" like above; lower 25" highly vesicular nonporphyritic pahoehoe
111 122	73	Vesicular	Upper 59" like above; lower 14" moderately to sparingly vesicular pahoehoe
122 -130	55	Dense	Moderately to sparingly vesicular pahoehoe, close to aa in texture.
130 -145	45	Variable	Upper 7" clinker; lower 38" medium-gray, sparingly vesicular, nonporphyritic aa
145 -151	51	Dense	Like above
151 -155	10	Permeable	Clinker, (loose?)

155 -175	121	Dense	Medium-gray sparingly vesicular aa, with a few small phenocrysts of feldspar and of olivine, the latter reaching 3 mm across
175 -177.5	16	Do	Like above
177.5-179	19	Permeable?	Partly decomposed clinker
179 -190	19	Variable	Upper 7" like above; lower 12" like below
190 -201	97	Dense	Mediu-gray sparingly vesicular aa with moderately agundant small phenocrysts of feldspar
201 - 212	24	Permeable	Upper 12" like above; lower 12" loose clinker
212 -218	10	Do	Upper 4" clinker, lower 6" clinkery aa
218 -225	5	Do	Clinker and clinkery aa
225 -232	12	Do	Clinkery aa, like below
232 -238	52	Dense	Medium-gray sparingly vesicular nonporphyritic aa
238 -244	22	Do	Like above; a 2" clinkery layer 6" below top
244 -255	37	Do	Like above
255 -265	75	Do	Like above
265 -275	50	Do	Upper 48" like above; lower 2" like below
275 -283	55	Vesicular	Highly vesicular medium-gray pahoehoe, nonporphyritic
283 -285	24	Do	Like above. (Note--core wrongly marked by driller; 30" recovery in this 2' interval!)
285 -296	32	Do	Like above
296 -307	45	Do	Like above; upper 4" slightly reddened, probably flow top
307 -318	58	Do	Like above
318 -332	55	Variable	Upper 30" like above; lower 25" like below, locally clinkery
332 -345	72	Dense	Sparingly vesicular medium-gray aa, essentially nonporphyritic but with a very few small phenocrysts of feldspar
345 -358	48	Vesicular	Highly to moderately vesicular medium-gray to brownish-gray pahoehoe, with moderately abundant phenocrysts of feldspar & olivine
358 -370	47	Do	Like above

~~For Red Hill AOC Party Use Only~~

B:\605771032-HNL11900-Work\920 GIS\02 Maps\Field\Existing Wells 12202021.mxd 12/20/2021

Location Map

Legend

- Existing Basal Monitoring Well and Existing Elevated Head Adjacent Location
- Existing Conventional Monitoring Well Location; Red Hill Shaft
- Existing Multilevel Monitoring Well Location
- Existing Test Boring
- Water Supply Well
- OWDF Conventional Monitoring Well - Basal
- OWDF Conventional Monitoring Well - Perched
- BWS Conventional Monitoring Well
- Stream
- Red Hill Facility Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2019
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Some locations are subject to field verification.
5. **Revised December 2021.**

N

0 600 1,200 2,400 Feet

Existing Monitoring Well and Water Supply Well Locations
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

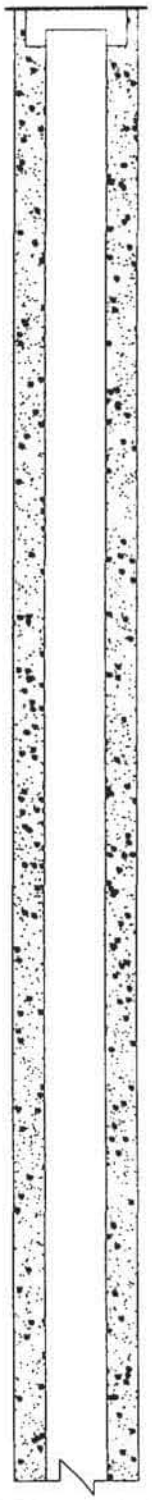
PROJECT: Red Hill Bulk Storage Facility
CLIENT: PACNAVFACENGCOM

Boring/Monitoring Well No. B-V1D
Project No. CTO 0229

LOCATION: V1D - Basal Aquifer	ELEVATION: 102.56		
DRILLER: Salisbury & Associates, Inc.	DATE DRILLED: 2/13/01	LOGGED BY: (b) (6)	
DRILL RIG: SAITECH EH5, Portable Core Drill	DEPTH TO WATER>	FIRST: 86.0	COMPL.: 86.1
BORING ANGLE: 90	WELL DIAMETER (inch): 1"		

Corrected Elevation/ Boring Length (ft)	Core Run Number	PID Reading (ppm)	Sample Number	Core Recovery %	Graphic Log	SOIL DESCRIPTION
102.56 (0)	1	NM		100		Concrete 0-2' over fine to coarse sand with fine gravel
102.06	2	172		83		and silt 2-2.5; basalt 2.5'; no odor
98.56	3	NM		71		Small to large vesicles; no odor; 10YR 3/1
		NM				Small to medium vesicles; no odor; 10YR 3/1 to 2/1
		99.2				
95.36	4	NM		0		Small vesicles; no odor; 5YR 3/2 to 10YR 2/2
94.16	5	NM		33		Small to medium vesicles; no odor; 5YR 3/2 to 10YR
93.66	6			100		2/2
91.76 (10)	7	124		105		Small to large vesicles; no odor; 10YR 2/2
	8			93		Small to large vesicles; no odor; 10YR 2/2 to 3/2
86.06	9	NM		96		Primarily small to medium vesicles; no odor; 10YR 2/2
81.66 (20)	10	NM		100		Small to primarily large vesicles; no odor; 10YR 2/2 to 5YR 3/2 to 10YR 3/1
76.26	11	3.2		100		Small to large vesicles; no odor; 10YR 3/1 to 5YR 3/2
71.26 (30)	12	10.8		100		Small to medium vesicles; no odor; 5YR 3/2 to 10YR 3/1
66.16	13	NM		102		Small to large vesicles; no odor; 5YR 3/2 to 10YR 3/1
60.96 (40)	14	NM		100		Small to large vesicles; no odor; 10YR 2/2 to 5YR 3/2
57.26						
56.91	15	NM		98		Small to medium vesicles; no odor; 10YR 2/2 to 5YR 3/2
						Void
53.06 (50)	16	NM		98		Small to medium vesicles; no odor; 10YR 2/2 to 5YR 3/2
48.06	17	1.0		89		Small to medium vesicles; no odor; 10YR 2/2 to 5YR 3/2
43.36 (60)	18	6.9		100		Small to large vesicles; no odor; 10YR 3/1 to 2/2 to 5YR 3/2
38.36	19	1.8		83		Small to large vesicles; no odor; 10YR 2/5 to 5YR 3/2
34.26 (70)	20	0.0		92		Small to medium vesicles; no odor; 10YR 2/1 to 2/2 tp 5YR 3/2
29.16	21	0.0	RH-BR-V1D-S01	102		Small vesicles; no odor; 10YR 2/1

WELL CONSTRUCTION



This information pertains only to this boring and should not be interpreted as being indicitive of the site.

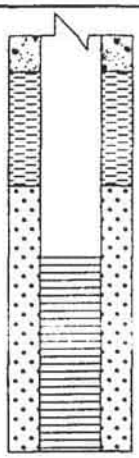
Corrected elevations are provided for angle borings.

PROJECT: Red Hill Bulk Storage Facility
CLIENT: PACNAVFACENGCOM

Boring/Monitoring Well No. B-V1D
Project No. CTO 0229

LOCATION: V1D - Basal Aquifer	ELEVATION: 102.56		
DRILLER: Salisbury & Associates, Inc.	DATE DRILLED: 2/13/01	LOGGED BY: (b) (6)	
DRILL RIG: SAITECH EH5, Portable Core Drill	DEPTH TO WATER>	FIRST: 86.0	COMPL.: 86.1
BORING ANGLE: 90	WELL DIAMETER (inch): 1"		

Corrected Elevation/ Boring Length (ft)	Core Run Number	PID Reading (ppm)	Sample Number	Core Recovery %	Graphic Log	SOIL DESCRIPTION	WELL CONSTRUCTION
24.06	22	0		100		Medium vesicles; no odor; 10YR 2/2	
18.86	23	0.0	RH-BR-V1D-S02	106		Medium vesicles; no odor; 10YR 2/2	
15.66	24	0.0		96		Large vesicles; no odor; 10YR 2/1	
10.16	25	0.0		86		Small vesicles; no odor; 10YR 2/2	
9.56						Clinker zone 93-100'	
6.56	26	0.0		56		Medium vesicles; clinker zone; no odor; 10YR 2/1	
4.96	27	0.0	RH-BR-V1D-S03	50		Medium vesicles; clinker zone; no odor; 10YR 2/2	
4.96						Clinker zone	
2.56						B-V1D terminated at 100.0'	



80 90 100 110 120 130 140 150

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Corrected elevations are provided for angle borings.

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW01R

Sheet 1 of 7

Date(s) Drilled	02/17/2021 - 03/03/2021	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	PQ core / Ream 5.375"	Drill Bit Size/Type	4.83" PQ diamond bit / 5.375" hole opener	Total Depth of Borehole	98.5 feet
Drill Rig Type	Hagby Onram 1000	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	102 feet
Groundwater Level	El. 18.09' msl (3/8/2021)	Location	RHSF (Tunnel)	Inclination from Horizontal/Bearing	90°
Borehole Completion	2-inch diameter monitoring well.			Hammer Data	N/A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
102	0								Concrete and Gravel Tunnel Floor and Fill		0.0	[1.3]	start coring 2/17/21 PID Tunnel 3.9ppm.
	1								Basalt gravel, cobble, and sand fill		0.0		
100	2						IF		**BASALT Pahoehoe** Olive black (5Y 2.5/2). Unweathered, strong to very strong IF. Mechanical		0.0	[1.3]	Circulation, added drilling water. PID Tunnel 0.0ppm.
	3	1	1	100		37	IF		1. 60°, J, N, Cl+Mn+Fe, Pa, Wa, SR		0.0		Circulation, able to add more water
							M				0.0	[4.8]	End coring 2/17/21 Begin coring 2/18/21. PID tunnel 0.0ppm.
98	4						1				0.0		
	5						IF		IF. Cl, Su, some mechanical fractures		0.0	[1.4]	PID Tunnel 0.0ppm.
									1. 60°, J, N, Cl, Pa, Pl, SR				
96	6	2	2	100		67							Lost circulation.
	7						M 1				0.0		Circulation returns, addition of more water.
							M		grades to blackish red (7.5R 2.5/3) and moderate brown (7.5YR 4/4), <1mm vesicles				
94	8						IF				0.0	[4.5]	Circulation w/ addition of water. PID Tunnel 0.0ppm.
							1						
	9								IF. Cl, Su, some mechanical fractures		0.0		
							IF						
92	10	3	3	100		35			olive black (5Y 2.5/2), vesicles increase to >1mm		0.0		
							2		1. 45°, J, VN, Cl+Fe, Pa, Wa, SR 2. 90°, J, VN, Cl+Fe+Mn, Pa, Pl, SR 3. 60°, J, VN, Cl+Mn, Sp, Ir, R				
	11						IF						
							3				0.0		
90	12						M		1. 75°, J, VN, Mn, Sp, Pl, SR		0.0	[3.5]	Circulation w/ addition of water. PID Tunnel 0.0ppm.
							M						
	13						1						

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW01R

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13														
		4	4	100		30		IF	color grades to moderate yellowish brown (2.5Y 6/8) and dark reddish brown (2.5YR 3/4)						
88	14							M	blackish red (7.5R 2.5/3), vesicles 2mm-10mm						Lost circulation, approximately 2120 gallons of water used. End coring 2/18/21.
	15								Altered plagioclase and pyroxene				0.0		
		5		100		100							0.0	[2.2]	Begin coring 2/19/21. PID Tunnel 0.0ppm.
86	16							1	1. 80°, J, N, Cl+Mn+Fe, Pa, Ir, VR				0.0	[1.7]	Approximately 1550 gallons of water used. PID Tunnel 0.0ppm.
		6	5	90		0		2	2. 10°, J, VN, Cl+Fe, Sp, Wa, SR						
	17							3	3. 0°/15°, J, N, Cl+Mn+Fe, Ir, VR						
								4	4. 0°, J, MW, Cl, Sp, Wa, SR				0.0		
								5	5. 90°, J, VN, Cl+Mn+Uk, Pa, Pl, R						
84	18								grades to grayish black (5YR 3/1), aphanitic				0.0	[4]	Approximately 2840 gallons of water used. PID Tunnel 0.0ppm.
	19							1	1. 0°, J, VN, Cl+Mn, Sp, St, VR						
		7		108		0		2	2. 0°, J, N, Cl+Mn+Fe, Su, Pl, R				0.0		
									IF. Cl, Su						
82	20							IF							End coring 2/19/21.
													0.0	[7.9]	Begin coring 2/22/21. PID Tunnel 0.6ppm. Approximately 570 gallons of water used.
	21							1	1. 0°, J, N, Cl, Sp, Ir, VR						
			6					M	2. 30°, B, N, Cl+Fe, Su, Wa, SR						
		8		92		36		2	3. 75°, J, VN, Cl, Sp, St, VR				0.0		
80	22							IF	flow margin, dusky brown (7.5YR 3/3), ropy texture, <1mm vesicles						
									dark gray (5YR 4/1), vesicles 1-5mm						
	23							3					0.0		
									becomes dark gray (5YR 4/1), slightly weathered, strong to very strong, vesicles <20mm				0.0	[3]	Approximately 2160 gallons of water used. PID Tunnel 0.7ppm.
									1. 45°, J, VN, Cl+Mn, Pa, Wa, SR						
78	24							1	2. 10°, J, VN, Cl+Mn, Pa, Ir, VR						
		9		100		100									
	25		7					2					0.0		
													0.0	[2.3]	Approximately 1680 gallons of water used. PID Tunnel 1.0ppm.
76	26								becomes grayish black (5YR 3/1), very finely vesiculated basaltic melt enclaves						
		10		100		100		M							
	27							M							
									vesicles decrease to 1-2mm				0.0		
74	28		8										0.0	[2.8]	Approximately 1590 gallons of water used.
	29														

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/5/2021 RHMW01R

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW01R

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29	11		112		100		M	1. 5°, J, T, Fe, H, Su, Ir, R		0.0		
72	30							1	← dark reddish brown (5YR 4/3) oxidation along healed fracture		0.0		
			9					1 IF 2	dark reddish brown (5YR 4/3), moderately weathered grades dark gray (5YR 4/1), unweathered with visible plagioclase lathes		0.0	[1.9]	Approximately 2390 gallons of water used. PID Tunnel 1.3ppm.
70	31	12		88		56		3	1. 0°, B, N, Fe+Cl, Su, Wa, VR 2. 90°, J, VN, Cl+Fe, Su, Ir, VR 3. 75°, J, VN, Cl+Fe, Su, Ir, VR 4. 0°, B, N, Fe+Cl, Su, Ir, VR				
	32							4			0.0		End coring 2/22/21.
	33						N.R.		No Recovery				
								IF	dark reddish brown (5YR 4/3), color and texture change indicative of flow margin		0.0	[1.9]	Begin coring 2/23/21. PID Tunnel 0.0ppm.
68	34	13		108		68			dark reddish brown (5YR 4/3), moderately weathered IF. Fe+Cl, texture of flow margin. ← dark gray (5YR 4/1), unweathered, 1 to 8mm vesicles, weathered olivine and pyroxene visible		0.0		
	35							1	1. 70°, J, VN, Fe+Mn+Cl, Sp, Wa, SR		0.0		
			10					M					
66	36								1. 60°, J, T, H 2. 30°, J, MW, Cl, Pa, Ir, VR 3. 30°, J, MW, Cl, Pa, Ir, VR		0.0	[2.2]	Approximately 2070 gallons of water used. PID Tunnel 0.3ppm.
		14		80		36		1 M 2 3			0.0		
	37								vesicles to 30mm				
							NR		No Recovery				
64	38								← 10-30mm vesicles		0.0	[1.3]	Approximately 6920 gallons of water used. Partial core run due to no advancing then resume. PID Tunnel 0.2ppm.
	39								1. 10°, B, N, Cl+Mn+Fe, Su, Ir, VR 2. 90°, J, VN, Cl+Fe, Su, Ir, SR 3. 0°, J, VN, Cl+Fe, Su, Pl, R 4. 0°, J, VN, Cl+Fe, Su, Pl, R 5. 45°, B, N, Cl+Fe, Su, Ir, VR				
			11					M			0.0		
62	40								← <10mm vesicles				
		15		100		74					0.0		
	41										0.0		
								1 2 3 4	← dark reddish brown (5YR 4/3), moderately weathered, strong, vesicles 1-3mm, flow contact				
60	42										0.0		
			12					M 5	← flow contact.				End coring 2/23/21.
	43								← dark reddish brown (5YR 4/3) to dark grey (5YR 4/1), moderately weathered, strong, 40 to 100mm vesicles		0.0	[1.8]	Begin coring 2/24/21. PID Tunnel 0.0ppm. Approximately 2500 gallons of water used.
58	44	16		84		60		1 2 3 M	← light olive brown (2.5Y 5/6) staining of vesicles. 1. 0°, J, VN, Cl, Fe, Su, Pl, VR 2. 0°, J, VN, Cl, Fe, Su, Pl, VR 3. 0°, B, N, Cl, Fe, Su, Pl, SR 4. 15°, J, N, Fe, Su, Wa, VR				
	45												

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW01R

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45										0.0		
56	46	17	13	112		56			dark grey (5YR 4/1), unweathered, strong 1. 90°, J, N, Fe, Su, Wa, VR 2. 0°, J, N, Fe, Su, Ir, VR		0.3	[1.6]	Approximately 2800 gallons of water used. PID Tunnel 0.3ppm.
	47								IF. Fe		0.3		
54	48	18		84		48			IF. Mechanical Abundant altered pyroxene, olivine, plagioclase.		0.7	[1.7]	Approximately 2650 gallons of water used. PID Tunnel 0.2ppm.
52	50						NR		No Recovery				
	51	19	14	112		100			mix of natural and mechanical IF 1. 60°, VN, Fe, Su, Wa, R 2. 60°, VN, Fe, Su, Wa, R 3. 90°, N, Fe, Su, Pl, VR		0.3	[1.7]	Approximately 2660 gallons of water used. PID Tunnel 0.2ppm.
50	52												End coring 2/24/21.
	53	20		88		52			Section logged using field photos of core. Core box disarranged in transit. 1. 65°, J, N, Fe+Cl, Su, Pl, SR 2. 65°, J, N, Fe, Sl, Su, Pl, R		0.0	[3.9]	Begin coring 2/25/21. PID Tunnel 0.0ppm. Approximately 1155 gallons of water used.
48	54												
	55	21	15	108		52					0.0		
46	56								Section logged using field photos of core. Core box disarranged in transit. 1. 0°, J, VN, Fe+Cl, Su, Pl, R 2. 30°, J, T, Fe+Cl, Su, Pl, R		0.0	[4.4]	Approximately 1020 gallons of water used. PID Tunnel 0.0ppm.
	57										0.0		
44	58	22	16	92		64			dark gray (5YR 4/1), slightly weathered, strong. Vesicles grade from 5mm at top of run to 20mm at bottom of run 1. 90°, J, VN, Fe+Cl, Su, Pl, R 2. 0°, J, VN, Cl+Fe, Su, Ir, VR		0.0	[2.2]	Approximately 2010 gallons of water used. PID Tunnel 0.0ppm.
42	60										0.0		
	61										0.0	[1.9]	Approximately 2390 gallons of

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/5/2021 RHMW01R

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW01R

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	61								vesicles grade from >30mm to 1mm				water used. PID Tunnel 0.0ppm.
40	62	23		112		100		M			0.0		
	63		17					M	vesicles grade from 3mm to 30mm		0.1	[1.9]	Approximately 2340 gallons of water used. PID Tunnel 0.4ppm.
38	64	24		88		32		1 IF M	IF. Fe+Cl, Su				
	65							M M	1. 10°, B, N, Cl+Fe, Su, Pl, Ir, R		0.0		
36	66	25		112		100		M	1. 0°, B, N, Fe, Su, Pl, Ir, R 2. 0°, B, N, Fe+Cl, Su, Pl, Ir, R		0.2	[1.8]	Approximately 2510 gallons of water used. PID Tunnel 0.4ppm.
	67							1					
34	68							2	increase in vesicularity, decrease in size to 2mm		0.0		End coring 2/25/21.
	69	26	18	88		48		M M M	vesicles increase to 20mm vesiculation decreases, size decreases to 1mm		0.7	[2.5]	Begin coring 2/26/21. PID Tunnel 0.0ppm. Approximately 1800 gallons of water used.
32	70							M 1	vesiculation increases, size increases to 30mm 1. 75°, J, VN, Cl+Fe+Mn, Pl, SR				
	71	27		112		20		IF	IF zones natural, contain dark red brown (5YR 3/4), moderately weathered oxidized fragments		0.8	[4.8]	Approximately 930 gallons of water used. PID Tunnel 0.0ppm.
30	72							IF					
	73	28	19	88		56		1 M M IF 2	1. 15°, B, N, Cl, Su, Pl, VR 2. 45°, J, VN, Fe, Su, Wa, SR IF zones natural, contain dark red brown (5YR 3/4), moderately weathered oxidized fragments		0.9	[4.8]	Approximately 930 gallons of water used. PID Tunnel 0.1ppm.
28	74												
	75							M	grayish black (5YR 3/1), slightly weathered, strong				
26	76	29	20	100		100		1 M	1. 25°, J, VN, Cl+Mn, Su, Wa, SR vesicles grade to 15mm		0.5	[2.9]	Approximately 1530 gallons of water used. PID Tunnel 1.1ppm.
	77												

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/5/2021 RHMW01R

~~For Red Hill AOC Party Use Only~~

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW01R

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
24	78							M	vesicles grade to 3mm grayish black (5YR 3/1), slightly weathered, weathered pyroxenes visible			[3.1]	Approximately 1440 gallons of water used. PID Tunnel 0.0ppm.
	79	30		92		80		M 1 2	1. 10°, J, VN, Fe+Cl, Su, Wa, VR 2. 30°, J, VN, Cl+Fe, Su, Pl, SR dark red brown (5YR 3/4), moderately weathered, oxidized, abundant clays		0.2		
22	80												
	81	31	21	100		16		1 2 3 4 5	1. 0°, VN, Fe+Mn, Su, Wa, R 2. 90°, VN, Fe+Mn, Su, Wa, R 3. 0°, VN, Fe+Mn, Su, Wa, R 4. 70°, VN, Fe+Mn, Su, Wa, R 5. 0°, VN, Fe+Mn, Su, Wa, R		0.0	[2.5]	Approximately 1770 gallons of water used. PID Tunnel 0.0ppm.
20	82							M	vesiculation increases, vesicles decrease in size to <1mm				
	83							M					
18	84	32	22	96		80		M 1 M	vesiculation grades to 30mm <1mm vesicles		15.1	[3.6]	On 3/1/21 DTW = 83.865' bgs. Approximately 1250 gallons of water used.
	85							M	Rock transmits water when sprayed. Faint odor present when logging on 07/01/2021				
16	86	33		112		60		M	1. 0°/80°, J, VN, Cl+Mn, Sp, Ir, R 1. 90° curved, J, VN, Cl, Sp, Ir, VR 2. 0°, VN, Cl, Su, Pl, VR		0.1	[3.5]	Approximately 1290 gallons of water used. PID Tunnel 0.5ppm.
	87							IF 1 2	IF. Cl, Fe				
14	88	34	23	88		68		1 M M	1. 0°, J, VN, Fe, Sp, Wa, R		0.4	[2]	End coring 2/26/21. Begin coring 3/1/21. PID Tunnel 2.6ppm. Approximately 2250 gallons of water used.
	89												
12	90							M					
	91	35		96		72		M	1. 0°, B, N, Cl+Fe, Su, Wa, Sr		0.4	[2.3]	Approximately 1950 gallons of water used. PID Tunnel 2.6ppm.
10	92		24					M 1					
	93							IF					

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/5/2021 RHMW01R

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW01R

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	93								**BASALT - a'a Clinker** No Recovery, a'a clinker assumed			[1.7]	Approximately 2620 gallons of water used. PID Tunnel 1.6ppm.
8	94	36		0		0	N.R						
	95												
	96							IF	**BASALT - a'a Clinker** No Recovery, extent of a'a clinker assumed			[4.7]	Approximately 950 gallons of water used. PID Tunnel 2.6ppm.
6	97	37		23		0	NR						
4	98												
	99								98.5' BGS TD RHMW01R was concrete cored from the tunnel floor surface to 0.5 ft below ground (i.e., tunnel floor) surface (bgs) and then hand cleared from 0.5 ft to 1.5 ft bgs with refusal on hard basalt. PQ coring commenced from 1.5 ft to 98.5 ft bgs total coring depth. The borehole was reamed from 1.5 ft to 98.5 ft bgs total reaming depth with a 5 3/8" modified PQ hole opener bit. RHMW01R well was installed with 2 inch diameter Schedule 80 polyvinyl chloride (PVC) well casing. The well was screened between 74 and 94 ft bgs (~ 8 and 28 ft msl); #3 Monterey sand filter pack from 71.8 ft to 97.4 ft bgs; bentonite pellet seal from 66.8 ft to 71.8 ft bgs; bentonite slurry from 6 ft to 66.8 ft bgs; and cement bentonite grout from tunnel floor surface to 6 ft bgs. The well surface completion consists of a flush mounted steel 6 inch diameter traffic box set in the concrete tunnel floor. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 64,635 gallons of water were used during drilling and rock coring. The borehole was developed using the drill rig bailer, surge block and submersible pump; a total of 77 gallons of development water were removed.				End drilling 3/1/21, total depth = 98.5' BGS
2	100												
	101												
0	102												
	103												
-2	104												
	105												
-4	106												
	107												
-6	108												
	109												

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/5/2021 RHMW01R

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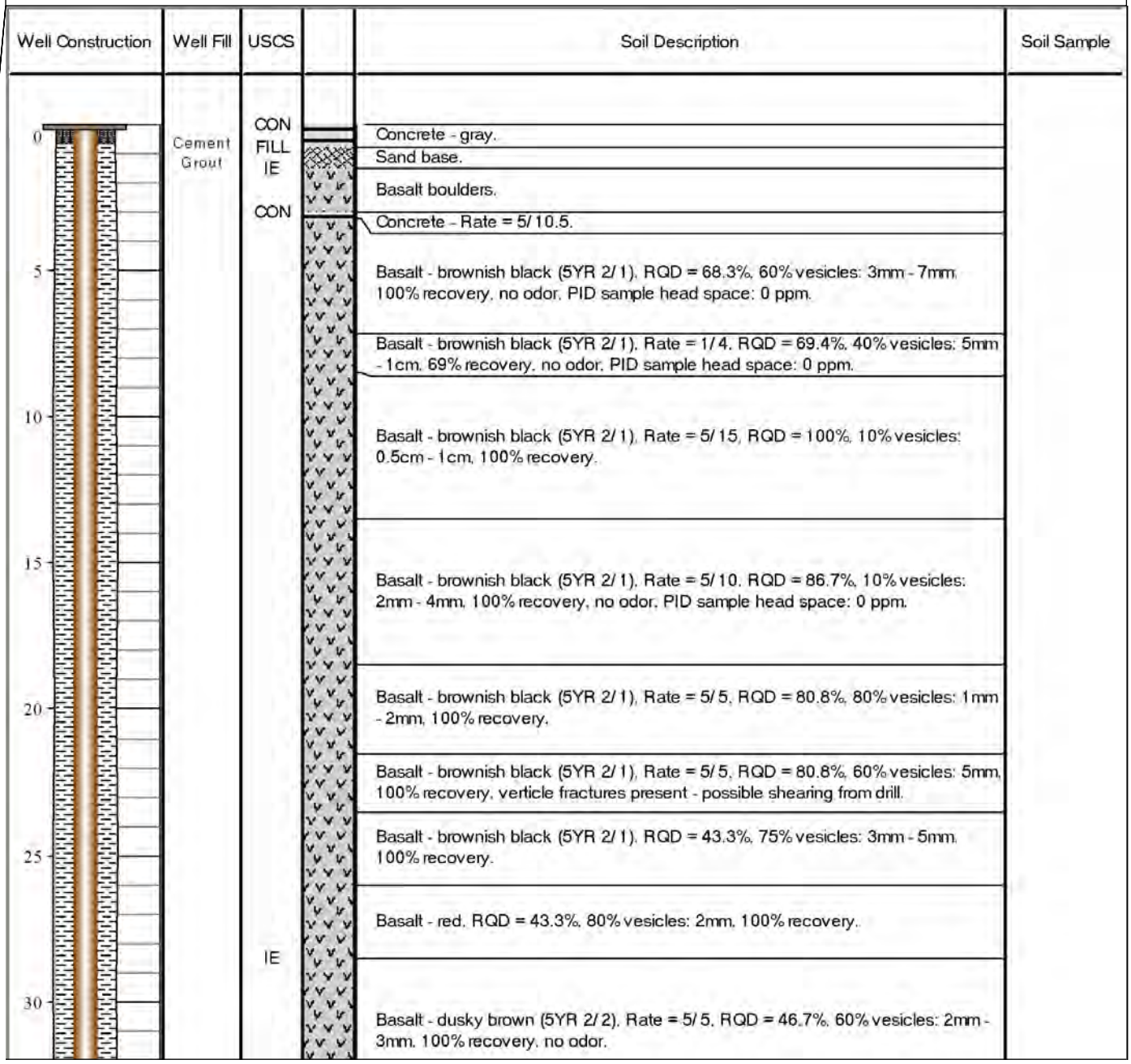
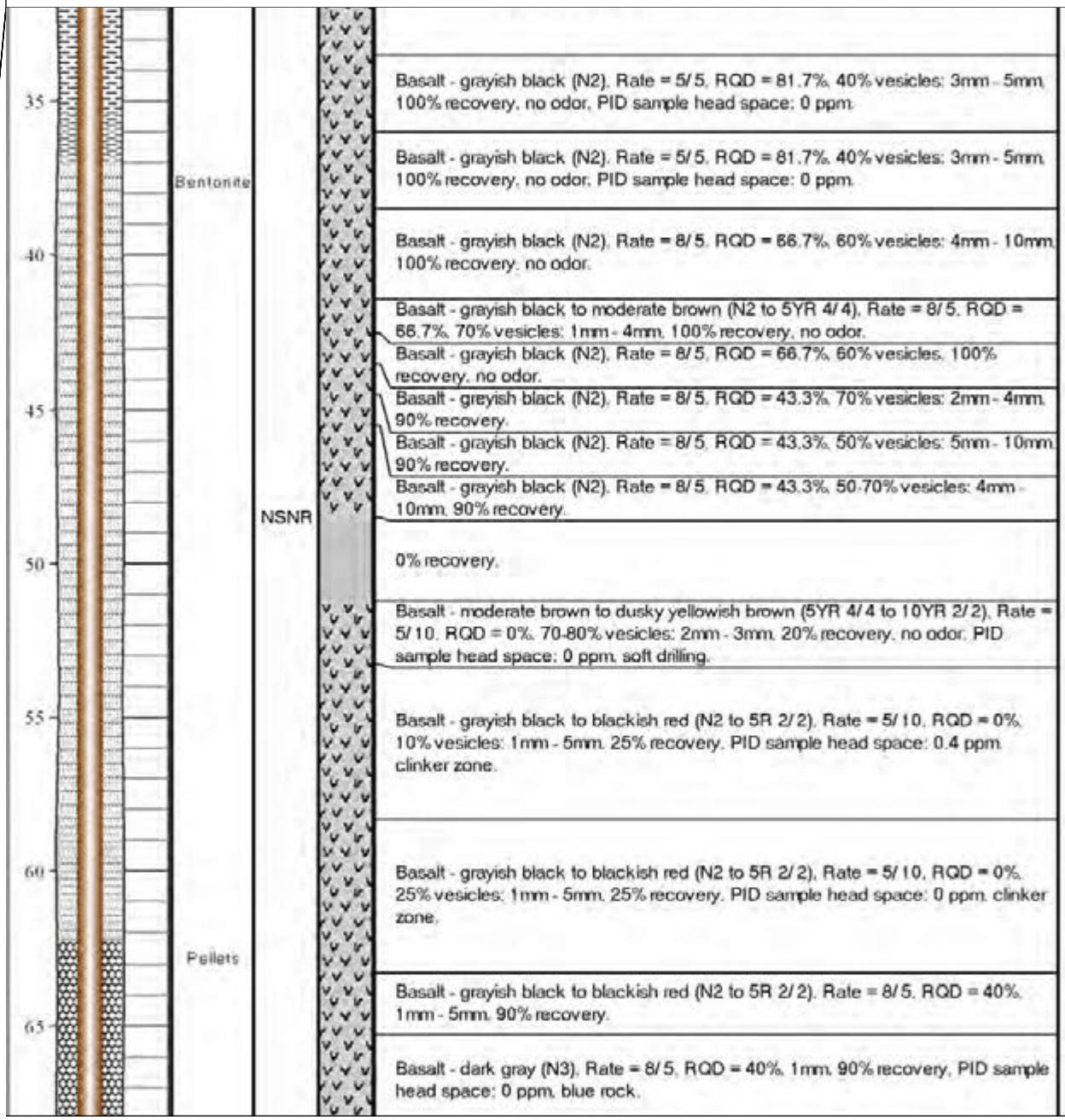
GEOLOGIC BOREHOLE LOG

Location: **RHSF**	Station Name: **RHMW02**	Location Type: **Monitoring Well**
Location Description: **lower access tunnel, N of Tank 6**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **106.57**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **5**
Total Depth (ft): **103.5**	Date Drilling Started: **27 July 2005**	Date Drilling Ended: **28 July 2005**
Remarks:		



GEOLOGIC BOREHOLE LOG

Location: **RHSF**	Station Name: **RHMW02**	Location Type: **Monitoring Well**
Location Description: **lower access tunnel, N of Tank 6**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **106.57**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **5**
Total Depth (ft): **103.5**	Date Drilling Started: **27 July 2005**	Date Drilling Ended: **28 July 2005**
Remarks:		



Basalt - grayish black (N2). Rate = 5/5. RQD = 81.7%. 40% vesicles: 3mm - 5mm. 100% recovery. no odor. PID sample head space: 0 ppm.

Basalt - grayish black (N2). Rate = 5/5. RQD = 81.7%. 40% vesicles: 3mm - 5mm. 100% recovery. no odor. PID sample head space: 0 ppm.

Basalt - grayish black (N2). Rate = 8/5. RQD = 66.7%. 60% vesicles: 4mm - 10mm. 100% recovery. no odor.

Basalt - grayish black to moderate brown (N2 to 5YR 4/4). Rate = 8/5. RQD = 66.7%. 70% vesicles: 1mm - 4mm. 100% recovery. no odor.

Basalt - grayish black (N2). Rate = 8/5. RQD = 66.7%. 60% vesicles. 100% recovery. no odor.

Basalt - grayish black (N2). Rate = 8/5. RQD = 43.3%. 70% vesicles: 2mm - 4mm. 90% recovery.

Basalt - grayish black (N2). Rate = 8/5. RQD = 43.3%. 50% vesicles: 5mm - 10mm. 90% recovery.

Basalt - grayish black (N2). Rate = 8/5. RQD = 43.3%. 50-70% vesicles: 4mm - 10mm. 90% recovery.

0% recovery.

Basalt - moderate brown to dusky yellowish brown (5YR 4/4 to 10YR 2/2). Rate = 5/10. RQD = 0%. 70-80% vesicles: 2mm - 3mm. 20% recovery. no odor. PID sample head space: 0 ppm. soft drilling.

Basalt - grayish black to blackish red (N2 to 5R 2/2). Rate = 5/10. RQD = 0%. 10% vesicles: 1mm - 5mm. 25% recovery. PID sample head space: 0.4 ppm. clinker zone.

Basalt - grayish black to blackish red (N2 to 5R 2/2). Rate = 5/10. RQD = 0%. 25% vesicles: 1mm - 5mm. 25% recovery. PID sample head space: 0 ppm. clinker zone.

Basalt - grayish black to blackish red (N2 to 5R 2/2). Rate = 8/5. RQD = 40%. 1mm - 5mm. 90% recovery.

Basalt - dark gray (N3). Rate = 8/5. RQD = 40%. 1mm. 90% recovery. PID sample head space: 0 ppm. blue rock.

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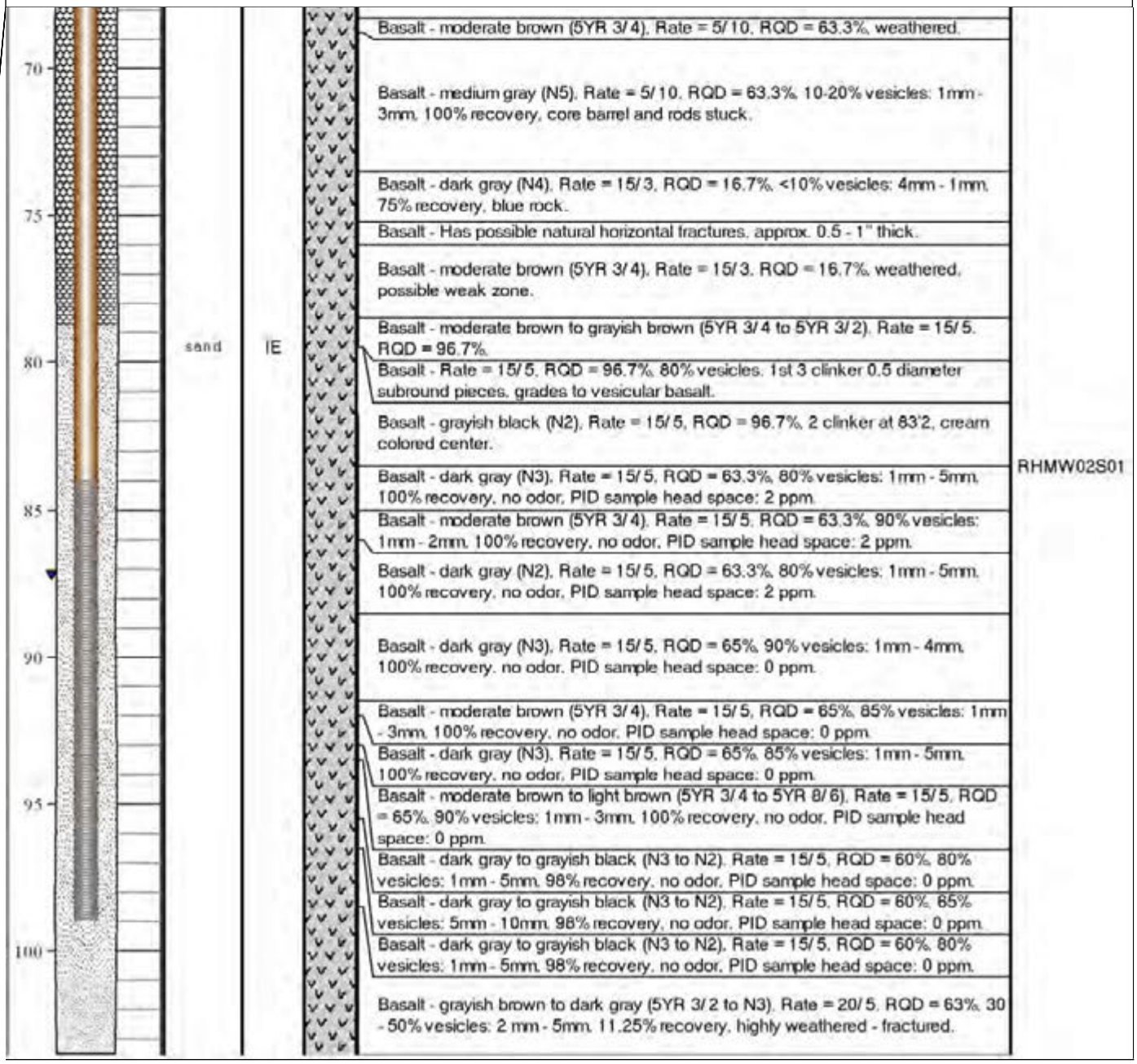
GEOLOGIC BOREHOLE LOG

Location: **RHSF**	Station Name: **RHMW02**	Location Type: **Monitoring Well**
Location Description: **lower access tunnel, N of Tank 6**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **106.57**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **5**
Total Depth (ft): **103.5**	Date Drilling Started: **27 July 2005**	Date Drilling Ended: **28 July 2005**
Remarks:		



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Well Construction Log

Location:	Red Hill BFSF	**Station ID:**		**Station Name:**	RHMW02	**Date:**	7/27/2005
Sys_Samp_Code:		**Elevation:**		**TD:**	103.5'	**Time**	**Start:**
Driller:	(b) (6)	**CO.:**	VWD	**Date Finished:**	7/28/2005		**Finish:**

Drilling Protocol

Hole Diameter:	5"	**Drilling Method:**	Coring	**Inclination:**	90°	**Azimuth:**	n/a

Casing

Material:	PVC Sch 80	**Diameter**	**ID:**	1.939	**From:**	0'	
			OD:	2.375	**To:**	84'	

Screen

Material:	PVC Sch 80	**Diameter**	**ID:**	1.939	**From:**	84'	**Slot #:** 0.02
			OD:	2.375	**To:**	99'	

Annular Fill

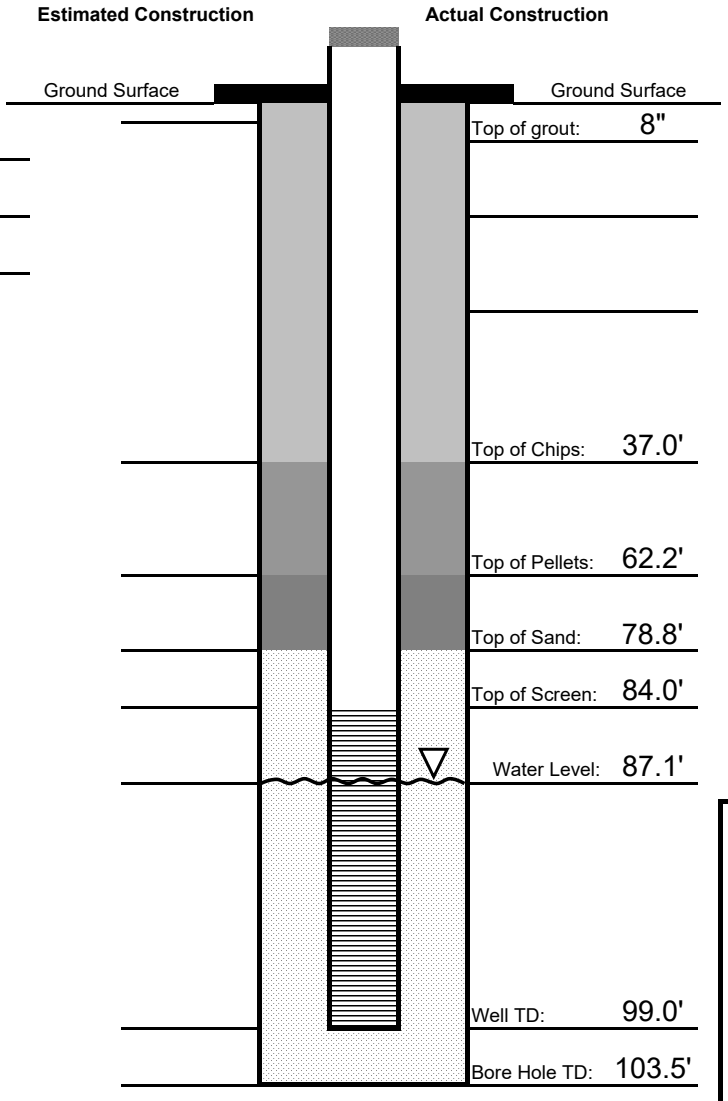
Sand:	Monterey #3	**Type**	**Bentonite**	**Chips:**	12	**Bags**	**Grout:**	0	**Bags**
	4	**Bags**		**Pellets:**	2	**Bkts**	**Cement:**	10	**Bags**

Surface Casing

Type: Traffic Cover

Diameter: 12"

Length: 12"



Cement
Grout
B. Chips
B. Pellets
Sand

Notes:

Borehole caved in to 99'

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Well Development Log

Location: Red Hill BFSF	**Station ID:**	**Station Name:** RHMW02	**Diameter:** 2"	**Date:** 9/8/2005	
Sys_Samp_Code:		**Elevation:**	**Material:** PVC	**Time**	**Start:** 1400
Sampler: (b) (6)		**Dry: yes / no**	**Balier Dia./L (in):** 1.5 X 90		**Finish:** 1530
CO.: TEC/VWD		**TD:** 99.0'	**Development Method:** SS Bailer		

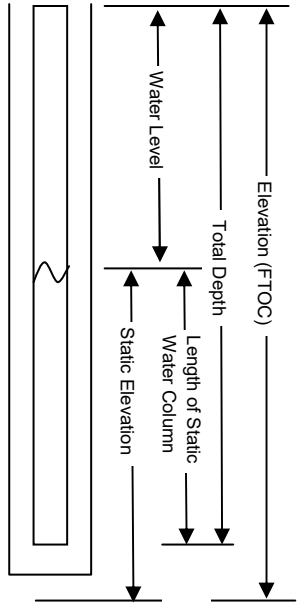
Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	Temp C°	Color	EC	Turbidity/ Sand (ppt)	Comments
9/8/05	1434	87.3'	3.50	7.48	25.0	Slightly Cloudy	0.83	0.41	
9/8/05	1445	87.3'	6.50	7.30	24.5	Slightly Cloudy	0.82	0.41	
9/8/05	1456	87.3'	10.25	7.26	24.3	Slightly Cloudy	0.84	0.42	
9/8/05	1502	87.3'	13.50	7.21	24.2	Slightly Cloudy	0.81	0.40	
9/8/05	1505	87.3'	14.25	7.24	24.2	Slightly Cloudy	0.81	0.41	
9/8/05	1507	87.3'	15.00	7.22	24.3	Slightly Cloudy	0.81	0.41	

Casing Volume Information

A	Hole Diam.	=	5.00
B	Well OD	=	2.375
C	Well ID	=	1.939
D	H2O Level	=	87.31
E	TD	=	99.00
F	Est. Filter Porosity	=	0.40

Vc=3.14(C/2)^2(E-D)

Vf=3.14[(A/2)^2-(B/2)^2](E-D)(F)



Casing ID	VOL Gal/Ft
1.00	0.04
1.50	0.09
2.00	0.16
2.50	0.26
3.00	0.37
3.50	0.50
4.00	0.65
4.50	0.83
6.00	1.50
7.00	2.00
8.00	2.60

Notes:

Well	**Vc=**	1.78	gal
	Vf=	3.67	gal
	Vt=	5.45	gal
	3Vt=	16.35	gal
Bailer	**V=**	0.68	gal

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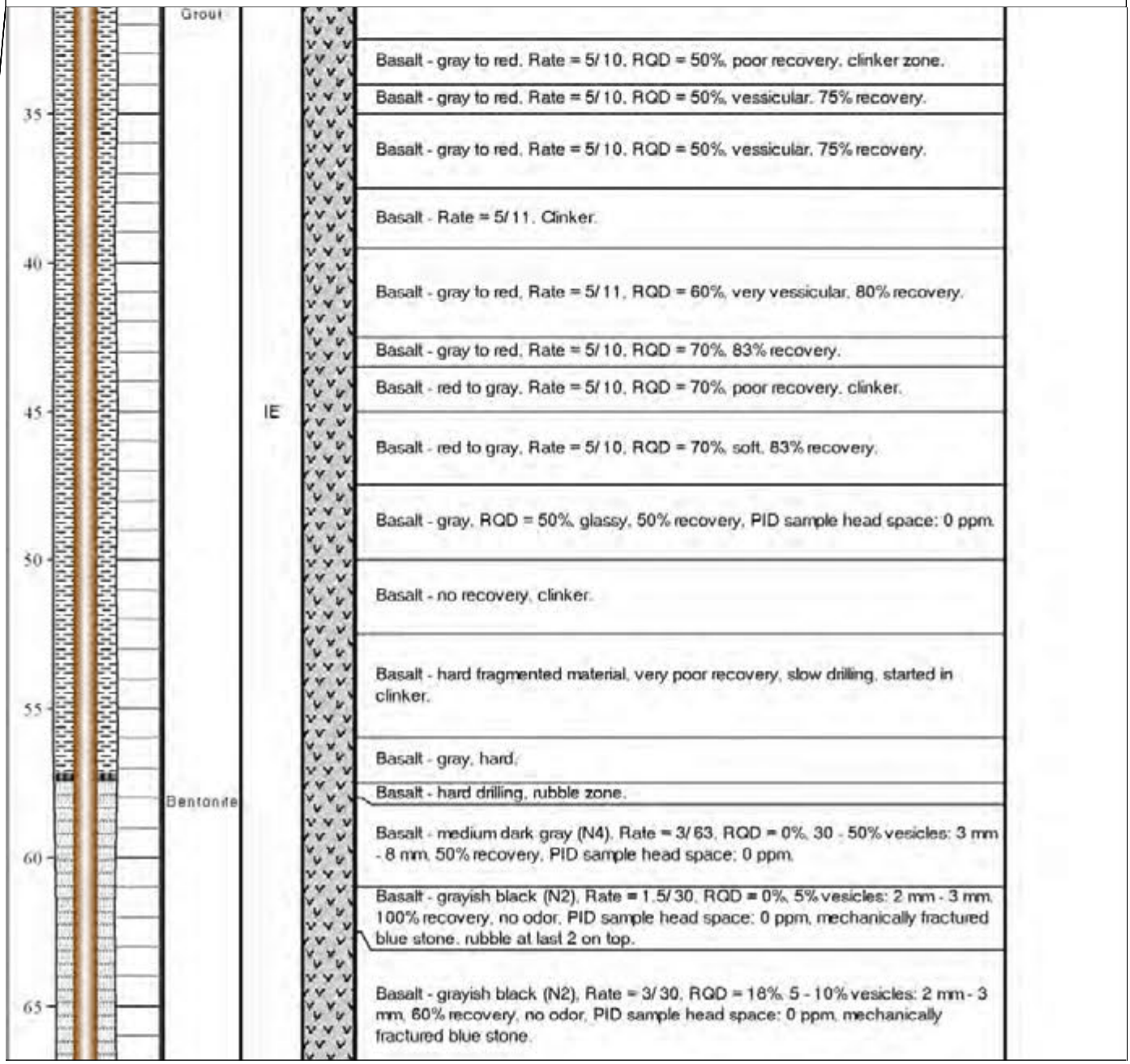
GEOLOGIC BOREHOLE LOG

Location: **RHFSF**	Station Name: **RHMW03**	Location Type: **Monitoring Well**
Location Description: **lower access tunnel, N of Tank 14**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **122.11**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **5**
Total Depth (ft): **118**	Date Drilling Started: **2 September 2005**	Date Drilling Ended: **7 September 2005**
Remarks:		

Well Construction	Well Fill	USCS	Soil Description	Soil Sample
0	Cement Grout	CON	Concrete.	
5			Basalt - dark gray to grayish brown (N3 to 5YR 3/2), Rate = 1/30, RQD = 33%, 80% vesicles: 1mm - 2mm, 100% recovery, PID sample head space: 0 ppm.	
			Basalt - grayish black (N2), Rate = 3/10, RQD = 73%, 70 - 90% vesicles: 1mm - 2mm, 100% recovery, PID sample head space: 0 ppm.	
			Basalt - moderate brown (5YR 3/4), Rate = 3/10, RQD = 73%, 70 - 90% vesicles: 1mm - 2mm, 100% recovery, PID sample head space: 0 ppm.	
			Basalt - dark gray (N3), Rate = 3/10, RQD = 73%, 30 - 80% vesicles: 1 mm - 10mm, 100% recovery, PID sample head space: 0 ppm.	
10			Basalt - dark gray (N3), Rate = 3/10, RQD = 90%, 30 - 80% vesicles: 1 mm - 10mm, 100% recovery, PID sample head space: 0 ppm.	
			Basalt - moderate brown (5YR 3/4), Rate = 3/10, RQD = 90%, 70 - 90% vesicles: 1 mm - 5mm, 100% recovery, PID sample head space: 0 ppm.	
15			Basalt - light brown (5YR 5/6), Rate = 4.5/12, RQD = 11%, 75 - 95% vesicles: 1 mm - 3mm, 66% recovery, PID sample head space: 0 ppm.	
			Basalt - dark gray (N3), Rate = 4.5/12, RQD = 11%, 80 - 90% vesicles: 1 mm - 5mm, 66% recovery, PID sample head space: 0 ppm.	
20			Basalt - soft gray, Rate = 1/3, RQD = 42%, highly vessicular, 100% recovery.	
			Basalt - soft gray, Rate = 1/3, RQD = 42%, 100% recovery.	
			Basalt - soft gray, Rate = 1/3, RQD = 42%, highly vessicular, soft - fractured, 100% recovery.	
			Basalt - red to soft gray, Rate = 5/18, RQD = 48%, vessicular, 100% recovery.	
25	Bentonite		Basalt - red, Rate = 5/18, RQD = 48%, vessicular, soft - fractured, 100% recovery.	
30			Basalt - red to soft gray, vessicular, fractured, poor recovery, clinker zone.	

GEOLOGIC BOREHOLE LOG

Location: **RHFSF**	Station Name: **RHMW03**	Location Type: **Monitoring Well**
Location Description: **lower access tunnel, N of Tank 14**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **122.11**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **5**
Total Depth (ft): **118**	Date Drilling Started: **2 September 2005**	Date Drilling Ended: **7 September 2005**
Remarks:		



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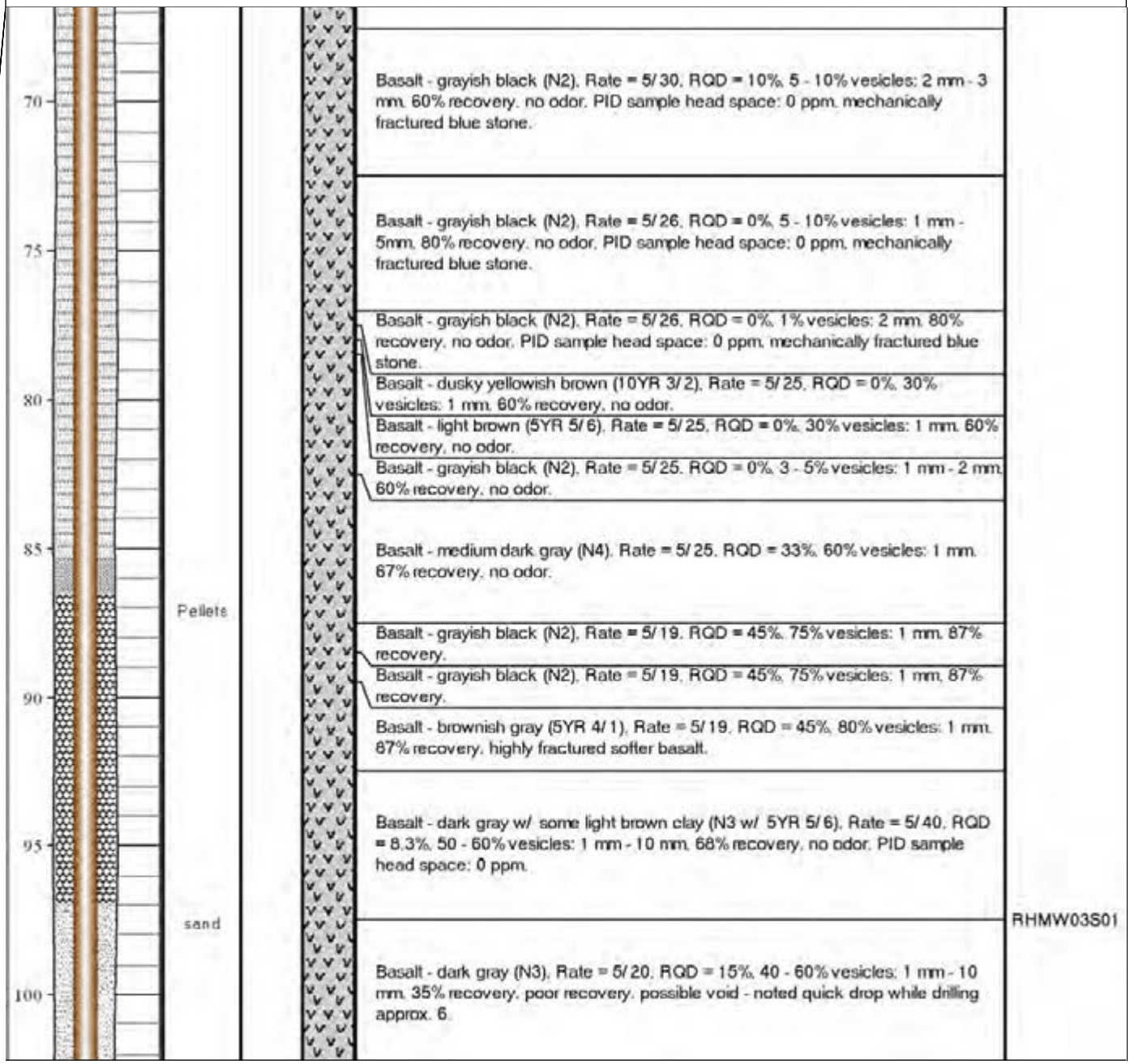
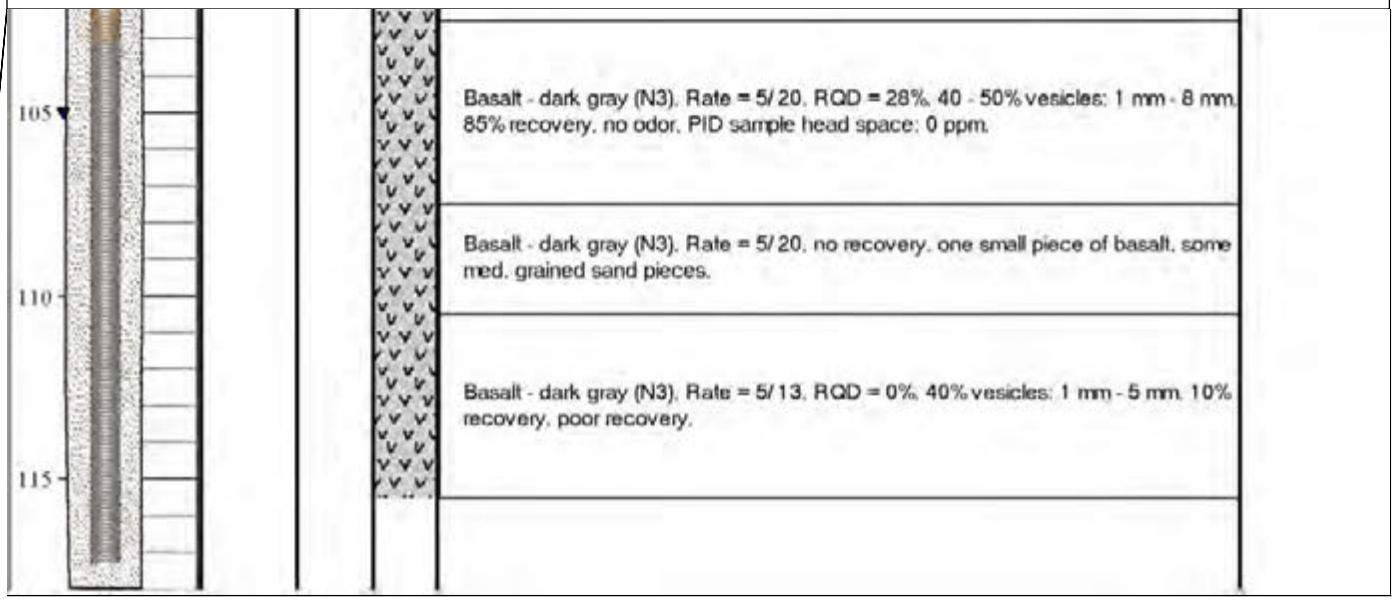
GEOLOGIC BOREHOLE LOG

Location: **RHFSF**	Station Name: **RHMW03**	Location Type: **Monitoring Well**
Location Description: **lower access tunnel, N of Tank 14**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **122.11**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **5**
Total Depth (ft): **118**	Date Drilling Started: **2 September 2005**	Date Drilling Ended: **7 September 2005**
Remarks:		



GEOLOGIC BOREHOLE LOG

Location: **RHFSF**	Station Name: **RHMW03**	Location Type: **Monitoring Well**
Location Description: **lower access tunnel, N of Tank 14**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **122.11**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **5**
Total Depth (ft): **118**	Date Drilling Started: **2 September 2005**	Date Drilling Ended: **7 September 2005**
Remarks:		



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Well Construction Log

Location:	Red Hill BFSF	**Station ID:**		**Station Name:**	RHMW03	**Date:**	9/2/2005
Sys_Samp_Code:		**Elevation:**		**TD:**	118.0'	**Time**	**Start:**
Driller:	(b) (6)	**CO.:**	VWD	**Date Finished:**	9/7/2005		**Finish:**

Drilling Protocol

Hole Diameter:	5"	**Drilling Method:**	Coring	**Inclination:**	90°	**Azimuth:**	n/a

Casing

Material:	PVC Sch 80	**Diameter**	**ID:**	1.939"	**From:**	0'	
			OD:	2.375"	**To:**	102.3'	

Screen

Material:	PVC Sch 80	**Diameter**	**ID:**	1.939"	**From:**	102.3'	**Slot #:** 0.02
			OD:	2.375"	**To:**	117.3'	

Annular Fill

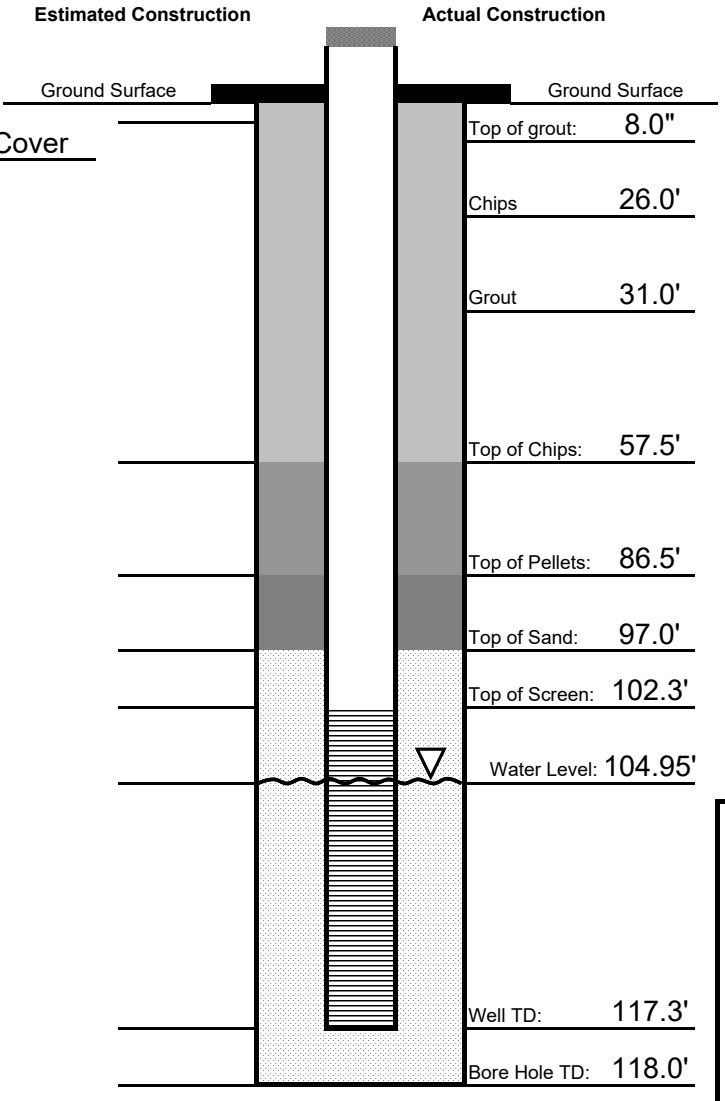
Sand:	Monterey #3	**Type**	**Bentonite**	**Chips:**	8	**Bags**	**Grout:**	0.5	**Bags**
	2	**Bags**		**Pellets:**	1.5	**Bkts**	**Cement:**	9	**Bags**

Surface Casing

Type: Flush Traffic Cover

Diameter: 12"

Length: 12"



Cement
Grout
B. Chips
B. Pellets
Sand

Notes:

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Well Development Log

Location: Red Hill BFSF	**Station ID:**	**Station Name:** RHMW03	**Diameter:** 2"	**Date:** 9/7/2005	
Sys_Samp_Code:		**Elevation:**	**Material:** PVC	**Time**	**Start:**
Sampler: (b) (6)		**Dry: yes / no**	**Balier Dia./L (in):** 1.5 X 30		**Finish:**
CO.: TEC/VWD		**TD:** 117.3	**Development Method:** PVC Bailer		

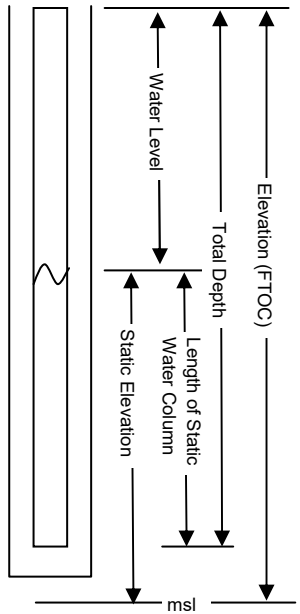
Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	Temp C°	Color	EC	Turbidity/ Sand (ppt)	Comments
9/7/05	1421	104.2	0.23	5.40	26.7	Dk Grayish	1.42	0.71	
9/7/05	1428	104.2	0.69	6.21	26.5	Dk Grayish	1.44	0.72	
9/7/05	1433	104.2	1.61	6.24	26.4	Dk Grayish	1.37	0.69	
9/7/05	1437	104.2	2.30	6.27	26.3	Dk Grayish	1.36	0.68	
9/7/05	1444	104.2	2.99	6.36	26.2	Dk Grayish	1.20	0.60	
9/7/05	1451	104.2	4.14	6.33	26.1	Dk Grayish	1.20	0.60	
9/7/05	1455	104.2	4.83	6.30	26.1	Dk Grayish	1.15	0.57	
9/7/05	1500	104.2	5.52	6.32	26.2	Dk Grayish	1.01	0.55	
9/7/05	1510	104.2	6.67	5.39	26.2	Dk Grayish	1.03	0.52	
9/7/05	1518	104.2	7.59	5.37	26.2	Dk Grayish	1.02	0.51	
9/7/05	1526	104.2	8.51	5.39	26.2	Dk Grayish	1.02	0.50	
9/7/05	1527	104.2	8.74	5.57	26.3	Dk Grayish	1.01	0.50	

Casing Volume Information

A	Hole Diam.	=	5.00
B	Well OD	=	2.375
C	Well ID	=	1.939
D	H2O Level	=	104.20
E	TD	=	117.30
F	Est. Filter Porosity	=	0.40

Vc=3.14(C/2)^2(E-D)

Vf=3.14[(A/2)^2-(B/2)^2](E-D)(F)



Casing ID	VOL Gal/Ft
1.00	0.04
1.50	0.09
2.00	0.16
2.50	0.26
3.00	0.37
3.50	0.50
4.00	0.65
4.50	0.83
6.00	1.50
7.00	2.00
8.00	2.60

Notes:

Well	**Vc=**	2.00	gal
	Vf=	4.11	gal
	Vt=	6.11	gal
	3Vt=	18.32	gal
Bailer	**V=**	0.23	gal

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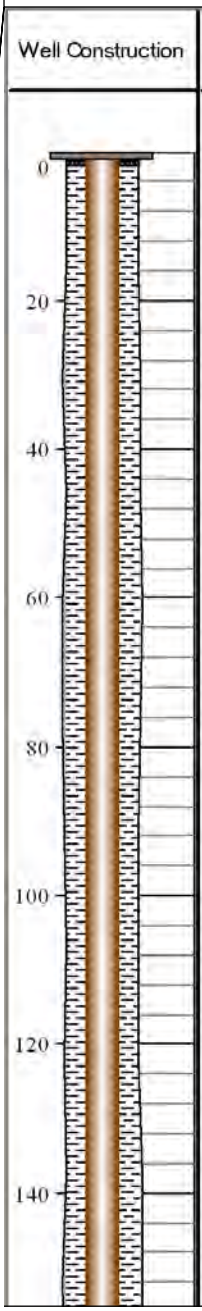
GEOLOGIC BOREHOLE LOG

Location: **RHFSF**	Station Name: **RHMW04**	Location Type: **Monitoring Well**
Location Description: **west. access rd., S of Navy Firing Range**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **313.03**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **8**
Total Depth (ft): **320.5**	Date Drilling Started: **22 July 2005**	Date Drilling Ended: **26 July 2005**
Remarks:		



Well Construction	Well Fill	USCS	Soil Description	Soil Sample
	Cement Grout	GW	Well-graded gravel with sand - dark reddish brown (5YR 2.5/2), medium stiff, moist, 80% gravel, 15% fines, 5% fines, road base.	RHMW04S02
			Basalt bedrock.	
			Basalt - moderate brown (5YR 3/4), Rate = 5/5, 50 - 80% vesicles.	
			Basalt - dark gray (blue rock) (N3), Rate = 5/10, massive, 5% small crystals.	
		IE	Basalt - dark gray (N3), Rate = 5/10, 70 - 90% vesicles:small.	
			Basalt - dark gray (N3), Rate = 5/7, massive.	
			Basalt - dark gray (N3), Rate = 5/10, 70 - 90% vesicles.	
			Basalt - dark gray (N3), Rate = 5/10, vesicles.	
			Basalt - dark gray (N3), Rate = 5/10, vesicles.	
			Basalt - dark gray (N3), Rate = 5/12, vesicles.	
		NSNR	Rate = 5/18, no recovery.	
			Basalt - moderate brown to dark gray (5YR 3/4 to N3), Rate = 5/12, vesicles.	
			Basalt - dark gray (N3), Rate = 5/16, vesicles with min. deposits, Perched water encountered - to approx. 130 feet.	
			Basalt - dark gray (N3), Rate = 5/15, massive.	
			Basalt - dark reddish brown to dark gray (10YR 3/4 to N3), Rate = 5/20, vesicles.	
			Basalt - medium dark gray to dark gray (N4 to N3), Rate = 5/15, vesicles.	
		IE	Basalt - dark reddish brown to dark gray (10YR 3/4 to N3), Rate = 5/15, massive and vesicles.	
			Basalt - dark reddish brown (10YR 3/4), Rate = 5/10, vesicles.	
			Basalt - dark gray (N3), Rate = 5/12, vesicles.	

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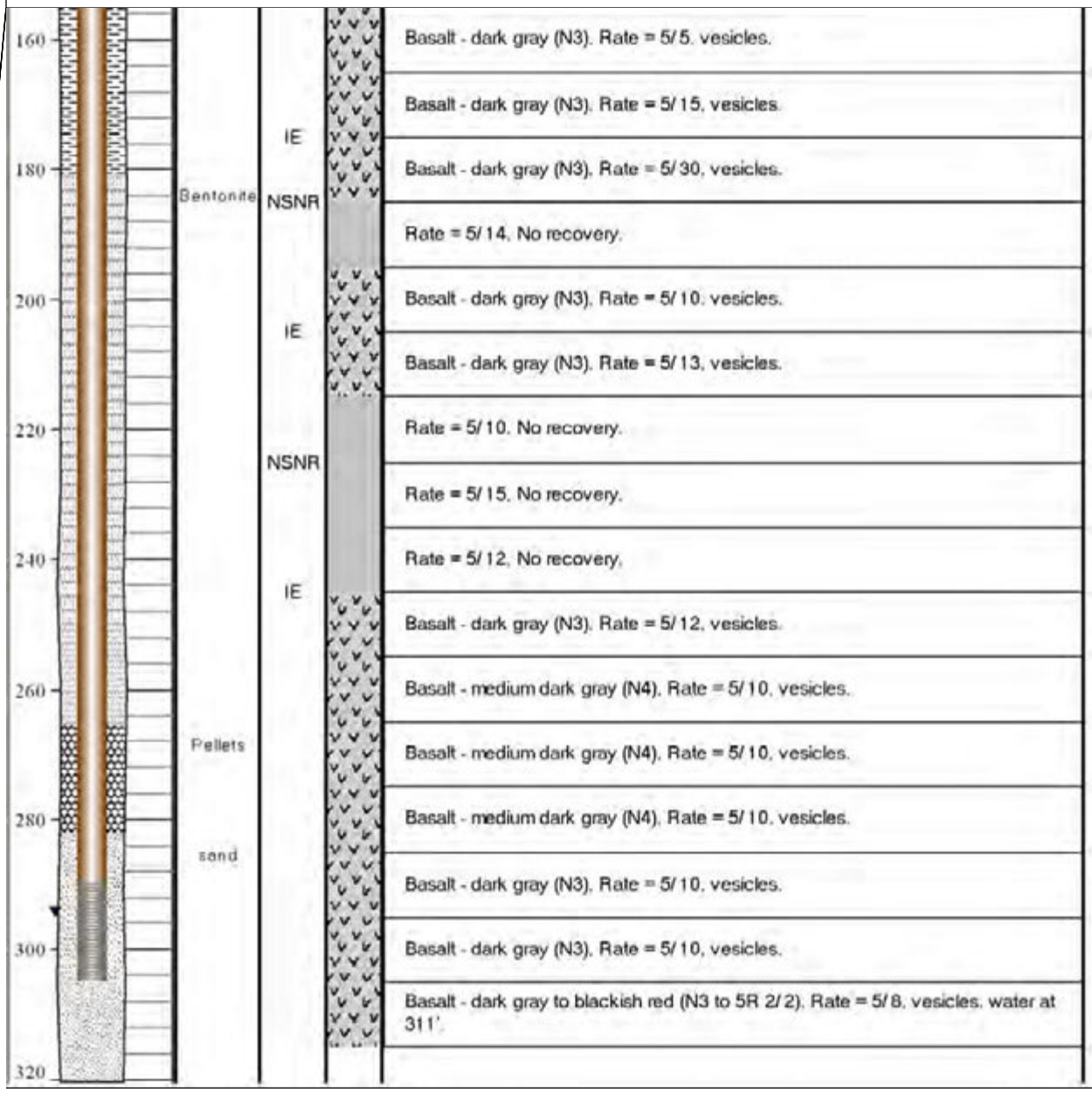
GEOLOGIC BOREHOLE LOG

Location: **RHFSF**	Station Name: **RHMW04**	Location Type: **Monitoring Well**
Location Description: **west. access rd., S of Navy Firing Range**		Establishing Company: **TEC Inc.**
Drilling Foreman: (b) (6)		Drilling Company: **Valley Well Drilling**
Geologist: (b) (6)	Ground Surface Elevation (ft): **313.03**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**		Borehole Diameter (in): **8**
Total Depth (ft): **320.5**	Date Drilling Started: **22 July 2005**	Date Drilling Ended: **26 July 2005**
Remarks:		



Basalt - dark gray (N3). Rate = 5/5. vesicles.
Basalt - dark gray (N3). Rate = 5/15. vesicles.
Basalt - dark gray (N3). Rate = 5/30. vesicles.
Rate = 5/14. No recovery.
Basalt - dark gray (N3). Rate = 5/10. vesicles.
Basalt - dark gray (N3). Rate = 5/13. vesicles.
Rate = 5/10. No recovery.
Rate = 5/15. No recovery.
Rate = 5/12. No recovery.
Basalt - dark gray (N3). Rate = 5/12. vesicles.
Basalt - medium dark gray (N4). Rate = 5/10. vesicles.
Basalt - medium dark gray (N4). Rate = 5/10. vesicles.
Basalt - medium dark gray (N4). Rate = 5/10. vesicles.
Basalt - dark gray (N3). Rate = 5/10. vesicles.
Basalt - dark gray (N3). Rate = 5/10. vesicles.
Basalt - dark gray to blackish red (N3 to 5R 2/2). Rate = 5/8. vesicles. water at 311'.

Well Construction Log

Location:	Red Hill BFSF	**Station ID:**		**Station Name:**	RHMW04	**Date:**	7/22/2005
Sys_Samp_Code:		**Elevation:**		**TD:**	320.5'	**Time**	**Start:**
Driller:	(b) (6)	**CO.:**	VWD	**Date Finished:**	7/26/2005		**Finish:**

Drilling Protocol

Hole Diameter:	8"	**Drilling Method:**	Air Rotary	**Inclination:**	90°	**Azimuth:**	n/a

Casing

Material:	PCV Sch 80	**Diameter**	**ID:**	3.826"	**From:**	0'	
			OD:	4.5"	**To:**	290'	

Screen

Material:	PCV Sch 80	**Diameter**	**ID:**	3.826"	**From:**	290'	**Slot #:**	0.02	
			OD:	4.5"	**To:**	305'			

Annular Fill

Sand:	Monterey #3	**Type**	**Bentonite**	**Chips:**	16	**Bags**	**Grout:**	2	**Bags**	
	6	**Bags**		**Pellets:**	6	**Bkts**	**Cement:**	40	**Bags**	

Estimated Construction **Actual Construction**

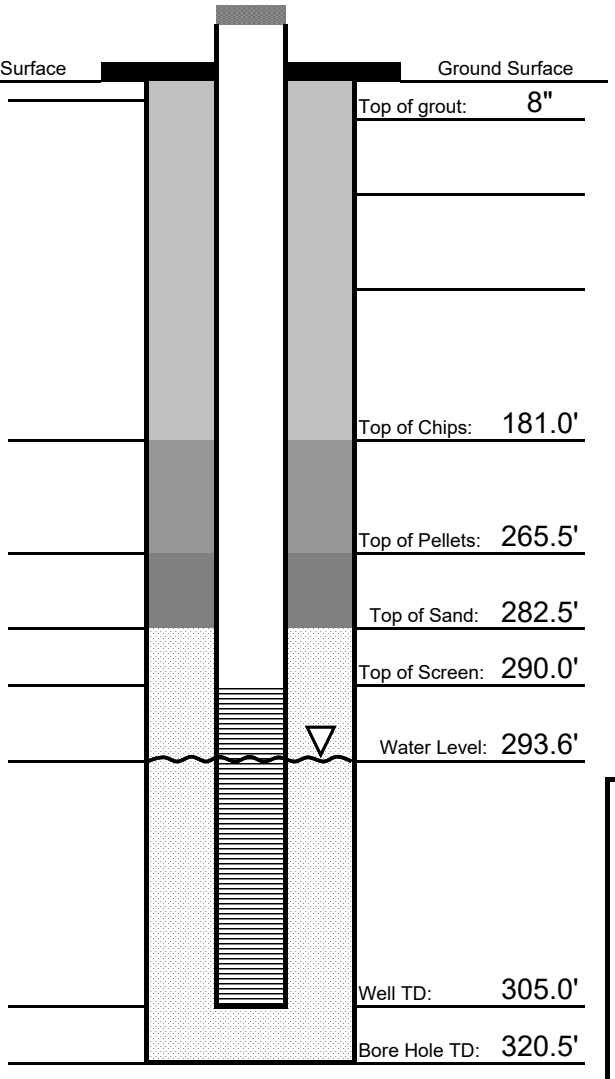
Surface Casing

Type: Traffic Cover

Diameter: 12"

Length: 12"

Pad: 3X3



Cement
Grout
B. Chips
B. Pellets
Sand

Notes:

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Well Development Log

Location:	Red Hill BFSF	**Station ID:**	**Station Name:**	RHMW04	**Diameter:**	4"	**Date:** 7/26/2005
Sys_Samp_Code:			**Elevation:**		**Material:**	PVC	**Time** Start: 1415
Sampler:	(b) (6)		**Dry: yes / no**		**Balier Dia./L (in):**	4 X 48	Finish: 1515
CO.:	VWD		**TD:**	305'	**Development Method:**	SS Bailer	

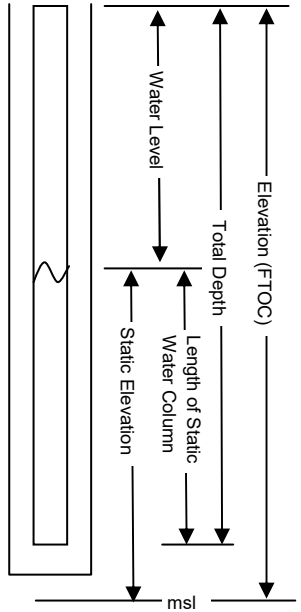
Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	Temp C°	Color	EC	Turbidity/ Sand (NTU)	Comments
7/26/05	1418	294.1	5.00	7.68	22.3	-----	0.58	450	
7/26/05	1425	294.1	10.00	7.38	22.9	-----	0.53	999+	
7/26/05	1431	294.1	15.00	7.26	22.7	-----	0.56	999+	
7/26/05	1436	294.1	20.00	7.30	22.8	-----	0.54	999+	
7/26/05	1443	294.1	25.00	7.17	22.4	-----	0.53	999+	
7/26/05	1451	294.1	30.00	7.20	22.6	-----	0.53	650	
7/26/05	1456	294.1	35.00	7.27	22.48	-----	0.52	600	
7/26/05	1503	294.1	40.00	7.21	22.33	-----	0.52	400	
7/26/05	1508	294.1	45.00	7.21	22.12	-----	0.53	450	

Casing Volume Information

A	Hole Diam.	=	8.00
B	Well OD	=	4.500
C	Well ID	=	3.826
D	H2O Level	=	294.10
E	TD	=	305.00
F	Est. Filter Porosity	=	0.40

Vc=3.14(C/2)^2(E-D)

Vf=3.14[(A/2)^2-(B/2)^2](E-D)(F)



Casing ID	VOL Gal/Ft
1.00	0.04
1.50	0.09
2.00	0.16
2.50	0.26
3.00	0.37
3.50	0.50
4.00	0.65
4.50	0.83
6.00	1.50
7.00	2.00
8.00	2.60

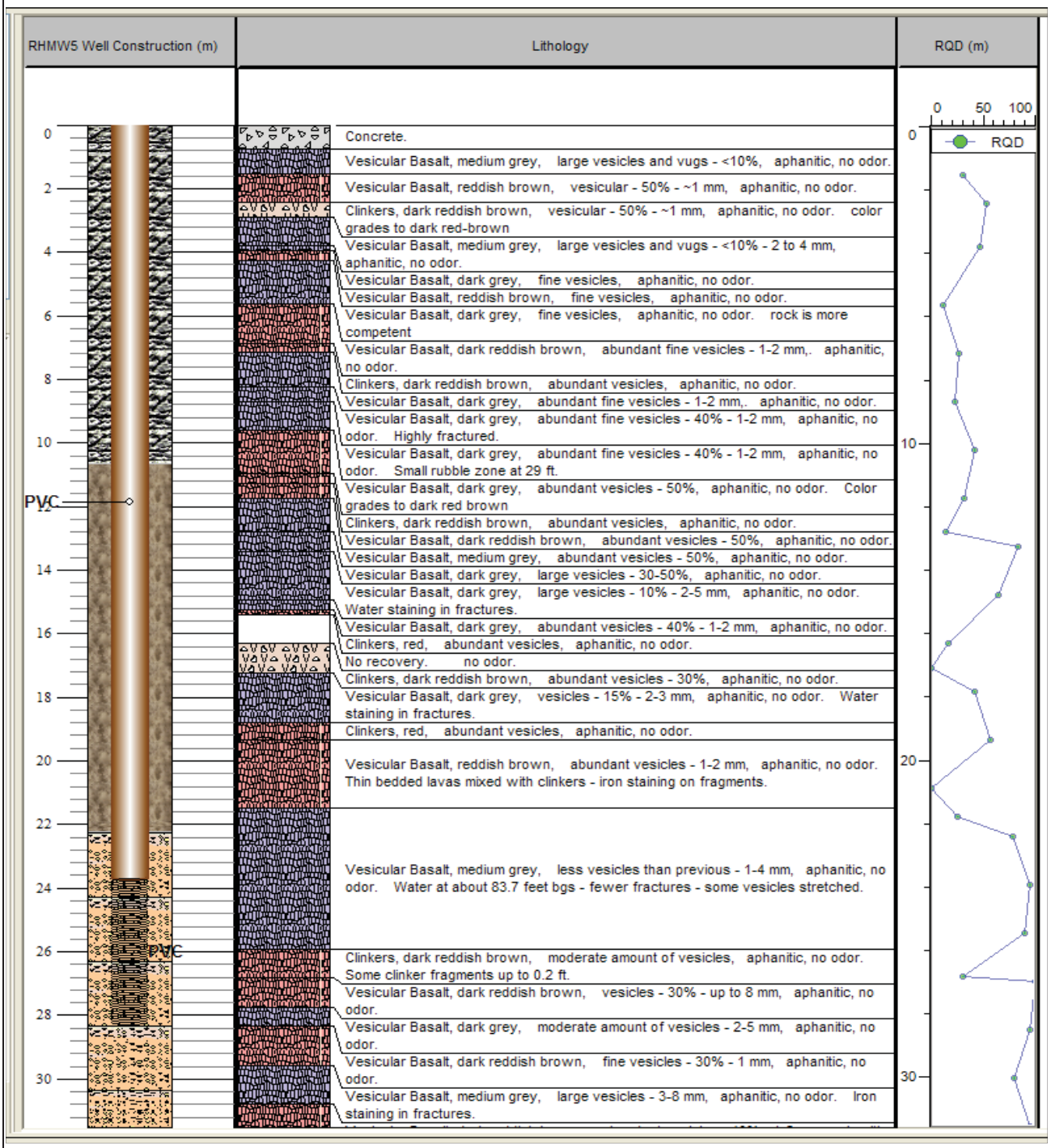
Notes:

Well	**Vc=**	6.47	gal
	Vf=	7.73	gal
	Vt=	14.20	gal
	3Vt=	42.59	gal
Bailer	**V=**	2.59	gal

~~For Red Hill AOC Party Use Only~~

Project Name:	**Red Hill Bulk Fuel Storage Facility, LTM 2009**			
Contract No:	N47408-04-D-8514, T.O. 54	**Location:**	At Bend in Lower Tunnel Between Adit 3 and Adit 5	
Well Identifier:	RHMW05		**Drilling Technique:**	Air Rotary Coring
Start Date:	April 10, 2009		**Bit Type/Size:**	Diamond Core /4.8-inches diam
End Date:	April 24, 2009		**Filter Pack:**	1 mm, silica sand
Completion Type:	Flush Mounted			
Riser Material:	2-inch, Schedule 80 PVC, flush threaded		**Annular Seal:**	Bentonite Chips/Pellets
Screen Material:	2-inch, Schedule 80 PVC, 0.02 slot size		**Groundwater Elevation**	
Screened Interval:	78 ft to 93 ft below ground surface		**Range between 7/14/2009 and 3/25/2010**	

Coordinates (m):	Northing	Easting	Elevation	
NAD 83, HI State Plane, Zone 3, FIPS 5103	(b) (3) (A)	(b) (3) (A)	31	83.09 to 83.96 ft below top of casing



TEC Representative : (b) (6), P.G. **Driller:** (b) (6); Valley Well Drilling, Inc.

GEOLOGIC LOG

~~For Red Hill AOC Party Use Only~~

DATE STARTED: 28-Aug-14
DATE COMPLETED: 17-Sept-14
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit
PAGE 1 OF 10
WELL NO.: RHMW06

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Auger, HQ core, Air Rotary
BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

SURFACE ELEV.: 255.81 ft amsl
SOUNDING TUBE ELEV.: 259.01 ft
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
0	(0.0, 10.0) Clay		CLAY				SURFACE COMPLETION: 3.5' x 3.5' x 2' concrete pad w/ 8" above-ground steel casing
5							WELL CASING: Material: SCH. 80 PVC; Diameter: 4"; Interval: +3.2-230 bgs
10	(10.0, 11.5) Clay: dark brown, CL, little silt, plastic, small rounded pebbles, poor recovery, Note: basalt cobbles and boulders within clay are present from ground surface to the saprolite contact		CLAY	0.0	12/19/19		WELL SCREEN: Material: SCH. 80 PVC; Screen Opening: 0.020; Diameter: 4"; Interval: 230-260 bgs
	(11.5, 15.0) Clay		CLAY				
15	(15.0, 16.5) Clay: dark yellowish brown, CH, stiff, plastic, small angular rock fragments, poor recovery				21/25/100 for 4"		CONDUCTOR CASING: Material: PVC; Diameter: 10"; Interval: 0-40 bgs
	(16.5, 20.0) Clay						
20	(20.0, 21.5) Clay: dark yellowish brown to gray, friable, dry		CLAY	0.0			DEPTH INTERVAL: Concrete: 0-3; Cement Grout: 3-40 bgs; Bentonite Chips: 40-215 bgs; Bentonite Seal: 215-223 bgs; Sand Pack: 223-269 bgs; Hole Cuttings: 269-270 bgs
	(21.5, 23.0) Clay		CLAY	0.0			
	(23.0, 24.5) Clay: gray basalt in tip, cobble (?), only tip recovery		SAPR	0.0			
25	(24.5, 35.0) Saprolite: start coring, in and out of weathered basalt and saprolite, mottled yellowish to dark yellowish brown saprolite, thin bands of gray vesicular basalt, solid rock contact at about 35 feet bgs, NOTE: THE GSA ROCK COLOR CHART (1991) WAS USED FOR THE FOLLOWIING WET COLOR DESCRIPTIONS		VLBA	0.0			**NOTE:** All intervals are measured from ground surface.
30							

amsl - Above Mean Sea Level
bgs - Below Ground Surface
ft - feet
mm - millimeter(s)
N/A - Not Applicable
NS - Not Sampled
PID - Photoionization Detector
ppmv - Parts per Million, Volume per Volume
SAA - Same as Above
Horizontal Survey System: NAD 83 Epoch 2010.0
Elevations: Local Mean Sea Level (feet)

DP - Direct Push
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
TD - Total Depth
HS - Head Space
ERPIMS CODE DESCRIPTIONS:
ASPT - Asphalt
CLAY - Clay
CLGV - Clay and Gravel
CLSD - Clay and Sand
CLSL - Clay and Silt

CN - Concrete
COBL - Cobble or Boulder
CORL - Coral
FILL - Fill or other Man-Made Deposits
GVL - Gravel
GVLP - Gravel, predominantly pebble-sized
GVSL - Gravel and Silt
NDPS - No Description Provided, Problems in Sampling
NSNR - No Sample or No Recovery Obtained
PTHM - Peat, Humus, and other Organic Material
SAPR - Saprolite

SD - Sand
SDSL - Sand and Silt
SDGR - Sand and Gravel
SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
SLSD - Silt and Sand
VLBA - Basalt, Lava
VLTF - Volcanic Tuff

GEOLOGIC LOG

~~For Red Hill AOC Party Use Only~~

DATE STARTED: 28-Aug-14
DATE COMPLETED: 17-Sept-14
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW06

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Auger, HQ core, Air Rotary
BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

SURFACE ELEV.: 255.81 ft amsl
SOUNDING TUBE ELEV.: 259.01 ft
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
35	(35.0, 40.0) Basalt: olive gray, 5Y 4/1, pumice-like vesicular with small semi-round voids, vertical fracture at 37 ft with iron stained and weathered surfaces, 3 ft. recovery				75%		
40	(40.0, 45.0) Basalt : SAA, vesicular with 30% small and round voids, competent, infilled voids near bottom at 44 ft.				90%		
45	(45.0, 50.0) Basalt: SAA, vesicular with up to 35% voids, variable size and shape voids-some larger than 5 mm., moderate strength w/ mechanical fractures		VLBA	0.0	80%		
50	(50.0, 55.0) Basalt: olive gray to greenish gray, dense, 10% voids, oblique fractures w/ weathered surfaces, drilling water return		VLBA	0.0	50%		
55	(55.0, 60.0) Basalt: greenish gray and dense from 55-57, up to 1 in. vugs w/ some secondary infilling, transitions back to olive gray vesicular basalt		VLBA	0.0	NA		
60							

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Elevations: Local Mean Sea Level (feet)

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HSA - Hollow Stem Auger
SSA - Solid Stem Auger
TD - Total Depth
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NDPS - No Description Provided, Problems in Sampling
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PTHM - Peat, Humus, and other Organic Material
SAPR - Saprolite

SD - Sand
SDSL - Sand and Silt
SDGR - Sand and Gravel
SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
SLSD - Silt and Sand
VLBA - Basalt, Lava
VLTF - Volcanic Tuff

GEOLOGIC LOG

~~For Red Hill AOC Party Use Only~~

DATE STARTED: 28-Aug-14
DATE COMPLETED: 17-Sept-14
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW06

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Auger, HQ core, Air Rotary
BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

SURFACE ELEV.: 255.81 ft amsl
SOUNDING TUBE ELEV.: 259.01 ft
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
60	(60.0, 65.0) Basalt: olive gray, vesicular w/ 30% small round voids, iron-stained voids and natural fractures from 63-65 ft.		VLBA	0.0	75%		
65	(65.0, 70.0) Basalt: SAA, large angled fracture at 67.5 ft., voids infilled with white mineral, grades to non-vesicular and more dense at 69 ft.		VLBA	0.0	80%		
70	(70.0, 75.0) Basalt: lost core, trip out, recover 2 ft. of gray vesicular basalt		VLBA	0.0	NA		
75	(75.0, 80.0) Basalt: brownish black 5YR 2/1, vesicular, grades to brownish gray 5YR 4/1 with larger voids at 76 ft., some secondary infilling of voids from 76-77 ft, some fractures		VLBA	0.0	75%		
80	(80.0, 85.0) Basalt: grayish black (N2), dense, vugs with pristine "needle-like" zeolite cyrstals, light coating of white to bluish gray amporphous silica within voids indicative of the movement of water, large fracture at 82 ft. with secondary rust colored mineralization		VLBA	0.0	80%		
85	(85.0, 90.0) Basalt: dark gray (N3), hard, dense, competent, 10% open voids, as large as 5 mm., some infilling of voids with amorphous quartz or zeolite, 10% slightly weathered olivine phenocrysts, Note: first occurrence of phenocrysts, rock above is aphanitic w/ very few phenocryts		VLBA	0.0	80%		
90							

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BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

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DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
90	(90.0, 93.0) Basalt: partial run, SAA, transitions to as much as 35% voids, zones where voids are infilled with reddish orange clay-like soft silica, large infilled fracture at 90-91 ft.		VLBA	0.0	80%		
	(93.0, 98.0) Basalt: SAA, 25 % voids, range from 1 mm. to 8 mm., zones w/ infilling of voids, few fractures		VLBA	0.0	90%		
95							
	(98.0, 100.0) Basalt: SAA, few healed or infilled fracture zones		VLBA		60%		
100	(100.0, 105.0) Basalt: SAA, grades dense, competent, and unweathered at 104 ft., cyrstalline texture, few olivine phenocrysts, lost circulation, switched over to all water and no air		VLBA	0.0	75%		
105	(105.0, 110.0) Basalt: SAA, grades from dense and hard to low density and weak pumice-like vesicular w/ 50% small and round voids at 109 ft.		VLBA	0.0	85%		
110	(110.0, 115.0) Basalt: SAA, dark gray vesicular, zones with reddish orange soft silica along fractures and in voids, 6 in. clay zone at 114 ft., possibly a weathered zone between flows		VLBA	0.0	50%		
115	(115.0, 120.0) Basalt: SAA, dark gray, variable void percentage througout, mechanical breaks, reddish orange soft silica where weathered		VLBA	0.0	60%		
120							

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GEOLOGIC LOG

DATE STARTED: 28-Aug-14
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WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW06

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Auger, HQ core, Air Rotary
BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

SURFACE ELEV.: 255.81 ft amsl
SOUNDING TUBE ELEV.: 259.01 ft
NORTHING: (b) (3) (A)
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DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
120	(120.0, 125.0) Basalt: SAA, washout from 123-124 ft., 60% recovery		VLBA	0.0	50%		
125	(125.0, 130.0) Basalt: dark gray (N3), stronger rock, 25% voids, large irregular voids up to 10 mm., fresh high-angle fracture at 128.5 ft., minor infilling of voids at 129 ft. w/ reddish orange soft silica, mechanical breaks		VLBA	0.0	85%		
130	(130.0, 135.0) Basalt: dark gray (N3), overall brown from oxidation, looks like broken up rubble zone at top of flow, lava inclusions, secondary infilling in weak zones		VLBA	0.0	40%		
135	(135.0, 140.0) Basalt: dark gray (N3), harder and dense, vesicular basalt, 20% voids, two high-angle fractures at 139 ft., coated fracture surfaces and some infilling of voids		VLBA	0.0	85%		
140	(140.0, 145.0) Basalt: SAA, aphanitic-crystalline texture, dense, irregular voids, a few fresh fractures w/light iron-oxide staining		VLBA	0.0	80%		
145	(145.0, 150.0) Basalt: dark gray, compentent, moderate strength, mechanical breaks, not much infilling of voids		VLBA	0.0	90%		
150							

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GEOLOGIC LOG

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DATE STARTED: 28-Aug-14
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LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW06

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Auger, HQ core, Air Rotary
BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

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NORTHING: (b) (3) (A)
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DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
150	(150.0, 155.0) Basalt: dark gray, crystalline, dense, some olivine, 5% voids, mechanical breaks		VLBA	0.0	80%		
155	(155.0, 160.0) Clinker: switched bits and went to air, poor recovery, bad core resulting from air coring, rounded, red rock possibly clinker		VLBA	0.0	NA		
160	(160.0, 163.0) Clinker: grayish red 10R 4/2 clinker, lost water circulation, diesel odor in ambient air from apparent venting of tanks		VLBA	BG=1.5	NA		
165	(163.0, 168.0) Basalt: dark gray, hard, dense, crystalline texture, some quartz, 10% voids, trace secondary black mineral coating, fresh fractures w/ little secondary mineralization on surfaces, PID interference from background fumes in ambient air		VLB	BG=27	90%		
	(168.0, 170.0) Basalt: SAA, finish run, silica-coated vertical fracture, some mechanical breaks		VLBA	0.0			
170	(170.0, 175.0) Basalt: SAA, dark gray, two healed fractures from 170-171, grades to rubbly broken zone, weathered rock and mud from 172-175, poor recovery		VLBA	0.0	NA		
175	(175.0, 180.0) Basalt: dark gray and less compentent pumice-like vesicular w/ about 30% small round voids, few thin broken zones, several healed fractures		VLBA	0.0	50%		
180							

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GEOLOGIC LOG

DATE STARTED: 28-Aug-14
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LOGGER: (b) (6)
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WELL NO.: RHMW06

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

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DRILL RIG TYPE: Mobile B-59 and B-90
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BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

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DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
180	(180.0, 185.0) Basalt: dark gray vesicular, variable void percentage, broken zone from 181-183 ft., fractures and voids infilled with reddish orange soft silica		VLBA	0.0	50%		
185	(185.0, 190.0) Basalt: SAA, grades to brownish gray then back to dark gray, less voids from 190-192 ft, fractured w/ gouged slickenside surfaces at 193 ft., infilling of voids with soft silica		VLBA	0.0	70%		
190	(190.0, 195.0) Basalt: dark gray (N3), vesicular, variable void size, shape, and percentage, more compentent, fractures at 194 ft., coated fracture surface with reddish orange silica and black oxides and infilling of voids below fractures, mechanical breaks,		VLBA	0.0	70%		
195	(195.0, 200.0) Basalt: dark gray, vesicular, larger connected voids, dense, light olive brown coating in voids indicative of the movement of water, some olivine, few horizontal fractures		VLBA	0.0	50%		
200	(200.0, 205.0) Basalt: dark gray (N3), cyrstalline texture, compentent and consistent core, subtle flow layering w/ stretched voids, horizontal fractures from 200-201 feet, secondary black oxides		VLBA	0.0	90%		
205	(205.0, 210.0) Basalt: dark gray, weathered w/ secondary infilling, broken zones		VLBA	0.0	50%		
210							

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LOGGER: (b) (6)
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WELL NO.: RHMW06

COMPANY NAME: PARSONS
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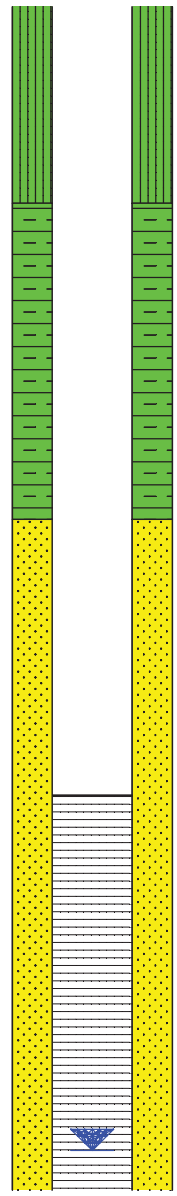
210	(210.0, 215.0) Basalt: brownish gray 5YR 4/1, 30% voids, less dense, broken w/ soft silica infillling, dark reddish brown non-vesicular bands, grades to dark gray at 214 ft.		VLBA	0.0			
215	(215.0, 220.0) Basalt: brownish gray 5YR 4/1, w/ dark yellowish brown bands, less competent, moderate strength, broken zone from 218-219 w/ secondary infilling, olive gray w/ 10% voids from 219-220 ft.		VLBA	0.0			
220	(220.0, 225.0) Basalt: grayish red 10R 4/2, low density and weak, weathered matrix,		VLBA	0.0	75%		
225	(225.0, 230.0) Basalt: SAA, alternating with dark gray vesicular, olive gray basalt w/ 30% voids at 229 ft., irregular voids up to 1 in., light silica coating in voids indicative of the movement of water		VLBA	0.0			
230	(230.0, 235.0) Basalt: SAA, but more competent, up to 30% irregular voids, increase in void percentage near bottom of run, black oxide secondary mineralization in some voids and surfaces		VLBA	0.0	90%		
235	(235.0, 240.0) Basalt: dark brown to dark yellowish brown to olive to greenish black, possible alteration to serpentine or chlorite in places, friable in places, non-competent, weathered to clay		VLBA	0.0	25%		
240							



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WELL NO.: RHMW06

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BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

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EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
240	(240.0, 245.0) Basalt: brownish gray, moderate density and strength, low void percentage, grades to olive gray vesicular basalt that is low density and weak, zones of infilling with clay-like pinkish gray soft silica		VLBA	0.0	60%		
245	(245.0, 250.0) Basalt: olive gray, 3-foot partial run, blocked off, variable void percentage, moderate density and strength, large and irregular open voids that are lightly coated with secondary amporphous silica indicative of water saturated conditions, finish 2-foot run, SAA, <10% voids, voids infilled with white mineral		VLBA	0.0	75%		
250	(250.0, 255.0) Basalt: SAA, from 250-253, more infilling of voids, grades to olive black 5YR 2/1 basalt, shows slickenlines along fracture plane and possible serpentine or talc-like secondary alteration on fracture surfaces		VLBA	0.0	70%		
255	(255.0, 260.0) Basalt: SAA, olive black, light density and weak, pumice-like vesicular, 30% small and round voids, some infilled, grades to olive gray and more dense basalt w/ larger voids, slickenlines on fracture surfaces		VLBA	0.0	50%		
260	(260.0, 265.0) Basalt: SAA from 260-262 ft., grades back to olive black light density vesicular basalt, 3 in. band of white silica at 263 ft., weak rock and strongly oxidized at 264 ft., lost water pressure during coring at 263 feet		VLBA	0.0	50%		Well TD = 260 ft bgs
265	(265.0, 270.0) Basalt: SAA, poor recovery, weak and broken rock		VLBA	0.0	NA		
270							

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NS - Not Sampled
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ppmv - Parts per Million, Volume per Volume
SAA - Same as Above
Horizontal Survey System: NAD 83 Epoch 2010.0
Elevations: Local Mean Sea Level (feet)

DP - Direct Push
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
TD - Total Depth
HS - Head Space
ERPIMS CODE DESCRIPTIONS:
ASPT - Asphalt
CLAY - Clay
CLGV - Clay and Gravel
CLSD - Clay and Sand
CLSL - Clay and Silt

CN - Concrete
COBL - Cobble or Boulder
CORL - Coral
FILL - Fill or other Man-Made Deposits
GVL - Gravel
GVLP - Gravel, predominantly pebble-sized
GVSL - Gravel and Silt
NDPS - No Description Provided, Problems in Sampling
NSNR - No Sample or No Recovery Obtained
PTHM - Peat, Humus, and other Organic Material
SAPR - Saprolite

SD - Sand
SDSL - Sand and Silt
SDGR - Sand and Gravel
SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
SLSD - Silt and Sand
VLBA - Basalt, Lava
VLTF - Volcanic Tuff

GEOLOGIC LOG

DATE STARTED: 28-Aug-14
DATE COMPLETED: 17-Sept-14

~~For Red Hill AOC Party Use Only~~

LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW06

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Auger, HQ core, Air Rotary
BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air

SURFACE ELEV.: 255.81 ft amsl
SOUNDING TUBE ELEV.: 259.01 ft
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
270	(270.0, 275.0) Basalt: olive gray, large open voids coated with silica and black oxides from 270-272 ft., grades to more dense and fractured, back to brownish gray at the bottom		VLBA	0.0	75%		
275	(275.0, 280.0) Basalt: SAA, grades back to olive gray, zone w/ large coated open voids, some infilling w/ white mineral in smaller voids, few vertical fractures w/ slickenlines on fresh fracture surfaces		VLBA	0.0	75%		
280							

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GVSL - Gravel and Silt
NDPS - No Description Provided, Problems in Sampling
NSNR - No Sample or No Recovery Obtained
PTHM - Peat, Humus, and other Organic Material
SAPR - Saprolite

SD - Sand
SDSL - Sand and Silt
SDGR - Sand and Gravel
SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
SLSD - Silt and Sand
VLBA - Basalt, Lava
VLTF - Volcanic Tuff

~~For Red Hill AOC Party Use Only~~

CLIENT: JBPHH SITE: Red Hill Bulk Fuel Storage Facility

DATE: 9-10 October 2014 WELL NUMBER: RHMW06

DEVELOPER SIGNATURE: (b) (6)

DEVELOPMENT DESCRIPTION: Surged with block for 15 min, removed about 40 gallons on 9 October by surging and bailing with a clean 6-foot long, 3.5-inch-diameter, 4-gallon stainless steel bailer. Water was too turbid to measure accurately. Another 250 gallons were removed on 10 October until the turbidity was lower and the water relatively sediment free. A total of 290 gallons were removed. The evacuated groundwater was transferred to properly labeled 55-gallon drums and the on-site roll-off bin pending analytical results for proper off-site disposal.

Depth to well bottom (ft-btoc):	263.3	Water Column in Well Pipe (ft)	22.09
Depth to water (ft-btoc)	241.21	Well Pipe Diameter (in)	4.0
Water Column (ft)	22.09	Well Pipe Factor (gal/ft)	0.65
Sand Pack Length (ft)	46	**Water Volume in Well Pipe (gal)**	**14.36**
Water Column in Sand Pack (ft)	22.09	**One Well Volume (gal)**	**18.782**
Borehole Diameter (in)	8	Volumes to be removed (min)	10
Sand Pack Factor (gal/ft)	0.2	**Gallons to be removed (min)**	**187.78**
Water Volume in Sand Pack (gal)	**4.42**		

PURGE MEASUREMENTS: A Horiba U-52 meter with flow cell was used.

Purge Device: Stainless steel bailer Purge Rate (gal/hr): 40 to 50

Time	**Vol** (gal)	**Temp** (ºC)	**pH**	**Cond** (mS/cm)	**Turb** (NTU)	**DO** (mg/L)	**ORP** (mv)	**Comments**
1400	20	23.39	7.42	1.27	over	4.62	142	Turbid
1430	40	23.43	7.61	0.992	over	5.08	145	No drawdown
10/10								
0735	60	24.20	7.02	0.840	953	4.87	196	
0754	80	23.08	7.74	0.771	623	4.76	155	Sediment
0924	120	24.03	7.52	0.701	227	4.73	157	
1005	170	24.41	7.17	0.671	112	4.70	148	Let settle
1050	195	24.49	7.43	0.655	87.6	4.65	136	
1210	250	24.53	6.85	0.650	90.3	5.06	130	
1226	275	24.37	6.99	0.656	89.1	4.53	129	
1236	285	23.98	6.82	0.656	83.9	4.76	124	
1320	290	24.39	6.86	0.665	79.3	4.94	130	Some fine sand

Notes: Final water level was the same as pre-development. Final height of well casing was same as for development or about 2.5 ft above ground surface. Limited drawdown indicates good recharge and high permeability at this location.

GEOLOGIC LOG

DATE STARTED: 19-Sept-14
DATE COMPLETED: 6-Oct-14

~~For Red Hill AOC Party Use Only~~
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW07

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Ream, HQ core, Air Rotary
BOREHOLE DIAMETER: 12" Ream, 4" Core, 8" Air

SURFACE ELEV.: 216.53 ft amsl
SOUNDING TUBE ELEV.: 220.29 ft
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
0	(0.0, 10.0) Clay		CLAY				SURFACE COMPLETION: 3.5' x 3.5 'x 2' concrete pad w/ 8" above-ground steel casing
5							WELL CASING: Material: SCH. 80 PVC; Diameter: 4"; Interval: +3.76-184 bgs
10	(10.0, 11.5) Clay: dusky yellowish brown (10YR 2/2), CH, stiff, plastic, slightly moist, Note: basalt cobbles and boulders within clay were contacted from ground surface to the saprolite contact		CLAY	0.0	35/50 for 12"		WELL SCREEN: Material: SCH. 80 PVC; Screen Opening: 0.020; Diameter: 4"; Interval: 184-214 bgs
	(11.5, 20.0) Clay		CLAY				
15							CONDUCTOR CASING: Material: PVC; Diameter: 10"; Interval: 0-40 bgs
20	(20.0, 21.5) Clay: pulverized rock and sand, probably a cobble at this depth broken up by air hammer bit, Note: dry clay from 10 to 20 feet with some sand		CLAY	0.0	100 for 3"		DEPTH INTERVAL: Concrete: 0-3; Cement Grout: 3-40 bgs; Bentonite Chips: 40-176 bgs; Bentonite Seal: 176-179 bgs; Sand Pack: 179-230 bgs; Hole Cuttings: 230-235 bgs
	(21.5, 23.0) Clay		CLAY	0.0			
25	(23.0, 27.0) Saprolite: no split spoon recovery at 24 ft, reddish brown cuttings, likely saprolite		SAPR	0.0			
	(27.0, 45.0) Basalt: gray with vesicles, cuttings from air hammer to 42 feet, then rock core from 40 to 45 feet with description as follows: 2 feet of cement grout (from conductor casing), dark gray (N3)		VLBA	0.0			NOTE: All intervals are measured from ground surface.
30							

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SSA - Solid Stem Auger
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HS - Head Space
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VLBA - Basalt, Lava
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GEOLOGIC LOG

~~For Red Hill AOC Party Use Only~~

DATE STARTED: 19-Sept-14
DATE COMPLETED: 6-Oct-14
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit
PAGE 2 OF 8
WELL NO.: RHMW07

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Ream, HQ core, Air Rotary
BOREHOLE DIAMETER: 12" Ream, 4" Core, 8" Air

SURFACE ELEV.: 216.53 ft amsl
SOUNDING TUBE ELEV.: 220.29 ftl
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
30	basalt, broken and rubbly zones with secondary pinkish to reddish orange soft silica or zeolite infilling spaces between rock fragments, few voids, moderate strength, one oblique fracture at 43 feet, NOTE: THE GSA ROCK COLOR CHART (1991) WAS USED FOR WET COLOR DESCRIPTIONS						
35							
40							
45	(45.0, 50.0) Basalt: broken or rubbly zone from 45-49 ft, top of flow, weak rock, irrregular fractures and voids infilled with secondary pink to orange to red soft silica, dark gray basalt at 49 ft.		VLBA	0.0	<50%		
50	(50.0, 55.0) Basalt: dark gray (N3), aphanitic texture, trace phenocrysts, hard, dense, variable 5% to 20% voids that are horizontally stretched, subhorizontal to subvertical fractures w/ soft silica and seconday black oxide mineralization along thinly parted fracture planes, 100% recovery		VLBA	0.0	80%		
55	(55.0, 60.0) Basalt: broken and rubbly similar to 45-50 ft., highly weathered with copious amounts of red to brown soft silica in voids and open space between rock fragments, very weak		VLBA	0.0	40%		
60							

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SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
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VLBA - Basalt, Lava
VLTF - Volcanic Tuff

GEOLOGIC LOG

~~For Red Hill AOC Party Use Only~~

DATE STARTED: 19-Sept-14
DATE COMPLETED: 6-Oct-14
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW07

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Ream, HQ core, Air Rotary
BOREHOLE DIAMETER: 12" Ream, 4" Core, 8" Air

SURFACE ELEV.: 216.53 ft amsl
SOUNDING TUBE ELEV.: 220.29 ftl
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
60	(60.0, 65.0) Basalt: consolidated and cemented grayish red clinker from 60-62 ft, then dark gray (N3) basalt, aphanitic, harder, 10% voids, irregular fractures bottom with red to orange soft silica		VLBA	0.0	60%		
65	(65.0, 70.0) Basalt: dark gray (N3), aphanitic, hard, strong, slight flow layering with stretched voids, few thinly parted fractures, rubbly at bottom with lava inclusions		VLBA	0.0	80%		
70	(70.0, 75.0) Basalt: dense medium bluish gray (5B 5/1) mixed with dark gray to grayish red, grades to loose to consolidated clinker-like zone from 72.5-75 ft.		VLBA	0.0	90%		
75	(75.0, 80.0) Basalt: dark gray to grayish black (N2), broken rock, black cinder inclusions, 20% to 30% voids, overall weak rock, looks permeable but does not appear to contain water, red to orange soft silica and harder tan silica in voids and cracks, lost water circulation after this run		VLBA	0.0	40%		
80	(80.0, 85.0) Basalt: grayish black (N2), pumice-like vesicular, small-spherical voids up to 40%, some infilling of voids with soft silica, few angled fractures with soft reddish orange silica, moderate strength and density, porous and could transmit water		VLBA	0.0	60%		
85	(85.0, 90.0) Basalt: SAA, vesicular, slight lower void percentage, few fractures with silica coating		VLBA	0.0	80%		
90							

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GEOLOGIC LOG

~~For Red Hill AOC Party Use Only~~

DATE STARTED: 19-Sept-14
DATE COMPLETED: 6-Oct-14
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW07

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Ream, HQ core, Air Rotary
BOREHOLE DIAMETER: 12" Ream, 4" Core, 8" Air

SURFACE ELEV.: 216.53 ft amsl
SOUNDING TUBE ELEV.: 220.29 ftl
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
90							
	(90.0, 95.0) Basalt: SAA, some larger connected voids up to 5 mm., some fractures and voids with soft silica infilling, moderate strength and density,		VLBA	0.0	>80%		
95							
	(95.0, 100.0) Basalt: SAA, but more variable void shape and density, good RQD, i.e., limited fractures		VLBA	0.0	80%		
100							
	(100.0, 105.0) Basalt: SAA, variable void percentage up to 30%, porous, few horizontal fractures		VLBA	0.0	90%		
105							
	(105.0, 110.0) Basalt: SAA, with color change to lighter gray (N4), 6 in. grayish red band at 108 ft., weaker rock, some secondary infilling of voids, one high-angle fracture with soft silica on fracture surfaces		VLBA	0.0	60%		
110							
	(110.0, 115.0) Basalt: possible large void, bit dropped from 110-111.5 ft., only 1.5 feet of recovery, olive gray basalt, zone of loose or broken rock		VLBA	0.0			
115							
	(115.0, 120.0) Clinker: SAA, poor recovery, loose or broken rock, possible clinker zone		VLBA	0.0	40%		
120							

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SLCL - Silt and Clay
SLGV - Silt and Gravel
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VLBA - Basalt, Lava
VLTF - Volcanic Tuff

GEOLOGIC LOG

DATE STARTED: 19-Sept-14
DATE COMPLETED: 6-Oct-14

~~For Red Hill AOC Party Use Only~~

LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW07

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Ream, HQ core, Air Rotary
BOREHOLE DIAMETER: 12" Ream, 4" Core, 8" Air

SURFACE ELEV.: 216.53 ft amsl
SOUNDING TUBE ELEV.: 220.29 ftl
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
120	(120.0, 125.0) Basalt: SAA from 120-122 ft., grades to dark reddish brown (10R 3/4) basalt, 20% to 30% irregular voids infilled with soft silica and black oxides, 50% infilled, some olivine phenocrysts in aphantic matrix, flow layering		VLBA	0.0	40%		
125	(125.0, 130.0) Basalt: SAA, grades back to gray, small voids that grade larger (up to 5 mm,) from 128-130 ft., fractures and voids with secondary silica and dark oxide mineralization indicative of water percolation		VLBA	0.0	60%		
130	(130.0, 135.0) Basalt: SAA to 132 ft., 20% large and mostly open voids, grades to hard and dense non-vesicular gray basalt, some partially weathered olivine, overall crystalline texture		VLBA	0.0	80%		
135	(135.0, 140.0) Basalt: SAA, grades to large open voids (15%), then to increasingly smaller and more numerous small voids (30%), fractures and infilled voids at 133.5 ft.		VLBA	0.0	80%		
140	(140.0, 145.0) Clinker: consolidated clinker-like fragments loosely held together by reddish soft sillica, overall conglomeritic appearance		VLBA	0.0	25%		
145	(145.0, 150.0) Clinker: SAA, poor recovery		VLBA	0.0	25%		
150							

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CLSL - Clay and Silt

CN - Concrete
COBL - Cobble or Boulder
CORL - Coral
FILL - Fill or other Man-Made Deposits
GVL - Gravel
GVLP - Gravel, predominantly pebble-sized
GVSL - Gravel and Silt
NDPS - No Description Provided, Problems in Sampling
NSNR - No Sample or No Recovery Obtained
PTHM - Peat, Humus, and other Organic Material
SAPR - Saprolite

SD - Sand
SDSL - Sand and Silt
SDGR - Sand and Gravel
SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
SLSD - Silt and Sand
VLBA - Basalt, Lava
VLTF - Volcanic Tuff

GEOLOGIC LOG

DATE STARTED: 19-Sept-14
DATE COMPLETED: 6-Oct-14

~~For Red Hill AOC Party Use Only~~

LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

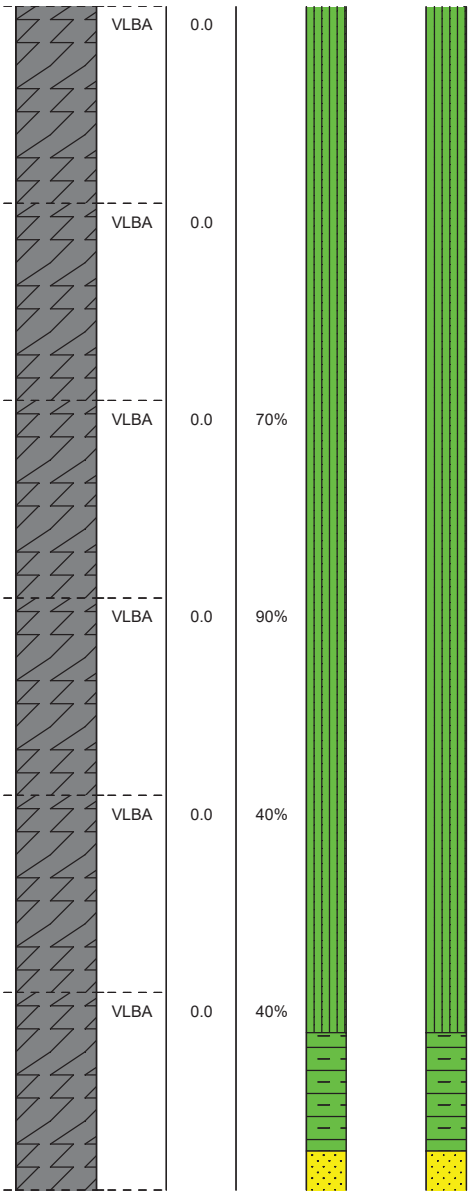
WELL NO.: RHMW07

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Ream, HQ core, Air Rotary
BOREHOLE DIAMETER: 12" Ream, 4" Core, 8" Air

SURFACE ELEV.: 216.53 ft amsl
SOUNDING TUBE ELEV.: 220.29 ftl
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
150	(150.0, 155.0) Basalt: med gray (N4), flow layering w/ horizontallly stretched voids (10%), secondary black oxide mineral, volcanic lava inclusions, two horizontal fractures		VLBA	0.0			
155	(155.0, 160.0) Basalt: SAA, highly fractured at 157 ft., parallel fractures w/ slate-like parting causing rock to block off in core tube, fewer voids		VLBA	0.0			
160	(160.0, 165.0) Basalt: fractured to 161 ft., then vesicular basalt w/ stretched voids (10% to 15%), more competent		VLBA	0.0	70%		
165	(165.0, 170.0) Basalt: SAA to 169 ft., compentent, few voids and fractures, bottom 1 foot is loose w/ soft silica		VLBA	0.0	90%		
170	(170.0, 175.0) Basalt: SAA, continuous from above, overall weak rock, zones that are more competent with 1 in. voids, volcanic lava inclusions some that are reddish brown, capable of transmitting water		VLBA	0.0	40%		
175	(175.0, 180.0) Basalt: dark gray, zones of healed high-angle fractures at 177 ft. and 179 ft., large open voids, 10% to 15% voids		VLBA	0.0	40%		
180							



amsl - Above Mean Sea Level
bgs - Below Ground Surface
ft - feet
mm - millimeter(s)
N/A - Not Applicable
NS - Not Sampled
PID - Photoionization Detector
ppmv - Parts per Million, Volume per Volume
SAA - Same as Above
Horizontal Survey System: NAD 83 Epoch 2010.0
Elevations: Local Mean Sea Level (feet)

DP - Direct Push
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
TD - Total Depth
HS - Head Space
ERPIMS CODE DESCRIPTIONS:
ASPT - Asphalt
CLAY - Clay
CLGV - Clay and Gravel
CLSD - Clay and Sand
CLSL - Clay and Silt

CN - Concrete
COBL - Cobble or Boulder
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GEOLOGIC LOG

~~For Red Hill AOC Party Use Only~~

DATE STARTED: 19-Sept-14
DATE COMPLETED: 6-Oct-14
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW07

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Ream, HQ core, Air Rotary
BOREHOLE DIAMETER: 12" Ream, 4" Core, 8" Air

SURFACE ELEV.: 216.53 ft amsl
SOUNDING TUBE ELEV.: 220.29 ftl
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
180	(180.0, 185.0) Basalt: dark gray to black w/ lava inclusions, grades to gray to grayish red vesicular basalt, low-angle fractures, alot of soft red silica, 10% to 20% voids, some infilled, moderate strength		VLBA	0.0	50%		
185	(185.0, 190.0) Basalt: dark gray to olive black, vesicular, 20% voids-large and open, some olivine, few fractures, large void from 188-189 no core, some white amorphous quartz silica or zeolite infilling voids at 190 ft		VLBA	0.0			
190	(190.0, 195.0) Basalt: SAA, grades to smaller voids, healed fractures, moderate strength, core may be saturated, thin coating of secondary mineralization on void surfaces indicative of saturated or below water table conditions		VLBA	0.0	80%		
195	(195.0, 200.0) Basalt: dark gray, vesicular, larger connected voids, dense, light olive brown coating in voids indicative of below water saturated conditions, some olivine, few horizontal fractures		VLBA	0.0	80%		
200	(200.0, 205.0) Basalt: SAA, to 203 ft., grades to olive gray non-vesicular basalt with lava inclusions, weak- mechanical breaks from coring process, secondary black oxide and reddish soft silica		VLBA	0.0	60%		
205	(205.0, 210.0) Clinker: rubbly and loose, pebbly fragments held loosely by soft reddish silica, partial run		VLBA	0.0	20%		
210							

amsl - Above Mean Sea Level
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PID - Photoionization Detector
ppmv - Parts per Million, Volume per Volume
SAA - Same as Above
Horizontal Survey System: NAD 83 Epoch 2010.0
Elevations: Local Mean Sea Level (feet)

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ERPIMS CODE DESCRIPTIONS:
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NDPS - No Description Provided, Problems in Sampling
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SLCL - Silt and Clay
SLGV - Silt and Gravel
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VLBA - Basalt, Lava
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GEOLOGIC LOG

~~For Red Hill AOC Party Use Only~~

DATE STARTED: 19-Sept-14
DATE COMPLETED: 6-Oct-14
LOGGER: (b) (6)
WEATHER: 90 degrees Fahrenheit

WELL NO.: RHMW07

COMPANY NAME: PARSONS
OFFICE LOCATION: South Jordan, Utah
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01
LOCATION: Red Hill BFSF, HI JOB NUMBER:749435

DRILLING SUBCONTRACTOR: Valley Well Drilling
DRILL RIG TYPE: Mobile B-59 and B-90
DRILLING METHOD: Ream, HQ core, Air Rotary
BOREHOLE DIAMETER: 12" Ream, 4" Core, 8" Air

SURFACE ELEV.: 216.53 ft amsl
SOUNDING TUBE ELEV.: 220.29 ftl
NORTHING: (b) (3) (A)
EASTING: (b) (3) (A)

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
210	(210.0, 215.0) Basalt: med. dark gray, hard, dense, stronger rock, few voids, few thinly parted high angle fractures w/ limited secondary mineralization		VLBA	0.0	80%		
215	(215.0, 220.0) Basalt: SAA, hard and dense, few thinly parted and healed fractures- vertical to high angle, does not appear saturated		VLBA	0.0	80%		
220	(220.0, 225.0) Basalt: SAA, but voids are horizontally stretched, bottom 2 feet weak and broken, core saturated in zones of weakness		VLBA	0.0	60%		
225	(225.0, 230.0) Sand: medium to coarse moderately well sorted black sand (SW-SP), contains grains of weathered basalt and light grains of quartz, olivine, carbonate(?), angular to semi-rounded, probably a beach sand deposited between flows, deposited on grayish red fractured basalt that is present at bottom 2 feet of run		VLBA	0.0	NA		
230	(230.0, 235.0) Basalt: SAA, grayish red, few zones of broken fragments, thin clay zones, grades to gray basalt at bottom, poor recovery and RQD		VLBA	0.0	<50%		
235	(235.0, 240.0) Basalt: medium gray, vesicular, open voids with grayish coating, 20% voids, some black oxide and white (zeolite ?) mineralization, abundant green olivine (20%), olivine is mostly unweathered, looks permeable		VLBA	0.0	100%		
240							Well TD = 214 ft bgs

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bgs - Below Ground Surface
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SAA - Same as Above
Horizontal Survey System: NAD 83 Epoch 2010.0
Elevations: Local Mean Sea Level (feet)

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~~For Red Hill AOC Party Use Only~~

CLIENT: JBPHH SITE: Red Hill Bulk Fuel Storage Facility

DATE: 8-9 Oct 2014 WELL NUMBER: RHMW07

DEVELOPER SIGNATURE: (b) (6)

DEVELOPMENT DESCRIPTION: Surged with block for 20 min, removed about 40 gallons and surged again. Water was turbid and foamy from drilling foam used to fluidize and lift cuttings from the open hole. Approximately 220 gallons of water were removed on 8 October by surging and bailing with a clean 6-foot long, 3.5-inch-diameter, 4-gallon stainless steel bailer. Another 260 gallons were removed on 9 October until the turbidity was low and the water sediment free. A total of 480 gallons were removed. The evacuated groundwater was transferred to properly labeled 55-gallon drums and the on-site roll-off bin pending analytical results for proper off-site disposal.

Depth to well bottom (ft-btoc):	217.6	Water Column in Well Pipe (ft)	20.2
Depth to water (ft-btoc)	197.4	Well Pipe Diameter (in)	4.0
Water Column (ft)	20.2	Well Pipe Factor (gal/ft)	0.65
Sand Pack Length (ft)	51	**Water Volume in Well Pipe (gal)**	**13.13**
Water Column in Sand Pack (ft)	20.2	**One Well Volume (gal)**	**17.17**
Borehole Diameter (in)	8	Volumes to be removed (min)	10
Sand Pack Factor (gal/ft)	0.2	**Gallons to be removed (min)**	**171.7**
Water Volume in Sand Pack (gal)	**4.04**		

PURGE MEASUREMENTS: A Horiba U-52 meter with flow cell was used.

Purge Device: Stainless steel bailer Purge Rate (gal/hr): 40 to 50

Time	Vol (gal)	Temp (ºC)	pH	Cond (mS/cm)	Turb (NTU)	DO (mg/L)	ORP (mv)	Comments
0955	55	27.35	9.36	1.75	over	10.9	95	Water foamy
1015	75	25.84	9.71	1.57	1000	10.08	67	
1030	95	25.58	9.88	1.54	649	10.14	73	WL=206
1038	110							WL=201 after 22 min. of recovery
1115	130	25.65	6.39	1.44	233	8.97	94	
1135	150	26.72	6.43	1.32	82	9.08	96	
1237	170	25.71	7.40	1.12	15	9.86	123	Recalibrate pH
1300	205	25.74	7.42	0.999	10.4	9.61	105	
10/9								
0710	230	25.10	6.67	1.35	35.1	7.40	192	
1000	415	24.81	7.28	1.13	13.3	7.57	118	WL=207.2
1100	440	24.51	7.22	1.07	9.2	7.02	98	
1115	455	24.44	7.67	0.989	10.7	7.02	77	
1125	470	24.04	7.37	0.962	5.4	6.93	87	Water still foamy
1145	480	24.49	7.34	0.962	7.5	7.03	88	Little fine sand

Notes: Initial pH inaccurate, replaced electrode solution. Accurate after 170 gallons removed and recalibration. Maximum drawdown was about 10 feet, or half of the water column, and indicates poor recharge and lower permeability at this location.

~~For Red Hill AOC Party Use Only~~

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Key to Log

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SOIL SAMPLES: Type	Number	Blows /12 in.	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation (in feet) referenced to mean sea level (MSL).

2 **Depth:** Distance (in feet) below the collar of the borehole.

3 **Run No.:** Number of the individual coring interval.

4 **Box No.:** Number of the core box which contains core from the corresponding run.

5 **Recovery:** Amount (in percent) of core recovered from the coring interval; calculated as length of core recovered divided by length of run.

6 **Fractures per Foot:** (Fracture Frequency) The number of naturally occurring fractures in each foot of core; does not include mechanical breaks (induced by drilling) or healed fractures. "NA" indicates not applicable due to lack of core recovery.

7 **R Q D:** (Rock Quality Designation) Amount (in percent) of intact core (pieces of sound core greater than 4 inches in length) in each coring interval; calculated as the sum of lengths of intact core divided by length of core run. RQD of highly weathered/altered rock does not meet soundness requirements, but provides some indication of rock quality with respect to the degree of fracturing.

8 **Fracture Drawing:** Sketch of the naturally occurring fractures and mechanical breaks, showing the angle of the fractures relative to the cross-sectional axis of the core. "NR" indicates no recovery.

9 **Fracture Number:** Location of each naturally occurring fracture (numbered) and mechanical break (labeled "M"). Naturally occurring fractures are described in Column 11 (keyed by number) using descriptive terms defined on Sheet 2 (Items a through g).

10 **Lithology:** A graphic log of material encountered using symbols to represent differing soil and types; graphic symbols are explained below.

11 **Description:** Lithologic description in this order: rock type, color (Munsel), texture, grain size, weathering, strength, and other features; descriptive terms are defined on Sheet 2. Also, abbreviated description of fractures numbered in Column 9 using terms defined on Sheet 2.

12 **Well Schematic:** Schematic of piezometer, inclinometer or well installation; graphic symbols are explained below.

13 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

14 **Sample Number:** Sample identification number.

15 **Blows /12 in.:** Number of blows required to advance sampler 12 inches beyond first 6 inch interval or distance noted, using a 140-lb hammer with a 30-inch drop (unless otherwise noted).

16 **Drill Time [Rate]:** Time (in 24-hour clock) marking start and finish of each run; drill rate (in feet per hour) is reported in brackets.

17 **Field Notes and Test Results:** Comments and observations regarding drilling or sampling made by driller or field personnel. Field and lab tests are indicated using abbreviations explained below.

TYPICAL MATERIAL GRAPHIC SYMBOLS

Silty SAND (SC)
Clayey SAND (SC)
Fat CLAY (CH)
BASALT Breccia
BASALT a'a Clinker
Basalt

TYPICAL SAMPLER GRAPHIC SYMBOLS

Grab sample
Standard Penetration (SPT) split spoon sampler
Modified California sampler with brass liners

TYPICAL WELL GRAPHIC SYMBOLS

Blank casing in cement grout
Blank casing in filter sand
Blank casing in cement-bentonite grout
Slotted casing in filter sand
Blank casing in bentonite pellets
Filter sand, native fill or slough

OTHER GRAPHIC SYMBOLS

First water encountered at time of drilling and sampling (ATD)
Water level measured at specified time after completion of drilling and sampling
Minor change in material properties within a stratum
Inferred or transitional contact

FIELD AND LABORATORY TEST ABBREVIATIONS

LL Liquid Limit (from Atterberg Limits)
PI Plasticity Index (from Atterberg Limits), NP=Non Plastic
PP PP Pocket penetrometer field consitency reading, tst
SA Sieve Analysis, %fines (<#200 sieve) and gravel (>#4 sieve)
WA Wash on #200 sieve, % fines (<#200 sieve)
UC Unconfined compressive strength (qu), psf

Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Key to Log

KEY TO DESCRIPTIVE TERMS USED ON CORE LOGS

DISCONTINUITY DESCRIPTORS

a Dip of discontinuity, measured relative to a plane normal to the core axis.

b **Discontinuity Type:**

- F - Fault
- J - Joint
- Sh - Shear
- Fo - Foliation
- V - Vein
- B - Bedding

c **Aperture (inches):**

- W - Wide (0.5-2.0)
- MW - Moderately Wide (0.1-0.5)
- N - Narrow (0.05-0.1)
- VN - Very Narrow (<0.05)
- T - Tight (0)

d **Type of Infilling:**

- Bi - Biotite
- Cl - Clay
- Ca - Calcite
- Ch - Chlorite
- Ep - Epidote
- Fe - Iron Oxide
- H - Healed
- K^+ - Potassium
- My - Mylonite
- No - None
- Py - Pyrite
- Qz - Quartz
- Sd - Sand
- Si - Silt
- SiCl - Silty Clay
- Uk - Unknown

e **Amount of Infilling:**

- Su - Surface Stain
- Sp - Spotty
- Pa - Partially Filled
- Fi - Filled
- No - None

f **Surface Shape of Joint:**

- Pl - Planar
- Wa - Wavy
- St - Stepped
- Ir - Irregular

g **Roughness of Surface:**

- Slk - Slickensided [surface has smooth, glassy finish with visual evidence of striations]
- S - Smooth [surface appears smooth and feels so to the touch]
- SR - Slightly Rough [asperities on the discontinuity surfaces are distinguishable and can be felt]
- R - Rough [some ridges and side-angle steps are evident; asperities are clearly visible, and discontinuity surface feels very abrasive]
- VR - Very Rough [near-vertical steps and ridges occur on the discontinuity surface]

ROCK WEATHERING / ALTERATION

Description	Recognition
Residual Soil	Original minerals of rock have been entirely decomposed to secondary minerals, and original rock fabric is not apparent; material can be easily broken by hand
Completely Weathered/Altered	Original minerals of rock have been almost entirely decomposed to secondary minerals, although original fabric may be intact; material can be granulated by hand
Highly Weathered/Altered	More than half of the rock is decomposed; rock is weakened so that a minimum 2-inch-diameter sample can be broken readily by hand across rock fabric
Moderately Weathered/Altered	Rock is discolored and noticeably weakened, but less than half is decomposed; a minimum 2-inch-diameter sample cannot be broken readily by hand across rock fabric
Slightly Weathered/Altered	Rock is slightly discolored, but not noticeably lower in strength than fresh rock
Fresh/Unweathered	Rock shows no discoloration, loss of strength, or other effect of weathering/alteration

ROCK STRENGTH

Description	Recognition	Approximate UCS Range
Extremely Weak Rock	Can be indented by thumbnail	35 to 150 psi
Very Weak Rock	Can be peeled by pocket knife	150 to 750 psi
Weak Rock	Can be peeled with difficulty by pocket knife	750 to 3,500 psi
Medium Strong Rock	Can be indented 5 mm with sharp end of pick	3,500 to 7,500 psi
Strong Rock	Requires one hammer blow to fracture	7,500 to 15,000 psi
Very Strong Rock	Requires many hammer blows to fracture	15,000 to 37,500 psi
Extremely Strong Rock	Can only be chipped with hammer blows	>37,5000 psi

~~For Red Hill AOC Party Use Only~~

Project: CT053 – Red Hill Bulk Fuel Storage Facility Project Location: CT053 Project Number: 60481245	Log of Boring RHMW08 Sheet 1 of 20

Date(s) Drilled	08/17/2016	Logged By	[redacted] (b)(3)	Checked By (Date)	(b)(6) [redacted]
Drilling Method	HQ core / air rotary	Drill Bit Size/Type	HQ diamond bit / 8" tricone bit	Total Depth of Borehole	315.0 feet
Drill Rig Type	Mobile B-59 / T3	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	307.8
Groundwater Level		Location		Inclination from Horizontal/Bearing	90°
Borehole Completion	4-inch diameter monitoring well. See RHMW08 Well Cross Section for details			Hammer Data	140 lbs/30-inch drop

Elevation, feet	Depth, feet	ROCK CORE: Run No.	ROCK CORE: Box No.	ROCK CORE: Recovery,%	ROCK CORE: Fractures per Foot	ROCK CORE: R Q D, %	ROCK CORE: Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	SAMPLES: Number	SAMPLES: Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								FILL Soft, moist, dark reddish-brown (5YR 3/3), Sandy CLAY (CL), with abundant debris (concrete, metal pipe pieces, rebar etc.)							
	1															
306	2															
	3															
304	4															
	5															
302	6								ALLUVIUM Moist, dark reddish brown (5YR, 3/3), Sandy CLAY (CL) with some large gravel							
	7															
300	8															
	9															
298	10		1													
	11															
296	12	1		46		0								0	48	
	13															

Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW08

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
294	13													
	14								BASALT Volcanic Breccia Red (2.5YR, 4/8) mottled with dark reddish gray (2.5YR, 4/1), moderately weathered, weak rock					
	15				0		M							
292	16				0									
	17						M		1. 45, J, N, Mn, Su, Pl, SR 2. 30–50, J, N, Mn, SP, Ir, SR					
		2		96	1	60						0	72	
290	18						1		highly weathered zone					
					1									
	19						2							
					1									
288	20						M							
					0		M							
	21						M							
					1		1							
286							M							
	22						M							
		3		96	10+	56			highly fractured zone			0	60	
	23						M							
					10+									
284							M							
	24													
					10+				highly weathered and fractured zone					
	25								becomes moderately strong, with 2% vesicles					
			2		2		1							
282							1							
	26				1									
									1. 60, J, N, Mn, Sp, Pl, SR 2. 65, J, N, Mn, SP, Pl, SR 3. 70, J, N, Cl, Sp, Wa, R					
	27						2							
							M							
		4		100	1	66	M		becomes weak			0	48	
280														
	28						3							
					10+				highly fractured zone					
	29													

Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW08

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29				0		M							
278	30				NA				BASALT Volcanic Breccia Red (2.5YR, 4/8), highly to completely weathered, extremely weathered. Breaks down to a soft moist Sandy CLAY(CL)					
	31	5		73	NA	0						0	170	
276	32				NA		NR							
	33				0		M		BASALT Massive a'a Dark gray (N3), slightly weathered, strong					
274	34	6		50	NA	40	M NR		BASALT a'a Clinker Red (2.5YR, 4/8) mottled with gray (2.5YR, 4/1), highly weathered weak rock			0	30	
	35		3		NA									
272	36				NA									
	37	7		100	NA	12						0	72	
270	38				NA									
	39				1				1. 65, J, N, Mn, Su, Pl, SR					
268	40				1				BASALT Massive a'a Dark gray (N3), slightly weathered, strong to very strong, with 2% vesicles (vesicles mostly 0.5mm with few 5.0mm in diameter).					
	41				2		M L		1. 75, J, Mw, Fe+Mn, Sp, Pl, SR 2. 20, J, N, Fe, Sp, Pl, SR 3. 18, J, N, Fe+Mn, Sp, Pl, SR 4. 22, J, N, Fe+Mn, Sp, Pl, SR 5. 60, J, N, Fe, Sp, Pl, SR					
266	42	8		100	2	78	L					0	84	
	43				1		FD							
264	44				NA		3 4 5R		becomes moderately weathered with 3% vesicles, that are stretched and varying in size					
	45								BASALT a'a Clinker					

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45				NA				Red (2.5YR, 4/8) to dark red (2.5YR, 3/6), highly weathered weak rock.						
262	46		4		NA		NR								
	47	9		50	NA	0							0	168	
260	48				NA										
	49				NA										
258	50				NA										
	51				NA										
256	52	10		96	NA	0							0	108	
	53				1		M M 1		BASALT Massive a'a Dark gray (N3), moderately weathered, strong, with 15% vesicles (vesicles 1.0 mm to 5.0mm in diameter, few are partially filled with clay or calcite, partially stretched).						
254	54				1				1. 85, J, N, Cl+Fe, Sp, Pl, R						
	55						M								
					1		1								
252	56						M		← with a few large (>7.0 mm) vesicles						
					1		2								
	57	11	5	100	1	96	3		1. 30, J, N, Cl, Pa, Wa, R 2. 20, J, N, Mn, Sp, Pl, SR 3. 10, J, N, Fe, Su, Pl, SR				0	84	
250	58				0		M								
	59						M								
					0		M								
248							M								
	60				NA				BASALT Volcanic Breccia Dark gray (N3) clasts with reddish yellow (5YR, 7/8) matrix, highly weathered, weak to moderately strong.						
	61														

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Log of Boring RHMW08

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	61				NA										
246	62	12		80	NA	NA							0	60	
	63				NA										
244	64				NA		NR								
	65								becomes moderately weathered, strong						
242	66		6		0		M								
	67	13		100	0	95	M						0	60	
240	68				0										
	69				0		M								
238	70				0				red (2.5YR, 5/8), highly weathered, weak						
	71				NA										
236	72				0										
	73	14		100	0	52	M		BASALT Massive a'a Dark gray (N3), moderately weathered, moderately strong, with 2% vesicles, 1.0 mm in diameter. 1. 50, J, N, Mn, SP, Pl, SR				0	84	
234	74				0		I								
	75				10+				weak zone with many mechanical fractures becomes moderately weathered, strong to very strong						
232	76		7		0		M								
	77				0		M								

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Log of Boring RHMW08

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	77															
		15		100	0	100	M							0	72	
230	78						M									
					0		M									
	79						M									
					0		M									
228	80						M									
					1				with 5% vesicles that are 0.5 mm to 5.0 mm and slightly stretched							
	81						1									
					0											
226	82						M									
		16		100	1	99	2		1. 10, J, N, Cl, Sp, Wa, SR 2. 40, J, N, Cl+Fe, Sp, Wa, SR					0	72	
	83															
					0											
224	84						M									
			8		0											Drilled to 100 feet bgs on 8-19-2016. Apparent perched water zone noticed at around 92 feet bgs, based on groundwater level measurements and water observed recharging in the borehole. This coincides with a basalt a'a clinker interval encountered between 90.8 feet and 93.5 feet bgs. Drilled ahead to 140 feet bgs on 8-26-2016. Encountered massive a'a basalt flow at 110 feet to 114.5 feet bgs. Depth to water dropped to 123 feet bgs. A basalt a'a clinker interval encountered between 100 feet and 110 feet bgs may also contain perched water. Borehole was backfilled with bentonite until conductor casing could be installed to seal off perched zones.
	85															
					1		1									
222	86								1. 65, J, N, Cl, Sp, Wa, SR 2. 75, J, N, Cl+Fe, Sp, Wa, SR 3. 30, J, N, Cl, Su, Wa, SR 4. 35, J, N, Cl, Sp, Wa, SR 5. 80, J, N, Cl+Fe, Sp, Wa, SR							
					1		M									
	87															
		17		100	1	98	M 2							0	72	
220	88						M									
					1		3									
	89						M									
					1		M 4									
218	90								vesicles partially filled with carbonate							
					NA											
	91								BASALT a'a Clinker Dark gray (N3) with red oxidation (2.5YR, 4/8), highly weathered, weak, with red clay on the surface of may clasts.							
					NA											
216	92	18		100		20								0	102	
					NA											
	93															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	93													
			9		10+				BASALT Massive a'a Dark gray (N3), moderately weathered, moderately strong, with 10% vesicles. Some vesicles are large, irregularly shaped and partially filled with red clay.					
214	94	19		100	10+	52	M M					0	60	
	95						M		decrease in weathering					
					0									
212	96						M M							
					1		M		dark gray (N3), moderately weathered, moderately strong to strong					
	97						1							
		20		100	1	90	M					0	72	
210	98						2 3		increase to 20% vesicles					
					2				1. 60, J, N, Cl+Fe, Sp, Wa, SR 2. 50, J, N, Cl+Fe, Sp, Wa, SR 3. 45, J, N, No, N, Wa, SR 4. 10, J, N, Sl+Fe, Sp, Wa, SR					
	99						4							
					1		M							
208							M							
	100				1				BASALT a'a Clinker Dark gray (N3) with red oxidation (2.5YR, 4/8), highly weathered, weak, with red clay on the surface of may clasts.					
					NA									
	101	21		80		8			solid piece of massive a'a			0	72	
206					NA									
	102													
					NA									
	103	22	10	100		NA						0	360	
					NA									
204	104	23		100		NA			welded a'a clinker			0	300	
					NA									
	105													
					NA									
202	106													
		24		80	NA	NA						0	132	
	107													
					NA									
200														
	108								with some welded a'a clinker					
					NA									
	109													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	109	25		80	NA	NA								0	60	
198	110				1				BASALT Massive a'a Dark gray (N3), moderately to slightly weathered, strong, with 7% vesicles that are slightly stretched. 1. 10, J, N, Cl, Sp, Wa, SR 2. 30, J, N, Cl+Fe, Sp, Wa, SR 3. 30, J, N, Cl, Sp, Ir, R 4. 20, J, N, Fe+Cl, Sp, Wa, SR						
	111				2		M 1 M 2 M 3									
196	112						M									
		26	11	100	1	75	4 M		highly weathered zone with clay on surface of broken clasts					0	60	
	113				0		M		increase to 15% vesicles							
194	114															
					NA		M		BASALT a'a Clinker Dark gray (N3) with red oxidation (2.5YR, 4/8), highly weathered, weak, with red clay on the surface of may clasts.							
	115															
192	116				NA											
					NA											
	117															
		27		72	NA	NA								0	180	
190	118						M		BASALT Massive a'a Dark gray (N3), moderately to slightly weathered, strong, with 10% vesicles that are slightly stretched. 1. 20, J, Mw, Fe+Cl, Sp, Wa, SR 2. 30, J, N, Fe+Cl, Sp, Wa, SR 3. 25, J, N, Fe+Cl, Sp, Wa,SR 4. 35, J, N, No, N, Wa, SR							
					0		M									
	119						1 M 2 M 3 M 4									
188					4											
	120															
					2		M									
	121								1. Many mechanical fractures partially coated with Fe 2. 50, J, Mw, Fe+Mn, Su, Pl, SR 3. 50, J, N, Fe+Mn, Sp, Pl, SR 4. 20, J, N, No, N, Wa, SR							
					2		M									
186		28		94		57	M							0	222	
	122															
					0		M		with a few large vesicles							
	123															
			12		1				decrease to 1% vesicles							
184							1									
	124								increase to 5% vesicles							
		29		100	0	100	M		1. 70, J, N, Fe, Su, Pl, SR					0	60	
	125															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	125				NA				BASALT a'a Clinker Dark gray (N3) with red oxidation (2.5YR, 4/8), highly weathered, weak to very weak, matrix supported.					
182	126				NA									
	127				NA									
		30		52	NA	NA						0	144	
180	128				NA									
	129						NR							
					1									
178	130				NA									
	131				NA									
176		31		96		NA			with manganese staining on some the surface of some of the clasts			0	130	
	132				NA									
	133				NA									
174	134						M							
		32	13	90	1	60	M		BASALT Massive a'a Dark gray (N3), moderately to highly weathered, strong rock.			0	360	
	135						M		becomes highly fractured					
172					10+									
	136								1. 40–70, J, Mw, Fe+Cl, Sp, Ir, SR					
					10+									
	137													
		33		72	0	8	M		massive a'a pieces, dark gray (N3), moderately weathered, strong, 15% vesicles			0	72	
170							M							
	138								BASALT a'a Clinker Dark gray (N3) with red oxidized clay (2.5YR, 4/8), highly weathered, weak to very weak					
					NA									
168	139													
					NA		NR							
	140													
					NA									
	141													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	141						NR							
166		34		50	NA	0						0	26	
	142													
					NA									
	143													
					0				BASALT Massive a'a					
164									Dark gray (N3), slightly weathered, very strong, with 7% vesicles					
	144	35		92		92						0	60	
					0									
	145		14				1							
					0		M							
162							10							
	146													
					0									
							M							
	147								1. 60, J, T, Mn, Su, Pl, S					
									2. 45, J, N ,Cl, Fi, Wa, SR					
		36		94	0	74			3. 85, J, N, Cl, Fi, Wa, SR			0	30	
160	148						M							
					1									
							3							
	149													
					2		UNA							
158														
	150						1							
					1		M		1. 90, J, Vn, Fe+Mn, Su, Pl, S					
									2. 0, J, N, Cl, Pa, Wa, SR					
	151								3. 20, J, T, Fe+Mn, Su, Wa, SR					
					5				4. 10, J, Vn, Cl, Fi, Wa, SR					
							2		5. 80, J, Vn, Cl, Fi, Pl, SR					
156									6. 45. J, T, Fe, Su, Wa, SR					
	152						M							
							3							
							4							
		37		100	2	50						0	38	
	153						M		← 1% vesicles					
							5							
					0									
154														
	154								BASALT Pahoehoe					
			15				M		Dark reddish brown (10R 3/4), moderately weathered, strong, 10–15% small vesicles					
					2									
	155						M							
					2									
152							M		1. 60, J, T, Fe, Su, Pl, SR					
	156						1		2. 10, J, T, Fe, Su, Pl, S					
									3. 45, J, T, Mn, Su, Pl, SR					
							10		4. 45, J, N, Cl, Fi, Pl, SR					
					2				5. 45, J, N, Cl, Fi, Pl, SR					
									6. 45, J, N, Fe, Su, Pl, SR					
	157								7. 60, J, Vn, Fe, Su, Pl, SR					

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157													
		38		100	2	80			Dark gray (N3), slightly weathered, with 25–30% vesicles			0	100	
150	158				0									
	159				3				vesicles increase in size to >1/8" in diameter					
148	160				0				1. 30, J, Vn, Mn, Su, Wa, R 2. 45, J, N, Cl, Fi, Wa, SR 3. 10, J, N, Cl, Pa, Wa, R 4. 10, J, N, Cl, Pa, Ir, R 5. 70, J, T, Fe+Mn, Su, Pl, SR					
	161				1									
146	162													
		39	16	100	2	78			Dark reddish brown (10R 3/4), moderately weathered			0	60	
	163				1									
144	164				1									
	165				2				1. 45, J, Vn, Cl, Pa, Ir, R 2. 20, N, Cl, Fi, Wa, R 3. 30, T, Mn, Su, Pl, SR					
142	166				0									
	167													
		40		100	1	78						0	100	
140	168						3		flow boundary					
	169				0		M							
					2		M							
138	170								Dark gray (N3), slightly weathered to fresh, strong, with 30% vesicles					
					0									
	171		17				M							
					0									
136	172						M		20% vesicles, up to 1/4" diameter					
		41		100	0	86						0	100	
	173													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	173															
					0				1. 30, J, Vn, Fe+Mn, Su, Pl, SR 2. 85, J, Vn, Cl, Pa, Wa, SR 3. 10, J, Vn, Cl, Pa, Wa, SR							
-134	174				3											
	175															
					1				1. 0, J, N, Cl, Fi, Wa, SR 2. 0, J, Vn, Cl, Pa, Wa, SR 3. 70, J, Mw, Cl, Fi, Wa, SR							
-132	176				2											
	177															
		42		100	0	36								0	75	
-130	178				0											
	179		18													
					1				4. 45, J, T, Fe+Mn, Su, Wa, SR							
-128	180															
					2				1. 20, J, T, Fe, Su, Ir, SR 2. 70, J, T, Fe, Su, Wa, SR 3. 70, J, N, Cl, Pa, Wa, SR							
	181															
					1				flow boundary							
-126	182															
		43		100	0	78								0	100	
	183															
					0											
-124	184						3		4. 10, J, T, Fe+Mn, Su, Wa, SR 5. 70, J, Vn, Fe+Mn, Su, Wa, SR							
					2											
	185															
					0		M		BASALT a'a Clinker Dark gray (N3) with red Clay (2.5YR. 4/8), highly weathered, weak to very weak							
-122	186						M		very little recovery							
					1											
	187								BASALT Massive a'a Dark gray (N3), slightly weathered, very strong, with 15% vesicles							
		44		72	1	0	M							0	43	
-120	188						M		highly fractured							
					2				1. 90, J, Mw, Cl, Fi, Wa, R 2. 30, J, N, Cl, Pa, Pl, SR							
	189															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	189		19		1				3. 30, J, N, Cl, Pa, Pl, SR						
118	190														
					2		1 M 2		1. 10, J, T, Fe, Su, Wa, SR 2. 10, J, Vn, Cl, Pa, Wa, SR 3. 20, J, Vn, Cl, Pa, Wa, SR						
	191				NA		3								
116	192								BASALT a'a Clinker Grayish red (10R, 4/2), highly to completely weathered, very weak, with clay infilling				0		
		45		100	NA	10								60	
	193				NA										
114	194														
					NA										
	195								} thin zone of massive a'a core						
112					NA										
	196				NA								0		
	197								BASALT Massive a'a Dark gray (N3), slightly weathered, strong, with fractures with clay infilling						
		46		100	1	0								60	
110	198						1								
					3				1. 90, J, N-Mw, Cl, Fi, Wa, SR 2. 0, J, T, Fe+Mn, Su, Pl, S 3. 85, J, Vn, Cl, Pa, Pl, S 4. Complex fractures, J, N, Cl, Pa, Wa, SR						
	199						2 3								
108					2										
	200						4		BASALT a'a Clinker Grayish red (10R, 4/2), highly to completely weathered, very weak, with clay infilling						
					NA										
	201								BASALT Massive a'a Dark gray (N3), slightly weathered, strong, with fractures with clay infilling, with 1-5% vesicles						
			20		2										
106	202						1								
		47		100	2	75	2		1. 10, J, N, Cl, Fi, Wa, R 2. 45, J, Mw, Cl, Fi, Wa, SR 3. 45, J, N, Cl, Pa, Pl, SR 4. 45, J, T, Fe+Mn, Wa, SR 5. 0, J, Vn-N, Cl, Pa, St, R				0	50	
	203						3								
104					2		4								
	204						5								
					0										
	205														

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	205								<1% vesicles					
					1		M		1. 45, J, T-Vn, Fe+Mn, Pa, Pl, SR 2, Complex fractures, J, T-Vn, Fe+Mn, Su, Pl, S					
102	206	48		100	2	63	1 2							
	207				0		M					0	45	
100	208								▼ 10% vesicles					
					1		1		1. 10, J, Mw, Cl, Fi, Ir, SR					
	209	49		100		95						0	40	
					0		M							
98	210								▼ 5% vesicles					
					2		M		1. 70, J, N, Cl, Pa, Wa, SR 2. 20, J, Vn, Cl+Fe, Su, Ir, SR 3. 0, J, Vn, Cl+Fe, Su, Ir, SR 4. 0, J, N, Cl, Pa, Wa, SR					
	211						2							
					1		M							
96	212						3							
		50		100	1	40						0	45	
	213						M							
					3									
94							M							
	214				2		5		5. 90, J, Vn-N, Cl, Po, Pl, S 6. 0, J, Mw, Cl, Fi, Wa, R					
							M							
	215						M							
					1		1		1. 80, J, T, Fe+Mn, Su, Pl-Wa, S 2. 60, J, Bn, Fe, Su, Pl, S 3. 0, J, T, Fe+Mn, Su, Wa, SR					
92	216				2		2 3							
	217													
		51		100	0	74						0	50	
90							M							
	218				0									
							M							
	219				0				▼ becomes Welded a'a Clinker					
88														
	220								BASALT a'a Clinker Dark reddish brown (10R, 4/6), highly to completely weathered, very weak to weak					
					NA									
	221													

Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW08

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	221				NA										
-86	222	52		94	0	20			BASALT Pahoehoe Thin flows with variable color (10R, 4/6 to 10R, 4/2), moderately weathered, moderatel strong to strong, with 30% vesicles 1/2" in diameter				0	50	
	223				1		1 M		vesicles become 1/8" in diameter						
-84	224				0				1. 50, J, Vn, Fe+Mn, Su, Pl, SR						
	225				2		1		1. 40, J, T, Fe+Mn, Su, Pl, SR						
-82	226						2		2. 40, J, T, Fe+Mn, Su, Wa, SR						
					1				vesicles vary in size						
	227						M		Dark gray (N3), slightly weathered, strong to moderately strong						
		53		100	0	68							0	100	
-80	228				0				3. Complex of 10, 70, 70, 0 degree, J, T, Fe+Mn, Su, Wa, SR						
	229				2		3								
-78	230								40% very small vesicles (1/16" diameter)						
					0										
	231				2		1								
-76	232						2		1. 10, J, Vn-N, Cl, Pa, St, SR 2. 70, J, Vn, Cl, Pa, Wa, SR 3. 0, J, Mw, Cl, Fi, Wa, R 4. 90, J, Vn, Cl, Pa, Wa, SR 5. 0, J, T, Fe, Su, Pl, SR						
		54		100	0	72	M						0	150	
	233				2		3 4								
-74	234				1		5								
	235								30% vesicles (1/4" to 1/8" diameter)						
					0										
-72	236				0		M		30%-40% vesicles (1/16" diameter)						
	237														

Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW08

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	237													
		55		100	2	96	1					0	100	
-70	238						2		← 20–30% vesicles (1/4" to 1/8" diameter)					
					0				1. 30, J, Vn, Cl, Pa, Pl, SR 2. 60, J, Vn, Cl, Pa, Pl, SR					
	239						M							
					0									
-68	240													
					0		M							
	241													
					1		1		← moderately reddish brown (10R, 4/6), moderately weathered, moderately strong to strong			0		
-66	242						M							
		56		100	2	58	2		1. 45, J, T, Fe, Su, Pl, S				100	
							3		2. 0, J, Mw, Cl, Pa, Ir, R					
	243						M		3. 90, J, N, Cl, Fi, Wa, SR					
					1		4		4. 45, J, Bn, Cl, Pa, Wa, SR 5. 80, J, N, Cl, Fi, Wa, SR					
-64	244													
					1		5							
							M							
	245								← dark gray (N3), slightly weathered, strong to very strong					
					1									
-62	246						1		1. 70, J, T, Fe+Cl, Su, Pl, SR					
					2		2		2. 20, J, N, Cl, Pa, Wa, SR 3. 40, J, N, Cl, Pa, Wa, SR 4. 30, J, T, Fe+Cl, Su, Pl SR 5. 0, J, N, Cl, Fi, Wa, SR			0		
	247													
		57		100	3	80							100	
-60	248						3							
					0									
							M							
	249						4							
					2									
-58							5							
	250													
					2		1							
	251						2		1. 45, J, Vn, Cl, Pa, Pl, SR 2. 45, J, Vn, Cl, Pa, Pl, SR					
					2		3		3. 45, J, Vn, Cl, Fi, Pl, SR			0		
-56							M		4. 30, J, N, Cl, Fi, Pl, SR					
	252						M		5. 15, J, N, Cl, Fi, Pl, SR					
		58		100	1	84	4						100	
	253													

Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW08

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	253				0		M							
-54	254				1		M M 5		moderately reddish brown (10R, 4/6), moderately weathered, moderately strong					
	255				2		1 2		dark gray (N3), slightly weathered, moderately strong to strong					
-52	256				1		3		1. 15, J, Vn, Cl, Fi, Pl, SR 2. 45, J, N, Cl, Fi, Ir, R 3. 10, J, Vn, Cl, Pa, Wa, SR 4. 45, J, Vn, Cl, Pa, Pl, SR 5. 45, J, Nw, Cl, Fi, Wa, SR			0		
	257	59		80	1	52	4						60	
-50	258				1		M							
	259				0		5		no recovery					
-48	260				1		1		40% vesicles (<1/16" diameter)					
	261				3		2 3		1. 20, J, Mw, Cl, Fi, Ir, R 2. 20, J, T, Fe+Mn, Su, Pl, S 3. 30, J, Mw, Cl, Fi, Wa, SR 4. 90, J, N, Cl, Fi, Wa, SR			0		
-46	262						4		flow boundary 30% vesicles (1/16" to 1/8" diameter)					
	263	60		100	1	74	M 5 M		15% vesicles (1/4" to 1/2" diameter)				60	
-44	264				2		M 6		5. 45, J, Vn, Cl, Pa, Pl, SR 6. 0, J, N-MW, Cl, Fi, Wa, SR 7. J, Vn, Fe+Cl, Su, Pl, SR					
	265				1		7							
-42	266				1		M							
	267				0				1. 5, J, Vn, Cl, Pa, Wa, R			0		
	268	61		100	0	86	1						150	
-40	269				1									

Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW08

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269				0		M M								
-38	270								highly weathered, weak, with vesicles filled with clay dark gray (N3), slightly weathered, very strong						
					0										
	271														
					0										
-36	272														
		62		100	1	88	M		1. 90, J, N, Cl, Pa, Wa, R 2, 60, J, Vn, Cl, Pa, Pl, SR				0	100	
	273						1								
					0										
-34	274														
					1		2								
	275								grayish red (10R, 8/2), moderately weathered, moderately strong, with 20% small vesicles						
					1		1								
-32	276						M								
					1		M 2		dark yellowish brown (10YR, 2/2), moderately to slighlty weathered, strong, with 30% vesicles (1/8" to 1/4" diameter)						
	277						M								
		63		100	0	84			1. 20, J, Vn, Cl Pa, Ir, R 2. 30, J, Vn, Cl, Pa, Pl, SR 3. 75, J, Vn, Cl, Fi, Pl SR 4. 70, J, Vn, Cl, Pa, Pl, SR				0	150	
-30	278						M								
					1		3								
	279						M		dark gray (N3), slightly weathered, very strong, with 20% vesicles (1/4" to 1/2" diameter)						
					1										
-28	280						4								
					0										
	281						M		1. 0, J, Vn, Cl, Fi, Wa, Pl, SR 2. 60, J, T, Fe+Mn, Su, Pl, SR 3. 70, J, T, Fe, H, Pl, SR						
					1		1								
-26	282						M								
		64		100	0	92							0	75	
	283														
					0										
-24	284								moderately weathered, strong, with 40% vesicles (<1/16" diameter)						
					2		1								
	285														

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Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW08

Sheet 19 of 20

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	285						1 M 2		1. 0, J, N, Cl, Fi, Wa, SR 2. 0, J, N, Cl, Fi, Wa, SR					
22					2									
	286								moderately dark gray (N4), slightly weathered, very strong to moderately strong with 40% vesicles (<1/16" diameter)					
					1		3							
	287						M							
		65		100	1	66	M 4					0	100	
20	288								slightly weathered, very strong, with 35% vesicles (1/8" to 1/4" diameter)					
					0									
	289								3. 30, J, Mw. Cl, Fi, Pl, SR 4. 70, J, T, Fe+Mn, Su, Pl, S 5. 60, J, T, Fe+Mn, Su, Wa, SR					
					1		5							
18	290													
					1				1. 75, J, Bn, Cl, Pa, Pl, SR 2. 60, J, T, Fe+Cl, Su, Pl, SR 3. 20, J, Bn, Fe+Cl, Pa, Pl, SR					
	291													
					1		1							
16	292						M							
		66		96	0	66						0	100	
	293						M		moderately weathered, strong, with 35% vesicles (<18" diameter)					
					2		2 3							
14	294						M							
					0									
	295													
					0		M		1. 80, J, Vn, Cl, Pa, Pl, SR 2. 0, J, Vn, Fe+Cl, Pa, Wa, S					
12														
	296								40% to 50% vesicles (<1/16" diameter)					
					2		M 1 2							
	297						M					0		
		67		90	1	60	M		3. 50, J, T, Fe, Su, Pl, SR				100	
10	298						3 M							
					NA				BASALT a'a Clinker light brown (5YR, 6/4) to moderate reddish orange (10R, 6/6), highly weathered, weak					
	299													
					NA									
8	300								no recovery					
					NA									
	301													

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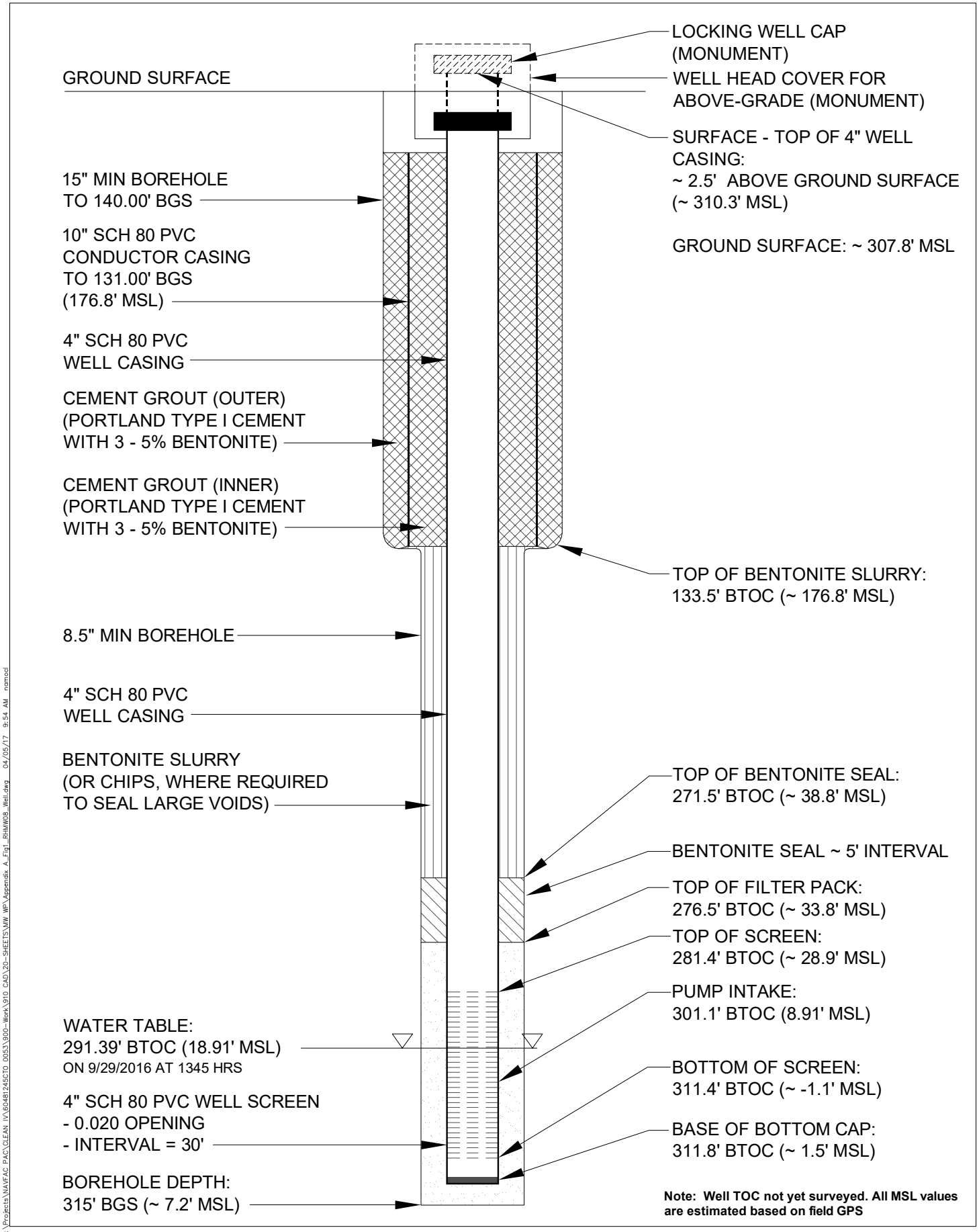
Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW08

Sheet 20 of 20

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	301															
-6	302	68		87	NA	0			thin flow of massive a'a, grayish red (10R, 4/2), moderately weathered, strong					0	36	
	303				NA											Boring drilled with tricone reaming bit from 303' to 315'. No core recovered or logged.
-4	304															
	305															
-2	306															
	307															
0	308															
	309															
-2	310															
	311															
-4	312															
	313															
-6	314															
	315															
-8	316															
	317															



S:\Projects\NAVFAC PAC\CLEAN IV\606481245CTO 0053\300-Work\910 CAD\20-SHEETS\MW WP\Appendix A_Fig1_RHMW08_Well.dwg 04/05/17 9:54 AM namocl

Appendix A Figure 1
Cross Section of RHMW08 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY
CTO53	RHMW08	RHMW08	(b) (6)

METHOD
- OVERPUMPAGE ☐
- BAILER ☒
- SURGE BLOCK ☐
- AIR LIFT ☐
- OTHER

INITIAL WATER LEVEL: 288.9' bgs (289.77' btoc)
INITIAL TOTAL DEPTH: 315'

FINAL WATER LEVEL: 390.98' btoc
FINAL TOTAL DEPTH: 315'

REMARKS:

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY							COMMENTS
DATE	TIME	METHOD	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (ppt)	
10/5/16	1317	Bailer			100	7.36	24.80	0.531	85.6		800	6.96	No odor. No sheen, light brown. PID: 0.0
10/5/16	1330				120	7.56	23.71	0.466	120.5		503	10.00	No odor. No sheen, light brown. PID: 0.0
10/5/16	1333				135	8.23	24.11	0.484	65.7		477	5.38	
10/5/16	1340				150	8.25	24.81	0.482	72.0		428	5.93	No odor. No sheen, light brown. PID: 0.0
10/5/16	1345				165	8.35	22.50	0.449	121.5		468	10.27	No odor. No sheen, light grayish. PID: 0.0
10/5/16	1346				180	8.29	21.83	0.409	5.82		170	0.2	
10/5/16	1348				186	8.54	24.10	0.412	5.81		115	0.2	No odor. No sheen, light grayish. PID: 0.0
10/5/16	1410				192	8.54	24.10	0.412	5.81		115	0.2	No odor. No sheen, light grayish. PID: 0.0
10/5/16	1412				198	8.54	24.10	0.412	5.81		115	0.2	No odor. No sheen, light grayish. PID: 0.0
10/5/16	1417				210	8.68	21.63	0.405	10.27		134	0.2	No odor. No sheen, light gray. PID: 0.0
10/5/16	1420				216	8.56	21.72	0.443	8.24		431	0.2	
10/5/16	1424				222	8.79	21.35	0.465	8.18		492	0.2	
10/5/16	1429				228	8.74	21.69	0.397	8.32		221	0.2	
10/5/16	1436				246	8.65	21.58	0.386	9.40		147	0.2	

10/5/16	1442				258	8.61	21.48	0.390	7.77		261	0.2	
10/5/16	1444				264	8.68	21.02	0.387	8.76		220	0.2	
10/5/16	1447				270	8.68	21.44	0.355	9.12		284	0.2	
10/5/16	1450				276	8.82	21.24	0.316	9.90		101	0.2	
10/5/16	1511				282	8.76	23.85	0.281	8.99		40.8	0.1	
10/5/16	1513				288	8.74	21.94	0.328	8.28		222	0.2	
10/5/16	1515				294	8.79	21.97	0.263	9.42		195	0.1	
10/5/16	1517				300	8.80	21.85	0.231	9.57		294	0.1	
10/5/16	1519				306	8.79	21.78	0.188	9.69		128	0.1	
10/5/16	1521	Bailer			312	8.70	21.15	0.355	8.93		105	0.2	
10/5/16	1526				318	8.63	21.40	0.376	8.94		246	0.2	
10/5/16	1533				324	8.77	22.41	0.255	9.17		124	0.1	
10/5/16	1535				340	8.70	21.36	0.218	9.84		80.3	0.1	
10/5/16	1537				346	8.68	21.38	0.184	9.80		115	0.1	
10/5/16	1540				352	8.64	20.94	0.258	9.97		130	0.1	
10/5/16	1543				358	8.68	21.08	0.221	9.54		126	0.1	
10/5/16	1543				362	8.66	20.95	0.258	9.77		148	0.1	
10/5/16	1546				368	8.65	20.90	0.262	9.39		133	0.1	
10/5/16	1558				374	8.66	20.83	0.257	9.80		92.0	0.1	
End Purge													

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Project: CT053 – Red Hill Bulk Fuel Storage Facilty Project Location: CT053 Project Number: 60481245	Log of Boring RHMW09 Sheet 1 of 26

Date(s) Drilled	07/19/2016	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	HQ core / air rotary	Drill Bit Size/Type	HQ diamond bit / 8" tricone bit	Total Depth of Borehole	405.0 feet
Drill Rig Type	Mobile B-59 / T3	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	391.52
Groundwater Level	El. 17.7' (7/29/2016)	Location	(b) (3) (A) [redacted]	Inclination from Horizontal/Bearing	90°
Borehole Completion	4-inch diameter monitoring well. See RHMW09 Well Cross Section for details			Hammer Data	140 lbs/30-inch drop

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								ALLUVIUM Soft, moist, reddish-brown (5YR 5/3), CLAY to Silty CLAY (CL)							Hand cleared to 5 ft bgs
390	1															
	2								VOLCANIC SAPROLITE Highly to completely weathered volcanic rock. Weathers to – Soft, moist, mottled reddish brown (5YR 5/3) to grey-brown (5YR 3/2), CLAY (CL)							
388	3															
	4															
386	5															
	6															
384	7															
	8															
382	9															
	10		1									1	50/3"	0		
380	11															HSA drilling becomes hard; refusal at 13.5 ft bgs
	12								BASALT Massive a'a Gray (5YR 3/5), moderately weathered, strong, 1% vesicles							
	13															

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 2/20/2017 RHMW09

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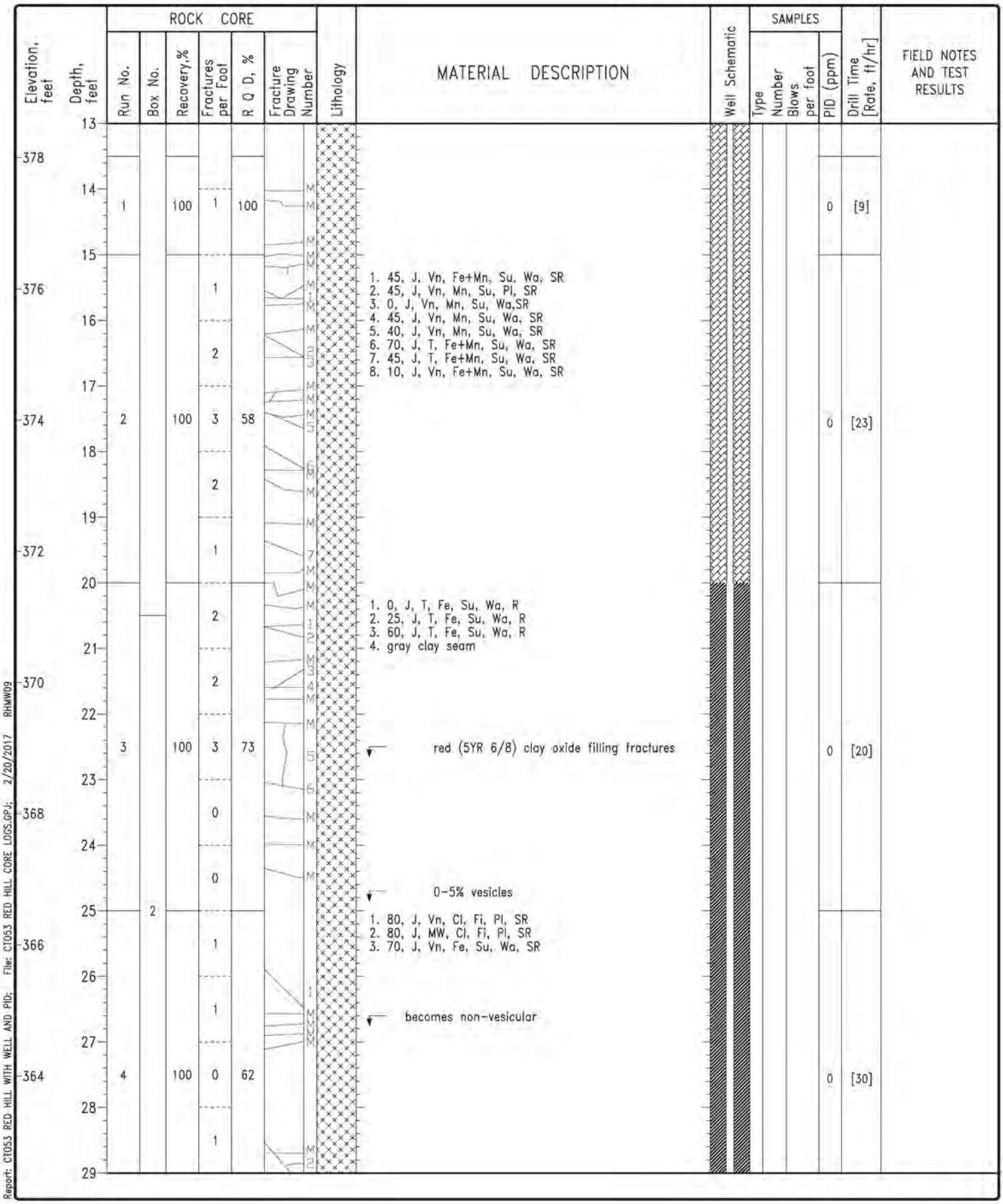
Project: CTO53 – Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW09

Sheet 2 of 26



Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/20/2017 RHMW09

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Project: CTO53 – Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW09

Sheet 3 of 26

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29						M									
362					1		J									
	30						J									
					4		J		1. 20, J, T, Fe, Su, Pl, SR 2. 15, J, T, Fe, Su, Pl, SR 3. 70, J, T, Fe, Su, Pl, SR							
	31						J		4. 0, J, T, Ch, Su, IR, SR 5. 80, J, T, Fe, Su, Wa, SR							
360					NA				BASALT a'a Clinker Reddish brown (5YR 5/3), moderately to highly weathered, moderately strong to weak, welded locally							
	32	5		70	NA	13								0	[21]	
	33								a'a core, slightly weathered, strong							
358					1		M		BASALT Massive a'a Orangish-red (10R 4/4), slightly weathered, strong, aphanitic, 10–15% vesicles							
	34															
			3		NA				No recovery							
	35								BASALT Massive a'a Reddish gray-brown (5YR 5/2), slightly weathered, very strong, massive, fractured, 10–15% vesicles							
356					NA		M									
	36						M									
					0		M		gray (5YR 5/1), less weathered							
	37						J		1. 0, J, T, Fe, Su, Pl, SR 2. 45, J, T, Fe, Su, Pl, SR							
354		6		100	4	53	J		3. 45, J, Vn, Cl, Fi, Pl, SR 4. 0, J, T, Fe, Su, Wa, SR 5. 30, J, T, Fe, Su, Wa, SR					0	[20]	
	38						M		6. 0, J, T, Fe, Su, Wa, SR 7. 0, J, T, Fe, Su, Wa, SR							
					3		M		8. 45, J, T, Fe, Su, Wa, SR							
	39						S									
352					3		J									
	40						M		BASALT a'a Clinker Dark gray (N3) with mottled reddish brown (5YR 5/3) Fe-oxide, highly to completely weathered, very weak to weak, welded locally							
					NA											
350	41															
					NA											
	42															
		7		64	NA	7			a'a core, gray (N3), slightly weathered, strong to very strong					0	[30]	
	43								a'a core, gray (N3), slightly weathered, strong to very strong							
348					NA				1. 0, J, T, Fe, Su, Wa, SR							
	44															
					NA				no recovery							
	45															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/20/2017 RHMW09

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Project: CTO53 – Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW09

Sheet 4 of 26

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45															
346					1				BASALT Massive a'a Gray (N4), slightly weathered, extremely strong, 15% vesicles							
	46		4						1. 25, J, T, Fe, Su, Wa, SR 2. 70, J, T, Fe, Su, Wa, R 3. 10, J, T, Fe, Su, Wa, SR 4. 30, J, T, Fe, Su, Wa, R 5. 70, J, T, Fe, Su, Wa, SR							
					1											
	47								6. 45, J, T–Vn, Fe, Su, PL, SR							
344		8		100	2	66								0	[38]	
	48															Water level recorded – no water encountered
					1											
	49															
342					3											
	50								1% vesicles							
					NA				BASALT a'a Clinker Reddish brown (5YR 5/3), highly weathered, weak, mottled							
	51															
340					NA											
	52								BASALT Massive a'a Gray (N4), slightly weathered, extremely strong, large stretched vesicles – 10–15%, massive							
		9		80	0	55								0	[35]	
	53								1. 10, J, T, Fe, SU, Wa, SR							
338					1											
	54								BASALT a'a Clinker Dark gray (N3) mottled, highly weathered, weak, welded locally							
					NA											
	55															
336					0				BASALT Massive a'a Medium dark gray (N4), slightly weathered, extremely strong, 15% vesicular							
	56								BASALT a'a Clinker Gray (N4), moderately weathered, very weak							
			5		NA											
	57								BASALT Massive a'a Dark gray (N3), slightly to moderately weatered, strong, 5–10% vesicles							
334		10		82	3	53			1. 0, J, N, Fe, Sp, Wa, SR 2. 90, J, N, Fe+Cl+Mn, Sp, Wa, SR 3. 30, J, N, Mn+Fe, Sp, Wa, SR 4. 10, J, N, Cl+Mn, Sp, Wa, SR 5. 60, J, N, Cl+Mn, Sp, Wa, SR					0	[33]	
	58															
					1											
	59															
332					NA				possible void							
	60								medium gray (N3)							
					1											
	61															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/20/2017 RHMW09

Project: CTO53 – Red Hill Bulk Fuel Storage Facilty
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Project Number: 60481245

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
330	61															
	62				3				1. 15, J, N, M, Sp, Wa, SR 2. 60, J, Mn+Uk, Sp, Wa, SR 3. 10, J, Mn+Cl, Sp, Wa, SR 4. 45, J, N, Fe, Sp, Wa, SR 5. 45, J, N, Fe+Mn, Sp, Wa, SR						
	63	11		100	3	75								0	[50]	
328	64				2											
	65				0				BASALT Pahoehoe Brown (5YR 4/4), moderately weathered, weak to moderately strong, 100% infilling of vesicles with clay, 40% small vesicles							
326	66		6		1											
	67				2											
324	68	12		100	1	14			highly fractured, very weak 1. 40, J, T, Fe, Su, SR 2. 45, J, T, Fe, Su, SR 3. 30, J, T, Fe, Su, SR 4. 0, J, T, Fe, Su, SR 5. 0, J, T, Fe, Su, SR 6. 70, J, Vn, Cl, Pa, SR					0	[50]	
	69				2											
322	70				0				completely weathered, extremely weak, pervasive alteration of pahoehoe							
	71				NA											
320	72				NA											
	73	13		40	NA	0			no recovery					0	[100]	
318	74				NA											
	75				NA				BASALT Volcanic Breccia Dark reddish brown (10R 3/4), variegated colors of clasts, moderately to highly weathered, weak							
316	76		7		NA											
	77				NA											

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
314	77															
	78	14		100	NA	0								0	[23]	
					NA											
	79															
312					NA											
	80															Water in core rods dropped from 15.5 to 22.5 ft bgs over 6 minutes; no perched water
					NA											
	81															
310					NA											
	82								dusky red (10R 2/2)							
		15		100	NA	20								0	[43]	
	83															
308					NA											
	84						1		BASALT Massive a'a Medium gray (N5), slightly weathered, extremely strong, 1–5% vesicles							
					1		M		1. 90, J, T–Vn, Cl, Pa, Wa, SR							
	85						1		nonvesicular							
306					2		2									
	86						3		1. 45, J, Vn, Fe+Cl, Pa, Wa, SR 2. 30, J, Vn, Fe+Cl, Pa, St, R 3. 10, J, T, Fe, Su, Wa, R 4. 55, J, T, Fe, Su, Wa, SR 5. 15, J, T, Fe, Su, Wa, SR 6. 85, J, Vn, Fe+Cl, Pa, Pl, Sm							
					2											
	87		8													
304		16		100	1	100	4							0	[50]	
	88						UF									
					1											
	89															
302					1		M									
	90						6									
							M		1. 10, J, T, Fe, Su, Wa, SR 2. 10, J, T, Fe, Su, Wa, SR 3. 15, J, T, Fe, Su, Wa, R 4. 15, J, T, Fe, Su, Wa, R 5. 90, J, N, Cl+Fe, Pl–Wa, SR–R							
					1		M									
	91						M									
							1									
							and									
300					3		3									
		17		100		25	M							0	[50]	
	92						4									
					2		M									
							M									
	93						M									

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
298	93				NA				BASALT Welded a'a Clinker Dark reddish brown (10R 3/4), variegated color of clasts, moderately to highly weathered, weak							
	94	18		100	NA	0								0	[50]	
296	95				NA											
	96		9		0				BASALT Massive a'a Reddish brown (10R 4/6), completely weathered, weak, vesicles infilled with clay grayish red (10R 4/2), moderately weathered, 10–15% vesicles							
	97								1. 70, J, Vn, Cl, Fi, Wa, SR 2. 20, J, T, Fe, Su, Wa, R 3. 90, J, N, Cl, Fi, Pl, SR							
294	98	19		100	1	0	1 M							0	[43]	
	99				1		2 M		highly weathered, with 1% vesicles							
292	100				1		3 M		medium gray (N4), slighly weathered, 20% large vesicles 1% vesicles							
	101				2		4 M		1. 80, J, N, Fe+Cl, Pa, Wa, SR 2. 45, J, N, Fe+Cl, Pa, Wa, SR 3. 30, J, N, Cl, Su, Wa, SR 4. 40, J, T, H, No, Pl, SR 5. 45, J, Mw, Fe+CL, Fi, Wa, SR 6. 20, J, Mw, Fe, Sp, Wa, SR							
290	102				1		5 M									
	103	20		100	2	0	6 M		breccieated					0	[60]	
288	104				0				pale brown (5YR 5/6, slightly weathered, strong, less than 1% vesicles							
	105		10		0				BASALT Volcanic Breccia Pale reddish-brown (10R 5/4), highly weathered, weak to moderately strong; note clayey matrix in weaker zones, stronger zones appear welded							Water in core rods dropped from 63.18 to 78 ft bgs in 5 minutes; no perched water
286	106				NA											
	107				NA											
284	108	21		100	NA	0								0	[60]	
	109				NA											

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
282	109				NA											
	110				NA				moderately strong							Water in core rods dropped from 60.4 to 78.05 ft bgs in 10 minutes; no perched water
	111															
280					2				BASALT Massive a'a Medium gray (N5), slightly weathered, very strong, massive, less than 1% small vesicles							
	112								1. 70, J, MW-W, Fe+Cl, Pa, Wa, R 2. 15, J, N, Fe+Cl, Pa, Wa, R							
		22		100	1	32			3. 15, J, N, Fe+Cl, Pa, Wa, R					0	[75]	
	113		11						4. 60, J, T, Fe, Su, Wa, SR 5. 90, J, T, Fe, Su, Wa, SR							
278					1				6. 30, J, T, Fe, Su, St, R 7. 15, J, T, Fe, Su, St, SR							
	114															
					4											
	115								1-5% vesicles							
276					0				1. 70, J, T, Fe, Su, W, SR 2. 50, J, T, Fe, Su, Wa, SR 3. 20, J, T, Fe, Su, Wa, SR							
	116															
					1											
	117															
274		23		100	2	78								0	[33]	
	118															
									5-10% vesicles							
	119				0											
272					1											
	120								1. 45, J, T, Fe, Su, Pl, S 2. 20, J, T, Fe, Su, Pl, S 3. 30, J, T, Fe, Su, Pl, S							
					1											
	121															
270					2											
	122								BASALT a'a Clinker Dark reddish brown (10R 3/4), highly weathered, very weak							
		24		34	NA	14								0	[43]	
	123															
268					NA				no recovery							
	124		12													
					NA											
	125															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
266	125				NA											
	126				NA											
	127															
264	128	25		75	NA	0			no recovery					0	[40]	
	129				NA											
262	130				1		M 1		BASALT Massive a'a Dark reddish gray (2.5YR 3/1), moderately weathered, moderately strong, 5% vesicles, massive 1. 90, J, N, Fe+Cl, Pa, Wa, R							Water in core rods dropped from 62 to 76.7 ft bgs in 5 minutes; no perched water
					0				dark gray (2.5Y 4/1)							
260	131				0											
	132	27		96	0	65			weak red (10R 4/2), welded a'a clinker					0	[60]	
258	133				0											
	134				0				dark gray (2.5Y 4/1), slightly weathered, very strong, less than 1% vesicles							
	135		13													
256					1		1		1. 40, J, T, Fe+Mn, Su, Wa, SR 2. 60, J, Vn, Cl, Pa, Wa, SR 3. 45, J, Vn, Cl, Pa, Wa-Pl, SR 4. 45, J, Vn, Cl, Pa, Wa, Sm 5. 60, J, T, Mn, Su, Wa, SR 6. 60, J, T, Mn, Su, Wa, SR 7. 80, J, T, Mn+Cl, Su, St, SR 8. 90, J, T, Mn, Su, St, R							
	136				4											
	137															
254	138	28		100	3	50	M							0	[33]	
	139				1		M									
252					0											Water level recorded – no water encountered
	140				1		M		dark bluish gray (Gley 4/1), 1-5% vesicles							
	141				1											

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
250	141				1		1 2		1. 55, J, N, No, N, Pl, SR 2. 55, J, N, No, N, Pl, SR 3. 70, J, N-MW, Cl+Fe, Pa, Pl, SR 4. 25, J, N, Cl, Pa, Wa, SR							
	142															
		29	14	100	1	84								0	[43]	
	143						M 3									
248					1											
	144						4									
					1											
	145						1		1. 65, J, N, Mn, Sp, Wa, SR 2. 45, J, M, No, N, Wa, SR 3. 5, J, MW, Fe+Cl, Sp, Wa, SR 4. 25, J, N, Fe+Cl, Sp, Wa, SR 5. 20, J, N, Fe+Cl, Su, Pl, SR 6. 15, J, N, Fe+Cl, Pa, Wa, SR 7. 5, J, N, Fe+Cl, Pa, Wa, SR 8. 5, J, N, Ca, Sp, Pl, SR						
246					1											
	146						M 2									
					1											
	147						M									
244		30		100	1	74	M 3							0	[50]	
	148						4									
					4											
	149						7 DRUM									
242					2		CD									
	150								BASALT a'a Clinker Dark reddish brown (10YR 3/4), highly weathered, very weak						
					NA											
	151															
240					NA											
	152															
		31		36	NA	0			no recovery					0	[75]	
	153		15													
238					NA											
	154															
					NA											
	155															Water in core rods dropped from 84 to 89.9 ft bgs in 7 minutes; no perched water
236					NA											
	156															
					0				BASALT Massive a'a Bluish gray (Gley 4/2), moderately weathered, strong, 5% small to medium vesicles; highly fractrured/broken							
	157															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157								from 157.4–158 ft bgs, becoming very strong							
234	158	32		70	0	44			1. 55, J, N, Mn, Sp, Wa, SR 2. 45, J, N, Ca, Sp, Wa, SR 3. 45, J, N,					0	[60]	
	159				1											
232	160				2											
	161				10+				highly fractured							
230	162				10+				5–10% vesicles							
	163	33		90	3	54			1. 50, J, N, Na, N, Wa, SR 2. 40, J, MW, Fe+Cl, Pa, Wa, SR 3. 70–90, J, W, Cl+Ca+Fe, Fi, Wa, SR 4. 20, J, MW, Cl+Mn, Sp, Wa, SR 5. 20, J, MW, Cl+Mn, Sp, Wa, SR					0	[43]	
228	164				2											
	165		16		2											
226	166				3				1. 80, J, N, Fe, Sp, Wa, SR 2. 75–90, MW, Cl+Fe, Pa, Wa, R 3. 65, MW, Cl+Fe, Sp, Wa, R 4. 65, MW, Cl+Fe, Sp, Wa, R							
	167				2				highly fractured							
224	168	34		100	1	34								0	[38]	
	169				0											
222	170				0											
	171				3				1. 15, J, N, Fe, Sp, Pl, SR 2. 30, J, Mw, Fe+Cl, Sp, Wa, SR 3. mechanical 4. 65, J, N, Cl+Fe, Sp, Wa, SR 5. 55, J, N, Fe+Mn, Sp, Wa, R 6. 30. J, N, Fe, Sp, Wa, R 7. 65, J, N, Mn, Sp, Wa, R 8. 60, J, N, No, N, Wa, R 9. 45, J, N, No, N, Wa, R							
220	172				1											
	173	35		100	1	40								0	[30]	

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
218	173		17		3											
	174				1											
	175								1. 15, J, N, Fe, Sp, Wa, R 2. 10, J, N, Fe, Sp, Wa, R 3. 85, J, Fe, Su, Wa, R 4. 70, J, Fe, Su, Wa, SR 5. 50, J, Mn, Sp, Pl, SR 6. 45, J, Fe, Sp, Wa, SR						
216	176				3											
	177				3											
214		36		100	NA	44			BAKED PALEOSOL Dark reddish brown (10R 3/4), highly weathered, weak					0	[20]	
	178				NA											
	179								BASALT Volcanic Breccia Reddish gray (10R 5/1), moderately weathered, strong, clasts are rounded ranging in size from sand to gravel; becomes predominantly sand size clasts, weak to very weak at 180.4 ft bgs							
212					1											
	180				NA				← Highly weathered, very weak, many mechanical breaks							Water in core rods dropped from 164.8 to 165.6 ft bgs in 10 minutes; circulation water is mixed with foam and bentonite, slowing dissipation into formation; no perched water
	181				NA											
210																
	182				NA											
	183	37	18	64	NA	64								0	[50]	
208					NA											
	184				NA											
	185															
206					NA											
	186				NA											
	187															
204		38		66	NA	46			BASALT Massive a'a Medium gray (N4), slightly weathered, very strong, 5–10% vesicles					0	[30]	
	188								1. 45, J, MW, Mn, Su, Wa, R							
					0											
	189															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
202	189				1		1									
	190				0											Water in core rods dropped from 147.6 to 153.3 ft bgs over 23 minutes; circulation water is mixed with foam and bentonite, slowing dissipation into formation; no perched water
					0		M									
200	191						M									
					0		M									
	192						M									
		39		90	10+	44	M		becomes moderately weathered weak rock, moderately oxidized with some vesicles filled with Fe+Mn					0	[50]	
	193		19													
198					10+											
	194															
					NA											
	195															
196					NA											
	196								becomes slightly to moderately weathered, strong							
					1		M		1. 80, J, Mw, Fe, Sp, Wa, R							
	197						1		2. 70–90, J, N, Fe, Su, Wa, SR							
194		40		80	2	30	2		3. 70, J, N, Fe, Sp, Wa, SR					0	[43]	
	198						3		4. 55, J, N, Wn, Sp, Wa, SR							
					2		4									
	199						M		Highly weathered							
192							M									
					NA		M									
	200								BASALT Massive a'a Medium gray (N4), highly weathered, very weak							
					NA											Water in core rods dropped from 162.7 to 167 ft bgs over 36 minutes; circulation water is mixed with foam and bentonite, slowing dissipation into formation; no perched water; stop drilling due to sheared rod at 130 ft bgs, repaired on 7/23/16
	201															
190					NA				no recovery							
	202															
		41		44	NA	20	M		slightly weathered, very strong, 1–5% vesicles					0	[43]	
	203						M									
188					0		M									
	204		20				M									
					10+		M		highly broken/fractured							
	205															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	205								**BASALT Massive a'a** Medium to dark gray (N4), slightly weathered, weak to moderately strong							
186					0											
	206								← weak to moderately strong, highly to intensely fractured							
					10+				1. 75, J, N, Mn, Sp, Wa, SR 2. 65, J, N, Na, N, Wa, SR							
	207						1 12									
184		42		84	2	32			} very strong rock					0	[38]	
	208								← weak to moderately strong, highly to intensely fractured, with little recovery							
					10+											
	209															
182					10+											
	210															
					NA											
	211								**BASALT Massive a'a** Medium dark gray (N4), slightly weathered, strong, 5–10% noticeably stretched and with subverticle angle vesicles							
180					0		M									
	212						M		} highly weathered, weak zone							
		43		80	0	54			1. 70–90, J, N, Mn, Su, Wa, SR					0	[60]	
	213						M									
178					0											
	214						M									
					1		M 1									
	215		21				M									
176					1		1									
	216	44		100		56			1. 85–90, J, N, Mn, Sp, Wa, SR							
					0		M									
	217						M									
174					1		M							0	[15]	
	218						M 1		1. 5, J, N, Mn+Cl, Sp, Wa, SR 2. 70, J, N, Mn, Su, Wa, SR							
					2		M									
	219	45		76		48	2 M									
172					NA				**BASALT a'a Clinker** Dusky red (10R 3/3), clasts are moderately weathered, strong							
	220															
					NA											
	221															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
170	221				NA											
	222	46		20	NA	0			No recovery					0	[19]	
	223															
168					NA											
	224															
					NA											
	225															Water level recorded – no water encountered
166					NA				No recovery							
	226															
					NA											
	227		22				M		BASALT Massive a'a Medium dark gray (N4), slightly to moderately weathered, strong to moderately strong, 10–15% vesicles (many mechanical breaks)							
164		47		70	1	66	M		1. 15, J, N, Uk+Mn, Sp, Wa, SR					0	[33]	
	228						M									
					0		M									
	229						M									
162					0		M									
	230						M		half of the vesicles become large and elongated							Water level recorded – no water encountered
					0		M		1. 20, J, N, Cl, Su, Wa, SR 2. J, N, Cl, Su, SR 3. 10, N, Cl+Mn, Sp, Sa, SR 4. 15, N, Cl+Mn, Sp, Wa, SR 5. 70–90, Mn, Sp, Wa, SR							
	231						M									
160					0		M									
	232						M									
		48		100	1	78	M							0	[33]	
	233						M									
158					2		M									
	234						M									
					4		M									
	235						M		1. 80, J, N, Cl, Pa, Wa, SR 2. 30, J, N, Cl, Pa, Wa, SR 3. 75–80, Jn, N, Mn+Cl, Sp, St, SR 4. 25, J, N, Cl+Mn, Pa, Wa, SR 5. 70, J, N, Mn, Sp, Wa, SR 6. 65, J, N, No, N, Wa, R 7. 25, J, N, Cl, Sp, Wa, R							
156					3		M									
	236						M									
					1		M									
	237						M									

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	237													
154		49		100	2	60						0	[25]	
	238				1				BASALT Pahoehoe Dark reddish brown (2.5 YR 2.5/4), moderately weathered, moderately strong to strong, 50% vesicles (unstretched); 3-inch zone of completely weathered at 238.8 ft bgs					
	239		23											
152					2									
	240				1				vesicles become partially filled with clay					
	241								grades to very dark gray (5YR, 3/1), slightly weathered					
150					1									
	242	50		93		78			1. 70–30, J, N, Mn, Sp, IR, R 2. 65, J, N, Cl, Sp, Wa, R			0	[17]	
	243				0									
148					0									
	244								50–60% vesicles, moderately strong to weak, increase in mechanical fractures					
		51		100	0	100						0	[60]	
	245								1. 80–90, J, N, No, N, Wa, R 2. 25, J, N, Fe, Su, IR, SR 3. 10, J, N, Fe+Mn, Su, Wa, SR 4. 20, J, N, Mn, Sp, Wa, SR 5. 15–20, J, N, Mn+Fe, Sp, Wa, SR					
146					1									
	246				0									
	247													
144		52	24	100	1	80						0	[43]	
	248								slightly oxidized					
					2									
	249													
142					1									
	250								moderately strong					
					0				zone of large vesicles					
	251													
140					2									
	252								1. 30, J, N, Fe, Sp, Wa, R 2. 45, J, N, No, N, Wa, R 3. 45, J, N, No, N, Wa, R					
		53		100	2	86						0	[50]	
	253								weak with lots of mechanical fractures					

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
138	253				0											
	254				0											
	255								← moderately strong with 50% vesicles							
136					1											Water level recoreded to 242.9 ft bgs; End of drilling 7/26/16; begin 7/27/16 – no water encountered to bottom of hole
	256		25						1. 60, J, Mn, Sp, Wa, SR 2. 55, J, N, No, N, Wa, SR 3. 65, J, N, No, N, Wa, SR							
	257				1											
134		54		100	0	98								0	[50]	
	258															
	259				2				small zone of stretched vesicles, 30% (258.6–259.2 ft bgs)							
132					1											
	260															
	261				2				1. 35, J, Fe, Sp, Wa, R 2. 80, J, N, No, N, Wa, R 3. 35, J, N, Fe+Cl, Wa, SR 4. 70, J, N, No, N, Wa, R 5. 40, J, N, No, N, Wa, R							
130					1											
	262															
	263	55		100	1	98								0	[50]	
128					2				← zone of stretched vesicles, 20%							
	264		26													
	265				1				← becomes weak (many mechanical breaks), 50% vesicles							
126					10+											
	266								1. 35, J, N, No, N, Wa, R 2. 90, J, N, No, N, Wa, R							
	267				1											
124		56		90	1	90			becomes dusk red (10R 3/2)					0	[38]	
	268															
	269				0				← Reddish black (2.5YR 2.5/1) with large vesicles [partially filled with clay (10% filled)], moderately strong ← moderately weathered, moderately strong,							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269								50–60% vesicles (stretched dipping)						
122					0										
	270								1. 70, J, N, No, N, Wa, SR 2. 25, J, N, Mn, Sp, Wa, SR 3. 10, J, N, Mn+Other, Pa, Wa, SR 4. 50, J, N, Mn+Sd, Sp, Wa, R 5. 70, J, N, Mn, Sp, Wa, SR						
	271				1				40% small vesicles starting at 271 ft bgs						
120					2										
	272														
		57		100	1	90			Dusky red (10R 3/2), moderately strong to weak				0	[38]	
	273														
118			27		2										
	274								moderately strong, 50% vesicles (larger)						
					0										
	275								grades to reddish black (2.5YR 2.5/1)						
116					0				1. 70, J, N, No, N, Wa, R 2. 85–90, J, N, Mn, Sp, Wa, SR 3. 25, J, N, Mn, Su, Wa, SR to S 4. 65, J, N, Fe+Mn, Sp, Wa, SR 5. 10, J, N, Fe+Cl, Sp, Wa, SR 6. 10, J, N, Fe+Cl, Sp, Wa, SR 7. 65, J, N, Mn, Sp, Wa,						
	276														
					2										
	277														
114		58		92	2	62							0	[43]	
	278														
					2										
	279														
					1				FAT CLAY Soft, moist, pale brown (10YR 6/3), Fat CLAY (CL). Surrounded by 1–inch completely/highly weathered clay rich gravel, very weak on top and bottom		RH062				
112															
	280								BASALT Massive a'a very dark gray (5Y 3/1), slightly to moderately weathered, strong, 5% stretched vesicles						
					2										
	281								1. 60, J, N, Cl, Sp, St, SR 2. 80–90, J, N, Mn, Sp, Wa, SR 3. 70–80, J, N, Mn, Sp, Wa, SR 4. 30, J, N, Mn, Su, Wa, SR 5. 35, J, N,						
110					4										
	282														
		59	28	100	2	40							0	[30]	
	283														
108					NA				BASALT a'a Clinker Weak red (10R 4/3), moderately to highly weathered, weak, highly fractured						
	284														
					NA										
	285														

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	285															Water recorded – 284.4 ft bgs and dropping
-106					NA											
	286				0		M		BASALT Massive a'a Very dark gray (10YR 3/1), highly weathered, weak, 5–10% vesicles 1. 70–90, J, N, Cl, Sp, Wa, R 2. 50–60, J, N, Mn, Sp, Wa, SR 3. 30, J, N, Mn, Sp, Wa, SR							
	287						M									
-104		60		80	1	48	1							0	[33]	
	288						M									
					3		M									
	289						M									
-102					2		M		← moderately strong to weak (many mechanical fractures)							
	290						3									
							M									
					1		M									
	291						M									
-100					0		M									
	292						M		← vesicles (5%) become large and irregular shaped with mechanical breaks along vesicles							
		61	29	76	0	70	M							0	[33]	
	293						M									
-98					0											
	294						M									
					NA				BASALT a'a Clinker Dark reddish brown (2.5YR 3/3), moderately to highly weathered, weak, highly fractured							
	295															Water in core rods dropped from 294 to 295 ft bgs in 10 minutes; no pereched water
-96					NA				} no recovery							
	296	62		50		0								0	[20]	
					NA											
	297								} no recovery							
-94					NA											
	298						1		BASALT Massive a'a Very dark gray (10YR 3/1), slightly weathered, moderately strong, 10% vesicles							
		63		83	1	70			1. 70, J, N, Fe+Mn, Sp, Wa, R					0	[36]	
	299						M									
-92					0											
	300								BASALT Pahoehoe Dark red (10R 3/6), moderately weathered, weak, 60–70% vesicles; no recovery from 300–300.4 ft bgs; grades to dark gray (N3), moderately weathered,							
					NA											
	301															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	301								moderately strong at 300.8 ft bgs							
-90					1				1. 30, J, N, Mn+Cl, Sp, Wa, SR 2. 10, J, N, Fe, Sp, Pl, SR							
	302															
		64	30	90	0	80			zone with large vesicles					0	[50]	
	303															
-88					2											
	304															
					1				slightly oxidized, 50–60% vesicles							
	305								1. 30–40, J, N, Fe, Sp, Wa, R 2. 70, J, N, Fe+Cl, Sp, Wa, R							
-86					0											
	306															
					1											
	307								dark reddish brown (2.5YR 3/3), weak (many mechanical fractures/breaks)							
-84		65		100	1	95								0	[75]	
	308															
					1											
	309															
-82					0											
	310								very dark gray (7.5YR 3/1), moderately weathered, moderately strong, with 50–60% vesicles							
					1				1. 30, J, N–MW, Fe+Mn, Su, Wa, S+Slk 2. 20, J, N, Fe, Sp, Wa, R 3. 65, J, N, Cl+Sa, Sp, Wa, R							
	311															
-80			31		NA				moderately to highly weathered, oxidized, weak zone							
	312															
		66		100	1	76								0	[100]	
	313															
-78					NA				moderately to highly weathered, oxidized, weak zone							
	314															
					1				50% vesicles, vesicles become medium to large							
	315								1. 20, J, N, Fe, Su, Wa–Pl, SR 2. 65, J, N, Fe, Mn, Sp, Wa, SR							
-76					0											
	316															
					0											
	317															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time (Rate, ft/hr)	FIELD NOTES AND TEST RESULTS
	317															
74		67		100	1	95			← moderately strong to weak (many mechanical fractures)					0	[75]	
	318															
					0											
	319															
72					1											
	320		32													
					0											
	321															
70					0											
	322								1. 80–90, J, N, Mn, Sp, Wa, R 2. 5, J, N, M+Fe, Sp, Wa, SR 3. 50–90, J, N, Mn+Sa, Wa, R							
		68		100	0	80								0	[100]	
	323															
68					2											
	324															
					1											
	325															
66					1				← grades to dark reddish brown (2.5YR 3/4), 50–60% vesicles 1. 20–40, J, N, Fe+Cl, Sp, IR, R 2. 60, J, N, Fe, Sp, Wa, SR 3. 20, J, N, Mn, Sp, Wa, SR 4. 50–70, J, N, Fe, Su, Wa, SR to S							
	326															
					2											
	327								← moderately to highly weathered zone with some vesicles filled with clay or CaCO3							
64		69		100	0	90								0	[100]	
	328															
			33		0				← moderately weathered, moderately strong							
	329															
62					0											
	330								← dark reddish gray (10R 3/1), with 40% vesicles (large)							
					1				← discrete change from large to small/medium vesicles, 50–60% (possible pahoehoe flow contact) 1. 5, B, N, No, N, Wa, R							
	331															
60					0											
	332								← 60% vesicles (small)							
		70		100	0	100								0	[75]	
	333															

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	333								grades to very dark gray (10YR 3/1) with 40-50% large to medium vesicles							
58					0											
	334								few vesicles contain apparent olivine crystals							
					0											
	335								vesicles become small to medium							Water level recorded - no water encountered
56					0											
	336								1. 15, J, N, Fe, Su, Wa, SR 2. 10, J, Fe, Su, Pl, SR							
					1											
	337								slightly oxidized zone							
54		71	34	100	0	99			60-70% vesicles (small)					0	[100]	
	338															
					1				slightly oxidized zone							
	339															
52					0											
	340								1. 15, J, N, Fe+Mn, Sp, Wa, SR 2. 15, J, N, Fe, Su, Wa, R							
					0											
	341															
50					1											
	342															
		72		100	0	99								0	[150]	
	343															
48					1											
	344															
					0											
	345															
46			35		0											
	346															
					0											
	347								few apparent olivine crystals							
44		73		100	0	100								0	[150]	
	348															
					0											
	349															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
42	349				0		M									
	350						M		40–50% vesicles							
					0		M									
	351						M									
40					0											
	352						M									
		74		100	0	100	M							0	[100]	
	353															
38			36		0											
	354						M									
					0		M									
	355						M									
									becomes brownish black to very dark gray (10YR 3/1), moderately to slightly weathered, moderately strong, 50% small vesicles							End of drilling 7/27/16; 1,700 gallons of water used with 2 cups of foam; begin drilling 7/28/16
36					1											
	356						1		1. 55, J, N, Fe, Sp, Wa, R							
					0		M									
	357															
34		75		100	1	94	M							0	[100]	
	358						2									
							M		highly weathered oxidized zone							
					1		3		40–50% vesicles (medium to large)							
	359						M									
32					0											
	360						1		zone with only 5% vesicles							
					1											
	361						2									
30			37				M		1. 65, J, N, Fe+Mn, Sp, Wa, SR 2. 25, J, N, Fe, Sp, Wa, R 3. 30, J, N, Fe, Sp, Wa, R							
	362				1											
		76		100	0	98	M							0	[75]	
	363															
28					0		M									
	364						3		oxidized, moderately weathered							
					2		3		oxidized, moderately weathered							
	365															

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	365								1. 80, J, N, Mn+Cl, Sp, Wa, R							Water in core rods dropped from 352.1 to 357.9 over 20 minutes; no perched water
-26					0											
	366															
					0											
	367															
-24		77		100	1	90								0	[75]	
	368															
					0											
	369								highly weathered, oxidized							
-22			38		0											
	370								grades to very dark gray (5YR 3/1), moderately weathered, moderately strong, 40% vesicles (medium)							
					0				1. 45, J, MW, Fe+H, Fi, Wa, SR 2. 0, J, MW, Fe, Su, Wa, SR							
	371															
-20					2											
	372															
		78		100	0	94								0	[100]	
	373															
-18					0											
	374									▼						
					1				highly weathered, oxidized							
	375								1. 20, J, MW, Fe+Mn, Fi, Wa, SR							
-16					0											
	376															
					0											
	377		39													
-14		79		100	0	99								0	[100]	
	378															
					0											
	379															
-12					1											
	380								slighly oxidized, weak to moderately strong (many mechanical breaks)							
									1. 15, J, N, Fe, Su, Wa, R 2. 65, J, N, Fe, Su, Wa, R							
					1											
	381															

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	381													
10	382				0									
		80		100	1	99			vesicles partially filled with Fe oxide			0	[100]	
	383													
8					0									
	384													
					0									
	385		40						1. 20, J, N, Cl, Sp, Wa, SR, 30% of vesicles filled with clay 2. 20, J, N, Fe, Su, Wa, SR-R, small bands of Fe weathering above 3. 30, J, N, Cl, Sp, Wa, SR, 20% of vesicles filled with clay					Water level recorded – Steady at 373.5 ft bgs after multiple readings
6					0									
	386													
					0									
	387													
4		81		100	1	99			30% vesicles			0	[75]	
	388													
					1				moderately to highly weathered, oxidized, increase to 50% vesicles, oxidized 2mm-thick bands of reddish brown (10R 4/6)					
	389													
2					1				moderately strong					
	390													
					1				1. 10, J, N, Cl+Fe+Mn, Sp, Wa, SR, vesicles partially filled 2. 10, J, N, Cl+Mn, Sp, Wa, SR-R, 10% of vesicles with spotty Cl+Mn infilling					
	391								highly fractured, weak (possible void)					
0					0				vesicles(large) decrease to 20–30%					
	392								highly fractured					
		82		80	0	44						0	[100]	
	393													
-2					2									
	394		41											
					NA				no recovery vesicles decrease to 15%, become large, minimally stretched					
	395								vesicles significantly decrease to less than 5%					
-4					0									
	396													
					0									
	397													

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 2/20/2017 RHMW09

Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW09

Sheet 26 of 26

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-6	397	83		80	0	80	M		20–30% vesicles (medium)					0	[75]	
	398				0		M									
	399								becomes highly weathered, oxidized							
-8					NA				no recovery							
	400								dark red (10R 4/8), highly weathered, highly fractured, weak with 15% of vesicles filled with coralline fine–medium sand							
					10+											
	401								1. 50, J, N, Sd, Sp, Wa, SR							
-10					10+		I									
	402		42													
		84		94	0	60	M							0	[75]	
	403						M									
-12					0		M									
	404						M									
					0		M									
	405								Bottom of Boring; TD = 405 ft bgs							Complete drilling 7/28/16; 1,150 gallons of water used downhole, 650 gallons of water–foam mix including 2 cups of foam injected from top of casing
-14	406															
	407								Used a total of 14,000 gallons of circulation water; 1,300 gallons of water–foam mix with 3.3 gallons of foam, added from top of casing; 235 gallons of MaxGel–water slurry with 5, 50–lb bags of MaxGel bentonite powder.							
-16	408															
	409															
-18																
	410															
	411															
-20																
	412															
	413															

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 2/20/2017 RHMW09

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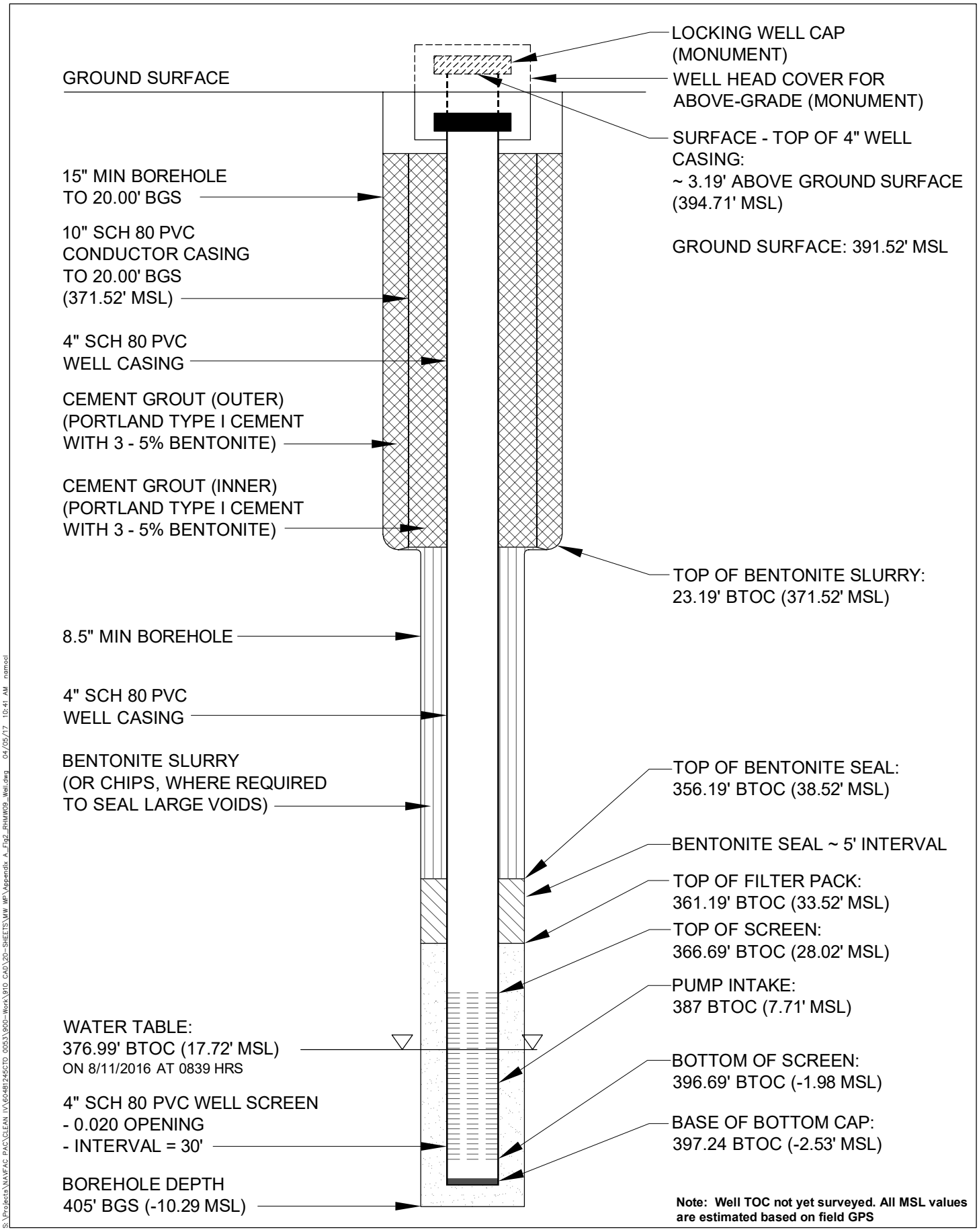

S:\Projects\NAVFAC_PAC\CLEAN_IV\6048\245CTO_0053\900--Work\910_CAD\2D--SHEETS\MW_WP\Appendix A_Fig2_RHMW09_Well.dwg 04/05/17 10:41 AM namocl

Appendix A Figure 2
Cross Section of RHMW09 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY
CTO53	RHMW09	RHMW09	(b) (6)

METHOD
- OVERPUMPAGE ☐
- BAILER ☒
- SURGE BLOCK ☐
- AIR LIFT ☐
- OTHER

INITIAL WATER LEVEL: 373.8' bgs
INITIAL TOTAL DEPTH: 394'

FINAL WATER LEVEL:
FINAL TOTAL DEPTH:

REMARKS:
Horiba keeps shutting off for no reasons 1120, 1150,every ½ hour? Why? 1222, 1254, 1324, 1355, 1426, 1457, 1528, 1559

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

Running 4 cycles/min

DEVELOPMENT LOG:

0900 start bailing

DATE	TIME	METHOD	ELAPSED TIME	FLOW RATE (gpm)	CUMULATIVE WATER REMOVED GALLONS	WATER QUALITY pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (%)	COMMENTS
8/15/16	0945	Bailer		~3.5 gal./6min		7.44	23.22	0.525	10.18	125	961	0.03	
8/15/16	1000					7.65	23.29	0.515	8.54	135	921	0.02	
8/15/16	1015					7.58	24.51	0.502	7.40	143	667	0.02	
8/15/16	1030					7.61	24.42	0.485	6.94	137	>1000	0.02	
8/15/16	1045				~23 gal.	7.55	24.60	0.477	6.51	146	730	0.02	
8/15/16	1100					7.51	24.81	0.463	6.45	149	629	0.02	
8/15/16	1115					7.51	24.27	0.429	6.73	151	460	0.02	Changed buckets
8/15/16	1130					7.46	23.18	0.385	8.32	158	359	0.02	
8/15/16	1145					7.46	23.56	0.389	8.15	159	371	0.02	
8/15/16	1200					7.47	23.83	0.383	8.04	159	341	0.02	
8/15/16	1215				~59 gal. @ 1221	7.47	23.76	0.384	8.06	160	374	0.02	
8/15/16	1230					7.46	24.25	0.384	7.97	160	314	0.02	
8/15/16	1245					7.48	23.98	0.384	7.99	166	337	0.02	
8/15/16	1300					7.54	23.22	0.392	8.30	166	213	0.02	1248 switched buckets

8/15/16	1315	Bailer		~3.5 gal./6min		7.53	23.50	0.394	7.98	161	178	0.02	
8/15/16	1330					7.53	23.93	0.390	7.87	159	164	0.02	
8/15/16	1345					7.51	23.58	0.386	7.87	159	112	0.02	1340 switched buckets
8/15/16	1400					7.50	23.39	0.386	7.82	159	89.8	0.02	
8/15/16	1415					7.50	23.73	0.382	7.78	159	83.3	0.02	
8/15/16	1430				~114 gal.	7.48	23.40	0.380	7.88	168	61.1	0.02	
8/15/16	1445					7.48	23.73	0.373	7.76	173	47.2	0.02	Switched buckets
8/15/16	1500					7.43	23.32	0.370	7.98	171	39.8	0.02	
8/15/16	1515					7.44	23.79	0.370	7.58	170	37.3	0.02	
8/15/16	1530					7.47	23.78	0.368	6.63	166	41.6	0.02	
8/15/16	1545					7.46	23.99	0.368	7.68	164	48.4	0.02	Switched buckets
8/15/16	1600					7.46	24.00	0.369	8.27	162	43.8	0.02	
8/15/16	1615					7.47	24.91	0.361	7.58	162	37.0	0.02	
8/15/16	1630					7.47	25.36	0.359	7.47	163	36.6	0.02	
End Purge for 8/15/16													
8/16/16	0915	Bailer			150								
8/16/16	0930												
8/16/16	0945					7.54	22.86	0.374	6.88	124	28.4	0.02	
8/16/16	1000					7.51	23.20	0.374	6.68	131	34.9	0.02	
8/16/16	1015					7.50	24.12	0.373	6.58	135	35.6	0.02	
8/16/16	1030					7.47	23.70	0.368	6.51	138	38.8	0.02	
8/16/16	1045					7.41	23.44	0.364	6.92	145	34.9	0.02	
8/16/16	1100				4th drum full	7.40	24.02	0.364	7.05	147	28.5	0.02	
8/16/16	1115					7.39	24.14	0.360	7.01	150	28.1	0.02	
8/16/16	1130					7.37	24.24	0.356	6.65	153	28.0	0.02	
8/16/16	1145					7.32	24.16	0.356	6.36	153	26.1	0.02	Bigger bailer
8/16/16	1200					7.32	24.45	0.357	6.11	155	26.7	0.02	5 gal. bail
8/16/16	1215					7.31	23.93	0.351	6.88	157	19.2	0.02	
8/16/16	1230					7.31	24.22	0.352	6.47	158	18.6	0.02	
8/16/16	1245					7.31	25.29	0.352	7.59	158	16.4	0.02	
8/16/16	1300				5th drum full	7.31	25.47	0.345	7.00	161	18.1	0.02	
8/16/16	1315					7.28	24.72	0.345	5.98	164	17.0	0.02	
8/16/16	1330					7.28	25.09	0.349	7.02	164	14.9	0.02	

8/16/16	1345				1435 6th drum full	7.29	25.41	0.349	6.37	164	15.4	0.02	
8/16/16	1400					7.20	24.29	0.338	6.09	164	13.9	0.02	
8/16/16	1415					7.18	2.23	0.340	5.82	165	13.5	0.02	
8/16/16	1430					7.19	24.54	0.332	6.62	165	15.1	0.02	
8/16/16	1445					7.20	24.59	0.338	6.75	165	13.9	0.02	
8/16/16	1500	Bailer				7.22	25.12	0.339	6.88	164	13.3	0.02	
8/16/16	1515					7.22	25.30	0.339	6.84	165	12.5	0.02	
8/16/16	1530					7.58	23.62	0.344	7.16	146	21.1	0.02	
8/16/16	1545					7.64	23.89	0.345	7.03	143	29.6	0.02	
8/16/16	1600					7.72	23.97	0.347	7.00	139	21.4	0.02	
8/16/16	1615					7.53	24.64	0.340	7.65	152	17.3	0.02	
8/16/16	1630					7.54	24.89	0.335	7.37	157	19.4	0.02	
End Purge for 8/16/16													
8/17/16	0915				350	8.16	21.98	0.358	5.51	92	29.5	0.02	
8/17/16	0925					8.25	21.94	0.355	4.96	100	26.9	0.02	0930 changed buckets
8/17/16	0935					7.74	22.08	0.357	4.90	128	73.4	0.02	
8/17/16	0945					7.66	22.72	0.358	4.94	135	67.2	0.02	
8/17/16	0955					7.61	22.95	0.359	7.25	141	72.2	0.02	changed buckets
8/17/16	1005	Bailer				7.63	22.76	0.355	5.91	141	65.7	0.02	
8/17/16	1015					7.66	22.65	0.351	4.89	141	60.9	0.02	
8/17/16	1025					7.70	23.24	0.349	4.58	139	65.6	0.02	1032 changed buckets
8/17/16	1035					7.60	23.98	0.345	4.52	147	48.8	0.02	
8/17/16	1045					7.54	24.33	0.343	4.27	149	28.4	0.02	
8/17/16	1055					7.48	22.91	0.345	4.45	152	34.6	0.02	1050 changed buckets
8/17/16	1105				2nd drum full								
End Purge for 8/17/16													
8/22/16	1458		0		0	5.96	23.83	0.364	10.26	207	32.6	0.02	Water clear
8/22/16	1510		12		10.5	6.60	23.62	0.341	9.52	157	95.4	0.02	*
8/22/16	1523		13		17.5	7.01	23.19	0.338	15.01	142	109.0	0.02	*
8/22/16	1537	Bailer	14		23.5	7.14	22.69	0.337	10.07	146	78.9	0.02	No odor
8/22/16	1552		15		29.5	7.19	22.55	0.334	9.69	147	65.9	0.02	No odor
8/22/16	1605		13		35.5	7.19	22.33	0.336	9.62	147	63.4	0.02	No sheen

8/22/16	1617	Bailer	12		44.5	7.17	22.24	0.333	9.61	147	43.4	0.02	
8/22/16	1630		13		47.5	7.19	22.18	0.328	10.34	149		0.02	
8/22/16	1643		13		53.5	7.16	22.07	0.330	9.36	151	43.6	0.02	
8/22/16	1605		6		55.0	Not collected							
End Purge													

Notes:

Bailer pulls 3.5 gal.

Calibrated Horiba with acid solution (Auto Cal Solution – pH 4.00, 0.0 NTU, 4.49 ms/cm, Lot#C3820539 Exp. 4/2017.

Depth to water tagged at 1450: 372.80' bgs.

* After 2nd bailer (6 gal.) a thin sudsy sheen without color on water surface.

~~For Red Hill AOC Party Use Only~~

Project: CT053 – Red Hill Bulk Fuel Storage Facility Project Location: CT053 Project Number: 60481245	Log of Boring RHMW10 Sheet 1 of 32

Date(s) Drilled	03/06/2017	Logged By	(b) (6)	Checked By (Date)	(b) [redacted]
Drilling Method	HQ core / air rotary	Drill Bit Size/Type	HQ diamond bit / 8" tricone bit	Total Depth of Borehole	501.0 feet
Drill Rig Type	Mobile B-59 / T3	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	490.97
Groundwater Level	El. 18.2' (3/31/2017)	Location	(b) (3) (A)	Inclination from Horizontal/Bearing	90°
Borehole Completion	4-inch diameter monitoring well. See RHMW10 well cross section for details.			Hammer Data	140 lbs/30-inch drop

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								ALLUVIUM Very soft, reddish-brown (10R 4/6), CLAY (CL)							Hand auger to 5 ft bgs
490	1															
	2															
488	3															
	4															
486	5		1													Begin hollow stem auger
	6															
484	7															
	8															
482	9															
	10															
480	11								VOLCANIC SAPROLITE Variably weathered volcanic rock. Moderately yellowish brown (10YR 5/4) to pale brown (5YR 5/3), slightly to moderate weathered, CLAY (CL) with harder intervals of slightly weak basalt							Variable drilling with mostly soft and some hard intervals
	12															
478	13															

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 8/1/2017 RHMW10

Project: CT053 – Red Hill Bulk Fuel Storage Facilty
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW10

Sheet 2 of 32

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
476	13															
	14															
	15															
	16															
474	17															
	18		1													
472	19	1		100	1	60	M M 1		BASALT Massive a'a Medium gray (N35), slightly weathered, very strong, 5% large vesicles					0	[19]	End of drilling 3/6/17; Begin 3/7/17 Drilling refusal with auger bit
	20				0		M M									
470	21	2		100	2	52	1 2		1. 90, J, T 2. 45, J, Vn, Fe+Mn, Su, St, SR 3. 0, J, T, Fe+Mn+Cl, Su, Ir, SR					0	[25]	
	22				3		3		4. 20, J, T, Fe+Mn, Su, Wa, SR 5. 0, J, T, Fe+Mn, Su, Pl, SR							
468	23				1		4 5		6. 90, J, VN–N, Fe+Cl, Fi, Pl, SR 7. 20, J, VN–N, Fe+Cl, Fi, Wa, SR 8. 30, J, T, Fe+Mn, Su, Ir, Sr 9. 5, J, VN, Cl, Pa, Wa, Sr							
	24						6 7 8 9									
466	25				3											
	26	3		100	0	38	M		Saprolite Moderately red (5R 5/6), completely weathered, extremely weak					0	[50]	
	27				0				BASALT Pahoehoe Moderately reddish brown (10R 4/6), highly weathered, very weak, 35%– 40% small vesicles infilled with clay							
464	28				0		1 2 IF		1. 60, J, Vn, Cl, Pa, Wa, SR 2. 20, J, N, Fe+Cl, Pa, Wa, SR 3. 90, J, Vn, Fe+Cl, Pa, Pl, S							
	29				2		3		4. 30, J, Vn, Fe+Mn, Fi, Pl, SR 5. 45, J, T, Fe+Mn, T,Su, Pl, SR							
462																

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 8/1/2017 RHMW10

Project: CTO53 – Red Hill Bulk Fuel Storage Facility
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW10

Sheet 3 of 32

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29				2		4 5		less weathered, grayish red (10R 4/2)							
	30				2		M 1 2									
460	31				3		3 4 5									
	32	4		100	2	53	6		1. 30, J, T, Fe, Su, St, R 2. 30, J, T, Fe, Su, St, R 3. 20, J, T, Fe, Su, St, R 4. 0, J, MW, Cl, Pa–Fi, St, R					0	[100]	
458	33		2				7		5. 0, J, MW, Cl, Pa–Fi, St, R 6. 30, J, VN, Fe+Cl, Pa, Wa, SR 7. 0, J, VN, Fe+Cl, Pa, Wa, SR							
	34				10+		F1		F1. J, T–VN, Fe+Cl, Pa, Wa, SR F2. J, T, Fe+Mn, Su, Wa, SR							
					10+		F2									
456	35								moderate gray (N5) to dark gray (N3), fresh to slightly weathered, strong							
					2		M 1									
	36				10+		M 2		1. 15, J, VN, Cl, Fi, Wa, R 2. 10, J, T, Fe+Mn, Su, Ir, R 3. 60, J, N, Cl, Fi, Pl, SR 4. 60, J, T–VN, Fe+Mn, Pa, Wa, R 5. 0, J, T, Fe+Mn, Su, Wa, SR 6. 60, J, T, Fe+Mn, Su, Pl, SR							
454	37						M E M									
		5		100	10+	65	M F2 F3							0	[30]	
	38				0											
452	39				3		M 4 5 6									
	40				3		1 2		grayish red (5R 5/4), slightly to moderately weathered, banded intervals of high vesicularity (20–30%) to less than 1% vesicles							
450	41				1		3		1. 30, J, VN, Cl, Fi, Pl, Sm 2. 30, J, T, Fe, Su, Wa, SR 3. 20, J, VN, Cl, Fi, Pl, Sm							
	42						M 4 5 6		4. 90, J, T, Fe, Su–Pa, Wa, SR 5. 45, J, T, Fe, Su, Pl, S 6. 45, J, T, Fe, Su, Wa, SR 7. 90, J, T, Fe, Su, Ir, SR							
		6		92	2	28								0	[27]	
448	43		3						BASALT a'a Welded Clinker							
					1		7		BASALT Massive a'a							
	44								1. 90, J, N, Fe+Cl, Pa, Ir, R 2. 0, J, N, Fe+Cl, Pa, Wa, SR							
446	45				0											

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 8/1/2017 RHMW10

Project: CT053 – Red Hill Bulk Fuel Storage Facility
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW10

Sheet 4 of 32

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	SAMPLES PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45						1 2									
					1		M									
	46								**BASALT a'a Clinker** Moderately reddish brown (10R 4/6), completely weathered, extremely weak							
					NA											
444	47	7		100	NA	13								0	[30]	
	48				NA				**BASALT Airfall Deposit** Dark reddish brown (10R 3/4), completely weathered, extremely weak, with 1" rounded spatter clasts in fine grained matrix							
442	49															
					NA											
	50															
					NA											
440	51															
					NA											
	52		4													
		8		100	1	33	1		**BASALT Massive a'a** Dark gray (N4), unweathered to slightly weathered, very strong, with <1% vesicles					0	[17]	
438	53															
					2		2 3 4		1. 10, J, T, Fe+Mn, Su, Ir, SR 2. 70, J, T, Fe+Mn, Su, Pl, S 3. 30, J, T-VN, Fe+Cl, Pa, Wa, R 4. 20, J, T, Fe+Mn, Su, Wa,SR							
	54															
					1		5		5. 45, J, T, Fe, Su, Pl-Wa, S							
436	55															
					0											
	56															
					0											
434	57															
		9		100	1	98	1		1. 20, J, T, Fe+Mn, Su, Wa, R 2. 20. J, T, Fe+Mn, Su, Wa, R					0	[15]	
	58															
					1											
432	59						2 M									
					0											
	60						M									
			5		1				} healed vertical fractures							Driller experiencing core retrieval problems
430	61						M									

Project: CT053 – Red Hill Bulk Fuel Storage Facility
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW10

Sheet 5 of 32

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	61				2		1 M 2		1. 80, J, T, Fe+Mn, Su, Pl, SR 2. 0, J, T, Fe+Mn, Su, Pl, S 3. 45, J, VN, Fe+Cl, Pa, Wa, SR					
	62	10		100	0	83						0	[30]	
428	63				1		3							Total water used to 63 ft bgs ~3600 gal
	64				0				increase in vesicles up to 5–10%					
426	65				0		M							
	66				1		1		1. 20, J, T, Fe+Mn, Su, Pa, R 2. 5, J, T, Fe+Mn, Su, Wa, Sr 3. 0, J, T, Fe+Mn, Su, Wa, Sr 4. 0, J, T, Fe+Mn, Su, Wa, S 5. 70, T, Fe+Mn, Sp, Pl, VR					
424	67						2							
	68	11		100	2	85	3					0	[21]	Some Water return, water loss ~400 gal
	69				1		4							
422	70		6		1		5							
	71				1		1 M		1. 0, J, T, Fe+Mn, Su, Wa, SR 2. 60, J, T, Fe+Mn, Su, Wa, SR 3. 0. J, T, Fe+Mn, Su, Wa, R 4. 60. J, VN, Cl, Fi, Pl, SR 5. 30. J, VN, Cl, Pa, Pl, SR					
420	72				2		2 3							
	73	12		100	0	95	M 4					0	[75]	Some Water return, water loss ~500 gal
	74				2		M 5							
418	75				0									
	76				0		M							End of drilling 3/7/17; Begin 3/8/17
416	77				10+		1F 1							
414														

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
412	77															
	78	13		100	1	26	2 M 3		**BASALT Pahoehoe** Dark reddish brown (10R 3/4), highly weathered, very weak moderately weathered, moderately strong to weak					0	[30]	
	79				1											Lose water return for the remainder of the boring, water loss ~500 gal
	80		7		1		4		1. 70, J, T, Fe+Mn, Su, Pl, S 2. 80, J, T, Fe+Mn, Sp, Ir, R 3. 45, J, VN–N, Uk, Pa, Ir, R 4. 45, J, VN, Fe+Mn, Pa, Pl, R							
410	81				0		1		1. 60, J, VN, Fe+Cl, Fi, Pl, S–SR 2. 0, J, VN, Fe+Cl, Pa, Ir, R 3. 70, J, VN, Fe+Cl, Pa, Ir, R 4. 0, J, T, Fe+Mn, Su, St, SR							
	82				3		2 3									
	83	14		94	NA	35			**BASALT Tuff** Pale reddish brown (10R 5/4), highly weathered, weak to very weak					0	[25]	Water loss ~500 gal
408	84				NA											
	85				10+		4 IF		**BASALT Pahoehoe** Reddish brown (10R 5/4), highly weathered, moderately weak, intensely fractured							
406	86				NA				**BASALT Tuff** Dark yellowish brown (10YR 4/2) mottled with brown (5YR 4/4), highly weathered, weak, with alternating fine grained deposits							
	87				NA		1		1. 10, J, T, Fe+Mn, Su, Ir, SR 2. 80, J, T, Fe+Mn, Su, Pl, SR							Water loss ~400 gal
404	88	15		80	NA	16	2							0	[19]	
	89				10+		IF IF		**BASALT Massive a'a** Dark yellowish brown (10YR 4/2), slightly to moderately weathered, moderately strong, fractured with clay infilling							
402	90				10+		NR									
	91		8		10+		IF IF									
400	92				10+				pervasively fractured, highly weathered, weak							
	93	16		100	NA	16			**BASALT a'a Clinker** Moderately reddish brown (10R 4/6) to dark reddish					0	[21]	
398																

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	93				NA				brown (10R 3/4), moderately to highly weathered, weak, partially welded in intervals							Water loss ~600 gal
	94						NR									
396	95				NA											
	96				NA											
	97				NA											Water loss ~600 gal
394		17		100	NA	0								0	[16]	
	98				NA											
	99				NA											
392					NA											
	100				NA				moderately weathered							Water level in core rods dropped from 36.05 to 49.06 ft bgs in 11 minutes
	101				NA				dusky red (5R 3/4)							
390					NA											
	102		9		NA											
		18		50	NA	0								0	[23]	
388	103				NA											Water loss ~600 gal, drill chatter and core jamming
	104				NA											
					NA											
386	105						1 M		welded, slightly to moderately weathered, strong to moderately strong							Core chatter and jamming, begin pumping water down annulus of borehole
					NA				1. 90. J, T, Fe+Mn, Su, Wa, SR							
	106						2 M		2. 30, J, T, Fe+Mn, Su, Wa, R							
					NA											
384	107															
		19		100	NA	88			highly weathered with mottled orange (10R 6/6) clay					0	[25]	
	108						2									Water loss ~500 gal
					NA											
382	109															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	109				NA											
	110															
380	111		10		1		1		BASALT Massive a'a Dark gray (N3), fresh to slightly weathered, very strong, with <1% vesicles 1. Healed tight seam 2. 70, J, T, Fe+Mn, Su, Pl, SR-S 3. 70, J, VN, Fe+Cl, Pa, SR							
	112	20		100	2	100	2		4. 30, J, T, Fe+Mn, Su, Pl, SR 5. 10, J, T, Fe+Mn, Su, St, R-VR					0	[25]	
378	113				1		3									
	114				1		4		vesicular/scoriaceous, 7% vesicles, strong, slightly weathered, with scoriaceous, highly weathered, welded clinker inclusions							Water loss ~600 gal
					0		5									
376	115				0											
	116								non-scoriaceous, <1% vesicles							
					0				1. 20, J, T, Fe+Mn, Su, Wa, R 2. 70, J, VN, Fe+Cl, Pa, Pl, SR 3. 45, J, VN, Fe+Cl, Pa, St, R 4. 90, J, VN, Fe+Cl, Sp, Wa, R 5. 2, J, T, Fe+Mn, Su, Wa, R 6. 10, J, T, Fe+Mn, Su, Wa, R 7. 70, J, N, Fe+Cl, Sp, Wa, R							
374	117						1									
		21	11	100	1	68								0	[19]	Water loss ~500 gal
	118						2									
					2		3									
372	119						IF		5% vesicles							
					4		4									
							5									
							IF									
							6									
	120						7									
					1		1		1. 70, J, VN, Fe+Cl, Pa, Wa, R 2. 0-45, J, T, Fe+Mn, Su, St, R 3. 70, J T, Fe+Mn, Su, Wa, R 4. 45, J, T, Fe+Mn, Su, St, VR 5. 45, J, T, Fe+Mn, Su, St, SR 6. 45, J, T, Fe+Mn, Su, St, VR 7. 90, J, VN, Fe+Cl, Pa, Wa, R							
370	121						2									
					2											
	122						3									
							IF									
		22	12	85	10+	32	IF							0	[20]	Water loss ~500 gal
							5									
							6									
368	123						7		moderate red (5R4/6), highly to completely weathered, weak to extremely weak, pervassively fractured							
					NA											
	124															
					NA											
366	125															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	125				NA				less silt, more sand size particles (likely mechanical)							
	126				NA											
364	127	23		50	NA	12								0	[16]	Water loss ~500 gal
	128				NA											
362	129				NA				BASALT Welded a'a Clinker Moderately reddish brown (10R 4/6) to dark reddish brown (10R 3/4), slightly to moderately weathered, strong to moderately strong, with 10% vesicles							
	130				NA											
360	131				1		1		BASALT Massive a'a Dark gray (N4), slightly weathered, strong, with 5% vesicles 1. 45, J, T, Fe+Mn, Su, Wa, R 2. 5, J, T, Fe+Cl, Sp, Wa, R 3. 45, J, T, Fe+Mn, Su Wa, R							
	132	24	13	100	1	100	2							0	[27]	
358	133				1				10% vesicles							
	134				0		3									
356	135				2		1 2		olivine crystal in vesicle 1. 45, J, N, Fe+Cl, Fi, Wa, SR 2. 45, J, VN, Fe+CL, Pa, Wa, R 3. 45, J, T, Fe+Cl, Sp, Wa, R 4. 10, J, VN, Fe+Cl, Sp, Wa, R 5. 70, J, VN, Fe+Cl, Pa, Wa, R 6. 70, J, VN, Fe+Cl, Pa, Wa, R 7. 80, J, VN, Fe+Cl, Pa, Wa, R 8. 45, J, VN, Fe+Cl, Pa, Wa, R							
	136				0											
354	137	25		100	3	65	3 5 4							0	[30]	Water loss ~100 gal
	138				2		6 7									
352	139				1		8									
	140				1		1 IF 2		1. 60, J, VN, Fe+Cl, Pa, Wa, R 2. 5, J, VN, Fe+Cl, Pa, Wa, R 3. 45, J, VN, Fe+Cl, Pa, Wa, R							
350	141															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	141				1											
	142															Water loss ~250 gal
		26		82	10+	36	M 3 IF							0	[33]	
-348	143								void							Drill string drops ~0.5 ft
					10+		IF		dark reddish brown (10R 3/4), moderately weathered, moderately strong to weak, highly fractured/rubble							
	144															
					10+											
-346	145															
					10+											
	146															
					10+		1 M		slightly weathered, moderately strong to strong, grades from dark reddish brown (10R 3/4) to medium dark gray (N4)							
-344	147						IF		medium dark gray (N4), 10% vesicles							Water loss ~550 gal
		27		80	1	8	M							0	[14]	
	148						M 2		1. 20, J, T, Fe+Mn, Su, Wa, VR 2. 45, J, VN, Fe+Cl, Sp, Wa, R							
					10+											
-342	149						M									
					10+		NR									
	150		14						moderately to highly weathered, weak to moderately strong, intensely fractured (possibly mechanically)							End of drilling 3/8/17, no water encountered; Begin 3/9/17, water level recorded at 149.75 ft bgs
					NA		IF									
-340	151															
					NA		NR									
	152															Per driller: soft drilling 150~153.8 ft bgs
		28		48	NA	8								0	[30]	
-338	153															Water loss ~300 gal
					NA											
	154						MB		BASALT a'a Clinker Reddish brown (10YR 4/6) to medium dark gray (N4), slightly to moderatelyweathered, strong to moderately strong, with 10% vesicles							Per driller: better drilling at 153.8 ft bgs
					3		1 2 3									
-336	155						1 2 3		1. 15, J, VN, Fe+Mn, Su, St, VR 2. 15, J, N, Fe+Mn, Su, IR, R 3. 35, J, N, Fe+Mn, Su, St, VR							
					4		4									
	156								BASALT Massive a'a Dark gray (N4), slightly weathered, strong to very strong, 10% vesicles, many stretched							
					2		5									
-334	157															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157						6		1. 20, J, VN, Fe, Su, St, VR							Water loss ~250 gal
		29		100	2	48	7		2. 20, J, VN, Fe, Su, St, VR					0	[75]	
							8		3. 75, J, VN, Fe+Mn+Cl, Sp, Pl, SR							
							9		4. 0, J, VN, Fe, Su, Wa, R							
	158						10		5. 75, J, VN, Fe+Mn, Sp, Wa, R							
					2				6. 15, J, VN, Fe+Mn+Cl, Sp, Wa, R							
									7. 60, J, VN, Fe+Mn+Cl, Sp, Wa, R							
							11		8. 80, J, VN, Fe+Mn+Cl, Sp, Wa, R							
332	159								9. 45, J, VN, Fe+Mn+Cl, Sp, Wa, SR							
					0				10. 45, J, VN, Fe+Mn, Su, Wa, SR							
									11. 20, J, N, Fe+Mn, Su, St, R							
	160								15% vesicles, less stretched							
					2		1									
							M									
330	161						2		1. 45, J, VN, Fe+Mn, Su, Wa, SR							
							3		2. 20, J, VN, Fe+Mn, Su, Wa, SR							
					2		5 4		3. 0, J, VN, Fe+Mn, Su, Wa, SR							
							6		4. 90, J, VN, Fe+Mn, Su, St, R							
	162								5. 0, J, VN, Fe+Mn, Su, St, R							
									6. 10, J, VN, Fe+Mn+Cl, Su, Wa, SR							Water loss ~250 gal
		30	15	100	1	93	MB		7. 10, J, VN, Fe+Mn, Su, Wa, SR							
328	163								8. 45, J, VN, Fe+Mn, Su, Wa, SR					0	[25]	
					1											
	164						7									
							8									
					1											
326	165								Some stretched vesicles							
							M									
					3		1									
							2		1. 50, J, VN, Fe+Mn+Cl, Sp, Wa, SR							
							3		2. 50, J, VN, Fe+Mn+Cl, Sp, Wa, SR							
							4		3. 90, J, VN, Fe+Mn, Su, Wa, SR							
	166								4. 0. J, VN, Fe+Mn+Cl, Sp, Pl, SR							
					0				5. 5, J, VN, Fe+Mn, Sp, Pl, SR							
							M		6. 15. J, VN, Fe+Mn, Su, Wa, R							
324	167								7. 60, J, VN, Fe+Mn, Su, Wa, R							
							5		8. 0, J, VN, Fe+Mn, Su, Pl, SR							
									9. 10, J, VN, Fe+Mn, Su, St, SR							Water loss ~450 gal
		31		100	2	63	6		10. 60, j, VN, Fe+Mn+Cl, Su, St, SR					0	[27]	
	168						M									
					2		7									
							8									
322	169						9									
					2											
							10									
	170		16													
					1											
							1									
320	171								1. 5, J, VN, Fe+Mn, Su, Pl, SR							
					1				2. 75, J, Vn, Fe+Mn, Su, IR, R							
							2		3. 45, J, VN, Fe, Mn, Su, Pl, SR							
	172								4. 85, J, VN, Fe+Mn, Su, Wa, SR							
									5. 85, J, VN, Fe+Mn+Cl, Sp, Wa, SR							
									6. 5, J, VN, Fe+Mn, Su, Wa, SR							Water loss ~400 gal
		32		96	3	80			7. 90, J, T, H, No, IR, R							
318	173						5 4		8. 0, J, N, Fe+Mn+Cl, Sp, Wa, VR					0	[27]	
							3		9. 90, J, T, H, No, Pl, S							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	173				2		6 7		10. 90, J, N, Fe+Mn+Cl, Sp, Wa, R							
	174				2		8 9 10									Per driller: softer drilling 174.5~175 ft bgs
-316	175						IF 1		**BASALT Pahoehoe** Dark reddish brown (10R 3/4), moderately to highly weathered, weak, with ~30% rounded vesicles, intensely fractured							
	176				10+		MB 2		slightly to moderately weathered, strong, larger vesicles, with trace clay infill from 176 ft to 176.3 ft bgs							
-314	177	33		96	1 2	57	3		1. 45, J, N, Fe+Mn+Cl, Sp, Pl, R 2. 45, J, VN, Fe+Mn+Cl, Sp, St, VR 3. 30, J, VN, Fe+Mn, S, Pl, SR 4. 60, J, N, Fe+Mn, Su, Wa, SR 5. 60, J, VN, Fe+Mn+Cl, Sp, Pl, SR					0	[50]	Water loss ~350 gal
	178				1		4		30–40% vesicles, vesicles smaller							
-312	179				10+		5 IF		intensely fractured							
	180						NR		no recovery							
					10+				**BASALT a'a Clinker** Dark reddish brown (10R 3/4) to dark gray (N4), moderately weathered, moderately strong to weak, intensely fractured, with clayey sand (possibly mechanical)							
-310	181				10+		1		1. 45, J, VN, Cl, Sp, Ir, VR							
	182	34		42	10+	6	MB NR							0	[18]	Water loss ~1800 gal (included water to re-advance casing to 184 ft bgs)
-308	183				10+				no recovery							
	184		17		10+											Inner barrel stuck, pull casing; WL recorded in open hole to 184.2 ft bgs (bottom of hole)
-306	185				NA				moderately to highly weathered, weak to moderately strong, traces of clay on fracture and clinker fragment surfaces, intensely fractured							
	186						IF		1. 30, J, N, Fe+Cl, Sp, Ir, VR 2. 45, J, N, Fe+Mn, Su Ir, VR							
					NA		1									
-304	187	35		50	NA	80	2 IF NR							0	[27]	Water loss ~400 gal
	188								no recovery							
					NA											
-302	189															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	189				NA		NR		no recovery							
	190															
300	191				NA		IF									
	192	36		88	10+	22	1 3 IF 4		BASALT Massive a'a Gray (N4), slightly weathered, strong to very strong, with ~15% vesicles with trace clay on vesicle walls					0	[23]	Water loss ~800 gal
298	193						2		large vesicle with clay coating and dark reddish brown (10R 3/4) alteration on walls							
	194				10+		5 6 IF		1. 60, J, N, Fe+Si, Sp, Pl, R 2. 75, J, VN, Fe+Mn+Si, Sp, Pl, SR 3. 10, J, N, Fe+Mn+Cl, Sp, Ir, VR 4. 0, J, VN, Fe+Mn, Su, Pl, SR 5. 45, J, VN, Fe+Mn, Su Wa, R 6. 60, J, VN, Fe+Mn, Su, Pl, S							
296	195				10+		NR									
	196	37	18	86	NA	35	IF		BASALT a'a Clinker Moderately brown (5YR 3/4) to dark reddish brown (10R 3/4), highly to moderately weathered, weak to moderately strong					0	[25]	Water loss ~900 gal
294	197				NA		IF		BASALT Massive a'a Medium dark gray (N4) to dark reddish brown (10R 3/4), moderately weathered to slightly weathered, strong, intensely fractured							
	198				10+		1 2 3		medium dark gray (N4), slightly weathered, strong to very strong, 15% vesicles 1. 20, J, VN, Fe+Mn, Su, Ir, VR 2. 90, J, VN, Fe+Mn+Cl, Sp, Wa, SR 3. 15, J, Vn Fe+Mn, Pa, Wa, R 4. 60, J, VN, Fe+Mn, Su, Pl, SR							
292	199				1		4									
	200				10+		NR		no recovery							
	201	38		100	1	78	IF		very dense, 5–10% vesicles					0	[30]	Water level in core rods dropped from 197.3 to 198.08 ft bgs in 36 minutes
290	201				3		IF		1. 15, J, VN, Fe+Mn, Su, Pl, SR 2. 0, J, VN, Fe+Mn, Su, St, VR 3. 85, J, VN, Fe+Mn+Cl, Su, Pl, SR 4. 5, J, VN, Fe+Mn, Su, Pl, SR 5. 5, J, VN, Fe+Mn, Su, Wa, SR 6. 0, J, VN, Fe+Mn+Cl, Sp, Wa, SR 7. 80, J, VN, Fe+Mn, Su, Wa, SR							Water loss ~750 gal
	202						2 3 4 5									
288	203				1		6									
	204				2											
286	205				1		7		dark reddish brown (10R 3/4) to medium dark gray (N4), ~35% vesicles, smaller vesicles							

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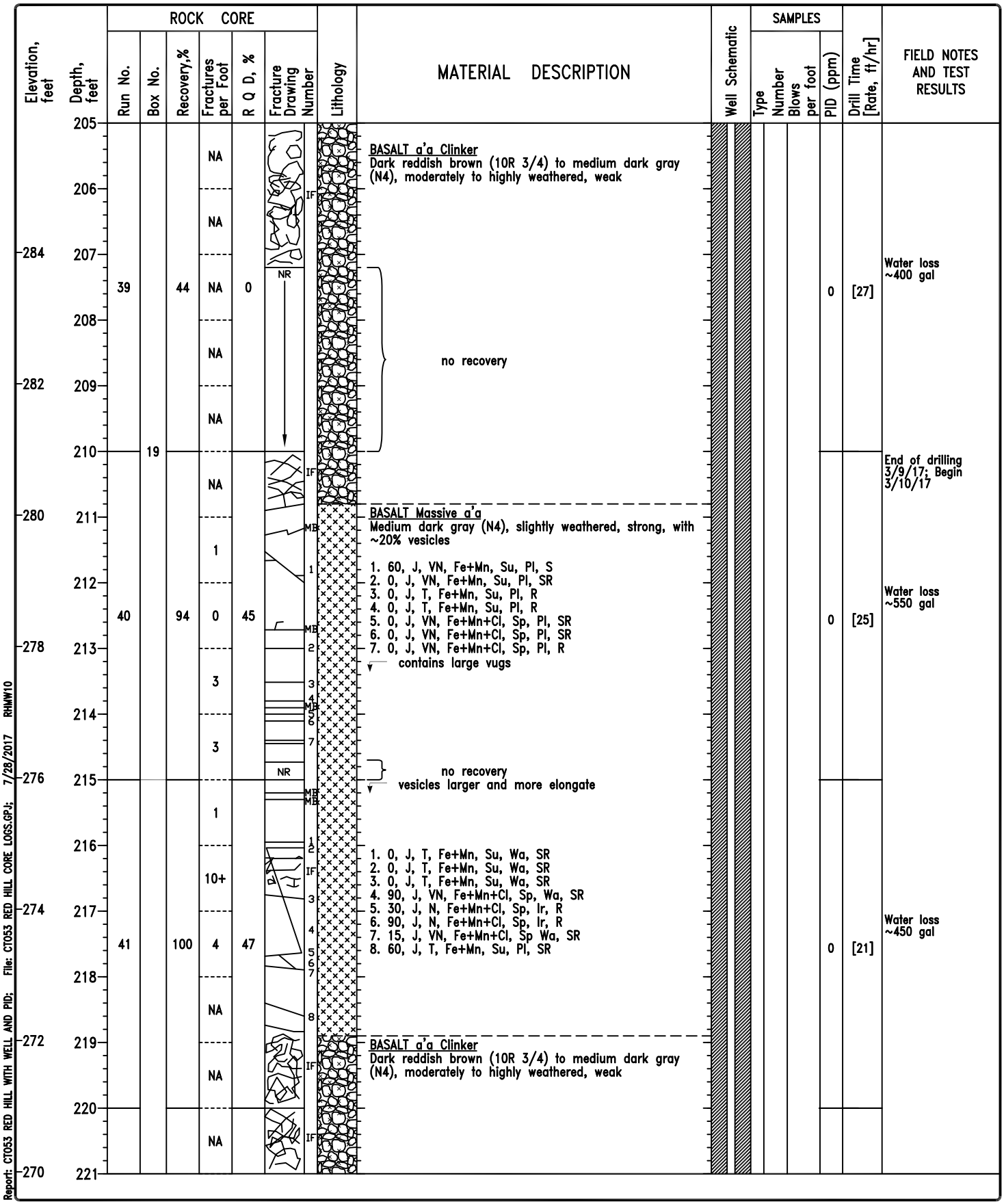

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
268	223	42	20	52	NA	0	NR		no recovery					0	[25]	Water loss ~350 gal
266	225				10+		IF		BASALT Massive a'a Medium dark gray (N4) to dark reddish brown (10R 3/4), slightly weathered, moderately strong to very strong, intensely fractured, fracture surfaces with Fe/Mn staining, ~20% vesicles							
264	227	43		100	10+	18	IF		medium dark gray (N4), slightly weathered, strong to very strong, highly to intensely fractured (some mechanical) 1. 45, J, VN, Fe+Mn, Su, Pl, SR 2. 5, J, VN, Fe+Mn, Su, Wa, R 3. 10, J, VN, Fe+Mn, Su, Wa, SR 4. 80, J, T, Fe+Mn, Su, Pl, SR					0	[23]	Water loss ~350 gal
262	229				3		IF		intensely fractured							
260	231	44		100	1	40	IF		intensely fractured					0	[25]	Water loss ~200 gal
258	233				0		MB		BASALT Pahoehoe Medium dark gray (N4), slightly weathered, moderately strong to strong, ~40% vesicles with 2" moderate reddish brown (10R 4/6) weak, burn margin/alteration zone at 231.6' bgs 1. 45, B, N, Fe+Mn, Su, Wa, R 2. 60, J, VN, Fe+Mn, Su, Wa, SR 3. 5, J, VN, Fe+Mn, Su, Pl, SR							
256	235		21		2		IF		brownish black (N4), intensely fractured 1. 60, J, VN, Fe+Mn+Cl, Sp, Wa, R 2. 70, J, VN, Fe+Mn+Cl, Sp, Wa, R 3. 60, J, VN, Fe+Mn+Cl, Sp, Wa, R 4. 45, J, VN, Fe+Mn+Cl, Sp, Wa, R 5. 80, J, VN, Fe+Mn+Cl, Sp, Wa, R 6. 45, J, VN, Fe+Mn+Cl, Sp, Wa, R 7. 0, J, N, Fe+Mn, Su, Wa, SR 8. 90, J, N, Fe+Mn, Su Wa, SR 9. 45, J, N, Fe+Mn, Su, Wa, SR							
254	237				2											

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Project: CT053 – Red Hill Bulk Fuel Storage Facility
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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
252	237	45		100	10+	50			10. 30, J, N, Fe+Mn, Su, Pl, SR 11. 90. J, Fe+Mn+Cl, Sp, Wa, R					0	[60]	Water loss ~125 gal
	238				2				dark reddish brown (10R 3/4), smaller vesicles							
	239				3											
250	240				10+				medium dark gray (N4), larger vesicles							
	241				1				1. 90, J, N, Fe+Cl, Fi, Wa, SR 2. 45, J, N, Fe+Cl, Fi, Wa, SR 3. 0, J, VN, Cl, Sp, Wa, R 4. 30, J, VN, Cl, Pa, Wa, R 5. 20, J, T, Fe+Mn+Cl, Pa, St, SR–R 6. 20, J, T, Fe+Mn+Cl, Pa, St, R 7. 45, J, VN, Fe+Mn+Cl, Pa, Wa, VR							
248	242	46	22	100	1	18								0	[60]	Water loss ~150 gal
	243				3				smaller vesicles							
	244				10+				mottled medium dark gray (N4) and dark reddish brown (10R 3/4)							
246	245								intensely fractured with Fe+Mn+Cl on fractures							
	246				10+				1. 2, J, VN, Fe+Mn+Cl, Pa, Wa, R 2. 10, J, MW, Fe+Mn+Cl, Pa, Wa VR 3. 0, J, N–MW, Fe+Mn+Cl, Pa, Wa, R 4. 20, J, VN, Fe+Mn+Cl, Pa, Wa, R 5. 10, J, N, Fe+Mn+Cl, Pa, Wa, R–VR 6. 70, J, VN, Fe+Mn+Cl, Pa, Wa, R 7. 90, J, VN, Fe+Mn+Cl, Pa, Wa, R							
244	247				0											
	248	47		100	2	55			highly weathered, weak to very weak					0	[60]	Water loss ~150 gal
	249				2											
242	250				2											
	251		23		1				1. 20, J, N, UK, Su, St, R 2. 90, J, MW, Fe+Mn+Cl, Sp, Wa, R (Uk = grayish olive (10Y 4/2) skin with white clay vein smaller vesicles							
240	252				10+				3. 60, J, VN, Fe+Mn+Uk, Su, Pl, SR–R (Uk = light olive gray (5Y 5/2) skin with white clay veins larger vesicles							
	253	48		100	10+	20			4. 60, J, VN, Fe+Mn+Cl, Sp, Wa, R					0	[100]	Water loss ~150 gal
238																

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 7/28/2017 RHMW10

Project: CTO53 – Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	253															
	254				10+		4		intensely fractured with Fe+Cl							
					10+		IF									
-236	255								40% vesicles, vesicles become larger (2–3mm)							
					3		M									
							1		1. 70–90, J, VN, Fe+Mn+Cl, Fi, Wa, R							
	256						2		2. 70, J, VN, Cl, Sp, Wa, R							
					1		3		3. 0, J, VN, Fe+Mn+Cl, Pa, Wa, R							
							4		4. 0, J, VN, Fe+Mn+Cl, Pa, Wa, R							
-234	257						M		5. 45, J, T, Cl, Sp, Wa, R							
		49		100	2	33	5		vesicles <1mm, with 1 inch band of gray, very strong, 10% vesicles					0	[50]	Water loss ~150 gal
	258						6									
					1											
							7		smaller vesicles							
-232	259						M		6. 5, J, VN, CL, Sp, Wa, VR							
					10+				7. 10, J, T, Cl, Sp, Wa, R							
							8		8. 90, J, VN, Fe+Mn+Cl, Pa, Wa, R							
	260		24				IF									
							MB		larger vesicles (1–2mm)							End of drilling 3/10/17; Begin 3/13/17
					10+		MB									
							IF									
-230	261						MB									
					10+		MB									
							IF									
							MB		highly to intensely fractured, mostly mechanical breaks, some surfaces contain traces of Fe+Mn+Cl							
	262						MB									
							MB									
		50		78	10+	43	IF							0	[13]	Per driller: something grabbing bit, Pull casing (bit badly worn, replace)
-228	263															
					10+		NR		no recovery							
	264						1		1. 5, J, VN, Fe, Su, Wa, SR							Water loss ~300 gal
					1											
-226	265						1		1. 80, J, T, Fe+Mn, Su, Pl, SR							
					1				2. 45, J, VN, Fe+Mn+Cl, Sp, Pl, SR							
									vesicles 2–3mm in diameter							
	266						MB									
					10+				3. 60, J, VN, Fe+Mn+Cl, Sp, Pl, SR							
							2		4. 60, J, T, Fe+Mn, Su, Wa, R							
-224	267						IF									
		51		76	10+	38	IF		smaller vesicles, intensely fractured, moderately weathered, ~50% vesicles, vesicles contain trace clay infill					0	[60]	Water loss ~250 gal
	268															
							3		dark reddish brown (10R 3/4), slightly weathered, more dense, ~25% vesicles, vesicles 2–6mm							
					2		MB									
-222	269						4									

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Project: CT053 – Red Hill Bulk Fuel Storage Facility
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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	SAMPLES PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269				10+		NR		no recovery							Worn bit at 270 ft bgs. Pull casing and replace
	270								~30% vesicles ~1–2mm in diameter 1. 45, J, VN, Fe+Mn+Cl, Sp, Pl, SR 2. 0, J, VN, Fe+Mn+Cl, Sp, Ir, R 3. 90, J, T, Fe+Mn, Su, Wa, SR 4. 30, J, VN, Fe+Mn, Su, Wa, SR 5. 0, J, VN, Fe+Mn, Pa, Wa, R 6. 0, J, VN, Fe+Mn+Cl, Sp, Wa, SR 7. 0, B, N, Fe+Mn+Cl, Pa, Wa, SR						
220	271				2											rough drilling and drill chatter
	272				10+				moderately to highly weathered, weak to moderately strong, highly to intensely fractured with clay coating on fracture surfaces							
	273	52	25	96	10+	20			dark reddish brown (10R 3/4), pale yellow-orange (10YR 8/6), and black (N1), very weak to weak, ~50% vesicles, clayey completely weathered layer 272.6'–272.8' bgs 8. 60, J, VN, Fe+Mn+Cl, Sp, Pl, SR 9. 50, J, VN, Cl, Sp, Ir, SR 1/4" black (N1), glassy deposit 10. 5, J, VN, Cl, Sp, Wa, R					0	[9]	
218	274				10+				dark reddish brown (10R 3/4), moderately weathered, weak, highly to intensely fractured, 40–50% vesicles(many filled with grayish brown (5Y 8/4) clay) 11. 80, J, VN, Fe+Mn+Cl, Sp, Pl, SR 12. 15, J, VN, Fe+Mn+Cl, Sp, Wa, SR							Driler says bit badly worn. End drilling 3/13/17, Water level in core rods fell 3.71 ft in 11 minutes; Begin 3/15/17, pull casing and replace bit with Christensen surface set bit
	275								alternates with bands of brownish black (5YR 2/1), possible flow boundaries							
	276				1				1. 90, J, T, H, Wa, SR 2. 45, J, VN, Mn+Cl, Sp, Wa, SR 3. 85, J, VN, Mn+Cl, Sp, Wa, SR 4. 45, J, VN, Fe+Mn, Sp, Pl, S 5. 45, B, VN, Fe+Mn, Sp, Ir, VR (possible baked paleosol)							
216	277				2											
214	278	53		100	0	43								0	[17]	
	279				10+				BASALT Massive a'a Medium dark gray (N4), slightly weathered, strong, intensely fractured, with ~15% vesicles (some stretched) ~1–5mm in diameter, few vugs up to 40mm							
212	280				10+											
	281				10+				1. 75, J, T, Fe+Mn, Su, Pl, SR 2. 85, J, VN, Fe+Mn, Su, Ir, R 3. 45, J, VN, Fe+Mn, Su, Wa, SR 4. 30, J, T, Fe+Mn, Su, Wa, VR 5. 30, J, VN, Fe+Mn, Su, Pl, R 6. 20, J, VN, Fe+Mn, Su, Pl, R 7. 5, J, N, Fe+Mn+Uk, Pa, Ir, R 8. 50, J, Fe+Mn, Su, Pl, SR 9. 10, J, VN, Fe+Mn, Su, Pl, SR 10. 5, B, VN, Uk, Ir, VR 11. 30, J, VN, Uk, Sp, Wa, R 12. 15, J, VN, Uk, Sp, Wa, R Uk = white (N9) waxy clay (halloysite?)							
210	282				2											
	283	54	26	100	3	37								0	[12]	Water loss ~300 gal
208	284				3											
	285				3				BASALT Welded a'a Clinker Medium dark gray (N4) mottled with moderate brown (5YR 3/4), moderately weathered, weak							
206																

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	285								**BASALT Pahoehoe** Dark gray (N3), slightly weathered, strong, ~30% vesicles (vesicles 1"–3" in diameter)						
					2		M 1 2		dark reddish brown (10R 3/4), ~50% vesicles							
	286					3	M		brownish black (5YR 2/1) 1. 30, J, VN, Fe+Mn, SP, Pl, SR							
					2	4			2. 10, B, VN, Cl, Pa, Wa, R 3. 60, J, T, H, Fi, Pl, SR							
-204	287						IF M IF 7		intensely fractured with Uk coating (halloysite?) dark gray (N3), larger vesicles ~1–5mm							Water loss ~300 gal
		55		100	10+	75								0	[43]	
	288						M		4. 45, J, T, Fe+Mn, Su, Pl, SR 5. 80, J, T, Fe+Mn, Su, Pl, SR 6. 0, J, VN, Cl, Pa, Pl, SR							
					0											
-202	289						M									
					0											
	290		27				M		vesicles ~1–3mm							
					0		M									
-200	291						M		1. 50, J, T, Fe+Mn, Su, Pl, SR 2. 50, J, T, Fe+Mn, Su, Pl, SR							
					0											
	292						M									Water loss ~200 gal
		56		95	0	87								0	[43]	
-198	293						M									
					1											
	294					M	M									
					1		2 M									
-196	295						M									
					1		1		1. 0, J, T, Fe, Su, Ir, R 2. 90, J, T, Fe, Su, Wa, SR							
	296						2		3. 30, J, T, Fe, Su, Pl, SR 4. 60, J, T, Fe, Su, Pl, SR							
					3	3	4		5. 5, J, VN, Fe, Sp, Wa, SR							
-194	297						5 IF		intensely fractured							Water loss ~200 gal
		57		100	10+	68	6		dark reddish brown (10R 3/4), vesicles filled with clay					0	[21]	
	298						M		medium dark gray (N4), vesicles 3–10mm							
			28		0				6. J, VN, Cl, Sp, Wa, R 7. 80, J, VN, Fe+Mn, Su, Pl, SR 8. 0, J, VN, Fe+Mn, Su, Wa, SR							
-192	299															
					2	M	7 8		vesicles 1–3mm							
	300						IF		fine to coarse grained basalt sand (mechanically pulverized) dark gray (N3), 40% vesicles							End of drilling 3/15/17; Begin 3/16/17
					10+											
-190	301						M									

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Project: CT053 – Red Hill Bulk Fuel Storage Facility
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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	301				0				vesicles 2–5mm vesicles 1–3mm							
	302	58		100	2	58	M 1 2		1. 45, J, T, UK, No, Wa, R 2. 60, J, T, Uk, No, Wa, R 3. 45, J, VN, Cl, Sp, Wa, R					0	[33]	Water loss ~400 gal
188	303				1											
	304				NA				4. 70, J, VN, Fe+Mn+Cl, Su–Sp, Wa, R							
186	305				NA				**BASALT a'a Clinker** Dark gray (N3) to dark reddish brown (10R 3/4), moderately weathered, moderately strong to weak							
	306	59	29	68	NA	22	NR							0	[14]	
184	307				NA				**BASALT Massive a'a** Dark gray (N3), slightly weathered, strong, with 5%–7% elongated vesicles 1. 45, J, MW, Fe+Mn, Su, St, SR 2. 60, J, T, Fe+Mn, Su, Wa, SR 3. 70, J, T, Fe+Mn, Su, Wa, SR 4. 30, J, T, Fe+Mn, Su, Wa, SR 5. 30, J, VN, Fe+Mn+Cl, Sp, Wa, SR							Water loss ~300 gal
	308				3											
182	309				4				moderately weathered with 50mm elongated void, weak to very weak 6. 90, J, T, Fe+Mn+Cl, Su, Pl, S							
	310				2				slightly weathered, strong 7. 5, J, VN, Fe+Mn+Cl, Su–Sp, St, R 8. 10, J, MW, Fe+Mn, Su, Wa, SR							Water level in core rods dropped from 305.98 to 307.5 ft bgs in 25 minutes
180	311				1											
	312	60		100	1	82	5		1. 40, J, VN, Fe+Mn+Cl, Sp, Wa, R 2. 45, J, T, Fe+Mn, Su, Wa, R 3. 0, J, T, Fe+Mn, Su, Wa, R 4. 5, J, T, Fe+Mn, Su, Wa, SR 5. 90, J, VN, Fe+Mn+Uk, Sp, Wa, SR 6. 0, J, VN, Fe+Mn+Uk, Sp, Wa, SR 7. 5, J, VN, Fe+Mn+Uk, Sp, Wa, R 8. 5, J, T, Fe+Mn, Su, Wa, R 9. 0, J, Vn, Fe+Mn+Uk, Pa, Wa, R					0	[17]	Water loss ~800 gal
178	313				1		6									
	314				2											
176	315				10+		2		1. 0, J, VN, Fe+Mn+Cl, Sp, Wa, R 2. 80, J, VN, Fe+Mn+Cl, Su, Wa, R 3. 0. J, T, Fe+Mn+Cl, Su, Wa, R 4. 80. J, VN, Fe+Mn+Cl, Su, Wa, R 5. 10, J, VN, Fe+Mn+Cl, Su, Wa, R 6. 70, J, VN, Fe+Mn, Su, Pl, SR 7. 5, J, T, Fe+Mn+Cl, Sp, Wa, R							
	316						6									
	317				2		4									
174																

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	317															
	318	61	30	74	NA	22	IF		BASALT a'a Clinker Dark gray (N3) and dark reddish brown (10R 3/4), highly to moderately weathered, weak, with clay along fracture surfaces					0	[17]	Water loss ~300 gal
					NA				vesicles filled with moderate reddish brown (10R 4/6) clay							
172	319				1		7		BASALT Pahoehoe Dark reddish brown (10R 3/4), moderately weathered, moderately strong, 40% vesicles 1. 0, J, VN, Fe+Mn, Su, Wa, R 2. 60, J, VN, Fe+Mn, Su, Wa, R							
	320						1		3. 70, J, N, Fe+Mn+Cl, Fi, Wa, SR							
					3		2		4. 60, J, T, Fe+Mn+Cl, Sp, Wa, R							
							3		5. 60, J, T, Fe+Mn+Cl, Sp, Wa, R							
170	321						IF		20% vesicles, 2–5mm diameter 6. 50, B, VN, Fe+Mn+Cl, Fi, Wa, R (flow contact)							
					10+		4		7. 60, B, N, Fe+Mn+Cl, Fi, Wa, SR (flow contact)							
	322						5		dark gray (N3) with occasional light brown (5YR 5/6) halo along fractures							
		62		100	1	50	6		40% vesicles, 1mm diameter 8. 90, J, T, Fe+Mn, Su, Wa, R					0	[50]	Water loss ~300 gal
									9. 0, J, T, Fe+Mn, Su, Wa, R							
168	323						7									
					4		8		dark gray (N3), slightly weathered, strong, 10% vesicles 2–10mm diameter							
							9		10. 5, J, N, Fe+Mn+Cl, Pa, Wa, R							
	324						10		11. 90, J, VN, Fe+Mn+Cl, Pa, Wa, R 12. 20, J, N, Fe+Mn+Cl, Pa, Wa, R							
					3		11									
							12									
166	325						13									
							IF									
					0				1. 20, J, T, Fe+Mn, Su, Wa, SR 2. 30, J, T, Fe+Mn, Su, Wa, SR							
	326						1		3. 30, J, VN, Fe+Mn+Cl, Sp, Wa, R							
					1											
164	327															
		63	31	100	1	64			30–40% vesicles 0.5–3mm diameter					0	[43]	Water loss ~250 gal
							2									
	328				10+		IF		intensely fractured, highly weathered, very weak, dark reddish brown mottling							
162	329								dark gray (N3), moderately weathered, moderately strong							
					10+		M									
	330						3									
					1		M		15% vesicles 2–20mm diameter							
									1. 45, J, T, Fe+Mn, Su, Wa, SR							
160	331						1		2. 30, J, N, Fe, Su, Wa, R 3. 20, J, T, Fe+Mn+Cl, Fi, Pl, SR							
					0		M									
									40% vesicles 0.5–1mm diameter							
	332						M									
									4. 60, J, T, Fe+Mn, Su, Wa, R 5. 30, J, T, Fe+Mn, Su, Wa, R							
		64		100	3	56	2		6. 70, J, T, Fe+Mn, Su, Pl, SR					0	[75]	
158	333						3		7. 70, J, VN, Fe+Mn+Cl, Sp, Wa, R							
							4									

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Project: CT053 – Red Hill Bulk Fuel Storage Facility
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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	333				2		5 IF 6 M		8. 30, J, VN, Fe+Mn+Cl, Sp, Wa, R							
	334				10+		7 8 IF		intensely fractured with moderate reddish brown (10R 4/6) mottling vesicles 1–3mm diameter							
156	335		32				1 M M									
					2		2 M									
	336						3 M		1. 45, J, VN, Fe+Mn+Cl, Sp, Wa, R 2. 60, J, T, Fe+Mn, Su, Wa, R							
					2		4		3. 45, J, T, Fe+Mn+Cl, Sp, Wa, R 4. 70, J, T, Fe+Mn+Cl, Sp, Wa, R							
154	337						M		5. 90, J, VN, Fe+Mn+Cl, Pa, Wa, R							Water loss ~150 gal
		65		100	1	62	M 5							0	[100]	
	338						IF									
					10+											
152	339															
					0											
	340						M		1. 5, J, VN, Fe+Mn, Su, St, R 2. 30, J, T, Uk, No, Wa, R							
					0		M M		3. 20, J, T, Fe+Mn, Su, St, S–SR 4. 10, J, T, Uk, Su, Pl, SR with medium dark gray (N6) alteration zone							
150	341															
					10+		1		5mm medium dark gray (N4) alteration zone at 341.5' bgs							
	342						IF									
		66		100	2	60	2 3		dark reddish brown (10R 3/4) mottling					0	[43]	Water loss ~250 gal
148	343						M 4									
					2		5		larger vesicles 2–5mm diameter, ~10% red olivine/iddingsite within vesicles 5. 0, J, VN, Cl, SP, R							
	344						6		6. 0, J, VN, Cl, Sp, R Uk=greenish gray (5G 6/1) skin							
					1											
146	345						M		25% vesicles 5–10mm diameter, 10% olivine in vesicles							
					0		M M		1. 70, J, VN, Fe+Mn+Cl, Sp, Wa, SR							
	346						M M		2. 20, J, VN, Fe+Mn+Cl, Sp, Wa, SR 40% vesicles, 0.5–2mm diameter							
					10+		M 1 IF									
144	347						2		moderately weathered, moderately strong, with dark reddish brown (10R 3/4) mottling							Water loss ~150 gal
		67	33	100	1	43	3 M		30% vesicles 1–3mm diameter					0	[75]	
	348						M		3. 30, J, T, Cl, Sp, St, R							
					10+											
142	349						IF									

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Project: CT053 – Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW10

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	349				10+		IF		intensely fractured, moderately weathered, moderately strong with dark reddish brown (10R 3/4) mottling							
	350						IF									
					10+		M		grades to larger vesicles (up to 10mm at at 352.8' bgs)							
140	351						M									
					0		M									
	352						M									Water loss ~150 gal
		68		100	0	100								0	[100]	
									grades to smaller vesicles. 20–25% olivine in vesicles							
138	353				1		M									
							1									
	354						M		1. 60, J, VN–N, Uk, Su, Wa, R							
					1											
136	355						1		~10% olivine, some olivine in rock matrix							
							M									End of drilling 3/16/17; Begin 3/17/17
					0		M									
	356						M		1. 60, J, VN, Fe+Mn, Su, Wa, SR							
					0		M									
							M									
134	357						M									Water loss ~200 gal
		69		64	10+	38			intensely fractured, some fracture surfaces have Fe+Mn staining					0	[75]	
	358						NR									
					10+				no recovery							
132	359															
					10+		M									
	360		34				M		vesicles 1–5mm diameter							
					0		M									
130	361						M									
					0		M									
	362						M		vesicles 2–5mm diameter, ~20% olivine							Water loss ~200 gal
		70		100	0	100								0	[100]	
128	363						M									
					0											
	364								vesicles 1mm diameter							
					10+		M									
126	365						IF		intensely fractured							
							M									

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 7/28/2017 RHMW10

Project: CT053 – Red Hill Bulk Fuel Storage Facility
Project Location: CT053
Project Number: 60481245

Log of Boring RHMW10

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	365								1. 5, B, VN, Fe, Su, Wa, SR 2. 10, J, VN, Fe+Mn, Su, Wa, SR 3. 5, J, VN, Fe+Mn, Su, Wa, SR 4. 30, J, VN, Fe+Mn, Su, Wa, SR							
	366				10+				dark reddish brown 10R 3/4, slightly to moderately weathered, intensely fractured, without olivine							
					2				dusky brown (5YR 2/2), slightly weathered, strong							
124	367	71		100	0	76			dark gray (N3), ~25% vesicles 2–10mm diameter, trace olivine, ~5% plagioclase					0	[150]	Water loss ~300 gal
	368				0				~50% vesicles 1–2mm diameter							
122	369				1											
	370		35						1. 50, J, VN, Cl, Sp, Wa, SR							
					1				~25% vesicles 2–10mm diameter							
120	371				0				2. 40, J, VN, Fe+Mn, Su, Ir, VR 3. 90, J, VN, Fe+Mn, Su, Wa, VR 4. 45, J, T, Fe+Mn, Su, Pl, SR							
	372	72		100	0	0			35% vesicles 1–2mm diameter					0	[75]	Water loss ~300 gal
118	373				3				vesicles and fractures have have Fe+Mn staining							
	374				0				vesicles 2–5mm diameter, olivine ~5%							
116	375				0				1. 10, B, VN, Fe+Mn, Su, Pl, SR 2. 0. J, T, Fe+Mn, Su, Pl, SR 3. 0, J, T, Fe+Mn, Su, Pl, SR 4. 85, J, VN, Fe+Mn, Su, Wa, SR 5. 35, J, T, Fe+Mn, Su, Pl, SR							
	376				10+											
114	377	73	36	100	10+	70			intensely fractured with Fe surface coating and ropey pahoehoe texture on fracture surfaces					0	[50]	Water loss ~300 gal
	378				10+				intensely fractured							
112	379				0											
	380				1				1. 45, B, VN, Fe+Mn, Sp, Wa, SR brownish black (5YR 2/1), moderately strong, ~40 vesicles, trace olivine							
110	381															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	381								2. 70, J, T, Fe+Mn, Su, Pl, SR							
					1		M M									
	382						3									Water loss ~350 gal
		74		85	10+	18	IF		intensely fractured					0	[50]	
-108	383						4		3. 90, J, VN, Fe+Mn, Su, Wa, SR							
					10+		M		4. 60, J, VN, Fe+Mn, Su, Wa, R							
							IF 5		5. 60, J, T, Fe+Mn, Su, Pl, SR							
	384						6		6. 45, J, VN, Fe+Mn, Su, Wa, SR							
					10+		NR		no recovery							
-106	385		37													
					0		M		dark gray (N3), without olivine and plagioclase phenocrysts							
							M M									
	386						M M									
							1 M									
					10+		2									
-104	387						IF M		intensely fractured with oxidized staining on surfaces							
		75		88	10+	60	M							0	[50]	Water loss ~350 gal
							IF M		intensely fractured with oxidized staining on surfaces							
	388						M									
					0		M		1. 90, J, VN, Fe+Mn, Su, Wa, SR							Core sample diameter becoming norrower. Per driller: soft rock vibrating in core barrel wearing down the core
							M M		2. 0. J, VN, Fe+Mn, Su, Wa, SR							
-102	389						M									
					10+		NR		no recovery							
	390						M									
					0											
-100	391								1. 45, J, VN, Mn+Fe, Su, Wa, SR							Water loss ~200 gal
					1											
	392						1 M		medium dark gray (N4), strong, ~25% vesicles 1–2mm diameter, ~25% plagioclase, 5–10% olivine							
		76		100	0	100								0	[38]	
-98	393															Core returns to full diameter
					0											
	394															
					0											
-96	395		38				M M									
					0											
	396						M M		~5–10% vesicles 1mm diameter							
							M M		~35% vesicles 1–5mm diameter							difficult drilling with drill chatter
					0		M		~10% vesicles 1mm diameter							
-94	397						M M M									

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	397								~40% vesicles 1–3mm diameter							
		77		74	0	74								0	[50]	Water loss ~400 gal
	398								core mis-shapen due to re-drilling from 397.6' – 398.7' bgs, no visible phenocrysts							dropped core (recovered 2.6'). Send inner barrel back down and retrieve another 1ft of core
					0											
92	399						NR		no recovery							
					10+											
	400								~50% vesicles							
					0				1. 45, J, VN, Fe+Mn, Su, Wa, SR 2. 0, J, VN, Fe+Mn, Su, Wa, SR							
90	401						IF		intensely fractured (mechanically)							
					10+		1 2									
	402								~25–30% vesicles 2–10mm diameter, 5% olivine, 5% plagioclase							
		78		100	0	85	M							0	[50]	Water loss ~350 gal
88	403															
					10+		IF		intensely fractured with Fe+Mn stains							Per driller: inner barrel may be full. Pull inner barrel (cored 41" and recovered 41"). resume coring
	404															
					0											
86	405								60% vesicles, no visivble phenocrysts							
					0											End of drilling 3/17/17; Begin 3/20/17; difficulty retrieving inner barrel, pull casing; 1.6' of core recovered from inside casing.
	406															
					0											
84	407						NR									Water loss ~300 gal
		79	39	40	10+	40								0	[100]	
	408								dropped core and no recovery							
					10+											
82	409															Re-advance casing but cannot get inner barrel to latch
					10+											
	410						IF		very dusky red (10R 2/2) to dark gray (N3), slightly to moderately weathered, ~50% vesicles							End of drilling 3/20/17; Begin 3/21/17
					10+											
80	411						M		1. 45, J, VN, Fe+Mn, Su, Wa, SR							
					10+		M									
	412						IF		intensely fractured with traces of Fe+Mn staining							
		80		60	10+	52	M							0	[150]	Water loss ~200 gal
78	413						IF									

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 7/28/2017 RHMW10

Project: CTO53 – Red Hill Bulk Fuel Storage Facility
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW10

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	413				10+		NR		no recovery							
	414				10+											
76	415						IF*		traces of white clay in vesicles							
		81		40	10+	13	1 M M M M		1. 90, J, T, Cl, Sp, Wa, SR					0	[150]	inner barrel will not latch. Pull casing to clear bit then re-advance.
	416				10+		IF*		intensely fractured, some oxidized fracture surfaces, most fractures are mechanical							
74	417						NR									Water loss ~100 gal
	418				10+				no recovery							
72	419				10+											
	420		40				IF M									
	421				10+		1 M 2 M		1. 60, J, VN, Cl, Fe, Mn, Sp, Wa, R 2. 65, J, VN, Fe+Mn, Su, Wa, SR 3. 0, J, VN, Fe+Mn, Su, Pl, S 4. 90, J, VN, Fe+Mn, Su, Wa, SR 5. 90, J, VN, Fe+Mn, Su, Wa, SR							Water loss ~400 gal
70	422				2		M 3 4 M M									
		82		60	1	36	M 5		medium dark gray (N4), slightly weathered, strong to very strong, ~30% vesicles 1-3mm					0	[60]	
68	423						NR									
	424				10+				no recovery							no recovery inside inner barrel. pull casing and recover 3 ft of core inside casing
	425				10+											
66					1		M M 1		alternating bands of small (1-3mm diameter) vesicles and larger (2-5mm diameter) vesicles 1. 0, B, VN, Fe, Su, Wa, R							
	426						NR									
	427				10+											
64		83		22	10+	0			no recovery					0	[50]	Water loss ~450 gal
	428															
					10+											
62	429															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 7/28/2017 RHMW10

Project: CT053 – Red Hill Bulk Fuel Storage Facility
Project Location: CT053
Project Number: 60481245

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	429				10+		NR									No recovery inside core barrel. pull casing and recover 1.1 ft of core from inside casing install Boart Longyear diamond impregnated bit
	430				10+											
60	431				10+		IF		dark reddish brown (10R 3/4), slightly to moderately weathered, strong, intensely fractured (mechanical), ~50% vesicles							
	432						NR									Water loss ~450 gal
		84	41	70	10+	25			no recovery					0	[33]	
58	433															
					10+		1		medium dark gray (N4), slightly weathered 1. 45, J, VN, Fe+Mn, Su, Pl, VR							
	434						M M 2		strong to very strong, ~25% vesicles 2–10mm diameter							
					10+		M M		2. 0, J, VN, Fe+Mn, Su, Wa, VR							
56	435						M		1. 45, J, T, Fe+Mn, Su, Pl, SR							
					2		1 2		40% vesicles 1–3mm diameter							
	436						M M M		2. 45, J, T, Fe+Mn, Su, Pl, SR 3. 0, B, VN, Fe, Su, Wa, SR							
					1		M 3		dark reddish brown (10R 3/4), moderately weathered							
54	437						M		4. 30, J, T, Fe+Mn, Su, Wa, SR 5. 0, B, VN, Fe+Mn, Su, Ir, R 6. 15, B, VN, Fe, Su, Wa, R							Water loss ~250 gal
		85		100	3	74	4 M							0	[75]	
	438						5 6		dark redish brown (10R 3/4), moderately weathered, moderately strong							
					0		7 M		7. 90, J, VN, Fe+Mn, Su, Wa, SR 8. 5, J, VN, Fe+Mn, Su, Wa, SR 9. 75, J, VN, Cl, Sp, Wa, SR 10. 10, J, T, Fe+Mn, Su, Pl, S							
52	439						M									
					3		8 9 10									
	440						M M		25% vesicles 2–8mm diameter							End of drilling 3/21/17; Begin 3/22/17
					0		M		grades from 25% vesicles 2–8mm diameter at 440.6' bgs to 40% vesicles 0.5–1mm diameter at 442'bgs							
50	441						M M M									Water loss ~200 gal
					1		M M 1									
	442						IF		10mm zone of grayish red (5R 4/2), possible flow boundary or alteration zone							
		86		–	10+	–	IF		1. 15, J, VN, Fe+Mn, Su, Ir, R 2. 15, J, T, Fe, Su, Pl, SR					0	[75]	
48	443						2 NR									1 foot of core dropped, pull casing to recover core
					10+											
	444								no recovery							
					10+											
46	445															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	445						IF		40–50% vesicles 1–3mm diameter							
					10+		M		1. 60, J, T, Fe+Mn, Su, Wa, R							
	446						M		2. 30, J, T, Fe+Mn, Su, Wa, R							
							M		3. 70, J, VN, Fe+Mn+Cl, Sp, Wa, R							Water loss ~400 gal + 3/4 bag of bentonite
					1	M	M									
-44	447						1 M									
							M									
		87	42	72	3	52	2		grayish red (5R 4/2) mottled, moderately to highly weathered, weak					0	[27]	
	448						IF									Core warm to the touch, pull casing to replace bit
					10+		IF		BASALT a'a Clinker							
							NR		Moderately red (5R 5/4), highly to completely weathered, weathered to clay							
-42	449															
					NA				no recovery							
	450						NR									End of drilling 3/22/17; Begin 3/23/17, water level recorded – no water encountered; install Christensen surface set bit
					NA											
-40	451						2 M		BASALT Massive a'a							
					10+		1 2 M		Dark gray (N3), slightly weathered, strong to very strong, with ~5% small vesicles and 10% olivine phenocrysts up to 5mm in diameter							
	452						3 4 M		20% vesicles 3–10mm diameter, some vesicles stretched							Water loss ~1000 gal + 1/2 bag bentonite
		88		72	2	34	M		1. 0, J, VN, Cl, Su, Ir, R					0	[30]	
							M		2. 45, J, VN, Fe+Mn, Su, Wa, SR							
-38	453						M		3. 50, J, VN, Fe+Mn, Su, Wa, SR							
							M		4. 50, J, VN, Fe+Mn, Su, Wa, SR							
					1		5 M		5. 45, J, VN, Fe+Mn, Su, Wa, SR							
	454						IF									
							MB 5									
					10+		NR									
									no recovery							
-36	455						IF		intensely fractured, moste fracture surfaces contain Fe+Mn stains and trace white waxy clay infill (halloysite?)							
					10+											
	456															
					10+											
-34	457								more stretched vesicles							Water loss ~1000 gal + 1/2 bag bentonite
		89		80	10+	0								0	[17]	
	458															
									fewer stretched vesicles							
					10+											
	459															
-32							NR									
					10+				no recovery							
	460															
							1		~10% vesicles 1–2mm diameter							
					3		M 2 M 3		dark gray (N3) to dusky brown (5YR 2/2)							
-30	461								1. 80, J, VN, Fe+Mn, Su, Wa, SR							
									2. 5, J, VN, Fe, SU, Ir, R							

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Project: CT053 – Red Hill Bulk Fuel Storage Facility
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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	461				NA				3. 90, J, VN, Fe+Mn, Su, Wa, SR BASALT a'a Clinker Dusky brown (5YR 2/2) to dark reddish brown (10R 3/4), moderately to highly weathered, moderately strong to weak, intensely fractured, oxidized							Water loss ~400 gal + 1/2 bag bentonite
	462						NR									
		90		36	NA	13								0	[60]	
28	463								no recovery							Per driller: softer drilling 462~465 ft bgs
					NA											
	464															
					NA											
26	465		43						medium drak gray (N4) to dark reddish brown (10R 3/4)							
					NA											
	466															Water loss ~400 gal + 1/2 bag bentonite
					NA											
24	467															
		91		70	NA	12			highly to completely weathered, weathers to sandy clay					0	[60]	
	468						NR									
					NA				no recovery							
22	469															
					NA											
	470						M		BASALT Massive a'a Medium dark gray (N4), slightly weathered, strong to very strong, with 15% (2–5mm diameter)							End of drilling 3/23/17; Begin 3/24/17
					1		M1M		~20% vesicles 1–10mm diameter, few larger vesicles up to 30mm diameter							
20	471						M									
					0		M									
	472						M									
		92		76	1	76M	M2M		1. 0, J, T, Fe+Mn, Su, Wa, SR 2. 30, J, VN, Fe+Mn, Su, Wa, SR					0	[18]	Water loss ~750 gal + 1/2 bag bentonite
18	473						M									
					0		M									
	474						NR									
					10+				no recovery							Water level in core rods dropped from 466.1 to 466.96 ft bgs in 50 minutes. continues to drop steadily
16	475						M									
					0		M		15% vesicles, more stretched							
	476						M		1. 0, J, T, Fe+Mn, Su, Wa, SR 2. 3, J, T, Fe+Mn, Su, Wa, SR 3. 0, J, T, Fe+Mn, Su, Wa, SR 4. 70, J, T, Fe+Mn, Su, Wa, SR 5. 0, J, T, Fe+Mn, Su, Wa, SR 6. 3, VN, Fe+Mn+Ca, Sp, Wa, St							Water loss ~800 gal + 1/2 bag bentonite
					2		M									
14	477						M									

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	477								7. 0, J, T, Fe+Mn, Su, Wa, SR 8. 0, J, T, Fe+Mn, Su, Wa, SR 9. 4, J, VN, Fe+Mn, Su, Wa, SR 10. 0, J, VN, Fe+Mn, Su, Wa, R					0	[13]	
	478	93		100	3	78										
	479				2				brownish black (5YR 2/1), 25% vesicles							Water in level core rods dropped from 465.1 to 466.45 ft bgs in 40 minutes. continues to drop steadily
12	480		44		2				flow textures							
	481				NA				BASALT a'a Clinker Dusky brown (5YR 2/2) to moderately reddish brown (10R 4/6), highly weathered, very weak to weak							
10	482				NA											
	483	94		34	NA	0			no recovery					0	[33]	Water loss ~450 gal + 1/2 bag bentonite
8	484				NA											
	485				NA				BASALT Massive a'a Medium dark gray (N4), slightly weathered, strong to very strong, with 20% vesicles (1–10mm diameter with few vugs up to 60mm)							Water level in core rods dropped from 472.52 to 472.8 ft bgs in 40 minutes. WL stabilizes at 472.8 ft bgs
6	486				0				1. 0, J, VN, Fe+Mn, Su, Wa, R 2. 20, J, VN, Fe+Mn, Su, Wa, SR 3. 5, J, VN, Fe+Mn, Su, Wa, SR 4. 0. J, VN, Fe+Mn, Su, Wa, R 5. 90, J, VN, Fe+Mn, Su, Pl, SR 6. 0, B, N, Cl, Sp, Pl, S 7. 80, J, VN, Fe+Mn, Su, Ir, R							Slow drilling 485 – 488.5 ft bgs
	487				00											Water loss ~650 gal + 1/2 bag bentonite
4	488	95	45	80	3	54								0	[15]	last 18 inches of core run faster penetration, Per driller: last few inches felt like good rock
	489				2				no recovery							
2	490				10+				BASALT Pahoehoe Grayish brown (5YR 3/2) to medium dark gray (N4), slightly weathered, strong, 40–50% vesicles (1–3mm diameter)							Water level in core rods dropped from 472.7 to 472.75 ft bgs in 20 minutes. WL stabilizes at 472.75 ft bgs
	491				2				1. 88, J, VN, Fe+Mn, Su, Wa, R 2. 0, J, VN, Fe+Mn, Su, Wa, SR 3. 2, B, VN, Cl, Sp, Wa, R							
0	492				10+											Water loss ~650 gal + 1/2 bag bentonite
	493	96		52	10+	50			no recovery, possible void					0	[43]	drill string dropped from 492 to 493 ft bgs
−2																

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 7/28/2017 RHMW10

Project: CT053 – Red Hill Bulk Fuel Storage Facility
Project Location: CT053
Project Number: 60481245

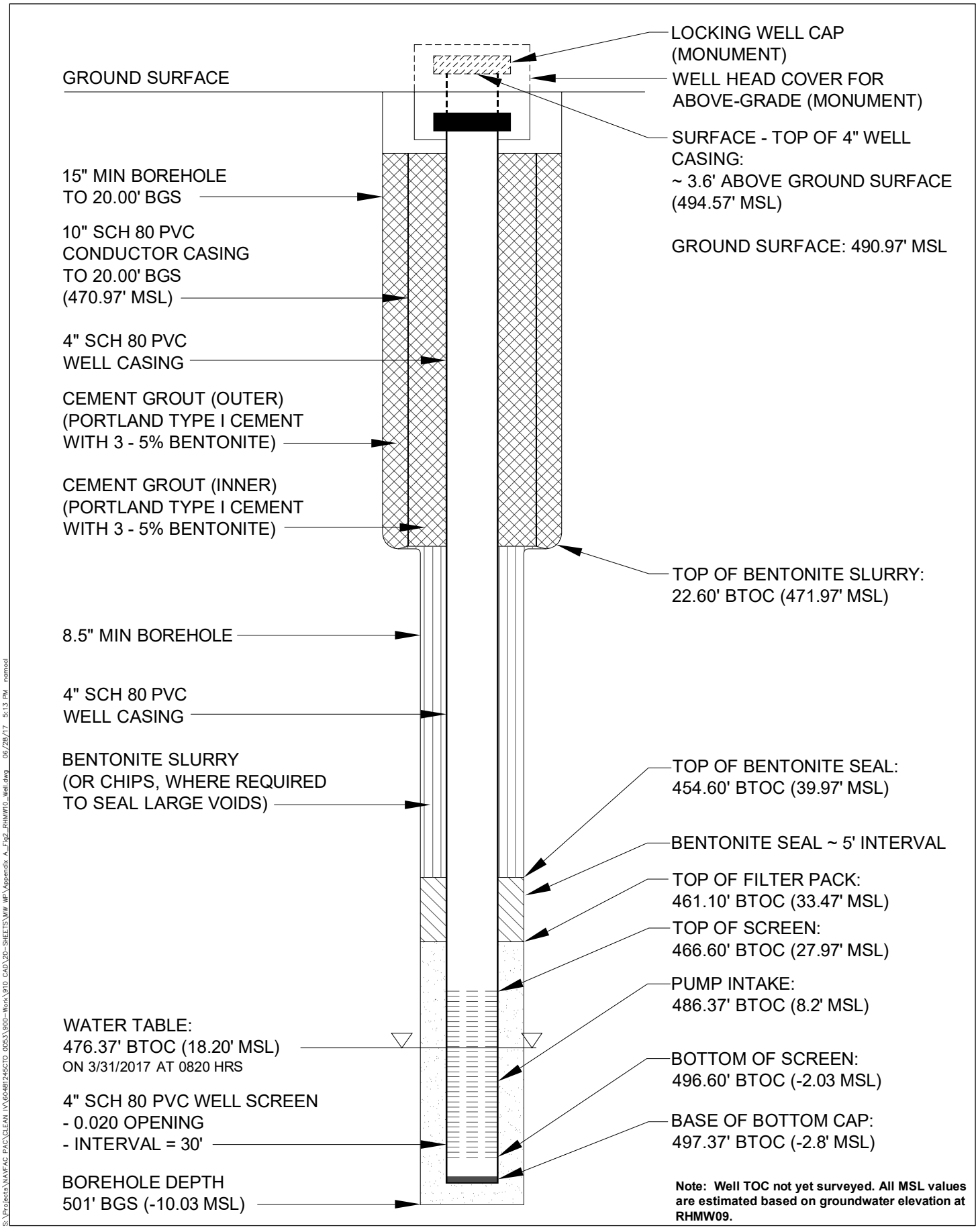
Log of Boring RHMW10

Sheet 32 of 32

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	493				0		M M M		35% vesicles ~1mm diameter							
	494				10+		NR		no recovery							
-4	495		46		10+		M		50% vesicles 1–3mm diameter, intensely fractured (most mechanical, some oxidized surfaces)							Water level recorded – 472.8 ft bgs
	496				10+		M IF									
-6	497	97		72	10+	72	M M							0	[75]	Water loss ~350 gal + 1/2 bag bentonite
	498				0		IF M M									
-8	499				10+		NR		no recovery							Water level recorded – 472.8 ft bgs
	500								Bottom of Boring; TD = 500 ft bgs							Complete drilling 3/24/17
-10	501															
	502								Used a total of approximately 30,025 gallons of circulation water and 5–3/4 50–lb bags of Maxgel bentonite powder during coring.							
-12	503															
	504															
-14	505															
	506															
-16	507															
	508															
-18	509															

Report: CT053 RED HILL WITH WELL AND PID; File: CT053 RED HILL CORE LOGS.GPJ; 7/28/2017 RHMW10

~~For Red Hill AOC Party Use Only~~



S:\Projects\NAVFAC_PAC\CLEAN_IV\60481245\TO_0053\900-Work\910_CAD\2D-SHEETS\WW_WP\Appendix A_Fig2_RHMW10_Well.dwg 06/28/17 5:13 PM namsol

Appendix A Figure 1
Cross Section of RHMW10 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY
CTO 053	RHMW10	Red Hill	(b) (6)

METHOD
- OVERPUMPAGE ☐
- BAILER ☒
- SURGE BLOCK ☒
- AIR LIFT ☐
- OTHER

1st bailer volume = 2.5 gal.

2nd bailer volume = 2.0 gal.

INITIAL WATER LEVEL: 472.7' bgs
INITIAL TOTAL DEPTH:

FINAL WATER LEVEL:
FINAL TOTAL DEPTH:

REMARKS:
Well casing vol.= 13 gal.
Annulus + rat hole volume (40% porosity) = 18.56 gal.
Unit well volume = 31.56 gal.
3 unit well volumes = 94.68 gal.

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

DEVELOPMENT LOG:

DATE	TIME	METHOD	ELAPSED TIME	FLOW RATE (gpm)	CUMULATIVE WATER REMOVED (based on 2 gal. per bail) GALLONS	WATER QUALITY pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (ppt)	COMMENTS
4/5/17	1258	Bailer/surge block	0		2.5	6.74	23.15	0.372	8.05	55.9	1542.4	0.18	
4/5/17	1450		1.52		4.5	7.25	24.65	0.386	7.61	40.4	74.0	0.18	New bailer. Water clear.
4/5/17	1507		7		10.5	7.43	23.02	0.353	8.15	75.2	175.0	0.17	
4/5/17	1515		8		16.5	7.39	22.61	0.353	8.50	80.7	260.0	0.18	
4/5/17	1523		8		22.5	7.61	22.14	0.353	8.34	105.9	243.0	0.18	
4/5/17	1535		12		28.5	7.33	22.78	0.352	8.35	123.4	102.0	0.17	
4/5/17	1546		11		34.5	7.25	22.78	0.346	8.37	105.3	154.6	0.17	1 well volume
4/5/17	1602		16		42.5	7.49	22.12	0.335	8.55	136.1	94.0	0.17	
4/5/17	1610		48		48.5	7.60	22.10	0.337	8.50	142.9	69.3	0.17	
4/5/17	1619		9		54.5	7.63	22.21	0.349	8.45	144.4	88.5	0.18	Clean optics.
4/5/17	1628		9		60.5	7.64	22.23	0.342	8.48	152.4	157.5	0.17	
4/5/17	1638		10		66.5	7.64	22.12	0.340	8.55	156.1	88.5	0.17	Actual removed = 55 gal.
4/5/17	1645		7		72.5	7.71	22.19	0.343	8.40	156.8	103.2	0.17	

End Purge for 4/5/17. Actual Volume Removed = 55 gal.

4/6/17	0724		0		57	6.34	21.64	0.309	8.39	150.9	59.6	0.16	
4/6/17	0734		10		63	7.03	21.48	0.305	8.37	150.9	113.0	0.16	Recalibrate sp. cond.
4/6/17	0744		10		69	7.22	21.66	0.353	8.38	114.0	55.4	0.17	
4/6/17	0754		10		75	7.23	21.58	0.357	8.47	123.0	92.2	0.17	
4/6/17	0804		10		81	7.53	21.70	0.357	8.42	123.6	85.3	0.17	
4/6/17	0814		10		87	7.63	21.59	0.368	8.38	129.7	155.0	0.18	
4/6/17	0824		10		90	7.66	21.61	0.367	8.49	134.5	70.8	0.18	
4/6/17	0834		10		96	7.71	21.87	0.372	8.32	136.0	72.5	0.18	
4/6/17	0844		10		102	7.67	21.90	0.363	8.59	147.2	63.5	0.17	
4/6/17	0854		10		108	7.70	21.87	0.359	8.50	147.9	140.1	0.17	
4/6/17	0904		10		114	7.71	21.86	0.363	8.49	141.6	1.353.0	0.17	
4/6/17	0914		10		120	7.75	21.85	0.354	8.48	139.9	95.5	0.17	
4/6/17	0924		10		126	7.67	22.10	0.363	8.39	126.9	45.1	0.17	Actual volume = 55 gal. Swab hole.
4/6/17	0955		31		114*	7.44	22.42	0.390	8.18	60.6	258.8	0.19	* based on actual volume + 2 bails
4/6/17	1006	Bailer/surge block	11		120	7.54	21.77	0.364	8.39	102.7	210.6	0.17	
4/6/17	1023		17		130	7.70	22.14	0.365	8.47	64.7	149.3	0.17	
4/6/17	1033		10		136	7.71	22.36	0.362	8.38	105.4	97.5	0.17	
4/6/17	1044		11		142	7.58	22.05	0.350	8.59	105	78.5	0.17	
4/6/17	1056		12		148	7.57	21.93	0.349	8.55	123.3	57.3	0.17	
4/6/17	1107		11		154	7.74	22.09	0.353	8.54	133.3	54.1	0.17	
4/6/17	1119		12		160	7.73	22.12	0.349	8.45	136.4	46.0	0.17	
4/6/17	1130		11		166	7.73	22.38	0.354	8.38	135.0	32.8	0.17	
4/6/17	1138		8		172	7.70	22.45	0.345	8.46	137.0	33.2	0.16	(actual – 165 gal.) swab/surge well
4/6/17	1210		32		169	7.59	22.50	0.357	8.43	60.4	235.9	0.17	
4/6/17	1220		10		179	7.59	22.59	0.363	8.31	107.2	118.4	0.17	
4/6/17	1229		9		187	7.68	22.44	0.360	8.26	125.6	113.9	0.17	
4/6/17	1243		14		195	7.67	22.48	0.359	8.46	128.8	80.8	0.17	
4/6/17	1255		13		205	7.71	22.42	0.339	8.59	133.9	76.4	0.17	
4/6/17	1305		10		211	7.71	22.48	0.359	8.37	137.0	57.3	0.17	
4/6/17	1315		10		217	7.68	22.36	0.342	8.50	150.9	46.0	0.16	
4/6/17	1328		13		225	7.75	22.48	0.349	8.46	157.4	31.1	0.17	

4/6/17	1337	Bailer/surge block	19		231	7.69	22.50	0.349	8.50	155.4	35.2	0.17	
4/6/17	1346		19		237	7.70	22.14	0.328	8.35	150.6	13.1	0.16	
4/6/17	1354		8		243	7.70	22.10	0.323	8.51	134.6	10.1	0.15	
4/6/17	1358		4		249	7.53	22.11	0.324	8.52	143.2	9.7	0.15	220 gal.
4/6/17	1410		12		226	7.68	22.08	0.326	8.37	139.9	9.7	0.16	
4/6/17	1412		2		232	7.60	21.92	0.322	8.54	143.0	7.1	0.15	
4/6/17	1415		3		238	7.59	21.80	0.329	8.49	146.3	7.4	0.15	
4/6/17	1420		5		244	7.60	21.91	0.327	8.23	136.6	8.2	0.16	
4/6/17	1423		3		250	7.65	21.92	0.327	8.35	135.2	6.6	0.16	Actual = 230 gal.
End Purge													

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Date(s) Drilled	09/25/17	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	8" OD HSA / HQ core / PQ core / air rotary	Drill Bit Size/Type	HQ/PQ diamond bit / 9.5" tricone bit	Total Depth of Borehole	492.5 feet
Drill Rig Type	Mobile B-59 / T3	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	210.38 feet
Groundwater Level	El. 18.27' (10/26/2017)	Location	(b) (3) (A)	Inclination from Horizontal/Bearing	90°
Borehole Completion	Westbay Well			Hammer Data	140 lbs/30-inch drop

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
0								**FILL** Very stiff, dry, dark reddish-brown (5YR 5/2), Silty Sandy GRAVEL (GM), fine to coarse sand, angular and subangular gravel to less than 3" and cobbles to 4", predominantly 1" to 2" gravel, matrix composed of silt and fine sand, not plastic							Air knife to 22.8 ft bgs. Visually logged open hole. Installed 16 1/4" steel casing to 20 ft bgs. Pour 4 bags of 3/8" bentonite chips in annulus
1															
2															
3															
4															
5															
6															
7															
8								▼ slight moisture							
9								▼ decreased gravel							
10															
11															
12								▼ increased moisture and decreased gravel							
13															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/9/2018 RHMW11

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
13															
14															
15															
16															
17															
18								silt							
19															
20															
21															
22															
23															End of drilling 9/25/17; begin 10/02/17; Begin using 8" O.D. (4.24" I.D.) hollow stem auger and California Sampler
24															
25								Soft, moist, variable colored Dark reddish brown (5YR 3/2) to yellowish red (5YR 4/6), CLAY (CH) with sand, high plasticity, 20% fine to coarse sand and subangular gravel to 1", no odor			1	25 56 50	0.2		
26			100					Dry, gray (2.5Y 6/1 to 2.5Y 5/1), friable BASALT, oxidized on breaking surfaces, no odor							
27															
28															
29															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/9/2018 RHMW11

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
29															
30								Moist, Sandy CLAY (CH), ~15% SAND			2	9 17 38	0.1		
31			100					Moist, Brown (5YR 3/2) to gray (5YR 4/1) with orange mottling (5YR 5/6), Sandy Clayey GRAVEL (GC), ~30% fine to coarse sand, no odor Dry, gray (2.5Y 6/1) friable BASALT							
32															
33															
34															
35								Wet, dark brown (7.5YR 3/2), Clayey Sandy GRAVEL (GC), 15% clay, 30% fine to coarse sand, angular to subangular gravel to 1.5", no odor			3	15 21 25	0.1		
36			100					Moist, gray (10YR 5/1) to dark gray (10YR 4/1), highly friable BASALT, no odor Moist, dark brown (7.5YR 3/2), Clayey Sandy GRAVEL (GC), 10% clay, 20% fine to coarse sand, rounded gravel to 2", no odor							
37															
38															
39															
40								Wet, gray (7.5YR 5/1) mottled with dark brown (7.5YR 3/2), highly fractured BASALT with CLAY (GC), no odor			4	12 15 23			
41			100												
42			100					Wet, brown (10YR 4/3), Clayey Sandy GRAVEL (GC), medium plasticity, rounded gravel to 2.5", (possible slough)			5	18 20 50	0.0		
43								Moist to dry, gray (7.5YR 5/1) with yellowish brown (7.5YR 5/6) mottling, highly fractured, friable BASALT with trace clay			6	13 25 50	0.0		
44			100					Wet, yellowish red (5YR 5/6), Silty Sandy GRAVEL (GM), rounded gravel to 2.5" Wet, gray (7.5YR 5/1) with yellowish brown (7.5YR 5/6) mottling, highly fractured, friable BASALT with trace clay							
45											7	20 40	0.0		

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/9/2018 RHMW11

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
45			100					Dry, gray (7.5YR 5/1) with strong brown (7.5YR 5/6) mottling, highly fractured, friable BASALT with ~10-20% clay, no odor				50/4"			
46								Dry, gray (10YR 3/2), Sandy GRAVEL (GW), slight silt/clay, fine to coarse sand, rounded to subrounded gravel to 1", mostly 1/4" gravel, 25% silt, 40% sand, 45% gravel			8	23 50/4" 50/1"	0.0		
47			60												
48			47					Dry, gray (10YR 5/1) with yellowish brown (10YR 5/6) and very dark brown (10YR 2/2) mottling, highly fractured, friable BASALT with silt/clay, high plasticity, subrounded gravel to 2.5" with angular fractured rock fragments, no odor			9	20 50/4" 50/2"	0.0		
49								Stiff, dry, dark brown (10YR 3/3) with brown (10YR 5/3) oxidized mottling, Sandy CLAY (CH) with gravel, high plasticity, subrounded gravel to 2", no odor							End of drilling 10/02/17; begin 10/03/17
50													0.0	[60]	Begin coring using HQ system
51								Clay grades to olive gray (5Y 4/2)							
52	10		66		0			highly friable and fractured BASALT							Water loss ~400 gal
53		1						grades with highly friable/weathered basalt cobbles							
54															
55													0.0	[37.5]	
56								highly weathered, friable and fractured BASALT							
57	11		66		0										Water loss ~350 gal
58															
59		2													
60													0.3	[30]	
61															

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
61													End of drilling 10/03/17; begin 10/04/17
62								Basalt Boulder, massive a'a, gray (10YR 5/1), moderately to highly weathered, very weak to weak, <1% vesicles					Water loss ~200 gal
63	12	2	100		0								
64								**RESIDUAL SOIL** Brown (7.5YR 4/3) Silty CLAY (CH) with 10% gravel, plastic					
65								no recovery			0.1	[60]	
66								becomes pebble conglomerate with 40% gravel					
67	13		84		0								Water loss ~180 gal
68													
69								**VOLCANIC SAPROLITE** Moderately to completely weathered basalt rock, extremely weak to weak, weathers to sandy and gravelly clay and clayey gravel					
70		3						69 ft to 70 ft basalt boulder from 69 ft to 70 ft, massive a'a, very dark gray (7.5YR 3/1) with red brown stains, highly weathered, very weak, fractures are very tight with Fe+Mn			0.1	[50]	
71								no recovery					
72	14		80		0			saprolite derived from pahoehoe					Water loss ~300 gal
73								saprolite derived from a'a clinker					
74								saprolite derived from massive a'a					
75											0.0	[75]	End of drilling 10/04/17. Hole reamed to 15 1/2 inches from 42.7-75 ft bgs. Installed 10" steel casing to 75 ft bgs. Tremie grout into annulus:
76								no recovery					
77													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/9/2018 RHMW11

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
77													
78	15	3	60		0			Basalt Boulder, very dark greenish gray (GLEY 1 3/5GY) weak, highly fractured, with dark yellowish brown (10YR 4/4) clay					450 gal grout total (27.5 - 94 lb bags of cement, 3 - 50 lb bags bentonite). Begin drilling 10/11/17 Water loss ~100 gal
79								Stiff,dark brown (10YR 3/3) with reddish yellow (7.5YR 6/8) mottling, Sandy CLAY (CH) with gravel, fine to coarse sand, extremely weak to weak, angular gravel to ~1", high plasticity (Volcanic Saprolite)					
80		4						no recovery			0.1	[20]	
81													
82	16		90		0								Water loss ~100 gal
83													
84								contains occasional 2" angular to subangular gravel					Good water circulation near bottom of run 16
85											-	[75]	End of drilling 10/11/17; begin 10/12/17
86								no recovery					
87	17		60		0			0.2 ft zone of weak basalt cobble					Good water circulation, no water loss
88								0.2 ft zone of weak basalt cobble					
89								0.2 ft zone of intensely fractured, weak, basalt cobble					
90		5									-	[50]	
91								no recovery					
92								Basalt Boulder, massive a'a, highly to intensely fractured					Good water circulation, water loss ~25 gal
93	18		76		0			Dark brown (10YR 3/3),Clayey Gravelly SAND (SC), highly weathered to completely weathered basalt with clayey zones (Volcanic Saprolite)					

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/9/2018 RHMW11

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
93													
94								becomes clayey sandy gravel (GC)					
95								dark brown (10YR 3/3), sandy clay (CH)			0.0	[30]	
96													
97	19	5	100		0			grayish green (GLEY1 5/10Y) massive a'a boulder, moderately weathered, weak					Good water circulation, water loss ~25 gal
98								yelowish red (5YR 5/6) clayey sandy gravel (GC), highly weathered, extremely weak to weak basalt					
99													
100						NR		no recovery			0.0	[60]	
101								1. 0, J, VN, Fe+Mn, Sp, Wa, R 2. 20, J, VN, Fe+Mn, Sp, Pl, S 3. 10, J, VN, Fe+Mn, Sp, Wa, SR 4. 70, J, VN, Fe+Mn, Sp, Pl, SR 5. 10, J, VN, Fe+Mn, Sp, Pl, SR 6. 10, J, VN, Fe+Mn, Sp, St, SR					
102	20		86		0	1 2		basalt boulder, massive a'a, grayish green (GLEY1 4/2) and greenish black (GLEY1 2.5/1) with yellowish red (5YR 5/6) in fractures, moderately to highly weathered, highly fractured					Good water circulation, water loss ~25 gal
103						3 4 5 6							
104		6						clayey sandy gravel (GC)					
105						NR		no recovery			0.0	[100]	
106													
107	21		70		0	IF 1 2 3		Basalt, massive a'a, GLEY1 5/6, weak to moderately strong, ~15% vessicles 1-3mm (Volcanic Saprolite) vessicles become 0.5-3mm 1. 10, J, VN, Fe+Mn,St, SR 2. 90, J, VN, Fe+Mn, Wa, SR 3. M					Good water circulation, water loss ~25 gal
108						4 5 6 IF		4. 45, J, VN, Fe+Mn, Wa, SR 5. 70, J, VN, Fe+Mn, Wa, SR 6. 45, J, T, Fe, St, S					
109													

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109						IF							
								clayey intensely fractured clinker zone, highly weathered					
110		6				NR		no recovery			0.0	[43]	
111						IF		no clay					
112	22		80		8	1 IF		basalt, massive a'a, 5Y 4/1, 1-5% vesicles 1. 45, J, W, Cl, Fi, Wa, SR 2. 45, J, VN, Fe+Mn, Sp, Wa, SR 3. 0, J, N, Fe+Mn+Cl, Pa, St, SR 4. 45, J, W, Cl-Sd, Fi, Wa, SR 5. 45, J, N, Mn+Cl, Pa, Pl, SR 6. 45, J, Vn, Fe+Mn, Sp, St, SR 7. 45, J, VN, Fe+Mn, Sp, St, SR 8. 30, J, VN, Fe+Mn, Sp, Pl, SR 9. 45, J, VN, Fe+Mn, Sp, Wa, SR 10. M 11. 45, J, VN, Fe+Mn, Sp, Wa, SR 12. 0, J, VN, Fe+Mn, Sp, Wa, SR 13. 45, J, VN, Fe+Mn, Sp, Wa, SR				Good water circulation, water loss ~25 gal
113						2 3 4 5							
114						6 7 IF 8 9							
115		7				10 11 12		Basalt, pahoehoe, moderately weathered, moderately strong, highly fractured (Volcanic Saprolite)			0.0	[50]	
116						13		Basalt, massive a'a, dark gray (5YR 4/1) to dark reddish brown (5YR 3/3), highly weathered, highly to intensely fractured with zones of clay and fine to coarse, angular sand, occasional rounded gravel to 2"(Volcanic Saprolite)					
117	23		70		0	IF							Good water circulation, water loss ~25 gal
118													
119						NR		no recovery					
120											0.0	[30]	
121						IF							
122	24		86		12			becomes 5Y 4/1, slightly weathered, strong, 5% vesicles <0.5mm becomes <5% vesicles					Good water circulation, water loss ~25 gal
123						IF							
124		8				IF		clayey sand (SC) with rounded gravel to 0.5" from 124 ft to 124.3 ft becomes moderately weathered, moderately strong, ~25% vesicles 1-2mm					
125													

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125	125											0.0	[43]	
126	126						NF		no recovery					
127	127	25		66		0	1 IF 2		becomes very dark bluish gray (GLEY2 3/10B) with yellowish red (5YR 5/6) oxidation on fracture surfaces, moderately strong to strong, intensely to highly fractured 1. 90, J, MW, Pa, Ir, R 2. 90, J, MW, Pa, Ir, R					Good water circulation, water loss ~25 gal
128	128						IF		3. 80, J, W, Cl+Sd+Gr, Fi, Ir, R					
129	129		8				3							
130	130						1		no recovery			0.0	[21]	
131	131						2 3 4 5		1. 90, J, VN, Fe+Mn+Cl, Pa, Ir, R 2. 45, J, VN, Fe+Mn+Cl, Pa, Ir, R 3. 45, J, VN, Fe+Mn+Cl, Pa, Ir, R 4. 0, J, N, Fe+Mn, Sp, Wa, R 5. 70, J, N, Fe+Mn+Cl, Pa, Wa, R					
132	132	26		94		22	IF		6. 30, J, MW, Fe+Mn+Cl, Pa, Ir, R					Good water circulation, water loss ~25 gal
133	133								reddish brown (2.5YR 4/3) stiff clay (weathered clinker zone)					
134	134						6							
135	135						NF		no recovery			0.0	[43]	
136	136						IF							
137	137		9											Good water circulation
138	138	27		90		0	1 M 2 3 4		contains <5% vesicles 1. 20, J, N, Fe+Mn, Pa, Ir, R 2. 20, J, N, Fe+Mn, Pa, Ir, R 3. 20, J, N, Fe+Mn, Pa, Ir, R 4. 30, J, N, Fe+Mn, Pa, Ir, R					
139	139								reddish brown (2.5YR 4/3) very stiff clay (weathered clinker zone)					
140	140								no recovery			0.0	[50]	
141	141													

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	141								becomes weak to moderately strong, vesicles 0.5-1mm					
	142	28		90		12	IF		becomes highly weathered, very weak to weak, intensely fractured with reddish brown (2.5YR 4/3) clay					Good water circulation, no water loss
	143		9				1 IF		1. 45, J, VN, Fe+Mn, Pa, Ir, R					
	144													
	145								becomes extremely weak			0.0	[43]	
	146						IF M M M		1. 45, J, N, Cl, Fi, Ir, R 2. 60, J, VN, Cl, Fi, Pl, SR 3. 30, J, N, Cl, Fi, Ir, R 4. 20, J, VN, Fe+Mn, Pa, Ir, R 5. 90, J, VN, Fe+Mn, Pa, Ir, R 6. 45, J, VN, Cl, Fi, Pl, SR 7. 30, J, VN, Cl, Fi, Pl, S					
	147	29		100		0	1 2 M 3							Good water circulation, no water loss
	148						4 5 M		becomes moderately weathered, moderately strong					
	149		10				6 7		becomes highly weathered, extremely weak					
	150						IF		no recovery			0.0	[38]	
	151						IF		becomes highly to moderately weathered, weak to moderately strong					
	152	30		90		8								Good water circulation, no water loss
	153								reddish brown (2.5YR 4/3), Welded Clinker, highly weathered, extremely weak					
	154								becomes grayish green (GLEY1 4/2) highly weathered, weak					
	155								no recovery			0.0	[60]	End of drilling 10/12/17; begin 10/13/17
	156		11						stiff, reddish brown (2.5YR 3/3), sandy gravelly clay (CH), high plasticity, completely weathered clinker zone					
	157						IF		becomes moderately weathered					

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	157													
		31		82		0	1 2 3		1. 60-70, J, VN, Fe+Mn, Pa, Ir, R 2. 60-70, J, VN, Fe+Mn, Pa, Ir, R 3. 60-70, J, VN, Fe+Mn, Pa, Ir, R 4. 60-70, J, VN, Fe+Mn, Pa, Ir, R					
	158						4		Basalt, highly weathered pahoehoe, (2.5YR 4/2), very weak, intensely fractured with zones of clay (Volcanic Saprolite)					Good water circulation, no water loss
	159						M M		becomes dark greenish gray (GLEY1 4/10Y), extremely weak					
	160						M		no recovery			0.0	[100]	
	161		11						1. 30, J, MW, Fe+Mn, Sp, Ir, R 2. 5, J, VN, Fe+Mn, Sp, Ir, R					
	162						1 2 IF							
		32		92		18								Good water circulation, no water loss Collect geotechnical sample from 162.6 ft to 163.6 ft
	163								Stiff, Reddish brown (2.5YR 3/3), Sandy CLAY (CH) with gravel, fine to coarse sand, subrounded to subangular extremely weak gravel predominantly <0.5" (Volcanic Saprolite)					
	164						M							
	165											0.0	[100]	Hole reamed to 9 1/2" from 75-165 ft bgs. Installed 5" steel casing to 165 ft bgs. Tremie grout into annulus: 550 gal grout total (3 - 94 lb bags of cement, 1/4 - 50lb bags bentonite) Good water circulation, no water loss
	166						M IF M		becomes very stiff					
							M		becomes ~50% sand					
	167						M							
		33		100		20	M IF							
	168								grades with dark greenish gray (GLEY1 4/10Y) angular basalt cobbles					
	169		12				M M		2.5YR 5/6 to 2.5YR 4/6 welded clinker, highly weathered					
	170						IF					0.0	[60]	
	171								no recovery					
							IF		2.5YR 4/2 pahoehoe, highly weathered, extremely weak, 35% vesicles <1.5 mm					
	172								Stiff, 7.5YR 4/2, gravelly CLAY (CH) with cobbles and boulders, gravel extremely weak, subangular to angular, typically <1", highly to completely weathered massive a'a and pahoehoe (Volcanic Saprolite)					
		34		72		0								Good water circulation, no water loss
	173													

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173						IF							
174		12				M							Collect geotechnical sample from 174.3 ft to 175.0 ft
175											0.0	[75]	
176						IF							
177						M							
	35		100		22	IF M		greenish gray (GLEY1 4/10Y) with strong brown (5YR 5/8) oxidation, basalt a'a, highly weathered, extremely weak to very weak, intensely fractured					Good water circulation, no water loss
178								2.5YR 3/2, basalt pahoehoe, highly weathered, extremely weak, 40% vesicles up to 1mm					
						M							
179		13						greenish gray (GLEY1 4/10Y) with strong brown (5YR 5/8) oxidation, basalt a'a, highly to completely weathered, extremely weak, intensely fractured					
						IF							
180						M							
						M		2.5YR 3/2, basalt pahoehoe, completely to highly weathered, extremely weak, 40% vesicles up to 1mm			-	[75]	
181						M							
						IF		becomes stiff to soft, 7.5YR 4/2 to 7.5YR 5/2 CLAY (CH) with dark greenish gray (GLEY1 4/10Y) gravel and cobble fragments					
182						IF							
	36		100		0			remnant pahoehoe structure visible, 30% vesicles 1-2mm					Good water circulation, no water loss
183													
184								vesicles increase to 3mm					
185											-	[60]	
						N/R		no recovery					
186						M		Very stiff, brown (7.5YR 4/2) clayey sandy GRAVEL (GC), gravel highly weathered, extremely weak, subrounded to subangular greenish gray (GLEY1 4/10Y) and strong brown (7.5YR 5/6), with basalt a'a cobbles, highly to completely weathered basalt (Volcanic Saprolite)					
187		14				M							
	37		84		0								Good water circulation, no water loss
188						M		dark greenish gray (GLEY1 4/10Y), basalt a'a cobble, highly weathered, very weak from 188.1 ft to 188.5 ft bgs					
								gravel predominantly a'a clasts with some pahoehoe					
189													

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189						M IF		Brown (7.5YR 4/2) sandy clay (CH) with gravel, residual pahoehoe structure evident					
190						NR		no recovery			0.0	[60]	Collect geotechnical sample from 189.5 ft to 190 ft
191						M M		very stiff, brown (7.5YR 4/2) clayey sandy GRAVEL (GC), gravel highly weathered, extremely weak, subrounded to subangular greenish gray (GLEY1 4/10Y) and strong brown (7.5YR 5/6), highly to completely weathered basalt (Volcanic Saprolite)					
192	38		90		20	M M							Good water circulation, no water loss
193		14				IF							
194						IF		basalt boulder, massive a'a, grayish green (GLEY1 4/5GY) with strong brown (7.5YR 5/6) oxidized zones,highly to completely weathered, very weak to extremely weak, intensely fractured					
195						NR		no recovery			0.0	[75]	Collect analytical sample RHMW11-BS01-S01 -D195.1-195.5 from 195.1 ft to 195.5
196						M M							
197	39		90		26	M M 1		basalt boulder, massive a'a, dark greenish gray (GLEY1 4/5GY), highly weathered, very weak to extremely weak					Good water circulation Total water loss from 155 ft through 200 ft is 10 gal
198						M							
199						M M IF		basalt cobble, pahoehoe, dark reddish brown (5YR 3/3), completely to highly weathered, extremely weak, relict structure intact, ~40% vesicles 0.5-1mm basalt boulder, massive a'a, dark greenish gray (GLEY1 4/5GY), highly weathered, very weak to extremely weak					
200		15				M					0.0	[43]	End of drilling 10/13/17; begin 10/16/17
201						M M							
202	40		100		20	M IF M		basalt boulder, massive a'a, dark greenish gray (GLEY1 4/5GY), highly weathered, very weak					Water loss ~20 gal
203						M							
204						M M							
205													

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205		15						no recovery			0.0	[75]	
206						IF IF							
207								basalt boulder, massive a'a, dark greenish gray (GLEY1 4/5GY), highly weathered, very weak					Good water circulation, water loss ~20 gal
208	41		90		0	M M IF IF		Welded Tuff, highly to completely weathered, extremely weak, weathers to brown (7.5YR 4/2) clay with dark greenish gray (GLEY1 4/5GY) to black (GLEY1 2.5/N) basalt a'a gravel to cobble clasts, occasional red (10R 4/6) clast, stong brown (7.5YR 5/6) mottling around clasts(Volcanic Saprolite)					
209						M M							
210		16						no recovery			0.0	[50]	End of drilling 10/16/17; begin 10/23/17 using PQ coring system
211						IF M M M		basalt boulder, massive a'a, dark greenish gray (GLEY1 4/5GY), highly weathered, very weak, very stiff					
212						M							Good water circulation, water loss ~20 gal
213	42		90		0	M M M M M IF							
214						M 1 1 M		1. 45, J, T, Mn, Fi, Pl, Slk-S					
215											0.0		End of drilling 10/23/17; begin 10/24/17
216	43	17	100		0								
217								Stiff, reddish brown (5YR 4/3) clay (CH), highly to completely weathered pahoehoe, extremely weak, relic structure still visible, 30% vesicles 0.5-1mm (Volcanic Saprolite)					
218								no recovery			0.0	[300]	Some water circulation, water loss ~50 gal
219		18				M M M IF		becomes dark greenish gray (GLEY1 4/10Y)					
220	44		90		46			becomes yellowish red (5YR 5/6) 1. 20, J, VN, Cl, Sp, Ir, R					
221						1							

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221																
			18				M		Basalt, pahoehoe, dark greenish gray (GLEY 4/10Y), moderately weathered, extremely weak, vesicles increase to 2mm (Volcanic Saprolite)							
222							M		becomes yellowish red (5YR 5/6)							
							M							0.0	[50]	
223							IF									
									grades with dark greenish gray (GLEY 4/10Y) banding, 15% vesicles ~1mm							
224									dark greenish gray (GLEY1 4/10Y), very weak, 15-25% vesicles 1-2mm							Some water circulation, water loss ~80 gal
			19													
225		45		100		0	IF									
226																
									basalt boulder, massive a'a, dark greenish gray (GLEY1 4/10Y), moderately weathered, very weak, <5% vesicles							
227														0.0	[27]	
							IF		Brown (7.5YR 4/4), clayey gravel (GC) completely to highly weathered basalt, extremely weak, subrounded, medium to coarse sand clasts and occasional gravel and cobble in clay matrix (Volcanic Saprolite)							
228																
									pahoehoe cobble							
229																Some water circulation, water loss ~150 gal
			20				IF		a'a cobble							
230		46		100		0										
231																
									dark olive gray (5Y 3/2) pahoehoe boulder, highly weathered, very weak, 25-30% vesicles 2-3mm							
232														0.0	[23]	
							NR		no recovery							
233																
234							M									Some water circulation, water loss ~100 gal
							1									
235		47	21	74		0	M G I		1. 45, J, T, No, No, Pl, SR							
							IF									
236							IF									
237																

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	237		21											
							IF					0.0	[38]	End of drilling 10/24/17; begin 10/25/17
	238						IF		basalt boulder, massive a'a, very dark gray (5Y 3/1), moderately weathered, very weak, intensely fractured, <5% vesicles 1. 20, J, VN, Si, Fi, Ir, SR 2. 0, J, N, Cl, Sp, Ir, R 3. 20, J, ?, Cl, Sp, Ir, R 4. 10, J, N, Cl, Sp, Ir, R					
	239													
							1		Yellowish brown (10YR 5/6), basalt a'a clinker, highly weathered, extremely weak to very weak, red (2.5YR 4/8) alteration zone at 239.9 ft					
	240	48	22	100		22	2		Basalt, pahoehoe, dark brown (7.5YR 3/3), highly weathered, weak,15-20% vesicles, some vesicles filled with white clay (Volcanic Saprolite)					Good water circulation, water loss ~20 gal
							3							
	241						IF		becomes completely weathered, extremely weak, intensely fractured					
	242						4		becomes highly weathered, weak, ~25% vesicles, all vesicles filled with white clay			0.0	[38]	
	243						M							
							M							
	244								1. 30, J, VN, Cl, Fi, Pl, S					
							1		~50% vesicles filled with white clay					
	245	49	23	60		34	M							Good water circulation, water loss ~10 gal
							M							
							M							
	246						M							
							M							
	247								no recovery					
												0.0	[27]	
	248													
	249						IF		Basalt, massive a'a, grayish black (GLEY1 2.5/5GY), moderately weathered, weak to moderately strong, intensely fractured, oxidized fracture surfaces (Volcanic Saprolite)					
							1							
	250	50	24	70		0	IF		becomes strong 1. 60, J, ?, Fe+Mn, Pa, Pl, SR 2. 70, J, ?, Fe+Mn+Cl, Pa, Ir, R 3. 90, SH, T, Fe+Mn+Cl, Pa, Pl, Slk					Good water circulation, water loss ~10 gal
							M							
	251						M		Basalt, pahoehoe, reddish brown (5YR 4/3 to 5YR 4/4), highly weathered, weak, 40% vesicles 1-2mm, most vesicles filled with white clay from 250.9 to 251.2 ft (Volcanic Saprolite)					
							IF							
	252						M		at 251.2 ft becomes grayish black (GLEY1 2.5/5GY) with veins of white clay, moderately weathered, weak to moderately strong, ~25% vessicles					
							IF							
							2							
							M					0.0	[60]	
	253						3							

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	253						IF		highly to moderately weathered, very weak, intensely fractured, many fracture planes are planar/slickensided, white clay infill in vesicles					Good water circulation, water loss ~10 gal
	254													
	255	51	25	90		0	1 M IF		yellowish red (5YR 4/6) highly weathered, very weak to extremely weak oxidized zone 1. 80-90, Sh, T, Fe+Mn+Cl, Fi, Ir-Pl, Slk					
	256						M IF		grayish black (GLEY1 2.5/5GY), highly to moderately weathered, very weak, intensely fractured, vesicles filled with white clay					
	257								no recovery			-	[33]	
	258								Welded clinker, very dark gray (5YR 3/1), highly weathered, extremely to very weak, vesicles filled with white clay, frequent extremely weak zones of red (10R 4/6) alteration					
	259		26				M							
	260	52		86		52	1		red zones no longer observed					Good water circulation, no water loss
	261						IF		Basalt boulder, massive a'a, grayish black (GLEY1 2.5/5GY), intensely fractured, fracture planes oxidized with common slickensides and white clay, <5% vesicles 1-2mm 1. 70, Sh, ?, Fe+Mn+Cl, Pa, Ir, Slk-SR					
	262													
	263						IF		contains subrounded clasts coarse sand to gravel size up to 2", some clasts are yellowish red (5YR 5/6)			-	[27]	
	264		27				IF		1. 90, Sh, VN, Cl, Cl, Fi, Pl-Ir, Slk					
	265	53		100		10	M 1 IF		Basalt, pahoehoe, yellowish red (5YR 5/6), completely weathered, extremely to very weak (Volcanic Saprolite) becomes dark gray (5YR 3/1), very weak, ~40% vesicles, some filled with white clay, with yellowish red (5YR 5/6) oxidized zones					Good water circulation, no water loss
	266													
	267						M							
	268		28				M 1 2 3 M M		moderately weathered, moderately strong, 15% vesicles 1-2mm 1. 90, J, ?, Fe, Su, Ir, R 2. 60, J, N, Fe, Su, Ir, R 0.2 ft zone of 4mm vesicles filled with clay 3. 70, J, VN, Fe+Mn+Cl, Fi, Pl, S-SR			-	[43]	
	269													

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269								30-40% vesicles 0.5-2mm, dark reddish brown (5YR 5/6) oxidation around fractures 4 and 5 4. 30, J, VN, Fe, Su, Ir, R 5. 15, J, N, Fe, Su, Ir, R							
	270	54	28	100		44	IF (M)									Good water circulation, no water loss
	271								grades without white clay in vesicles							
	272															
			29											-	[30]	
	273								40-50% vesicles up to 3mm 30-40% vesicles 1mm							
	274								yellowish red (5YR 5/6) highly weathered oxidized zone							
	275	55		100		0			1. 60, J, ?, Fe+Mn+Cl, Sp, Ir, R 2. 45, Sh, Fe+Mn+Cl, Fi, Pl, S-Slk							Good water circulation, no water loss
	276		30													
	277								yellowish red (5YR 5/6) to dark red (2.5YR 3/6) oxidized zone							
	278						NR		no recovery very dark gray (5YR 3/1), moderately weathered, moderately strong, 25% vesicles 1-2mm, with occasional white and gray clay infilling vesicles					-	[33]	
	279		31				IF		**BASALT Pahoehoe** Very dark gray (5YR 3/1), slightly weathered, strong, 15-25% vesicles, alternating zones of smaller (0.5-1mm) and larger (3-5mm) vesicles							
	280	56		90		10			1. 20, J, N, Fe+Cl, Sp, St-Ir, VR 2. 5, J, T, No, No, Ir, R 3. 45, J, VN, Fe+Mn+Cl, Fi, Ir, R 4. 5, J, T, Cl, Sp, Ir, SR 5. 30, J, N, Cl, Pa, St, SR-VR 6. 0, J, N, Cl, Sp, Ir, R							Poor water circulation, water loss ~150 gal
	281															
	282		32											0.0	[100]	
	283								1. 20, J, VN, Fe+Mn+Cl, Pa, Ir, R 2. 20, J, VN, Cl, Sp, Ir, R 3. 30, J, N, Cl, Pa, St, R 4. 30 J, VN, Cl, Sp, Ir-Pl, SR 5. 20, J, T, Cl, Pa, Pl, Sr 6. 30, J, Cl, Sp, Wa, SR							
	284															Poor water circulation, water loss ~200 gal
	285															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
285		57		70		30	6									
							M									
286							M									Lost water circulation, drill string drops from 286 ft to 287.5 ft
							M									
							Void		void/lava tube							
287																
			33				1		very dark gray (GLEY1 3/N), 15% vesicles 3-10mm, some infilled with white or gray clay					0.2	[75]	End of drilling 10/25/17; begin 10/26/17
288																
									30-40% vesicles 1-5mm 1. 0, J, W, Cl, Sp, Ir, R 2. 45, J, MW, Cl, Sp, Ir-Pl, R 3. 60, J, N, Fe, Su, Ir-Pl, R 4. 90, J, VN, Cl, Sp, Pl, SR							
289							M									Depth to water stabilized at 192.11' bgs on 10/26/17
							2									
290		58		100		26	M									
			34				3		moderately weathered alteration/oxidation zone, strong, 30 to 40% vesicles 0.5-3mm							No water circulation for the remainder of boring. Water loss ~400 gal
291							IF		5. 80, J, T, Cl, Pa, Pl, SR 6. 45, J, ?, Cl, Sp, Wa, R							
							4									
292							5		moderately strong, 40% vesicles 0.5-1mm, 70% of vesicles filled with pale brown (2.5Y 7/4) clay							
							IF									
							6									
293							M		residual soil, clay (CH), highly weathered					0.0	[60]	
							M		moderately weathered alteration/oxidation zone, moderately strong, 40% vesicles 0.5-1mm							
							M									
							M									
							1									
294			35				M		slightly weathered, strong, 30% vesicles 1-3mm grading to 50% vesicles 3-5mm 1. 70, T, Cl, Pa, Ir, R 2. 70, T, Cl, Pa, Ir, R 3. 45, T, Fe, Su, No, Ir, R							
							2									
							3									
295		59		100		32	4		grades to 50% vesicles 0.5-1mm 4. 15, T Cl, Sp, Pl, SR 5. 40, VN, Cl, Sp, Ir, R							Water loss ~450 gal
							5									
							6									
296							M		vesicles grade to 1-3mm 6. 20, N, Fe+Mn, Su, Sp, SR 7. 60,T, No, No, Pl, R							
							7									
							M		vesicles grade to 0.5-1mm 8. 45, VN, No, No, St, R 9. 60, ?, No, No, Ir, R							
297							8									
							M									
							9		vesicles grade to 1-3mm							
							M									
			36				IF							0.0	[60]	
298							IF		moderately weathered, weak to strong, 50% vesicles 0.5-1mm with pale brown (2.5Y 7/4) and white (8.5/N) clay infill, very dark gray (GLEY1 3/N), pale brown (2.5Y 7/4) and white (8.5/N) clay on fracture surfaces							
299							M		slightly weathered, strong, 10-15% vesicles 2-10mm 1. 70, J, N, Cl, Sp, Ir, R 2. 20, J, N, Cl, Pa, Pl, SR 3. 90, J, VN, Fe+Mn+Cl, Sp, Ir, R 4. 15, J, N, Cl, Fi, Ir, SR 5. 5, J, N, Cl, Fi, Pl, SR 6. 5, J, VN, Cl, Sp, Ir, R							
							1									
							2									
300		60		100		42	3									Water loss ~400 gal
							M									
			37				M									
301																

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	301						4		30-40% vesicles 1-5mm grading to 0.5-1mm with depth							
			37				5									
	302						6									
							1		very dark gray (GLEY1 3/N), 30-40% vesicles 2-5mm					0.0	[60]	
	303						2		becomes brown (7.5YR 4/4), moderately weathered, weak to moderately strong							
							3		1. 50, J, Uk, Su, Ir-Pl, R							
									becomes fresh, strong							
	304								15% vesicles 5-10mm							
							4		30-40% vesicles 1-3mm							Water loss ~400 gal
									2. 50, J, T, Fe+Mn+Cl, Sp, Ir, R							
	305	61	38	100		32	5		3. 0, J, VN-N, Fe+Mn, Su, Ir, VR							
									4. 45, J, N, Cl, Sp, Pl, R							
									5. 0, J, N, No, No, Ir, VR							
							M		6. 5, J, T, Fe+Mn+Cl, Sp, Ir, R							
							M		slightly weathered, strong							
							M									
	306						6		15% vesicles 5mm							
							7									
									30-40% vesicles 1-3mm							
									7. 70, J, VN-N, Cl, Pa, Pl, SR-R							
							8		8. 20, J, T, Fe+Mn, Su, Pl, SR							
	307								9. 20, J, VN, Fe+Mn, Su, Ir, R							
							9		oxidized yellowish red (5YR 4/6 to 5YR 5/8), moderately weathered, moderately strong, with pale brown and white clay infill in vesicles					0.0	[75]	
							1		1. 0, J, MW, Cl, Pa, Ir							
	308								2. 0, J, N, Fe+Mn+Cl, Su-Sp, Ir, VR							
									3. 10, J, VN-MW, Fe+Mn+Cl, Pa, Ir, VR							
							2		4. 0, J, MW, Fe+Mn+Cl, Fi, Ir, VR							
									5. 10, J, MW, Cl+Mn, Sp, Ir, R							
	309		39						6. 30, J, VN, Uk, Su, Pl, Slk							
							3		very dark gray (GLEY1 3/N) slightly weathered, strong							
							4									
							5									
	310	62		100		36	6									Water loss ~350 gal
							M		oxidized yellowish red (5YR 4/5 to 5YR 5/8), completely weathered, extremely weak							
									highly weathered, very weak to weak							
							M									
	311						M									
							M									
									very dark gray (GLEY1 3/N), slightly weathered, strong, 25-40% vesicles 2-5mm							
							M		7. 15, J, T, No, No, Pl, R							
	312						7									
							M									
			40													
									1. 5, J, VN, Cl, Sp, Ir, R					0.0	[60]	
	313								2. 0, J, N, Fe+Mn, Su, Pl, SR							
									3. 5-10, J, MW, Mn+Cl, Sp, Pl, R							
							1		4. 0-45, J, VN, No, No, Pl, R							
	314						M		dark reddish brown (2.5YR 2.5/4) to yellowish red (5YR 4/6), highly weathered, weak, 0.1 ft zone of residual soil at 314.2 ft							
							M		very dark gray (GLEY1 3/N), slightly weathered, strong, 40% vesicles 0.5-2mm							
							2									
	315	63		100		62	3		fresh, strong, 40% vesicles 1-3mm							Water loss ~450 gal
									5. 0, SH, MW, Uk, Su, Ir, Slk							
									6. 70, SH, MW, Uk, Su, Wa, Slk							
			41				4									
	316								oxidized, moderately weathered							
							5									
							6		very dark gray (GLEY1 3/N), fresh to slightly weathered, strong, 25-30% vesicles 0.5-10mm							
	317															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
317									becomes fresh, 25% vesicles 5-10mm 1. 50, Sh, N, Cl+Uk, Sp, St-Ir, SR-Slk 2. 10, J, VN, Cl+Uk, Sp, Ir, SR-Slk 3. 5, J, T, Cl, Sp, Ir, R 4. 5-45, J, VN, Cl, Sp, St, R			0.0	[50]	
318														
319			42						5-40% vesicles 1-2mm 5. 2, J, T, Cl, Sp, Pl, R 6. 30, J, MW, Fe+Mn, Su, Ir, SR-R					
320		64		100		48			becomes slightly weathered					Water loss ~350 gal
321														
322			43						dark reddish brown (5YR 3/3), moderately weathered, moderately strong, oxidized very dark gray (GLEY1 3/N), fresh to slightly weathered, strong, 30-40% vesicles 0.5-5mm			0.0	[75]	
323									1. 45, J, ?, No, No, Pl-Ir, R 2. 45, J, ?, No, No, Pl-Ir, R 3. 5-10, J, Fe+Cl, Pa, Ir-St, VR					
324									moderately weathered, moderately strong, 40% vessicles 0.5-2mm fresh to slighily weathered, strong					Water loss ~450 gal
325		65		100		32								
326			44						moderately weathered, moderately strong fresh to slightly weathered, strong					
327														
328									becomes fresh, 40% vesicles 1-2mm			0.0	[100]	
329			45						25% vesicles 2-5mm 30-40% vesicles 1-3mm					
330		66		100		24			becomes reddish brown (2.5YR 4/3), slightly weathered, strong, 30-40% vesicles 1-3mm 1. 50, J, VN, No, No, Pl, R 2. 0, J, VN, Cl, Sp, Pl-Ir, R 3. 60, J, ?, Cl, Sp, Pl-Ir, R 4. 90, J, VN, Cl, Sp, Ir, R 5. 70-90, J, VN, No, No, Ir, R					Water loss ~350 gal
331														
332			46									0.0	[100]	
333														

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	333							M	40-50% vesicles 1-3mm							
								M	30% vesicles 2-5mm							
	334		46					IF								
								1	intensely fractured zone contains no infilling on fracture planes							
	335	67		100		20			1. 45, J, T, No, No, Pl, SR							Water loss ~400 gal
								IF	vesicles become 0.5-1mm							
	336															
	337															
			47											0.0	[100]	
	338						NR		no recovery							
								1	1. 45, J, ?, No, No, Pl, R							
	339							M	becomes dark gray (5YR 4/1), fresh to slightly weathered, strong, 30-40% variably sized vesicles 1-10mm							
								M								
	340	68		80		0		M								Water loss ~350 gal
								M								
								M								
	341		48					IF	intensely fractured zone contains no infill on fracture planes							
								M								
	342							M								
								IF								
									30% vesicles 1-4mm					0.0	[100]	End of drilling 10/26/17; begin 10/27/17
	343								40% vesicles 1-3mm							
								IF								
	344							M	1. 90-45, J, VN, No, No, Wa, R							
								1	2. 45-90, J, VN, No, No, Wa, R							
								2								
								M	intensely fractured zone contains no infill on fracture planes							
	345	69	49	100		42		IF								Water loss ~250 gal
	346															
									25% vesicles 1-5mm							
	347															
								M	25% vesicles 5-10mm					0.1	[75]	
	348							M								
								1	1. 70, J, MW, Mn, Su, Wa, SR							
			50					2	2. 45, J, MW, Mn-Cl, Su-Sp, Wa, SR							
	349								40% vesicles 1-3mm							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	349								becomes dark gray (5YR 4/1) with wark reddish brown (2.5YR 3/4) mottling, slightly weathered 3. 20, J, ?, Fe, Su, Pl, R 4. 30, J, ?, Cl, Sp, Pl, R 5. 20, J, ?, Fe, Su, Pl, VR 6. 45, J, N, Cl, Sp, Wa, R					
	350	70	50	100		32								Water loss ~300 gal
	351								dark reddish brown (2.5YR 3/4), slightly to moderately weathered, moderately strong to strong 7. 45, J, N, No, No, Wa, R 8. 90, J, N, Cl, Sp, Pl, R					
	352		51						dark gray (5YR 4/1), fresh to slightly weathered 30% vesicles 2-5mm					
	353	71		100		33			50% vesicles 3mm 25-50% vesicles 0.5-1mm 1. 60, J, N, Cl, Sp, Pl, R 2. 2, J, T, Mn-Fe, Su, Ir, R 3. 45, J, VN, No, No, Pl, SR			0.1	[100]	
	354								30-50% vesicles 1-3mm 4. 45, J, VN, No, No, Ir, VR 30-40% vesicles 0.5-1mm 5. 20, J, N, Fe+Mn, Su, Pl, R 6. 20, J, VN, Cl, Sp, Pl, R					
	355		52						7. 35, J, VN, Fe, Su, Pl, SR 8. 2-0, J, ?, Fe+Mn, Su, Ir, VR (contact alteration zone)					Water loss ~350 gal
	356								becomes dusky red (7.5R 3/4), slightly weathered, 25% vesicles 1-5mm 9. 20, J, ?, Fe+Mn, Su, Pl, R 10. 70, J, ?, Fe+Mn, Su, Pl, R 11. 35, J, ?, Fe+Mn, Su, Ir, VR					
	357								becomes dusky red (10R 4/4), 40%vesicles 0.5-1mm 1. 70, J, N, Cl, Sp, Ir, R 2. 0, J, VN, Fe+Mn, Su, Pl, SR					
	358	72	53	100		32			3. 70, J, N, Fe+Mn+Cl, Sp, Wa, R 4. 90, J, VN, Cl, SP, Wa, R 5. 45, J, VN, Fe+Mn, Sp, Pl, R			0.1	[75]	
	359								weak red (10R 4/4), 40-50% vesicles 1-5mm 6. 20, J, N, Cl, Sp, Pl, R 7. 70, J, N, Cl, Sp, Pl, R 8. 60, J, VN, Mn+Cl, Sp, Ir, R					
	360								grades to dark reddish gray (2.5YR 3/1)					Water loss ~350 gal
	361		54						2-5% olivine phenocrysts dark reddish brown (5YR 3/2), 30-40% vesicles 1-3mm					
	362								very dark gray (5YR 3/1) 1. 70, J, N, Fe+Cl, Su-Sp, St, R 2. 5, J, MW, Cl, Sp, IR, VR 3. 5, J, MW, Fe, Su, IR, VR 4. 20, J, N, No, No, Wa, R			0.0	[100]	
	363													
	364		55						oxidized zone with 50% vesicles 0.5mm					Water loss ~350 gal
	365													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
365		73	55	100		48			becomes dark gray (5YR 4/1), fresh to slightly weathered, 25-30% 2-10mm vesicles 5. 20, J, T, Mn+Cl, Sp, Pl, R 6. 90, J, N, Mn+Cl, Sp, Pl, R 7. 70, J, VN, Mn+Cl, Sp, Wa, R					
366														Water loss ~350 gal
									40% vesicles 1-3mm					
367			56						8. 80-70, J, N, Mn+Cl, Sp, Wa, R 40% vesicles 1-3mm			0.0	[75]	
368									moderately weathered, moderately strong zone 1. 20, J, N, Cl, Sp, Pl, R 2. IF/0, J, MW, Fe+Cl, Su-Sp, Ir, R 3. 60, J, VN, Mn+Cl, Sp, St-Pl, SR-R 4. 5, J, T, Fe+Cl, Sp, Pl, R 5. 70, J, T, Fe, Su, Pl, R 6. 70, J, T, Fe, Su, Pl, R					
369														
370		74		100		76			vesicles grade to 3-10mm 40%vesicles 1-3mm					Water loss ~350 gal
371			57											
372									moderately weathered, weak					
373									becomes dark olive gray (5Y 3/3), moderately strong, 40% vesicles 1mm			0.0	[75]	
374			58						becomes dark gray (5YR 4/1) to reddish brown (2.5YR 4/4), moderately to slightly weathered, moderately strong to strong					
375		75		100		66			becomes dark gray (5YR 4/1), fresh to slightly weathered, strong 1. 10, J, N, Fe+Cl, Pa, St, VR 2. 10, J, MW, Cl, Pa, Ir, VR 25% vesicles 3-15mm 3. 5-10, J, N-MW, Cl, Pa, Ir, VR 4. 70, J, T, Fe+Mn, Su, St, VR 5. 0, J, VN, Fe+Mn, Su, Pl, R 6. 70, J, VN, Fe+Mn, Su, Pl, R 7. 5, J, N, Fe, Su, Ir, R					Water loss ~400 gal
376														
377			59						40% vesicles 1mm					
378									dusky red (10R 3/4), moderately weathered, weak to moderately strong, 40-50% vesicles 1-2mm black, contact alteration zone			0.0	[60]	
379									dusky red (2.5YR 3/2), slightly to moderately weathered, moderately strong to strong 1. 0, J, N, Fe, Su, Ir, R 2. 90, J, VN, Cl, Sp, St, R 3. 30, J, VN, Cl, Sp, Pl, R 4. 5, J, VN, Fe+Mn, St, R 5. 5, J, VN, Fe+Mn, Ir, R 6. 60, J, T, Cl, Sp, R intensely fractured zone has Fe surface stains on most surfaces					
380		76	60	100		68			dark gray (5YR 4/1), slightly weathered, strong					Water loss ~400 gal
381														

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
381	381						M IF		dusky red (10R 3/4), moderately weathered, weak					
382	382						M		becomes dark gray (5YR 4/1), slightly weathered, strong, 40-50% vesicles 1-3mm					
			61				1		1. 90, J, T, Cl, Sp, Wa, R			0.0	[100]	
383	383													
384	384						M		vesicles increase to 3-5mm					
385	385	77		100		92	2		2. M?, 45, J, VN, No, No, St, R 3. 30, J, VN, Fe+Mn, Su, Ir, R					Water loss ~450 gal
			62				3 M							
386	386													
387	387						M							
							1 M					0.0	[75]	
388	388								1. 2. 5, J, MW?, Fe, Su, Ir, R 3. 20, J, MW?, Fe, Su, Ir, R 4. 45, J, T, No, No, Wa, R 5. 45, J, ?, No, No, Wa, R 6. 30, J, N, No, No, Wa, R 7. 85, J, N-MW, No, No, Pl, R 8. 30, J, N, No, No, Wa, R 9. 0, J, T, No, No, Pl, R					
389	389		63				M 2 3 4 IF							
390	390	78		100		52	5 6 M 7 8							Water loss ~350 gal
391	391													
392	392						9 M IF		dark gray (5YR 4/1), dark reddish brown (2.5YR 3/3), brownish yellow (10YR 6/6) alteration zone					
												0.0	[37.5]	
393	393													
394	394		64						no recovery					
395	395	79		50		8								Water loss ~500 gal for first 4 feet, ~100 gal for last 1 foot
396	396								**BASALT a'a Clinker** Variably colored dark reddish brown (2.5YR 3/3), yellowish red (5YR 4/6), weak red (2.5YR 4/2),very dark gray (5YR 3/1), gray (7.5YR 5/1), 0.5-2" angular fragments with 30-50% vesicles 1-3mm in diameter, spherical and lenticular vesicles					
397	397						1		1. 20, J, MW, Mn, Su, Wa, SR					

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/9/2018 RHMW11

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
397									**BASALT Massive a'a** Very dark bluish gray (5PB 3/1), slightly weathered, strong, 15% lenticular vesicles 2-10mm 2. 45, J, MW, Mn, Su, Pl-Wa, SR 3. 45, J, MW, Mn, Su, Wa, R					
398												0.0	[30]	
399			65						1. 5, J, VN, Fe+Mn, Su, Wa, SR 2. 5, J, W?, Fe+Mn, Su, Wa, SR-S 3. 0, J, VN, Fe+Mn, Su, Ir, R 4. 70, J, T, Fe+Mn, Su, Pl, SR 5. 90, J, VN, Fe+Mn, Su, Wa-Drusy, SR-VR 6. 5, J, VN, Fe+Mn, Su, Wa, SR 7. 0, J, N, Uk+Fe+Mn, Fi-Su, Ir, R-S					
400		80		90		18			} voids with drusy texture					Water loss ~400 gal
401									8. 0, J, N, Uk+Fe+Mn, Fi-Su, Ir, R-S **BASALT a'a Clinker** Red (10R 4/8) with very dark bluish gray (5PB 3/1) clasts and very dusky red (5R 2.5/2) on fracture planes, moderately to highly weathered, extremely					
402							NR		} weak to moderately strong } no recovery					
403			66						**BASALT Massive a'a** Very dark bluish gray (5PB 3/1), slightly weathered, strong, 15% lenticular vesicles 2-10mm 1. 0, J, MW-N, Fe, Su, Ir, VR (a'a texture, possible contact) 2. 70, J, ?, Fe, Su, Pl, SR 3. 90, J, VN, Fe, Su, Pl, R 4. 0, J, MW, Fe+Mn, Su, Ir, R (drusy void) 5. 90, J, VN, Fe+Mn, Su, St, R 6. 20, J, MW?, Fe+Mn, Su, Wa, SR 7. 45, J, VN?, Fe+Mn, Su, Pl, SR 8. 20, J, VN?, Fe+Mn, Su, Wa, SR 9. 70, J, N, Fe+Mn, Su, Pl, SR 10. 45, J, ?, Fe+Mn, Su, Pl, SR 11. 20, J, ?, Fe+Mn+Cl, Pa, Wa, R			0.0	[37.5]	
404														
405		81		100		48								Water loss ~500 gal
406			67											
407														
408									1. 0, J, N, Cl, Sp, Ir, R 2. 20, J, T, Fe+Mn, Su, Pl, R **BASALT a'a Clinker** Red (10R 4/8) with very dark bluish gray (5PB 3/1), moderately weathered, moderately strong 1. clinker contact 2. 60, J, VN, Fe+Mn+Cl, Sp, Pl-St, SR-R 3. 60, J, N, Fe+Mn+Cl, Sp, Wa, R 4. 15, J, N-MW, Fe+Mn+Cl, Pa, Wa, R 5. 80, J, T, Fe+Mn, Su, Wa, R			0.0	[25]	
409														
410		82	68	60		10								Water loss ~750 gal
411							NR		} no recovery					
412									6. 0, J, VN, Fe+Mn, Su, Ir, R 7. 70, J, VN, Fe+Mn, Su, Pl, SR					
413			69						} no recovery			0.0	[37.5]	End of drilling 10/27/17; begin

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
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Log of Boring RHMW11

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
413	413															10/30/17
414	414						NR		no recovery							
415	415	83	69	52		8	IF		dusky red (10R 3/2) and dark gray (GLEY1 4/N), moderately to highly weathered, strong to moderately strong, sub-angular to sub-rounded fragments 1/4" to 2"							Water loss ~550 gal
416	416						IF M									
417	417						M IF IF									
418	418						1		**BASALT Massive a'a** Dark gray (GLEY1 4/N), fresh to slightly weathered, strong, 15% lenticular vesicles 1-10 mm					0.0	[50]	
419	419		70				3 2									
420	420	84		100		80	4									Water loss ~500 gal
421	421		71				M 5 6 7									
422	422															
423	423								no recovery					0.0	[27.3]	
424	424		72				1 M		1. 70, J, VN, Fe+Mn, Su, Wa, R 2. 60, J, VN, Fe+Mn, Su, Wa, SR 3. 5, J, VN, Fe+Mn, Su, IR, R 4. 5, J, VN, Fe+Mn, Su, Ir, R							
425	425	85		96		70	M 2 M									Water loss ~750 gal
426	426						M 3									
427	427		73				4 M									
428	428						1 2 IF		1. 70, J, VN, Fe+Mn, Su, Wa, SR-R 2. 0, J, N, No, No, Ir, R grades with weak red (10R 4/4) mottling, moderately weathered **BASALT a'a Clinker**					0.0	[25]	
429	429															

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Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
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Project Number: 60481245

Log of Boring RHMW11

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	429								Weak red (10R 4/4) with dark gray (GLEY1 4/N) mottling, moderately to highly weathered, strong, sub-angular fragments 1/4" to 3"							
	430	86	73	32		12										Water loss ~1000 gal
	431								no recovery							
	432															
								IF						0.0	[50]	
	433							1 M	**BASALT Pahoehoe** Very dark greenish gray (GLEY1 3/3), slightly weathered, strong, 25-30% vesicles 1-20mm							
	434		74						1. 90, J, W, Fe+Mn+Cl, Su-Sp, Pl, R 2. 5, J, MW, Fe+Mn, Su, IR, R ▼ 30% vesicles 1-3mm with occasional 20mm 3. 5, J, MW, Fe+Mn, Su, IR, R 4. 5, J, MW, Fe+Mn, Su, Ir-Pl, R							
	435	87		100		46		2 3 4	5. IF, J, ?, Fe+Mn, SU, Ir, R							Water loss ~500 gal
	436							5 IF	▼ becomes dark reddish brown (2.5YR 3/3), highly weathered, weak to moderately strong, 40% vesicles 1mm							
	437								▼ becomes very dark greenish gray (GLEY1 3/3), slightly weathered, strong, 30% vesicles 1-3mm							
			75					IF						0.0	[50]	
	438															
	439							1 M M 2 3	▼ grades with dark brown (7.5YR 3/4) weathered patches, moderately weathered, moderately strong to strong, 40% vesicles 1-3mm 1. 70, J, T, No, No, Pl, R 2. 45, J, VN, No, No, Wa, R 3. IF, ?, Fe+Mn, Su, Ir, R							
	440	88		100		22		IF 4 M 6 M 5	4. 70, VN, Fe+Mn, Su, Wa, Pl, R 5. 20-45, J, VN, Fe+Mn, Su, Wa, R 6. 45, J, VN, Fe+Mn, Su, Wa, R							Water loss ~600 gal
	441		76													
	442							IF M	**BASALT Massive a'a** Very dark greenish gray (GLEY1 3/3) with dark reddish brown (2.5YR 3/3) oxidation, moderately weathered, moderately strong to strong, 25% vesicles 3-10mm, most lenticular							
														0.0	[37.5]	
	443							1 2 3 4	▼ becomes dark gray (GLEY1 4/4), slightly weathered, strong, 25% lenticular vesicles 3-10 mm 1. 90, J, N?, Fe+Mn, Su, IR, R (IF along joint) 2. 45. J. MW?, Fe+Mn, Su, IR, R (IF along joint) 3. 4. 70, J, MW, Fe+Mn, Su, Wa, R 5. 10, J, VN, Cl, Pa, Ir, R							
	444		77					5 M	▼ 10-15% vesicles, most spherical 6. 30, J, N, Fe+Mn, Su, Ir, R							Water loss ~700 gal
	445															

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Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO53
Project Number: 60481245

Log of Boring RHMW11

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
445		89		100		56	6 7 M 8 9 10		7. 70, J, N, Fe+Mn+Cl, Pa, Pl, SR 25% lenticular vesicles 2-5mm 8. 60, J, MW?, No, No, Wa, R (IF along fracture) 30% vesicles 1-3mm, most spherical 9. 60, J, MW?, No, No, Wa, R (IF along fracture) 10. 45, J, VN, No, No, Pl, R					
446			77											
447														
448			78				1 2 3 M		becomes 15-20% vesicles 0.5-1mm 1. 45, J, N, No, No, Wa, R 2. 50, J, VN, Fe+Mn, Su, St, R 3. 60, J, VN, Fe+Mn, Su, Wa, R 4. 70, J, VN-N, Fe+Mn, Su, Wa, R			0.0	[37.5]	
449														
450		90		100		50	4 M		becomes 25% vesicles 2-20mm					Water loss ~700 gal
451			79				IF		**BASALT a'a Clinker** Very dark gray (GLEY1 3/N), moderately to highly weathered, weak to moderately strong, sub-angular to angular, coarse sand (2.5") size fragments					
452							IF							
453							NR M		no recovery			0.0	[21.4]	
454							M 1 IF		**BASALT Massive a'a** Very dark gray (GLEY1 3/N), slightly to moderately weathered, strong, 30% lenticular vesicles 1-5mm becomes red (10R 4/6), moderately weathered, moderately strong to strong, 25% vesicles 1-10mm 1. flow contact 2. 20, J, VN, Fe+Mn, Su, Pl, SR 3. 70, J, VN, Fe+Mn, Su, Wa, R					
455		91		86		20	IF		becomes dark gray (GLEY1 4/4), slightly weathered, strong, 25% lenticualr vesicles 1-10mm					Water loss ~1100 gal
456			80				M							
457							2 3 M							
458							M 1 2 3 M		1. 90, J, VN, Fe+Mn, Su, Wa, R 2. 0, J, VN, Fe+Mn, Su, Ir, R 3. 0, J, MW, Fe+Mn, Su, Ir, R 4. 20, J, T, Fe+Mn, Su, Ir, R 5. 20, J, VN-MW, Fe+Mn, Su, Ir, R			0.0	[37.5]	
459							M 4		occasional vesicle voids up to 40mm					
460		92	81	100		48	5 M 6 M 7		6. 90, J, N, No, No, Ir, R 7. 90, J, VN, Fe+Mn, Su, Pl-Ir, R					Water loss ~700 gal
461														

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
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Log of Boring RHMW11

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
461									8. 70, J, VN, Fe+Mn, Su, Pl, SR-S 9. 20, J, VN, Fe+Mn, Su, Pl, SR-S							
462																
463									becomes moderately weathered with dusky red (10R 3/3) mottling					0.0	[42.9]	End of drilling 10/30/17; begin 10/31/17
464									**BASALT a'a Clinker** Dusky red (10R 3/3) with very dark gray (GLEY1 3/N) mottling, highly to moderately weathered, strong, 1/4" to 1" subangular to angular fragments							
465		93	82	62		28	NR		no recovery							Water loss ~700 gal
466									**BASALT Massive a'a** Very dark gray (GLEY1 3/N) with dusky red (10R 3/3) mottling, moderately weathered, strong, 25% lenticular vesicles 1-5mm							
467							NR		no recovery							
468									**BASALT a'a Clinker** Very dark gray (GLEY1 3/N) with dusky red (10R 3/3) mottling, moderately to highly weathered, strong, 1" subrounded fragments 1. 30, J, N, Fe+Mn, Su, Pl, SR-R 2. 50, J, VN, Fe+Mn, Su, Ir, R					0.0	[27.3]	
469			83						**BASALT Massive a'a** Very dark gray (GLEY1 3/N) with dark reddish gray (5R 3/1) mottling, moderately weathered, strong, 25% lenticular vesicles 1-5mm							
470		94		100		30			becomes dark gray (GLEY1 4/N), slightly weathered, 15% lenticular vesicles 1-5mm 1. 30, J, N-MW, Fe+Mn, Su, Ir, VR 2. 80-90, MW, Fe+Mn, Su, Ir-Wa, VR 3. 70, J, VN, Fe+Mn, Su, Pl-Wa, SR 4. 50, J, VN, Fe+Mn, Su, Pl, Wa, SR 5. 45, J, VN, Fe+Mn, Su, Ir, R 6. 20, J, VN, Fe+Mn, Su, Pl, SR 7. 70-90, J, MW-VN, Fe+Mn, Su, Wa, SR 8. 10, J, T, Fe, Su, Pl, SR							Water loss ~650 gal
471																
472																
473			84						1. mechanical break 2. mechanical break 3. 5-20, J, N, Fe+Mn, Su, IR, VR (drusy void) 4. 60, J, T, Fe+Mn, Su, Pl, SR-S 5. mechanical break					"	[30]	
474																
475		95		82		52			becomes dark gray (GLEY1 4/N) with dark reddish gray (5R 3/1) mottling 6. 90, J, N, Fe+Mn, Su, Ir, SR-S 7. 10, J, T, Fe+Mn, Su, Pl, St, SR-S							Water loss ~650 gal
476			85													
477							NR		**BASALT a'a Clinker**							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO53 RED HILL CORE LOGS.GPJ; 2/9/2018 RHMW11

Project: CTO53 - Red Hill Bulk Fuel Storage Facilty
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Log of Boring RHMW11

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
477							NR		no recovery					
478			85						no recovery			-	[25]	
479							NR							
480		96		64		64	IF		Dusky red (7.5R 3/3), dark brown (7.5YR 3/8), very dark gray (GLEY1 3/N) and dark gray (GLEY1 4/N), moderately to highly weathered, strong, 1/4" to 2" size, subrounded to subangular fragments					Water loss ~1000 gal
481							M		**BASALT Massive a'a** Dark gray (GLEY1 4/N) with occasional dusky red (7.5R3/3) mottling, moderately to slightly weathered, strong, 25% lenticular vesicles 1-5mm					
482			86				1 2		1. 45, J, VN, Fe+Mn, Su, PI, SR 2. 30, J, VN, Fe+Mn, Su, Wa, SR-R					
483							1 M		becomes dark gray (GLEY1 4/N), lenticular vesicles 1-20mm			-	[25]	
484							M							
485		97		100		100	M M		1. 0, J, VN, Fe+Mn, Su, Ir, R 2. 90, J, VN, Fe+Mn, Su, Ir, R					Water loss ~1200 gal
486			87				M 1 2		3. 70, J, VN, Fe+Mn, Su, Wa, SR 4. 80, J, VN, Fe+Mn, Su, Wa, SR-R					
487							M M 3 4							
488							IF		**BASALT a'a Clinker** Dark gray (GLEY1 4/N) with abundant dark reddish gray (5R 3/1) weak weathered areas, highly weathered, very weak to moderately strong 1. 70, J, N, Fe, Su-Pa, Ir, R 2. 60, J, N, Fe, Su-Pa, Ir, R			-	[23.1]	
489							1		**BASALT Massive a'a** Dark gray (GLEY1 4/N), moderately weathered strong, 30% vesicles 1-2mm, fractures are dark reddish gray (5R 3/1), highly weathered, very weak to weak					
490		98	88	76		0	M 2 IF		**BASALT a'a Clinker** Dark reddish gray (5R 3/1) with dark gray (GLEY1 4/N) mottling, highly weathered, very weak to weak					Water loss ~2000 gal
491							NR		no recovery					
492							3 4		**BASALT Pahoehoe** Dusky red (10R 3/2), moderately weathered, weak to moderately strong, 40% spherical vesicles 0.5-2mm 3. 80, J, T, No, No, Wa, R 4. 60, J, T, No, No, Wa, R					
493														

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Log of Boring RHMW11

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
493								Bottom of Boring; TD = 492.5 ft bgs							
494								Used a total of approximately 27,140 gallons of circulation water. Airknife from 0-20 ft bgs. Installed 16 1/4" steel casing to 20 ft bgs. Drill with 8" O.D. HSA from 22.5 ft bgs to 50 ft bgs. HQ core from 50 ft bgs to 210 ft bgs. Hole reamed to 15 1/2 inches from 42.7-75 ft bgs. Installed 10" steel casing to 75 ft bgs. Hole reamed to 9 1/2" from 75-165 ft bgs. Installed 5" steel casing to 165 ft bgs. PQ core from 210 ft bgs to 492.5 ft bgs. Installed Westbay MP38 multi-level well with 8 isolated sampling zones.							
495															
496															
497															
498															
499															
500															
501															
502															
503															
504															
505															
506															
507															
508															
509															

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GEOPHYSICAL RECORD OF BOREHOLE: RHMWW11

Geophysical Investigation at RHSF

AECOM

Project Number: 60481245

Client: NA

Date: January 31,2018

Datum: NA
Easting:E (b) (3) (A)
Northing:N (b) (3) (A)
Ground Elev msl: 230 ft

Depth Reference "0" at TOC
Drilling Method Air Rotary
Borehole Size: HQ/PQ diamond bit / 9.5" tricone bit
Drilled Depth: 492.5 ft

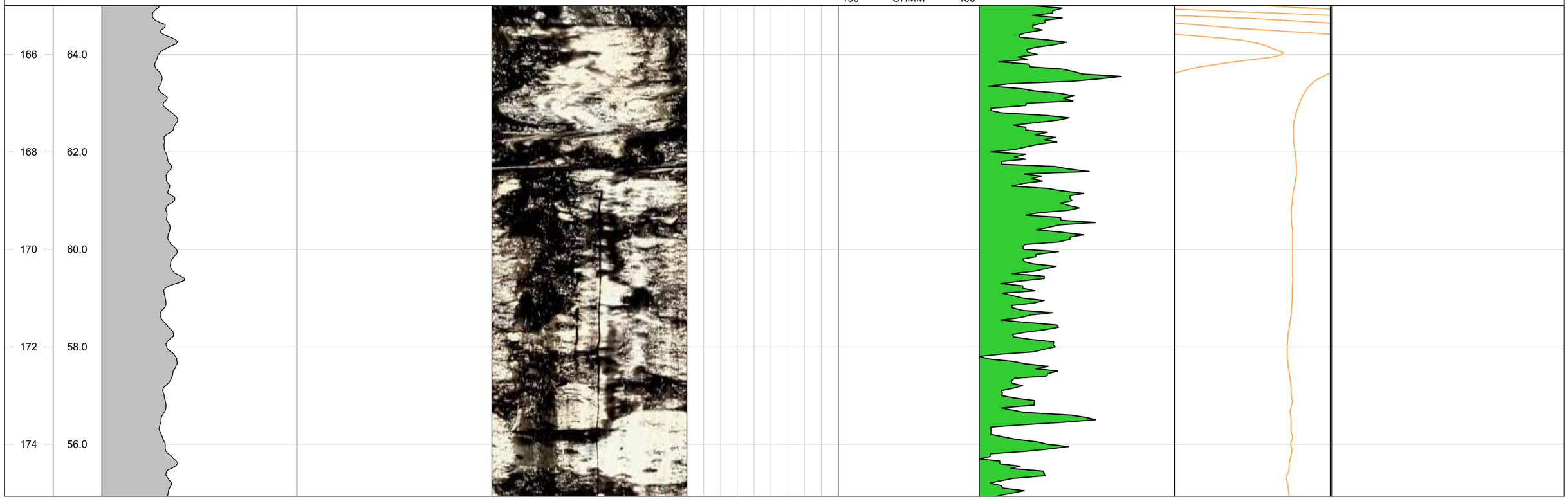
Drill Comp Date: 11/2017
Casing Stick-up: NA
Casing Diameter: NA
Casing Depth: NA

Location: Halawa Heights, HI
Log Date: 11/2017
Logged By: (b) (6)

1 - Major Open Joint / Fracture
2 - Minor Open Joint / Fracture
3 - Partially Open Joint / Fracture
5 - Bedding / Banding / Foliation

Notes:
Water Level: NA

Depth 1in:2ft
Elevation
Caliper 3 inch 12.5
Amplitude-NM 0° 90° 180° 270° 0°
Image-NM 0° 90° 180° 270° 0°
Tadpole 0 90
Short Normal Resistivity 300 OHMM 800
Gamma 0 CPS 20
SPR 400 OHM 1000
Temperature 11.5 DegC 12.5
Self Potential 50 mV 250
Conductivity 100 mS/m 300
FCond 700 uScm 900
Long Normal Resistivity 100 OHMM 400



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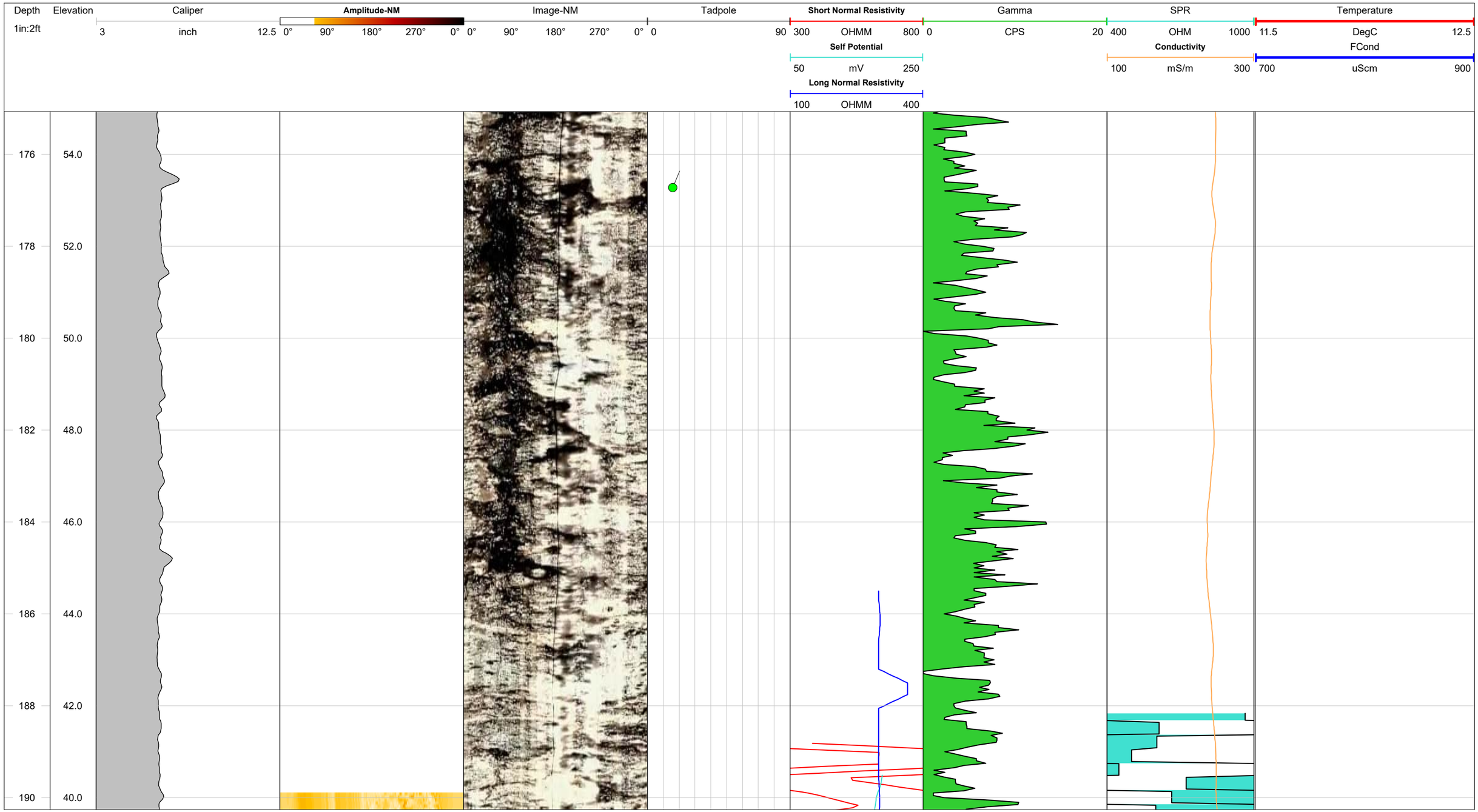

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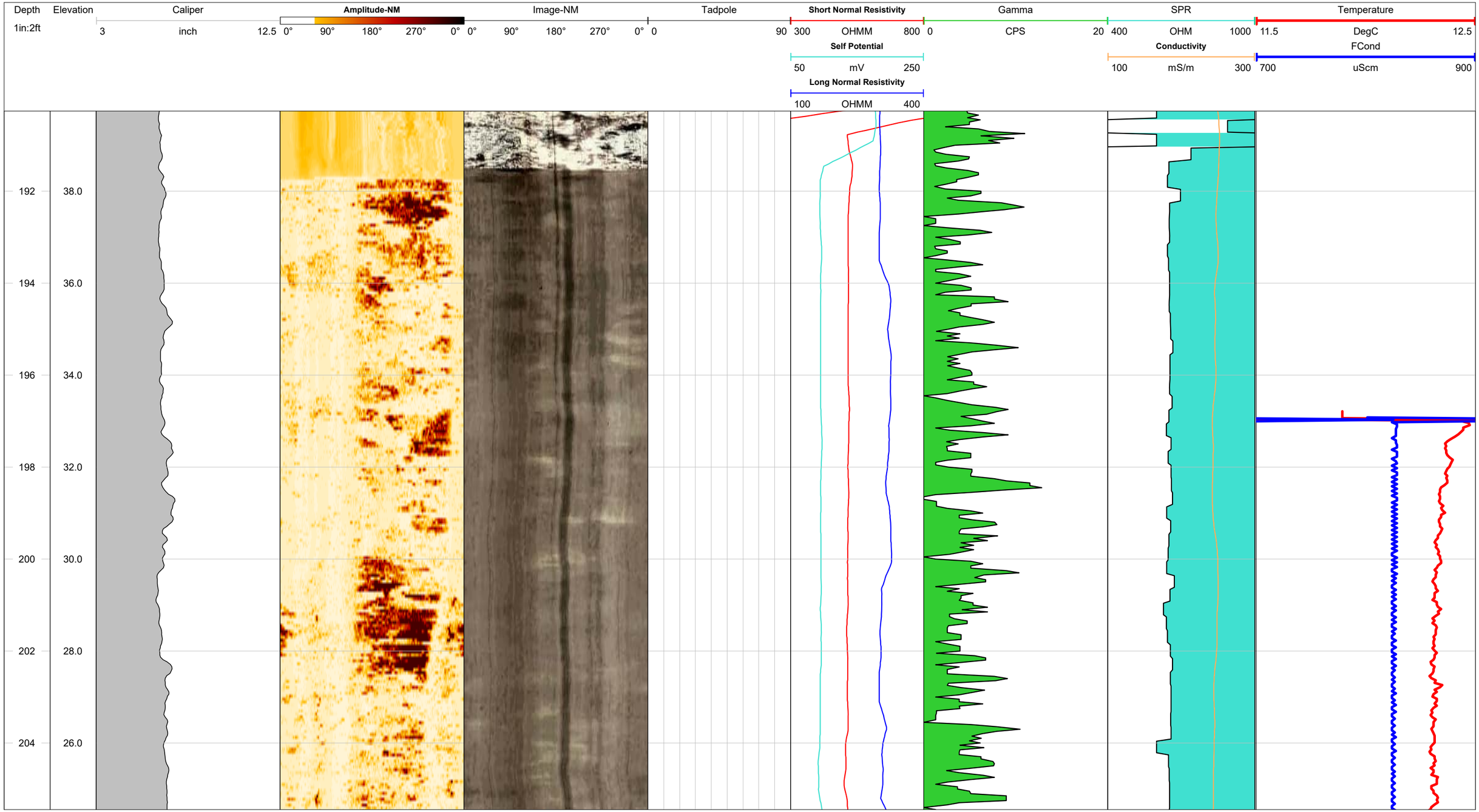

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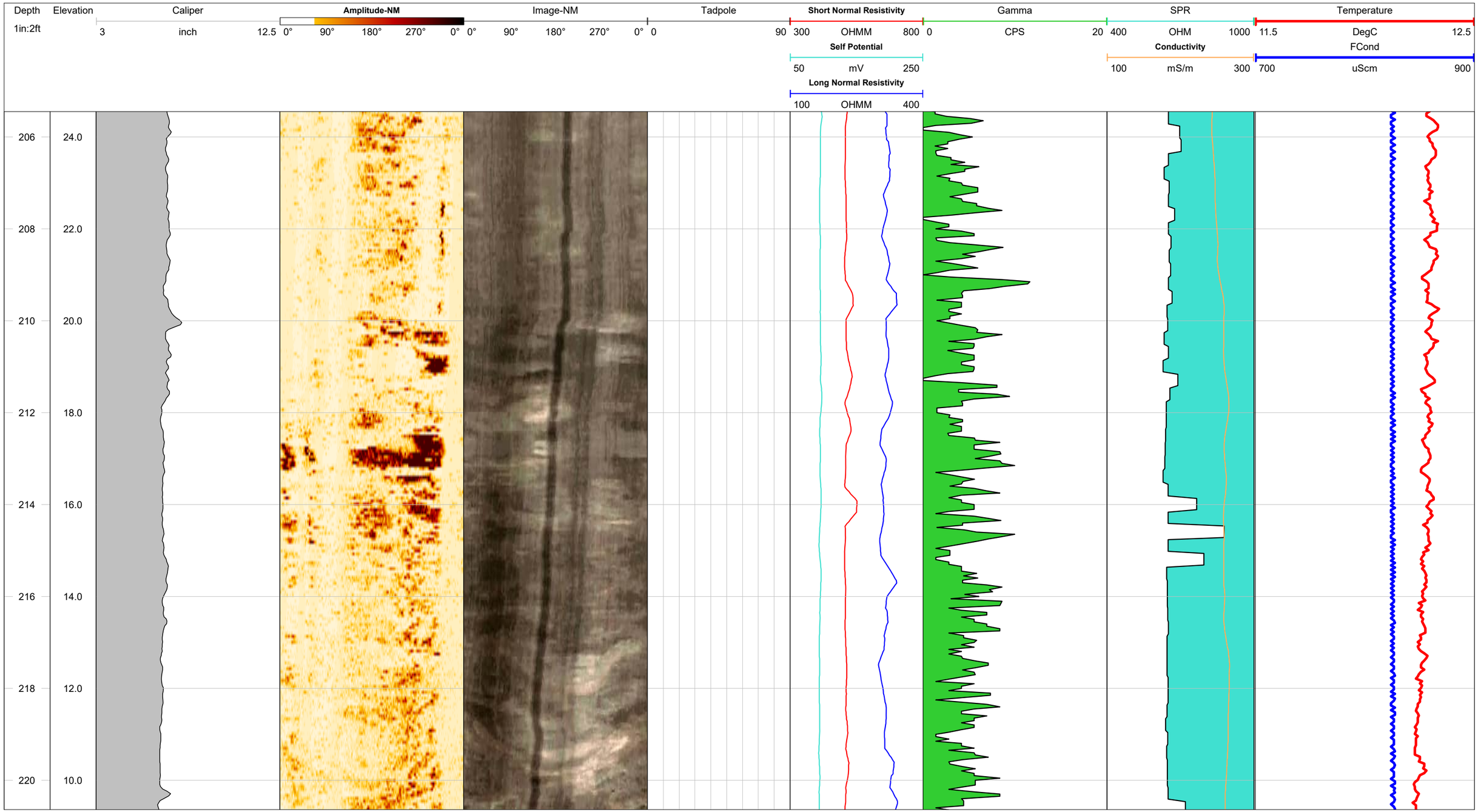

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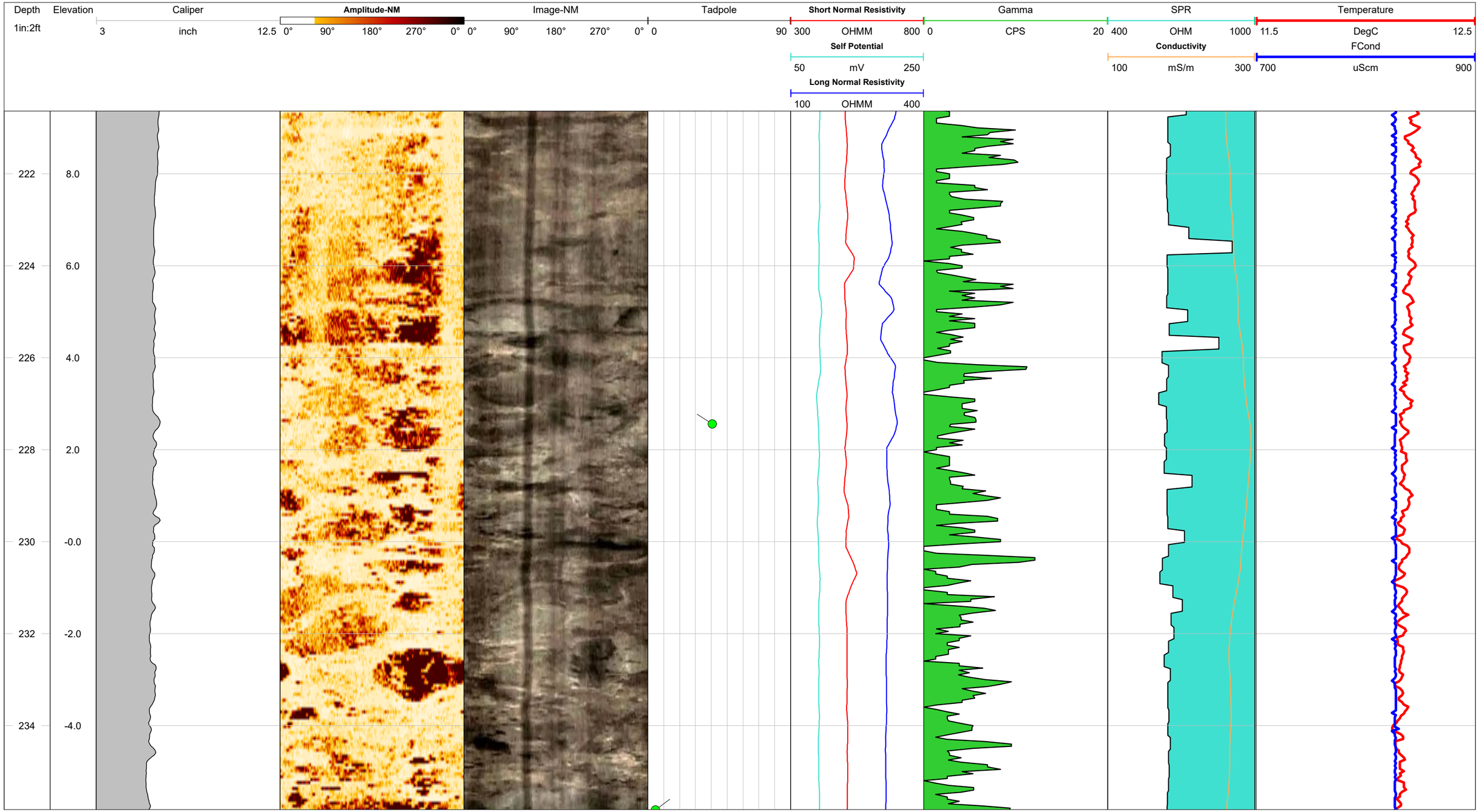

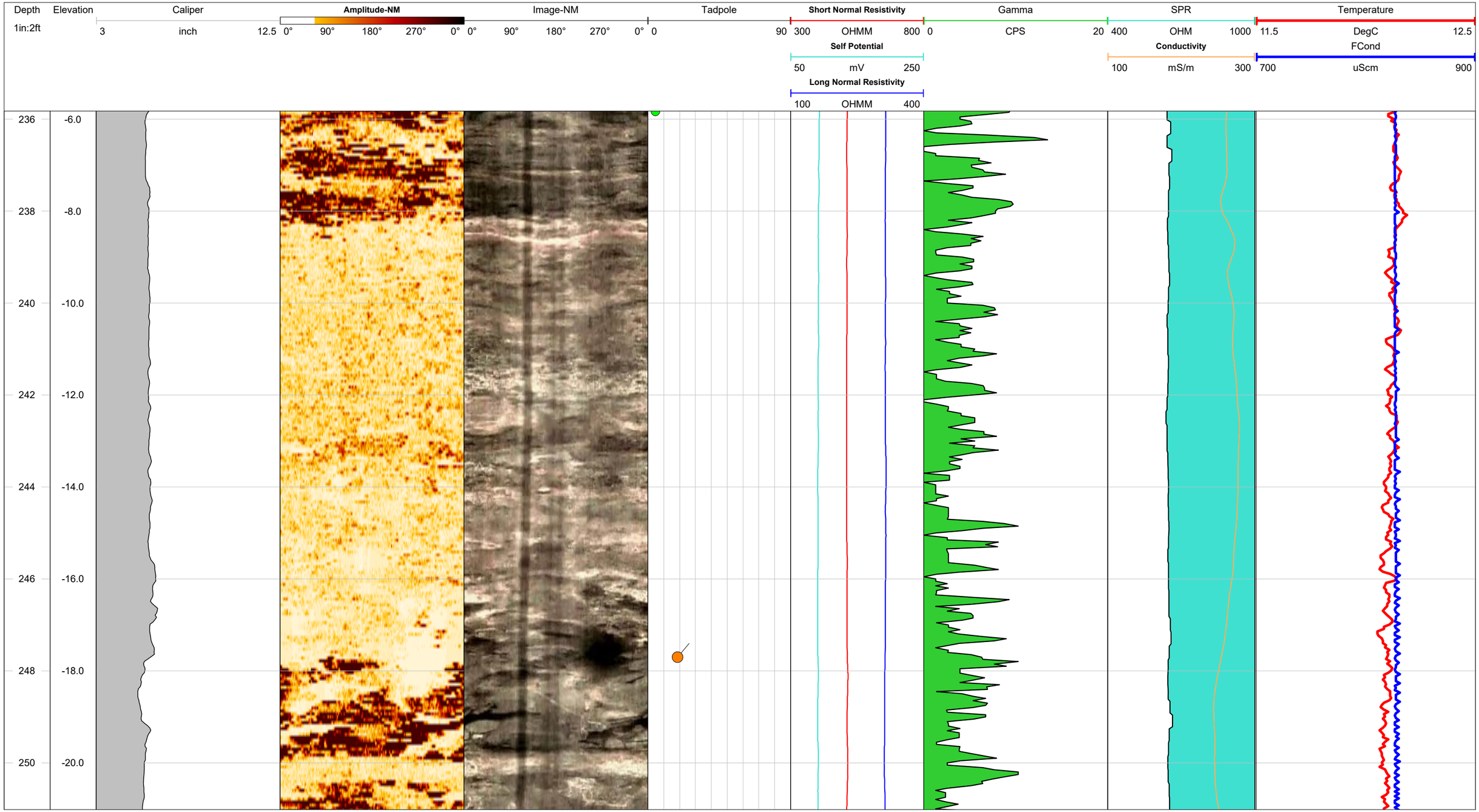

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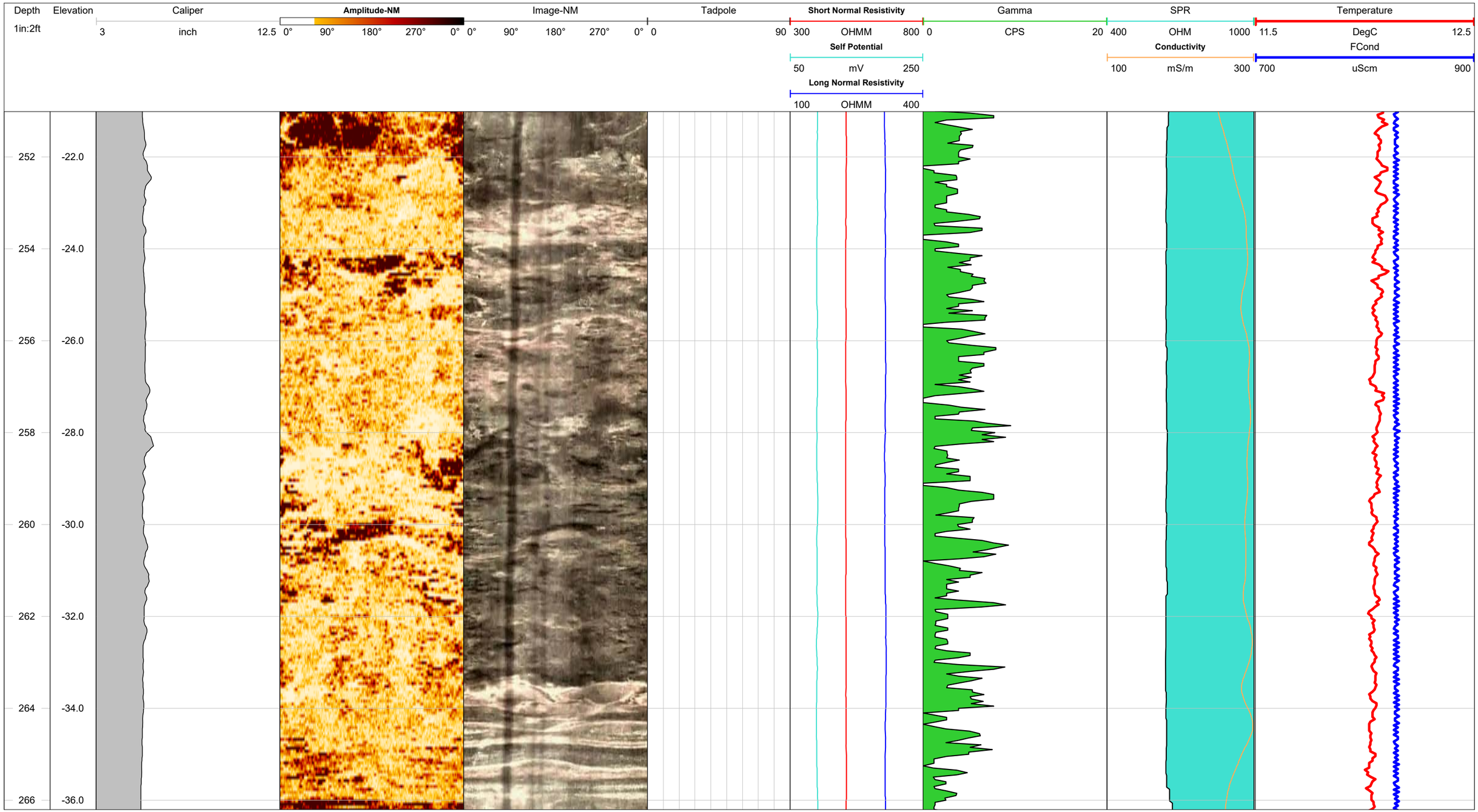

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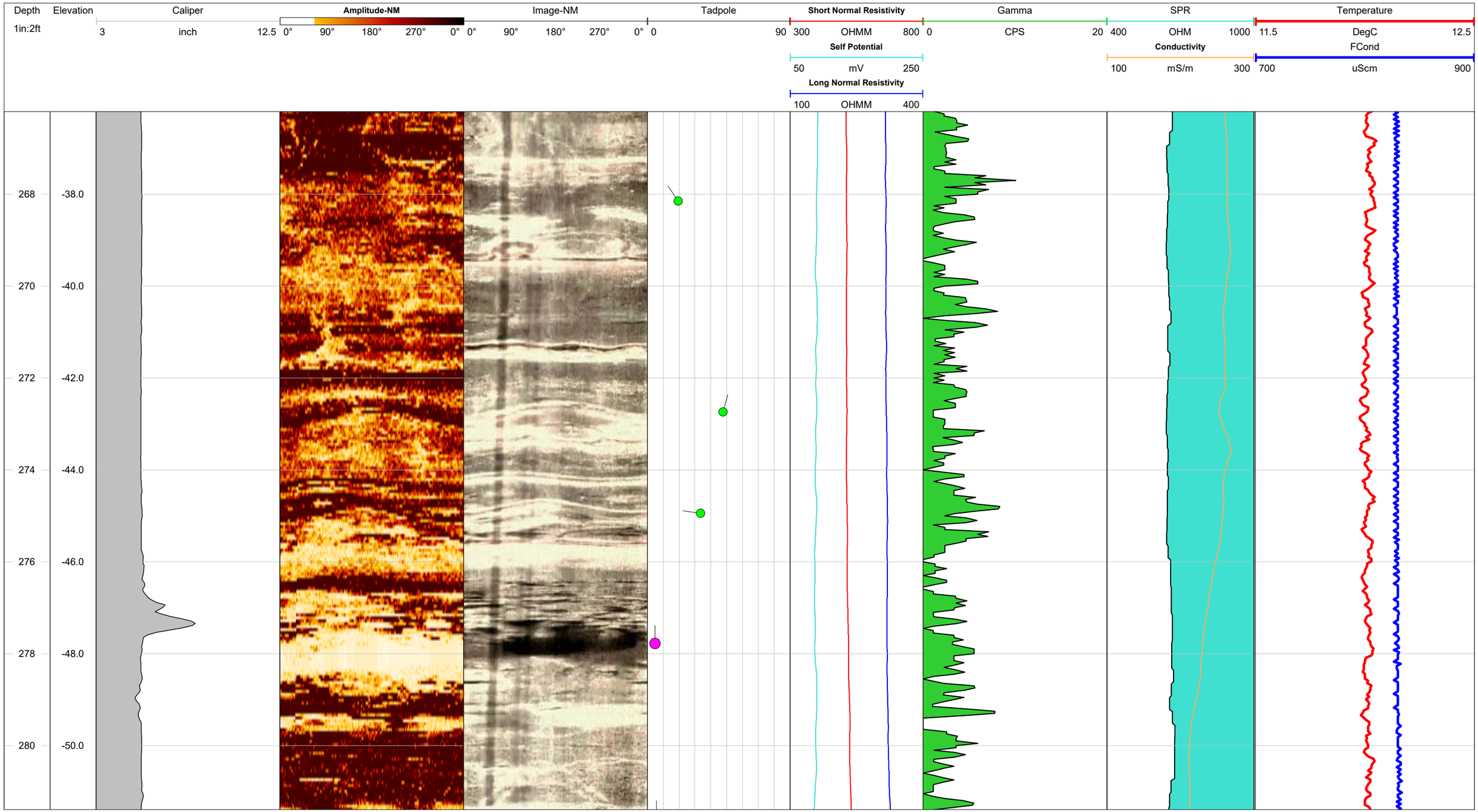

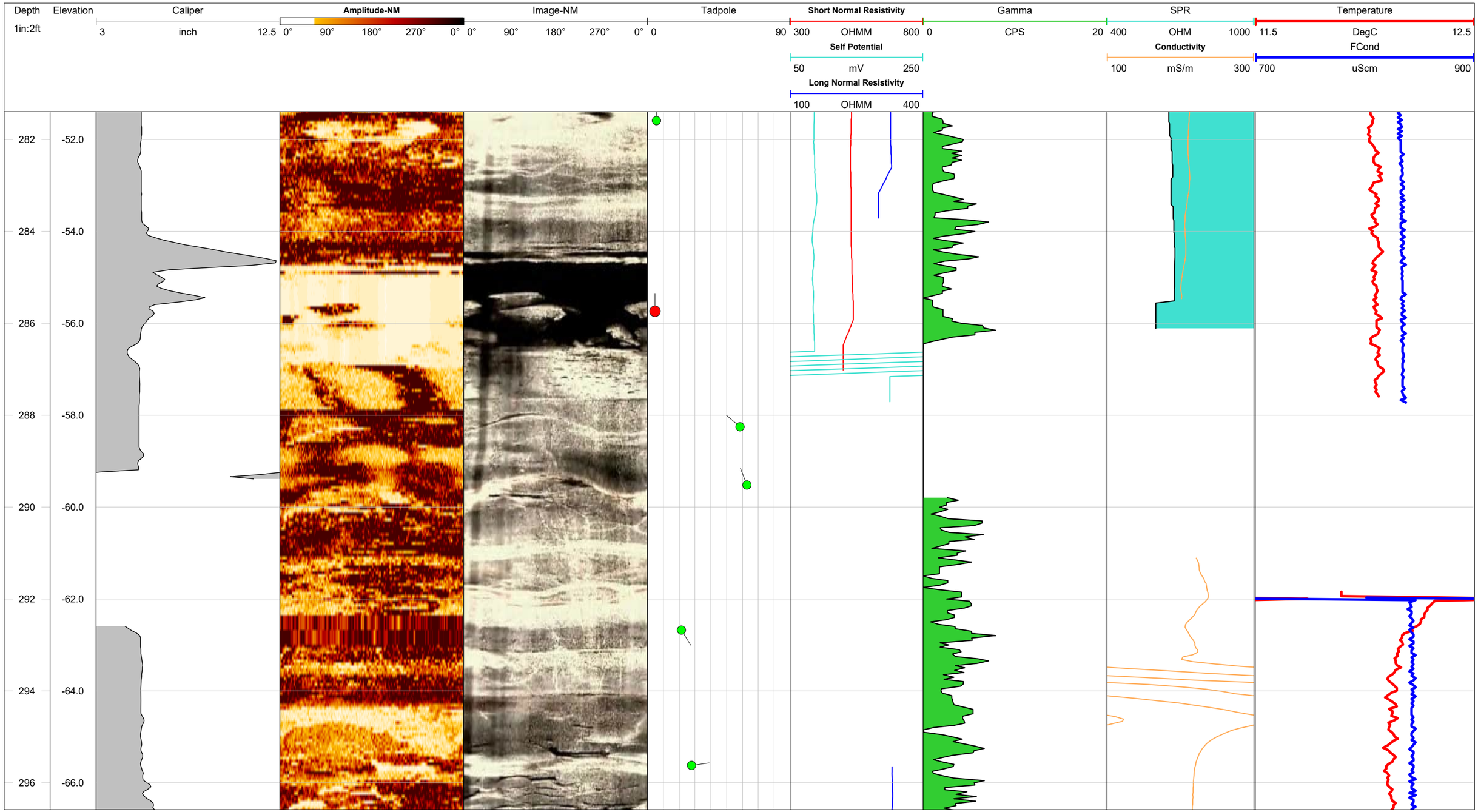

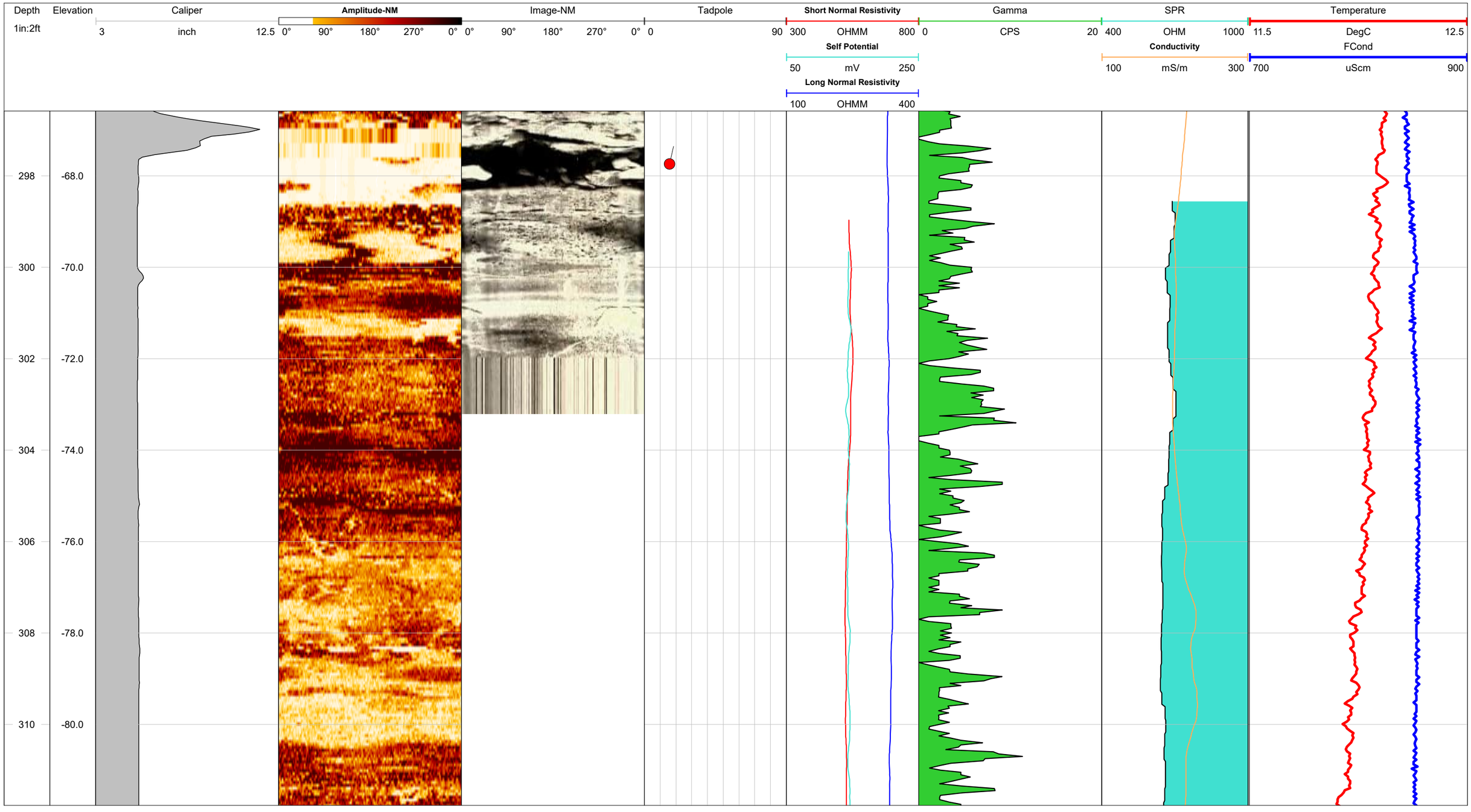

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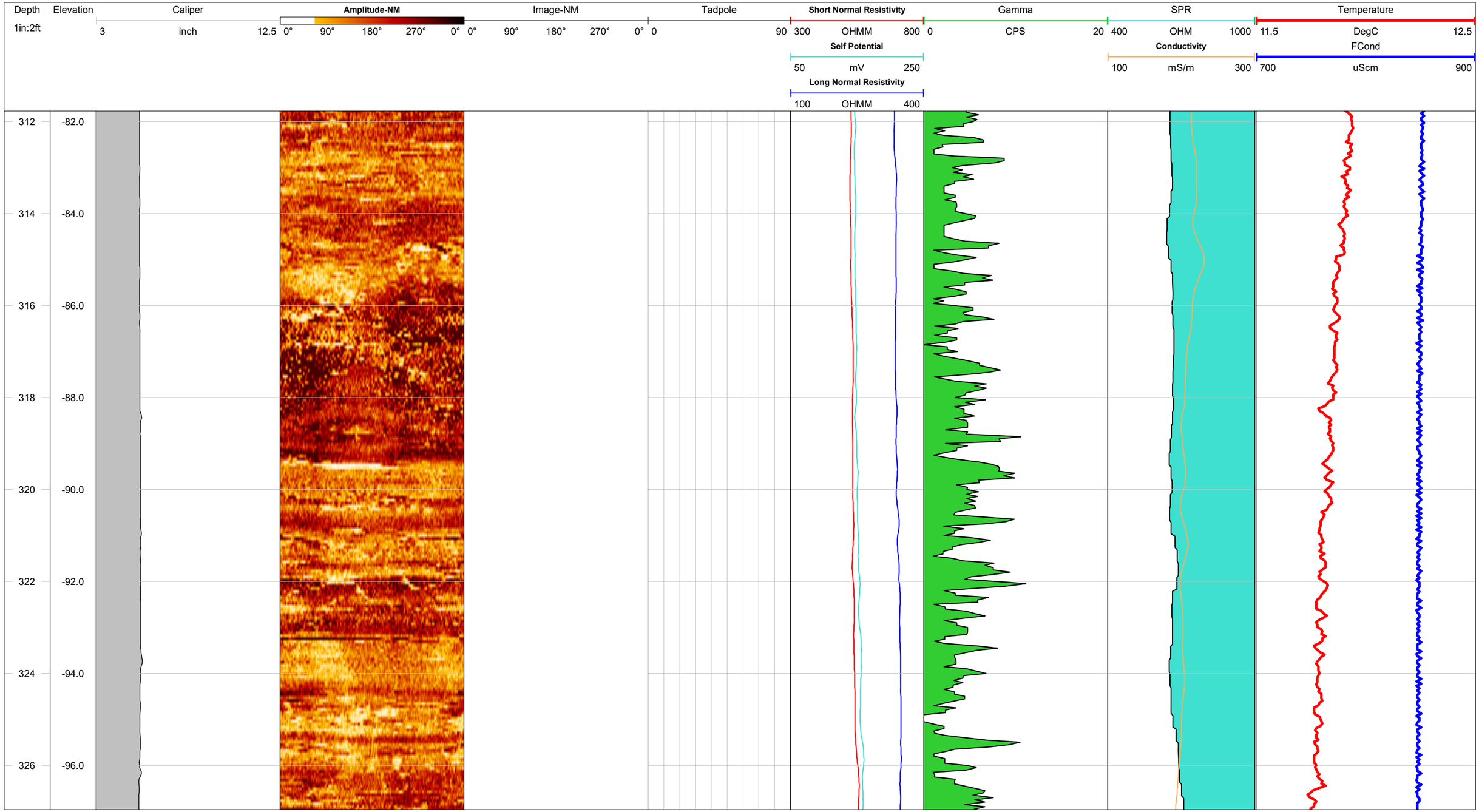

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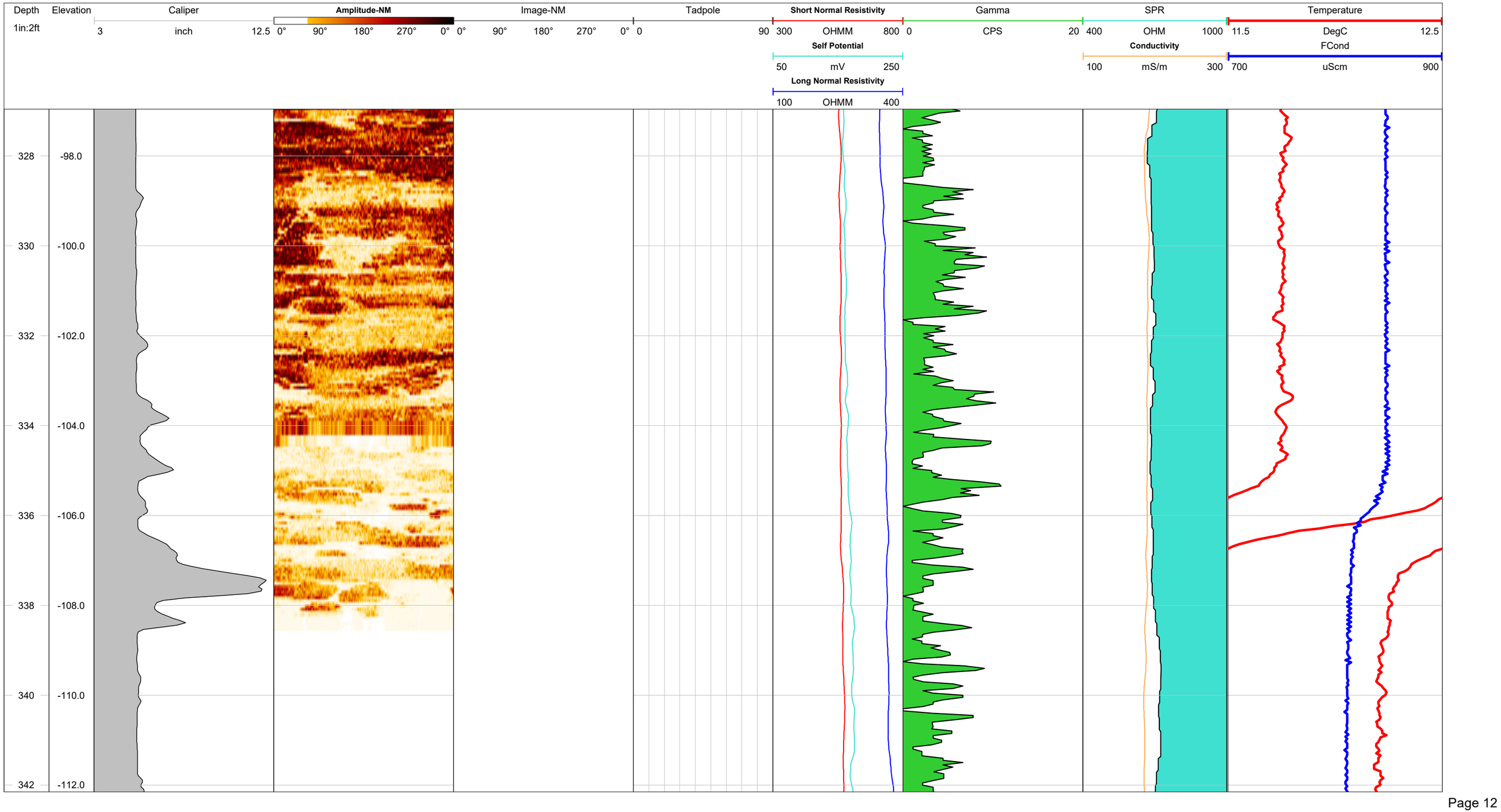

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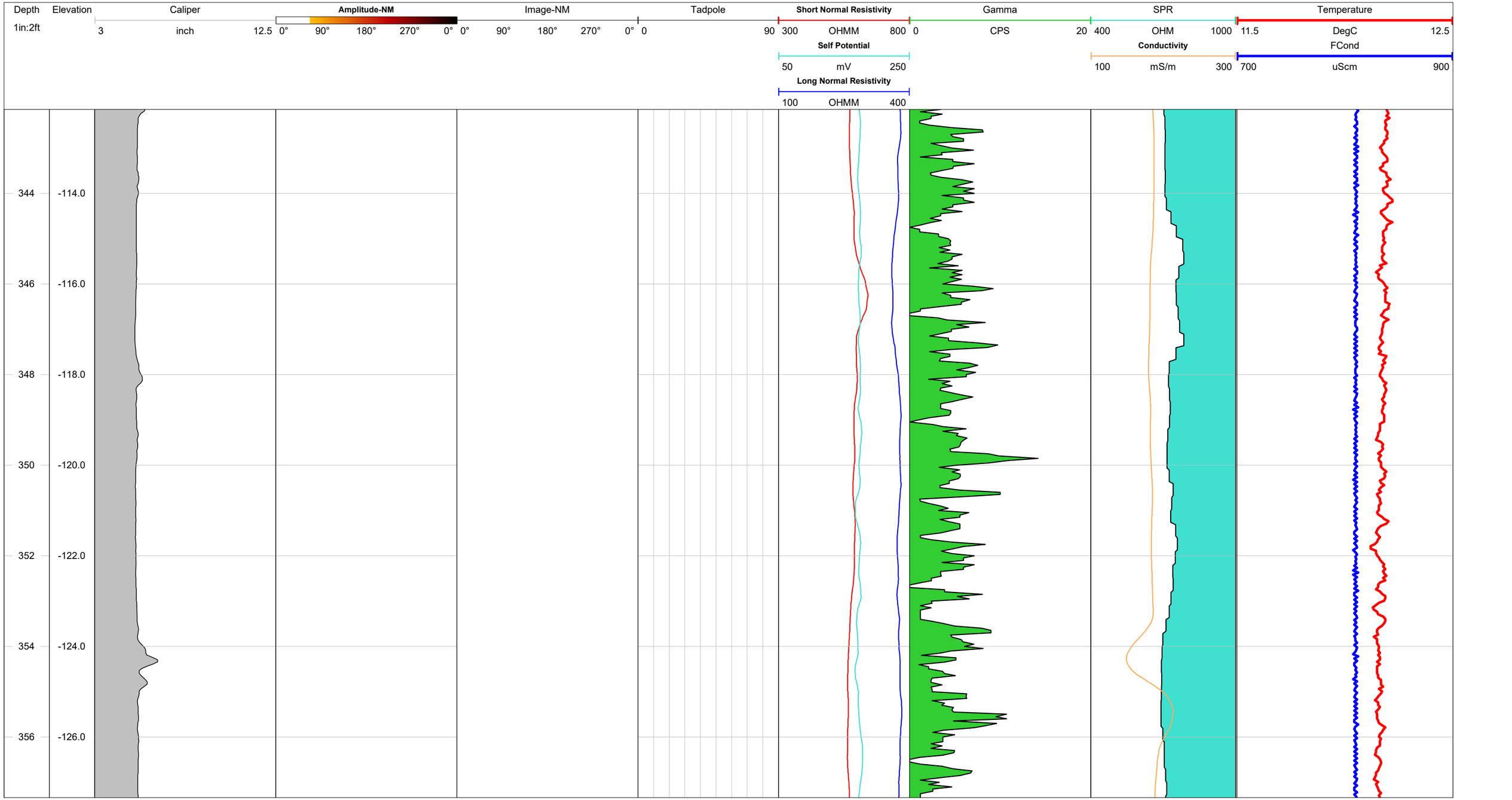

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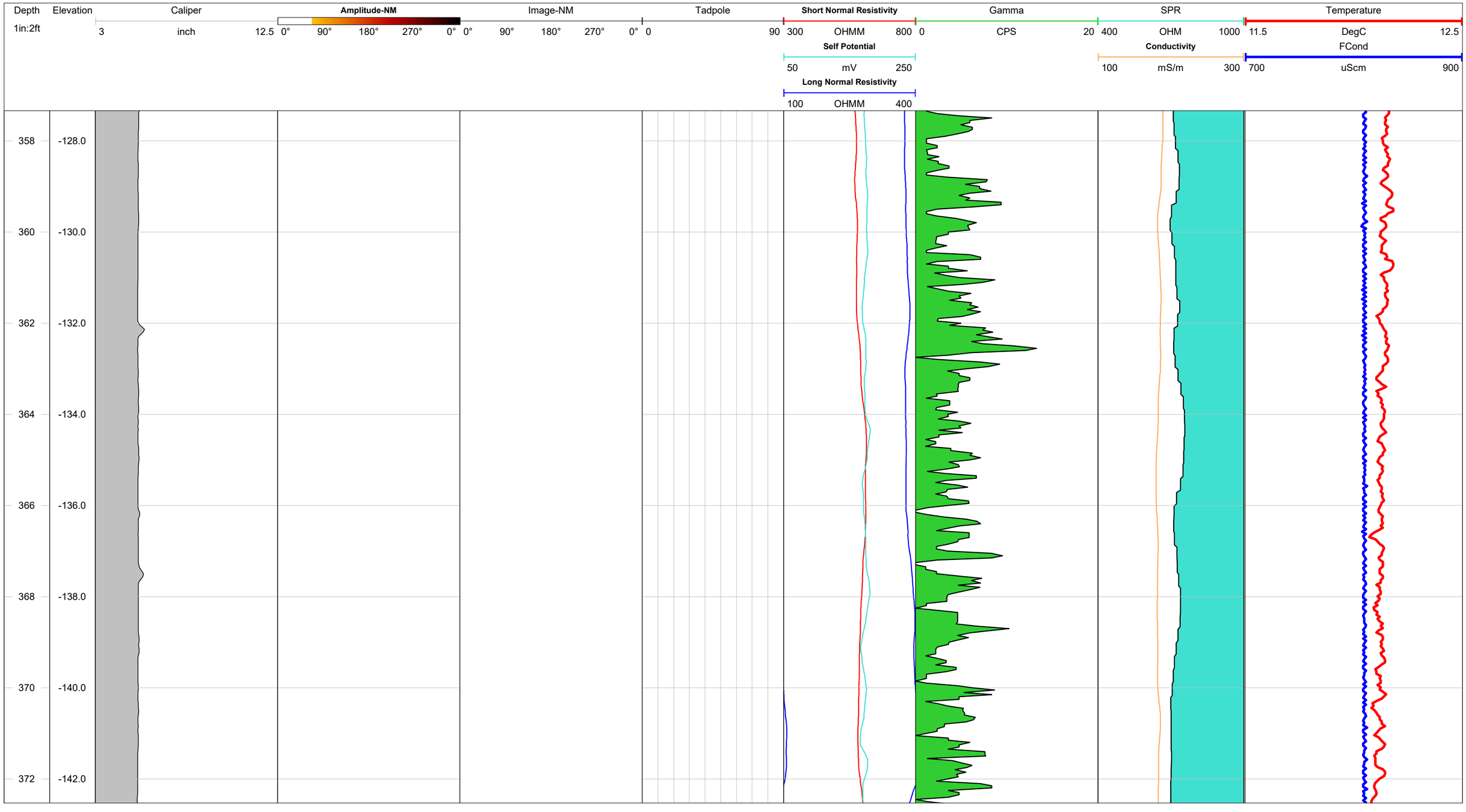

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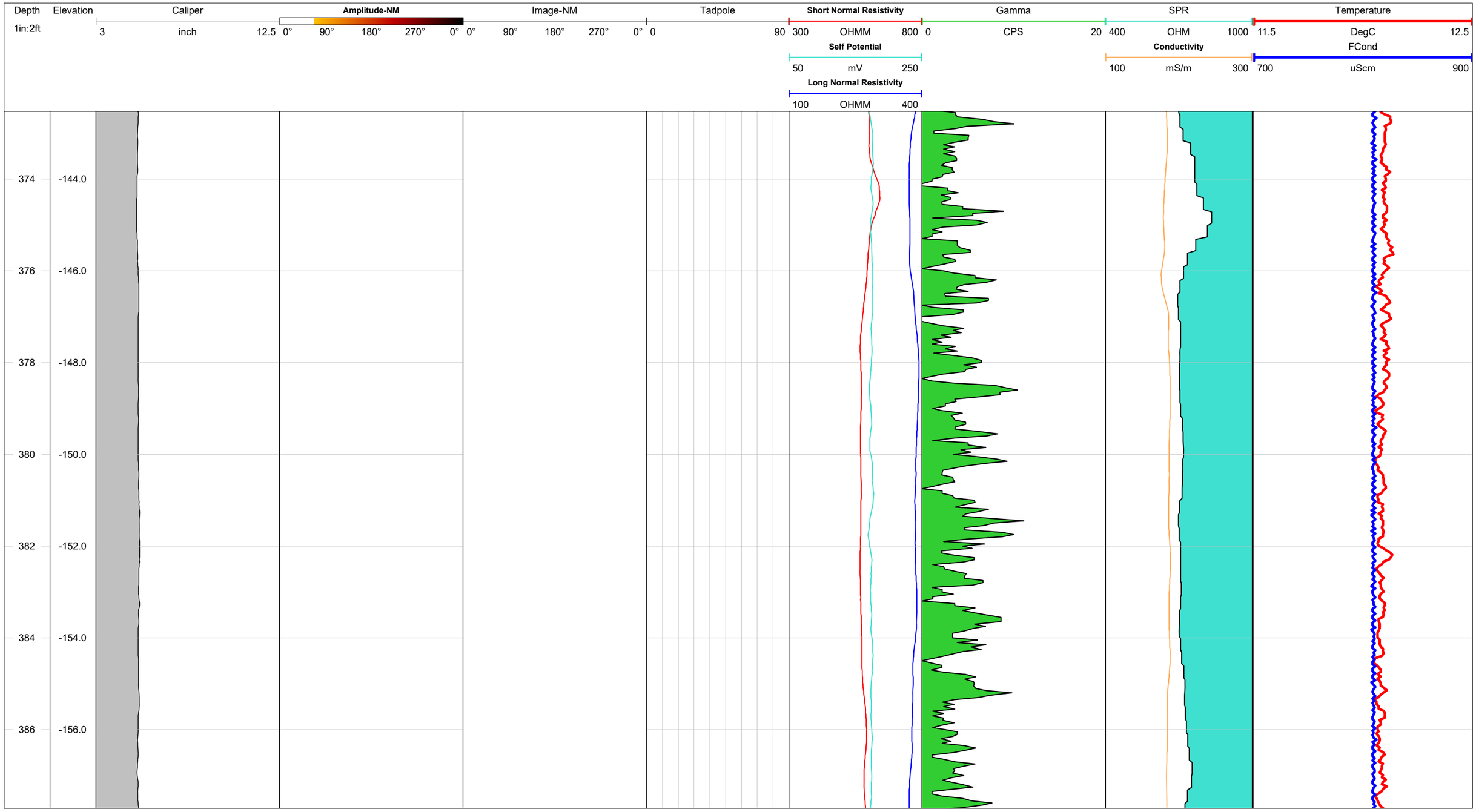

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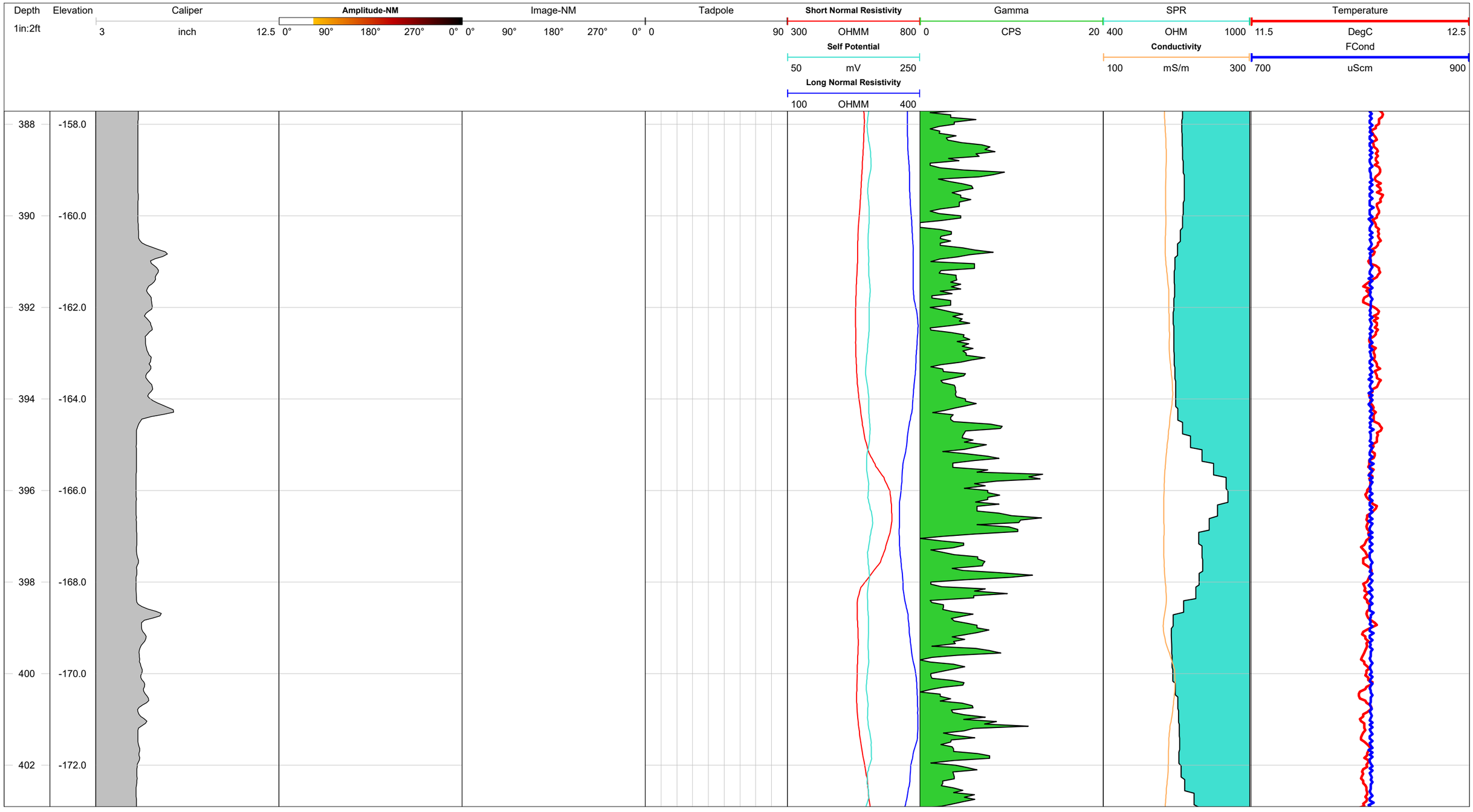

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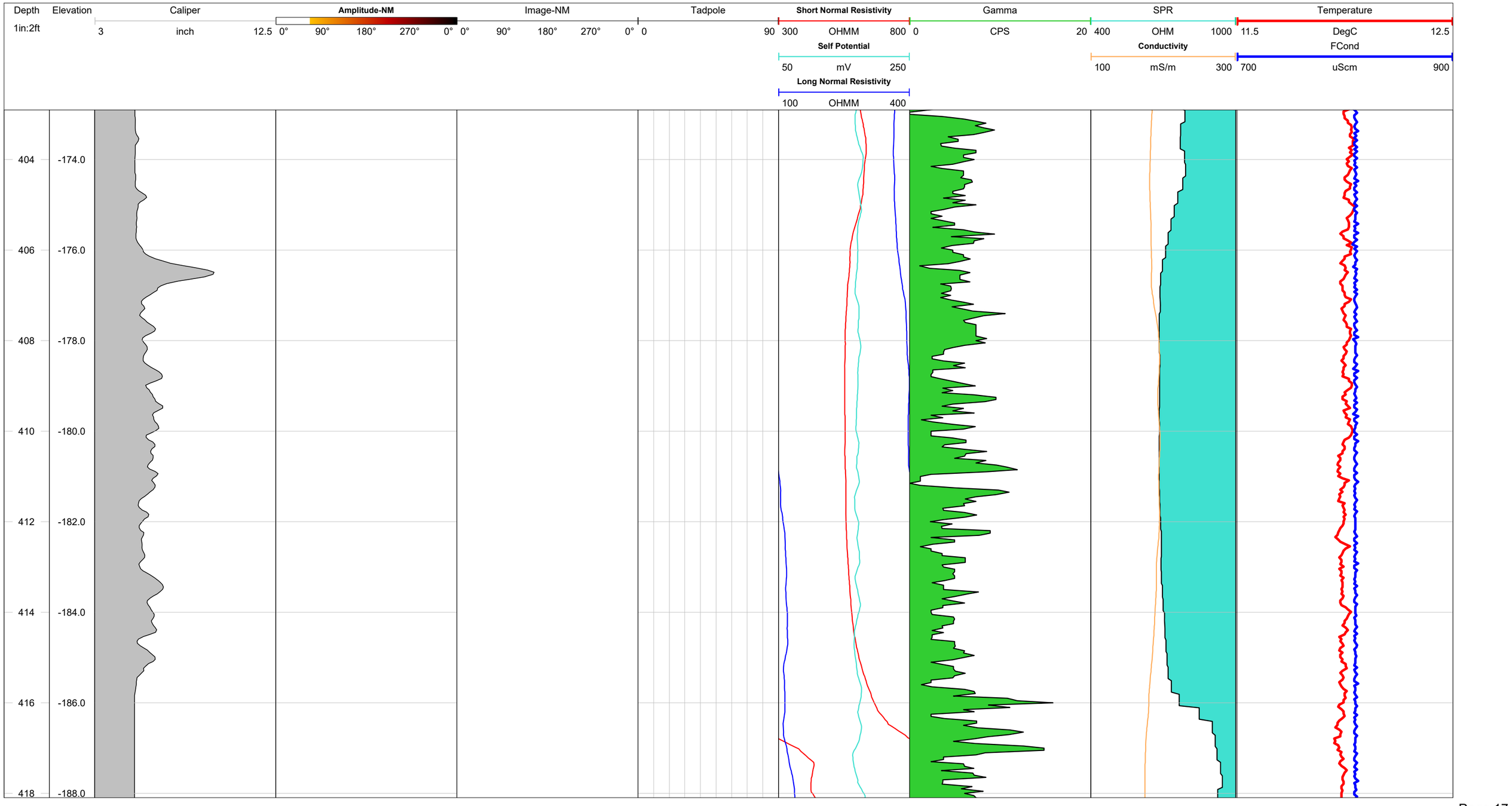

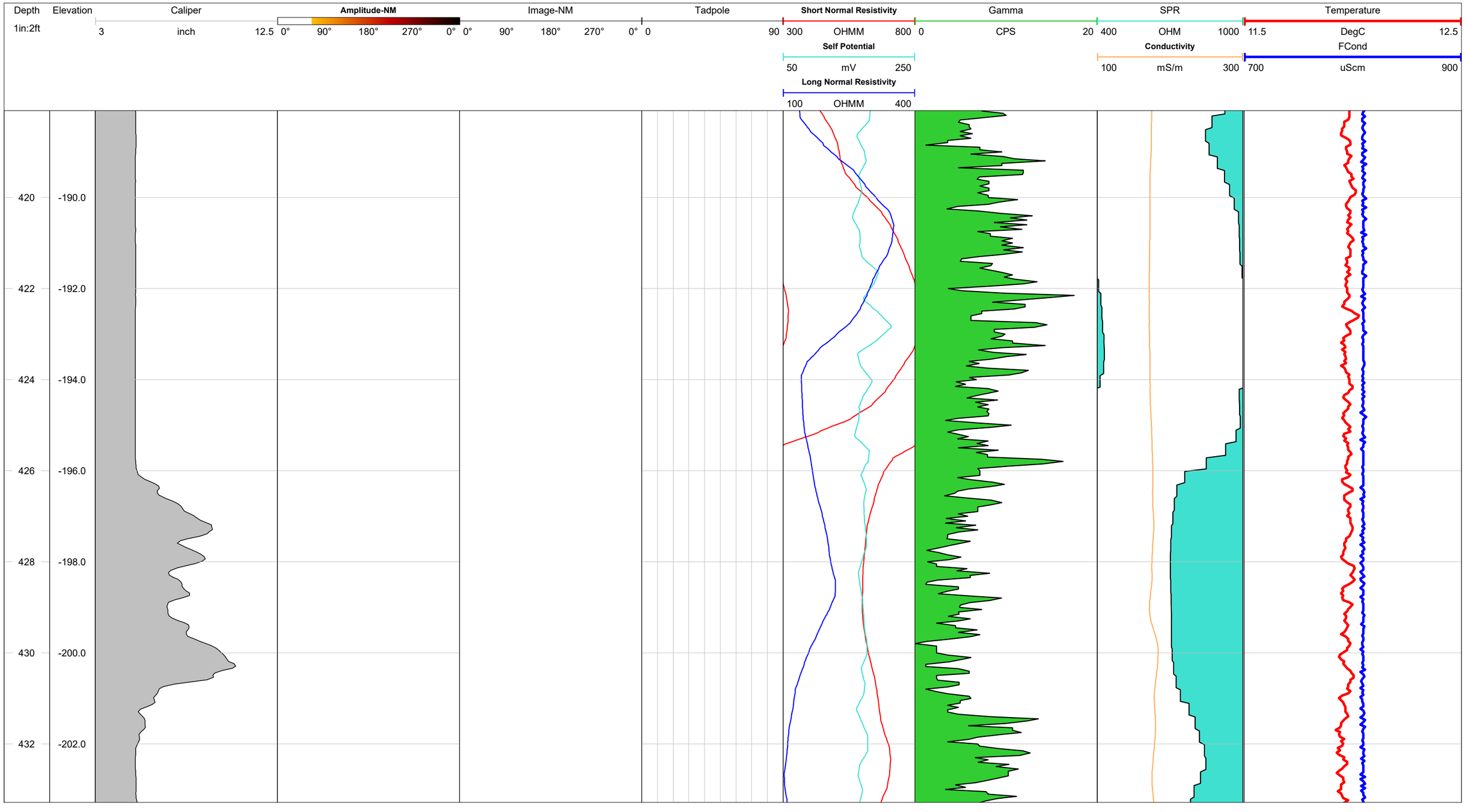

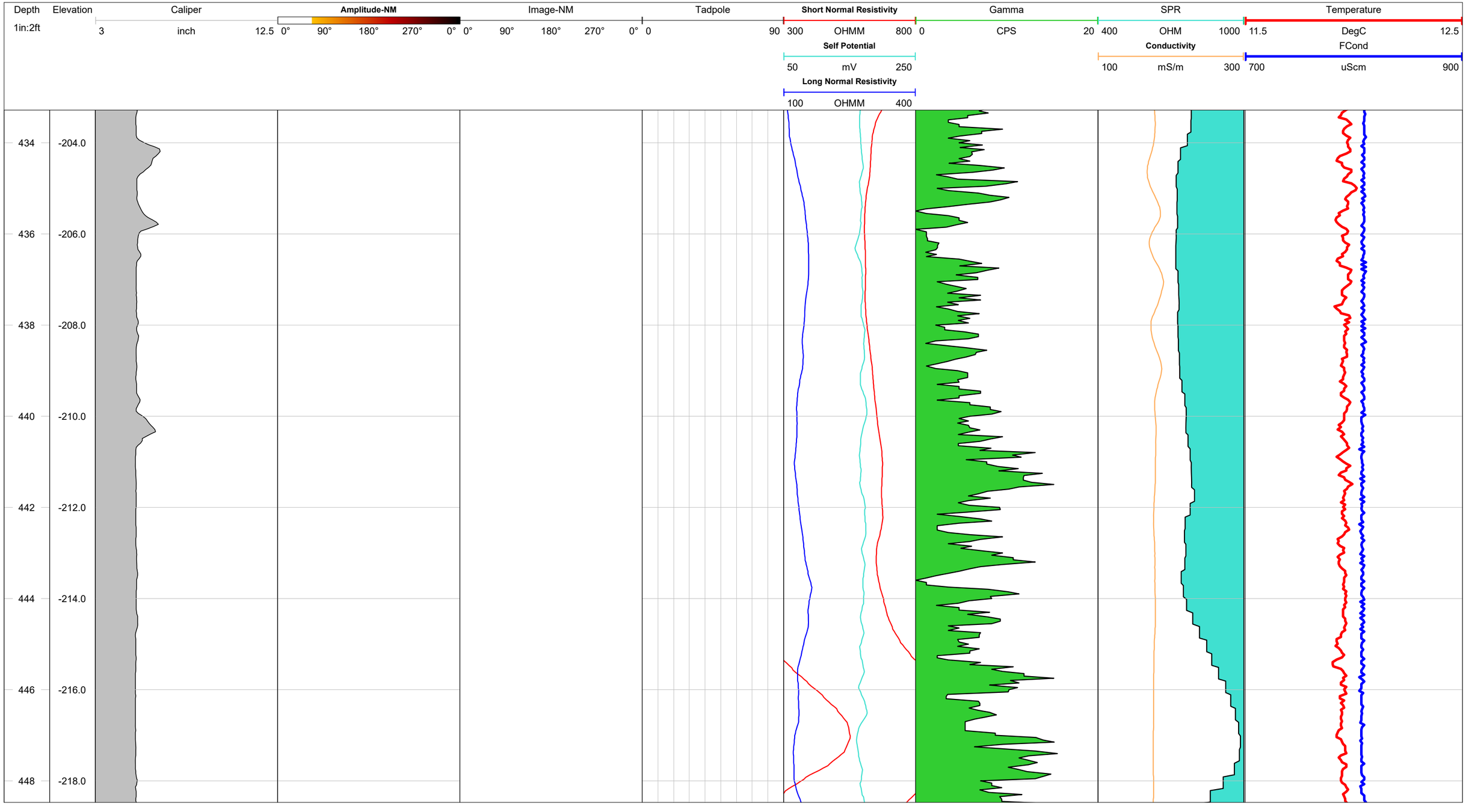

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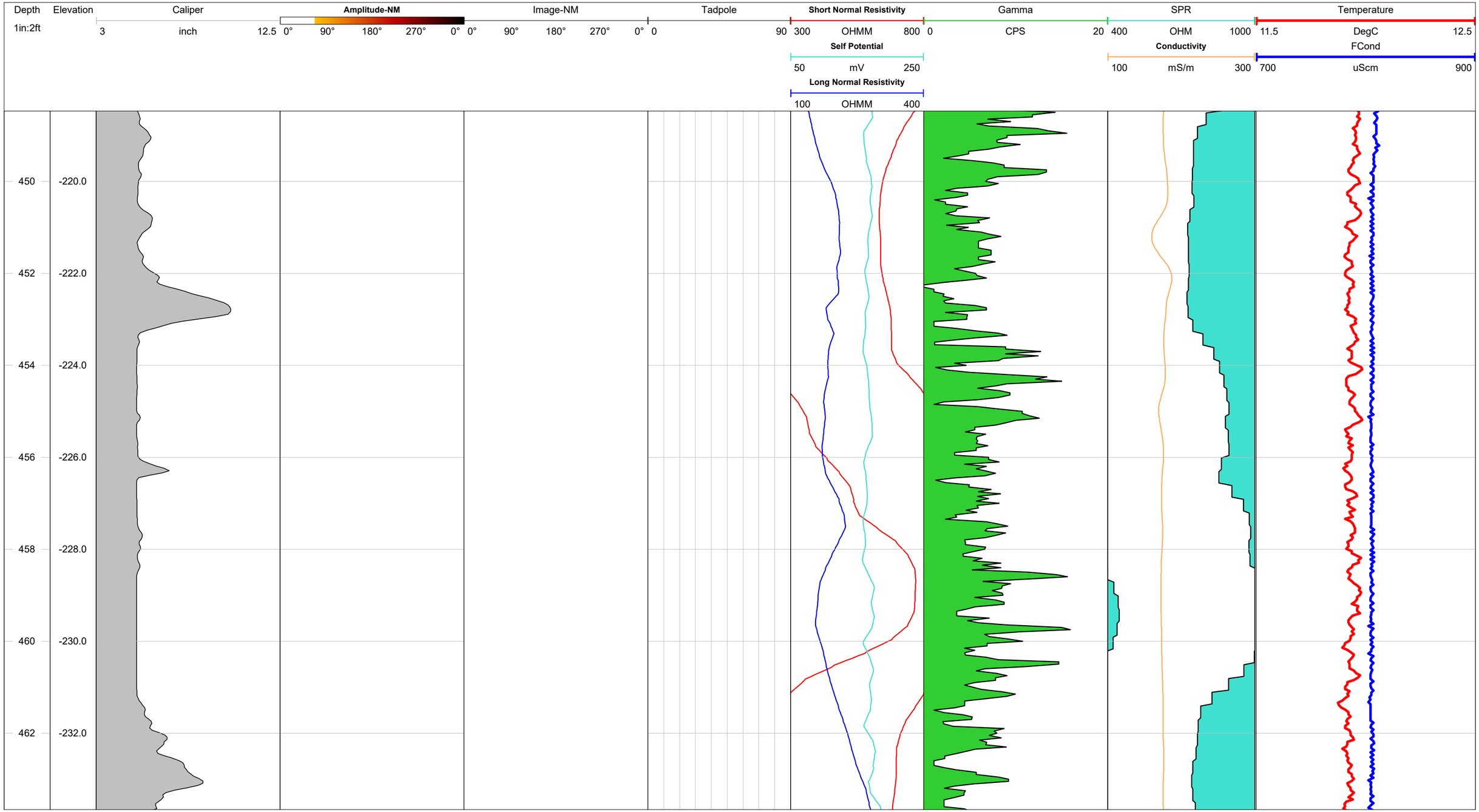

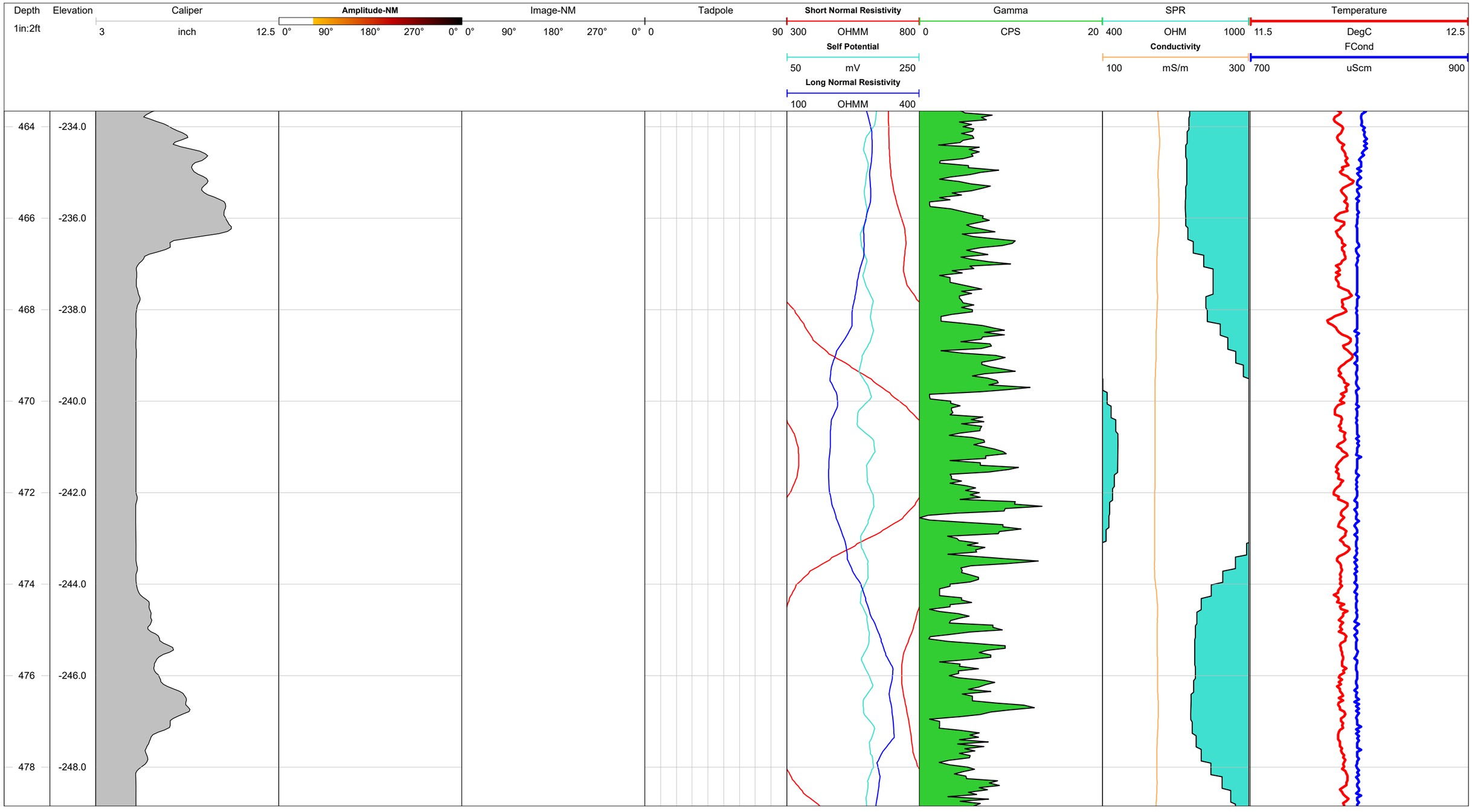

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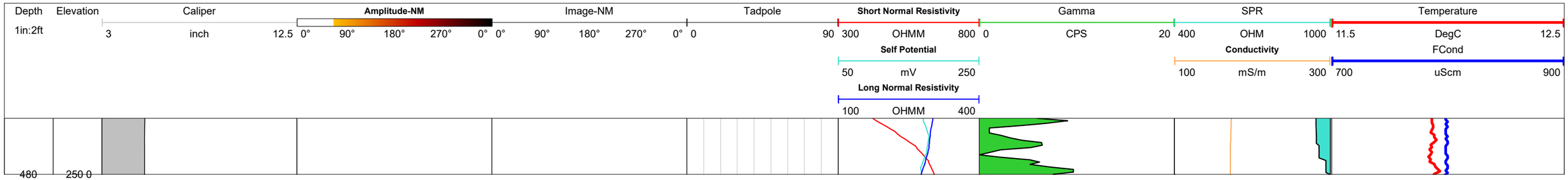

~~For Red Hill AOC Party Use Only~~

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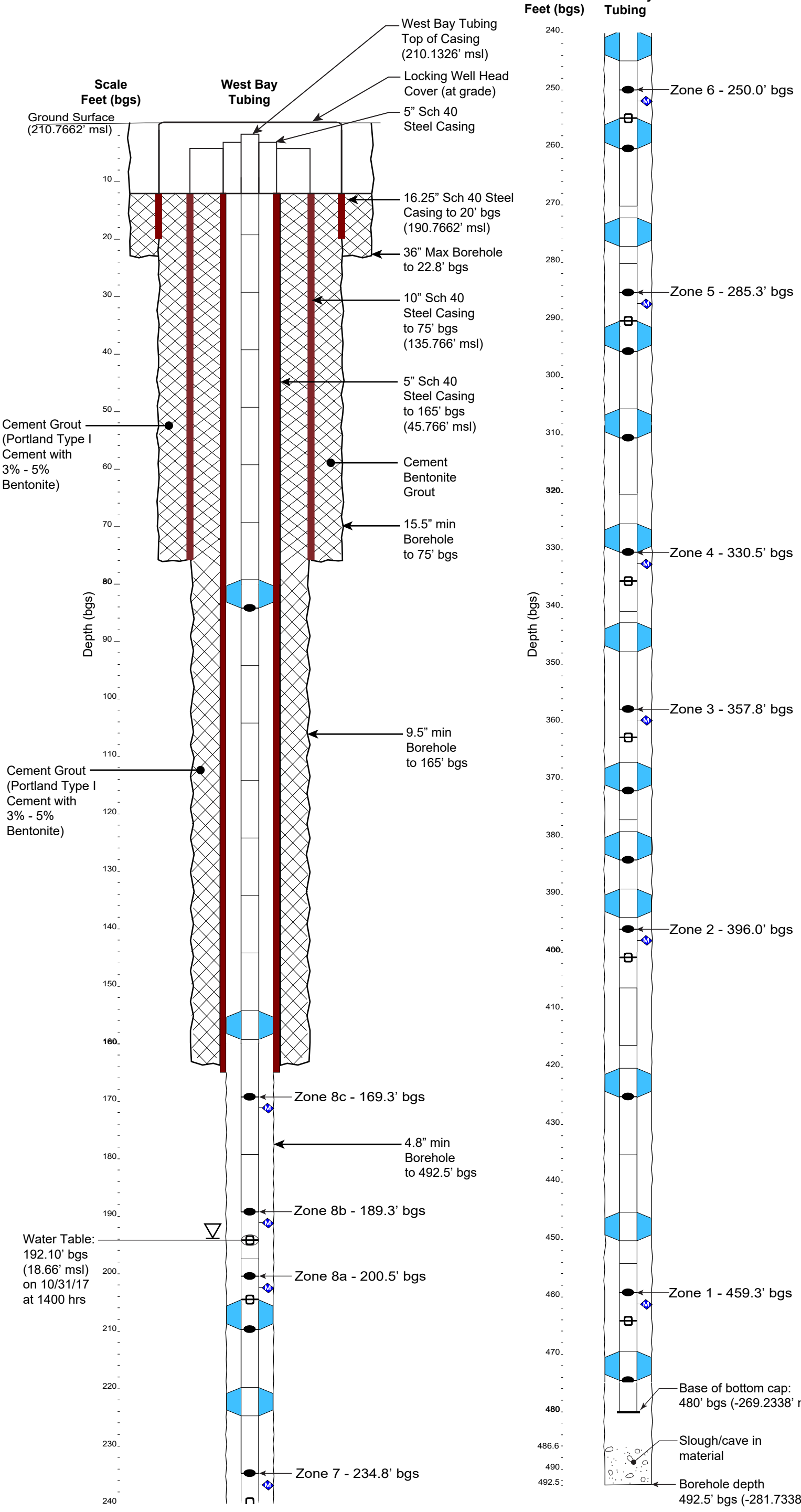
RHMW11 Monitoring Well



Legend

- Approximate Depth to Water in the Open Borehole within the Regional Basalt Aquifer Prior to Westbay System Installation
- Magnetic Sensor
- Packer
- Pump Port
- Sample Port

NOTE: DEPTHS BASED ON NOMINAL PORT POSITIONS, NO CORRECTIONS APPLIED - Nov 29, 2017

SOURCE: (c) WESTBAY INSTRUMENTS INC. 2000

Cross Section RHMW11 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawaii

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY
Red Hill 60481245	RHMW11	Halawa Correctional Facility	(b) (6)

METHOD
- OVERPUMPAGE ☐
- BAILER ☐
- SURGE BLOCK ☐
- AIR LIFT ☒
- OTHER

Grundfoss submersible

7.6 to 8.33 gpm

INITIAL WATER LEVEL: 193.58' btoc
INITIAL TOTAL DEPTH: 492.5'

FINAL WATER LEVEL: 193.57'
FINAL TOTAL DEPTH: Not Measured

REMARKS:
1 well volume = 1110 gal

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY							WATER LEVEL (ft btoc)
DATE	TIME	COMMENTS	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (ppt)	
Zone 1: pump intake at 225' bgs, casing bit at 229'bgs													
11/9	0942	Start purging											
11/9	0948		6	8.33	50.0								193.59
11/9	0950		8	8.33	66.6	6.19	23.67	0.304	9.89	57	58.0	0.1	
11/9	1000		18	8.33	149.9	6.64	23.58	0.204	5083	18	45.1	0.1	193.60
11/9	1002	Stop pumping to replace pump controller plug	20	8.33	166.6								
11/9	1007	Resume pumping											
11/9	1010		23	8.33	191.6	6.87	23.33	0.284	4.72	-26	20.0	0.1	193.59
11/9	1020		33	8.33	274.9	7.14	23.39	0.287	7.58	-26	12.0	0.1	193.59
11/9	1030		43	8.33	358.2	7.12	23.16	0.282	6.95	-25	7.0	0.1	193.59
11/9	1040		53	8.33	441.5	7.41	23.02	0.287	5.75	-26	5.5	0.1	193.59
11/9	1050		63	8.33	524.8	7.51	23.04	0.287	6.17	-14	4.2	0.1	193.59
11/9	1100		73	8.33	608.1	7.48	22.83	0.277	5.59	9	2.9	0.1	193.59
11/9	1105		78	8.33	649.7	7.61	22.65	0.287	5.00	-9	2.8	0.1	193.59
11/9	1110		83	8.33	691.4	7.59	22.65	0.289	7.44	-12	1.6	0.1	193.59

11/9	1115		88	8.33	733.0	7.64	22.60	0.289	7.58	-16	1.7	0.1	193.59
11/9	1120		93	8.33	774.7	7.67	22.52	0.289	7.74	-10	1.1	0.1	
11/9	1125		98	8.33	816.3	7.64	22.58	0.290	7.67	8	1.7	0.1	193.59
11/9	1130		103	8.33	858.0	7.65	22.58	0.289	7.69	-13	1.3	0.1	193.58
11/9	1135		108	8.33	899.6	7.71	22.50	0.289	7.72	-12	1.7	0.1	193.58
11/9	1140		113	8.33	941.3	7.71	22.26	0.289	7.42	-11	1.2	0.1	193.57
11/9	1145		118	8.33	982.9	7.70	22.29	0.290	6.68	-5	1.6	0.1	193.57
11/9	1150		123	8.33	1024.6	7.67	22.32	0.289	6.22	-27	1.2	0.1	193.57
11/9	1155		128	8.33	1066.2	7.71	22.58	0.289	6.99	-24	1.1	0.1	193.57
11/9	1200		133	8.33	1107.9	7.71	22.48	0.289	7.59	-26	1.1	0.1	193.57
11/9	1205		138	8.33	1149.5	7.71	22.32	0.290	6.03	-32	1.3	0.1	
11/9	1210		143	8.33	1191.2	7.71	22.50	0.291	5.70	-27	1.1	0.1	193.57
11/9	1215		148	8.33	1232.8	7.75	22.33	0.290	7.50	-29	0.7	0.1	
11/9	1220		153	8.33	1274.5	7.74	22.37	0.290	7.06	-30	0.9	0.1	193.57
11/9	1230		163	8.3	1357.8	7.73	22.44	0.290	5.31	-36	1.2	0.1	193.57
11/9	1235	Stop pumping, pull pump/casing up	168	8.33	Zone 1 total: 1399.4								
Zone 2: pump intake at 203' bgs, casing bit at 208'bgs													
11/9	1407	Start pumping											194.61 (192.5 bgs)
11/9	1411		4	8.33	33.3	7.36	25.20	0.279	4.16	-70	75.6	0.1	194.62
11/9	1420		13	8.33	108.3	7.12	24.22	0.280	4.72	-64	34.7	0.1	194.65
11/9	1430		23	8.33	191.6	7.45	23.58	0.350	6.20	-23	9.7	0.2	194.65
11/9	1440		33	8.33	274.9	7.67	24.15	0.319	7.31	-2	5.7	0.2	
11/9	1447	End purging. 2000 gal water tank ~8" from full	40	8.33	333.2	7.70	23.55	0.298	4.33	-14	4.2	0.1	194.65
11/10	0700												194.75
11/10	0701	Resume purging											
11/10	0705		44	8.33	366.5	5.71	22.32	0.403	4.01	63	1.1	0.2	
11/10	0715		54	8.33	449.8	6.18	21.96	0.277	3.23	7	0.9	0.1	194.78
11/10	0725		64	8.33	533.1	6.46	21.74	0.301	4.77	-14	1.1	0.1	194.80
11/10	0735		74	8.33	616.4	6.84	21.58	0.302	3.31	-15	0.0	0.1	194.80
11/10	0745		84	8.33	699.7	6.92	21.45	0.301	5.12	-20	0.0	0.1	194.80

11/10	0755		94	8.33	783.0	7.11	21.35	0.304	5.19	-15	0.0	0.1	
11/10	0805		104	8.33	866.3	7.19	21.34	0.303	5.35	-9	0.0	0.1	194.80
11/10	0815		114	8.33	949.6	7.32	21.75	0.300	5.44	-30	0.0	0.1	194.80
11/10	0825		124	8.33	1032.9	7.35	21.78	0.301	5.15	-15	0.0	0.1	
11/10	0835		134	8.33	1116.2	7.38	21.74	0.298	5.58	-2	0.0	0.1	194.80
11/10	0840		139	8.33	1157.9	7.42	21.77	0.299	5.34	-21	0.0	0.1	
11/10	0845		144	8.33	1199.5	7.43	21.84	0.299	6.04	-27	0.0	0.1	
11/10	0855		154	8.33	1282.8	7.45	22.05	0.298	5.07	-14	0.0	0.1	194.80
11/10	0910	Pull casing up	169	8.33	Zone 2 total: 1407.8	7.48	22.25	0.297	5.15	-1	0.0	0.1	194.80
Zone 3: pump intake at 198.5' bgs, casing bit at 199'bgs													
11/10	0958	Start purging											
11/10	1008		10	8.33	83.3	7.18	23.98	0.283	2.62	-34	0.1	0.1	193.72
11/10	1018		20	8.33	166.6	7.05	23.56	0.318	4.62	-46	0.2	0.2	193.73
11/10	1028		30	8.33	249.9	7.36	23.10	0.310	4.57	-25	0.1	0.1	193.73
11/10	1038		40	8.33	333.2	7.40	22.80	0.300	4.84	-21	0.1	0.1	
11/10	1048		50	8.33	416.5	7.46	22.83	0.295	4.47	-15	0.1	0.1	193.73
11/10	1058		60	8.33	499.8	7.47	22.94	0.294	5.10	-9	0.1	0.1	
11/10	1108		70	8.33	583.1	7.47	23.07	0.292	5.28	-6	0.1	0.1	193.73
11/10	1118		80	8.33	666.4	7.52	23.07	0.290	4.98	14	0.0	0.1	
11/10	1133	End purging	95	8.33	791.4	7.52	22.79	0.290	5.38	4	0.0	0.1	193.73
						7.47	23.54	0.264	5.16	-81	132	0.1	193.65
11/10	1400	Start purging				7.42	23.43	0.247	6.18	-62	95.4	0.1	193.65
11/10	1405		100	8.33	833.0	7.11	23.90	0.267	4.89	-14	74.9	0.1	193.67
11/10	1415		110	8.33	916.3	6.99	23.00	0.285	5.10	20	30.5	0.1	193.70
11/10	1425		120	8.33	999.6	7.18	23.11	0.322	4.16	82	13.5	0.1	193.70
11/10	1435		130	8.33	1082.9	7.42	22.83	0.316	6.14	74	4.7	0.1	
11/10	1440		135	8.33	1124.6	7.49	22.57	0.304	5.29	60	0.4	0.1	
11/10	1445		140	8.33	1166.2	7.50	22.51	0.300	5.48	54	0.0	0.1	193.70
11/10	1450		145	8.33	Zone 3 total: 1207.9	7.49	22.48	0.298	5.42	48	0.0	0.1	193.7
Zone 4: pump intake at 270' bgs, casing bit at 484'bgs													193.54
11/13	1030	Start purging				6.05	24.22	0.343	4.99	75	232	0.2	193.80
11/13	1038		8	7.6	60.8	6.52	23.54	0.288	3.78	11	114	0.1	193.81
11/13	1048		18	7.6	136.8	6.96	22.57	0.265	4.52	-34	919	0.1	193.80

11/13	1058		28	7.6	212.8	7.69	22.32	0.253	5.48	76	291	0.1	193.80
11/13	1108		38	7.6	288.8	7.74	22.38	0.250	5.57	105	135	0.1	193.78
11/13	1118		48	7.6	364.8	7.76	22.44	0.250	5.68	115	42	0.1	193.79
11/13	1128		58	7.6	440.8	7.77	22.54	0.249	5.13	115	21.8	0.1	193.77
11/13	1138		68	7.6	516.8	7.79	22.66	0.249	5.25	119	12.6	0.1	193.75
11/13	1148		78	7.6	592.8	7.79	22.41	0.248	5.15	116	9.3	0.1	193.74
11/13	1158		88	7.6	668.8	7.66	22.82	0.240	5.49	135	6.5	0.1	193.75
11/13	1208		98	7.6	744.8	7.78	22.34	0.248	5.54	122	5.4	0.1	
11/13	1218		108	7.6	820.8	7.83	22.05	0.248	4.80	112	4.1	0.1	
11/13	1223		113	7.6	858.8	7.82	21.71	0.249	4.90	95	3.5	0.1	193.75
11/13	1228		118	7.6	896.8	7.77	21.60	0.249	4.99	84	4.2	0.1	193.75
11/13	1233		123	7.6	934.8	7.64	21.71	0.248	5.13	91	4.2	0.1	193.75
11/13	1234	End purging	124	7.6	Zone 4 total: 942.4								193.50
					All zones total: 4957.5 gal								

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12

Sheet 1 of 15

Date(s) Drilled	05/09/2019 - 06/26/2019	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	HSA / Core Bucket Auger / Mud Rotary / Air Rotary / HQ core / PQ core	Drill Bit Size/Type	24" core bucket auger / 17.5" rotary / 9.875" rotary / HQ and PQ diamond bit	Total Depth of Borehole	215.0 feet
Drill Rig Type	Mobile B-59 / Mobile B-90 / T-3	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	237.6 Feet
Groundwater Level	53 Feet msl	Location	Halawa Correctional Facility	Inclination from Horizontal/Bearing	90°
Borehole Completion	3-inch diameter monitoring well.			Hammer Data	140 lbs/30-inch drop

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
0								**FILL** Gray basalt angular GRAVEL (GW), well graded drill pad (FILL), moist					0.0		Hand augered 0'-4.3' bgs. Encounter basalt boulder obstruction on 05/09/2019.
1								Moist, brown, SILTY GRAVEL (GM) with basaltic and coralline sand, fine to coarse, medium plasticity with some basalt cobbles (FILL). 40% gravel, 20% sand, 40% silt.				40 50-4"			
2															
3								Grades with more orangish-brown sand. 35% gravel, 30% sand, 35% fines.							Begin 8" HSA on 05/10/2019 at 0853 hours.
4								**Alluvium** Moist, dark brown, GRAVELLY FAT CLAY (CH), basaltic, subangular, coarse gravel (FILL).							
5			100								1				Augers grinding very hard at 4.0' bgs to ~5.0' bgs.
6								Moist, very dark grayish-brown (10YR3/2) FAT CLAY (CH) with basaltic sand and basaltic cobbles. 80% fines, 20% sand. Very hard grinding, light gray, slight weathered basalt gravel in auger cuttings, probably basalt.							Augers grinding very hard at 6.0' bgs to ~9.0' bgs. bgs.
7															
8															HSA to 9.0' bgs, then setup to HQ core. Using 8" HSA as temporary casing.
9								Very dark gray (N3) BASALT, massive a'a, slightly weathered, strong to very strong, 15% vesicles, 1-4m, stretched.					0.0	[150]	
10								Very dark grayish brown (10YR3/2) FAT CLAY (CH) seam. Basalt as above.							Good water return. Grayish water.
11															
12	1	1	72		30	NR		Dark grayish brown (10YR3/2) FAY CLAY (CH) with massive a'a basalt cobbles/boulders broken to gravel, slight to moderate weathering. Contains ~8mm platy mica crystal at 12' bgs.							
13								No recovery							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 3/18/2020 RHMW12

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12

Elevation, feet / Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
13						NR		No recovery					
14								Very dark gray (N3) basalt, massive a'a. Slightly weathered, very strong.			0.0		
15	2		85		0			Dark yellowish brown (10YR3/2) FAT CLAY (CH) with traces of moderately weathered basalt gravel. Very stiff.					Good water return. Grayish brown.
16						NR		Slight to moderately weathered basalt boulder, massive a'a.			0.0	[180]	
17	3	1	67		22			Dark grayish brown (10YR3/2) FAT CLAY (CH) with moderately weathered basaltic gravel and traces of mica around gravel. Clear, probably muscovite.					
18						NR							
19								Grades with slight to moderately weathered basalt cobbles, becomes soft to medium stiffness.			0.0	[80]	
20													
21	4		100		0								Light grayish brown water
22								Becomes more stiff.					
23	5	2	90		0			Very dark gray basalt cobble, slightly weathered, massive a'a. Dark grayish brown (10YR3/2) FAT CLAY (CH)			0.0	[60]	Light grayish brown water return
24											0.0	[100]	Recovered 3' of core, remainder stuck in barrel, approximately 3 inches. At 1234: DTW= 4.03' BTOC, stickup= 3.05' At 1316: DTW= 4.5' BTOC, stickup 3.05' Logged by JF. Brownish gray water, good return.
25						1 2 3		Very dark gray (gley 1 3/N) basalt, massive a'a. Slight weathering, ~7% vesicles at top, decreasing with depth. Stretched vesicles, ~3mm long. Very strong. 1. 10°, J, MW, CL-washed away, Fi, Wa, SR 2. 5°, J, MW, Cl-washed away + Fe, Pa, Pl, SR 3. 45°, J, MW, Cl, Fi, Pl, SR 4. 10°, J MW, Cl, Fi, Pl,SR 5. 0°, J, W, Cl, Fi, Ir, SR					
26	6		60		24	4							
27						5		Very stiff FAT CLAY (CH), same as above. Minor angular basalt gravel.					
28						NR							
29													

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Elevation, feet / Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
29		2						Grades to dark reddish brown (5YR3/2) moderate/very stiff FAT CLAY (CH). Trace basalt gravel and cobbles. Increasing cohesion with depth. Minor black staining in pore spaces, possible Mn infilling.			0.0	[100]	
30													Grayish brown water return
31	7		100		0								
32													
33													
34											0.0	[75]	
35													Grayish brown water return
36	8	3	100		0			Very wet					
37								Zone of increase angular basalt gravel, approximately 1' thick.					
38													Drilled to 39.0' bgs. DTW= 9.4' BTOC, stickup = 3.25' (1400 on 05/10/2019) Boring paused on 05/10/19 at 39.0' bgs at 1354. Continue drilling on 05/13/2019 at 0750.
39								Decrease gravel proportion in FAT CLAY (CH); increased sand to ~10%. Moderately stiff, less cohesive than above.			0.0	[60]	
40								Dark reddish brown (5YR3/3), hard, indurated weathered breccia TUFF (?) with angular 3-5 mm pebbles.					
41	9	4	90		37	1 2 3		Dark gray (Gley 3.1) basalt, massive a'a, slightly weathered, 5% vesicles, very strong (boulder). 1. 20°, J, N, Fe + Mn, Fi, Wa, SR 2. 20°, J, N, Fe + Mn, Fi Wa, SR 3. 30°, J, N, Fe + Mn, Fi, Wa, S					Good water return.
42						M							
43						M							
44								Dark reddish brown (5YR3/3) moderate to very stiff FAT CLAY (CH), trace basalt gravel.			0.0	[100]	
45													

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45													
46													
47	10	4	76		0								Good water return.
48						NR		No recovery					
49								Same as above.			0.0	[37.5]	
50													
51	11		92		0								Good water return.
52								Becomes silty, loosens.					
53								Becomes moderately stiff.					
54						NR		No recovery					
55								Same as above.			0.0	[60]	
56						M		Dark reddish brown (5YR3/3), hard, weathered indurated breccia (TUFF?) with angular basalt pebbles and cobbles. Weak.					
57	12	5	100		33	M M M							Good water return.
58						M							179.9' msl
59						1 2		**BASALT Pahoehoe** Dark brown (7.5YR3/2) slight to moderate weathered basalt, pahoehoe, 30% vesicles. Moderately strong. 1. 15°, J, N, Fe + Mn, Fi, Pl, SR 2. 30°, J, N, Fe + Mn, Fi, Pl, SR			0.0	[75]	
60						M 1		Becomes fresh, extremely strong, large vesicles. 1. 10°, J, N, Fe + Mn, Fi, Pl, S 2. 10°, J, N, Fe + Mn, Fi, Pl, SR 3. 5°, J, VN, Fe + Mn, Fi, Pl, S					Brown/gray water return.
61						M		4. 0°, J, N, Fe + Mn, Fi, Pl, SR					

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Elevation, feet / Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
61													
	13		100		86			5. 0°, J, N, Fe + Mn, Fi, Pl, SR					
62						2 3 4							
								Becomes slightly weathered, strong.					Good water return.
63						5 6 7		6. 0°, J, VN, Fe + Mn, Su Pl, S 7. 0°, J, N, Fe + Mn, Su, St, SR					
64								Becomes unweathered, very strong. 1. 15°, J, N, Fe + Mn, Su, Wa, SR 2. 10°, J, VN, Fe + Mn, Su Pl, S 3. 50°, J, N, Cl, Fi, Wa, R 4. 15°, J, N,CL, Pa, Wa, SR			0.0	[75]	
65						1 2 3							
66						M		Becomes slightly weathered, strong.					Good water return.
	14	6	100		84	4							
67						5		Becomes unweathered. Very strong. 5. 45°, J, N, Fe, Fi, Wa, R 6. IF, J, N, Fe + Mn, Su, Pl, SR					
68													
69						6		Highly Fractured			0.0	[75]	
								Same as above.					
70						M		**TUFF ashfall** Light yellowish brown (2.5YR6/4) moderate to highly weathered ash tuff, weak where in contact with overlying basalt. Extremely weathered where loose.					Good water return.
71													
	15	7	100		52	1		**BASALT Pahoehoe** Very dark gray (5YR3/1) moderately weathered, strong, basalt, pahoehoe with infilled vesicles (approximately 5-20%). 1. 45°, J, N, Fe + Mn + Cl, Fi, St, R					
72						2 3 M		2. 5°, J, VN, Fe + Mn, Su, Pl, S 3. 45°, J, N, Cl, S, Wa, SR 4. 90°, J, N, Cl, Fi, Pl, SR					
73													
74						4 1					0.0	[100]	
								Becomes slightly weathered, very strong. No infilling of vesicles (approximately 30-40%). 1. 15°, J, N, Fe + Mn, Su, Wa, R 2. 30°, J, VN, Fe + Mn, Pa, Wa, R 3. 20°, J, MW, Fe+ Mn + Cl, Fi, Pl, SR 4. 30°, J, MW, Cl, Fi, Pl, SR					Good water return.
75						2 3							
76													
	16		100		82	4							
77													

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Elevation, feet / Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
77													
78		7				5 6 7 M 8		5. 30°, J, MW, CL, Fi, Ir, SR 6. 60°, J, MW, Cl, Fi, Wa, SR 7. 5°, J, VN, Fe + Mn, Su, Pl, SR 8. 30°, J, VN, Fe + Mn, Su, Wa, SR -Note clay filled joints					
79								Slightly weathered, very strong, 30-40% vesicles.			0.0	[75]	158.6' msl
80						IF 1		IF. J, MW, Cl, Fi, Wa, SR 1. 45°, J, MW, CL, Fi, Pl, SR 2. 80°, J, N, Cl, Fi, Pl, SR -Note clay filled joints					Used ~400 gallons of water.
81	17		83		35	M 2							
82						M		Becomes slight to moderately weathered, strong.					
83						M M M NR		No recovery					
84						M 1					0.0	[60]	153.6 msl
85						M 2 M		1. 5°, J, N, Fe + Mn, SU, Pl, S 2. 10°, J, N, Cl, Fi, Pl, SR 3. 10°, J, N, Cl, Fi, Pl, SR 4. 5°, J, VN, Fe + Mn, SU, Wa, SR -Note clay filled joints					
86						3 M							
87	18	8	87		40	4 M		Becomes highly weathered, very to extremely weak. Infilled vesicles and intensely fractured.					Used ~100 gallons of water.
88						IF							
89						NR		No recovery					
90						1 2 3		Becomes slightly weathered to unweathered. Very strong, 20-30% vesicles. 1. 45°, J, VN, Cl, Fi, Pl, S 2. 45°, J, N, Cl, Fi, Pl, S 3. 45°, J, N, Cl, Fi, Wa, SR 4. 90°, J, N, Cl, Pa, Wa, SR 5. 60°, J, MW, Cl, Fi, Pl, SR 6. 50°, J, N, Cl, Fi, Pl, SR 7. 15°, J, N, Cl, Fi, Pl, SR 8. 45°, J, VN, Cl, Pa, Wa, SR 9. 45°, J, VN, Cl, Pa, Wa, SR -Note clay filled joints.			0.0	[60]	
91						4							
92	19	9	100		52	5 6 M 7							Used ~200 gallons of water.
93													

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Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
93						8							
94						9							
						M		Same as above. 1. 0°, J, VN, Fe + Mn, Su, Wa, SR 2. 45°, J, VN, Fe + Mn, Su, Pl, SR 3. 35°, J, VN, Cl, Su, Wa, SR 4. 30°, J, VN, Fe + Mn, Su, Wa, S 5. 45°, J, N, Cl, Fi, Wa, SR 6. 90°, J, N, Cl, Pa, Pl, S 7. 45°, J, N, Cl, Pa, Pl, SR			0.0	[60]	
95						1							
96	20	9	100		67	2							Used ~200 gallons of water.
						3							
97						IF		IF, N, Cl, Fi, Wa, SR					
						4							
98						5							
						6							
99						7							
						IF		IF section is more weathered.			0.0	[150]	
100						M		Same as above. 1. 60°, J, VN, Cl, Pa, Pl, S 2. IF, MW, Cl, Fi, Wa, SR (Halloysite) 3. 45°, J, VN, Cl, Pa, Pl, S (Halloysite) -Note clay filled joints					
101						M							
	21	10	100		60	1							
102						2		IF is more weathered.					Used ~200 gallons of water.
						3							
103						M							
104						M		Becomes unweathered, very strong to extremely strong, medium (2 mm) to large (5 mm) vesicles.			0.0	[75]	End 05/13/2019 Start 05/14/2019
105								~15% vesicles ~5% vesicles					
106													Used ~500 gallons of water.
	22	11	100		94	M							
107								~30% vesicles					
108						M							
						1							
109						M		1. 0°, J, T, Fe + Mn, Pa, Wa, SR					
						M		2. 20°, J, VN, Fe + Mn, Su, Wa, S					
						2							

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Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
109											0.0	[30]	
110								**BASALT A'a Clinker** Basalt cobbles, rounded cobble size due to core jamming; Contact from pahoehoe down into a'a, note massive a'a cobbles. No recovery may be a'a clinker.					
111	23		24		0	NR							Used ~700 gallons of water.
112								No recovery					
113													
114								**BASALT Massive A'a** Dark gray (7.5YR4/1), moderate to slightly weathered basalt, massive a'a. Note fractured with clay infilled vesicles. Recovered rounded cobbles is less weathered, very strong.			0.0	[42.8]	
115													Used ~450 gallons of water.
116	24	11	26		0	NR		**BASALT A'a Clinker**					Cannot pull core barrel out. Issues with core barrel jamming, rock loosened from above is jamming barrel and bit.
117													
118								No recovery					
119						4					0.0	[75]	
120						NR							
121	25		70		62	M M M		**BASALT Massive A'a** Becomes unweathered, extremely strong massive a'a, ~20% vesicles.					Used ~200 gallons of water.
122													
123						M M							
124		12				M		Bottom cored in at 124' bgs. Same as above. ~1% vesicles			0.0	[50]	
125													

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125						M		~10% vesicles					
126	26	12	96		94	1		1. 10°, J, VN, Cl, Fi, St + Pl, S					
127						M		~8% vesicles					Used ~200 gallons of water.
128						M		~5% vesicles Stop coring at 129' bgs. Prepping to pull out core assembly to ream open hole and set 10"					
129						NR		<1% vesicles No recovery					DTW= 111.2' bgs at 1048 End 05/14/2019 Begin coring with HQ core on 06/17/2019 at 1025.
130						1		**BASALT Massive A'a** gray, gley 6/N, unweathered, very strong, elongate semi rounded vesicles, 5%, 2-3mm 1. 60°, J, VN, Cl, Sp, St Wa, S			0.0	[42.8]	1028-1032- first run starting at bottom of 10" casing ~122' bgs to 125', previously logged as massive a'a. 1045 next run: 125' - 130', 125' to 129' previously logged. Log 129' to 130' at 1045 - 1051, start logging at 130'.
131						M		2. 20°, J, VN, Cl, Sp, Pl, S 3. 20°, J, VN, Wa, SR					
132	27	13	100		64	2 3		4. 80°, J, VN, Mn, Sp, Wa, S 5. 10°, J, VN, Mn, Sp, Wa, S 6. 45°, J, VN, Mn, Sp, Pl, S 7. 45°, J, VN, Cl, Sp, St, SR					
133						IF							
134						4 5		1% vesicles, <1mm					No water added, per driller. <30 gallons water. No returns.
135						6 7 1		2% vesicles, elongate 1. 70°, J, VN, Cl, Pa, Pl, SR (very pale brown [10YR5/3]) 2. 60°, J, VN, Mn, Sp, Wa, SR 3. 0°, J, VN, Mn, Cl, Sp, Wa, SR			0.0	[50]	
136								1% vesicles, <1mm 5% vesicles, elongated, <1-10mm					
137						2 3							
138	28		92		58	IF							
139						NR		**BASALT A'a Clinker** broken clinker pieces, loose, dark reddish brown, 5YR4/3, 10YR3/1, very dark gray, clay reddish yellow (7.5YR7/5) some a'a clinker clasts infilled with clay contact with heat alteration					
140						1		**BASALT Pahoehoe** black 2.5YR5/1, moderate weathering, strong, 20% vesicles, irregular and rounded, 4-25mm, partially infilled with clay. 1. 45°, J, VN, Cl, Sp, Wa, R			0.0	[150]	
141						2							

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141								2. 0°, J, VN, Cl, Mn, Sp, Wa, SR 3. 10°, J, VN, Cl Su, Mn Sp, Wa, R 4. 0°, J, VN, Mn, Cl, Sp, Wa, R					
142	29	14	102		78	3 4		30% vesicles, rounded, <5mm Possible flow contact-- dark reddish brown (2.5YR3/3), moderate weathering, strong 25% vesicles, rounded <2mm, partially infilled with clay. Dark reddish gray (2.5YR3/1), slightly weathered, strong, 15% vesicles, rounded 1-4mm					
143						5		5. 5°, J, VN, Cl Su, Mn Sp, Wa, SR 6. 10°, J, VN, Cl, Mn, Sp, Wa, SR 7. 0°, J, VN, Cl Su, Mn Sp, Pl, SR					
144						6 7 8 9		8. 45°, J, VN, Cl Su, Mn Sp, Pl, SR 9. 5°, J, VN, No, No, Pl, SR					
145						1					0.0	[75]	Used ~150 gallons of water. No returns.
146						2							
147	30		100		96			Possible heat alteration, moderate weathering, medium strong, brown (7.5YR4/2), 10YR5/3 brown, black 10YR2/1, 15% vesicles, subrounded to rounded, <2mm, partially infilled with clay. 1. 30°, J, VN, Clay, Mn Fe, Sp, Wa, SR 2. 20°, J, VN, Clay Su, Mn Fe, Sp, S					
148						3 4		3. 45°, J, VN, Clay, Mn Fe, Pl, SR 4. 0°, J, VN, Clay, Mn Fe, Pa, Pl, SR 5. 10°, J, VN, Clay, Mn, Pa, Pl, S					
149						5 6 7		6. 5°, J, VN, Clay Su, Mn Sp, Pl, S 7. 20°, J, VN, Clay Su, Mn Sp, Pl, S Becomes black (10YR2/1), slightly weathered, strong, 15% vesicles, <5mm subrounded to rounded.					
150						1					0.0	[150]	
151						M 2 M		Becomes dark gray (2.5Y4/1), slightly weathered, strong, 5% vesicles, rounded, 5-10mm, partially infilled with clay.					
152	31	15	90		76	3		Becomes 20% vesicles, rounded, 2-5mm					Used ~150 gallons of water. No returns.
153						4		Becomes very dark gray (GLEY 3/N), moderate weathering, medium strong, 25% vesicles, <2mm subrounded, partially infilled with clay. 1. 5°, J, VN, Clay, Pa, Wa, SR 2. 5°, J, VN, Clay Su, Mn Sp, Wa, S					
154						5		3. 5°, J, VN, Clay Su, Mn Fe Sp, Wa, S 4. 45°, J ,VN, Clay, Mn, Fe, Sp, Wa, SR 5. 45°, J, VN, Clay Su, Mn Fe Sp, Wa, SR					
155						1					0.0	[150]	
156						2 3 4		1. 5°, J, VN, Cl Su, Mn Sp, Wa, S 2. 0°, J ,VN, Fe Su, Mn Clay Sp, Pl, SR 3. 10°, J, VN, Clay, Fe, Mn, Sp, Wa St, SR 4. 30°, J, VN, Clay, Fe, Mn, Sp, Wa, SR 5. 10°, J, VN, Clay, Fe, Mn, Sp, Wa, SR					Used ~150 gallons of water. No returns.
157						5							

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157													
158	32		110		74	IF 6 7 8 9		10% vesicles, 2-8mm, subangular, partially infilled with clay 6. 10°, J, VN, Clay, Mn, SP, Wa, SR 7. 0°, J, VN, Clay, Sp, Wa, SR 8. 60°, J, VN, Clay Su, Mn, Sp, Wa, S 9. 20°, J, VN, Clay, Mn Fe, Sp, Wa St, SR					
159													
160						1 2 3		Becomes reddish brown (5YR4/3), moderate weathering, medium strong, 20% vesicles, rounded, <3mm, mostly infilled with clay. 1. 50°, J, VN, Clay, Mn, Fe, Su Sp, Wa, S 2. 0°, J, VN, Clay, Mn, Fe, Sp Su, Wa, St, SR 3. 0°, J, VN, Clay, Mn, Fe, Sp, Wa, R 4. 80°, J ,VN, Clay, Pa, Mn, Sp, Wa, S 5. 0°, J, VN, Clay, Pa, Mn, Sp, Wa, SR 6. 50°, J, VN, Clay, Mn Fe, Sp, Wa, SR			0.0	[150]	
161													
162	33	16	96		78	4 M							Used ~150 gallons of water. No returns.
163						M 5 M							
164						6		Becomes black (2.5Y2.5/1) slight to moderate weathering, strong, 20% vesicles, rounded, <2mm					
165											0.0	[75]	
166						1		1. 60°, J, VN, Mn, Clay, Fe, Sp, Wa, S					
167	34	17	104		92	M 2		**BASALT A'a Clinker** welded and clay infilled, brown (7.5YR4/3), gray (GLEY 6/N), black (Gley 2.5/N), infilled clay reddish yellow (2.5YR7/8), moderately weathered, medium strong to strong. 2. 40°, J ,VN, Clay, Mn, Fe, Sp Su, St, SR 3. 20°, J, VN, Clay Su, Mn Fe Sp, Wa, SR 4. 5°, J, VN, Clay Su, Mn Fe Sp, Wa, R					Used ~150 gallons of water. No returns.
168													
169						3		a'a boulder, gray (GLEY 6/N), slightly weathered, strong, 7% vesicles, elongate, 1-5mm					
170						4 M 1		1. 0°, J, VN, Mn, Clay, Sp, Wa, R 2. 0°, J, VN, Clay Su, Mn Sp, Wa, SR			0.0	[75]	
171						IF 2							Used ~150 gallons of water. No returns.
172	35		100		72			**BASALT Massive A'a** light gray (GLEY1 7/N), slightly weathered, very strong, 5% elongate vesicles, <5mm angular					
173						IF		fractures partially infilled with clay					

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173								3. 45°, J, VN, Mn, Clay, Sp, Pl, SR 4. 5°, J, VN, Mn, Clay, Sp, St, SR 5. 50°, J, VN, Mn, Sp, Su, SR					
174													
175											0.0	[60]	
176								1. 5°, J, VN, Clay, Su, Mn, Sp, Pl, S 2. 5°, J, VN, Clay, Mn, Sp, Wa, SR 3. 45°, J, VN, Mn, Sp, Wa, SR 4. 45°, J, VN, Mn, Sp, Wa, SR 5. 0°, J, VN, Mn, Sp, Wa, SR 6. 90°, J, VN, Mn, Sp, Wa, SR					Used ~150 gallons of water. No returns.
177													
178	36	18	100		88			Becomes 10% vesicles, irregular, elongated, 2-25mm					
179								Becomes 2% olivine, 2-5mm					
180											0.0	[60]	
181								1. 5°, J, VN, Mn, Sp, St, SR 2. 60°, J, VN, Mn, Sp, Wa, SR 3. 10°, J, VN, Mn, Sp, St, SR 4. 10°, J, VN, Mn, Sp, St, SR 5. 20°, J, VN, Mn, Clay, Sp, Wa, SR 6. 10°, J, VN, Mn, Clay, Sp, Wa, SR 7. 5°, J, VN, Mn, Clay, Sp, Wa, SR					Used ~150 gallons of water. No returns.
182													
183	37		100		56								
184													
185											0.0	[23]	
186								Becomes 1% vesicles, <1mm 1. 15°, J, VN, Mn, Sp, Clay, Pa, St, SR 2. 10°, J, VN, Mn Sp, Clay Pa, Wa, S 3. 45°, J, VN, Clay Pa, Mn Sp, Wa, S 4. 30°, J, VN, Clay Su, Mn Sp, Wa, S 5. 5°, J, VN, Clay, Mn, Sp, Wa, S 6. 60°, J, VN, Clay Su, Mn Sp, Wa, S 7. 5°, J, VN, Mn Fe Sp, Clay Su, St, SR 8. 10°, J, VN, Mn, Sp, St, R 9. 5°, J, VN, Mn Sp, Clay Su, St, S 10. 85°, J, VN, Mn Sp, Wa S					
187													Used ~150 gallons of water. No returns.
188	38	19	100		68								
189													

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
189													Drilling paused at 190' bgs. Water level = 125.1' bgs at 1433.
190						10 M 1 2		**BASALT A'a Clinker** cemented, brown (7.5YR4/3), very dark gray (10YR3/1), strong brown (7.5YR5/6), moderate weathering, medium strong. ⌐ No recovery			0.0	[50]	Resume coring on 06/18/2019 at 0658. Water level = 125.14' bgs at 0654.
191								**BASALT Pahoehoe** red (2.5YR4/8), moderately weathered, medium strong, 5% vesicles, irregular, <4mm, 10% weathered olivine					
192						3		⌐ Becomes dark reddish brown (5YR3/4), moderately weathered, medium strong, 5% vesicles, irregular, 2-10mm, 10% weathered olivine, partial clay infilled reddish yellow (5YR6/8).					Used ~200 gallons of water. No returns.
193	39		84		80			⌐ Becomes very dark gray (5YR3/3), slightly weathered, strong, 10% vesicles, subrounded, 2-25mm, 15% olivine. 1. 0°, J, VN, No, No, Wa, R 2. 15°, J, VN, Clay, Pa, Mn Pa, Mn Sp, Wa, SR 3. 0°, J, VN, No, No, Wa, R 4. 0°, J, VN, Clay Su, Mn Sp, Wa, R 5. 0°, J, VN, Clay Pa, Mn Sp, Wa, SR 6. 20°, J, VN, Clay Pa, Mn Sp, St, SR					
194						4 5 6							
195						M		⌐ 50 x 20mm vug ⌐ 50 x 25 mm vug 1. 90°, J, VN, Clay Pa, Mn Sp, Pl, S 2. 0°, J, VN, Clay Su, Mn Sp, Wa R 3. 0°, J, VN, Clay Su, Mn Sp, Wa, R			0.0	[100]	
196						1							Used ~200 gallons of water. No returns.
197													
198	40	20	102		88	M		⌐ Becomes dark reddish brown (5YR3/4), moderate weathering, medium strong, 2% vesicles, <5mm, mostly infilled with clay, reddish yellow (5YR6/8), 2% weathered olivine.					
199						2							
200						3 M M M M M M M M M M M					0.0	[60]	
201								1. 10°, J, VN, Clay, Mn, Sp, Wa, SR 2. 45°, J, VN, Clay Su, Mn Sp, Wa, SR 3. 45°, J, VN, Clay Mn Fe, Sp, Wa, R					
202						1 M							
203	41	21	98		74	M 2		⌐ Becomes very dark gray (7.5YR3/1), moderately weathered, medium strong, 5% vesicles, irregular, <5mm, mostly clay infilled, 10% weathered olivine					Used ~200 gallons of water. No returns.
204						3		⌐ Becomes very dark gray (10YR3/1), little to slight weathering, strong to very strong, 15% vesicles, subrounded, 2-8mm, 10% olivine, weathered and unweathered.					
205						M							

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12

Elevation, feet / Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
205													0.0	[150]	drilled to 210' bgs. Paused drilling at 0729. Water level = 124.85' bgs at 0945. Water level = 125.2' bgs at 0805.
206															
207	42	21	100		100			Becomes 10% unweathered olivine, 15% vesicles, subrounded, 2-20mm.							Used ~200 gallons of water. No returns.
208						M		20 x 15mm vug 20 x 8mm vug							
209								Becomes 20% vesicles, rounded, 1-4mm, 10% unweathered olivine.							
210													0.0	[100]	Resume coring PQ on 06/26/2019 at 0721. Light brown water return circulation.
211						1		Becomes 10% vesicles, <4mm, rounded, 10% unweathered olivine.							
212	43	22	100		94	2		Becomes 10% vesicles, subangular, 2-25mm, 10% unweathered olivine 1. 15°, J, VN, Mn, ???? 2. 45°, J, VN, Mn, Sp, Wa, R 3. 45°, J, VN, Mn, Sp, Wa, SR							
213						M									
214		23				3 M									Paused coring at 0724 to monitor water levels.
215								RHMW12 was hand cleared from ground surface to 4.3 ft below ground surface (bgs). The borehole was then drilled using 10" OD hollow stem auger from 0 to 9 ft bgs, where there was refusal. HQ coring commenced from 9 ft to 129 ft bgs. Reamed borehole with 17.5" tricone bit from 0 ft to 12 ft bgs with refusal. Drilled with 24" OD core bucket with production auger rig from 0 ft to 58.6 ft bgs. Installed 18" steel surface casing to 58 ft bgs. Reamed borehole with 17.5" tricone bit from 58 ft to 125 ft bgs. Installed 10" steel conductor casing to 123 ft bgs. HQ coring continued from 129 ft to 200 ft bgs. Borehole was reamed from 125 ft to 200 ft bgs with 9 7/8" tricone bit. Installed 5" steel casing to 200 ft bgs. PQ coring commenced from 200 ft bgs to a TD of 215 ft bgs. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 5,295 gallons of water were used during drilling and rock coring. A total of 675 gallons of development water were removed with pump set at 134' bgs. RHMW12 well construction was completed on January 27, 2020. The well was completed with 3 inch diameter Schedule 80 polyvinyl chloride (PVC) well casing. The well was screened between approximately 22 and 37 ft msl. The 3-inch PVC well casing was installed in the existing 5 inch diameter Schedule 40 steel casing from 0							End of boring on 06/26/2019 Total Depth = 215' bgs
216															
217															
218															
219															
220															
221															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
221								to 200 ft below ground surface (bgs) and in the ~4.83 inch-diameter open borehole (PQ size) from 200 to 215 ft bgs. The lower 15-ft section of casing in the open borehole was screened with 0.020 inch slots. The casing was stabilized inside the existing 5-inch-diameter Schedule 40 steel casing with K-Packer well seals top and bottom with centralizers spaced between the K-Packers. Packers were installed at approximately 5 ft and 190 ft bgs. There is a bentonite seal from 1 ft to 5 ft bgs. No annular materials were added, which will allow for removal of the PVC casing in the event that redesign is warranted in the future. The recommended well design will accommodate a number of sampling methods, including a submersible pump, HydraSleeves, and Snap Samplers. The surface completion consists of a steel vault designed to secure and lock the well.						
222														
223														
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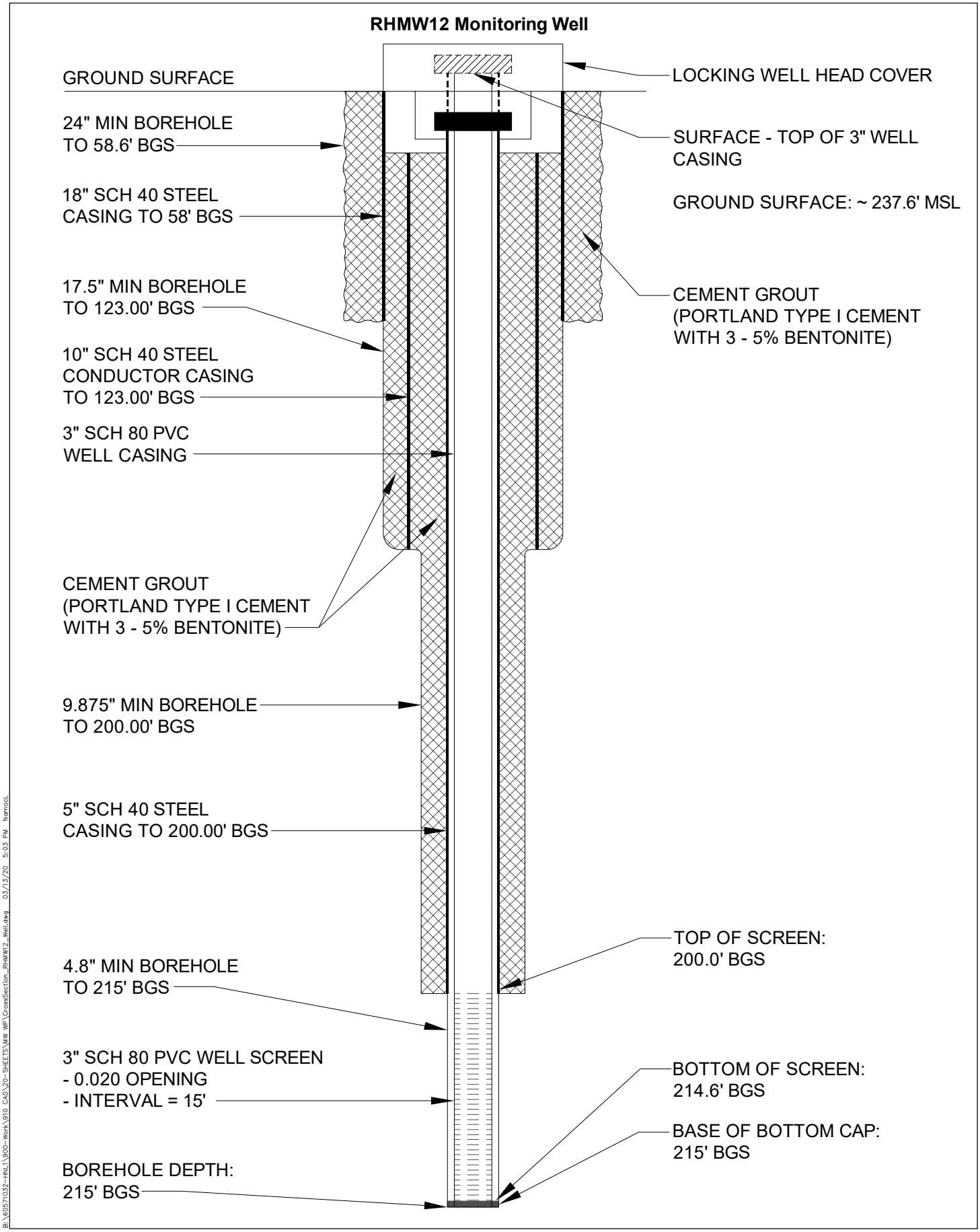

Cross Section of RHMW12 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY
Red Hill 60571032	RHMW12	Red Hill	(b) (6)

METHOD
- OVERPUMPAGE ☒
- BAILER ☐
- SURGE BLOCK ☐
- AIR LIFT ☐
- OTHER

Grundfoss submersible pump

7.04 gpm

INITIAL WATER LEVEL: 129.5' btoc
INITIAL TOTAL DEPTH: Not Measured

FINAL WATER LEVEL:
FINAL TOTAL DEPTH: Not Measured

REMARKS:
Casing stick up 2.2'

Pump intake 134' bgs

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY							TDS (ppm)	WATER LEVEL (ft btoc)
DATE	TIME	COMMENTS	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (psu)		
Zone 1: pump intake at 134' bgs														
6/20	0734	Start purging												
6/20	0740		9	7.04	63.36	6.80	28.24	4.48	4.26	183.7	32.7	2.4	2958.98	129.5
6/20	0743		11	7.04	77.44	7.01	25.87	4.55	4.06	190.0	23.3	2.5	2949.51	129.72
6/20	0745		16	7.04	112.64	7.04	25.74	4.45	4.15	198.5	15.8	2.4	2908.15	129.75
6/20	0750		21	7.04	147.84	7.07	25.76	4.31	4.23	204.0	11.0	2.3	2794.27	129.78
6/20	0755		26	7.04	183.04	7.07	26.06	4.16	4.54	212.0	7.4	2.2	2694.97	129.80
6/20	0800		31	7.04	218.24	7.06	25.90	4.14	4.87	219.4	4.5	2.2	2683.33	129.81
6/20	0805		36	7.04	253.44	7.06	25.72	4.10	4.91	220.6	6.0	2.2	2661.81	129.82
6/20	0810		41	7.04	288.64	7.05	25.60	3.90	4.99	220.3	4.1	2.1	2552.38	129.82
6/20	0815		46	7.04	323.84	7.05	25.47	3.73	5.10	210.2	3.6	2.0	2422.22	129.83
6/20	0820		51	7.04	359.04	7.05	25.45	3.62	5.17	201.6	2.8	1.9	2357.41	129.83
6/20	0825		56	7.04	394.24	7.04	25.42	3.37	5.16	194.0	3.0	1.8	2260.13	129.84
6/20	0830		61	7.04	429.44	7.04	25.69	3.36	5.16	190.8	3.04	1.8	2181.47	129.85
6/20	0835		66	7.04	464.64	7.03	25.59	3.85	5.16	188.3	1.95	2.1	2512.39	129.85

6/20	0840		71	7.04	499.84	7.03	25.74	3.93	5.29	191.5	2.01	2.1	2560.08	129.86
6/20	0845		76	7.04	535.04	7.02	25.74	3.91	5.35	193.1	2.8	2.1	2542.11	129.87
6/20	0850		81	7.04	570.24	7.02	25.64	4.13	5.44	194.9	2.3	2.2	2692.86	129.87
6/20	0855		86	7.04	605.44	7.02	25.62	4.00	5.44	194.9	2.15	2.1	2592.71	129.88
6/20	0900		91	7.04	640.64	7.02	25.59	3.81	5.45	195.5	2.5	2.0	2469.97	129.88
0905		Stop pumping, pull pump/casing up			Zone 1 total: 640.64									

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Date(s) Drilled	04/07/2021 - 06/24/2021	Logged By	(b) (6) (b) (6)	Checked By (Date)	(b) (6)
Drilling Method	HSA / HQ core / Air Rotary	Drill Bit Size/Type	24" core bucket auger / 6" HSA / HQ diamond bit / 9.25" mud rotary bit	Total Depth of Borehole	440.0 feet
Drill Rig Type	Mobile B-59 / Atlas Copco T3 / Mobile B-80	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	238 feet
Groundwater Level	El. 16.95' MSL (8/2/2021)	Location	Halawa Correctional Facility	Inclination from Horizontal/Bearing	90°
Borehole Completion	4-inch diameter monitoring well			Hammer Data	140 lbs/30-inch drop

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
238	0								**FILL** Well graded GRAVEL (GW), basalt, gray, angular, used as drill pad fill.							Hand auger 0 to 1' bgs. Encountered obstruction.
	1								**VALLEY FILL** SILTY, CLAYEY GRAVEL (GC-GM), medium brown, fine to coarse gravel, subrounded to angular, clayey silt, with fine to coarse grained sand, very low plasticity, slightly moist.							Begin 6.25" HSA
236	2															
	3											1			[5]	
234	4								**VALLEY FILL** Sandy LEAN CLAY (CL) with Gravel, brown (2.5Y 3/3), moist, fine to medium basalt gravel, fine sand, medium plasticity, increasing moisture with depth, increased clay% with depth.					0.0		
	5								**BASALT Massive A'a** Boulder, light to medium gray (5 YR 4/1), slightly weathered, strong to very strong, 10% 1-8mm vesicles, interbedded clay. 1. 15°, J, VN, Fe+Mn, Su, Ir, R 2. 5°, J, MW, Fe+Mn, Su, Pl, S 3. 5°, J, N, Fe+Mn, Su, Pl, S					[13]	Hard grinding at 5' bgs, refusal, pull HSA and begin coring
232	6						1 2 3									
	7	1		48		9	IF		No recovery							
230	8															
	9		1													
228	10						1		**BASALT Massive A'a** Boulder, same as above 1. 70°, J, MW, Fe+Mn, Su, Ir, S						[9.68]	
	11								No recovery							
226	12	2		64		33										
	13								**VALLEY FILL**							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW12A

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13								FAT CLAY (CH), medium to dark gray, (10YR 3/1), very moist to wet, stiff, very high plasticity, (>10% Sand)					
224	14							IF	**BASALT Massive A'a** Boulder, medium to dark gray (10YR 4/1) slightly weathered, very strong, 15% 1-12mm vesicles. 1. 20°, V, VN, Fe+Mn, Su, Pl, SR 2. 10°, J, VN, Fe+Mn, Su, Pl, SR 3. 10°, J, VN, Fe+Mn, Su, Ir, SR					
	15							1 2 3						End of coring on 4/7/2020
									VALLEY FILL FAT CLAY (CH) medium to dark gray, (10 YR 3/1), very moist to wet, stiff, very high plasticity, (>10% Sand)				[5.45]	Resume coring on 4/8/2020
222	16	3		75		50		1 2 IF	**BASALT Massive A'a** Boulder, medium to dark gray (10 YR 4/1) slightly weathered, very strong, 15% 1-12mm vesicles. 1. 20°, J, W, Fe+Mn, Su, Pl, SR 2. 10°, J, W, Fe+Mn, Su, Pl, SR					
	17							IF 1 2 IF	No recovery 10%, 1-10mm vesicles, occasional 10-25mm vug. 1. 0°, J, W, Fe+Mn, Su, Ir, SR 2. 10°, J, W, Fe+Mn, Su, Ir, SR				[18]	
220	18	4		33		33			No recovery					~50 gallons of water used, good circulation
	19													Difficult drilling Core barrel stuck inside drill pipe
218	20							IF 1 2 3 4 5	10%, 1-10mm vesicles, occasional 10-25mm vug. 1. 45°, J, VN, CL, Sp, PL, SR 2. 20°, J, N, CL, Sp, Ir, R 3. 20°, J, N, Fe+No, Su, Ir, SR 4. 10°, J, W, Fe+Mn, Su, Ir, SR 5. 10°, J, W, Fe+Mn, Su, Pl, R				[150]	
	21													~15 gallons of water used, good circulation
216	22	5		42		20			No recovery					
	23													
214	24		2											
	25							1 IF	10%, 1-10mm vesicles, occasional 10-25mm vug. 1. 30°, J, N, Fe+Mn, Su, Ir, S 2. 45°, J, N, Fe+Mn, Su, Ir, S				[37.5]	
212	26							2 IF						No water added, good circulation
	27								**VALLEY FILL** FAT CLAY (CH), reddish brown (10R 3/2), moist, stiff, low plasticity, firmly friable. Grades to dark gray (10Y 4/1), very moist to wet, high plasticity, stiff					
210	28	6		44		0			No recovery					
	29													

~~For Red Hill AOC Party Use Only~~

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
208	30						1		**BASALT Massive A'a** Boulder, dark to medium gray (7.5 YR 4/1), moderately weathered, medium to very strong, 20% 1-3mm vesicles, occasional vugs. 1. 80°, J, N, Fe, Su+Sp, Pl, R 2. 0°, J, MW, Cl, Su, Pl, S 3. 0°, J, N, Cl, Su, Ir, Sr becomes slightly weathered, very strong, 20% vesicles, occasional interbedded clay 4. 10°, J, N, Cl, Su, Pl, S 5. 75°, J, MW, N, Cl, Su, Ir, S						[50]	
	31						2							0.0		
206	32	7	2	30		24	3									No water added, good circulation
	33						IF									
204	34						4		No recovery							
	35						5									
202	36	8		36		20	IF		**VALLEY FILL** FAT CLAY (CH), dark to medium brown, (10 YR 3/4), moist to wet, stiff, low plasticity, firmly friable, occasional angular basalt fragments, decreasing moisture with depth.					0.0	[50]	No water added, good circulation, drilling fluid gaining viscosity
	37								no recovery							
200	38															
	39															
198	40						1									DTW 2.9' bgs
	41	9	3	32		20	2		**BASALT Massive A'a** Medium to dark gray (2.5 YR 4/1), slightly weathered, very strong, 20% 1-10mm vesicles, occasional 10-25mm vug. 1. 85°, J, N, Fe, Su, Ir, SR 2. 30°, J, MW, Fe+Mn+Cl, Su+Pa, Pl, S 3. 15°, J, N, Cl, Fi+Su, Wa, SR 4. 35°, J, MW, Cl, Fi+Su, Ir, S						[18.8]	Begin adding water
196	42						IF									
	43						3									~15 gallons of water added, good circulation
194	44						4		no recovery							
	45															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW12A

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
192	45						IF		**TUFF** Brecciated, dark reddish brown to grayish brown, moderately to highly weathered, moderately indurated, abundant 2-10mm xenoliths, with occasional firmly friable fragments.						[50]	
	46						IF		Intensely fractured, rounded basalt fragments							No water added
	47	10		32		0			No recovery							
190	48															
	49															
188	50														[33]	
	51								**VALLEY FILL** SILT with CLAY (ML-CL), dark reddish brown (10R 3/5), highly unconsolidated with 10-20mm easily friable fragments, little to no plasticity.							No water added, good circulation
186	52	11		100		28			**BASALT Pahoehoe** Medium to dark gray (10YR 4/1), slightly weathered, very strong, 40% 1-5mm vesicles, occasional 10-15mm vugs. 1. 0°, J, N, Fe+Mn, Fi, Ir, R 2. 30°, J, VN, Fe+Mn, Su+Fi, Wa, SR 3. 20°, J, MW, Fe+Mn, Su, Ir, R							
	53						1 2 3									
184	54															
	55						IF		becomes 1-8mm vesicles						[30]	
182	56						M 1		becomes 1-2mm vesicles							No water added, good circulation
	57	12		100		62	IF M M		becomes moderately weathered, with abundant Fe+Mn surface staining 1. 35°, J, N, Fe, Su, Pl, SR 2. 15°, J, VN, Cl+Fe+Mn, Su+Fi, Ir, R 3. 40°, J, VN,Cl+Fe+Mn, Su+Fi, Pl, SR 4. 30°, J, VN, Cl+Fe+Mn, Su+Fi, Pl, R 5. 30°, J, N, Cl+Fe+Mn, Su+Fi, Ir, R							
180	58						2 3 4 5									18" sch. 40 steel conductor casing installed to 58' bgs.
	59		4				M IF									
178	60															End of coring on 4/8/2020
							1 2 3		becomes moderately weathered, medium strong, Fe+Cl infilling and staining, 50% 0-8mm vesicles 1. 25°, J, N, Cl+Fe, Fi, Wa, R 2. 90°, J, N, Cl+Fe, Fi, Ir, R 3. 20°, J, MW, Cl+Fe, Fi, Ir, R					0.0	[50]	Resume coring on 4/19/2020
	61						IF									

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/5/2021 RHMW12A

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	61								4. 50°, J, N,Cl+Fe, Fi+Su, Ir, R 5. 35°, J, N, Cl+Fe, Fi, Pl, SR 6. 0°, J, W, Cl+Fe, Fi, Ir, R							
176	62	13		50		20										~200 gallons of water used
	63															
174	64						NR		No recovery							
	65								becomes less weathered, strong 1. 0°, J, N, Cl+Fe, Sp+Su, Ir, SR 2. 0°, J, MW, Fe, Sp, Ir, R						[50]	
172	66															
	67															
170	68	14	4	28		0	NR		No recovery					0.0		
	69															
168	70															End of coring on 4/19/2020
															[30]	Resume coring on 4/20/2020
	71								becomes moderately to highly weathered with abundant Cl and Fe infilling 1. 85°, J, T, Cl+Fe+Mn, Fi, Ir, SR 2. 45°, J, MW, Cl+Fe+Mn, Fi, Ir, SR 3. 30°, J, N, Cl+Fe+Mn, Fi+Su, Pl, SR 4. 15°, J, VN, Cl+Fe+Mn, Sp, Ir, R 5. 0°, J, N, Cl+Fe+Mn, Su+Pa, Pl, SR 6. 80°, J, VN, Cl+Fe+Mn, Su+Pa, Ir, R 7. 20°, J, N, Cl+Fe, Pa, Ir, R 8. 25°, J, N, Cl+Fe, Fi, Pl, R 9. 60°, J, MW, Cl+Fe+Mn, Fi, Ir, SR							~100 gallons of water used, good circulation
166	72	15		100		64										
	73		5													
164	74								becomes 1-10mm vesicles							
	75								1. 10°, J, N, Cl+Fe, Sp, Wa, R						[30]	
162	76								50% vesicles, becomes less weathered, medium strong to strong, occasional vug, abundant Cl infilling 2. 10°, J, VN, Cl+Fe, Sp, Wa, R 3. 30°, J, W, Fe+Mn, Su+Fi, Pl, SR 4. 20°, J, N, Cl, Sp, Wa, SR					0.0		~300 gallons of water used, good circulation Lost circulation
	77															

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	77															
		16		56		24			5. 10°, J, MW, Cl+Fe, Sp+Su, Ir, SR 6. 10°, J, MW, Cl+Fe+Mn, Fi, Ir,S R							Lost circulation
160	78													0.0		~300 gallons of water used
	79						NR		No recovery							
158	80								becomes less weathered, strong to very strong, 2-10mm vesicles						[50]	
							M M									
	81						M M									~300 gallons of water used
			5													
156	82	17		36		24										
	83						NR		No recovery							
154	84															
	85						IF 1		1. 15°, J, T, Cl+Fe, Sp, IR, VR						[100]	~100 gallons of water used
152	86															
	87	18		100		12										
150	88						2 3 4 5		becomes partially weathered, olivine+plagioclase+pyroxene, alteration haloes around fractures, gradation of vesicles from 1-35mm 2. 60°, J, MW, Cl+Fe+Mn, Pa, Wa, SR 3. 5°, J, VN,Cl+Fe+Mn, Pa, Pl, SR 4. 15°, J, T, Cl, Sp, Pl, R 5. 15°, J, VN, Cl, Sp, Ir, R							
	89						6		6. 45°, J, T, Fe, Py, Wa, SR 7. 60°, J, T, Fe+Mn, Pa, Pl, SR							
148	90		6				7 1 2 3		becomes 1-10mm vesicles, intense weathering on fracture surfaces, some infilling of vesicles, some zeolite masses up to 5mm thick						[75]	
	91						IF		1/2" thick, interbedded tuff at 91' bgs 1. 60°, J, T, Cl+Fe+Mn, Pa, Wa, SR 2. 0°, J, T, Cl+Fe+Mn, Pa, Pl, R 3. 10°, J, T, Cl+Fe+Mn, Su, Wa, R IF. Cl+Fe+Mn 4. 15°, J, N, Cl+Fe+Mn, Su, Wa, SR 5. 10°, J, MW, Cl+Fe, Pa, Ir, R 6. 30°, J, T, Cl+Fe+Mn, Pa, Wa, SR							~130 gallons of water used
146	92	19		100		92	4 5 6									
	93															

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Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	93								7. 0°, J, VN, Fe+Mn, Pa, Wa, S 8. 10°, J, T, Cl+Fe,+Mn, Fi, Ir, R 9. 10°, J, N, Cl+Fe, Pa, Ir, SR 10. 0°, J, VN, Cl, Pa, Ir, R						
144	94		6						becomes slightly weathered to fresh, 1-15mm vesicles, moderate to highly weathered around fractures 1. 60°, J, T, Cl+Fe, Su, Pl, SR 2. 0°, J, T, Cl+Fe, Sp, Ir, VR 3. 75°, J, T, Cl+Fe+Mn, Pa, Pl, SR 4. 0°, J, VN, Cl+Fe+Mn, Sp, Ir, R					[38]	
	95															
142	96															~130 gallons of water used
	97								5. 60°, J, VN, Cl+Fe+Mn, Pa, Wa, SR 6. 60°, J, T, Fe, Su, Wa, SR IF. Cl+Fe, large prismatic zeolites 7. 10°, J, MW, Cl+Fe+Mn, Fi, Ir, VR 8. 10°, J, T, Fe, Su, Pl, SR 9. 45°, J, VN, Cl+Fe+Mn, Pa, Wa, SR						
140	98	20		100		76										
	99															
138	100															End of coring on 4/20/2020
															[60]	Resume coring on 4/21/2020
	101		7						abundant clay infilling, clay is creamy white to coral pink in color 1. 75°, J, N, Cl+Fe, Fi, Ir, S 2. 45°, J, MW, Cl+Fe, Fi+Sp, Ir, R 3. 45°, J, N, Cl+Fe, Fi, Pl, R 4. 45°, J, MW, Cl+Fe, Fi, Ir, SR					0.0	Heavy rig chatter
136	102								5. 5°, J, N, Cl+Fe, Fi, Pl, R 6. 5°, J, MW, Cl+Fe, Fi+Sp, Pl, S 7. 85°, J, N, Cl+Fe, Fi, Ir, S 8. 85°, J, N, Cl+Fe, Fi, Pl, SR 9. 75°, J, N, Cl+Fe, Fi, Pl, S						~220 gallons of water used
	103	21		94		74										
134	104								becomes 20-30mm vugs 10. 45°, J, VN, Cl+Mn, Pa+Su, Ir, SR 11. 45°, J, MW, Cl+Mm, Pa+Su, Ir, R 12. 30°, J, MW, Cl, Pa, St, R becomes moderately to highly weathered						
	105						NR		No recovery becomes less weathered, strong to very strong, 40% 1-10mm vesicles						[43]	
132	106								1. 25°, J, N, Cl, Pa, Pl, R 2. 50°, J, VN, Fe, Su+Sp, Pl, R 3. 0°, J, N, Cl+Fe, Fi, Pl, R 4. 10°, J, VN, Cl+Fe+Mn, Sp+Su, Ir, R 5. 55°, J, N, Cl, Sp, Ir, R 6. 15°, J, N, Cl+Fe, Su+Sp, Pl, S						
	107		8													~200 gallons of water used
		22		68		48								0.0		
									becomes moderately weathered, medium strong IF becomes unweathered							
130	108								No recovery							
	109						NR									

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
128	109						NR		No recovery							
	110								becomes 30% vesicles 1. 15°, J, N, Cl, Sp+Su, Pl, SR 2. 20°, J, W, Fe, Su+Pa, Ir, R 3. 15°, J, MW, Cl+Fe, Pa+Sp, Ir, R 4. 10°, J, W, Cl+Fe+Mn, Fi, Ir, R					0.0	[60]	Heavy rig chatter
	111		8													~115 gallons of water used
126	112	23		96		82	IF		**BASALT A'a Clinker** Welded, medium to dark gray (N5/N4) with reddish brown (70 R 4/6), moderately to highly weathered increasing with depth, abundant clay infilling, 5-35mm clasts.							
	113								**BASALT Pahoehoe** Dark gray (N4), moderately weathered, medium strong, 20% 1-10mm vesicles, 10-35mm vugs, abundant clay infilling. 1. 0°, J, N, Fe+Mn, Fi, Ir, R 2. 30°, J, VN, Fe+Mn, Su+Fi, Wa, SR 3. 20°, J, MW, Fe+Mn, Su, Ir, R							
124	114								**BASALT A'a Clinker** same as above							
	115						NR		No recovery 4. 5°, J, N, Cl+Fe, Fi, Pl, SR 5. 10°, J, VN, Cl, Fi, Ir, R 6. 10°, J, VN, Cl, Fi, Ir, R 7. 15°, J, N, Cl, Fi, Ir, R 8. 20°, J, N, Cl, Fi, Ir, R						[42]	
122	116								**BASALT Massive A'a** Dark gray (N5), slightly weathered to fresh, very to extremely strong, 5% 1-2 mm vesicles, occasional 5-10mm vesicles 1. 30°, J, VN, No, Pl, S 2. 45°, J, VN, Cl, Sp, Pl, SR 3. 20°, J, VN, Cl, Sp, Ir, SR 4. 40°, J, N, Cl, Sp, Pl, S 5. 10°, J, N, Cl, Sp, Pl, S 6. 20°, J, VN, Cl, Sp+Su, Pl, S 7. 60°, J, MW, Cl, Sp, Pl, S 8. 60°, J, MW, Cl, Pa, Pl, S							
	117	24		92		80										~220 gallons of water use
120	118		9						becomes 15% 1-10mm vesicles							
	119															
118	120						NR		No recovery						[27]	End of coring on 4/21/2020 Resume coring on 4/22/2020
	121								becomes medium dark gray (N4), slightly weathered, very strong, 10% 1-10mm slightly elongated vesicles, occasional 30-40mm vug							
116	122	25		100		92			1. 25°, J, N, Cl, Su+Sp, Pl, SR 2. 25°, J, N, Cl, SU+Sp, PL, SR 3. 10°, J, VN, Cl, Sp, Ir, SR 4. 20°, J, CL, Su, Pl, Ir							~220 gallons of water use
	123															
114	124		10				M		becomes 15% vesicles							
	125						M									

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Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
125							1		becomes 0-15%, 1-12mm vesicles, rare large vesicles				[50]	
							2		1. 15°, J, N, Fe+Mn, Pa, St, VR					
							3		2. 5°, J, N, Fe, Su, Ir, VR					
112	126						IF		3. 15°, J, MW, Cl+Fe+Mn, Sp, Wa, SR					Heavy rig chatter
									IF. CL+Fe, Sp					
	127						M							
		26		100		83						0.0		
110	128		10											
							M							
	129													
108	130						1		becomes slight to moderately weathered, 0-5%, 1-5mm vesicles, rare 20-40mm vugs				[33]	
									1. 5°, J, T, Fe+Mn, Su, Pl, S					
	131						2		2. 5°, J, MW, Cl+Uk, Pa, Wa, R					
							3		3. 10°, J, MW, Si, Su, IR, SR					
106	132						4		4. 0°, J, T, Cl+Fe, Pa, IR, SR					
		27		112		40	5		5. 45°, J, MW, Uk, Su, Ir, R			0.0		
							6		6. 45°, J, T, Mn+Uk, Su, Pl, SR					
	133						7		7. 75°, J, T, Uk, Su, Pl, SR					~200 gallons of water used
							8		8. 85°, J, T, Fe+Mn+Uk, Su, Pl, SR					
							9		9. 0°-30°, J, T, Uk, Su, St, VR					
104	134		11				10		10. 85°, J, T, Mn+Si+Uk, Su, Pl, SR					
							IF		IF. Fe+Mn+Uk, Su					
							11		11. 85°, J, T, Si+Uk, Su, Pl, SR					
	135						12		12. 5°, J, MW, Cl+Uk, Su, Pl, SR				[50]	
							13		13. 0°, J, MW, Cl+Fe+Mn, Su, Ir, R					
							14		14. 5°, J, MW, Uk, Su, St, R					
							15		15. 0°, J, N, T, Fe+Uk, Su, Wa, SR					
							16		16. 0°, J, MW, Uk, Su, Wa, SR					
							17		17. 0°, J, MW, Su, Pl, SR					
							18		18. 0°, J, MW, Cl, Sp+Su, Pl, SR					
							19		19. 0°, J, N, Cl, Sp, Pl, SR					
							20		20. 0°, J, N, Cl, Sp, Pl, SR					
							21		21. 0°, J, N, Cl, Sp, Ir, SR					
							22		22. 90°, J, N, Cl, Sp, Pl, SR					
							1							
							2		1. 0°, J, N, Uk, Su, Pl, S					
							3		2. 0°, J, N, Fe, Su, Pl, S					
							IF		3. 5°, J, N, Cl, Sp, Pl, S					
102	136						1		4. 15°, J, N, Cl+Fe, Sp, Ir, SR					
							2		5. 5°, J, N, Uk, Sp, Ir, SR					
							3		6. 5°, J, MW, Cl, Sp, Pl, S					
							4		7. 25°, J, MW, Cl, Sp, Pl, SR					
	137						5		8. 15°, J, MW, Cl, Sp, Pl, SR					
							6		9. 5°, J, VN, Cl, Sp, Wa, SR					
							7		10. 0°, J, N, Cl, Su, Ir, SR			0.0		~200 gallons of water used
		28		88		28	8		11. 15°, J, N, Cl+Fe, Su, Pl, S					
							9		12. 5°, J, MW, Cl+Fe, Su+Sp, SR					
							10		13. 0°, J, W, Cl+Fe, Pa+Su, SR					
100	138						IF		14. 30°, J, W, Cl+Fe, Fi, VR					
							11		15. 45°, J, W, Cl+Fe, Ir, VR					
							12							
	139						13							
							14		**BASALT - A'a Clinker**					
							15		Welded, dark rusty red (5R 3/4) with dark grayish brown fragments, highly weathered, weak to very weak, crumbly in places, abundant clay infilling, 5-35mm clasts.					
							IF							End of coring on 4/22/2020
98	140								**BASALT Pahoehoe**				[50]	Resume coring on 4/23/2020
			12						Medium to dark gray (N4/N3) mottled with rusty red (5R 3/4), highly weathered/altered, weak to very weak, 50% 1-15mm vesicles with abundant clay infilling.					
	141													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	SAMPLES: PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
96	141								becomes dark reddish brown (10R 3/4), moderately weathered, medium strong, 50% 1-10mm rounded vesicles.			0.0		
	142	29	12	100		92			becomes moderately to highly weathered. becomes dusky gray (5R 3/4), 4-8mm vesicles, abundant clay infilling. 1. 45°, J, W, Cl+Fe, Su, Fi, Ir, R 2. 30°, J, W, Uk, Cl+Fe, Fi, Ir, R 3. 40°, J, VN, Cl, Fi, Pl, SR 4. 45°, J, VN, Cl, Fi, Pl, SR 5. 50°, J, VN, Cl, Fi, Wa, R 6. 45°, J, VN, Cl, Pa, Wa, R 7. 0°, J, N, Cl, Fi, Pl, S					~200 gallons of water used
94	143													
	144													
	145												[42]	
92	146								becomes moderate medium dark gray (N4/N3), clay infilling decreases. 1. 0°, J, N, Cl, Pa, Pl, SR 2. 0°, J, MW, Cl, Fi, Wa, SR 3. 0°, J, N, Cl, Pa, Pl, SR 4. 0°, J, N, Cl, Fi, Pl, SR 5. 10°, J, N, Cl, Pa, Pl, SR 6. 15°, J, MW, Cl, Sp, Pl, SR 7. 0°, J, MW, Cl, Sp, Ir, SR 8. 20°, J, VN, Cl, Su, Pl, SR 9. 0°, J, VN, Cl, Fi, Ir, SR 10. 30°, J, VN, Cl, Fi, Pl, SR 11. 25°, J, VN, Cl, Pa, Pl, SR					~200 gallons of water used
	147	30		100		88						0.0		
90	148													
	149													
88	150												[50]	
	151		13						becomes less weathered.					
86	152	31		100		100			1. 45°, J, N, Cl, Fi, Pl, S 2. 90°, J, VN, Cl, Fi, Pl, S 3. 30°, J, N, Cl, Fi+Sp, Ir, SR 4. 20°, J, VN, Cl, Fi+Sp, Pl, R			0.0		~200 gallons of water used
	153													
84	154													
	155												[38]	
82	156								increase in clay infilling in fractures and vesicles around fractures 1. 10°, J, MW, Cl, Fi, Ir, SR 2. 10°, J, N, Cl, Fi, Pl, SR 3. 45°, J, VN, Cl, Fi, Pl, S 4. 5°, J, N, Cl, Fi, Pl, SR					~200 gallons of water used
	157													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
80	157															
	158	32		100		58			becomes 1-6mm vesicles 5. 25°, J, VN, Cl, Fi, Pl, SR 6. 15°, J, VN, Cl, Pa, Pl, SR 7. 20°, J, VN, Cl, Fi, Pl, SR 8. 20°, J, VN, Cl, Fi, Pl, SR 9. 40°, J, VN, Cl, Fi, Ir, SR 10. 90°, J, VN, Cl, Fi, Pl, SR 11. 20°, J, VN, Cl, Fi, Ir, SR 12. 75°, J, VN, Cl, Fi, Pl, SR						
	159		14													
78	160								becomes fully altered plagioclase lathes visible throughout, glassy margins of flow lobes moderately altered and clay filled. 1. 80°, J, T, Cl+Fe+Mn, Fi, Pl, R						[33]	
	161															~200 gallons of water used
76	162	33		88		84										
	163															
74	164								2. 80°+0°, J, T, Cl+Fe+Mn, Fi, Ir, VR							
							NR		No recovery							
	165														[33]	
72	166								1. 35°, J, T, Cl+Fe+Mn, Fi, Ir, SR							
	167								2. 10°, J, N, Cl, Fi, Pl, SR 3. 15°, J, VN, Cl, Fi, Pl, S 4. 5°, J, N, Cl, Fi, Pl, SR							~200 gallons of water used
70	168	34		112		72			**BASALT A'a Clinker** Welded, dark grayish brown (5R 1/4) fragments, moderately weathered, weak to vey weak, partial infilling of voids, 5-40mm clasts. 5. 60°, J, N, Cl+Fe+Mn, Pa, Ir, VR 6. 5°, J, VN, Cl+Fe+Mn, Pa, Ir, VR 7. 5°, J, T, Cl+Fe, Pa, Ir, VR IF. Cl+Fe, Sp						
	169		15													
68	170								becomes unconsolidated gravel, 1-5mm becomes 20-70mm clasts, spotty clay infilling, Fe+Mn staining						[23]	
	171															~200 gallons of water used
66	172						NR		No recovery							
		35		22		0										
	173															

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Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
64	173						NR		No recovery			0.0		~200 gallons of water used
	174													
	175						IF						[21]	
62	176						IF		**BASALT Massive A'a** Dark gray (N3), fresh to slighty weathered, very strong, 1% 1-5 mm vesicles.					
	177		15											~200 gallons of water used
60	178	36		60		42						0.0		
	179						NR		No recovery					
58	180													End of coring on 4/23/2020
							1		becomes 5% vesicles 1. 45°, J, VN, Cl, Sp, Pl, SR 2. 30°, J, VN, Cl, Fi, Wa, S 3. 30°, J, N, Cl, Fi, Pl, S 4. 45°, J, VN, Cl, Pa+Sp, Pl, R 5. 30°, J, N, Cl, Pa+Sp, Pl, SR 6. 15°, J, N, Cl, Fi, Wa, SR 7. 15°, J, N, Cl, Sp, Pl, SR				[50]	Resume coring on 4/26/2020
	181						2							
							3							
							4							
							5							
56	182						6							~250 gallons of water used
		37		110		40	7							
	183						M							
							M		abundant mechanical fracturing					
							IF							
							M							
54	184						IF							
							IF							
			16				M							
							M							
							M					0.0		
	185						IF						[30]	Heavy rig chatter
							M		becomes 1-10mm vesicles					
							M		1. 0°, J, W, Cl, Pa+Sp, Ir, R 2. 5°, J, MW, Cl+Fe, Pa, Pl, SR 3. 10°, J, MW, Uk, Su, Pl, SR 4. 15°, J, VN, Cl+Fe, Fi, Pa, SR 5. 30°, J, N, Uk, Sp, Pl, SR					
52	186						1							
							IF							
							2							
							M							
	187						M							
							3							
							4							
		38		100		22	5							
50	188													
							IF							
	189													

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Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	189						IF									
							IF		**BASALT A'a Clinker** Welded, medium gray (N5) with reddish brown (10R 4/4) interbedded clay sections, moderately to highly weathered, weak to very weak, abundant clay and clay infilling, occasional 10-30 mm pebbles, common 1-10 mm interbedded clasts.							
48	190						IF								[5]	
							IF									Circulation problem, possible blockage, pause drilling
	191								**BASALT Pahoehoe** Dark reddish brown (10YR 3/4) to medium gray, highly to moderately weathered, weak to strong, abundant 1-5 mm olivine phenocrysts, 50% 1-10mm vesicles with 5% 20mm vugs. 1. 15°, J, T, Cl+Fe, Fi, Ir, R 2. 20°, J, VN, Cl, Fi,Pl, SR 3. 25°, J, N, Mn, Sp, Pl, SR							
46	192	39		92		84		1								Return water rusty red
								2								
	193							M								
44	194							3								
							NR		No recovery							End of coring on 4/26/2020
	195		17					1	clay in void at top of core becomes 30% 1-10mm rounded vesicles						[23]	Resume coring on 5/12/2020
42	196								30cm void, no infill							
	197							M								
		40		88		88			1. 10°, J, N, Cl, Sp, Wa, SR 2. 10°, J, MW, Cl, Fi, Wa, SR							~200 gallons of water used, retained circulation
40	198							2								
	199								becomes 40% 1-2mm, rounded vesicles void with surfaces covered in light olive (10Y 5/4) clay No recovery					0.6		
							NR									
38	200							M							[23]	Drill time estimated
								1	1. 5°, J, N, Cl+Mn, Pa+Sp, Wa, SR 2. 45°, J, MW, Cl+Mn, Fi, Pl, SR 3. 45°, J, MW, Cl+Mn, Fi, Pl, SR 4. 25°, J, N, Cl+Mn, Sp+Su, Wa, SR							
	201															
36	202							2	becomes weak, increasingly weathered olivine phenocrysts, signs of chemical weathering include iddingsite and clay filling of vesicles							~200 gallons of water used
		41	18	110		96		3								
	203															
34	204							4								
	205															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW12A

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	205								becomes highly weathered, weak, 30% 2-5mm vesicles, clay in most vesicles, waxy pale pinkish red clay						[50]	
32	206		18				1		1. 80°, J, VN, Cl+Mn, Fi+Sp, Wa, SR					0.0		
							2		2. 10°, J, MW, Cl, Fi, Ir, R							
							3		3. 10°, J, MW, Cl, Pa, Ir, R							~200 gallons of water used
	207								becomes moderately weathered, strong, no clay in vesicles, 1-5 mm olivine crystals still present							
		42		100		98										
30	208						4		4. 80°, J, MW, Cl+Mn, Fi+Sp, Wa, SR							
	209															
28	210								becomes highly weathered, weak, 30% 2-5 mm rounded vesicles, with waxy pale pinkish clay						[30]	
			19				1							0.0		
	211						2									
							3		becomes moderately weathered, strong, 0.5-2 mm irregular vesicles							~200 gallons of water used
							4		1. 10°, J, MW, Cl+Mn, Fi, Wa, S							
							M		2. 10°-50°, J, MW, Cl+Mn, Sp, St, R							
							M		3. 50°, J, MW, Cl+Mn, Sp, Ir, R							
26	212						M		4. 70°, J, MW, Cl+Mn, Fi, Pl, S							10" sch. 40 steel conductor casing installed to 212' bgs.
		43		100		86			5. 10°, J, T, Cl+Mn, No, Pl, SR							
	213						5		becomes 0.5-7 mm vesicles							
24	214															
							M									
	215															End of coring on 5/12/2020
		44		0		0	NR		No recovery						[8]	Resume coring on 6/2/2020
22	216															End of coring on 6/2/2020
							1		medium brown (5YR 3/4) to medium gray, highly weathered, weak to very weak, 20% 1-5 mm vesicles, abundant clay infilling, becomes more weathered with depth						[75]	Resume coring on 6/3/2020
	217						2		1. 40°, J, N, Cl+Mn, Fi, Ir, R							
									2. 15°, J, MW, Cl+Mn, Fi, Pl, R							~200 gallons of water used
20	218	45		50		50	IF									
			20				NR		No recovery							Water recirculating, medium brown
	219															
18	220														[43]	
									1. 5°, J, VN, Cl, Pa, Pl, R							
	221						1		becomes less weathered							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	221													Static water level depth measured on 8/2/2021
16	222	46	20	96		98			becomes medium gray, 30% vesicles 2. 5°, J, VN, Cl, Pa, Pl, R 3. 20°, J, VN, Cl+Mn, Pa, Pl, SR 4. 45°, J, VN, Cl, Sp+Su, Pl, SR					Water recirculating, medium brown
	223													
14	224													
	225								No recovery 30% 1mm vesicles			0.0	[60]	
12	226								1. 15°, J, VN, Cl+Fe+Mn, Pa, Pl, SR 2. 45°, J, VN, Cl+Fe+Mn, Pa, Pl, SR					
	227	47		100		100			becomes 15%, 20mm vesicles 3. 10°, J, VN, Cl+Fe+Mn, Pa, Wa, SR 4. 15°, J, VN, Cl+Mn, Pa, Wa, SR 5. 35°, J, VN, Cl+Mn, Sp, Pl, SR 6. 10°, J, VN, Cl+Fe+Mn, Pa, Ir, R					Water recirculating, medium brown
10	228													
	229													
8	230											0.0	[33]	
	231		21						1. 45°, J, VN, Cl, Sp, Pl, R 2. 10°, J, VN, Cl, F, Wa, R becomes highly weathered, weak					
6	232	48		100		70			3. 5°, J, N, Cl, F, Ir, SR 4. 40°, J, VN, Cl, Pa, Pl, VR 5. 25°, J, N, Cl, Pa, Pl, R 6. 10°, J, N, Cl, Su+Pa, Ir, R					Water recirculating, medium brown
	233								vesicle size increases to 5 - 10 mm, occasional vugs 7. 10°, J, MW, Cl, Su+Pa, Ir, SR					
4	234								8. 40°, J, VN, Cl + Mn, Sp, SR 9. 45°, J, VN, Cl + Mn, Sp, SR					
	235								becomes highly weathered, weak, abundant clay infilling becomes moderate reddish brown (10 R 4/6)				[38]	
2	236		22						1. 20°, J, N, Cl + Fe, Ir, SR 2. 35°,VN, Cl, Fi, SR					
	237													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	SAMPLES: PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	237													
		49		86		50			becomes less weathered, strong, medium dark gray (N4)					Water recirculating, medium brown
0	238						3 4 5		3. 0°, J, N, Mn, Sp, Pl, SR 4. 30°, J, VN, Mn, Sp, Pl, SR 5. 10°, J, MW, Cl, Fi, Ir, R					
	239						IF		becomes highly weathered, increase in % clay, extremely weak					
							NR							
-2	240		22										[50]	
							1		moderate weathering, 25% vesicles 1-10 mm in diameter					
	241													~20 gallons used to recharge hole
							2		1. 25°, J, N, Cl, Sp, Pl, SR 2. 15°, J, VN, Cl, Fi, Ir, R 3. 10°, J, MW, Cl, Fi, Ir, R					
-4	242	50		100		60								
							3							
	243								becomes highly weathered, very to extremely weak, moderate brown (5 YR 3/4), vesicles decrease to less than 1%					
-6	244						IF							
	245												[43]	
							IF							
-8	246						1		**BASALT A'a Clinker** Welded, moderate rusty red (5R3/4) to medium gray (N5), highly weathered, very to extremely weak, crumbly, abundant clay, occasional 1 - 3 mm elongated vesicles 1. 0°, J, N, Cl, Sp, Pl, SR 2. 10°, J, MW, Cl, Fi Ir, SR 3. 5°, J, MW, Cl, Fi, Ir, R 4. 0°, MW, Cl+Mn, Fi+Sp, R 5. 45°, J, W, Cl, Fi+Sp, Ir, R 6. 5°, MW, Cl, Fi, Ir, R					Water recirculating, reddish brown
	247						M 2 3							
-10	248	51		100		40								
							4 5 6							
	249						M M							
-12	250						IF		**BASALT Massive A'a** Medium gray (N5), moderately weathered, medium strong, 5% 1-10 mm elongated vesicles				[50]	
			23						**BASALT A'a Clinker** Welded, same as above 1. 0°, J, W, Cl+Fe, Fi, Ir, R 2. 0°, J, MW, Cl+Fe, Fi, Ir, R 3. 10°, J, MW, Cl+Fe, Fi, Ir, R 4. 5°, J, MW, Cl+Fe, Fi, Ir, R					
	251						1 2 3 4							No water used
-14	252													
		52		90		40	5		5. 15°, J, N, Cl, Fi, Ir, R 6. 10°, J, MW, Cl, Fi, Ir, R					
	253						6							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	SAMPLES: PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	253						7		7. 5°, J, MW, Cl, Fi, Ir, R					
							8		8. 0°, J, MW, Cl, Fi, Ir, R					
-16	254		23				9		9. 0°, J, N, Cl, Su+Pa, Ir, R					
							M							
	255						NR		No recovery				[38]	
							1		1. 0°, J, T, Mn+Cl, Fi, Pl, S					
-18	256													
							2		2. 0°, J, VN, Cl, Fi, Pl, SR					
	257								**BASALT - Massive A'a**					
		53		86		40	IF		Medium gray (N5), moderately weathered, rare vesicles to 20 mm					
-20	258								IF. Cl+Mn,+Uk					
							2							
	259						3		3. 60°, J, VN, Cl, Sp, Pl, R					
									4. 75°, J, VN, Cl, Mn, Sp, Pl, R					
							NR		No recovery					
-22	260		24										[27]	End coring on 6/3/2021 Resume coring on 6/4/2021
							IF		becomes less weathered, 1% 5-15 mm elongated vesicles					
	261						IF							
							1							
							2		1. 0°, J, MW, Mn,Sp+Su, Pl, SR					
-24	262						3		2. 0°, J, MW, Mn, Sp+Su, Ir, R					
							4		3. 15°, J, T, Mn+Cl, Sp, Ir, SR					
		54		96		18	5		4. 20°, J, VN, Mn+Cl, Fi+Su, Wa, SR					
							6		5. 20°, J, VN, Mn+Cl, Fi+Su, Wa, SR					
	263						7		6. 20°, J, VN, Mn+Cl, Su, Wa, SR					
							8		7. 5°, J, VN, Mn+Cl, Fi+Su, Ir, R					
							IF		8. 10°, J, MW, Mn+Cl, Su+Sp, Ir, SR					
-26	264						IF		**BASALT A'a Clinker**					
							IF		Loose, dark gray (N3) to dark reddish brown (10R 3/4), highly unconsolidated, crumbly, occasional 30-40 mm a'a fragments, abundant clay, abundant sand to pebble size frags					
	265						NR		No recovery				[50]	Water recirculating, light medium brown
-28	266						IF		becomes highly weathered, clay					
	267													
		55		76		0								
							1		**BASALT Massive A'a**					
-30	268		25				2		Medium dark gray (N4), moderately weathered, medium strong, 5% 1-5 mm angular and elongated vesicles					
									1. 10°, J, N, Mn,Sp, Ir, R					
							IF		2. 0°, J, N, Mn,Sp, IR, R					
	269						NR							

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269								No recovery						
-32	270						IF		IF. Cl+Mn					[33]	
							1		1. 15°, J, T, Mn, Sp, St, VR						
	271		25				2		2. 30°, J, T, Mn, Sp, Ir, SR						
							3		3. 45°, J, T, Mn, Sp, Ir, VR						
							4		4. 10°, J, T, Mn+Cl, Sp, Ir, VR						
-34	272						IF								
		56		90		44							0.0		~10 gallons of water used
	273						IF		**BASALT A'a Clinker, loose** Grayish red (5R 3/2) to blackish red (5 R1/2) to moderate yellow brown (10YR 3/4), highly weathered, extremely weak						
									BASALT Pahoehoe Grayish brown (5R 1/4) to moderate yellow brown (10YR 3/4), slightly weathered grading to highly weathered, strong to medium strong						
-36	274						5		5. 10°, J, VN, Cl, Fe, Pa, IR, VR						
							6		6. 0°, J, VN, Cl+Mn+Fe, Pa, IR, VR						
	275								**BASALT A'a Clinker** Welded, dark gray (N5) with dusky brown (5YR 2/2) common in matrix clasts, highly weathered, abundant clay, very to extremely weak					[50]	End coring on 6/4/2021 Begin coring on 6/7/2021
-38	276														
							IF								
	277														
		57		74		0							0.0		Water recirculating
-40	278														
	279								No recovery						
									BASALT Massive A'a Medium dark gray (N4) to dark gray (N5), slightly weathered, very strong, 5% 1-3 mm angular vesicles, abundant manganese staining vesicle size increases to 1-10mm						
-42	280						IF							[60]	
	281														
							IF								
-44	282														
		58	26	84		28	1		1. 0°, J, MW, Mn+Cl, Sp, Ir, SR						~5 gallons of water used
	283						2		2. 10°, J, N, Mn+Cl, Sp, IR, SR						
							IF		becomes highly weathered						
-46	284								No recovery						
	285														

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	285						1		**VOLCANIC SAPROLITE** Medium reddish brown (10YR 3/2), extremely weathered, extremely weak to firm, friable, abundant clay 1. 0°, J, MW, Cl, Fi, Pl, SR				[30]	
-48	286						IF		**BASALT Pahoehoe** Medium gray (N5) to medium dark gray (N3), moderately to highly weathered, very strong to extremely weak, 10% 1-2.5 mm vesicles becomes highly weathered, extremely weak, with abundant clay					
	287		26				2 3 4 5 6							
		59		80		0	IF		2. 0°, MW, Cl, Fi+Sp, Ir, SR 3. 0°, MW, Cl, Fi+Sp, Ir, SR			0.0		~10 gallons of water added
-50	288						7 8		becomes less weathered, very strong, vesicle size increases to 20-25 mm					
	289						9		4. 0°, MW, Cl, Fi+Sp, Ir, SR 5. 0°, MW, Cl, Fi+Sp, Ir, SR 6. 5°, N, Cl, Fi+Sp, Wa, SR					
							NR		No recovery					
-52	290								7. 40°, J, MW, Cl, Sp, Ir, SR 8. 45°, J, N, Mn, Su, Pl, SR 9. 45°, J, N, Mn, Su, Pl, SR				[20]	End coring on 6/7/2021 Resume coring on 6/8/2021
							M							
	291						1		vesicles become rounded 2-3 mm, 30% 1. 70°, J, N, Cl, Sp, Pl, R					
-54	292								becomes multicolored dark reddish gray (2.5 YR 3/1), reddish brown (2.5YR 4/3), and strong brown (7.5 YR 5/4), highly weathered, with white, waxy clay in some vesicles, very weak					
		60		84		66	2					0.0		No water added. Water changed color from brown to gray to brown.
	293								2. 70°, J, N, Cl+Mn+Fe, Sp+Su+Fi, Ir, SR					
									completely weathered becomes moderately weathered, strong, 10% 10-25 mm vesicles					
-56	294													
							IVR		No recovery					
	295		27										[43]	
									30% 0.5-2 mm rounded vesicles					
-58	296								multicolored, gray (7.5YR 5/1) and brown (7.5YR 5/3), with white waxy clay, weak medium gray (N5), slightly weathered, strong, 30% to 40% rounded vesicles, size increases from 1-5 mm with depth					
	297						1		1. 70°, J, N, Mn+Cl, Su, Pl+St, SR					
		61		100		86	M					0.0		~10 gallons of water added. No change in color.
-60	298						M							
									multicolored, gray (7.5Yr 5/1) and brown (7.5YR 5/3), with white waxy clay, weak					
	299													
							IF		becomes completely weathered and IF, with white waxy clay in vesicles medium gray (N5), slightly weathered, strong, 30% to 40% rounded vesicles, size increases from 1-5 mm with depth					
-62	300												[43]	
			28				IVR		No recovery					
									reddish brown, highly weathered, weak, white,					
	301													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	301						IF		waxy clay in vesicles less than 0.5 mm medium gray, slightly weathered, strong, 30% rounded vesicles 1-3 mm							
-64	302	62		80		40	1 2		1. 45°, J, N, Mn, Sp, Pl, SR 2. 35°, J, N, VN, Mn, Sp, Wa, SR					0.0		Water recirculating, light medium brown
	303						M		vesicles decrease to 0.5 mm same as 300.8							
-66	304		28				3 M		Very dark gray (5YR 3/1) highly to extremely weathered, weak 3. 0°, J, MW, Cl, Sp, Pl, SR							
	305						M		transition to medium gray (N5), slightly to medium weathered, medium strong, 40% 0.5-2 mm rounded vesicles						[75]	
-68	306															
	307	63		100		76	M M 1		vesicles become irregular 1. 20°, J, VN, No, Pl, SR strong brown (7.5YR 5/6), highly weathered, strong							Water recirculating, medium brown
-70	308						M		reddish brown (2.5YR 4/3)							
	309						M		dark reddish gray (2.5YR 4/1), completely weathered, with white, waxy clay in residual vesicles							
-72	310						2 M		2. 80°, J, N, Mn+Cl, Su+Fi, Pl, S					0.0	[43]	
	311						M IF		multicolored; dark reddish gray (5YR 4/2) to very dark gray (5YR 3/1), highly weathered							
-74	312	64		98		80			medium gray (N5), slightly to medium weathered, medium strong, 40% 0.5-2 mm vesicles							Water recirculating, medium brown
	313						M		highly weathered interval similar to 311'							
-76	314		29				1 M		1. 70°, J, VN, Cl, Sp, Wa, SR							
	315						2 3 M		2. 0°, J, MW, Cl, Sp, Wa, SR 3. 10°, J, MW, Cl, Sp+Pa, Wa, SR						[14]	
-78	316															
	317						M									

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	317		29													
		65		90		80										
-80	318						M		brown (7.5YR 4/2), moderately weathered, with white, waxy clay in vesicles							
	319															
-82	320														[43]	
	321						1		vesicle size decreases to 0.5-1 mm							
-84	322						2 3		vesicle size increases to 45% 0.5-2 mm							
		66		108		80			1. 5°, J, N, Mn+Cl+Fe, Sp/Su, Wa, SR 2. 60°, J, VN, Fe+Cl, Sp, Wa, SR 3. 10°, J, N, Fe+Cl, Sp, Wa, SR							
	323		30				M		reddish brown (5YR 4/4) and dark reddish gray (5YR 4/2), moderately weathered, medium strong							
-86	324						M 4 IF		4. 80°, Sh, VN, Mn, Sp, Wa, SR becomes completely weathered, extremely weak							
	325						IF 1		medium gray (N5), slightly to moderately weathered, medium strong, 40% 1-2 mm rounded vesicles multicolored; strong brown (7.5YR 5/5) and reddish brown (5YR 4/4), becomes highly weathered					0.0	[60]	Water recirculating, medium brown
-88	326						M		1. 45°, J, N, Cl+Mn+Fe, Su, Pl, S							
							M 2		same as 325', with an increase in <0.5 mm vesicles							
	327						M		2. 70°, J, VN, Mn+Cl+Fe, Su, Wa, SR							
		67		100		76	M M		reddish brown (5YR 4/4), highly weathered, with waxy clay in vesicles							
-90	328						3		3. 85°, J, VN, Mn+Cl+Fe, Sp, Wa, SR							
							M									
	329								20% 3-5 mm rounded vesicles							
							M		dark gray (5YR 4/4), highly weathered, weak, no vesicles visible							
-92	330								dark gray (5YR 4/1), dark reddish gray (5 YR4/2), slightly to moderately weathered, medium strong, 40% <0.5-2 mm rounded vesicles						[25]	
	331						1 2		1. 55°, J, T, H, No, Wa 2. 65°, J, T, H, No, Wa							
			31				M									
-94	332						M									
		68		100		80										
	333															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	333						3		3. 5°, J, N, Mn, No, Ir, reddish staining on fracture surfaces, possible heat alteration 30% 1-3 mm irregular vesicles							
-96	334						4		yellowish red (5YR 4/6) around joint							
	335		31						4. 5°, J, MW, Mn, Sp, IR, R						[75]	End coring on 6/8/2021 Resume coring on 6/9/2021
-98	336						1		moderate weathering							
	337	69		100		80	2 3 4 5 6		1. 40°, J, VN, Mn, Pa, Pl, R 2. 25°, J, MW, Cl, Fi, Ir, SR 3. 10°, J, VN, Mn+Cl, Sp, Pl, SR 4. 40°, J, VN, Mn, Pa, Pl, R 5. 10°, J, N, Mn+Cl, Sp, Ir, R 6. 20°, J, N, Mn+Cl, Sp, Ir, R					0.0		~10 gallons of water added
-100	338						7		7. 45°, J, T, Cl, Sp+Pa, Pl, SR 8. 15°, J, N, Cl, Sp, Pl, SR 9. 5°, J, T, Cl, Fi, Ir, SR							
	339						8 M									
-102	340		32				9 1		medium dark gray (N4), with moderate reddish brown (5YR 4/4) sections, slightly weathered, very strong to medium strong (where reddish brown), 25% 1-5 mm vesicles						[60]	
	341						M									
-104	342	70		100		100	2		1. 10°, J, T, Mn, Sp, Ir, SR 2. 30°, J, T, Mn, Sp, Pl, R 3. 40°, J, VN, Mn+Cl, Pl, S					0.0		
	343						3									
-106	344						M									
	345						1		1. 30°, J, N, Cl, Sp, Pl, R						[60]	Water recirculating
-108	346						2		2. 30°, J, N, Mn, Sp, Pl, R							
	347	71	33	100		96	3 M		3. 80°, J, T, Mn+Cl, Ir, R					0.0		
-110	348															
	349															

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	349		33											
-112	350								vesicle size increases to 1-8 mm				[43]	
	351		34				M							
-114	352	72		100		96	M					0.0		
	353						1		1. 35°, J, T, Cl, Sp, Ir, R					
-116	354						2		2. 30°, J, Cl, Sp, Pl, R					
	355								becomes predominantly reddish brown (10R 4/6), slight to moderate weathering				[50]	
-118	356		35											
	357						1		1. 35°, J, T, Cl, Sp, Ir, R					Water recirculating
		73		100		82	2 M		2. 35°, J, N, Cl, Sp, Ir, R			0.0		
-120	358						IF							
	359								vesicle size increases from 2-8 mm					
-122	360		36										[60]	
	361								becomes less weathered, strong to very strong, vesicle size decreases from 1-5 mm					
							1		1. 0°, J, T, Mn, Sp, Pl, R					
-124	362						2		2. 45°, J, T, Mn, Sp, Ir, R					
		74		100		86	3		3. 10°, J, T, Mn, Sp, Ir, R			0.0		
	363						4		4. 15°, J, T, Mn, Sp, Ir, R					
							5		5. 15°, J, T, Mn, Sp, Ir, R					
-126	364		37											
							IF							
	365													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	365														[38]	
-128	366						1		moderate reddish brown (10R 4/6), moderate weathering							
							2		1. 15°, J, N, Mn+Cl, Fi+Sp, Pl, SR							
							IF		2. 15°, J, N, Mn+Cl, Sp, Ir, SR							
							3		3. 0°, J, N, Cl, Sp, Pl, SR							
	367		37				4		4. 40°, J, VN, Cl, Sp, Pl, SR							
		75		80		36	IF							0.0		
-130	368															Complete loss of circulation at 368 ft bgs (-40 ft msl)
							IF									
	369						5		5. 0°, J, VN, Cl, Sp+Su, Pl, SR							
							NR		No recovery							
-132	370		38												[25]	
	371						IF									
									vesicles decrease to 1% >1 mm in size							
-134	372						1									~600 gallons of water added
		76		96		68			1. 50°, J, MW, Cl, Sp, Ir, R					0.0		
	373						2		2. 20°, J, VN, Mn, Sp, Pl, SR							
									25% 1-4 mm vesicles							
-136	374						3		3. 25°, J, VN, Mn, Sp, Pl, SR							
							NR		No recovery							
	375								30% 1-4 mm rounded vesicles						[43]	End coring on 6/9/2021 Resume coring on 6/10/2021, ~200 gallons of water added to begin coring
							IF									
-138	376		39				1		20% 2-6 mm rounded irregular vesicles							
									40% 1-2 mm rounded vesicles							
							2							0.0		
	377						M		1. 20°, J, N, Cl+Mn, Sp, Wa, SR							~400 gallons of water added during run
		77		88		64			2. 10°, J, VN, Mn, Sp, Wa, SR							
									3. 20°, J, N, Mn+Cl, Sp, Wa, SR							
-140	378						3									
									20% 2-6 mm rounded irregular vesicles							
	379															
							NR		No recovery							
-142	380														[75]	
	381															

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	381								reddish brown (5YR 4/5) and yellowish red (5YR 5/6), becomes moderately to highly weathered							
									1. 5°, J, MW, Mn, Sp, Wa, SR							
-144	382						1		2. 0°, J, MW, Mn, Sp, Wa, R							
							2		reddish brown (5YR 5/6), 20% 1-4 mm irregular vesicles							~400 gallons of water added
		78		100		60										
							M		40% <1 mm rounded vesicles							
	383		40				3		3. 90°, J, MW, Cl, Su, Wa, SR							
							4		4. 70°, J, MW, Cl, Su, Wa, SR							
									reddish brown (5YR 4/5) and yellowish red (5YR 5/6), becomes completely weathered, very weak							
-146	384						IF									
							M		dark gray (5YR 4/1), becomes moderately weathered, medium strong, 20% 1-2 mm vesicles							
							IF		becomes black (5YR 2.5/3), 30% relict plagioclase and pyroxene vesicles up to 1.5 cm.					0.0	[60]	
	385															
-148	386															
									dark reddish brown (10R 3/4) due to oxidation, 30% 1-2 mm vesicles.							
	387								oxidation fades to black							~300 gallons of water added during run #79
		79		108		100										
-150	388						M									
							M									
	389															
							M									
-152	390		41				IF								[38]	
									1. J, VN, Cl, Su, Ir, VR							
	391						1									
							2		2. J, VN, Cl, Su, Ir, VR							
-154	392						M									~300 gallons of water added during run #80
		80		92		96										
	393															
-156	394						M									
	395														[50]	
							M									
-158	396						IF		vesicles increase in size to 7 mm							
			42						no vesicles							
									vesicles 1mm - 1 cm							
	397								vesicles 1 cm							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW12A

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	397						1		vesicles increase in size to 1.5 cm 1. 75°, J, VN, Cl, Mn, Sp, Wa, SR					
		81		100		96	2		2. 60°, J, VN, Cl, Mn, Sp, Wa, SR					~300 gallons of water added during run #81
-160	398						3		3. 50°, J, VN, Cl, Mn, Sp, Wa, SR					
							4		4. 30°, J, VN, Cl, Sp, Wa, SR					
	399		42				5		5. 5°, J, N, Cl, Su, Pl, SR					
							6		6. 15°, J, N, Cl, Su, Pl, SR					
-162	400						1		reddish brown (5YR 4/3) to dark reddish brown (5YR 3/2), moderately weathered, medium strong to strong, 40% <0.5 mm irregular vesicles				[43]	
							M		1. 20°, J, MW, Cl, Mn, Sp, St, R					Recovered core broke at 403.5'
	401						2		2. 30°, J, MW, Mn, Sp, St, R					
							M							
-164	402						3		3. 40°, J, MW, Mn+Cl, Su, Wa, SR					
		82		90		42								~300 gallons of water added during run #82
	403						M							
							4		Clay layer, no vesicles					
							M		40% <0.5 mm vesicles 4. 60°, J, N, Mn+Fe, Sp, Ir, SR					
-166	404						M							
							M							
	405						NR		No recovery				[30]	
							IF		becomes moderately weathered, strong, with oxidized, clay coated IF zones, <1mm vesicles, and rare vugs up to >5 cm					
							1		1. 45°, J, VN, Cl, Fe, Su, Wa, Slk					
-168	406						IF							
	407						2		2. 25°, N, Cl, Fe, Mn, Su, Ir, R					~300 gallons of water added during run #83
		83		90		54								
-170	408		43											
	409						IF							
							NR		No recovery					
-172	410						1		unweathered to slightly weathered, 25% 1-3 mm vesicles				[75]	End coring on 6/10/2021 Resume coring on 6/11/2021
							M		1. 20°, J, T, Cl+Mn, Fi+Sp, Pl, S			0.0		
	411													
-174	412						2		2. 5°, J, N, Cl, Sp, Ir, R					~200 gallons of water added during run #84
		84		94		80								
	413													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	413		43				3		3. 0°, J, VN, Cl+Mn, Sp, Pl, SR					
-176	414								vesicles increase in size to 2-8 mm					
	415						NR		No recovery				[43]	
-178	416													
	417	85		100		94						0.0		~200 gallons of water added during run #85
-180	418		44											
	419						M M							
-182	420						IF		**BASALT A'a Clinker** Loose, medium dark gray (N4) to moderate reddish brown (10R 4/6), highly weathered, abundant reddish brown (10R 4/6) clay, weak to very weak, 10-35 mm subangular to subrounded clasts				[60]	
	421						IF							
-184	422	86		60		30	1 2		**BASALT A'a Clinker** Welded, predominantly medium dark gray (N5) with occasional interbedded reddish brown (10R 4/6) to moderate brown (5YR 4/4) clasts, highly weathered, extremely weak, abundant clay 1. 45°, J, T, Cl, Fi, Ir, R 2. 5°, J, Cl, Fi, Pl, R			0.0		~200 gallons of water added during run #86
	423						IF							
-186	424						NR		No recovery					
	425								**BASALT Massive A'a** Medium dark gray (N4) to dark gray (N3), slightly weathered, very to extremely strong, 10% 1-20 mm vesicles, occasional vugs, abundant clay on fracture surfaces 1. 0°, MW, Mn, Sp, Pl, R 2. 0°, MW, Mn, Sp, Ir, R 3. 0°, MW, Mn, Sp, Ir, R				[75]	
-188	426						1 2 3							
	427	87		100		36	4 5 6 7		4. 45°, MW, Mn+Cl, Sp, R 5. 90°, N, Mn+Cl, Sp+Su, R 6. 30°, MW, Mn+Cl, Sp+Su, R 7. 25°, MW, Mn+Cl, Sp+Su, R			0.0		~200 gallons of water added during run #86
-190	428		45				8 9		8. 5°, MW, Mn+Cl, Sp+Su, R 9. 5°, MW, Mn+Cl, Sp+Su, SR					
	429													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	429		45				10		10. 0°, N, Mn+Cl, Sp+Su, SR							
							11		11. 10°, J, N, Cl+Mn, Sp+Su, Ir, R							
-192	430						12		12. 0°, J, N, Cl+Mn, Sp+Su, Ir, R						[30]	End coring on 6/11/2021
							1		1. 60°, J, N, Mn, Sp, St, SR							
	431		46				2		2. 0°, J, N Mn, Sp, Wa, SR							~300 gallons of water used to refill borehole
							3		3. 30°, J, N, Mn, SP, Pl, SR							
							M		4. 50°, F, N, Mn, Sp, Pl , SR							
							4		5. 0° J, N, Mn+Cl, Pa, Wa, SR							
							5									
-194	432						6		vesicles become 1-20 mm elongated and irregular, with small cracks connecting vesicles							
		88		80		10	7									
							8		6. 0° J, N, Mn+Cl, Pa, Wa, SR							
	433						9		7. 70°, J, VN, Mn+Sp, St, SR							
							M		8. 10°, J, N, Mn, Su+Sp, St, SR							
							10		9. 30°, J, N, Cl+Su, Pa, Wa, SR							~600 gallons of water added during run #88
									10. 80°J, N, Cl+Fe+Mn, Fi, Pl, S							
-196	434						IF		intensely fractured							
							NR		No recovery							
	435															
							1		1. 10°, J, N, Mn, Sp, Wa, S						[30]	~500 gallons of water added during run #89
							2		2. 60°, J, VN, Mn, Sp, Pl, SR							
-198	436						3		becomes <5% <1mm vesicles with 5% 1-5mm irregular elongate vesicles							
							4									
							5									
							M		3. 45°, J, VN, Mn, Sp, St, S							
	437								4. 0°, J, N, Mn, Sp, Pl, SR							
							M		5. 0°, J, N, Mn, Sp, Pl, SR							
		89		64		34	M		cinder inclusion							
-200	438		47						**BASALT A'a Clinker** Loose, medium dark gray to dark reddish brown (N5, 10R 4/6), moderately to highly weathered, weak, 1-2mm angular clasts, 20-30mm rounded clasts							
	439						NR		No recovery							
-202	440								Borehole TD = 440' bgs							End of borehole.
	441															
-204	442								RHMW12A was hand cleared from ground surface to 1 ft below ground surface (bgs) with refusal on basalt boulders. The borehole was then drilled using 8.5" OD hollow stem auger to 20 ft bgs. HQ coring commenced from 5 ft to 60 ft bgs. Opened borehole with a 24" diameter core bucket bit from ground surface to 58 ft bgs. Installed 18" Schedule 40 steel conductor casing to 58 ft bgs. HQ coring continued from 60 ft to 215 ft bgs. Reamed borehole with a 17.5" tricone bit from 58 ft to 215 ft bgs. Installed 10" Schedule 40 steel conductor casing to 212 ft bgs. HQ coring continued from 215 ft to 440 ft bgs total coring depth. Borehole was reamed from 215 ft to 440 ft bgs total reaming depth with a 9 7/8" tricone bit.							
	443															
-206	444															
	445															

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW12A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	ROCK CORE: Box No.	ROCK CORE: Recovery, %	ROCK CORE: Fractures per Foot	ROCK CORE: R Q D, %	ROCK CORE: Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	SAMPLES: Number	SAMPLES: Blows per foot	SAMPLES: PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	445								RHMW12A well was installed with 4 inch diameter Schedule 80 polyvinyl chloride (PVC) well casing. The well was screened between ~413 and 433 ft bgs (~ -175 and -195 ft msl); with fill from 438' to 440' bgs; #3 Monterey sand filter pack from 408' to 538' bgs; bentonite pellet seal from 403' to 408' bgs; bentonite slurry from 210' to 403' bgs; and cement bentonite grout from ground surface to 210'. The well surface completion consists of a steel vault set in a concrete foundation designed to secure and lock the well. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 11,945 gallons of water were used during drilling and rock coring. The borehole was developed using the drill rig bailer, surge block and submersible pump; a total of 3,572 gallons of development water were removed.							
-208	446															
	447															
-210	448															
	449															
-212	450															
	451															
-214	452															
	453															
-216	454															
	455															
-218	456															
	457															
-220	458															
	459															
-222	460															
	461															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW13

Date(s) Drilled	08/21/19 - 10/14/19	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Hand auger, HSA, HQ core/ PQ core, Mud rotary	Drill Bit Size/Type	24" core bucket/prod auger, 10" HSA, HQ/PQ core diamond bit	Total Depth of Borehole	530.0 feet
Drill Rig Type	Mobile B-59 / Mobile B-90/ Watson 1100 and 2000	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	248.0
Groundwater Level	El. 19.50'	Location	RHSF	Inclination from Horizontal/Bearing	90°
Borehole Completion	Westbay MP38 Well			Hammer Data	140 lbs/30-inch drop

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
248	0								**FILL**						8/21/19: attempt hand clear and drill through gravel fill to boulder at 3' bgs
246	2								**VALLEY FILL**						
244	4	0					NR		no recovery - Washed out boulders		1	50/6"			Begin 10" HSA at 0714 to try to get through boulder, paused to repair rig, 1238 resume drilling HSA grinding sound at ~9ft bgs.
242	6	1									2	50/6"		[37.5]	Collect 12-18" sample per 5' run
240	8								(GC) Clayey Gravel 80G, 15F, 5S, subrounded gravel, gray (5Y6/1), brown matrix (7.5YR4/3), 750mm gravel light gray (10YR6/1)						
238	10	2					NR		(CH) Fat Clay with gravel 15G, 80F, 5S Brown (10YR4/3) subrounded, 15mm gravel pieces.		3	50/6"	2.5	[37.5]	Grinding sound at 10ft bgs.
236	12														
	13														

~~For Red Hill AOC Party Use Only~~

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13														
234	14								no recovery - Boulders likely washed out. Light gray (10YR6/1) subrounded boulder remnants.						
	15	3									4	50/6"	0.0	[33.33]	"no water but damp" per VWD. ~16ft grinding sound
232	16														
	17														
230	18														
	19								(GC) Clayey gravel, 80G, 15F, 5S Subrounded - subangular 750 mm. Some pieces gravel gray (5YR6/1)						
228	20	4							(CH) Fat Clay with gravel, 20G, 75F, 5S. Very dark gray (2.5Y3/1), subangular gravel pieces <6mm, gray (5YR6/1) some reddish yellow clay (5YR6/8)		5	100/2"	0.0	[15.38]	Grinding sound, "dried up" per VWD
	21								Subrounded boulder, light gray (10YR6/1) some reddish yellow clay (5YR6/8) on gravel pieces.						Grinding sound
226	22								**VOLCANIC SAPROLITE** highly weathered basalt, very weak, dark brown (10YR 3/3), yellowish red (5YR 5/6) clay, yellow (10YR 2/6) clay				0.0	[166.67]	Refusal. Added 5 gals water to hole to remove HSA rods - 5" PVC temporary casing lowered into hole to 21'bgs. Begin to set up for HQ core at 22ft bgs. Begin HQ coring on 8/22/19 at 0847. Light brown WR. 500 gals of WL but none lost now
	23	5	1	100		0	IF								
224	24						IF								
	25						IF		· basalt, highly weathered, weak, very dark black (2.5Y 2.5/1) 5% vesicles, 2-8mm, subrounded, yellowish red (5YR 5/6) clay, yellow (10YR 7/6) clay intensely fractured.				0.0	[60.24]	
222	26						IF								Light brown WR, No WL
	27						IF		· highly to completely weathered basalt, very weak, broken pieces mostly covered with clay						
220	28	6		84		0	IF		· basalt, highly weathered, weak, very dark rock (2.5Y 3/1), 2% subrounded, 1-4 mm, vesicles, yellow (10YR 7/6) clay, yellowish red (5YR 5/6) clay, intensely fractured a'a'.						
	29														

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 2/6/2020 RHMW13

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
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Project Number: 60571032

Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29								no recovery				
218	30		2				1		· greenish black (GLEY1 2.5/1), moderately weathered, medium strong, 5% subrounded 2-11m vesicles, partially infilled with clay		0.0	[75]	Monitoring water levels, see log book for details.
	31						2		· vesicles become 5%, 4-20 mm, subrounded to rounded, minerals infilling vesicles; translucent minerals, running across/connecting vesicles - needle like 1. 0°, J, VN, Cl, Sp, Wa, S 2. 0°, J, VN, Cl, Su, Pa, Pl 3. 5°, J, VN, Mn, Fe, Cl, Sp, Wa, S				Light brown WR, no WL
216	32	7		100		74	3 4		4. 10°, J, VN, Mn, Fe, Sp, Wa, S 5. 5°, J, VN, Cl, Sp, Wa, S 6. 0°, J, VN, Mn, Fe, Cl, Sp, Wa, S 7. 20°, J, VN, Mn, Fe, Cl, Su + Sp, Wa, S 8. 20°, K, VN, Mn, Fe, Sp, Cl, Su, St, S				
	33						5 6						
214	34												
	35						7 8				0.0	[75]	Monitor water levels, see log book for details.
212	36						1		· greenish black (GLEY1 2.5/1); moderately weathered; medium strong; 20% vesicles, rounded, <2 mm; possibly a'a · very dark greyish brown (10YR3/2); highly to completely weathered; weak to very weak; intensely fractured; clay coating most pieces, brown (5YR5/4); reddish yellow (7.5YR6/6); possibly massive a'a				Light brown WR, no WL
	37						IF						
		8	3	80		28							
210	38						IF						
	39								no recovery				
208	40										0.0	[75]	
	41						1 2		· very dark gray (7.5YR3/1); moderately to highly weathered; weak; 5% vesicles, irregular to subrounded, 1-12 mm, partially infilled with clay; possibly a'a 1. 0°, J, VN, clay, Su + Sp, IR, SR 2. 0°, J, VN, clay, Fe, Su + Sp, Wa, SR				Light brown WR, no WL
206	42	9		88		28			· highly to completely weathered, very weak, very dark gray (7.5YR3/1), clay coating most pieces, brown (5YR5/4), reddish yellow (7.4YR4/6)				
	43						NR		no recovery				
204	44						NR		**BASALT Massive a'a** very dark gray (10YR3/1); moderately to slightly weathered; medium strong to strong; 5%, <2 mm, subrounded vesicles, angular fractures; fracture faces Mn + Fe, clay coating Sp, light brown (2.5Y5/4); yellowish red (5YR4/6); yellow (10YR 8/10); likely				
	45												

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW13

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
204	45								massive A'a		0.0	[60]	Monitor water levels, see log book for details.
202	46						IF		· vesicles become elongated, 2-20 mm, partially infilled with clay. IF fractures partially infilled with clay, reddish-yellow (7.5YR7/6), yellow (2.5Y7/6)				Light brown WR, no WL
	47	10		100		36	IF						
200	48						1		1. 80°, J, N, Cl, Pa, Wa, S 2. 50°, J, N, Cl, Pa, IR, S 3. 5°, J, VN, Cl, Mn, Fe, Sp, Su, Wa, S 4. 50°, J, VN, Cl, Mn, Fe, Sp, Su, Wa, S				
	49						2 3 4 IF						
198	50		4				1		1. 0°, J, VN, Mn +Fe, Sp, Clay, Su, St, S IF coated with clay on faces		0.0	[75]	
	51						IF						No WL, Light brown WR
196	52	11		100		69	2		**BASALT Pahoehoe** reddish-brown (2.5YR4/4); moderately weathered; medium strong; 15% vesicles, 1-4 mm, rounded to subrounded, partially infilled with yellow (2.5Y7/6) clay 2. 35°, J, VN, Mn + Fe, Sp, Cl, Su, St, S 3. 0°, J, VN, Mn + Fe, Sp, Cl, Su, St, S 4. 0°, J, VN, Mn + Fe, Cl, Sp, Su, Pl, S 5. 90°, J, VN, Mn + Fe + Cl, Sp, Wa, S 6. 5°, J, VN, Mn + Fe, Cl, SP, IR, SR				
194	54						3 4 5 6		· possible flow contact- reddish-brown (2.5YR5/4), moderately to highly weathered, medium strong to weak, <2%, 2mm subrounded vesicles, mostly yellow (2.5Y7/6) clay infilling.				
	55						IF		· reddish-brown (2.5YR4/4); moderate weathering; strong to medium strong; 10% vesicles, 2mm rounded to subrounded; yellow (2.5Y7/6) clay		0.0	[150]	
192	56						1 2 3		1. 0°, J, VN, Mn, Fe, Cl, Sp, St, S · possible flow contact, very dark gray (10YR3/1); slightly to moderately weathered; medium strong to strong 15-25%, 1-3 mm, rounded to subrounded vesicles 2. 5°, J, VN, Mn, Fe, Sp, Cl, Su, Wa, S 3. 10°, J, VN, Mn, Cl, Sp, Wa, R				
	57	12	5	100		82							No WL, light brown WR.
190	58												
	59						4 5 6 7		4. 20°, J, VN, Mn, Sp, Cl, Su, Wa, SR 5. 20°, J, VN, Mn, Sp, Wa, SR - oxidized face 6. 90°, J, N, Mn, Sp, Cl, Su, Pa, S 7. 5°, J, VN, Mn, Fe, Cl, Sp, Wa, SR				
188	60										0.0	[100]	Monitor water levels, see log book for details.
	61												

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Log of Boring RHMW13

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
				ROCK CORE						SAMPLES					
186	61						1		1. 50°, J, VN, Cl, Mn, Fe, Sp, IR, SR - oxidized surface						
	62						2		2. 0°, J, VN, Mn, Sp, Wa, SR - oxidized surface						
							3		3. 45°, J, VN, Mn, Fe, Cl, Sp, Wa, SR						
		13		100		68	IF		IF - mostly covered with clay - reddish yellow (7.5YR7/6)						No WL, light brown WR.
									4. 0°, J, VN, Clay, Sp, Pl, SR						
	63														
184	64						4		▼ · becomes 10% vesicles, 1-8 mm, subangular to subrounded						
									▼ · becomes 10% vesicles, rounded, <2 mm, partially infilled with clay						
							5		5. 5°, J, VN, Mn, Cl, Sp, Wa, SR						
	65												0.0	[100]	
							1								
							2		1. 45°, J, VN, Mn, Fe, Cl, Sp, IR, SR						
182	66						3		2. 90°, J, VN, Cl, Filled with yellow (10YR7/6) clay						
									3. 5°, J, VN, Mn, Fe, Sp, Cl, Su, Wa, SR						No WL, light brown WR.
									4. 5°, J, VN, Mn, Fe, Cl, Sp, Pl, S						
									5. 90°, J, VN, Mn, Fe, Cl, Sp, St, S						
							4		6. 45°, J, N, Cl, Pa, Wa, S						
	67														
		14		100		66									
							5								
180	68						6								
							IF		**BASALT a'a clinker**						
	69								loose, highly to completely weathered; weak; clay matrix around clasts; dark reddish-gray (5YR4/2); very dark gray (5YR2/1), reddish-yellow (5YR4/6) clay						
			6				7		IF pieces covered with reddish-yellow (5YR6/6) clay						
							8		7. 0°, J, VN, Mn, Fe, Cl, Sp, Wa, SR						
									8. 10°, J, VN, Mn, Fe, Cl, SP, Wa, SR						
178	70												0.0	[75]	
							NR		} no recovery						
	71														No WL, light brown WR.
									▼ · completely weathered clinker (?), extremely weak, brown (7.5YR4/2)						
							IF								
176	72								**BASALT Massive a'a**						
							1		medium weathered; medium strong to strong; 10% vesicles, 2-12 mm, elongate, subangular, partially infilled with yellow (10YR7/6) clay						
		15		76		26			1. 5°, J, N, Mn, Sp, Cl, Pa, St, S						
	73						2		2. 10°, J, VN, Mn, Sp, Cl, Su, St, S						
							3		3. 10°, J, VN, Mn, Sp, Clay, Su, St, S						
									4. 45°, J, VN, Mn, Fe, Sp, Cl, Su, Wa, S						
174	74						4		5. 45°, J, VN, Mn, Sp, Cl, Su, Wa, S						
							5								
	75								**BASALT a'a clinker**						
									loose, completely weathered; extremely weak; clay matrix, dark reddish-gray (5YR4/2) clay, yellow (10YR7/6), reddish-yellow (5YR6/6)				0.0	[100]	Paused to bail and monitor water levels, see log book #13 for details (pg 44-46)
			7				1		▼ · highly to completely weathered, very weak to weak						
172	76						IF		1. 45°, J, N, Cl, Fe, Pa, Wa, SR						
							2		2. 20°, J, N, Cl, Fe, Pa, St, SR						
									▼ · dark yellowish-brown (10YR2/4), black (10YR2/1); highly weathered; weak; reddish-yellow (5YR7/6) clay						
							3		3. 0°, J, N, Mn, No, Wa, R						
	77								4. 0°, J, N, No, IR, R						

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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
170	77								5. 45°, J, W, Fe, No, Wa, SR				Add 100 gal water to hole.
	78	16	7	80		56	4 5 IF		· brown (10YR 3/4); completely weathered; extremely weak				Light brown WR, no WL
	79								no recovery				
168	80						VK		· Same as above, clay covered faces of IF pieces, reddish-yellow (5YR7/6) clay		0.0	[75]	
	81								· Clasts - gray (GLEY1 5/N); "matrix" dark reddish-brown (5YR 3/3), clay reddish yellow (7.5YR 6/6); medium to highly weathered, weak.				
166	82	17		90		78	1 2 3		1. 5°, J, N, Cl, Sp, Wa, R 2. 35°, J, N, Mn, Cl, Sp, Wa, R 3. 20°, J, N, Mn, Sp, Wa, SR 4. 45°, J, N, Mn, Sp, Cl, Su, Wa, SR 5. 45°, J, N, Mn, Sp, Cl, Su, Wa, SR 6. 10°, J, N, Cl, Su, IR, R				Light brown WR, no WL
	83						4 5 6						
164	84												
	85								**BASALT Massive a'a** gray (GLEY 5/N); slightly weathered; very strong; 15% vesicles, elongated, irregular, subrounded, 2-12 mm		0.0	[50]	Paused drilling to monitor WL. See log book #13 (pg 46-52) for details.
162	86		8				1 2						
	87	18		106		60	3 4		· becomes 2% vesicles, <1 mm 1. 90°, J, N, Mn, Sp, Cl, Pa, Wa, S 2. 50°, J, N, Mn, Sp, Cl, Pa, Wa, S 3. 20°, J, VN, Mn, Sp, Pl, S 3. 15°, J, VN, Mn, Sp, Wa, S 4. 15°, J, VN, Mn, Sp, Wa, S IF pieces have Cl (Su) on faces, Mn (Sp)				Light gray WR, 50 gal WL
160	88												
	89						IF		· becomes 10% vesicles, elongate, subrounded 1-7 mm				
158	90						1		1. 5°, J, VN, Mn, Fe, Cl, Sp, Wa, S 2. 90°, J, VN, Mn, Sp, Cl, Su, Wa, S - olive clay (5Y 5/4) 3. 0°, J, VN, Mn, Sp, Wa, S		0.0	[60]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
	91						2						
	92		9				3		· becomes 5% vesicles, elongate 2-30 mm				
156		19		100		80							Light gray WR, 20 gal WL
	93						4		4. 0°, J, VN, Mn, Sp, Cl, Su, Wa, S				

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Log of Boring RHMW13

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
154	93						5		5. 10°, J, VN, Mn, Sp, Cl, Su, Wa, SR				
	94												
	95										0.0	[42.86]	Add 50 gal
152	96		9						· becomes 2% vesicles, 1-8 mm subrounded				
	97						1						Light gray WR, ~50 gals WL
		20		100		86			1. 5°, J, VN, Mn, Cl, Sp, Wa, S 2. 20°, J, N, Cl, Su, Mn, Sp, Wa, SR 3. 30°, J, N, Mn, Cl, Sp, Wa, SR				
150	98												
	99						2		**BASALT a'a' Clinker** loose, clasts - black (10YR2/1); "Matrix" dark reddish-brown (5YR3/3), reddish-yellow (7.5YR6/6) clay; medium to highly weathered; weak				
148	100						3				0.0	[75]	Pause to monitor WL. See log book #13 (pg 46-52) for details
							1		1. 30°, J, VN, Mn, Cl, Sp, IR, S 2. 0°, J, VN, Mn, Fe, Cl, Sp, St, SR				
	101						2		**BASALT Pahoehoe** heat alteration (flow contact); red (2.5YR4/6) dark reddish-brown (5YR3/2); slightly weathered; strong; 15% vesicles, rounded to subrounded, 1-4 mm, partially infilled with clay				Light brown WR, 40-50 gals WL
	102						3		· becomes 10% vesicles, rounded, 3-10 mm, partially infilled with clay				
		21		100		86							
	103						4		· becomes very dark gray (5YR3/1); slightly weathered; strong; 20% vesicles, round, <2 mm, partially infilled with clay				
							5		3. 15°, J,VN, Mn, Fe, Sp, Cl, Su, Sp, Wa, SR 4. 40°, J, VN, Mn, Sp, Cl, Su, Wa, SR				
144	104		10				6		5. 60°, J, VN, Mn, Sp, Cl, Su, Wa, SR 6. 0°, J, VN, Mn, Sp, Cl, Su, Pl, S				
							7		7. 20°, J, VN, Cl, Sp, Wa, SR				
	105						8		8. 20°, J, VN, Mn, Cl, Sp, St, SR		0.0	[150]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
							1		1. 75°, J, VN, Mn, Sp, Cl, Su, Wa, SR - reddish-yellow (5YR7/8) clay				Light gray WR, "very little WL" per driller
142	106												
							2		2. 0°, J, VN, Mn, Sp, Cl, Su, Wa, SR 3. 5°, J, VN, Mn, Sp, Cl, Su, Pl, SR				
	107								IF - pieces covered with thick clay, partially infilled with yellowish-red (5YR4/0) clay				
		22		80		68							
140	108						3						
							IF						
	109												

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Project Number: 60571032

Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
138	109						NR		no recovery				
	110								· becomes very dark gray (7.5YR3/1); medium weathering; strong; 5-15% vesicles, round, <4 mm, partially infilled with reddish-yellow (5YR6/6) clay		0.0	[100]	
	111						1		· becomes very dark gray (GLEY 3/N), slightly weathered, strong, 45% 5mm, angular vesicles				"Very little WL" per driller, Light gray WR
136	112	23		92		74							
	113						2		· becomes 25% >3 mm, round vesicles, partially infilled vesicles with reddish-yellow (5YR6/6) clay 1. 10°, J, WM, Cl, Sp, Mn, Su, Wa, SR 2. 20°, J, N, Cl, Sp, Pl, S · becomes slightly weathered, strong, 15% <2 mm vesicles 3. 75°, J, N, Cl, Su, Mn, Sp, Wa, S 4. 0°, J, N, Cl, Su, Pl, S				
134	114		11				3 4						
	115								**BASALT a'a' Clinker** clasts - dark reddish-brown (5YR3/2); "matrix" - brown (10YR4/4) clay, reddish-yellow (7.5YR7/6); completely weathered; extremely weak 1. 0°, J, VN, Cl, Sp, IR, SR 2. 0°, J, VN, Mn, Cl, Sp, IR, SR 3. 0°, J, VN, Mn, Cl, Sp, Wa, S 4. 10°, J, VN, Mn, SP, Cl, Su, Wa, R IF pieces covered with clay		0.0	[75]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
132	116						1						
	117	24		100		64	2 IF						Light brown WR, no WL
130	118						3						
	119						IF						
128	120						4						
	121						NR IF		no recovery		0.0	[7.04]	Light brown WR, no WL
	122								**BASALT Massive a'a'** gray (GLEY1 5/N); moderately to slightly weathered; strong to very strong; 15% vesicles, 2-20 mm, elongate, subrounded, reddish-yellow (7.5YR6/8) clay infilling some vesicles 1. 40°, J, VN, Mn, Sp, Cl, Su, Wa, SR 2. 90°, J, VN, Mn, Sp, Cl, Su, Wa, SR 3. 5°, J, VN, Mn, Sp, Cl, Su, Wa, SR 4. 10°, J, VN, Mn, Sp, Cl, Su, Pa, SR 5. 5°, J, VN, Mn, SP, Cl, Su, St, SR 6. 5°, J, VN, Mn, SP, Cl, Su, St, SR				
126	123	25	12	92		22	1 2 3 4 5 6						Lost circulation
	124						IF 7 IF		**BASALT a'a' Clinker** loose, completely weathered; extremely weak; dark reddish-brown (5YR3/2); covered with reddish-yellow (7.5YR6/6) clay 7. 5°, J, VN, Mn, Sp, Cl, Su, Wa, SR IF pieces covered with reddish-yellow (7.5YR7/6) clay **BASALT Pahoehoe**				
	125												

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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
125	125								very dark brown (7.5YR2.5/3); slight to moderately weathered; medium strong to strong; 20% vesicles, <2 mm, mostly infilled with clay		0.0	[150]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
122	126								· becomes 10% vesicles, subrounded to rounded, 2-6 mm, partially infilled with clay				Added 500 gals, light brown WR, some WL.
							1		· becomes >20% vesicles, <2 mm, subrounded				
									· becomes 10% vesicles, <2 mm, subrounded, mostly infilled with clay				
	127						2						
		26		100		84	3		1. 0°, J, Mn, Cl, Pa, SR 2. 10°, J, Mn, Cl, Pa, SR 3. 0°, J, VN, Cl, Su, SR 4. 10°, J, VN, Mn, Fe, Cl, Sp, Wa, SR				
120	128						4		· becomes black (2.5YR2.5/1); dark reddish-brown (2.5YR2.5/4); slightly to moderately weathered; strong; 15% vesicles, rounded to subrounded, <2 mm, mostly infilled with reddish-yellow (7.5YR7/6) clay				
							M						
	129						5						
							6		5. 10°, J, VN, Mn, Sp, Cl, Sp, Su, Wa, SR 6. 5°, J, VN, Mn, Sp, Cl, Su, Wa, SR				
118	130										0.0	[75]	Added 500 gals, light brown WR, some WL.
	131												
			13										
116	132						1		· becomes very dark gray (5YR3/1); slightly weathered; strong; 15% vesicles, 2-7 mm, subrounded to rounded				
		27		100		74			1. 0°, J, VN, Mn, Cl, Sp, Pl, SR 2. 50°, J, VN, Mn, Sp, Cl, Sp, Su, Wa, SR 3. 90°, J, VN, Mn, Fe, Sp, Cl, Sp, Su, Wa, SR 4. 60°, J, VN, Mn, Fe, Cl, Sp, Wa, SR 5. 0°, J, N, Mn, Fe, Sp, Cl, Pa, Wa, SR				
	133						2						
114	134						3		· become 15% vesicles, <3 mm, subrounded to rounded				
							4						
							5						End coring at 135ft bgs to monitor WL, see log for details (logbook #13 pg 46-52)
112	135										0.0	[100]	
	136						1		· becomes 20% vesicles, rounded, <2 mm 1. 5°, J, VN, Mn, Cl, Sp, Wa, SR				
							2		2. 10°, J, VN, Mn, Fe, Cl, Wa, SR - oxidized face				Resume coring on 8/26/19 at 0728. Add 300 gals, light brown WR, most returned, some WL.
	137								heat alteration (possible flow contact); red (2.5YR5/8)				
							3		· becomes very dark gray (10YR3/1); slightly weathered; strong; 10% vesicles, rounded to sunrounded, 1-4mm				
		28		100		74	4						
110	138								3. 20°, J, VN, Mn, Sp, Wa, SR 4. 0°, J, VN, Mn, Sp, Wa, SR				
	139		14										
							IF		IF pieces coated with yellow (10YR7/6) clay Pahoehoe ropey texture on IF pieces				
108	140								**BASALT Massive a'a'** very dark gray (GLEY1 3/N); slightly weathered; strong; 10% vesicles, elongate, 2-25 mm, a few infilled with clay 1. 50°, J, VN, No, No, IR, SR		0.0	[60]	Add 300 gals, light brown WR, most returned, some WL.
	141						1						

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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
141													
		29		100		8			**BASALT a'a' Clinker** Loose, dark reddish-brown (5YR 3/2), highly weathered, weak clay on some pieces, reddish-yellow (7.5YR 7/6)"				Add 30 gals, some WL, Light brown WR.
106	142						IF		· becomes completely weathered; very weak				
	143								**BASALT Pahoehoe** very dark gray (7.5YR 3/1); unweathered; strong to very strong; 10% vesicles, rounded to subrounded, 1-6 mm		0.0	[40]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
							1		1. 15°, J, VN, Mn, Fe, Sp, Wa, SR - slight to oxidation on face				
							2		2. 50°, J, VN, Mn, Sp, Wa, S - oxidation on face				
104	144	30		100		50	3		3. 45°, J, VN, Mn, Sp, Su, Wa, S - oxidation on face				Add ~100 gals, some WL, most returned. Light brown WR.
	145						M				0.0	[60]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
									1. 0°, J, VN, Cl, SP, Wa, SR				
102	146								2. 0°, J, VN, Cl, Sp, Wa, SR				
							1		· becomes reddish-brown (5YR 4/3); moderately to highly weathered; weak				
	147		15						· becomes very dark gray (7.5YR 3/1); moderately weathered; medium strong; 10% vesicles, subrounded, 1-6 mm				Add 300 gals, some WL, most returned light brown WR.
		31		102		80			· becomes brown (7.5YR 4/3); completely weathered; very weak				
100	148						2		· becomes reddish-brown (5YR 4/3); moderately to highly weathered; weak				
							M						
							M						
	149						IF						
									BASALT a'a' Clinker clasts- very dark gray (10YR 3/1); moderately to highly weathered; weak to moderate strength; "matrix" - strong brown (7.5YR 4/6) clay				
							3		3. 60°, J, VN, Cl, Sp, IR, SR, Slk				
98	150								IF pieces - clay on some faces		0.0	[37.5]	Pause to monitor WL. See log book #13 (pg 46-52) for details.
							IF		**BASALT Massive a'a'** gray (GLEY 5/1); slightly to moderately weathered; medium strong; 5% vesicles, elongate, irregular, 1-10 mm, partially filled with very pale brown (10YR8/2) clay				
	151						1						Light gray WR, mostly returned, some WL.
							2		1. 0°, J, VN, Mn, Fe, Cl, Sp, St, S				
							3		2. 90°, J, VN, Mn, Fe, Sp, Wa, SR				
96	152						4		3. 70°, J, VN, Mn, Fe, Sp, Wa, SR				
		32		82		18	5		4. 0°, J, VN, Mn, Sp, Su, Fe, Cl, Sp, Wa, S				
									5. 90°, J, VN, Mn, Fe, Sp, Wa, S				
							6		6. 90°, J, VN, Mn, Fe, Sp, Wa, SR				
	153						7		7. 90°, J, VN, Mn, Fe, Cl, Sp, Wa, SR				
							8		8. 5°, J, VN, Mn, Fe, Cl, Sp, Wa, SR				High water pressure release
									IF pieces - angular, clay on pieces				
94	154		16				IF						
							NR		no recovery				
	155										0.0	[33.33]	High water pressure release. Light gray WR, added 500 gals mostly returned. Some WL.
							IF						
92	156												
	157												

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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157						IF		**BASALT a'a' Clinker** loose, dark reddish-brown (5YR 3/2); strong brown (7.5YR 5/6), yellowish-red (5YR 4/8), red (10YR 4/8); moderately to highly weathered; weak; some clay on clasts "welded clasts" - dark gray (2.5YR 4/1), dark reddish-brown (2.5YR 3/3), yellow (10YR 7/6) clay; moderately weathering; weak to medium strong 1. 5°, J, VN, Cl, Sp, Wa, SR				
		33		88		52							
90	158						1						
	159						IF		**BASALT Massive a'a'** gray (GLEY 5/1); slightly weathered; medium strong to strong; 5% vesicles, elongate, subrounded, 2-5 mm IF - yellow (10YR7/6) clay on some faces - Sp, Mn +Fe - Sp IF clay on some faces - yellow (10YR 7/6) - Mn +Fe - sp				
88	160						IF				0.0	[25]	
	161						IF						Light gray WR, added 500 gals, mostly returned, some WL.
86	162						IF						
		34		96		10	IF						
	163						IF						
84	164						IF						
	165								**BASALT a'a' Clinker** loose clasts - dark gray (7.5YR 4/1); strong brown (7.5YR 5/6), red (2.4YR 4/6) clay; moderately weathered; weak 1. 0°, J, VN, Cl, Sp, Wa, SR		0.0	[37.5]	
			17				1						
82	166						IF						Light brown WR, added 500 gals, mostly returned, some WL.
	167												
		35		44		12			no recovery				
80	168												
	169												
							1		**BASALT Pahoehoe** brown (7.5YR 4/8), red (2.5YR 4/6); highly weathered; weak; some clay 1. 20°, J, VN, Mn, Su, Pl, Slk				
78	170						1				0.0	[30]	Light brown WR, added 500 gals, mostly returned, some WL.
							2		1. 80°, J, VN, Mn, Sp, Wa, R 2. 0°, J, VN, Mn, Fe, Cl, Sp, Wa, SR				
	171						3		3. 0°, J, VN, Mn, Cl, Sp, Wa, R				
							M						
76	172								possible flow contact, becomes very dark brown (7.5YR2.5/3); moderately weathered; medium strong; some clay				
		36		100		82	4		4. 5°, J, VN, Mn, Cl, Sp, Wa, SR				
	173												

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Project Number: 60571032

Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
74	173												
	174						IF		· becomes completely weathered, extremely weak				
	175								· becomes very dark brown (7.5YR 2.5/3), completely weathered, extremely weak		0.0	[54]	Pause coring at 175ft bgs to monitor WL. See log book #13 8/26/19 for details 10" casing set at 172' bgs
72	176						NR		No Recovery				
	177	37		44		11							
70	178						IF						resume coring on 9/19/19, drill 172' to 175' at 0829-0831 light brown WR, no WL
	179		18										
											0.0	[66]	
68	180						M		· becomes gray (GLEY1 5/N) and strong brown (7.5YR 4/6), highly to moderately weathered, weak to medium strong, 10%, 2mm round to subrounded, partially infilled vesicles. reddish yellow (7.5YR 5/6) and white (10YR 3/1) clay infill.				pause to monitor WLs. No WL, light gray WR
	181						1 M M						
66	182	38		100		72			· becomes gray (GLEY1 6/N), highly to moderately weathered, medium strong, 10% 1-7mm, subrounded irregular vesicles, partially infilled with white (7.5YR 8/6) clay 1. 5°, J, VN, Mn, Fe, clay, Sp, SR 2. 45°, J, VN, Mn, Fe, Sp, Clay, Su, SR 3. 0°, J, VN, Mn, Sp, Clay, Su, S 4. 0°, J, VN, clay, Sp, St, R				
	183						2 3						
64	184								· becomes very dark grayish brown (10YR 3/2), moderately weathered, medium strong, 15% <2mm rounded vesicles				
	185						4				0.0	[50]	pause to monitor WL pause to add bentonite and create seal. End coring 9/19/19
62	186						1 2 3		1. 0°, J, VN, Mn, FE, clay, SP, Wa, SR 2. 0°, J, VN, Mn, clay, SP, Wa, SR 3. 80°, J, VN, Mn, FE, clay, SP, Wa, SR				
	187		19				4						resume coring on 9/20/19 brown WR, No WL
		39		100		38	5		possible flow contact reddish brown (5YR 4/3) moderately weathered, medium strong, 2% 1-3mm partially infilled vesicles, clay infilled. pipe vesicles 4. 10°, J, VN, Mn, Fe, clay, SP, Pl, S 5. 0°, J, VN, Mn, Fe, clay, SP, Wa, SR 6. 80°, J, VN, Mn, clay, SP, Wa, R 7. 0°, J, VN, Mn, Fe, Clay, Sp Wa, S				
60	188						6						
	189						7						

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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	189						8		8. 0°, J, VN, Fe, Sp, Ir, R IF -> Mn Fe, Clay sp - face shows evidence of oxidation.				
-58	190						IF 1		· becomes very dark gray (10YR 3/2) slightly to moderately weathered, medium strong, 10% 2-5mm subrounded - subangular vesicles.		0.0	[42]	pause to monitor WLs, end drilling for 9/20/19
	191		19						1. 0°, J, N, Clay, SP, IR, R 2. 0°, J, VN, Mn, Fe, Clay, SP, Wa, SR Oxidation on face 3. 90°, J, VN, Mn, Fe, clay, SP, Wa, SR 4. 15°, J, VN, Mn, Fe, Clay, SP, Wa, SR				resume coring on 9/23/19 light brown WR, gray/black at first foot of WR, white film on mudpan water. No WL
-56	192						2 3						
		40		100		76	4		· becomes dark grayish brown (10YR 3/2) highly weathered, weak, clay partially infilled vesicles				
	193						5		· becomes very dark gray (10YR 3/2) moderately weathered, medium strong, 10% 1-3mm subrounded vesicles.				
							6		5. 0°, J, VN, Mn, Fe, Clay, SP, Wa, R 6. 50°, J, VN, Mn, Fe, Clay, SP, Wa, R				
-54	194						7		· becomes medium strong to weak, 5% 1-2mm subrounded vesicles.				pause to bail and monitor
							M		7. 5°, J, VN, Mn, Clay, SP, Wa, R				
	195								· becomes very dark gray (10YR 3/1) slightly weathered, strong 15% 1-4mm subrounded to rounded vesicles.		0.0	[23]	
-52	196						1		1. 0°, J, VN, No, No, St, SR 2. 45°, J, VN, Mn, SP, Wa, SR 3. 5°, J, VN, Mn, Clay, SP, Wa, SR				light brown WR, no WL
	197						2		possible flow contact /thermal alteration, red (2.5YR 5/6)				
		41		100		54			· becomes very dark brown (10YR 2/2) moderately weathered, medium strong, 5% 1-3mm subrounded vesicles.				
-50	198		20				3 4		4. 85°, J, N, Clay, SP, IR, R				
	199						5		5. 45°, J, VN, Mn + Fe Sp, Clay Su, Wa, SR 6. 45°, J, VN, Mn, Fe, Clay, SP, Wa, SR - oxidation on face				
							IF						pause to bail and monitor
-48	200								red (2.5YR 5/6) heat alteration band		0.0	[42]	"orange stain" comes out in mudpan at start of run, no odor, no PID. No WL, light brown WR
							M M		· becomes very dark gray (10YR 3/1), slightly weathered, strong, 10% 1-2mm subrounded vesicles				
	201								1. 5°, J, VN, Mn, Clay, Sp, Wa SR 2. 15°, J, VN, No, No, Wa, R				
-46	202						1						
		42		100		80			· becomes 15% 1-2mm subrounded vesicles				
	203						2		· becomes dusky red (7.5YR 3/2) slightly weathered, strong, 20% <2mm rounded vesicles				
			21				3 4		· becomes very dark gray (10YR 3/1) slightly weathered, strong, 5% 4mm subangular to subrounded vesicles.				
-44	204								3. 15°, J, VN, No, No, Wa, R 4. 0°, J, VN, No, No, Wa, R				
	205						M						

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	205						IF				0.0	[60]	pause to monitor WL. End coring for 9/23/19 resume coring on 9/24/19 brown WR, no WL
42	206						1		· becomes 10% 1-5mm subrounded vesicles 1. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
							M		· becomes very dark brown (10YR 2/2) highly weathered, weak				
	207		21				2 3		2. 0°, J, N, Mn, Clay, SP, Wa, R - very little sp clay 3. 0°, J, N, Clay, SP, Wa, R				
		43		100		70	4		4. 0°, J, MN, No, No, Wa, R				
40	208						5		5. 0°, J, N, No, No, Wa, R 6. 0°, J, MN, Clay, Sp, Wa, R - very little Sp clay 7. 0°, J, MN, Clay, Sp, Wa, R - very little Sp clay				
							6						
	209						7		· becomes slightly weathered, strong 10% 1-4mm subrounded vesicles				
38	210												pause coring to bail and monitor WLs. (book #13)
									· becomes dark gray (GLEY1 4/N) unweathered, very strong 20% 1-4mm rounded to subrounded vesicles.		0.0	[75]	
	211								· becomes 2% 1-12mm rounded to subrounded vesicles.				brown WR. No WL
							1		· becomes 20% 1-6mm rounded to subrounded vesicles 1. 0°, J, VN, Mn, Fe, Sp, Wa, SR				
36	212								2. 10°, J, VN, Mn, Fe, Sp, Wa, SR 3. 10°, J, VN, Mn, Fe, Sp, Wa, SR				
		44		94		18	2		· becomes reddish brown (2.5YR 4/4) moderately to highly weathered, weak				
	213						M M 3						
							4		· becomes reddish brown (5YR 4/3) moderately weathered, moderate strength				
							5		· becomes brown (10YR 4/3) slightly weathered, strong 4. 50°, J, VN, Mn, Fe, Sp, Wa, SR				
34	214								5. 45°, J, VN, Mn, Fe, Sp, Wa, SR				
							NR		No Recovery				
	215		22								0.0	[60]	pause to monitor WLs (book #13)
							1		· becomes 5% 1-8mm, subrounded to rounded vesicles. 1. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
32	216								2. 20°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
									· becomes 20% 1-4mm, subrounded to rounded vesicles				
							2		· becomes 2% <2mm, rounded vesicles				brown WR. Lost circulation at 219' to 220' bgs. WL = 200 gals
	217						M		possible heat alteration /flow contact - dark yellowish brown (10YR 3/4), yellowish (5YR 4/6) and black (5YR 2.5/1)				
		45		100		78	M		· becomes very dark grayish brown (10YR 3/2) moderately weathered, medium strong				
30	218						3		3. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, R 4. 10°, J, VN, Mn, Fe, Clay, Sp, Wa, R				Void observed on video log between ~219' and 220' bgs.
							4		5. 0°, J, N, Mn, Fe, Sp, Wa, R				
	219						5		· becomes slightly weathered, strong 10% 1-4mm, rounded to subrounded vesicles · becomes 15% 1-6mm, subrounded vesicles				pause to monitor WL
									· becomes 10% 1-2mm subrounded to rounded vesicles				
28	220		23				IF		· becomes 15% 1-4mm rounded to subrounded vesicles		0.0	[75]	pause coring for 9/24/19
							IF		reddish black (2.5YR 2.5/1) unweathered, very strong, 10% 2-26mm subrounded to rounded vesicles				Installed 5" casing set at
	221												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	221						1		· becomes gray (10YR 5/1), unweathered, very to extremely strong				220' bgs resume coring on 10/7/19, light brown WR, add 50 gals, no WL
26							M						
	222						2		1. 15°, J, VN, Mn, Fe, Sp, Wa, SR 2. 0°, J, VN, Mn, Fe, Sp, Pl, SR				
							3		3. 0°, J, VN, Mn, Fe, Sp, Pl, SR 4. 5°, J, VN, Mn, Fe, Sp, Wa, SR				
		46	24	100		64	4						
	223						5		· becomes 20% 1-3mm rounded vesicles 5. 0°, J, VN, Mn, Fe, Sp, Pl, SR 6. 5°, J, VN, Mn, Fe, Sp, Wa, SR				
							6		7. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
							M		8. 35°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
24	224								· becomes slightly weathered, strong, 1% <1mm rounded vesicles				
							7		· becomes 15% 1-2mm rounded vesicles				
							8		· becomes 10% <1mm rounded vesicles				
							M		· becomes 2% 1-3mm rounded vesicles				
	225										0.0	[60]	pause to bail and monitor (book #15 page 38)
							M		· becomes gray (10YR 5/1), unweathered, very to extremely strong, 10% 1-4mm rounded to subrounded vesicles.				
22	226						1		· becomes 15% 1-7mm subrounded to rounded vesicles				resume coring on 10/8/19, light gray WR, No WL
			25				2		· becomes 10% 1-4mm rounded to subrounded vesicles				
	227								1. 5°, J, VN, No, No, Wa, SR 2. 0°, J, VN, Mn, Sp, Pl, SR				
		47		2		68	3		3. 10°, J, VN, Mn, Fe, Sp, St, S				
20	228						4		· becomes very dark gray (10YR 3/1) unweathered, strong to very strong, 20% 1-3mm rounded to subrounded vesicles. 4. 5°, J, VN, No, No, Wa, SR				
							5		5. 15°, J, VN, Mn, Fe, Sp, Wa, R				
							6		6. 80°, J, VN, Mn, Fe, Sp, Wa, R				
	229						7		7. 0°, J, VN, No, No, Wa, R				
							8		8. 0°, J, VN, Mn, Fe, Sp, Wa, SR				
							9						
							10		· becomes 15% 1-8mm rounded to subrounded vesicles. 9. 5°, J, VN, No, No, Wa, SR				
18	230								10. 0°, J, VN, No, No, Wa, SR		0.0	[150]	pause to bail and monitor (book #15, pg.43)
			26				1		1. 0°, J, VN, Mn, Fe, Sp, St, S				
							IF		2. 0°, J, VN, No, No, Sp, Wa, SR				light brown WR, No WL
	231						2						
16	232						IF		· becomes red (5YR 4/4), reddish brown (2.5YR 4/3) and reddish black (2.5YR 2.5/1) unweathered, very strong 15% 1-5mm rounded to subrounded vesicles. Possible flow contact.				
		48		100		56							
	233						IF		Mn + Fe on intensely fractured pieces, ropey texture				
14	234						3		IF - Mn + Fe on IF fragments, ropey texture 3. 0°, J, VN, Mn, Fe, Sp, Wa, R				
			27				4		4. 0°, J, VN, Mn, Fe, Sp, IR, SR - ropey texture				
							IF						
	235										0.0	[27]	pause to bail and monitor (book #15, pg.43) 235'-236' light brown WR.
							IF		· becomes dark reddish gray (2.5YR 3/1), slightly weathered, strong, 15% 1-3mm rounded to subangular vesicles. Halloysite in vesicles and in fractures.				
12	236								· becomes 10% 2-8mm subrounded vesicles, Mn and Fe on fractures				lost circulation ~236' bgs
	237												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	237						IF						pause to fill water truck.
		49		104		22							
10	238								Halloysite on fractures				add 50' gal. WL
							IF		1. 10°, J, VN, Mn, Fe, Halloysite, Sp, Wa, R 2. 5°, J, VN, No, No, IR, SR				
	239		28				1		3. 20°, J, VN, Mn, Fe, Sp, Halloysite Su, IR, SR				
							2		· becomes greenish black (GLEY1 2.5/10Y), slightly weathered, very strong, 10% 1-9mm subangular vesicles. Halloysite in vesicles and in fractures. SP+Su				
8	240						3				0.0	[300]	
	241						IF		· becomes very dark gray (GLEY1 3/N), unweathered, very strong, 10% 1-8mm rounded to subrounded vesicles.				add 300 - 400 gal, WL
6	242												
		50		100		14							
	243						1		1. 5°, J, VN, No, No, Wa, S				
							IF		· becomes 30% 1-4mm rounded vesicles.				
4	244								· becomes dusky red (2.5 YR 3/3) and reddish black (2.5YR 2.5/1), slightly weathered, strong, 5% <3mm rounded to subrounded vesicles.				
			29										
	245						IF				0.0	[300]	
							M		1. 70°, J, VN, No, No, Wa, SR 2. 15°, J, VN, No, No, Wa, SR				
2	246						1						
							2		· becomes dark brown (7.5YR 3/2), slightly weathered very strong, 15% <3mm subrounded to subangular vesicles.				
	247						3		3. 5°, J, VN, No, No, Wa, S				add 300 gal, WL
		51		94		58			very dark gray (GLEY1 3/N) unweathered, very strong, 5% <1mm rounded vesicles.				
0	248						IF		· becomes 10% 1-8mm rounded vesicles.				
	249												
							IF		· becomes reddish brown (2.5YR 4/4) slightly weathered, strong, 15% 1-3mm rounded vesicles.				
-2	250		30						No Recovery		0.0	[150]	
							IF		1. 90°, J, VN, Mn, Sp, Wa, SR 2. 20°, J, VN, Mn, Sp, Wa, SR				
	251						1						
							IF						
-4	252						2		· becomes 20% <2mm rounded vesicles.				add 300 gal, WL
		52		106		18							
	253						IF						

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	253												
-6	254		31				IF 3 IF		1% 1-4mm weathered olivine phenocrysts, 15% 1-5mm subrounded vesicles. 3. 45°, J, VN, Mn, Sp, Wa, S				
	255						NR		No Recovery		0.0	[150]	
-8	256						IF 1		heat alteration, possible flow contact very dark gray (10YR 3/1), slightly weathered, strong, 15% 1-4mm subrounded to subangular vesicles				
	257	53		88		28	IF		1. 5°, J, VN, Mn, Fe, Sp, Pl, S 2. 5°, J, VN, Fe, Sp, Pl, S				add 300 gal, WL
-10	258						2		· becomes very dark gray (10YR 3/1) and reddish brown (5YR 5/4), moderately weathered, medium strong. 10% 1-5mm subrounded vesicles.				
	259						IF						
-12	260		32				3		3. 0°, J, VN, No, No, IR, R		0.0	[100]	
	261						IF						
-14	262	54		10		40							700 gal WL
	263						1 2		· becomes very dark gray (GLEY1 3/N), slightly weathered, strong to very strong, 5% 2-12mm rounded to subrounded vesicles.				
-16	264						3 4		1. 90°, J, VN, Mn, Fe, Sp, Wa, S 2. 0°, J, VN, Mn, Fe, Sp, Wa, SR 3. 0°, J, VN, Mn, Fe, Sp, Wa, SR 4. 15°, J, VN, Mn, Fe, Sp, Wa, SR - Olivine Phenocrysts				
	265		33								0.0	[100]	
-18	266								reddish brown (2.5YR 4/3), highly weathered, very weak.				
	267	55		74		0	IF						300 gal WL
-20	268						NR						
	269												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269						NR		No Recovery				
-22	270						1		very dark gray (GLEY1 3/N) unweathered, very strong, 15% 1-8mm rounded to subrounded vesicles.		0.0	[300]	
			34				2		1. 45°, J, VN, Mn, Fe, Clay, Sp,Wa, S 2. 0°, J, VN, Mn, Fe, Sp, IR, SR				
	271						IF		3. 50°, J, VN, Mn, Fe, Sp, Wa, SR				
-24	272						3		· becomes 5% 1-12mm rounded to subrounded vesicles, 2% unweathered olivine phenocrysts.				
		56		100		84							300 gal WL
	273								· becomes 2% <1mm rounded vesicles 4. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, S 5. 50°, J, VN, Mn, Fe, Sp, Wa, S - oxidized Pa?				
-26	274						4		6. 10°, J, VN, Mn, Fe, Sp, Wa, S - Olivine Phenocryst				
			35				5		· becomes 5% 1-10mm rounded to subrounded vesicles				
							6						
	275						IF				0.0	[30]	
							1		1. 50°, J, VN, Mn, Fe, Sp, Wa, SR				
-28	276								40mm X 30mm vug				
							2		2. 0°, J, VN, Mn, Fe, Sp, Pl, S 3. 5°, J, VN, Mn, Sp, IR, R 4. 0°, J, VN, Mn, Fe, Clay, Sp, Pl, S				
	277	57		94		56			5. 5°, J, VN, Mn, Fe, Clay, Sp, Pl, S				
							3		· becomes very dark gray (10YR 3/1) moderately weathered, medium strong, 2% 1-4mm subrounded vesicles				300 gal WL
-30	278						4						
							5						
							6		· becomes red (2.5YR 4/6), slightly to moderately weathered, medium strong, 5% <3mm subangular vesicles, halloysite in some vesicles.				
	279						7						
			36						6. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 7. 15°, J, VN, Mn, Fe, Clay, Sp, IR, SR				
-32	280						IF		No Recovery		0.0	[75]	
							NR						
							IF		· becomes reddish brown (2.5YR 4/3), slightly weathered, strong, 10% <2mm subrounded vesicles. Some halloysite in vesicles.				
	281						1						
							2		1. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, S				
							3		2. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
-34	282						4		3. 80°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 4. 10°, J, VN, Mn, Fe, Clay, Sp, St, SR				
							5		5. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				300 gal WL
		58		106		74	IF						
	283								5% 2-12mm subrounded to rounded vesicles.				
-36	284		37				6		6. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, S				
									· becomes dark gray (10YR 4/1), slightly weathered, strong 5% 1-11mm subrounded to rounded vesicles.				
	285												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	285										0.0	[50]	
-38	286						1		· becomes 10% <2mm rounded vesicles.				
							2		**BASALT a'a' Clinker** loose dark reddish brown (5YR 3/2), completely weathered, extremely weak				
	287	59		56		20							500 gal WL - high pressure release
-40	288												
	289		38				NR		No Recovery				
									BASALT Massive a'a' very dark gray (7.5YR 3/1) moderately weathered, strong, 15% >3mm vesicles. highly fractured				end coring for 10/8/19
-42	290						IF		silty seam brown (7.5YR 4/2) may be drill cuttings, no weathering features, completely fractured.		0.0	[20]	resume coring on 10/9/19 at 0639
		60		150		0							
	291										0.0	[48]	0642 drill rig rotation bogging down, high water pressure, drill rods become stuck at 291 ft bgs (see log book #15 pf 49-50)
-44	292						NR		No Recovery				
	293	61		80		55			**BASALT a'a' Clinker** loose, reddish brown (2.5YR 4/3) too very dusky red (2.5YR 2.5/2), highly weathered, very weak. Clayey with signs of the drill shoe				
							1		**BASALT Pahoehoe** Brown (7.5YR 4/6) to very dark brown (7.5YR 2.5/2) moderately weathered, strong, 40% 1-2 mm round vesicles. Minimal clay infill in vesicles.				slow drilling - drill string appears to be binding up. 500 WL - high pressure release
-46	294						IF		1. 90°, J, N, Clay, Pa, Wa, R 2. 45°, J, N, Clay, No, Wa, R				
							2						
	295						1		· becomes highly weathered, weak, 50% 1mm vesicles indicative of flow boundary		0.0	[100]	
			39				2						
-48	296								· becomes moderately to slightly weathered, medium strong, 30% <5mm elongated vesicles 1. 90°, J, N, Clay, Pa, Wa, SR 2. 0°, J, MW, Clay, Pa, Pl, S				
							M						
	297												No WR - 200 gal WL
		62		110		76							
-50	298								· becomes 20% 5-10mm vesicles.				
							M						
	299								· becomes black (2.5Y 2.5/1) slightly to unweathered, strong to very strong, 5% 10mm vesicles				
-52	300		40						· grades to 40% 1-2mm vesicles.		0.0	[100]	
							IF		· becomes moderately weathered, medium strong, 5% 1mm vesicles partially infilled with clay.				
	301												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	301								· grades to dark gray (5YR 4/1), moderately weathered, medium strong, 40% 2mm rounded vesicles.				
-54	302		40				IF		· dark reddish brown (5YR 4/3) highly to moderately weathered, medium strong to weak, 40% 1-2 mm rounded vesicles, ropey texture with clay infill on IF pieces.				
		63		100		60	1		· becomes 35% 2-3mm vesicles.				
	303								1. 10°, J, N, Clay, Pa, Wa, SR IF - clay infill on fractures				
							IF						
-56	304								· becomes dark gray (5YR 4/1) moderately weathered, medium strong, 25% <6mm round vesicles slightly infilled with clay.				
							M						
	305										0.0	[50]	
			41										
-58	306								· grades to reddish gay (2.5 YR 4/1) slightly to moderately weathered, strong, 40% 1-2mm vesicles.				
							IF		· becomes moderately weathered, medium strong, partial clay infill on surface.				
							1						
	307						2		1. 10°, J, MW, No, No, IR, R 2. 90°, J, N, Mn, Sp, Pl, S dark reddish brown (2.5YR 5/3) 10-15% 3mm vesicles				No WR - 400 gals WL, adding water from surface down annulus
		64		100		60	3						
									3. 45°, J, MW, Mn, Fe, St, Wa, S Yellowish red (5YR 4/6), 25% 0.5mm vesicles.				
-60	308						IF						
	309								· becomes moderately to highly weathered, weak, 30% 1-2mm rounded vesicles, light brown (7.5YR 6/3) clay infill in vesicles.				
			42				4						
-62	310								4. 15°, J, N, No, Wa, R				
							1		· becomes dark brown(7.5YR 3/2) moderately weathered, medium strong, 30% 2-3mm vesicles.		0.0	[42.8]	
	311								**BASALT a'a' Clinker** Welded, yellowish red (5YR 5/6) to very dark gray (5YR 3/2) moderately weathered, strong.				
							IF						
-64	312								1. 10°, J, N, No, No, St, R 2. 25°, J, N, Mn, Fe, Su, Wa, S				No WR - 500 gal WL
		65		80		35	2						
	313								loose clinker fragments become dark reddish brown (2.5YR 4/3) and very dark gray (5YR 3/2) moderately weathered, strong, minimal clay infill				
-66	314												
	315		43				NR		No Recovery		0.0	[42.8]	
-68	316								· becomes dusky red (2.5YR 3/2) moderately weathered, strong.				No WR - 500 gal WL
	317												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	317	66		74		42	IF						
-70	318		43				1		**BASALT Massive a'a'** black (10YR 2/1) fresh to slightly weathered, strong 15% 5-10mm elongated vesicles, olivine phenocrysts				
	319								1. 15°, J, N, Mn, Sp, IR, S				
-72	320						IF				0.0	[37.5]	
							1						
	321						2		· becomes very dark gray (10YR 4/1) 1% >30mm elongated vesicles with 15% 1-2mm slightly weathered olivine phenocrysts. Phenocrysts slightly discolored.				No WR - 600 gal WL
							3		1. 10°, J, N, Mn, Sp, IR, R 2. 15°, J, N, Mn, Sp, Wa, S 3. 45°, J, N, Mn, Fe, Sp, Pl, S				
-74	322						IF		· becomes slightly weathered, strong 5% >10mm vesicles				
		67	44	92		44	4						
	323						5		4. 15°, J, N, Mn, Fe, Sp, Wa, S 5. 15°, J, N, Mn, Su, Wa, S				
							6		6. 0°, J, N, Clay, Sp, Wa, S 7. 35°, J, N, Mn, Sp, Wa, SR				drill rig rotation slowing - drill rods possibly binding, high pressure release
-76	324						7						
							IF						
							NR		No Recovery				
	325										0.0	[30]	
-78	326						1						
							IF		**BASALT a'a' Clinker** welded, dark reddish brown (2.5YR 2.5/4) to reddish black, (2.5YR 2.5/1) moderately weathered, weak to medium strong, intensely fractured, with Mn stains on surfaces.				
	327												No WR - 500 gal WL
		68		64		22	IF						
-80	328		45				NR						
	329								No Recovery				
-82	330										0.0	[60]	
	331								**BASALT Massive a'a'** very dark brown (7.5YR 2.5/2) slightly weathered, very strong, 30% 5-20mm irregular vesicles				No WR - 500 gal WL
							1						
-84	332						IF		1. 80°, J, VN, Mn, Sp, Wa, S 2. 5°, J, VN, No, No, St, R				
		69		100		86	2						
	333												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	333						3		3. 0°, J, VN, Mn, Sp, IR, R 4. 45°, J, VN, Mn, Sp, IR, R				
-86	334		46				4						
	335								· becomes very dark gray (5YR 3/1), slightly to moderately weathered, strong, 5% 10-15mm elongated vesicles.		0.0	[60]	
							1						
-88	336						IF		1. 90°, J, N, Mn, Fe, Clay, Su, Wa, R 2. 10°, J, N, Mn, Sp, IR, R 3. 10°, J, N, Mn, Sp, IR, R 4. 10°, J, N, Mn, Sp, Pl, S				
	337						IF						No WR - 500 gal WL
		70		104		56	2						
							3						
-90	338						4		· becomes dark gray (5YR4/1) slightly weathered, very strong				
			47										
	339						5		5. 15°, J, N, Mn, Sp, Wa, S 6. 5°, J, N, Mn, Su, Wa, S 7. 70°, J, N, Mn, Su, St, S				
							6						
-92	340						IF				0.0	[50]	
									No Recovery				
	341												
							IF		**BASALT a'a' Clinker** loose, dark red (2.5YR 3/6) and very dusky red (2.5YR 3/2) highly weathered, clay infill on fracture joints.				
-94	342								**BASALT Pahoehoe** dark reddish gray (2.5YR 4/1) slightly weathered, strong 30% 1-3mm elongated vesicles				No WR - 500 gal WL
		71		80		60	1						
	343								1. 10°, J, N, Mn, Sp, Wa, S				
			48										
-96	344								· becomes 40% 5-10mm vesicles				
							2						End coring on 10/9/19
	345								2. 45°, J, N, Mn, Sp, Wa, S		0.0	[60]	resume coring on 10/10/19
									· becomes very dark gray (10YR 3/1) slightly weathered, strong, 10% 10-30mm irregular vesicles				
-98	346						1		1. 10°, J, N, No, No, Pl, S				
	347								· becomes 30% 5mm vesicles.				
		72		108		88							
-100	348								· becomes moderately weathered, medium strong to weak, 40% 1-2mm vesicles				No WR - 200 gal WL
			49				IF		IF. highly vesiculated, moderately to highly weathered, weak				
	349												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	349								· becomes slightly weathered, strong, 20% >4mm vesicles				
							2		2. 20°, J, N, No, No, IR, R				high pressure release
-102	350										0.0	[37.5]	
									· becomes very dark gray (7.5YR 3/1) 30% 1mm rounded vesicles.				
	351						1		1. 80°, J, N, Halloysite, Sp, Wa, R				
									· becomes 10% <20mm elongated irregular vesicles.				
-104	352		50				2		2. 60°, J, N, Mn, Fe, Halloysite, Pa, St, R				No WR - 300 gal WL
		73		90		46			· becomes a mottled dark gray (GLEY1 4/N) and gray (GLEY1 5/N), slightly weathered, strong rock, 15% <10mm rounded vesicles.				
	353						IF						
									· becomes very dark gray (5YR 3/1) with 5% 10mm elongate vesicles.				
-106	354						3		3. 90°, J, N, Mn, Su, St, R				
									· becomes moderately weathered, strong to medium strong, 20% 1-2mm vesicles.				
	355						IF		No Recovery		0.0	[33.33]	
-108	356								**BASALT a'a' Clinker** loose, mottled dark gray (5YR 4/1) and dark reddish gray (5YR 4/2) with Halloysite veinlets, moderately weathered, minimal clay.				
									BASALT Massive a'a' Slightly to moderately weathered, strong to medium strong, 2-22mm elongated vesicles				
	357						IF						
		74		94		20							No WR - 500 gal WL
-110	358		51										
									· becomes slightly weathered, strong, 5% 10mm rounded vugs and 20% 1-2mm elongated pinched vesicles.				
	359						1		1. 40°, J, N, Mn, Sp, Wa, SR				
							2		2. 60°, J, N, Mn, Su, Pl, S				
-112	360								**BASALT a'a' Clinker** Loose, very dusky red (2.5YR 2.5/2) slightly weathered, strong to medium strong.		0.0	[42.85]	paused to retrieve more water
	361								· becomes reddish brown (2.5YR 4/4) and dark reddish brown (5YR 4/4), highly weathered, very weak, 25% <10mm elongated vesicles.				
-114	362								**BASALT Massive a'a'** Reddish brown (5YR 4/4) slightly to moderately weathered, strong, 25% <10mm elongated vesicles.				No WR - 600 gal WL
		75		100		32							
	363						IF		IF is highly fractured, Mn on fracture joints.				
-116	364		52										
							1		1. 15°, J, N, Mn, Sp, Wa, S				
	365												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	365										0.0	[6.38]	
-118	366						IF		**BASALT a'a' Clinker** loose, reddish brown (5YR 4/3) and dark reddish brown (5YR 3/2) moderately weathered, medium strong				drill rods possibly binding - 1 ft of clinker retrieved in core barrel, continues coring
	367	76		54		10							No WR - 1000 gals WL, high pressure release
-120	368								No Recovery				
	369						1		**BASALT Massive a'a'** dark gray (10YR 4/1) slightly to unweathered, very strong, 2-35 mm subangular elongated vesicles. vug - 40mm x 28mm				add 50 gals of mud - 1 bag of bentonite
-122	370		53				2		1. 60°, J, VN, Mn, Fe, Sp, Wa, SR 2. 60°, J, VN, Mn, Fe, Sp, Wa, SR		0.0	[30]	No WR for rest of log unless otherwise stated
	371						1						800 gals WL - stuck for part of run
-124	372	77		100		60	IF		1. 40°, J, VN, Mn, Fe, Sp, Wa, S 2. 5°, J, VN, Mn, Fe, Sp, St, S 3. 10°, J, VN, Mn, Fe, Sp, Wa, S 4. 10°, J, VN, Mn, Fe, Sp, Wa, S 5. 5°, J, VN, Mn, Fe, Sp, Wa, S				
	373						2						
-126	374						3						
	375						4						
							5						
							IF						
							IF						
							6		6. 45°, J, VN, Mn, Fe, Sp, Wa, S				
							7		7. 5°, J, VN, Mn, Fe, Sp, Wa, S				
											0.0	[37.5]	
			54				1		1. 25°, J, VN, Mn, Fe, Sp, Wa, S				
-128	376								**BASALT a'a' Clinker** loose, dusky red (2.5YR 3/2), dark reddish brown (5YR 3/3) and black (5YR 2.5/1) slightly weathered, medium strong.				high pressure release - 400 gals WL
	377						NR		No Recovery				
		78		92		28			**BASALT Pahoehoe** very dark gray (10YR 3/1) slightly weathered, strong 5% 1-6mm rounded to subrounded vesicles. 2. 10°, J, VN, Mn, Fe, Sp, Wa, SR				
-130	378						IF		· becomes 5% <2mm rounded to subrounded vesicles.				
	379						2		· becomes 10% 1-6mm rounded to subrounded vesicles.				
							IF		· becomes 5% 1-3mm rounded to subrounded vesicles				
-132	380		55				IF		· becomes dark red (2.5YR 2.5/4) slightly weathered, strong, 40% 1-2mm rounded vesicles, possible flow contact.		0.0	[100]	high pressure release - 300 gal WL
	381												

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	381								· grades to 25% 5-8mm vesicles.				
			55										
-134	382								· grades to dark reddish brown (5YR 3/4), moderately weathered, medium strong, 40% 1-2mm vesicles. Ropey textures on possible flow contact - mottled yellowish red (5YR 4/4)				
		79		106		40							
	383								1. 80°, J, VN, No, No, Wa, S 2. 0°, J, MW, Clay, Pa, Wa, R 3. 0°, J, MW, Clay, Pa,, Wa, R 4. 45°, J, VN, No, No, Wa, R 5. 45°, J, VN, No, No, St, R				
-136	384								· becomes dark reddish brown (5YR 2.5/2) 35% 2-4mm round vesicles.				
	385										0.0	[75]	
			56										
-138	386								· becomes very dark gray (GLEY1 3/N) moderately to slightly weathered, medium strong, 5% <2mm rounded to rubrounded vesicles. 1. 0°, J, N, Fe, Sp, Wa, R 2. 0°, J, N, Fe, Sp, Wa, R 3. 5°, J, N, Fe, Clay, Sp, Wa, R 4. 10°, J, VN, Fe, Sp, Wa, R				
	387												150 gal WL
		80		104		44							
-140	388								· becomes 15% 1-5mm rounded to subrounded vesicles. · becomes 15% <1mm rounded vesicles. 5. 5°, J, VN, No, No, Wa, SR 6. 0°, J, VN, Mn, Fe, Sp, St, SR 7. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 8. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
	389												
									· becomes gray (10YR 5/1) slightly weathered, strong, 10% 1-10mm subrounded to rounded vesicles.				
-142	390		57						· becomes 5% 1-4mm vesicles.		0.0	[75]	
									· becomes 15% <2mm vesicles.				
	391								· becomes reddish black (2.5YR 2.5/1), slightly weathered, strong, 20% 1-3mm rounded to subrounded.				
-144	392								1. 90°, J, VN, Mn, Fe, Clay, Sp, Pl, Slk 2. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR - Halloysite 3. 0°, J, VN, Mn, Fe, Sp, IR, SR - oxidized ropey texture				200 gal WL
		81		92		76							
	393								Heat alteration/ possible flow contact, becomes dark reddish gray (5YR 4/2), moderately weathered, medium strong, 5% 1-4mm rounded to subrounded vesicles.				
-146	394								· becomes 10% 1-4mm subrounded to rounded vesicles.				
									4. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, SR - Halloysite				
	395		58						No Recovery		0.0	[100]	
									1. 0°, J, VN, Mn, Fe, Sp, Wa, SR 2. 60°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
-148	396								· possible flow contact, becomes yellowish red (5YR 4/6) moderately to slightly weathered, strong, 20% <2mm rounded vesicles. 5% weathered olivine phenocrysts.				high pressure release
	397												

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	397						IF		3. 80°, J, VN, Mn, Fe, Sp, Wa, SR				
		82		108		70	3		4. 60°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
-150	398						4		˙ becomes very dark gray (10YR 3/1) unweathered to slightly weathered, very strong, 10% 1-10mm rounded to subrounded vesicles.				
							5		5. 0°, J, VN, Fe, Sp, Wa, SR				
	399		59						6. 20°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				200 gal WL
							6						
-152	400						IF		˙ dark reddish brown (5YR 3/2) and reddish yellow (7.5YR 6/6) highly weathered to completely weathered, very weak.		0.0	[75]	
							1						
							2		becomes very dark gray (10YR 3/1), slightly weathered, strong, 10% 1-8mm rounded to subrounded vesicles.				
	401						IF		1. 20°, J, VN, No, No, Wa, SR				
									2. 30°, J, VN, Mn, Fe, Sp, Wa, R				
							M		˙ becomes 20% 2mm rounded vesicles.				
-154	402						3						200 gal WL
		83		108		72			3. 20°, J, VN, Mn, Fe, Sp, St, SR				
									˙ becomes 10% 1-5mm rounded to subrounded vesicles.				
							4		˙ becomes 20% <2mm rounded vesicles.				
	403		60				5		4. 50°, J, VN, Mn, Fe, Sp, Wa, SR				
									5. 0°, J, VN, Clay, Sp, Pl, SR				
									˙ becomes dark gray (GLEY1 3/N), unweathered, very strong, 10% 1-4mm rounded to subrounded vesicles.				
-156	404								˙ becomes 5% 2-21mm subrounded vesicles.				
							6		6. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
							7		7. 0°, J, VN, Mn, Fe, Sp, Wa, SR				
									˙ becomes 15% 1-2mm rounded to subrounded vesicles.				
	405										0.0	[100]	
							IF						
-158	406								**BASALT a'a' Clinker**				
									loose, reddish brown (5YR 4/3) and dark reddish gray (2.5YR 3/2) slightly to moderately weathered, medium strong to weak.				
	407												150 gal WL
		84		88		8							
-160	408		61						1. 50°, J, VN, Mn, Fe, Clay, Sp, IR, SR				
									BASALT Massive a'a'				
	409						1		Very dark gray (5YR 3/1), slightly weathered, very strong, 10% vesicles.				
							IF						
							NR		No Recovery				
-162	410								**BASALT a'a' Clinker**		0.0	[75]	
									loose, dark reddish brown (5YR 3/2) reddish black (2.5YR 2.5/1) moderately weathered, medium strong.				
	411												high pressure release - 200 gal WL
							1		**BASALT Massive a'a'**				
							2		Dark gray (GLEY1 4/N), slightly weathered, strong, 5% 2-30mm elongate, subangular vesicles.				
-164	412						3						
							IF		1. 45°, J, N, Mn, Fe, Clay, Sp, Tr, SR				
		85		90		16			2. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, S				
	413						IF		3. 20°, J, VN, Mn, Fe, Clay, Sp, Wa, S				

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	413						IF		4. 50°, J, VN, Mn, Fe, Clay, Sp, Wa, S 5. 5°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
-166	414						4 5 M IF		· becomes 15% 1-4mm subrounded to subangular vesicles.				
	415		62						**BASALT a'a' Clinker** loose, red (10YR 4/8) and dark reddish brown (2.5YR 4/3), slightly weathered, medium strong		0.0	[42.85]	
-168	416								No Recovery				500 gal WL
	417												
		86		60		40							
-170	418								**BASALT Massive a'a'** very dark gray (GLEY1 3/N) unweathered, very strong 5% 2-30 mm elongate subrounded - subangular vesicles vug - 10mm x 35mm				
	419						1		1. 5°, J, MW, Mn Su, Fe, Sp, IR, SR 2. 20°, J, MW, Mn Su, Fe, Sp, IR, SR				
							2						
-172	420										0.0	[42.85]	
	421		63						vug - 10mm x 30mm				
							1		1. 0°, J, VN, Mn, Fe, Sp, Wa, S				
-174	422						2		2. 45°, J, VN, Mn, Fe, Clay, Sp, Wa, S				
							3		3. 5°, J, VN, Mn, Fe, Sp, Wa, SR				500 gal WL
		87		100		38	4		4. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, S				
	423						5		5. 20°, J, VN, Mn Su, Fe, Clay, Sp, IR, S				
							IF						
-176	424		64										
	425								**BASALT a'a' Clinker** loose, red (2.5YR 4/6), reddish brown (2.5YR 4/4) and dark gray (10YR4/1), slightly to moderately weathered, medium strong		0.0		
-178	426												500 gal WL. 1410 at 428' bgs out of water - end of coring for 10/10/19
	427						IF		**BASALT Massive a'a'** very dark gray (10YR 3/1), slightly weathered, strong, 3% 1-12mm elongate, subrounded irregular vesicles.				
		88		96		16							
-180	428						1		1. 90°, J, VN, Mn, Fe, Sp, St, SR				10/11/19 - resume coring at 0737. 150 gal WL
	429						IF						

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	429						IF		No Recovery				
-182	430										0.0	[37.5]	
	431		65				1 2		1. 90°, J, VN, Mn, Fe, Sp, Wa, S 2. 5°, J, VN, Mn, Fe, Sp, Pl, S 3. 45°, J, VN, Mn, Fe, Sp, Wa, SR 4. 0°, J, N, Mn, Fe, Sp, Wa, SR				
-184	432						3						400 gal WL
		89		104		24	4		vug - 50mm x 15mm vug - 33mm x 18mm				
	433						5		vug - 51mm x 18mm 5. 10°, J, VN, Mn, Fe, Sp, Wa, SR				
							6		6. 5°, J, VN, Mn, Fe, Sp, Wa, SR 7. 50°, J, VN, Mn, Fe, Sp, Wa, SR				
-186	434						7		vug - 35mm x 28mm vug - 30mm x 15mm vug - 55mm x 9mm				
	435						IF				0.0	[15]	0818 pause to check water truck (~437') 0824 resume coring
							1		becomes very dark gray (GLEY1 3/N) unweathered, very strong, 3% 1-12mm subangular, irregular, elongate vesicles. 1% unweathered olivine phenocrysts. 1. 30°, J, N, Mn, Fe, Sp, Wa, SR 2. 40°, J, VN, Mn, Fe, Clay, Sp, Wa, S 3. 40°, J, VN, Mn, Fe, Sp, Pl, S				
-188	436						2						
			66				3						
	437												800 gal WL
		90		68		40			**BASALT a'a' Clinker** loose, very dark gray (5YR 3/1), dark reddish brown (2.5YR 3/1) and reddish brown (5YR 5/3), moderately weathered, weak to medium strong.				
-190	438												
	439								No Recovery				
-192	440								**BASALT Massive a'a'** greenish black (GLEY1 2.5/10Y) unweathered, strong, 5% 2-25 mm subrounded, elongate, irregular vesicles.		0.0	[3.529]	
							1						0850 pause to fill water truck (~441) 0923 - resume coring
	441						2						
							IF						
-194	442		67										800 gal WL
		91		92		20	3		1. 0°, J, N, Mn, Fe, Sp, Wa, SR 2. 10°, J, VN, Mn, Fe, Sp, Wa, SR 3. 90°, J, VN, Mn, Fe, Sp, Wa, SR				
	443												
							IF						
-196	444												
	445												

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 2/6/2020 RHMW13

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	445										0.0	[33.33]	
-198	446		68				IF						
	447	92		100		40							300 gal WL
-200	448								**BASALT a'a' Clinker** Welded, reddish black (2.5YR 2.5/1) and dark brown (7.5YR 3/2), slightly weathered, strong to medium strong				
	449						IF		**BASALT Pahoehoe** dark reddish brown (2.5YR 2.5/3) slightly weathered, strong 15% 1-6mm, rounded - subrounded vesicles. · becomes dusky red (2.5YR 2/2) moderately weathered, medium strong, 3% <2mm rounded to subrounded vesicles.				
-202	450						IF		possible flow contact, becomes black (10YR 2/1), slightly weathered, strong, 10% vesicles 1-7mm rounded to subrounded.		0.0	[33.33]	
	451						1		· becomes very dark grayish brown (10YR 3/2) moderately weathered, medium strong.				
-204	452						2		**BASALT a'a' Clinker** Welded, dark reddish brown (2.5YR 3/3) reddish black (2.5YR 2.5/1) slightly weathered, strong, some loose clasts. 1. 40°, J, VN, No, No, IR, SR 2. 40°, J, MW, Mn, Sp, IR, SR 3. 0°, J, MW, Mn, Sp, IR, SR				High pressure release - 500 gal WL
	453	93		78		40	3						
			69				IF		**BASALT Massive a'a'** very dark gray (10YR 3/2) moderately weathered, strong, 5% 2-13 mm irregular, elongated, subangular - subrounded vesicles (possibly massive a'a' boulder?)				
-206	454						IF		**BASALT a'a' Clinker** loose, dark gray (10YR 4/1) very dark brown (10YR 2/2) slightly weathered, strong.				
	455						VR				0.0	[27.27]	
-208	456						NR		No Recovery				
	457												500 gal WL
		94		60		12							
-210	458						IF		1. 30°, J, VN, Mn, Fe, Sp, Wa, S 2. 0°, J, VN, Mn, Fe, Sp, Wa, S 3. 90°, J, VN, Mn, Fe, Sp, Wa, S				
	459						1		**BASALT Massive a'a'** very dark gray (10YR 3/1) slightly weathered, very strong, 1% 1-2mm subrounded vesicles. · becomes 3% 1-10mm elongate and subrounded vesicles.				
-212	460						2						
							3				0.0	[30]	
							1						
	461						IF		1. 45°, J, VN, Mn, Fe, Sp, Wa, S				

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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	461												high pressure release - 500 gal WL
			70						**BASALT a'a' Clinker** loose, very dark gray (5YR 3/2) and dark reddish brown (2.5YR 3/4), slightly weathered, medium strong.				
-214	462	95		76		16			**BASALT Pahoehoe** brown (7.5YR 4/2), moderately weathered, strong, 5% 1-34mm, subrounded - subangular vesicles.				
							2 IF						
	463						3 IF		2. 5°, J, N, Mn Su, Fe, Sp, IR, SR 3. 60°, J, VN, Mn Su, Fe, Sp, Wa, S				
-216	464						NR		**BASALT a'a' Clinker** No Recovery				
	465										0.0	[18.75]	
			71						**BASALT Massive a'a'** very dark gray (10YR 3/1), slightly weathered, very strong, 5% <1-18mm, subrounded - subangular, elongate vesicles.				400 gal WL
-218	466						IF						1215 - pause to check water truck ~467.5'
							1						
	467	96		92		28	2		1. 10°, J, VN, Mn, Fe, Sp, Wa, SR 2. 60°, J, MN, Mn, Fe, Sp, Wa, SR				1217 resume coring
-220	468						IF						
							3						
	469						4		3. 10°, J, VN, Mn, Fe, Sp, Wa, SR 4. 5°, J, VN, Mn, Fe, Sp, Wa, SR				high pressure release
							NR		No Recovery				pause coring on 10/11/19
-222	470						IF				0.0	[30]	resume coring on 10/14/19
	471		72										
							IF						
-224	472	97		100		36							800 gal WL
	473						IF						
-226	474								becomes 7% 1-11mm, subrounded vesicles				
	475								**BASALT a'a' Clinker** welded, yellowish red (5YR 4/6), dark reddish gray (2.5YR 4/1) and brown (7/5YR 4/4), moderately weathered, medium strong		0.0	[33.33]	
							1						
-228	476		73				2		**BASALT Pahoehoe** brown (7.5YR 4/2) moderately weathered, medium strong, 10% 1-15mm subrounded - subangular vesicles, 3% halloysite. vug 30mm x 20mm				high pressure release - 400 gal WL
	477												

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 2/6/2020 RHMW13

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	477						3		becomes gray (10YR 5/1) slightly weathered, strong, 5% 2-25mm rounded to subrounded vesicles.				
		98		100		72			· becomes dark gray (GLEY1 3/N) slightly weathered to unweathered, strong, 10% 1-8mm rounded to subrounded vesicles. 1% olivine phenocrysts. 3% halloysite				
-230	478						4		1. 45°, J, N, Mn, Fe, Clay, Sp,Wa, SR 2. 0°, J, MW, Mn, Fe, Clay, Sp, IR, SR				
	479						5		3. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, S 4. 50°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 5. 70°, J, MW, Mn, Fe, Clay, Sp, IR, SR 6. 80°, J, N, Mn, Fe, Sp, Wa, SR				
-232	480						6		**BASALT a'a' Clinker** welded, yellowish red (5YR 4/6) and red (2.5YR 4/4), moderately weathered, medium strong.		0.0	[33.33]	
			74				IF		**BASALT Massive a'a'** very dark gray (10YR 3/1), moderately weathered, medium strong, 3% olivine phenocrysts, 2% Halloysite				
	481								· becomes slightly weathered, strong, 10% 2-40mm subrounded elongate vesicles.				500 gal WL
-234	482						IF		· becomes moderately weathered, strong · becomes greenish black (GLEY1 3/10Y), slightly weathered, very strong, 5% 1-6mm subrounded to subangular vesicles.				
		99		86		32	1		· becomes very dark gray (GLEY1 3/N) unweathered, very strong, 5% 1-18mm subrounded, elongate vesicles.				
	483						2		1. 10°, J, VN, Mn, Clay, Sp, Pl, S 2. 30°, J, VN, Mn, Sp, Pl, S 3. 20°, J, VN, Mn, Clay, Sp, Pl, S 4. 10°, J, N, Mn, Fe, Sp, Wa, SR				
-236	484						3		· becomes slightly weathered, strong, 5% 1-8mm subrounded to subangular irregular vesicles.				
							4		vug - 32mm x 19mm No Recovery				
	485										0.0	[5.45]	
							1		1. 20°, J, VN, Mn, Fe, Sp, Wa, SR				500 gal WL
-238	486		75				IF						0750 run out of water ~489'
	487						IF		**TUFF** Olive yellow (2.5Y 6/6), moderately weathered, medium strong, dark red (2.5YR 3/6) laminated ~2mm				resume coring at 0833
		100		68		0			**BASALT a'a' Clinker** loose, reddish black (2.5YR 2.5/1), dark red (2.5YR 3/6) and dark reddish brown (5YR 3/4) slightly to moderately weathered, medium strong				
-240	488												
	489								No Recovery				
-242	490										0.0	[12]	
	491												high pressure release - 600 gal WL 0654 - pause drilling ~493' b/c core is jammed
-244	492								· becomes reddish clack (2.5YR 2.5/1), highly weathered, weak				resume at 0907
		101		76		0							
	493												

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Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	493								**BASALT Massive a'a'** very dark gray (GLEY1 3/N) unweathered, very strong, 10% 1-5mm elongate, subrounded - subangular vesicles.				
-246	494		76				IF IF						
	495										0.0	[37.5]	
									· becomes 2% <2mm subrounded vesicles.				
-248	496						1 2		· becomes 5% 1-7mm subrounded, elongate vesicles. 1. 90°, J, VN, Mn, Fe, Sp, Wa, SR 2. 10°, J, VN, Mn, Sp, Wa, SR				
	497						3 4		3. 0°, J, VN, Mn, Fe, Sp, Wa, SR 4. 0°, J, VN, Mn, Sp, Wa, S				
		102		104		82	5		· becomes 10% 1-12mm subrounded, elongate vesicles vug - 11mm x 32mm				400 gal WL
-250	498								5. 20°, J, VN, Mn, Sp, Wa, SR 6. 20°, J, VN, Mn, Fe, Sp, Wa, S				
							6		· becomes 2% 1-4mm subrounded, elongate vesicles				
	499		77				IF 7		7. 90°, J, VN, Mn, Fe, Sp, Wa, S				
-252	500						NR				0.0	[5.17]	
	501								No Recovery				high pressure release - 500 gal WL
-254	502								**BASALT a'a' Clinker** loose, dark reddish brown (2.5YR 3/3, and dark reddish gray (2.5YR 4/1), slightly weathered, medium strong				pause at 1002 ~ 503' to adjust hoses
		103		52		8							
	503						IF 1		**BASALT Massive a'a'** very dark gray (GLEY1 3/N) slightly weathered, very strong, 2% <2mm, elongate, subangular vesicles.				1001 - resume coring
-256	504						IF		· becomes 10% 1-8mm subrounded, elongate vesicles 1. 90°, J, VN, Mn, Fe, Sp, Wa, SR				
							2		2. 90°, J, VN, Mn, Sp, Wa, S · becomes 2% 1-6mm subrounded, elongate vesicles				
	505		78				IF		**BASALT a'a' Clinker** loose, red (2.5YR 4/6) and reddish black (2.5YR 2.5/1), moderately weathered, medium strong		0.0	[23.07]	
							IF M 1		**TUFF** Olive yellow (2.5Y 6/6) and reddish brown (5YR 4/4) moderately weathered, medium strong, laminated <2mm dark red (2.5YR 3/6)				
-258	506						2		**BASALT Pahoehoe** Very dark gray (10YR 3/1), slightly weathered, strong, 10% 1-19mm, subrounded - rounded vesicles. 1. 5°, J, VN, No, No, Wa, SR 2. 45°, J, N, No, No, Wa, SR				
	507						3						500 gal WL
		104		100		46	4 5 6		3. 0°, J, VN, Mn, Fe, Sp, Pl, S 4. 0°, J, VN, No, No, Wa, SR 5. 0°, J, VN, Mn, Fe, Sp, Wa, SR				
-260	508						7		6. 90°, J, VN, Mn, Fe, Sp, Wa, SR 7. 0°, J, N, No, No, Wa, SR				
	509						IF						

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 2/6/2020 RHMW13

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	509								· becomes 15% 1-7mm rounded to subrounded vesicles				
			79				8		8. 0°, J, N, Mn, Fe, Sp, Wa, SR				
							9		9. 90°, J, VN, No, No, Wa, SR				
-262	510						10		· becomes 10% 1-10mm subrounded to rounded vesicles		0.0	[50]	
							11		10. 0°, J, VN, Mn, Clay, Sp, Wa, SR				
							1		11. 90°, J, VN, No, No, Wa, SR				
	511						2						
							IF		· becomes 15%<2mm subrounded to rounded vesicles				
-264	512												200 gal WL
		105		100		28			1. 0°, J, N, No, No, Wa, SR 2. 20°, J, VN, Clay, Sp, Wa, SR 3. 0°, J, VN, Clay, Sp, Wa, SR				
	513						IF						
-266	514		80						· becomes 10% <2mm subrounded to rounded vesicles				
							3						
	515						IF				0.0	[17.64]	
-268	516						1		Halloysite in vesicles				
									1. 0°, J, VN, Mn, Sp, Pl, Slk 2. 20°, J, VN, Mn, Fe, Sp, Pl, SR 3. 0°, J, VN, Clay, Sp, Wa, SR				
	517						IF		4. 0°, J, VN, No, No, Pl, SR				high pressure release - 500 gal WL
		106		100		66							
-270	518						2						
							IF		· becomes 10% 1-9mm rounded to subrounded vesicles				
			81										
	519						3		· becomes unweathered, very strong, 15% <2mm rounded vesicles.				
-272	520						4		· becomes very dark grayish brown (10YR 3/2) unweathered, strong 15% 1-3mm rounded to subrounded vesicles.		0.0	[60]	
	521						1		1. 55°, J, VN, Mn, Clay, Sp, Wa, SR				
									· becomes reddish black (2.5YR 2.5/1), red (2.5YR 4/6), red (2.5YR 5/8) slightly to moderately weathered, medium strong, 10% <2mm rounded to subrounded.				
-274	522												
		107		100		20							high pressure release - 400 gal WL
	523												
			82				IF						
							IF		· becomes reddish black (2.5YR 2.5/1) moderate to slightly weathered, medium strong, 10% 1-5mm rounded to subrounded vesicles.				
-276	524												
	525												

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Log of Boring RHMW13

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	525										0.0	[50]	
-278	526						1 2		· becomes 10% <2mm rounded to subrounded vesicles				
							3		1. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 2. 0°, J, VN, Mn, Fe, Clay, Sp, IR, SR 3. 30°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 4. 0°, J, VN, Mn, Fe, Clay, Sp, Wa, SR				
	527								· becomes reddish brown (2.5YR 4/3), moderately weathered, medium strong, 5% <2mm rounded to subrounded vesicles				400 gal WL
		108		100		46	4						
-280	528		83				IF IF		· becomes brown (7.5YR4/3) moderately weathered, medium strong, 10% <1mm rounded to subrounded vesicles heat alteration - reddish black (2.5YR 2.5/1) possible flow contact.				
	529								· becomes red (2.5YR 4/6), reddish brown (2.5YR 4/4) moderately to highly weathered, medium strong clay on surface				
									· becomes dark reddish brown (2.5YR 3/3) highly weathered, weak				
-282	530								· becomes moderately weathered, medium strong				end of coring on 10/14/19 TD = 530' bgs
	531								RHMW13 was hand cleared from ground surface to 3 ft below ground surface (bgs). The borehole was then drilled using 10" OD hollow stem auger from 0 to 22 ft bgs, where there was refusal. HQ coring commenced from 22 ft to 175 ft bgs. Drilled with 24" OD core bucket with production auger rig from 0 ft to 40 ft bgs. Installed 18" steel surface casing to 40 ft bgs. Reamed borehole with 17.5" tricone bit from 40 ft to 175 ft bgs. Installed 10" steel conductor casing to 172 ft bgs. HQ coring continued from 175 ft to 220 ft bgs. Borehole was reamed from 173 ft to 220 ft bgs with 9 7/8" tricone bit. Installed 5" steel casing to 220 ft bgs. PQ coring commenced from 220 ft bgs to a TD of 530 ft bgs.				
-284	532												
	533												
-286	534								Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 30,600 gallons of water were used during drilling and rock coring. 50 lb bags of max gel bentonite powder were added to the borehole during rock coring at two drill depths for added lubrication. Upon completion of drilling, a gyroscopic survey was performed. The borehole was logged using 3-arm caliper and acoustic televiewer tools. The borehole was developed using a Grundfos pump placed at four selected depths. A total of 4,523 gallons of development water were removed: 1,000 gallons with pump set at 500' bgs, 1,050 gallons with pump set at 400' bgs, 1,073 gallons with pump set at 320' bgs and 1,400 gallons with pump set at 240' bgs.				
	535												
-288	536												
	537												
-290	538												
	539												
-292	540												
	541												

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 2/6/2020 RHMW13

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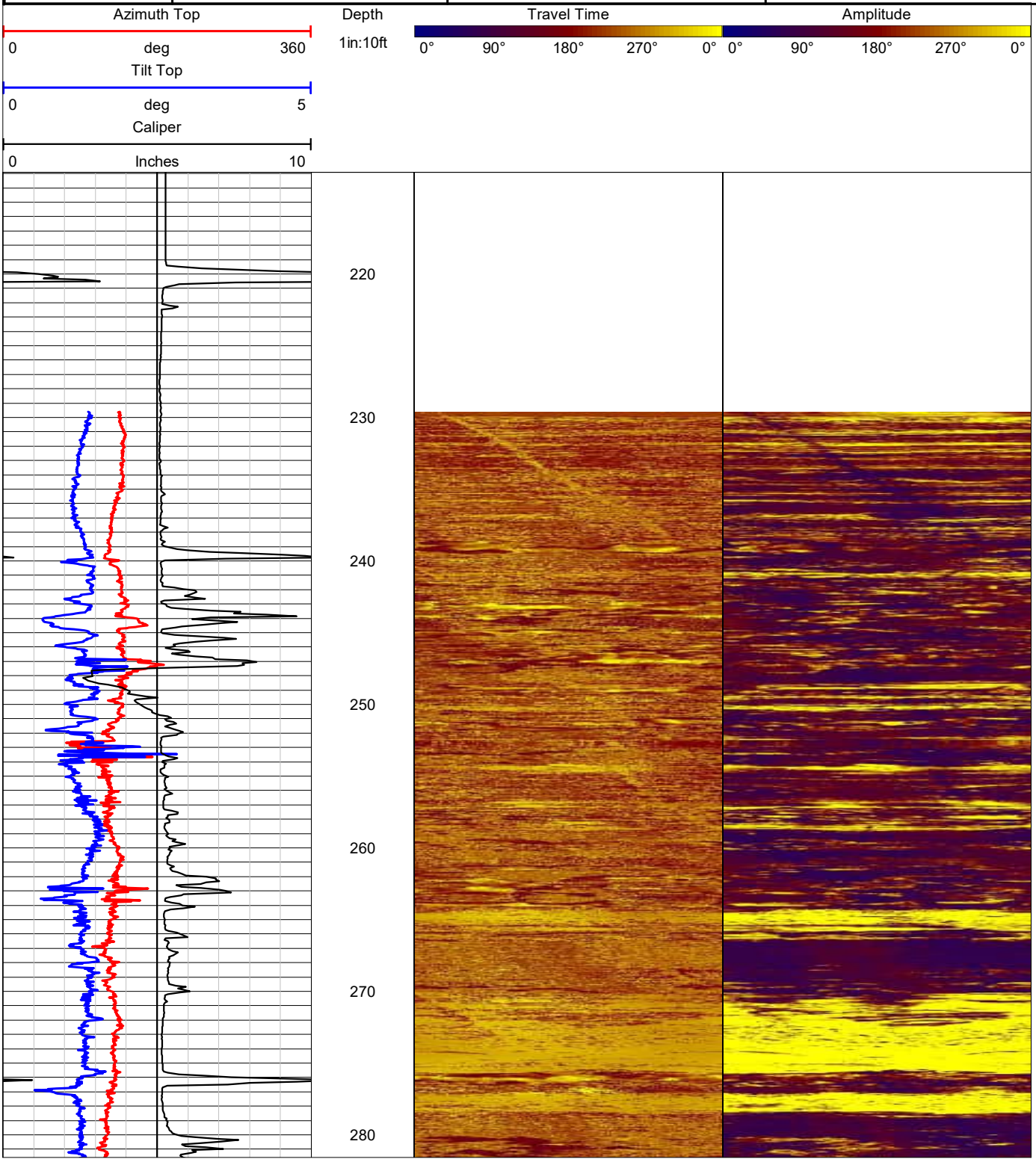
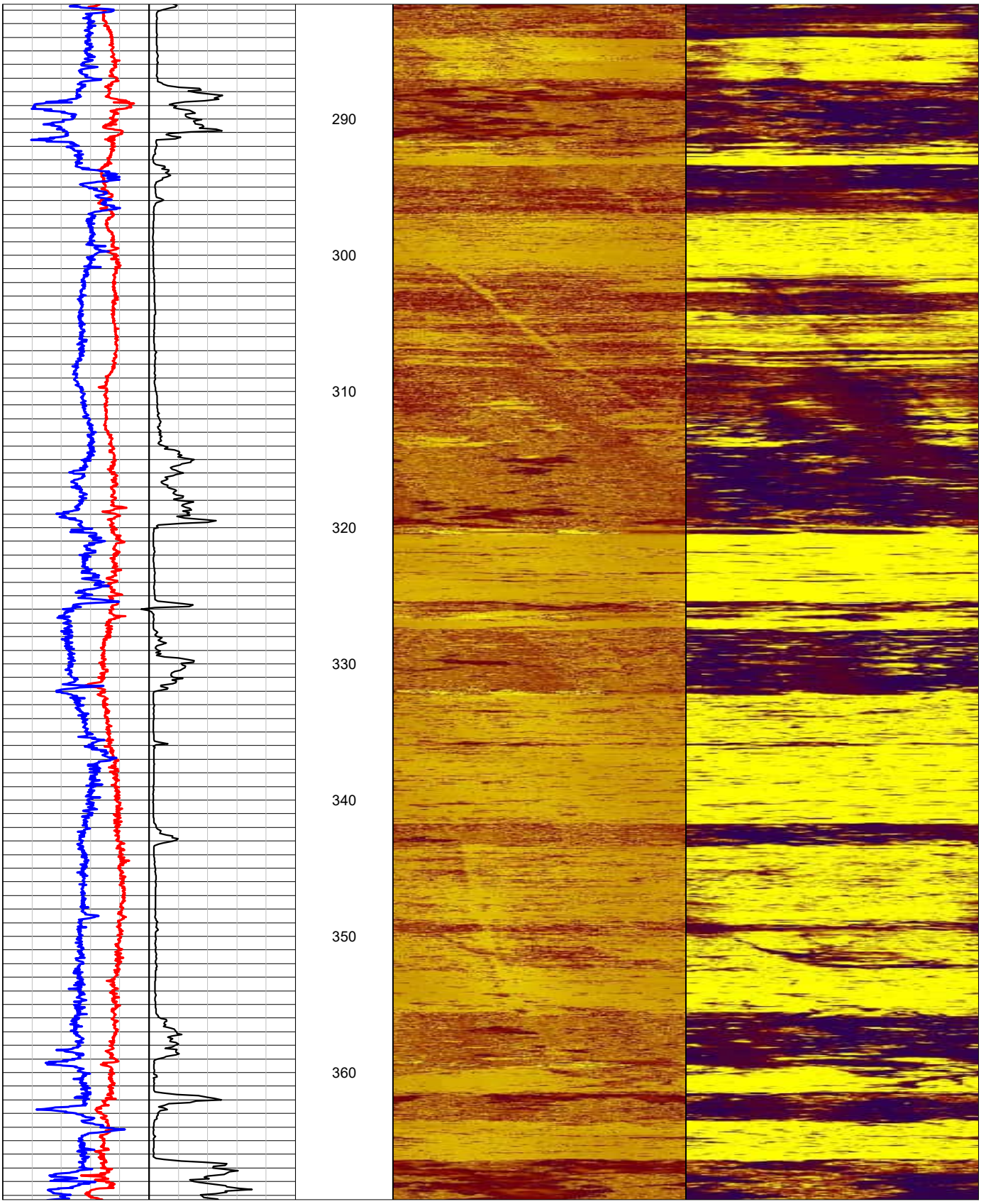
Geophysical Summary Plot

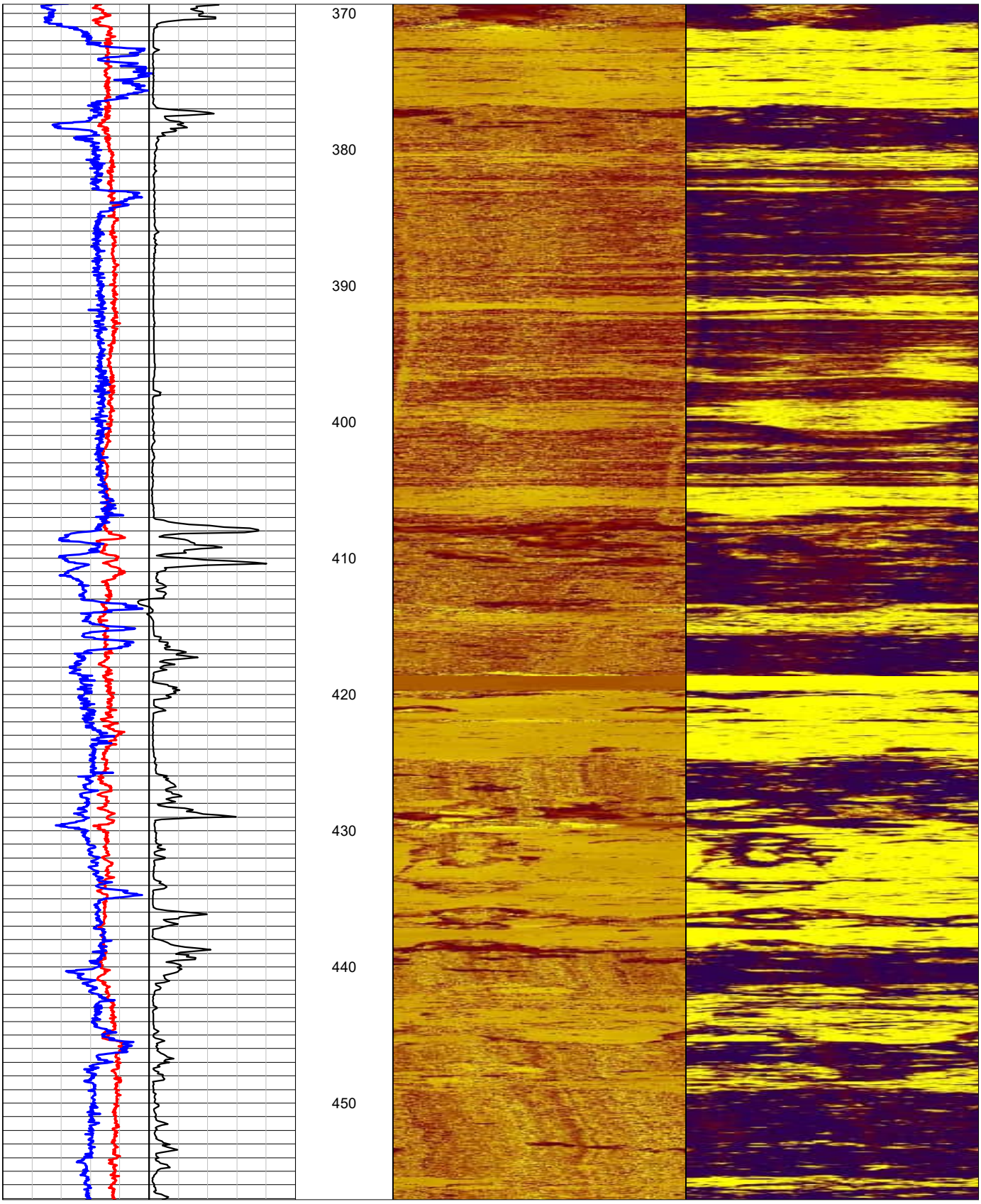
COLOG
borehole geophysics / hydrophysics

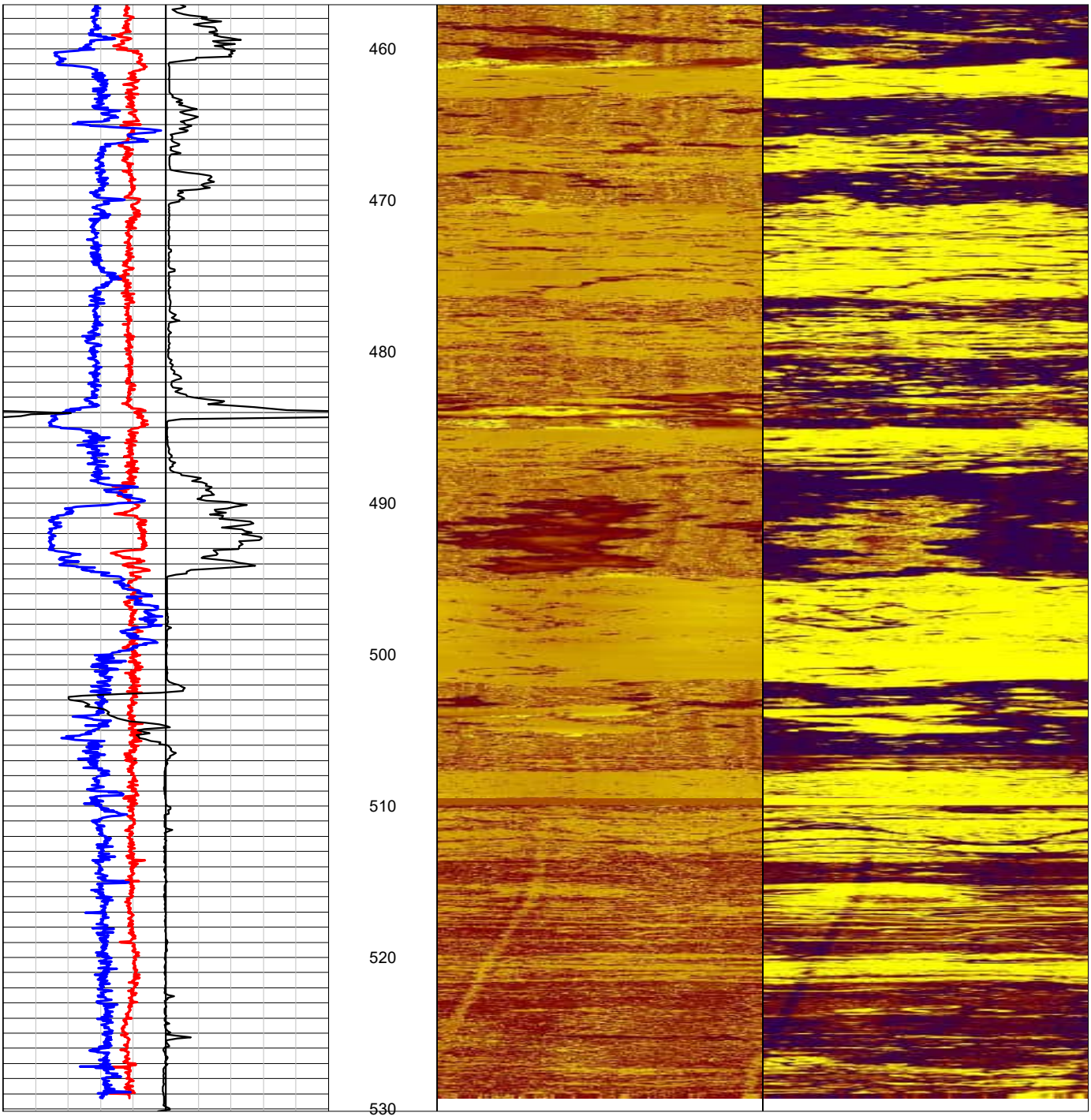
COMPANY: Valley Drilling	PROJECT: Red Hill
DATE LOGGED: 16-Oct-2019	WELL: RHMW-13

Colog, Inc. - Arizona
116 N. Roosevelt Ave, Suite 121, Chandler, AZ 85226
Phone: (480) 236-6815
www.colog.com









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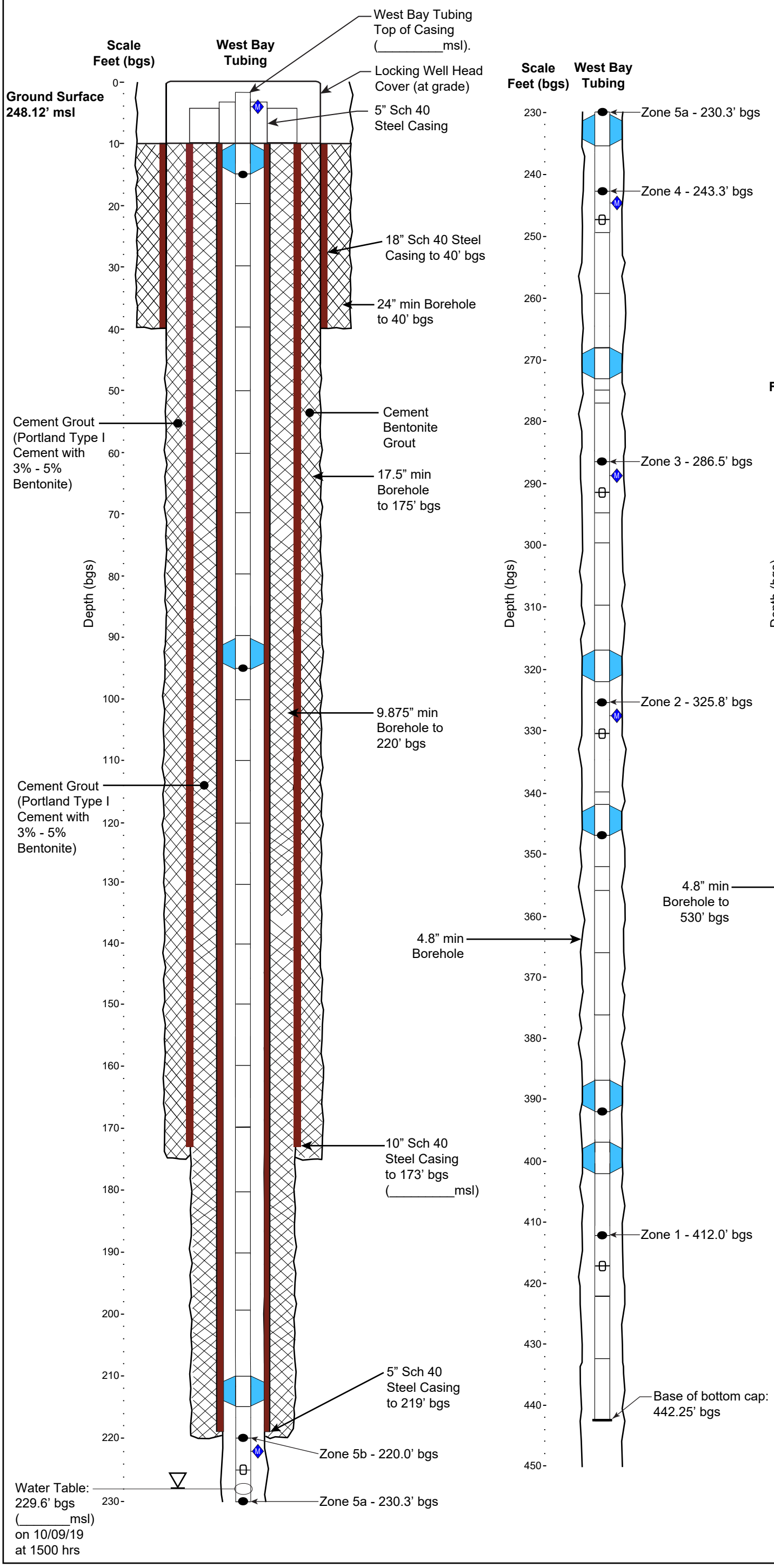
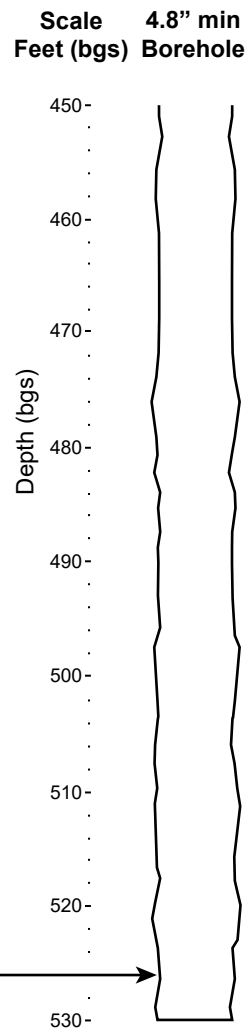
B:\60571032-HNL1\900-Work\921 Graphics\Well Logs\RHMW14\RHMW13_SummaryCompLog rev 1.ai

RHMW13 Monitoring Well





Legend

- Approximate Depth to Water in the Open Borehole within the Regional Basalt Aquifer Prior to Westbay System Installation
- Magnetic Sensor
- Packer
- Pump Port
- Sample Port

NOTE: DEPTHS BASED ON NOMINAL PORT POSITIONS, NO CORRECTIONS APPLIED - Nov 29, 2017
SOURCE: (c) WESTBAY INSTRUMENTS INC. 2000

Cross Section RHMW13 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawaii

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY
Red Hill 60571032	RHMW13	Red Hill	(b) (6)

METHOD
OVERPUMPAGE ☒
BAILER ☐
SURGE BLOCK ☐
AIR LIFT ☐
OTHER
Grundfoss submersible 6.67 gpm

INITIAL WATER LEVEL: 231.72' btoc
INITIAL TOTAL DEPTH: Not Measured

FINAL WATER LEVEL: _____'
FINAL TOTAL DEPTH: Not Measured

REMARKS:

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

DEVELOPMENT LOG:

DATE	TIME	COMMENTS	ELAPSED TIME	FLOW RATE (gpm)	CUMULATIVE WATER REMOVED GALLONS	WATER QUALITY pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (psu)	TDS (ppt)
Zone 1: casing bit at 500' bgs													
10/18	0701	Start purging											
10/18	702		1	6.67	7	6.55	22.80	0.52	3.04	-74.2	174.2	0.2	228.42
10/18	705		4	6.67	27	7.04	22.22	0.3	2.66	-39.6	213	0.1	173.69
10/18	709		8	6.67	53	7.32	22.07	0.28	2.27	-46.3	194	0.1	179.64
10/18	712		11	6.67	73	7.47	21.94	0.27	2.00	-61.3	174	0.1	185.01
10/18	716		15	6.67	100	7.65	21.85	0.27	2.06	-64.0	186	0.1	171.69
10/18	720	Spot check on ORP - sensor reading correctly	19	6.67	127	7.78	21.83	0.26	1.96	-65.9	167	0.1	170.04
10/18	727		26	6.67	173	8.01	22.09	0.27	6.46	122.9	147	0.1	171.65
10/18	730		29	6.67	193	8.37	21.76	0.27	7.24	113.9	154	0.1	175.75
10/18	735		34	6.67	227	8.52	21.68	0.27	7.57	111.7	53.3	0.1	175.07
10/18	740		39	6.67	260	8.55	21.66	0.27	7.49	110.7	26.1	0.1	174.32
10/18	747		46	6.67	307	8.56	21.64	0.27	7.86	110.9	21.8	0.1	173.86
10/18	751		50	6.67	334	8.56	21.64	0.27	7.89	110.1	17.9	0.1	173.64
10/18	755		54	6.67	360	8.58	21.61	0.27	7.98	108.9	13.7	0.1	173.56
10/18	800		59	6.67	394	8.58	21.64	0.27	8.03	108.4	9.37	0.1	173.31
10/18	805		64	6.67	427	8.59	21.62	0.27	8.06	108.4	8.94	0.1	173.36

10/18	810		69	6.67	460	8.59	21.64	0.27	8.06	107.8	8.67	0.1	172.82
10/18	820		79	6.67	527	8.59	21.69	0.27	8.03	108	8.08	0.1	172.89
10/18	830		89	6.67	594	8.58	21.71	0.27	8.08	108.9	6.99	0.1	172.56
10/18	840		99	6.67	660	8.49	22.18	0.27	8.13	124.2	5.62	0.1	172.53
10/18	850		109	6.67	727	8.57	21.9	0.27	8.19	126.7	5.11	0.1	172.49
10/18	900		119	6.67	794	8.58	21.75	0.27	8.25	124.5	4.73	0.1	172.2
10/18	910		129	6.67	860	8.59	21.73	0.27	8.15	119.2	3.79	0.1	172.21
10/18	920		139	6.67	927	8.59	21.73	0.26	8.29	114.7	3.78	0.1	172.04
10/18	930		149	6.67	994	8.58	21.74	0.26	8.3	115.5	3.7	0.1	172.16
		Stop pumping, pull pump/casing up			Zone 1 total:								

Zone 2: casing bit at 400' bgs													
		Start pumping											
10/18	1041		1	6.67	7	8.67	24.06	0.26	7.28	134.5	75.6	0.1	171.37
10/18	1046		6	6.67	40	8.63	22.71	0.26	6.96	163.3	88.4	0.1	171.33
10/18	1050		10	6.67	67	8.64	22.41	0.26	6.82	155.6	67.8	0.1	171.96
10/18	1055		15	6.67	100	8.66	22.2	0.26	6.73	153.6	82	0.1	170.61
10/18	1100		20	6.67	133	8.66	22.08	0.27	8.37	147.7	49.8	0.1	172.93
10/18	1105		25	6.67	167	8.67	22.04	0.27	8.53	142.9	9.47	0.1	172.69
10/18	1110		30	6.67	200	8.67	22.26	0.27	8.38	141.2	7.69	0.1	173.44
10/18	1115		35	6.67	233	8.67	22.3	0.27	8.53	138.6	7.3	0.1	172.72
10/18	1120		40	6.67	267	8.66	22.17	0.27	8.55	139.8	6.67	0.1	172.68
10/18	1125		45	6.67	300	8.65	22.21	0.27	8.53	142.3	-	0.1	172.57
10/18	1130		50	6.67	334	8.62	22.3	0.27	8.54	155	5.23	0.1	172.72
10/18	1135		55	6.67	367	8.64	22.44	0.27	8.49	162.2	4.49	0.1	172.83
10/18	1140		60	6.67	400	8.64	22.4	0.27	8.47	171.1	3.87	0.1	171.04
10/18	1150		70	6.67	467	8.64	22.85	0.27	8.33	171	2.89	0.1	170.66
10/18	1200		80	6.67	534	8.64	22.29	0.27	8.55	179.7	3.24	0.1	172.48
10/18	1210		90	6.67	600	8.64	22.21	0.27	8.5	170.9	2.57	0.1	172.17
10/18	1220		100	6.67	667	8.64	22.71	0.27	8.4	176	5.49	0.1	171.77
10/18	1240		120	6.67	800	8.65	22.39	0.27	8.51	166.3	3.17	0.1	172.96
10/18	100		140	6.67	934	8.64	22.55	0.27	8.46	168.5	2.55	0.1	172.87
10/18	120		160	6.67	1067	8.63	22.67	0.27	8.54	171.3	3.11	0.1	172.57
10/18	121		161	6.67	1074	-	-	-	-	-	-	-	-
10/18	122		162	6.67	1081	-	-	-	-	-	-	-	-
10/18	123		163	6.67	1087	-	-	-	-	-	-	-	-
10/18	124		164	6.67	1094	-	-	-	-	-	-	-	-
10/18	125		165	6.67	1101	-	-	-	-	-	-	-	-
		Stop pumping, pull pump/casing up			Zone 2 total: 1101								

Zone 3: casing bit at 320' bgs													
10/21	647		0	6.67	0								
10/21	650		3	6.67	20	7.22	22.8	0.23	3	123.1	-	0.1	152.02
10/21	656		9	6.67	60	7.72	22.09	0.26	5.62	121.8	-	0.1	169.36
10/21	705		18	6.67	120	7.93	21.91	0.26	7.37	114.6	6.4	0.1	170.22
10/21	712		26	6.67	173	7.61	21.91	0.26	7.61	106.8	3.87	0.1	170.85
10/21	722		35	6.67	233	8.19	22.07	0.26	7.77	108.8	2.56	0.1	170.6
10/21	730		43	6.67	287	8.24	22.14	0.26	7.79	103.3	2.38	0.1	170.41
10/21	756		69	6.67	460	8.31	22.46	0.26	7.92	101.7	1.66	0.1	170.12
10/21	807		80	6.67	534	8.32	22.62	0.26	7.89	103.7	1.1	0.1	169.9
10/21	832		105	6.67	700	8.36	22.93	0.26	7.9	108.8	0.66	0.1	169.85
10/21	856		129	6.67	860	8.3	24.34	0.26	7.82	134.8	0.68	0.1	168.38
10/21	917		150	6.67	1001	8.37	23.47	0.26	7.89	138.4	0.66	0.1	169.06
10/21	924		157	6.67	1047	8.38	23.62	0.26	7.9	137.3	0.62	0.1	169.47
10/21	928		161	6.67	1074	8.38	23.57	0.26	7.9	136.6	0.52	0.1	169.08
		Stop pumping, pull pump/casing up			Zone 3 total: 1074								

Zone 4: casing bit at 240' bgs													
10/21	1031	Start Purge											
10/21	1038		7	6.67	47	8.23	23.75	0.37	3.4	157.1	25.8	0.2	238.05
10/21	1048		17	6.67	113	8.17	23.16	0.33	5.37	149.4	11.9	0.2	215.67
10/21	1055		24	6.67	160	8.18	23.06	0.32	6.02	145.1	8.08	0.2	208.46
10/21	1100		29	6.67	193	8.19	22.98	0.31	6.29	142.4	8	0.2	204.67
10/21	1105		34	6.67	227	8.2	22.94	0.31	6.47	141.4	6.2	0.2	202.63
10/21	1115		44	6.67	293	8.2	22.92	0.31	6.72	138.5	6.06	0.1	199.06
10/21	1123		52	6.67	347	8.23	22.80	0.30	6.89	130.4	5.3	0.1	196.28
10/21	1126		55	6.67	367	8.23	22.85	0.3	6.94	138.6	5.5	0.1	196.28
10/21	1132		61	6.67	407	8.24	22.93	0.3	6.94	139.7	3.93	0.1	195.25
10/21	1142		71	6.67	474	8.24	23.46	0.3	7.04	148.1	3.52	0.1	192.12
10/21	1147		76	6.67	507	8.25	23.25	0.3	7.05	155.6	3.06	0.1	192.08
10/21	1155		84	6.67	560	8.26	23.17	0.29	7.12	163.8	2.82	0.1	191.69
10/21	1205		94	6.67	627	8.26	23.47	0.29	7.14	172	1.89	0.1	190.42
10/21	1215		104	6.67	694	8.28	23.17	0.29	7.07	173.6	3	0.1	189.38
10/21	1225		114	6.67	760	8.28	22.87	0.29	7.28	183.2	1.88	0.1	188.15
10/21	1235		124	6.67	827	8.28	23.16	0.29	7.29	154.6	1.9	0.1	187.56
10/21	1246		135	6.67	900	8.27	24.87	0.29	7.24	112.3	1.51	0.1	187.39
10/21	1255		144	6.67	960	8.27	24.84	0.29	7.23	158.4	1.59	0.1	187.36
10/21	110		159	6.67	1061	8.3	23.83	0.29	7.32	157.1	1.57	0.1	186.9
10/21	125		174	6.67	1161	8.3	24.6	0.29	7.26	162.5	1.63	0.1	185.69
10/21	140		189	6.67	1261	8.29	24.94	0.29	7.33	168.9	1.12	0.1	186.83
10/21	154		203	6.67	1354	8.31	24.25	0.29	7.36	182	1.3	0.1	185.27
10/21	158		207	6.67	1381	8.32	24.23	0.28	7.36	179.7	1.29	0.1	185.19
10/21	201		210	6.67	1401	8.31	24.46	0.29	7.39	177.4	1.23	0.1	185.45
		Stop pumping, pull pump/casing up			Zone 4 total: 1401								
					All Zones Total: 4570								

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Date(s) Drilled	**10/26/18 - 02/25/19**	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	**Core bucket, HSA, HQ core, PQ core**	Drill Bit Size/Type	**24" core bucket/prod auger, 10" HSA, HQ/PQ core diamond bit**	Total Depth of Borehole	**495.0 feet**
Drill Rig Type	**Mobile B-59 / Mobile B-90/ Watson 1100 and 2000**	Drilling Contractor	**Valley Well Drilling**	Approximate Surface Elevation	**180.23**
Groundwater Level	**El. ~20.45' (2/26/19)**	Location	**Halawa Correctional Facility**	Inclination from Horizontal/Bearing	**90°**
Borehole Completion	**Westbay Well**	▌ **Packer** ⊗ **Sample Port** ⋮ **Measurement Port**		Hammer Data	**140 lbs/30-inch drop**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
180	0								**FILL** Moist, dark brown (7.5YR 3/3), Silty Sandy GRAVEL (GM) with cobbles and boulders, sub rounded to rounded, 60% coarse, 20% sand, 20% fines, no odor							Air Knife for utility clearance. Visually logged open hole
	1								1-2 ft bgs boulder 22" x 13"							
	2								2.2-3 ft bgs boulder 36" x 24"							
178	3															End airknife at 3 ft bgs due to boulder obstructions
									Moist, brown (10YR 4/3), Clayey GRAVEL with Sand (GC), contains cobbles and boulders, gravel subrounded to subangular, fine to coarse, 60% coarse, 20 % sand, 20% fines							Resume drilling on 11/20/18 at 11:22 with 24" core bucket auger
	4															Core bucket grinding at 3.5 ft. Driller adding ~1 gal water/ft
176	5															
	6								Brown (10YR 5/3), GRAVEL with Silt and Sand (GW-GM), grades with more gravel, 70% gravel, 20% sand, 10% fines, well graded, boulders ~1 ft diameter							Intermittent grinding 4 ft - 9 ft
174	7															
	8															9-10 ft boulder
172	9								Boulder 9'-10'							10 ft easier drilling
	10								Brown (10YR 5/3) with gray (5Y 6/1) and pale yellow mottles (5Y 7/4) and yellowish brown (10YR 5/4), well graded GRAVEL with Silt and Sand (GW-GM), many cobbles and boulders							
170	11															
	12								**ALLUVIUM** Moist, brown (10YR 5/3) with gray (5Y 6/1) and pale yellow mottles (5Y 7/4) and yellow brown (10YR 5/6), Sandy CLAY with gravel (CH), rounded, weathered,					56.6		At 12 bgs, strong odor, PID=56.6 ppm. Grinding hard at 9ft pull up,
168	13															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
166	13								friable, 60% fines, 25% sand, 15% gravel, strong odor, with cobbles and boulders 0.25-0.75 ft highly to moderately weathered, angular to rounded							bucket and rock still left in hole Collect ERH 717 from ~12-19 bgs for TPHd/o and PAH from cuttings, 1 gal ziplock bag
	14															At 14.5 ft switch to auger bucket. *PID in bit bin equals 63 ppm. Down hole = 38 ppm
164	15								Same, strong odor, cobbles and boulders have black surface stains, possibly manganese, some fracture surfaces have slight irridescence					63*		At 16.4 ft switch back to core barrel. **PID= 256 ppm in bit bin
	16								Seepage into hole observed at 16 ft bgs							At 17.4 ft very easy drilling
162	17													256**		At 18 ft ***PID=250 ppm in bit bin. PID=156 ppm on rock
	18													250***		At 19 ft, ****PID=5.0 ppm on bottom of core
	19													5****		14:14 hrs at 19.58 ft
160	20													20.9		Water trickling in at ~16 ft bgs End drilling at 21.5 ft at 14:30 on 11/20/18.
	21															
158	22								Moist, brown (10YR 4/3) with reddish (7.5YR 6/6), yellow Sandy Fat CLAY (CH) with gravel, 15% gravel, 20% sand, 75% fines, subrounded to subangular fine to coarse gravel predominantly coarse gravel, no odor PID=0.0ppm							Resume drilling from 21.5 ft at 10:20 on 01/03/19
	23															
156	24								Wet, dark yellowish brown (10YR 4/4) with reddish yellow (7.5YR 6/6), Sandy SILT (ML) with gravel, 30% sand, 20% gravel, 50% fines with cobbles and gravel, rounded to subangular basaltic, fine to coarse, no odor. PID=0.0ppm							
	25															
154	26								Same color as above, cobbles became angular possibly broken up boulders, black staining surfaces					0.0		
	27								Same color as above, cobbles become angular possibly broken up boulders, black staining surfaces with roots							
152	28								Grades with more cobbles, some angular, very wet because water accumulated in hole bottom during lunch ~2 ft of water in 40 min water infiltrates in ~ 16 ft bgs					0.0		
	29															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
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Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
150	29								Moist, dark brown (10YR 3/3) with dark gray (10YR 4/1) and brownish yellow (10YR 6/6), Sandy Fat CLAY (CH) with gravel matrix, with angular highly weathered friable basalt cobbles, black staining on fractured surfaces, 20% sand, 15% gravel, 65% fines					0.0		
	30															
	31															
148	32															Driller adding water from top of hole
	33															
146	34								Moist, gray (10YR 5/1) with dark yellowish brown (10YR 3/4) and yellow (10YR 7/6), fat CLAY with sand 5% gravel, 20% sand, 75% fines (CH)							Driller adding water from top of hole
	35															
	36															Driller adding water from top of hole
144														0.0		
	37								Grades with some cobbles					0.0		
	38															Driller adding water from top of hole
142	39													0.0		
	40															
140	41								Wet, dark yellowish brown (10YR 4/4), Clayey GRAVEL with Sand (GC), friable, angular, highly weathered, possible perched zone at 42 ft bgs							Driller adding water from top of borehole. Water appears to be infiltrating in at ~42 ft bgs. See logbook 6 pg 139 for water level monitoring. Install 20" OD steel conductor to 45 ft bgs, and tremie grout cement bentonite into annulus
	42															
138	43															
	44															
136	45															Drill to 45.2 ft bgs

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
134	45								Wet, dark brown (7.5YR 3/2) to brown (7.5YR 4/2), gravelly Fat CLAY (CH) with sand, 30% gravel, 15% sand, 55% clay, contains cobbles and possible boulders, fine to coarse, subrounded to angular Driller says formation is soft.			1				Boring resumed on 1/10/19 from 45 ft bgs using 10" OD HSA (8 5/8" ID). Auger bit advanced with slide hammer and auger casing follows. Formation is soft. Bulk sample 1 obtained by slide hammering 6" concrete coring bit into center of HSA casing (to ensure plumbness) to retrieve auger bit
132	46															
130	47															
128	48															
126	49															
124	50															
122	51			100					Becomes moist, grades with mottles of strong brown (7.5YR 5/6) and dark brown (7.5YR 2.5/2) weathered gravel, friable			2	5 15 35	0.0		Sampling with downhole hammer on wireline and modified california sampler
120	52															
	53															
	54			67					Becomes dark gray (5YR 4/1) and strong brown (7.5YR 4/6)			3	4 4 16	0.0		
	55			100					Dark greenish gray (10Y 4/1) BASALT, moderately weathered, weak, friable, black stains of fracture surfaces, probably boulder			4	15 50/6"	0.0		
	56															
	57	5		67			IF IF		very dark greenish gray (10Y 3/1), a'a BASALT, slightly weathered, strong, 15% vesicles, vertical joints Joints 0-90, J, VN, Mn/Fe, Su, Wa, R 56-59 ft light brown water return, water loss ~5 gal						[13.8]	Augering slow driller suspects boulders. After sampling to 56 ft bg bottom of hole at 55 ft bgs. Then drill auger casing without center bit to 57 ft bgs Prepare to begin coring. Boring paused at 56 ft bgs on 1/10/19 at 15:45
	58						NR		no recovery							
	59								Strong brown (7.5YR 4/6) to very dark greenish gray, Fat CLAY (CH) with trace of basaltic gravel Core sample stuck inside core barrel, very high plasticity, very stiff clay. Leave in for now, will need to use pressure to push out. Recovered 1.5 ft of core from barrel on 1/22/19						[37.5]	Resume drilling at 56 ft bgs on 1/11/19 at 08:35 using HQ core. Tag hole to 59 ft bgs after run 5
	60		2													
120	61															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
118	61															
	62	6		54		C										Light brown water return, water loss ~10 gal
	63															High back pressure when casing joint broke
116	64													0 0	[30]	
	65						1 fr ht		Moist, greenish gray (10BG 5/1) and strong brown (7.5YR 4/6), Gravelly Fat CLAY (CH) with sand and gravel fine to medium, very weathered friable, subrounded to angular, 20% gravel, 10% sand, 60% fines very dark greenish gray (10Y 3/1), basalt boulder 30% vesicles, slightly weathered							Light brown water return, water loss ~10 gal
114	66						4		grades back to Gravelly Fat CLAY (CH) with sand and bands of dark brown (10YR 3/3), fat clay, very stiff 1-3 45, J, VN, Mn/Fe, Sp, Wa, SR, 4 5, J, VN, Mn/Fe, Su, IR, R 5 5, J, VN, Mn/Fe, Su, Wa, SR						
	67	7		100		13										
112	68								Basalt cobble at 68.2 ft							
	69						15		very dark greenish black (10Y 2.5/1), basalt pahoehoe boulder, slightly weathered, medium strong, 40% vesicles basalt boulders, mixed pahoehoe and a'a with clay seams and gravel heat alteration, possible flow boundary noted in boulder					0 0	[60]	
110	70															Light brown water return, water loss ~5 gal
	71	8		80		22										
108	72								grades with more gravel, subangular to angular medium to coarse, highly to slightly weathered							
	73						NR		no recovery							
106	74						IF		**SAPROLITE** Dark greenish gray (5GY 4/1), BASALT Massive a'a, slightly weathered, strong, 5% vesicles, intensely fractured. Massive a'a cobblestones/boulders with dark grayish brown (2.5Y 3/2), Gravelly Fat CLAY (CH) with sand seams, gravel fine to coarse, subrounded to angular slightly to highly weathered 75.3 - 76 ft clay seam					0 0	[17.5]	Light grayish brown water return, water loss ~10 gal
	75															
	76	9		100		C										Drill string water pressure high
104																
	77															

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Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
102	77								very dark greenish gray (10Y 3/1) with streaks of brown (7.5YR 4/2) basalt massive a'a, slight weathering, strong, 5% vesicles (elongate)							High water back pressure when casing joint broken
	78	10		67		36			At 77.5 ft becomes very dark gray (N3), smaller vesicles ~1 mm, more spherical					0.0	[30]	Light grayish brown water return
	79						NR		no recovery						[25]	
100	80								At 78 ft very dark greenish gray (10Y 3/1), 20% vesicles, slight to moderately weathered, clay seam in between two boulders likely washed out							
	81	11		84		C			At 79.3 ft Moist, dark reddish brown (5YR 3/2) Sandy Fat CLAY (CH) with gravel, gravel is slightly to moderately weathered, subrounded to angular, contains very dark gray (3N), slightly weathered basalt a'a cobbles 5-10% vesicular, cobbles appear to be from the same flow and clay is completely weathered basalt, weathered in place							Light brown water return, water loss ~10 gal
98	82															
	83						NR		no recovery							
	84								becomes dark reddish brown (5YR 2.5/2 to 5YR 3/4), Fat CLAY (CH) with sand, contains traces of gravel, coarse, angular, slightly weathered and basalt a'a cobbles					0.0	[25]	
96	85															Light brown water return, water loss ~50 gal
	86															
94	87	12		84		C										Boring paused on 1/11/19 at 89 ft at 12:04 Pull out HQ casing and prepare for 10" casing install
	88															10" steel casing installed to 86 ft bgs on 1/17/19
92	89						NR		no recovery							
	90								Very dark gray (N3), pahoehoe cobble 89-89.5 ft, 35% vesicles, slight weathering					0.0	[33.3]	Resume drilling on 1/22/19 at 08:08
90	91								Dark reddish brown (5YR 3/2), Fat CLAY (CH) with 25% gravel, angular, basaltic, with basaltic cobbles, slightly to moderately weathered, black stains on fracture surfaces							
	92	13		100		2			91-92 ft Sandy Fat CLAY with gravel (CH), 25% sand, 15% gravel, 60% fines							Dark grayish brown water return, no water loss
88	93															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	93								93-93.5 ft basalt pahoehoe cobble, moderately weathered							
86	94						IF		Massive basalt a'a boulder/cobbles, very dark gray (N3), slightly to moderately weathered, strong with possible washed out clay seams in joints					0.0	[60]	
	95								Dark reddish brown (5YR 3/2) Sandy Elastic SILT (MH) with gravel, 15% gravel, 20% sand, 65% fines. Gravel is subrounded to angular, poorly graded							Dark brown water return, no water loss
84	96	14		86		0			Massive basalt a'a cobble, very dark gray (N3), slightly weathered, hard, 15% stretched vesicles							
	97								96.75 ft dark reddish brown (5YR 3/2) Gravelly Elastic Silt (GM) wih sand, 30% gravel, 15% sand, 55% fines. Gravel subangular, well graded							
	98								Massive basalt a'a cobble, as above with black stains on fracture surfaces (97.5-97.8 ft)							
82							NR		no recovery							
	99								At 99 ft dark reddish brown, Sandy Elastic SILT (MH) with gravel, 15% gravel, 20% sand, 65% silt, contains slightly weathered basalt cobbles, gravel sub angular, moderate to highly weathered					0.1	[30]	
80	100															Dark brown water return, no water loss
	101								**BASALT** *Pahoehoe* Moderately weathered, very dark gray (N3) to dark gray (N4), strong to modium strong, 35% vesicles, spherical, 0.5-1 mm							
		15		92		36	1									
78	102						2									
							3									
	103						4									
							5									
							6		grades with bands of vesicles <0.5 mm							
							7		1 50, J, N, Sd, Si, Fe, Pa, Wa/R, R 2 0, J, N, Sd/Si/Fe, Pa, Wa R 3 0, J, VN, Mn/Fe, Su, Pl, SR 4 10, J VN, Si/Mn/Fe, Pa, Pl, SR 5 45, F VN, Mn/Fe, Su, Wa, SR 6 10, J VN, Mn/Fe, Su ST, R 7 60, J VN, Mn/FE, Su, Pl, Se							
	104															
76							1		At 104 ft grades to 40% vesicles					0.0	[60]	
							2		1 0, J, VN, Mn, Sp, Pl, SR 2 90, J VN, Fe, Mn, Su, Wa, SR 3 30, J VN, Mn, Sp, ST, R 4 5, J, VN, Fe/Mn, Su, Wa, R 5 60, J, VN, Fe/Mn, Su, Wa, R 6 50, J, VN, Fe/Mn, Sp, Pl, SR 7 0, J, VN, Fe/Mn, Su, Wa, R 8 2, J, VN, Fe/Mn, Su, Pl, S 9 50-40, VN, Fe/Mn, Su, ST, SR, Joint 10 10, J, VN, Fe/Mn, Su, Wa, SR							
	105						3									
							4									
	106						5									Dark brown water return
74		16		108		70	6									
							M									
	107						7									
							8		107.2-107.4 ft zone of 10% vesicles <0.5 mm							
	108						9									
72																
							10		At 108.75 ft becomes highly weathered, yellowish red (5YR 4/6), weak, possible flow boundary							
	109															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R.Q.D. %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	109						1		1 5, J, N, Cl, Fe, Mn, Pa, Ir, VR					0.1	[100]	
									becomes dusky red (2.5YR 3/2) to reddish black, moderate to highly weathered, weak to medium strong							
-70	110						2		2-3, 10, J, VN, Fe, Mn, Sp, Wa, SR 4 5, J, VN, Fe, Mn, Cl, Sp, Wa, SR							Dark brownish gray water return, water loss ~10 gal
							3		5 45, J, VN, Fe, Mn, Cl, Sp, Wa, SR							
	111						4		6 5, J, VN, Fe, Mn, Su, Ir, VR 7 60, J, VN, Fe, Mn, Cl, Pa, Ir, VR							
		17		100		84	5		8 15, J, VN, Fe, Mn, Cl, Pa, Wa, R							
-68	112						6									
							7									
	113						8									
	114													0.0	[75]	
-66							1									
	115						2		115-116.4 ft contains weathered olivine and plagioclase phenocrysts 0.5-1 mm, 2-5%							Dark brownish gray water return, water loss ~10 gal
									1 40-80, J, Cl, Fe, Mn, Pa, Ir, R, VN becomes slightly to moderately weathered, very dark gray (N3), moderately strong to strong, 20-30% vesicles							
-64	116						3		2 5, J, Cl, Sp, Ir, VR, VN							
		18		100		84	4		At 115 ft becomes slightly weathered to fresh, strong to very strong, vesicles up to 10 mm 3 35, J, Fe, Cl, Mn, Sp, Pl, SR, VN							
	117						5		At 115.7 ft vesicles become 1-5 mm 4 35, J, N, Fe, Mn, Cl, Pa, Pl, SR							
							6		At 116.4 ft becomes reddish black to very dark gray, slightly to moderately weathered, medium strong vesicles <0.5 mm, some filled with clay							
-62	118						7		5 0, J, N, Cl, Si, Pa, Pl, SR							
							8		At 117.75 ft becomes slightly weathered, strong, very dark gray (N3), 35% vesicles (1-2 mm) 6 50, J, N, Cl, Mn, Fe, Pa, Pl, R							
	119						1		7 5, J, N, Cl, Fe, Mn, Pa, Ir, R 8 10, J, VN, Cl, Fe, Mn, Sp, Pl, SR					0.1	[150]	
									At 119.2 ft becomes moderately weathered, weak, vesicles filled with clay							
-60	120						2		becomes slightly weathered to fresh, strong, 40% vesicles 1-2 mm, traces of weathered olivine ~1% 1 50-20, J, VN, Cl, Mn, Fe, Sp, Ir, SR							Dark brownish gray water return, water loss ~10 gal
							3		2 15, J, VN, Cl, Sp, Wa, SR 3 0, J, VN, Cl, Sp, Pl, SR							
	121						4		4 75, J, VN, Cl, Fe, Mn, Pa, Ir, R 5 10, J, VN, Cl, Fe, Mn, Sp, Wa, SR							
		19		94		78										
	122								vesicles 0.5-1 mm							
-58							5		122.7-122.8 ft moderate weathering around fracture							
	123								vesicles 1-2 mm							
									no recovery							
	124						NR		At 124 ft becomes 30% vesicles					0.1	[150]	Driller says no water return 124-125 ft
-56																
	125								At 124.8 ft becomes reddish black (2.5YR 2.5/1)							

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	125								with reddish yellow (7.5YR 7/6), vesicles infill, moderate to highly weathered, medium strong to weak, vesicles 0.5-1 mm 1. 10, J, N-VN, Cl, Mn, Fe, Pa-Sp, Ir, R 2. 20, J, N-Vn, Cl, Mn, Fe, Pa- Sp, Ir, R 3. 75, J, VN, Cl, Mn, Fe, Sp, Pl, SR 4. 60, J, N-VN, Cl, Mn, Fe, Pa-Sp, Ir, R 5. 5, J, N, Cl, Pa, Ir, S, reddish yellow filling 6. 50, J, Cl, Mn, Fe, Pa, Ir, R 7. 50, J, Cl, Mn, Fe, Pa, Ir, R 8. 20, J, Cl, Mn, Fe, Pa, Pl, SR						
54	126	20		96		56			no recovery 127.5-127.85 becomes intensely fractured, likely clay infill washed out becomes slightly weathered very dark gray (N3), medium strong to strong, vesicles 1-2 mm						Dark brownish gray water return, water loss ~10 gal
52	127								becomes 0.5-1 mm vesicles 1. 5, J, N, Cl, Mn, Fe, Pa, IR, R 2. 60, J, N-VN, Cl, Mn, Fe, Pa, Pl, SR 3. 45, J, N-VN, Cl, Mn, Fe, Pa, Sa-R					0.1	[100]	
	128		9						becomes brown (7.5YR 4/4), moderate to highly weathered, medium strong to weak, 5% vesicles (filled by clay) becomes very dark gray, slighly weathered, medium strong to strong, 30-35% vesicles, 0.5-1 mm						Dark brownish gray water return, water loss ~10 gal
50	129															Water loss in HQ casing fell 21.5 ft from 79.7 ft bloc to 101.2 in 21 min
	130	21		96		62			becomes brown (7.5YR 4/3), moderate to highly weathered, medium strong to weak, 10% vesicles, 0.01-0.5 mm 4. 10, J, VN, Cl, Mn, Fe, Sp to Su, Pl, S 5. 60, J, VN, Cl, Mn, Fe, Sp, Pl, S 6. 5, J, N-MW, Cl, Mn, Fe, Pa, IR, R 7. 0, J, N-VN, Cl, Mn, Fe, Sp, Pl, SR 8. 5, J, N, Cl, Mn, Fe, Pa, IR, R 9. 80, J, VN, Cl, Mn, Fe, Sp, Pl, S						Boring paused at 11:25 on 1/22/19 at 134 ft bgs. Plan to install 5" casing to 134 ft bgs
48	131															
	132															134-135 ft was drilled out with 9 7/8" tricone, no core available. 5" steel casing installed to 135 bgs on 1/24/19
46	133								no recovery							
	134								becomes slightly weathered, very dark gray (N3), strong to medium strong, 30-35% vesicles (0.5-2 mm) spherical					0.0	[75]	Resume coring from 135 ft using PQ core on 2/18/19
44	135								grades with dark red (2.5YR 3/6) on fracture surface, possible flow contact							
	136								slightly to moderatly weathered, very dark gray, medium strong, 20% vesicles (1-5 mm), spherical to stretched							Dark brownish gray water return, water loss ~10 gal
	137	22		84		44			137.3-137.5 ft Welded Clinker Moderately weathered, dark red (2.5YR 3/6), yellowish brown (10YR 5/6) and black (N2.5)							
42	138								At 137.5 ft becomes intensely fractured with yellowish red (5YR 5/6) clay on fracture surfaces and in vesicles, moderately weathered							
	139								no recovery							Faster drilling at ~139 ft bgs
40	140		12						1. 45, B, VN, Fe, Mn, Cl, Sp, IR, SR 2. 50, J, VN, Fe, Mn, Cl, Sp, IR, R 3. 20, B, N, Fe, Mn, Cl, Sp, ST, R					0.1	[50]	
	141															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R.Q.D., %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
38	141							IF	At 140 ft greenish black (10Y 2.5/1) with yellowish red (5YR 5/6) clay in vesicles, moderately weathered, medium strong, 20% vesicles less than 1 mm At 141.2 ft becomes intensely fractured with yellowish red (5YR 5/6) clay on fracture surfaces 1. 0, J, VN, Fe, Mn, Su, Pl, SR 2. 0, J, VN, Fe, Mn, Cl, Sp, Pl, SR 3. 0, J, VN, Fe, Mn, Cl, Sp, Pl, SR 4. 30, J, VN, No, No, Ir, SR At 142.5 ft vesicles become 1-3 mm, less clay infil						Dark brownish gray water return, water loss ~100 gal
	142	23		100		34										
36	143															
	144						4									
34	145		13				1 2		grades without clay in vesicles, fractures still have clay infill 1. 70, J, VN, Fe, Mn, Cl, Sp, Pl, SR 2. 70, J, VN, Fe, Mn, Cl, Sp, Wa, SR					0.1	[50]	
	146															
	147							IF	becomes very dark gray (7.5YR 3/1) to strong brown (7.5YR 4/6), intensely fractured, highly weathered, very weak							
32	148	24		100		48	3 4 5 6		3. 60, J, VN, Fe, Mn, Cl, Sp, Wa, SR Becomes greenish gray (10Y 2.5/1), slight to moderate weathering, medium strong, 15-20% vesicles 0.5-3 mm, predominantly <1 mm 4. 90, J, VN, Fe, Mn, Cl, Sp, Wa, SR 5-6. 50, J, VN, Fe, Mn, Cl, Sp, IR, SR 7. 25, J, VN, Fe, Mn, Cl, Sp, IR, SR 8. 20, J, VN, Fe, Mn, Cl, Sp, IR, R						
	149						7 8									
30	150								becomes moderately weathered, weak to medium strong					0.1	[60]	
	151	25		104		96	1 2		black (N 2.5), yellowish red (5YR 5/6) and dark brown (7.5YR 3/4), alteration probable flow boundary. 150.9-151.3 ft with clay infill in vesicles At 151.2 ft becomes very dark gray (N3), slightly weathered, strong, 15-20% vesicles 1-5 mm some stretched At 151.5 ft grades without vesicle infil' 1. 0, J, VN, Cl, Sp, Pl, SR 2. 0, J, Vn, Fe, Mn, Cl, Sp, Pl, SR 3. 10, J, Vn, Fe, Mn, Su, Pl, SR 4. 5, J, VN, Cl, Fe, Mn, Sp, ST, SR 5. 5, J, VN, Cl, Sp, IR, R 6. 50, J, VN, Fe, Mn, Cl, Sp, Pl, SR 7. 5, J, VN, Cl, Sp, IR, R 8. 80, J, VN, Mn, Su, Pl, SR						Dark gray brown water return, water loss ~100 gal
28	152						3									
	153						4 5 6 7 8									
26	154						M									
	155						M M							0.1	[60]	
24	156		16				M									
	157								vesicles become 0.5-1 mm, some infilled with clay							

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-22	157															
	158	26		96		76			1. 45, J, VN, Cl, Fe, Mn, Sp, Pl, S 2. 15, J, VN, Fe, Mn, Su, Pl, S 3. 85, J, VN, Fe, Mn, Su, Wa, SR 4. 0, J, VN, No, No, Wa, SR 5. 75, J, VN, Fe, Mn, Cl, Pa, Pl, SR							Dark grayish brown water return, water loss ~100 gal
	159		17													
-20	160								becomes black (N 2 5), highly weathered, weak most vesicles filled with clay					0.1	[42.9]	
	161								becomes moderately weathered, weak to medium strong 1. 70 J, VN, Fe, Mn, Cl, Sp Wa/SR 2. 60 J, VN, Mn, Su Wa, SR 3-4. 0, J, VN Cl, Sp, Pl, SR							
	162								grades with trace clay infill in vesicles. Intensely fractured zone contains high angle joints with Fe, Mn stains and clay 5. 5, J, VN, Cl, Sp, IR, R							
-18	163	27		110		62										
	164															
-16	165		18						grades with more clay infill 6 and 8. 5. J. VN. Cl. Mn. Sp. R. R 7. 90 J. VN. Cl. Mn. Sp. IR. R 1. 15 J. VN. Cl. Sp. Wa. SR					0.1	[60]	Clean out circulation pit
	166								becomes highly weathered, weak, most vesicles filled with clay, 35-40% vesicles less than 0.5 mm 2. 0, J< VN, Cl Sp, IR. SR 3. 30. J. Cl. Mn. Sp. IR. R							Dark gray water return, water loss ~100 gal. Tighter formation, drill string binding
-14	167															
	168	28		96		50			becomes very dark gray (N3), slight to moderately weathered, strong, 20-30% vesicles 0.5-3 mm 4. 0, J, VN, Cl, Sp, Wa, SR							
	169								becomes very dark gray (N3) to dark reddish brown (5YR 3/2), moderately weathered, medium strong, possible flow boundary at 168.8 ft, vesicles 0.5-1 mm filled with clay 5. 40 J, VN, Cl, Mn, Sp, Wa, SR 6. 60 J, VN, Cl, Fe, Mn, Sp Wa, SR							
-12	170													0.1	[37.5]	
	171								becomes very dark gray (N3), moderately weathered, medium strong, vesicles 1-3 mm with no infill 1. 10. J. VN. Cl. Sp. IR. SR 2. 90. J. VN. Cl. Sp. Wa. SR							Dark gray water return, water loss ~100 gal
	172								vesicles become 0.5-1 mm and filled with clay 3. 0, J. VN Cl. Sp, Pl. SR 4. 10. J. VN. Cl, Sp. Pl. SR 5. 80. J. VN. Fe. Mn. Cl. Sp. Pl. S 6. 35. J. VN. Cl. Sp. IR. SR							
-10	173	29		100		90										

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R.Q.D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	173								7. 90, J, VN, Cl, Fe, Mn, Sp, Wa, SR 173.5-173.6 ft brown (7.5YR 4/4), alteration band angled ~45 degrees 8. 0, J, VN, Cl, Fe, Su, IR, SR 9. 5, B, N, No, No, IR, R							
-6	174															
	175								**BASALT Welded a'a Clinker** Dark reddish brown (2.5YR 2.5/4) to (5YR 2.5/2), moderately weathered, medium strong 1. 5, J, VN, Fe, Mn, Cl, Sp, IR, R 2. 15, J, VN, Mn, Su, Wa, SR 3. 0, J, VN, No, No, IR, R 4-5. 0, J, VN, No, No, IR, R					0.1	[33.3]	Grayish brown water return
-4	176															
	177	30		100		64			becomes dusky red (2.5 YR 3/2) to reddish black (2.5YR 2.5/1), moderately weathered, weak to medium strong 6. 5, B, VN, Mn, Su, IR, R							
-2	178															
	179		23						becomes weak, more friable							
	180								**BASALT Massive a'a** Very dark gray (N3), slightly weathered to fresh, strong to very strong, traces of olivine ~1%, 10% vesicles ~1 mm, stretched 1. 5, J, VN, Mn, Su, IR, SR 2. 10, J, VN, Mn, Fe, Su, Pl, SR 3. 10, J, VN, Mn, Fe, Su, Pl, SR 4. 20, J, VN, Mn, Fe, Cl, Sp, Pl, SR 5. 15, J, VN, Mn, Fe, Su, Pl, SR					0.1	[42.9]	Gray water return
0	181															
	182															
-2	183	31		100		64			vesicles become more stretched, ~15% vesicles 6. 10, J, VN, Mn, Fe, Su, Pl, SR							
	184															
-4	185								1. 5, J, VN, Mn, Fe, Su, Pl, SR 2. 5, J, VN, Mn, Fe, Su, Pl, SR 3. 10, B, N, No, No, IR, R					0.1	[60]	
	186								**BASALT a'a clinker**							
-6	187						NR									
	188	32		18					no recovery							Driller says easy drilling at end of run Recovered 0.9 ft of core, remaining core dropped down hole. Will pull casing next shift
-8	189															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-10	190								no recovery							Boring paused at 190 ft bgs on 2/18/19 at 15:17
	190								Loose gravel, dark reddish brown (2.5YR 2.5/3) and dark red (2.5YR 3/6) mottled with yellowish brown (10YR 5/6), consolidated, low permeability, highly to completely weathered, very weak, friable, weathered to Sandy SILT (ML)					0.0	[60'	Boring resumed on 2/19/19 at 08:08. Driller able to get core barrel to latch without pulling casing. No additional core recovered. Brown water return, water loss ~150 gal
-12	191	33		100		0										
	192								grades with dark reddish brown (2.5YR 2.5/3)					0.0	[60'	
	193	34		77		0										Brown water return, water loss ~150 gal
-14	194															
	195								no recovery							Boring paused at 195 ft bgs on 2/19/19 at 08:23 due to rain
-16	196								**BASALT Pahoehoe** Dark reddish brown (5YR 2.5/2) to very dark gray (5YR 3/1), moderate to highly weathered, medium strong, ~10% olivine phenocrysts, 25% vesicles 1-2 mm, intensely fractured					0.0	[50'	Resume coring on 2/20/19 at 07:02. DTW = 134.9 ft btoc
									At 196 ft grades with red (2.5YR 4/6), becomes highly to completely weathered, very weak							
	197	35		100		7										Light brown water return, water loss ~150 gal
-18	198								becomes very dark gray (N3) to greenish black (5GY 2.5/1), moderate to highly weathered, medium strong, 15% olivine, some weathering, 25-30% vesicles							
	199															
-20	200								becomes moderately weathered, vesicles 1-5 mm					0.0	[33.3'	
							1		1 5, J, VN, Mn, Fe, Su, Wa, SR							
	201		26				2		2 75, J, VN, Mn, Fe, Cl, Sp, Wa, SR							
									3 ID, J, VN, Do, Mn, Su, IR, R							
									4 ID, J, VN, Fe, Mn, Su, Wa, SR							
-22	202						3		5 ID, J, VN, Fe, Mn, Su, Pl, SR							Brownish gray water return, water loss ~150 gal
							4									
		36		84		50	5									
	203								very elongate vesicles							
							IF									
	204						IF		Possibly mechanically broken when opening shoe							
-24							NR		no recovery							
	205															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-26	205	37		130		40	IF 1 2 1 IF IF		**BASALT a'a clinker** Welded, dark reddish brown (5YR 3/2) and black (2.5N) clasts with yellow (10Y 7/6) weathering and alteration, moderately weathered, weak to medium strong, less permeable 1 5 J, VN, No, No, IR, R 2 5 J, VN, No, No, IR, R 3 0 J, VN, No, No, IR, R becomes loose clinker fragments, coarse gravel size, with yellow (10Y 7/6) to strong brown (7.5YR 5/6) clay on surfaces					0.0	[30]	Cored 1 ft to pick up any possible dropped core. Recovered 1 ft of core (welded clinker)
	206													0.0	[21.8]	
-28	207															Grayish brown water return, water loss ~150 gal
	208	38		93		8	IF 1 2 3 4 5		**BASALT Massive a'a** Very dark gray (N3) to greenish black (5GY 2.5/1) and spots of dark yellowish brown (10YR 3/6) weathering and alteration; moderate to highly weathered, medium strong to weak, 15% vesicles 1-3 mm 1 60, J, VN, Fe, Mn, Su, Pl, SR 2 0, J, VN, Fe, Mn, Su, Pl, SR 3 0, J, VN, Fe, Mn, Su, Pl, SR 4 10, J, VN, Fe, Mn, Su, Pl, SR 5 20, J, VN, Fe, Mn, Su, IR, R Large vug at 210 ft bgs (contains Fe coating), evidence of core grading on fractures 1 and 4. Intensely fractured zone at 208.2 ft bgs contains fracture healed with 3 mm thick white clay						
-30	209															
	210						IF							0.0	[17.6]	
	211						1 2		At 210 ft becomes very dark gray (N3), slightly to moderately weathered, medium strong to strong At 211 ft high angle light gray striations (possibly from core barrel), 15% vesicles <0.5 mm							
-32	212	39		100		38	3 4 5									
	213															
-34	214								**BASALT a'a clinker** Loose clinker fragments, very dark gray (N3) and black (2.5N) clasts with yellow (10YR 7/6) highly weathered, weak to medium strong. IF is highly angled with Fe and Mn staining 1 5 J, N, No, No, Pl, SR 2 75, J, VN, Fe, Mn, Su, Wa, R 3 75, J, VN, Fe, Mn, Su, Wa, R 4 5, J, VN, Fe, Su, Wa, SR 5 90, J, VN, Fe, Mn, Su, Wa, R						
	215													0.0	[37.5]	
-36	216						IF 1		**BASALT Pahoehoe** Dark reddish brown (2.5YR 4/4), moderate to highly weathered, weak to moderately strong, 20% vesicles <0.5 mm At 216 ft becomes dark reddish brown (2.5YR 3/3), moderately weathered, medium strong to strong, 25% vesicles <0.5 mm to 0.5 mm 1 90, J, VN, Fe, Mn, Cl, Su, Wa, R 2 0, J, VN, Fe, Mn, Cl, Su, Su, Wa, R 3 0, J, VN, No, No, Wa, SR						Grayish brown water return, water loss ~150 gal
	217						2 M									
-38	218	40		100		46	3 4									
	219						IF 5		becomes reddish/yellowish red (5YR 4/3), highly weathered, weak, alteration zone, 30% vesicles 0.5-1 mm becomes reddish black (2.5YR 2.5/1), slightly weathered, medium strong to strong, contains yellow (10YR 7/6) clay veins 4 25, J, VN, Fe, Mn, Cl, Su, Wa, R 5 5, J, VN, No, No, Wa, SR						
-40	220		33				M		becomes reddish black (2.5YR 2.5/1) to black (2.5N) with yellow (10YR 7/6) clay veins and vesicle infill, slightly weathered, medium strong to strong, 30% vesicles 0.5-1 mm At 220.6 ft grades to <0.5 mm					0.0	[27.3]	Grayish brown water return, water loss ~150 gal
	221															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-42	221								1. 0, J, VN, No, No, Pl, SR 2. 75, J, VN, No, No, Pl, SR 3. 10, J, VN, Fe, Mn, Cl, Su, Wa, S 4. 80, J, VN, Fe, Mn, Cl, Sp, Wa, SR 5. 80, J, VN, Fe, Mn, Cl, Sp, Wa, SR							
	222	41		94		64										
	223								**BASALT Massive a'a** Very dark gray (N3), moderately weathered, medium strong, vesicles 3% 1-2 mm irregularly shaped. Grades to 5% vesicles 0.5-1 mm irregularly shaped. flow boundary heat alteration contact black (5YR 2.5/1)							
-44	224															
	225								no recovery At 225 ft becomes moderately weathered, strong, 5% vesicles 1-10 mm irregular shaped, predominantly >3 mm					0.0	[33.3	When retrieving core from run 42, only 0.5 ft was recovered, send core barrel back down and try and recover. Unable to recover with core barrel, tripped out rods, remaining core from run 42 was recovered after casing was pulled Grayish brown water return, water loss ~150 gal
-46	226								becomes slightly weathered, strong to very strong, hard to very hard. IF is a mix of natural fractures and mechanical fractures. Fe, Mn, clay surface staining 1 90, J, VN, Fe, Mn, clay, Sp, Pl, S 2 5, J, VN, No, No, Pl, SR							
	227	42		100		82										
-48	228															
	229															
-50	230								becomes very dark gray (N3), slightly weathered, strong, 10% vesicles, 5-15 mm, 5% weathered olivine phenocrysts 1 0, J, VN, No, No, Wa, SR 2 30, J, VN, No, No, Wa, SR 3 0, J, VN, Mn, Cl, SP, R					0.0	[75	
	231		36													
-52	232	43		100		84			becomes 25% vesicles, 5-15 mm							
	233								becomes 30% vesicles, 1-5 mm, 2% weathered olivine phenocrysts							
-54	234								**BASALT Pahoehoe** Reddish black (2.5YR 2.5/1) with yellow (10YR 7/6) clay veins and vesicle infill, slightly weathered, medium strong, 20% vesicles <1 mm, contact flow boundary heat alteration 1 0, J, VN, Fe, Mn, clay, Sp, Wa, SR 2 0, J, VN, Fe, Mn, clay, Sp, Wa, SR 3 0, J, VN, Fe, Mn, clay, Sp, Wa, SR 4 0, J, VN, No, No, Wa, SR 5 5, J, VN, Fe, Mn, clay, Sp, Wa, SR 6 45, J, N, clay, Fi - infilled clay							
	235		37													
-56	236								236.2-236.6 ft zone of slightly weathered, weak clay infilled vesicles					0.0	[50	Brown water return Faster drilling: 236-237 ft and 238-239 ft
	237		~~38~~													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	237															
		44		100		32			Contact flow boundary, heat alteration reddish brown (5YR 4/4)							
-58	238								At 237.6 ft becomes reddish brown (5YR 5/3) with very pale brown (5YR 8/2) clay veins, moderate to highly weathered, weak, 20% vesicles 1-5 mm, irregular, 5% Mn							
	239															239-240 ft reddish brown water return
	240								becomes reddish brown (5YR 4/3), moderately weathered, medium strong, 25% vesicles <1 mm					0.0	[42.9'	
-60									clay infilled vesicles with very pale brown (10YR 2/3)							Grayish brown water return, water loss ~ 150 gal
	241								becomes 15% vesicles, 1-5 mm							
	242								Contact, flow boundary, heat alteration, dark reddish brown (5YR 3/3) 3% vesicles <2 mm, some vesicles infilled with clay, moderately weathered, weak to medium strong rock 242.8-244 ft clay veins gray (6/N) 1 20, J, VN, Mn, Cl, Sp, Wa, R 2 20, J, VN, Mn, Sp, Wa, SR 3 0, J, VN, Mn, Sp, Cl, Su, Wa, SR							
-62		45		92		76										
	243															
	244								becomes yellowish red (10YR 5/6), highly weathered, weak							
-64									no recovery							
	245								becomes brown (7.5YR 4/3), 15% Mn, moderate to highly weathered, weak					0.0	[50'	
									becomes very dark grayish brown (10YR 2/2) 20% vesicles <2 mm IF likely partly mechanical							Grayish brown water return, water loss ~150 gal
	246		4C						becomes highly weathered, weak							
-66									moderately weathered, medium strong, 20% vesicles <5 mm							
	247								highly weathered, weak, 40% vesicles <1 mm partially infilled with clay, Mn and Fe							
		46		104		42										
	248															
-68									black (10YR 5/1), slightly to moderately weathered medium strong, 30% vesicles, rounded, <2 mm, 3% Mn, 1% olivine 1 0, J, VN, No, No, Pl, R 2 60, J, VN, Mn, Sp, Pl, S 3 5, J, VN, No, No, Wa, R 4 0, J, VN, Mn, Fi, No, No							
	249		4'													
	250								becomes brown (10YR 4/3) with yellow (10YR 8/8) clay infills, 5% Mn highly weathered, weak					0.0	[50'	
-70																
	251								becomes very dark gray (10YR 3/1), 30% vesicles <1 mm, partially infilled with clay, highly weathered, weak							Grayish brown water return, water loss ~150 gal
	252															
-72		47		100		10			yellowish brown (5YR 4/6), angled, 20 mm wide discoloration							
	253															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
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Log of Boring RHMW14

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	253															
-74	254						IF		**BASALT a'a clinker** Loosely cemented, black (5YR 2.5/1) with dark reddish brown (5YR 3/4) with traces of yellow (10YR 5/8) clay, highly weathered, weak, intensely fractured							
	255													0.0	[27.3]	
-76	256						M M									Grayish brown water return, water loss ~150 gal
	257	48		100		68	IF		**BASALT Massive a'a** Very dark gray (10YR 3/1), slightly weathered, medium strong 256.6-257 ft includes very pale brown (10YR 8/4) clay infills 257-257.6 ft becomes gray (6/N) with pale brown (2.5Y 8/2) clay infills, moderately weathered, medium strong, 5% vesicles, irregular, <1 mm							
-78	258						1 2		At 257.8 ft elongate vesicles increased to 10%, <1 mm 1 0, J, VN, Fe, Mn, Cl, Su, Wa, S 2 10, J, VN, Fe, Mn, SP, P, S 3 0, J, VN, No, No, P, S 4 0, J, VN, Cl, SP, P, S							
	259						3		interconnected 10-50 mm, elongate vesicles 10% vesicles, <5 mm 5 10, J, VN, Cl, Sp, P, S							Boring paused at 260 ft on 2/20/19 at 14:42
-80	260		44				4 5 1		1 25, J, VN, Mn, Fe, some Cl, Sp, P, S 2 0, J, VN, Mn, Fe, Cl, Sp, P, S 3 0, J, VN, Mn, Cl, Sp, Wa, S 4 75, J, VN, Mn, Cl pinkish white (10YR 8/1), Su, Wa, SR				0.0	[50]	Boring resumed on 2/21/19 at 07:17. DTW = 122.4 ft btoc
	261						2 3		50 mm vug with Mo, Fn, clay 5 60, J, VN, No, No, Wa, S 6 5, J, VN, Cl (pockets), Sp, Wa, S							
-82	262	49		94		11	4 M 5 M		becomes black (10YR 2/1), slightly weathered, strong, 10% elongated vesicles, 1-30 mm 7 0, J, VN, Mn, Fe, Cl, Sp, P, S 8 5, J, VN, No, No, Wa, SR							
	263						6 7									Easier drilling 263-265 ft
-84	264						8		**BASALT a'a clinker** Welded, very dark brown (5YR 3/1) clasts with reddish brown (5YR 4/4) alteration, highly weathered, very weak. Grading with depth to red (2.5YR 4/8) reddish brown (5YR 4/4) dark reddish brown (5YR 3/4), likely from alteration, highly weathered, very weak							Grayish brown water return
	265						IF		**BASALT Pahoehoe** Dusky red (2.5YR 3/2) and dark grayish red (2.5 YR 3/4), highly weathered, very weak				0.1	[33.3]	
-86	266						1		At 265.2 ft becomes dark gray (5YR 4/1), moderately weathered, medium strong to strong, 10-15% vesicles <1 mm							Grayish brown water return
	267						2		zone of intense 50% vesicles, rounded, <5 mm							
		50		106		81	3									
-88	268						M		becomes moderately weathered, moderate strength, 10-15% vesicles, <5 mm, partially infilled with very pale brown (10YR 8/4) clay 1 0, J, VN, No, No, P, S 2 0, J, VN, No, No, Wa, R 3 5, J, VN, Fe, Mn, Cl, Sp, Wa, R							
	269															

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Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
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Log of Boring RHMW14

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269								4. 10, J, VN, No, No, Wa, R 269.2-269.6 ft zone of intense 50% vesicles, rounded, <2 mm							
-90	270		47											0 1	[50]	
	271								becomes highly weathered, very weak, with yellowish brown (10YR 5/8) alteration and 10% Mn becomes dark gray (5YR 4/1), moderately weathered, weak, with clay veins and vesicle infills, very pale brown (10YR 8/4), Mn infills, vesicles 5-10% <2 mm							Grayish brown water return
-92	272	51		100		52			1 0. J, VN, Mn, Fe, clay, Su, Wa, SR 2 5. J, VN, Mn, clay, Su, Wa, S 3 10. J, VN, Fe, clay, Sp, Wa, R							
	273								273-273.2 ft zone of intense 50% vesicles, rounded <1 mm 4 65, J, VN, Mn, Fe, Cl, Sp, Wa, R 5 65, J, VN							
-94	274								becomes yellowish brown (10YR 5/4), highly weathered, very weak, clay and Mn veins and vesicle infills, 15% Mn, Fe, clay, Sp, Wa, R							
	275								becomes very dark gray (10YR 3/1), 10-15% vesicles infilled Fe staining, highly weathered, very weak very dark gray (10YR 3/1), moderately weathered, weak, 2% vesicles <2 mm, Fe vesicle infills and staining, very pale brown (10YR 8/3) infills and staining					0 1	[33.3]	Grayish brown water return
-96	276								276 4-277.1 ft dark gray (10YR 4/1), moderately weathered, medium strong, 10% vesicles 5-10 mm, some 30 mm clay and Fe infills At 276.6 ft Fe, Mn, clay infilled vesicles and staining							
	277	52		100		60			becomes moderately weathered, weak, with dark reddish brown (2.5YR 3/3) alteration, 30% vesicles <0.5 mm, mostly infilled with clay white (10YR 8/1)							
-98	278								At 277.8 ft becomes dark gray (5YR 4/1), 10-30% vesicles <0.5 to 5 mm, Fe, Mn and clay infills and staining olive brown (2.5Y 4/3) clay staining 1 20, J, VN, Cl, Sp, Wa, R 2 10, J, VN, Cl, Sp, P, S 3 5. J, VN, No, No, P, SR 4 0. J, VN, Fe, Cl, Sp, ST, R 5 0. J, VN, Fe, Cl, Sp, ST, R 6 0. J, VN, No, No, ST, SR 7 0. J, VN, Fe, Cl, Sp, Wa, R 8 65, J, VN, Fe, Mn, Cl, Su, P, S							
	279															
-100	280								becomes moderately weathered, medium strong 5-15% vesicles, 1-10 mm 1 5. J, VN, Mn, Fe, Cl, Su, P, S 2 15, J, VN, Mn, Fe, Cl, Su, Wa, S 3 65, J, VN, Mn, Fe, Cl, Su, Wa, S					0 0	[33.3]	280-284 ft grayish brown water return
	281															
-102	282	53		64		32			becomes highly weathered, intensely fractured strong brown (5YR 4/6) clay, Mn staining. **Residual soil**, Sandy SILT (MH), F 50%, S 40%, G 10%, completely weathered, brown (7.5YR 4/2), strong brown (5YR 4/6) matrix with very pale brown (10YR 8/4), relic fractures (fractures vesicles veins present)							
	283								**BASALT, Pahoehoe** highly weathered, very weak, dark reddish gray (5YR 4/2) clast, yellowish red (5YR 5/6) alteration, dark reddish brown (5YR 2.5/2) clay infills very pale brown (10YR 8/3), Mn infill staining At 283.4 ft dark reddish gray (5YR 4/2), moderately weathered, weak, 30% vesicles <0.5 mm partialy infilled with clay							
-104	284															284-285 ft brown water return
	285								**BASALT** a'a clinker							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	285								no recovery no recovery					0.0	[25	Grayish brown water return
-106	285								Loose clinker, moderately weathered, weak, very dark gray (5YR 3/1), reddish brown (5YR 4/4), Fe staining, clay infills and staining very pale brown (10YR 8/3), round cobbles 10-30 mm diameter							
	287	54		80		42.5	M M 1		Welded clinker, clinker clasts are gray (2.5Y 5/1) with reddish brown (5YR 5/3) matrix, moderately weathered, weak to medium strong, traces of clay, larger clinker clasts							
-108	288						2		**BASALT Massive a'a** Gray (2.5Y 3/1), moderate to slightly weathered, medium strong, 5-10% elongate irregular vesicles, 1-10 mm, clay infills/seams (weathered to clay) pale brown (2.5Y 8/2) 1 0, J, VN, clay, Sp, Wa, S 2 75, J, VN, clay, Sp+Su, P, S 3 0, J, VN, clay, Sp+Su, P, S 4 15, J, VN, clay, Sp+Su, Wa, S 5 5, J, VN, Fe, Mn, Su, Wa, S 6 30, J, VN, No, No, Wa, SR							
	289						3 4 5 6									
-110	290													0.0	[23	Grayish brown water return
	291						1 2 3		At 288.8 ft grades to slightly weathered, strong (no clay veins) 1 5, J, VN, Mn, Fe, Su+Sp, Wa, SR 2 85, J, VN, No, No, P, S 3 65, J, VN, No, No, P, S 4 75, J, VN, Mn, Sp, Wa, S 5 10, J, VN, No, No, Wa, S 6 90, J, VN, Mn, Sp, P, S 7 10, J, VN, Mn, Sp, P, S 8 20, J, VN, Mn, Cl, Sp, P, S 9 20, J, VN, Mn, Sp, P, S 10. 75, J, VN, Mn, Su, P, S 11. 10, J, VN, Mn, Sp+Su, Cl, Sp, Wa, S							
-112	292	55		100		96	4 5 6 7									
	293						8 9 10 11									
-114	294															Boring paused at 295 ft on 2/21/19 for maintenance
	295						1		**BASALT a'a clinker** Black (7.5YR 2.5/1) welded clasts with dark reddish brown matrix (5YR 3/3), moderately weathered, weak					0.0	[25	Boring resumed on 2/22/19 at 07:21, DTW = 143.15 ft btoc
-116	296								becomes loose, 20-80 mm diameters with very pale brown (10YR 8/3) clay infills 1, 15, J, VN							Grayish brown water return, water loss ~135 gal
	297	56		66		67			no recovery							
-118	298								**BASALT Pahoehoe** Reddish brown (5YR 4/3), moderately weathered, weak, 20% vesicles, rounded, <1 mm							
	299						M M		At 298.2 ft heat alteration reddish yellow (7.5YR 7/8), 10 mm wider, No, No, Wa, R At 298.5 ft becomes dark reddish brown (5YR 3.2) moderately weathered, weak, 15% vesicles, <1 mm rounded, partially infilled with clay At 298.9 ft some clay infilled veins very pale brown (10YR 8/3) clay heat alteration, 50 mm wide, yellowish red (5YR 5/6)							
-120	300		54											0.0	[45	Grayish brown water return
	301															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
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Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	301						M		black (5YR 2.5/1), slightly weathered, hard, strong, 25% vesicles, 1-6 mm, rounded							Cored 4.5 ft, recovered 5.5 ft, extra 1 ft was from previous run which dropped
-122	302	57		122		84	1									
							2		dark gray (10YR 4/1), moderately weathered medium strong, 5% vesicles, 1-5 mm							
	303						3		1 90, J, VN, No, No, P, SR 2 0, J, VN, No, No, P, SR 3 5, 90, J, VN, No, No, Wa, SR							
							IF									Water loss ~135 gal
-124	304		55						black (5YR 2.5/1), slightly weathered, hard, strong, 15% vesicles, 1-8 mm							
															[41.3]	At 304.5 ft core barrel was full, run stopped short
	305						IF		dark brown (2.5YR 3/1), slightly weathered, medium strong to strong, 30% vesicles <2 mm							
-126	306						M		becomes moderately weathered, moderate strength, 15% vesicles 1-8 mm							
							1									Grayish brown water return, water loss ~ 135 gal
	307	58		100		51	2		307 2-307 5 ft 5% vesicles <1 mm, partially infilled with clay, very pale brown (10YR 8/3) clay							
							3		307 5-308 1 ft becomes 20% vesicles, rounded, 1-2 mm							
-128	308						M		heat alteration reddish yellow (7.5YR 6/6)							
							4		308.2-308.5 ft becomes dark reddish brown (5YR 3/2), 25% vesicles <2 mm							
	309						5		At 308.4 ft black (5YR 2.5/1), moderate to slightly weathered, medium strong to strong, 1% vesicles, irregular rounded 2-8 mm, partially infilled with very pale brown (10YR 8/3) clay 1 0, J, VN, Mn, Cl, Sp, P, R 2 0, J, VN, Mn, Sp, P, SR							
							6									
-130	310						7		3 75, J, VN, Mn, Cl, Sp, Wa, R 4 0, J, VN, Cl, Sp, P, R 5 45, J, VN, Mn, Fe, Cl, Su, Wa, SR 6 10, J, VN, Mn, Fe, Cl, Su, Wa, SR 7 90, J, VN, Mn, Fe, Cl, Su, Wa, SR					0.0	[60]	
	311		57				1		At 310 ft black (5YR 2.5/1), slightly weathered, strong							Grayish brown water return, water loss ~ 135 gal
							2		becomes dark reddish brown (5YR 3/1), 35% vesicles, rounded <2 mm, yellow (10YR 8/6) clay vein							
-132	312	59		100		92			becomes dark gray (5YR 4/1) and gray (5YR 5/1), slightly weathered, medium strong to strong, 10-40% vesicles, rounded <0.5-8 mm 1 50, J, VN, No, No, Wa, SR 2 0, J, VN, Mn, Fe, Cl, Su, ST, SR 3 75, J, VN, Cl, Sp, P, R 4 75, J, VN, Mn, Fo, Su, P, S							
	313						3									
							4									
-134	314		58						becomes dark reddish brown (5YR 2.5/2), moderately weathered, medium strong, 10% vesicles, rounded <0.5-4 mm 5 0, J, VN, Mn, Fe, Su, P, R 6 90, J, VN, Mn, Fe, Su, Wa, R							
							5									
	315						6							0.0	[33.3]	
							M		becomes very dark gray (5YR 3/1), slightly weathered, medium strong, 10% vesicles, rounded, <2 mm							
-136	316						M		315.8-316 ft heat alteration red (2.5YR 4/6) and reddish yellow (7.5YR 6/8)							Grayish brown water return, water loss ~ 135 gal
							1		At 316 ft 15% vesicles, 1-5 mm, partially infilled with very pale brown (10YR 8/3) clay							
	317															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
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Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	317								1 65, J, VN, Cl, Sp, Wa, SR 2 0, J, VN, Cl, Mn, Fe, Su+Sp, Wa, R 3 65, J, VN, Cl, Mn, Fe, Su+Sp, Wa, SR 4 0, J, VN, No No, Wa, R 5 90, J, VN , No, No,P, SR						
	318	60		100		88										
-138																
	319								dark gray (10YR 5/1), slightly weathered, strong to very strong, 25-40% vesicles, rounded/irregular, 1-20 mm							
	320								30-50% vesicles, rounded, <2 mm 1 possibly heated infilled, 65, 2 15, J, VN, No, No, P, R 3 75, J, VN, No, No, Wa, SR 4 0, J, VN, No No, Wa, R					0 0	[75	
-140																
	321															Grayish brown water return, water loss ~ 135 gal
	322	61		96		72										
-142																
	323															
	324								highly fractured, reddish brown (5YR 4/4), black (5YR 2.5/1), dark reddish gray (2.5YR 4/1), medium strong rock, remnant ropey pahoehoe texture							
-144																
	325								no recovery dark gray (5YR 4/1), slightly weathered, hard, 15-30% vesicles, irregularly rounded, 1-20 mm 1 75, J, N, Mn, Sp, Wa, SR 2 75, J, VN, Mn, Sp, P, SR 3 0, J, VN No No, Wa, SR					0 0	[75	
	326		61													
-146																
	327															Grayish brown water return, water loss ~ 135 gal
	328	62		98		62										
-148																
	329								328.8-331.4 ft more elongate 5-20% vesicles, 5-20 mm							
	330		62						45 mm vug					0 0	[37.5	
-150																
	331															Grayish brown water return, water loss ~ 135 gal
	332								331 4-332 4 ft becomes IF, red (2 5YR 4/6), reddish brown (2 5YR 4/4), moderate to slightly weathered, hard, 15% vesicles, irregular to rounded, <4 mm, Mn infills, very pale brown (10YR 8/2) clay infills							
-152																
	333	63		106		34			becomes very dark gray (10YR 3/1), moderately weathered, medium strong to strong, 5-15% vesicles rounded to irregular, <5 mm, partially clay infilled							

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Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-154	334		63				IF 1 2 3 IF		1. 0, J, VN, Cl, Sp, P, SR 2. 0, J, VN, Mn, Cl, Sp, Wa, SR 3. 75, J, VN, Mn, Cl, So, Na, SR 334-334.6 ft dip of 75 degrees, heat alteration zone, 30 mm wide, dark reddish brown (2.5YR 3/3) and reddish yellow (7.5YR 6/8) black (5YR 2.5/1), slightly weathered, strong, 30% vesicles, rounded <2 mm			0.0	[60]	
-156	335						IF 1 2		335.4-335.7 ft very pale brown (10YR 8/3) clay staining on fractures pieces very dark gray (10YR 3/1), slightly weathered strong 335.6-336.4 ft 10-20% vesicles, rounded, 2-5 mm 336.4-336.6 ft 50% rounded vesicles, <2 mm					
-158	337	64		98		66	3		337-337.2 ft yellow (10YR 8/6) clay infills and staining 337.4-338 ft 20% vesicles, rounded, 2-8 mm					Grayish brown water return, water loss ~ 135 gal
-160	339		65				4 5 6 7 IF 1		becomes 30% vesicles, rounded, <2 mm 1. 0, J, VN, No, No, Wa, SR 2. 0, J, VN, Cl, Sp, ST, R 3. 0, J, VN, Cl, Sp, ST, R 4. 5, J, VN, Cl, Sp+Su, Wa, R 5. 0, J, VN, Fe, Cl, Sp, Wa, SR 6. 0, J, VN, Mn, Fe, Cl, Sp, Wa, R 7. 0, J, VN, Cl, Sp, Wa, R IF pieces yellowish red (5YR 4/6), black (5YR 2.5/1) with clay staining yellow (10YR 8/8) and very pale brown (8/3), Mn staining, slightly weathered, strong, 10% vesicles rounded <4 mm			0.0	[75]	
-162	341	65		102		74	2 3 4 IF 5 6 7		At 340 ft very dark gray (10YR 3/1), slightly weathered, strong, 30% vesicles, rounded <2 mm heat alteration brownish yellow (10YR 6/6) becomes black (5YR 2.5/1), slightly weathered, strong, 10-20% vesicles, rounded/irregular 1-5 mm 341.4-341.6 ft 50% vesicles, rounded/irregular, 5 mm 1. 0, J, VN, Mn, Fe, Cl, Su+Sp, Wa, R 342-342.4 ft 50% vesicles, rounded, 1-2 mm 2. 10, J, VN, No, No, Wa, SR 3. 5, J, VN, Mn, Fe, Cl, Sp, Wa, R IF pieces reddish brown (5YR 4/3) staining, Mn infills 25% vesicles rounded, <0.5 mm black (5YR 2.5/1), slightly weathered, strong, 25-40% vesicles, rounded, <3 mm 4. 0, J, VN, Mn, Fe, clay, Sp, Wa, R 5. 15, J, VN, No, No, Wa, R 6. 5, J, VN, No, No, Wa, R 7. 20, J, VN, No, No, Wa, R					Grayish brown water return, water loss ~ 135 gal
-164	343													
-166	345											0.0	[100]	
-168	347	66		106		44	1 IF		IF pieces red (2.5YR 4/6) staining 1. 0, J, VN, No, No, P, R 2. 90, J, VN, Cl, Su+Sp, P, SR					Grayish brown water return, water loss ~ 135 gal
	349		68											

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	349								IF pieces have yellow (2.5Y 8/6) and pale brown (2.5Y 8/3) staining							
-170	350						2 1		becomes dark gray (10YR 4/1), moderately weathered, hard-strong, 5% vesicles, irregular, <4 mm partially clay infilled At 350.5 ft becomes 20% vesicles, rounded-irregular, 1-10 mm, slightly weathered, strong					0.0	[33.3]	
	351						2									
-172	352								becomes gray (10YR 5/1), slightly weathered, 10% vesicles, irregular/rounded, 2-10 mm 1. 0, J, VN, Cl, Sp, Wa, R 2. 5, J, VN, No, No, P, SR 3. 0, J, VN, No, No, Wa, R							
	353	67		88		36	IF		no recovery becomes dark gray (10YR 4/1), slightly weathered, strong, 40% vesicles, rounded, <2 mm							At 353 ft lost circulation. Per driller, drill rods fell 352-353 ft. No water return for rest of boring unless otherwise noted DTW = 164.63 ft btoc at 10:53 drilled to 355 ft
-174	354						3									
	355													0.0	[150]	
-176	356						IF 1		1. 30, J, VN, No, No, P, S 2. 0, B, VN, Mn, Su, P, S 3. 0, B, VN, No, No, P, S							
	357						2		possible flow boundary, red (2.5YR 4/6), reddish black (2.5YR 2.5/1) and light brown (7.5YR 6/4), 30-40% vesicles, rounded, <1 mm, slightly weathered, strong							Water loss ~ 125 gal
-178	358	68		100		32	IF 3		very dusky red (2.5YR 2.5/2), slightly weathered, hard, 10% vesicles completely infilled with clay pale brown (2.5Y 8/2) At 358.1 ft dark reddish brown (2.5YR 3/2) and reddish brown (2.5YR 4/4), moderately weathered, strong, 50% vesicles, rounded, <2 mm. Possible flow boundary							
	359						IF		becomes slightly to moderately weathered							
-180	360						1 2		1. 35, J, VN, No, No, Wa, SR (includes clay vein yellow 10YR 8/8) 2. 65, J, VN, Mn, Sp, clay Su, Wa, SR					0.0	[60]	
	361								clay staining and infills very pale brown (10YR 8/3) and Mn infills on IF pieces							
-182	362	69		100		10			becomes reddish black (2.5YR 2.5/1), slightly weathered, strong, 15-25% vesicles, <1 mm, partly infilled with clay pale brown (2.5Y 8/2), irregular pieces have clay, Su+Mn spoting							Water loss ~ 125 gal
	363						IF									
-184	364		72						increase in clay Su coating of irregular pieces becomes brown (10YR 4/3)							
	365															

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Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	365						IF		becomes black (5YR 2.5/1) and dark reddish brown (5YR 3/4) slightly weathered, strong, 30% vesicles, round, 1-2 mm, partially infilled with clay white (10YR 8/1)					0.0	[100]	
-186	366						1		becomes dark reddish brown (5YR 3/2), moderately weathered, medium strong to strong, 15% vesicles completely infilled with clay, white (10YR 8/1)							
	367	70		10E		36	2		becomes reddish brown (5YR 4/3), slightly weathered, strong, 20-30% vesicles, rounded, 1-10 mm, partly infilled with clay very pale brown (10YR 8/3)							No water return, water loss ~ 125 gal
-188	368						3		1. 0, J, VN, Mn, Fe, clay, Su, P, S 2. 0, J, VN, clay, Sp, Wa, R 3. 0, J, VN, Mn clay, Sp, P, R 4. 45, J, VN, clay, Sp, Wa, SR							
	369						IF		369.2-369.4 ft 2% vesicles, <0.5 mm becomes dark reddish gray (2.5YR 3/1), slightly weathered, hard, 5-15% vesicles, rounded, <2 mm							
-190	370						M		370.4-370.5 ft red (2.5YR 4/6), slightly weathered, medium strong to strong, 40% vesicles, <1 mm					0.0	[100]	
	371	71		10C		18	1		371-371.2 ft red (2.5YR 4/6), slightly weathered medium strong to strong, 40% vesicles, <1 mm							Water loss ~ 125 gal
-192	372						2		At 371.2 ft becomes dark reddish gray (2.5YR 3/1), slightly weathered, strong, 10-30% vesicles, rounded, 1-4 mm							
	373						3									
							4									
							IF		IF pieces have clay surface staining and partial vesicle infills, white (10YR 8/1) and yellow (10YR 8/6) 1. 0, J, VN, Mn, Cl, SP, Wa, R 2. 55, J, VN, Mn, Cl, SP, Wa, R 3. 0, J, VN, Mn, Cl, SP, Wa, R 4. 5, J, VN, Mn, Cl, SP, Wa, R							
-194	374						M									
	375								375.2-375.4 ft 5% vesicles, <0.5 mm, mostly infilled with clay					0.0	[100]	
			7E				IF		halloysite mineral partially infilled fracture, 15 mm wide, white (2.5Y 8/1)							
-196	376															
	377	72		10C		62	1		becomes dark gray (10YR 4/1), slightly weathered, strong, 10-40% vesicles, <0.5 to 10 mm, rounded 1. 90, J, VN, Mn, Cl, Sp, Wa, R 2. 0, J, VN, Mn, Cl, Sp, ST, SR 3. 5, J, VN, Cl, Sp, Wa, R 4. 0, J, VN, No, No, Wa, R							Water loss ~ 125 gal
-198	378						2									
							3									
	379		7E				4									
-200	380													0.0	[100]	
							1		At 380.9 ft IF pieces become partly dark reddish brown (2.5YR 3/4), slightly weathered, strong, 40% vesicles, rounded, <1 mm							Water loss ~ 125 gal
	381						IF									

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-202	382	73		100		56			becomes black (5YR 2.5/1), slightly weathered, strong, 30% vesicles, round, 1-8 mm 1. 0, J, VN, No, No, Wa, R 2. 0, J, VN, No, No, Wa, R						
	383								Becomes 50% vesicles, rounded, <2 mm 3 0, J, VN, No, No, ST, R 4 90, J, VN, No, No, Wa, R 5 5, J, VN, No, No, Wa, R 6 85, J, VN, No, No, Wa, R						
-204	384															
	385								1. 0, J, VN, No, No, Wa, R 2. 16, VN, No, No, Wa, R 3. 5, J, VN, No, No, Wa, R					0.0	[150]
-206	386															
	387								386.8-387.4 ft becomes 40% vesicles, rounded, <1 mm							
		74		102		86										Water loss ~ 125 gal
-208	388								becomes 30% vesicles, rounded, 1-4 mm							
	389								389-389.4 ft becomes 25% vesicles, rounded, 1-8 mm							Boring paused at 390 ft on 2/22/19, DTW= 164.57 ft at 11:21
	390		79						becomes 30% vesicles, rounded/irregular, <4 mm greenish gray (5/10Y), possible flow contact black (5YR 2.5/1), slightly weathered, strong, 10% vesicles, rounded, <3 mm					0.0	[100]	Boring resumed at 390 ft on 2/25/19 at 07:11, DTW= 163.48 ft
-210	391								At 390.5 ft becomes dark reddish gray (2.5YR 3/1), slightly weathered, hard, 5% vesicles, rounded, slightly elongate, 2-12 mm, partially infilled with halloysite becomes 15% vesicles, rounded, <2 mm becomes 1% vesicles, rounded and elongate <5 mm						
	392								becomes black (5YR 2.5/1), slightly weathered, strong, 20% vesicles, rounded, <4 mm At 392.3 ft greenish gray (5/10Y), 2% vesicles, <0.5 mm, possible flow contact						
-212		75		96		58										Water loss ~ 160 gal
	393								At 392.5 ft becomes dark reddish gray (2.5YR 3/1) slightly weathered, strong, 20% vesicles, rounded, <1 mm At 393 ft becomes 30% vesicles, rounded, 1-5 mm						
	394								becomes 15% vesicles, rounded/elongate, 2-10 mm 1 85, J, N, halloysite, Sp, Wa, SR 2 5, J, VN, halloysite, Sp, Wa, SR 3 0, J, VN, halloysite, Sp, Wa, SR 4 0, J, VN, halloysite, Sp, Wa, SR 5 5, J, VN, No, No, Wa, R 6 5, J, VN, No, No, Wa, R 7 0, J, VN, Cl, Sp, Wa, R 8 90, J, VN, No, No, Wa, R						
-214	395													0.0	[100]	
	396		81						At 394.9 ft becomes 30% vesicles, rounded, 1-5 mm							Water loss ~ 160 gal
-216	397								At 395.6 ft possible flow boundary, dark grayish							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	397								brown (10YR 4/2)					
		76		104		72			396.2-396.5 ft becomes 10% vesicles rounded/elongate, 1-10 mm					
-218	398								becomes black (10YR 2/1) and reddish brown (2.5YR 4/4) slightly weathered, medium strong to strong, 40% vesicles, rounded, <1 mm					Water loss ~ 160 gal
									1 0. J, VN, No, No, Wa, R 2 0. J, VN, No, No, Wa, SR 3 5. J, VN, Mn, Sp, St, SR					
	399								Sp to Wa with halloysite, Mn, Fe, yellow (10YR 8/6) clay					
	400								becomes black (5YR 2.5/1), slightly weathered, strong, 30% vesicles, rounded, <2 mm			0.0	[100]	Drilling paused at 07:32 due to rain 0747
-220									becomes 5% vesicles, elongate, 1-10 mm					
	401		82						1 0. J, VN, No, No, Wa, R 2 0. J, VN, No, No, ST, R 3 5. J, VN, Mn, Cl, Sp, Pl, SR 4 0. J, VN, No, No, Wa, SR					
	402								possible flow contact/heat alteration, black (2.5N), red (2.5Y 4/6), dark reddish brown (2.5YR 3/3), yellowish brown (10YR 5/8), some halloysite					
-222		77		100		66			At 402 ft becomes reddish brown (2.5YR 4/2), slightly weathered, strong, 15% vesicles, rounded, <2 mm					Water loss ~ 160 gal
	403								403.5-403.7 ft heat alteration dark reddish brown (2.5YR 3/3) black (2.5N), red (2.5Y 4/6)					
	404								At 403.8 ft becomes 10% vesicles rounded/irregular, 1-10 mm					
-224									5 15, J, VN, Mn, Cl, Sp, Wa, R 6 15, J, T, No, No, Wa, R 7 0. J, VN, Mn, Cl, Sp, Wa, R					
	405		83									0.0	[75]	
	406								becomes 20% vesicles, rounded, 1-3 mm					
-226									becomes very dark gray (5YR 3/1), slightly weathered, hard, 10-25% vesicles, rounded/irregular, some elongate, 1-8 mm, vesicles infilled with clay					
	407								possible flow contact/heat alteration greenish gray (5/10Y)					Water loss ~ 160 gal
		78		104		84			1. 0, J, VN, No, No, Pl, R 2. 0, J, VN, Cl, Sp, Wa, R 3. 75, J, VN, Cl, Mn, Fe, Sp, Pl, SR 4. 0, J, VN, Cl, Sp, Pl, R 5. 0, J, VN, No, No, Wa, S 6. 45, J, VN, Cl, N, Fe, Su, Pl, S 7. 5, J, VN, No, No, Wa, SR 8. 0, J, VN, No, No, Wa, SR					
-228	408													
	409													
	410											0.0	[60]	
-230									becomes very dark gray (10YR 3/1), slightly weathered, strong, 10-20% vesicles, rounded, 1-5 mm, some clay veins white (10YR 8/1) and very pale brown (10YR 8/3)					
	411								1 90. J, VN, Cl, Mn, Sp+Su, Pl, S 2 0. J, VN, No, No, Wa, SR 3 0. J, VN, No, No, Wa, SR 4 25. J, VN, Mn, Fe, Cl, Su+Sp, Pl, S 5 0. J, VN, No, No, ST, SR					Water loss ~ 160 gal
	412													
-232		79		100		48								
	413													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-234	414		86				4 5 IF		becomes black (5YR 2.5/1) and dark reddish brown (10YR 3/3), slightly weathered, strong, 40% vesicles, rounded, <1 mm At 414 ft possible flow contact/heat alteration black (2.5/N), red (2.5Y 4/6), yellowish brown (10YR 5/8) At 414.3 ft becomes dark reddish brown (2.5YR 3/4), slightly weathered medium strong to strong, 30% vesicles, rounded/irregular, <0.5-2 mm					0.0	[150]	
-236	416						1 IF		becomes dark reddish gray (2.5YR 3/1), 15% vesicles, elongate, 1-5 mm, partially infilled with halloysite fractures Su+Sp, Mn, clay, halloysite 1 0, J, VN, Cl, Sp, Wa, SR							
-238	418	80		100		36	M M M IF		becomes reddish black (2.5/N), yellow (10YR 8/8), slightly weathered, strong, 30% vesicles, rounded, <2 mm							Water loss ~ 160 gal
-240	420						1		becomes black (5YR 2.5/1), slightly weathered, strong, 20% vesicles, rounded, 1-5 mm 1 S, J, VN, Cl, Sp, Pl, SR 2 0, J, VN, No, No, Pl, R 3 90, J, VN, No, No, Wa, SR 4 0, J, VN, No, No, Wa, SR					0.0	[100]	
-242	422	81		100		54	2		becomes 30% vesicles, rounded, <1 mm becomes dark reddish brown (2.5YR 3/3) and black (YR 2.5/1), slightly weathered, strong, 40% vesicles, rounded, <1 mm							Water loss ~ 160 gal
-244	424						IF 3 4		becomes black (5YR 2.5/1), slightly weathered strong, 15% vesicles, rounded/irregular, 1-5 mm becomes 30% vesicles, rounded, 1-5 mm, 5% weathered olivine phenocrysts 2-4 mm							
-246	426		85				1		becomes 10% vesicles, irregular, 1-10 mm At 425.9 ft becomes very dark gray (10YR 3/1), slightly weathered, strong, 10% vesicles, rounded, irregular, <1 mm					0.0	[150]	
-248	428	82		104		62	2 3 4 IF		At 426 ft becomes black (2.5/N), slightly weathered, strong, 10-25% vesicles, rounded, 1-8 mm 1 0, J, VN, No, No, ST, SR 2. 45,J, VN, Mn, Fe, Cl, Su, Pl, VS 3. 0, J, VN, No, No, Wa, SR 4. 10, J, VN, No, No, ST, S 5. 10, J, VN, Mn, Cl, Su, ST, S							Water loss ~ 160 gal
	429															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	429		90						heat alteration/possible flow boundary black (2.5YN), dark red (2.5YR 3/6), light red (2.5YR 7/8), yellow (10YR 8/8). At 429.2 ft becomes reddish brown (2.5YR 4/4) and dark reddish gray (2.5YR 3/1) and yellow (10YR 6/8), olive brown (2.5Y 4/4), slightly weathered, strong, 40% vesicles, rounded, <1 mm. At 430 ft becomes 10-40% vesicles, rounded, 1-5 mm, Mn infills, and staining							
-250	430						5 IF							0.0	[60]	
	431						IF									
-252	432	83		100		16	M IF		becomes very dark gray (10YR 3/1), slightly weathered, strong, 10% vesicles, rounded, 1-10 mm							Water loss ~ 160 gal
	433						M		becomes very dark gray (10YR 3/1), olive brown (2.5Y 4/4), reddish brown (2.5YR 4/4), 15-30% vesicles, rounded, <1 mm							
-254	434						IF		IF, -Mn, Sp+Sa.							
	435						1		becomes dark gray (2.5Y 4/1), slightly weathered strong, 10% vesicles, rounded, <4 mm					0.0	[100]	
-256	436		92				2		heat alteration/potential flow boundary, black (2.5YN), olive brown (2.5Y 4/4) and yellow (10YR 3/8)							
	437	84		100		42	IF		At 436.1 ft becomes dark grayish brown (10YR 4/2), slightly weathered, strong, 20% vesicles, rounded, 1-4 mm 1. 85, J, VN, Mn, Cl, Sp, Wa, S 2. 90, J, VN, Mn, Cl, Sp+Su, Wa, SR 3. 0, J, VN, Mn, Sp, Wa, R 4. 80, J, VN, Mn, Sp, Wa, R 5. 0, J, VN, Mn, Sp, ST, R							Water loss ~ 160 gal
-258	438															
	439		93				3 4 5									
-260	440								becomes reddish black (2.5/1), slightly weathered, strong, 30% vesicles, rounded, <2 mm IF some reddish brown (2.5YR 4/4), Mn spoting and staining 1. 25, J, VN, Mn, Sp, Wa, R 2. 25, J, VN, Mn, Sp, Wa, R 3. 15, J, VN, Mn, Sp, Wa, SR 4. 15, J, VN, Mn, Sp, Wa, SR					0.0	[150]	
	441						IF									
-262	442	85		100		40										Water loss ~ 160 gal
	443						1 2 3 4									
-264	444								At 444.8 ft becomes black (5YR 2.5/1), slightly weathered to no weathering, strong to very strong, 30% vesicles, rounded, <1 mm							
	445															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	445													0 0	[75	
	446								becomes 15% vesicles, rounded, <0.5-2 mm							
-266									becomes 5% vesicles, rounded/elongate, 5 mm becomes 10% vesicles, rounded, <0.5 mm							
	447								becomes 30% vesicles, rounded/irregular, 1-4 mm							
		86		96		88			becomes 10% vesicles, rounded/irregular, 2-10 mm							Water loss ~ 160 gal
	448								becomes 30% vesicles, rounded, 4-10 mm becomes 20% vesicles, rounded, <2 mm							
-268							1		1. 0, J, VN, No, No, Wa, SR 2. 10, J, VN, Mn, Sp, Wa, SR 3. 0, J, VN, Mn, Sp, Wa, R							
	449						2									
							3									
	450		96						1. 75, J, VN, No, No, Wa, SR 2. 0, J, VN, Mn, Cl, Sp+Su, Wa, SR 3. 0, J, VN, No, No, ST, SR 4. 0, J, VN, Fe, Su, Wa, SR					0 0	[60	
-270							1									
	451						2									
							3									
	452						4									
-272		87		104		50	M									
	453															Water loss ~ 160 gal
							M		5. 10, J, VN, Mn, Sp, Wa, SR							
	454						5		**BASALT a'a Clinker** Red (2.5YR 4/6) and light red (2.5YR 6/8) with dark gray (2.5Y 4/1) slightly weathered, strong clasts, loose							
-274																
	455								At 454.2 ft becomes reddish brown (2.5YR 4/3) and reddish black (2.5YR 2.5/1), red (2.5YR 4/6)					0 0	[75	
									455.5-456.7 ft becomes welded a'a clinker, very dark gray (10YR 3/1) with reddish brown (2.5YR 4/3)							
	456						M									
-276							IF									
							M									
	457															Water loss ~ 160 gal
		88		60		8										
	458															
-278																
	459								no recovery							
	460														[50	
-280									**BASALT Massive a'a** Gray (5/N), slightly weathered, strong to very strong, 10% vesicles, very elongate/stretched 2-30 mm							
	461						1									

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	461								1. 10, J, VN, Mn, Sp, Wa, SR 2. 10, J, VN, Mn, Fe, Sp+Su, Wa, S 3. 10, J, VN, No, No, Wa, SR 4. 25, J, VN, No, No, Wa, SR 5. 25, J, VN, No, No, Wa, SR						
-282	462	89		100		60										
	463															Water loss ~ 160 gal
-284	464															
	465								1. 45, J, VN, Mn, Sp, Wa, S 2. 0, J, VN, Mn, Sp, Wa, S					0.0	[50	
-286	466															
	467	90		100		94										Water loss ~ 160 gal
-288	468															
	469															
-290	470								▼ becomes gray (6'N), slightly weathered, very strong, 2% vesicles, rounded/irregular, <1 mm 1 20, J, VN, Mn, Sp, Cl, Su+Sp, ST, S 2 0, J, VN, Mn, Cl, Sp, Wa, S 3 75, J, VN, Mn, Cl, Sp, Wa, S 4 80, J, T, Wa-sealed					0.0	[42.9	
	471		101													
-292	472	91		74		28			**BASALT** a'a Clinker Black (10YR 2/1) and reddish brown (2.5YR 4/3) moderately weathered, strong, loose							Water loss ~ 500 gal
	473															~473-474 ft high water pressure
-294	474								no recovery							
	475		102						**BASALT** Pahoehoe Reddish black (2.5YR 2.5/1), slightly weathered, strong to very strong, 20% vesicles, rounded/irregular, 1-5 mm ▼ At 475.2 ft roppy pahoehoe texture 1 15, J, VN, No, No, Wa, SR 2 5, J, VN, No, No, Wa, R 3 0, J, VN, Mn, Sp, Wa, R 4 0, J, VN, No, No, Wa, SR					0.0	[60	
-296	476															Water loss ~ 500 gal
	477															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-298	478	92	102	104		62			5 0, J, VN, Mn, Wa, SR becomes dark reddish brown (5YR 3/3), slightly weathered, strong to very strong 40% vesicles, rounded, <0 5-4 mm							
	479		103				IF		becomes black (10YR 2/1) slightly weathered, strong to very strong, 30% vesicles, round, 1-2 mm 1% weathered olivine phenocrysts, 2 mm							
-300	480						IF M							0.0	[75	
-302	481	93		100		32	1 IF 2 IF IF		becomes black (10YR 2/1), slightly weathered, very strong, 20% vesicles, irregular, 1-15 mm becomes 10% vesicles, irregular, 1-10 mm becomes reddish brown (2.5YR 4/3) and yellow (10YR 7/8), slightly weathered, very strong, 20% vesicles, round, 1-2 mm							Water loss ~ 500 gal
-304	483						3 4 5		becomes black (5YR 2 5/1), slightly weathered very strong, 20% vesicles, rounded, 1-4 mm 1 15, J, VN, No No ST, R 2 0, J, VN, Mn, Sp, ST SR 3 0, J, VN, Mn, Sp, Wa, S 4 45, J, VN, No, No, Pl, S 5 45, J, VN, clay, Su, Wa, SR							
-306	485						1 2							0.0	[60	
	486								IF stained with yellowish red (5YR 5/6) 1 40, J, VN, No, Pl, SR 2 40, J, VN, No, Pl, SR 3 10, J, VN, Cl, Su, Wa, SR 4 0 J, VN, No, No, Wa, SR 5 45, J, VN, No, No, Wa, SR 6 45, J, VN, Mn, Fe, Sp, Wa, SR							
-308	487	94		100		22	IF M		becomes black (10YR 2/1), slightly weathered, very strong, 25% vesicles, rounded 1-3 mm							Water loss ~ 500 gal
	489						3 4 5 6		becomes 15% vesicles, rounded/irregular, 1-10 mm							
-310	490								**BASALT a'a Clinker** Loose, reddish brown (2 5YR 5/4), dusky red (2 5YR 3/2), dark reddish brown (2 5YR 3/3), clay veins and staining yellow (10YR 8/8) and very pale brown (10YR 8/3), slightly to moderately weathered, medium strong to strong					0.0	[42.9	
-312	492	95		54		C			no recovery							Water loss ~ 500 gal
	493															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/17/2019 RHMW14

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW14

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-314	493															
	494		106						no recovery							End boring at 14:45 at 495 ft on 2/25/19. DTW=163.31 btoc.
	495								Boring complete at 495 ft bgs							2/26/19 DTW= 163.53 btoc (159.78 ft bgs)
-316	496								Used a total of approximately 9,875 gallons of circulation water and two 50 lb bags of max gel bentonite powder. Airknife from 0-3 ft bgs. Drill with 24"OD auger core bucket from 3 ft bgs to 45 ft bgs. Installed 20" steel casing to 45 ft bgs. Drill with 10"OD HSA from 45 ft bgs to 56 ft bgs. HQ core from 56 ft bgs to 89 ft bgs. Ream borehole with 17.5" tricone to 89 ft bgs. Install 10" steel casing to 88 ft bgs. HQ core from 89 ft bgs to 134 ft bgs. Borehole reamed to 135 ft bgs with 9 7/8" tricone. 5" steel casing installed to 135 ft bgs. PQ core from 135 ft bgs to 495 ft bgs. Installed westbay MP38 multi-level well with 8 isolated sampling zones.							
	497															
-318	498															
	499															
-320	500															
	501															
-322	502															
	503															
-324	504															
	505															
-326	506															
	507															
-328	508															
	509															

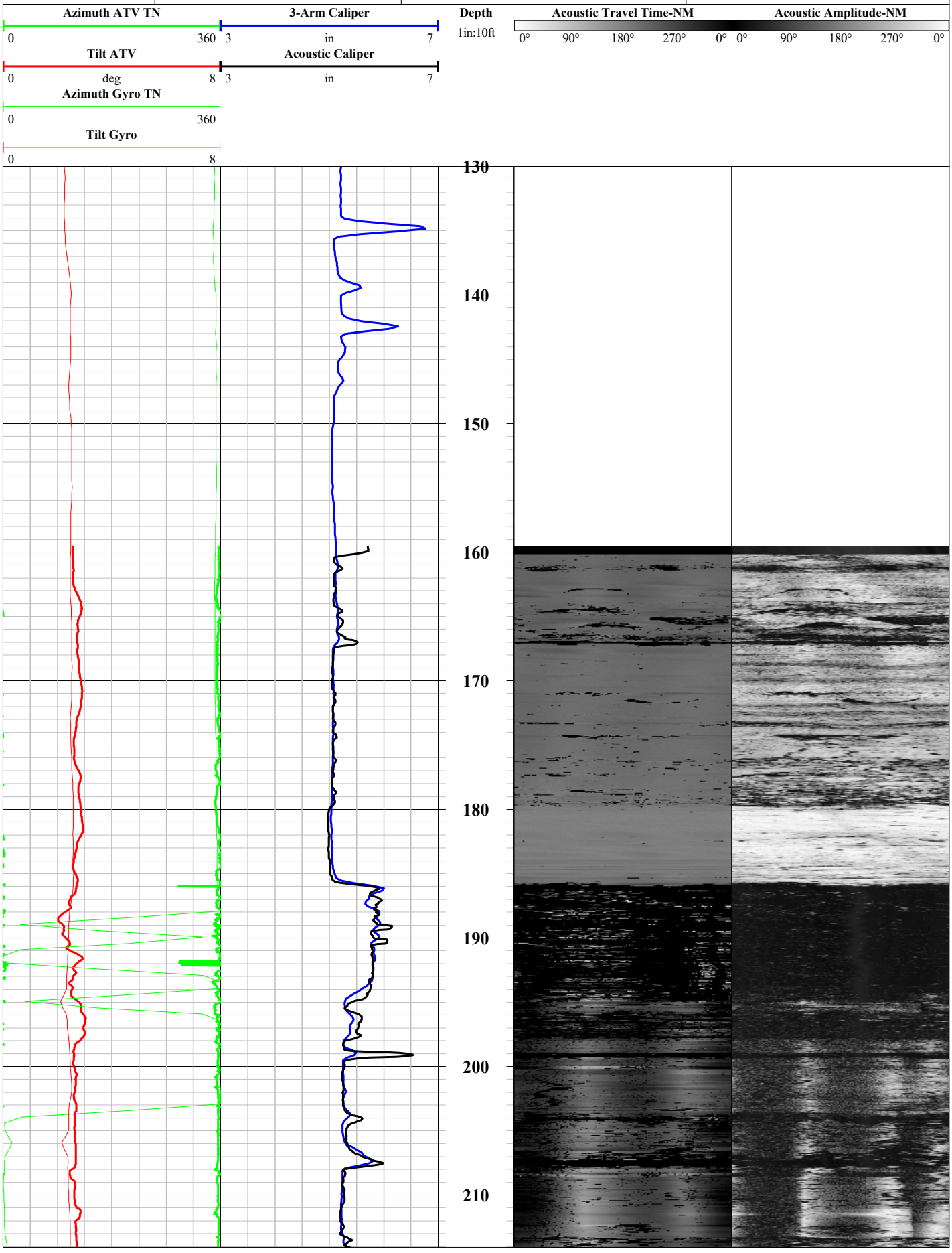
~~For Red Hill AOC Party Use Only~~

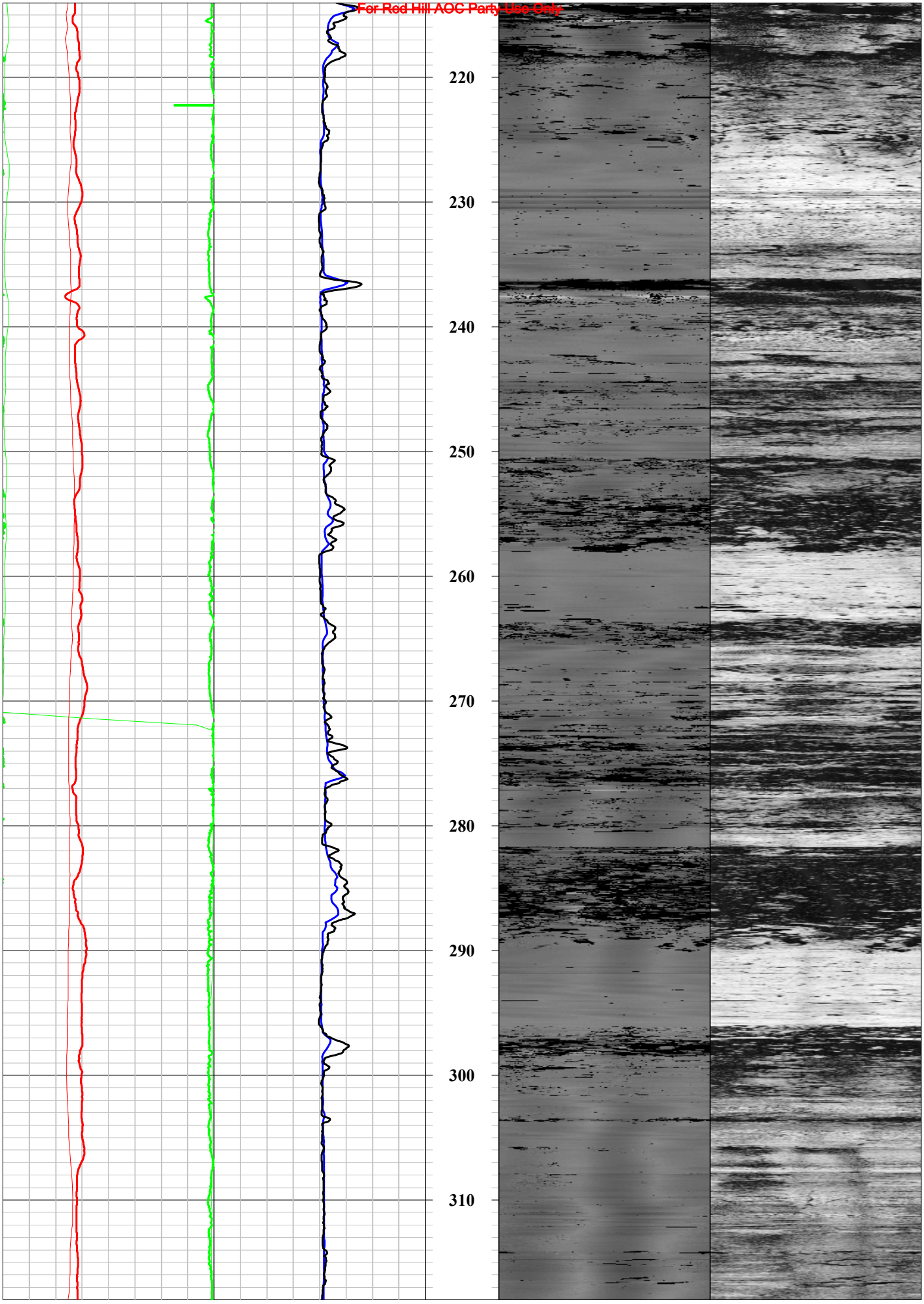
Acoustic Televiewer

COLOG
borehole geophysics / hydrophysics

COMPANY: Valley Well Drilling	PROJECT: Red Hill CTO
DATE LOGGED: 5 March 2019	WELL: RHMW14

Colog, Inc.
810 Quail Street, Suite E, Lakewood, CO 80215
Phone: (303) 279-0171, Fax: (303) 278-0135
www.colog.com




For Red Hill AOC Party Use Only
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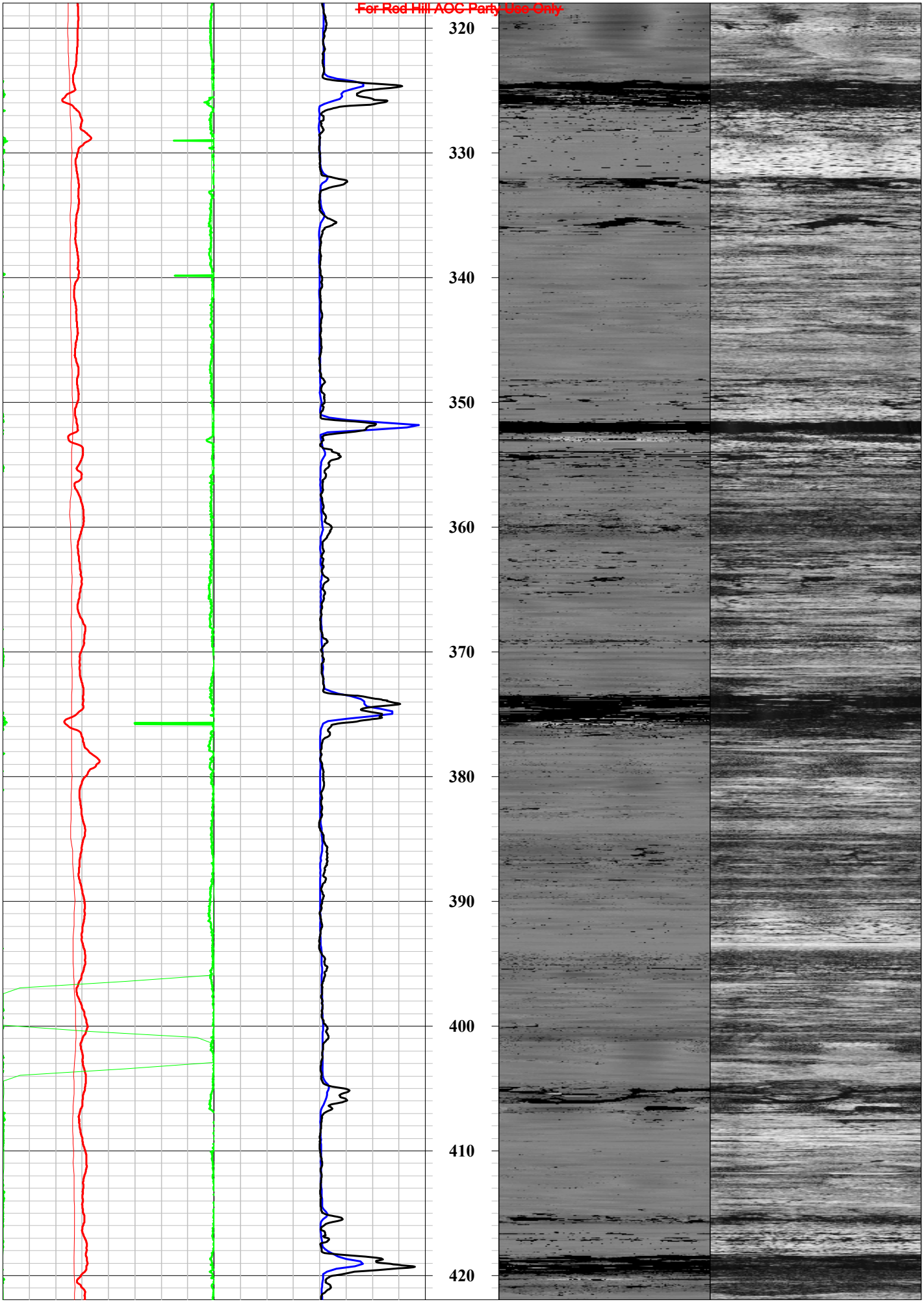
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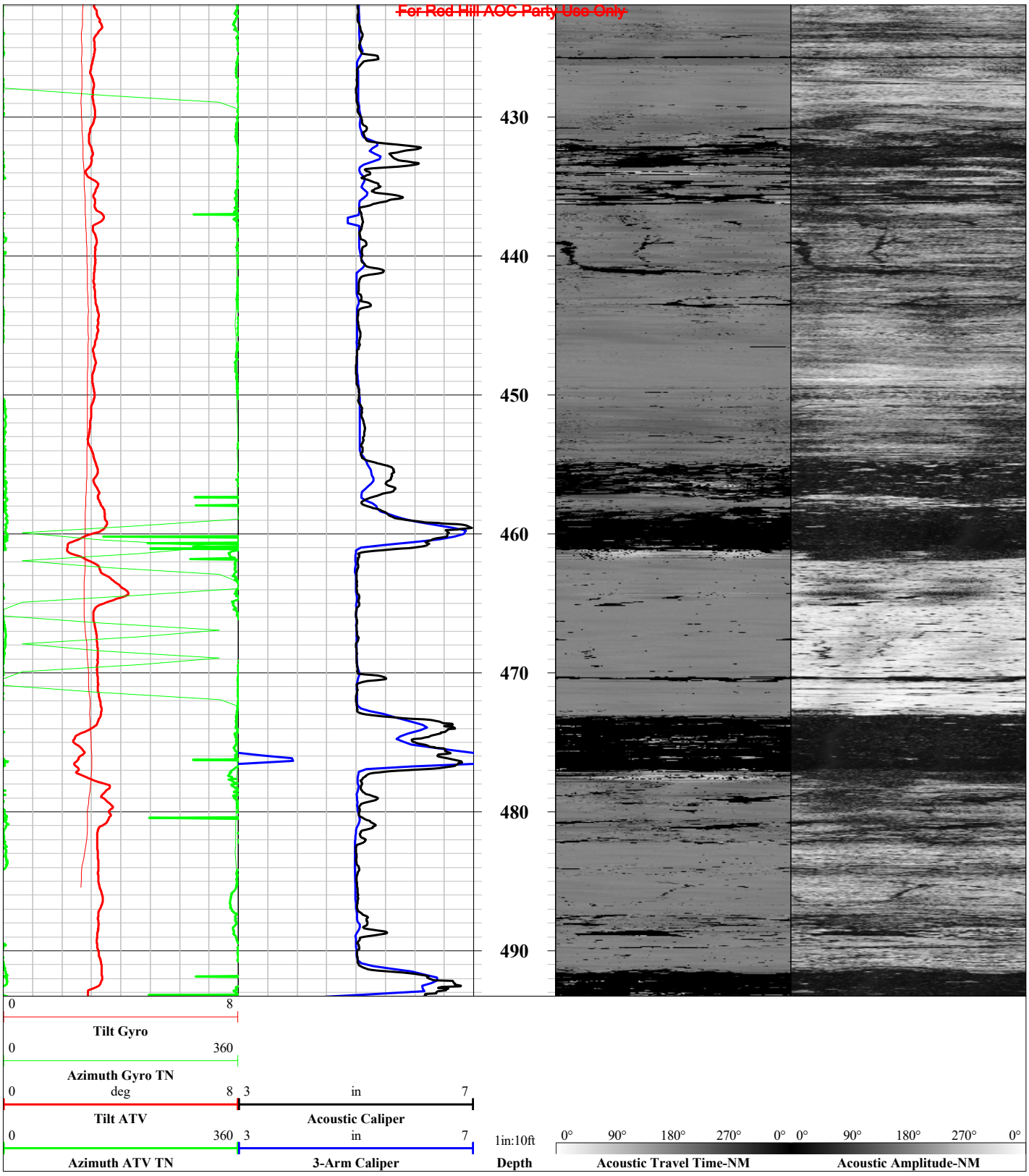
~~For Red Hill AOC Party Use Only~~
430
440
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Tilt Gyro
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7
Tilt ATV
Acoustic Caliper
0
360
3
in
7
Azimuth ATV TN
3-Arm Caliper
1in:10ft
Depth
0°
90°
180°
270°
0°
0°
90°
180°
270°
0°
Acoustic Travel Time-NM
Acoustic Amplitude-NM

~~For Red Hill AOC Party Use Only~~

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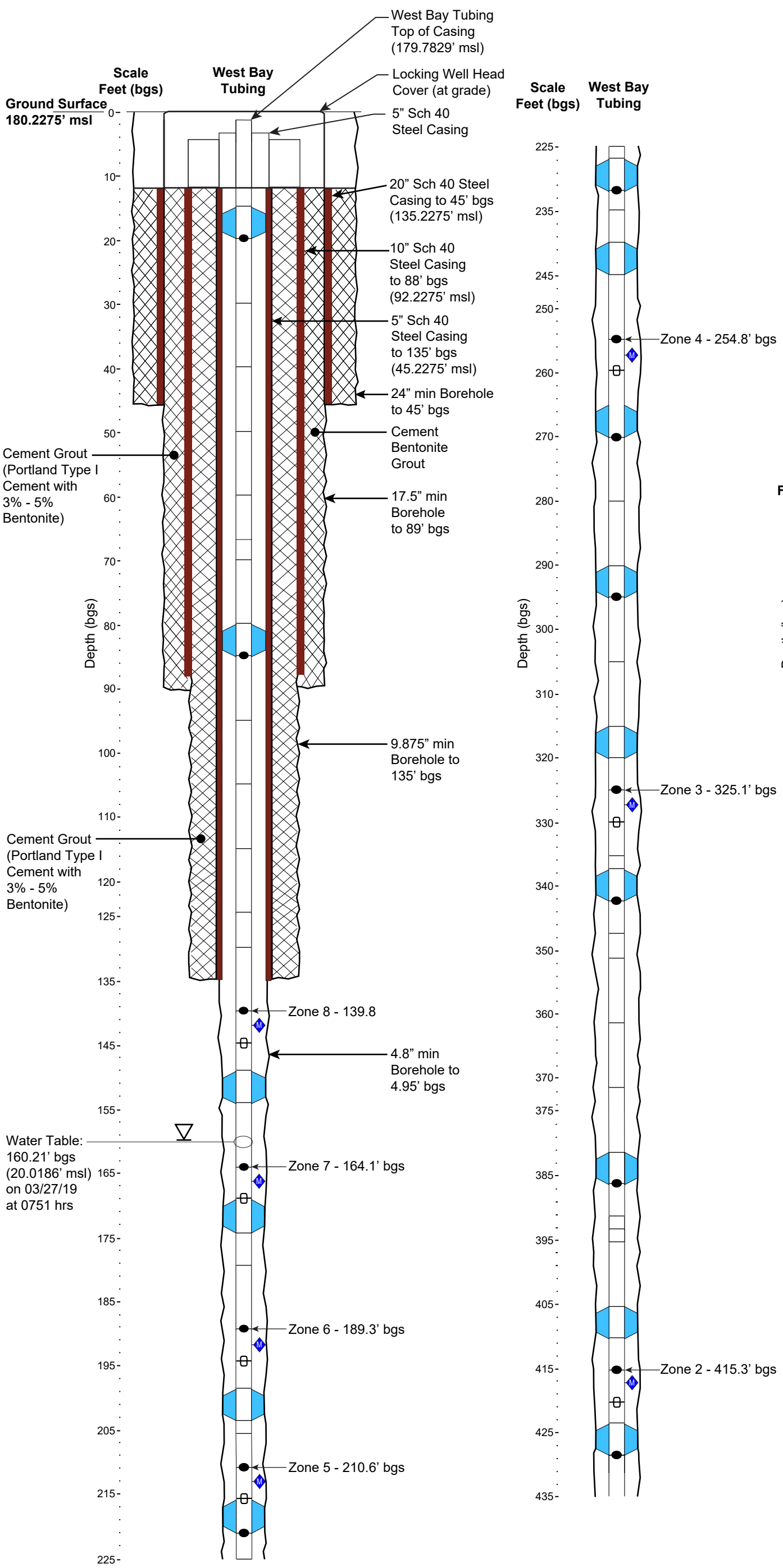
RHMW14 Monitoring Well



Legend

- Approximate Depth to Water in the Open Borehole within the Regional Basalt Aquifer Prior to Westbay System Installation
- Magnetic Sensor
- Packer
- Pump Port
- Sample Port

NOTE: DEPTHS BASED ON NOMINAL PORT POSITIONS, NO CORRECTIONS APPLIED - Nov 29, 2017
SOURCE: (c) WESTBAY INSTRUMENTS INC. 2000

Cross Section RHMW14 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawaii

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY
Red Hill 60571032	RHMW14	Red Hill	(b) (6)

METHOD
- OVERPUMPAGE ☒
- BAILER ☐
- SURGE BLOCK ☐
- AIR LIFT ☐
- OTHER

Grundfoss submersible 6.6 gpm

INITIAL WATER LEVEL:161.60' btoc
INITIAL TOTAL DEPTH: Not Measured

FINAL WATER LEVEL: 161.64'
FINAL TOTAL DEPTH: Not Measured

REMARKS:
casing stick up = 1.75'

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY							WATER LEVEL (ft btoc)
DATE	TIME	COMMENTS	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (ppt)	
Zone 1: casing bit at 456' bgs													
2/27	0823	Start purging											
	0900		37	6.6	244	7.79	22.23	0.39	6.83	68.8	2.77	0.2	161.61
	0910		47	6.6	310	8.31	22.36	0.39	6.55	57.5	2.41	0.2	161.62
	0915	Water quality meter will not turn on – continue purging											–
	0930		67	6.6	442								161.62
	1033		120	6.6	792	8.18	22.39	0.38	7.15	0.8	2.1	0.2	161.63
	1039	Spot check ORP w 228mV standard. Sensor reads 228.2											–
	1043		130	6.6	858	8.05	22.31	0.39	7.11	26.4	2.15	0.2	–
	1053		140	6.6	924	8.12	22.31	0.39	7.03	-43.7	2.14	0.2	161.63
	1058		145	6.6	957	8.13	22.35	0.39	6.40	-54.4	2.01	0.2	161.63
	1103		150	6.6	990	8.13	22.35	0.39	6.93	-65.5	2.01	0.2	–
	1108		155	6.6	1023	8.13	22.21	0.38	6.92	-69.6	2.03	0.2	161.64
	1113		160	6.6	1056	8.13	22.13	0.39	6.98	-73.1	1.99	0.2	–
	1118		165	6.6	1089	8.13	22.18	0.39	7.02	-81.1	2.02	0.2	161.64
	1123		170	6.6	1188	8.12	22.35	0.38	6.95	-72.1	2.01	0.2	–

2/27	1128		175	6.6	1155	8.12	22.35	0.38	6.92	-71.8	1.92	0.2	161.63
	1133		180	6.6	1254	8.12	22.31	0.38	6.90	-72.3	2.09	0.2	161.63
		Stop purging, pull pump/casing up			Zone 1 total: 1254								
Zone 2: casing bit at 351' bgs													
2/27	1307	Start pumping											161.49
	1312		5	6.6	33	8.3	24.14	0.39	4.53	4.9	37.4	0.2	_
	1317		10	6.6	66	8.19	23.17	0.39	4.73	-5.4	39.3	0.2	161.49
	1327		20	6.6	132	7.67	22.79	0.38	0.75	-79.0	66.1	0.2	_
	1337		30	6.6	198	7.95	22.75	0.38	3.39	-98.6	37.3	0.2	161.49
	1347		40	6.6	264	8.02	22.79	0.37	4.25	-103.5	25.5	0.2	161.49
	1357		50	6.6	330	7.92	22.75	0.38	4.65	-115.0	20.2	0.2	_
	1407		60	6.6	396	7.90	22.73	0.38	4.92	-119.4	5.21	0.2	_
	1417		70	6.6	462	7.85	22.49	0.38	4.87	-122.2	3.80	0.2	161.49
	1422		75	6.6	495	7.86	22.57	0.38	4.93	-122.9	2.93	0.2	161.49
	1427		80	6.6	528	7.86	22.56	0.38	4.95	-123.4	2.72	0.2	161.49
		Stop pumping, pull pump/casing up			Zone 2 total: 528	Checked ORP sensor in 228 mV solution, sensor reads 225.5 mV							
Zone 3: casing bit at 296' bgs													
2/28	1010	Start purging											
	1015		5	6.6	33	7.67	23.75	0.39	0.93	-186.4	82.5	0.2	161.59
	1025		15	6.6	99	7.59	23.64	0.38	0.46	-123.5	98.4	0.2	_
	1035		25	6.6	165	7.66	23.24	0.35	4.67	-83.0	29.5	0.2	161.59
	1045		35	6.6	231	7.75	22.99	0.36	5.19	-93.2	5.72	0.2	_
	1055		45	6.6	297	7.68	22.84	0.36	5.08	-95.7	5.01	0.2	_
	1115		65	6.6	429	7.61	22.67	0.37	5.06	-102.7	3.13	0.2	161.60
	1135		85	6.6	561	7.60	22.81	0.37	5.29	-108.2	2.94	0.2	_
	1145		95	6.6	627	7.60	22.83	0.37	5.31	-108.4	2.01	0.2	161.60
	1150		100	6.6	660	7.60	22.81	0.37	5.12	-109.7	2.03	0.2	161.60
	1205		115	6.6	759	7.61	22.84	0.37	5.18	-110.9	1.92	0.2	161.60
	1210		120	6.6	792	7.61	22.88	0.37	5.15	-111.1	1.89	0.2	_
	1220		130	6.6	858	7.61	22.82	0.37	5.13	-110.8	1.97	0.2	161.60
		Stop pumping, pull pump/casing up			Zone 3 total: 858								

Zone 4: casing bit at 170' bgs													
2/28	1303	Start purging											
	1308		5	6.6	33	7.21	23.33	.037	2.53	-29.1	79.4	0.2	161.61
	1318		15	6.6	99	7.16	23.44	0.37	2.84	-18.2	57.3	0.2	161.61
	1328		25	6.6	165	7.16	23.38	0.37	3.65	-24.70	21.5	0.2	_
	1338		35	6.6	231	7.47	23.11	0.37	5.12	-26.4	10.8	0.2	161.61
	1348		45	6.6	297	7.64	22.97	0.37	5.92	-35.40	4.31	0.2	_
	1358		55	6.6	363	7.65	22.81	0.37	5.79	-36.40	3.48	0.2	161.62
	1408		65	6.6	429	7.64	22.80	0.37	5.70	-35.30	2.61	0.2	_
	1418		75	6.6	495	7.65	22.75	0.37	5.72	-35.10	1.85	0.2	161.62
	1428		85	6.6	561	7.65	22.80	0.37	5.66	-34.00	1.21	0.2	_
	1433		90	6.6	594	7.65	22.80	0.37	5.91	-35.10	1.30	0.2	161.62
	1438		95	6.6	627	7.66	22.77	0.37	5.71	-35.90	1.12	0.2	161.62
	1443		100	6.6	660	7.66	22.79	0.37	5.72	-37.10	1.28	0.2	161.62
		End purging			Zone 4 total: 660								
Zone 4: casing bit at 165' bgs													
3/26	0934	Start purging											
	0935		1	7.0	7								161.85
	0941		7	7.0	49	6.57	24.55	0.35	0.68	-46.7	53.6	0.2	161.86
	0946		12	7.0	84	6.70	23.99	0.34	0.95	-53.5	26.3	0.2	161.90
	0951		17	7.0	119	6.78	23.87	0.34	0.54	-76.3	41.5	0.2	161.92
	0956		22	7.0	154	6.86	23.81	0.34	0.42	-88.4	49.7	0.2	161.92
	1001		27	7.0	189	6.93	23.74	0.34	0.34	-99.2	62.1	0.2	161.92
	1011		37	7.0	259	7.04	23.55	0.32	0.51	-77.5	51.3	0.2	161.92
	1021		47	7.0	329	7.14	23.38	0.32	2.53	-51.3	32.5	0.2	161.92
	1031		57	7.0	399	7.18	23.35	0.31	3.64	-34.0	18.8	0.2	161.92
	1041		67	7.0	467	7.19	23.27	0.31	3.87	-23.5	17.6	0.2	161.92
	1041	Paused to switch out tank (550 gal) 42 mins											_
	1123	Resume purge	72	7.0	504	7.30	23.30	0.31	3.55	-8.8	19.4	0.1	161.92
	1128		77	7.0	539	7.25	24.50	0.32	3.83	-1.2	15.3	0.2	161.92
	1133		82	7.0	574	7.13	23.77	0.32	3.32	8.1	11.3	0.2	161.92
	1138		87	7.0	588	7.14	23.65	0.32	4.06	11.9	15.7	0.2	161.92

3/26	1143		92	7.0	644	7.18	23.56	0.32	4.24	13.3	15.2	0.2	161.92
	1148		97	7.0	679	7.21	23.47	0.32	4.44	14.3	12.4	0.2	161.92
	1153		102	7.0	714	7.16	23.47	0.33	3.87	12.7	9.3	0.2	161.91
	1158		107	7.0	749	7.17	23.41	0.33	4.46	12.2	7.0	0.2	161.91
	1203		112	7.0	784	7.24	23.38	0.32	4.90	13.0	5.2	0.2	161.91
	1208		117	7.0	819	7.28	23.31	0.32	5.22	12.9	3.7	0.2	161.91
	1213		122	7.0	854	7.30	23.35	0.32	5.37	12.1	2.9	0.2	161.90
	1218		127	7.0	889	7.31	23.33	0.32	5.46	11.9	2.7	0.2	161.90
	1223		132	7.0	924	7.31	23.36	0.32	5.42	12.6	2.7	0.2	161.90
	1228		137	7.0	959	7.31	23.42	0.32	5.45	13.4	2.3	0.2	161.90
	1233		142	7.0	994	7.31	23.24	0.32	5.50	14.4	3.1	0.2	161.90
	1233	End purging	142		994	Tank full at 600 gals							
					All zones total: 4294								

~~For Red Hill AOC Party Use Only~~

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
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Log of Boring RHMW15

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Date(s) Drilled	11/29/17 - 07/12/19	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	HSA / HQ core / PQ core / air rotary	Drill Bit Size/Type	20" tricone / 10" HSA / 14 3/4 " hammer / 9 7/8" tricone bit / HQ/PQ dimaond bit	Total Depth of Borehole	590.0 feet
Drill Rig Type	Mobile B-59 / T3	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	309.9996
Groundwater Level	19.5 feet msl	Location	RHSF	Inclination from Horizontal/Bearing	90°
Borehole Completion	Westbay Well			Hammer Data	N/A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
309	0								**FILL** Dry, dark reddish-brown (2.5YR 3/3), Silty sandy gravel (GM), 50% subangular gravel to 1.5", 20% fine to coarse sand, 30% silt, no odor					11/29/17. Hand Dig. Clear to 2.5' bgs.
	1													
308	2								**VOLCANIC SAPROLITE** Highly to completely weathered volcanic rock. Weathers to - Dry, brown (7.5YR 4/3), sandy silt (ML), with sand					Begin HSA at 2.5' bgs.
	3													
306	4													
	5						IF		**WELDED TUFF** White (2.5Y 9/1) matrix with greenish black (GLEY2 2.5/1) clasts and dusky red (10R 3/3) oxidation, welded, highly weathered, extremely weak, clasts are subangular to subrounded, coarse sand to gravel size up to 1.5"			0.0	[25]	20 ft drilling becomes difficult w/ HSA. Start HQ coring.
304	6						1							
	7	1		100		0	2 IF M M		1. 5, J N, Cl, Fi, Ir, SR 2. 0, J, VN, Fe, Su, Ir, R 3. 2, J, N, Fe+Cl, Fi, Ir, R 4. 20, J, VN, Fe, Su, Ir, R 5. 20, J, N, Cl, Fi, Pl, Sr 6. 2, J, VN, Fe+Mn, Su, Sr 7. 2, J, VN, Fe+Mn, Su, SR					Water loss ~300 gal
302	8													
	9		1				3 4 5 6 7		**BASALT Massive a'a** Greenish black (10Y 2.5/1), moderately weathered, weak to moderately strong					
300	10						M		**BASALT a'a Clinker** White (2.5Y 9/1) matrix with greenish black (10Y 2.5/1) clasts, welded, highly weathered, weak to medium strong, clasts are subangular to subrounded, coarse sand to gravel size			0.0	[42.9]	
	11						M							
298	12	2		100		48	M M							Water loss ~300 gal
	13						1							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 12/2/2019 RHMW15

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
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Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13								**BASALT Massive a'a** dusky red (10R 3/3) oxidation, moderately weathered, strong							
296	14								10% vesicles 1mm							
	15								1. 5°, J, VN, Fe, Su, Ir, R 2. 45°, J, VN, Fe+Mn, Su, Pl, SR 3. 70°, J, MW, Fe+Mn, Su, Wa, SR 4. 60°, J, N, Fe+Mn, Su, Wa-Pl, SR					0.0	[20]	
294	16								1. 20°, J, VN, Cl, Fi, Ir-Pl, SR 2. 90°, J, VN, Fe+Mn+Cl, Su-No, SR 3. 30°, J, VN, Fe+Mn, Pl, SR							
	17	3		100		0										Water loss ~300 gal
292	18		2						10% vesicles 2-3mm							
	19															
290	20								dark greenish gray (10G 4/1)					0.0	[37.5]	
	21								5% lenticular vesicles 1-10mm							
288	22	4		100		46			1. 20°, J, N, Fe+Cl, Fi, Ir, SR 2. 90°, J, N, Fe+Mn+Cl, Fi, Pl, SR 3. 20°, J, VN, Fe+Mn, Su, Wa, R 4. 10°, J, VN, Fe+Mn, Su, Wa, R 5. 20°, J, VN, Fe+Mn, Su, Wa, R							Water loss ~300 gal
	23								10% lenticular vesicles 1-10mm							
286	24								6. 10°, J, VN, Fe+Mn, Su, Wa, R 7. 60°, J, VN, Fe+Mn, Su, Wa, R 8. 20°, J, N, Fe-Mn, Su, Pl, R 9. 45°, J, VN, Fe-Mn, Su, St, R IF pieces: 0-45, J, VN, Fe+Mn, Su, Ir, R							
	25								**BASALT a'a Clinker** White (2.5Y 9/1) to dusky red (10R 3/4) matrix with very dark gray (7.5YR 3/1) clasts, welded, moderately weathered, very weak, clasts are subangular to subrounded, coarse sand to gravel size 1. 0, J, VN, Fe+Mn, Su, IR, R IF zone: 0-45, J, VN, Fe+Mn, Su, Pl-Ir, Sr-R					0.0	[75]	
284	26		3													Water loss ~250 gal
	27	5		100		68			**BASALT Pahoehoe** Weak red (10R 4/4), moderately weathered, very weak, 40% vesicles 1mm, all vesicles filled with pale yellow (2.5Y 8/2) clay							
282	28								2. 30, J, VN, Fe+Mn, Su, Ir, R 3. 20, J, VN, Fe+Mn, Sp, Wa, R 4. 60, J, VN, Fe-Mn, Su-Sp, Pl-Wa, SR 5. 20, J, VN, Fe-Mn, Su-Sp, Pl-Wa, R 6. 0. J, N, Fe-Cl, Pa, Wa, R							
	29															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
280	30		3						~50% of vesicles filled with clay					0.0	[100]	
									1. 60°, J, T, Fe+Mn, Sp, Pl, R 2. 60°, J, T, Fe+Mn, Sp, Pl, R							
	31						IF		dusky red (10R 3/2), weak, <20% of vesicles have clay infill IF pieces: 0-70, J, VN, Fe+Mn+Cl, Sp-Fi, Pl-Ir, SR-R, pale yellow (7.5Y 8/2) clay on fractures							Water loss ~200 gal
278	32								occasional 5-10mm vesicles							
		6		100		70			3. 10°, J, N, Fe+Mn+Cl, Pa, St, R 4. 0°, J, VN, No, No, Wa, R 5. 10°, J, T, Cl, Sp, Ir, R							
	33															
									grades to dark gray (5Y 4/1), slightly weathered, moderately strong							
276	34															
	35		4						10% lenticular vesicles 5-15mm					0.0	[100]	
274	36															
									40% 0.5-2mm rounded vesicles							Water loss ~200 gal
	37								1. 90°, J, VN, Fe+Mn, Su, Wa, R 2. 0°, J, VN, Fe+Mn+Cl, Sp, Pl, R 3. 20°, J, VN, Fe+Mn, Su, Wa, R 4. 90°, J, VN, Fe+Mn, Su, St, R 5. 90°, J, VN, Fe+Mn, Su, Wa, R 6. 45°, J, VN, Fe+Mn, Su, St, R 7. 70°, J, VN, Fe+Mn+Cl, Pa, Wa, R 8. 0°, J, N, Fe+Mn+Cl, Pa, Pl, R 9. 90°, J, VN, Cl, Sp, Wa, R 10. 0°, J, N, Fe+Mn+Cl, Pa, Pl, R							
		7		100		40										
272	38															
	39															
270	40													0.0	[150]	
									1. 70-90°, J, N, Cl, Sp, Ir, VR 2. M?; 0, J, N, Cl, Sp, Ir, R 3. 0°, J, N-MW, Cl, Fi, Pl, SR 4. 20°, J, N, Cl+Fe+Mn, Pa, R 5. 5°, J, VN, Cl, Sp, Pl, R							Water loss ~200 gal. 40-45' lost circulation
	41															
268	42		5													
		8		80		18			**BASALT Massive a'a** Dark gray (10YR 4/1), moderately weathered, weak, <5% vesicles							
	43						IF		IF zone: 0-90, J, VN-N, Fe+Mn+Cl, Sp-Fi, Pl-Ir, R-VR							
266	44															
							NR		no recovery							End of drilling 11/29/17
	45															

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Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45								**BASALT a'a Clinker** Reddish black (2.5YR 2.5/1) to dusky red (10R 3/4), moderately weathered, weak, subangular to angular gravel size fragments, intensely fractured with very pale yellow (2.5Y 9.5/2) clay coating on fracture surfaces					0.0	[33.3]	Resume on 11/30/17. Corel barrel plugged at 45.5', retract barrel at clear. Intermittent poor water return
264	46															
	47		5													
		9		46		0	NR		no recovery							Water loss ~325 gal
262	48															
	49															
260	50						NR		grades with more clay on fracture surfaces					0.0	[75]	Intermittent poor WR
	51							1								
258	52							2	**BASALT Massive a'a** Very dark gray (Gley1 3/N), slightly weathered, strong, 20% vesicles 1-10mm, vesicles stretched and elongate							
		10		90		60		3 4 5	1. 45, J, T, Fe+Mn, Su, Wa, SR 2. 30, J, N, No, No, IR, VR 3. 0, J, T, Fe, Su, St, R 4. 5, J, T, Fe+Mn+Cl, Sp, Wa, R 5. 20, J, T, Fe+Mn+Cl, Sp, Wa, SR							Water loss ~300 gal
256	53							6	6. 20, J, T, Fe+Mn+Cl, Sp, St, R							
	54							M	7. 0, J, VN, Fe+Cl, Sp, Wa, SR							
	55		6					7						0.0	[75]	Intermittant poor WR
								1 2	grades to 15% vesicles 1-5mm, most very elongate							
254	56							3	1. 75°, J, T, Fe+Mn, Su, Wa, S-SR 2. 0°, J, VN, Fe+Mn+Cl, Sp-Pa, Wa, SR 3. 15°, J, VN, Fe+Mn+Cl, Pa, Wa, SR							
								M 4	4. 0°, J, VN, Cl, Pa, Wa, R 5. 45°, J, T, Fe+Mn, Su, Pl, S							
	57								grades to 5% vesicles 1-2mm							
		11		84		47		5								Water loss ~300 gal
252	58							IF	**BASALT a'a Clinker** Reddish brown (2.5YR 4/3) to dusky red (2.5YR 3/2), moderately to highly weathered, very weak, sandy gravel with traces of clay no recovery							
	59						NR		becomes welded, moderately weathered, medium strong							
250	60		7					1	1. 20°, J, VN, Cl, Sp, Pl, SR					0.0	[75]	Water loss ~300 gal
								IF	becomes non-welded, fine to coarse gravel size fragments							
	61															

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Log of Boring RHMW15

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
248	61															
	62	12		56		10	NR		no recovery							Intermittant poor WR
	63															
246	64						2 IF		**BASALT Massive a'a** Very dark gray (5YR 3/1), moderately weathered, medium strong to strong, 20% vesicles 1-3mm 2. 10, B, N, No, No, Ir, VR							Water loss ~300 gal
	65								grades with ~17% olivine phenocrysts					0.0	[75]	Intermittent poor WR
244	66		7				1 2 3 4 5 6		1. 0°, J, VN, Fe+Cl, Sp, Ir, VR 2. 80°, J, VN, Fe+Mn+Cl, Sp, Ir, VR vesicles become 2-5mm, very friable between joints 1 and 3, breaks to coarse gravel 3. 0°, J, VN, Fe+Mn+Cl, Sp, Ir, VR 4. 45°, J, VN, Fe+Mn, Su, Ir, VR 5. 60°, J, VN, Fe+Mn, Su, Pl, SR-S 6. 0°, J, VN-N, Fe, Su, Ir, R							
	67	13		100		25										
242	68						7 8 9 10 11 IF		**BASALT a'a Clinker** Very dark gray (Gley1 3/N) to yellowish red (5YR 5/8), welded, moderately to highly weathered, weak, fracture planes very rough 7. 15-30, J, Fe+Cl, Sp, Ir, VR 8. 15-30, J, Fe+Cl, Sp, Ir, VR 9. 15-30, J, Fe+Cl, Sp, Ir, VR 10. 15-30, J, Fe+Cl, Sp, Ir, VR 11. 15-30, J, Fe+Cl, Sp, Ir, VR							Water loss ~300 gal
	69															
240	70						NR		no recovery becomes brown (10YR 4/3) to very dark gray (Gley1 3/N) with yellowish red (5YR 5/8) on fractures, weak to moderately strong					0.0	[100]	Intermittent poor WR
	71						1									
238	72						IF									
	73	14		96		30	1 IF 2 3		**BASALT Massive a'a** Very dark gray (Gley1 3/N), slightly weathered, strong, 5% vesicles 1mm, intensely fractured with many vertical fractures IF zone: Fe+Mn, Su, Pl, S-SR 1. 90, J, N, Fe+Cl, Sp, Wa, VR 2. 10, J, VN, Fe+Mn, Su, Ir, R 3. 30, J, VN, Fe+Mn, Su, Pl, S 4. 30, J, VN, Fe+Mn, Su, Pl, S 5. 20, J, VN, Fe+Mn, Su, Pl, S							Water loss ~300 gal
236	74		8				4 5									
	75						M		15% vesicles, fresh to slightly weathered, trace olivine					0.0	[75]	Intermittent poor WR
234	76						M 1 IF 2 3 4		1. 0°, J, T, Fe+Mn, Su, Pl, S-SR 2. 50°, J, VN, Fe+Mn+Cl, Pa, Pl, S-SR 3. 85°, J, VN, Fe+Mn+Cl, Pa, Pl-St, SR-R 4. 85°, J, VN, Fe+Mn+Cl, Pa, Pl-St, SR-R 5. 0°, J, T, Fe+Mn, Su, Pl, S 6. 0°, J, T, Fe+Mn, Su, Pl, S							
	77															

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Log of Boring RHMW15

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
77	77															
		15	8	100		52										
232	78								**BASALT a'a Clinker** Dusky red (2.5YR 3/2) with very dark gray (Gley1 3/N) clasts, welded, moderately weathered, weak							Water loss ~300 gal
	79								becomes non-welded, very weak, highly weathered, friable, broken to gravel and cobble size clasts							
230	80													0.0	[50]	Intermittent poor WR
	81								basalt boulder, slightly weathered, strong, 15% vesicles 1-3mm 1. 80°, J, VN, No, No, Wa, R							
228	82															
		16		60		38										Water loss ~300 gal
	83															
226	84															
	85													0.0	[21.4]	Intermittent poor WR
224	86		9						no recovery							
	87															
		17		35		12										Water loss ~400 gal
222	88															
	89															
220	90								**BASALT Massive a'a** Very dark gray (Gley1 3/N) to dusky red (2.5YR 3/2), slightly to moderately weathered, medium strong to strong, 10% vesicles 1mm, trave olivine 1. 20, J, VN, Fe+Mn, Su, Pl, SR 2. 30, J, T, Fe+Mn, Su, Pl, S 3. 0, J, N, No, No, Ir, VR 4. ? 5. 60, J, VN, Fe+Mn, Su, Wa, SR 6. 5, J, VN, Fe+Mn, Su, Wa, R					0.0	[42.9]	Intermittent poor WR
	91															
218	92															
		18		100		68			92.3-92.5 Dark reddish brown (2.5YR 3/4), intensely fractured zone, possibly clinker							Water loss ~450 gal
	93															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
216	93		9				4 M M		**BASALT a'a Clinker** Dark reddish brown (2.5YR 3/4) with very dark gray (Gley1 3/N) clasts, welded, moderately to highly weathered, weak					
	94						5 6		**BASALT Massive a'a** Very dark gray (Gley1 3/N), slightly weathered, strong, 5% vesicles					
	95						M		**BASALT a'a Clinker** Dark reddish brown (2.5YR 3/4) with very dark gray (Gley1 3/N) clasts, welded, moderately weathered, medium strong			0.0	[60]	Intermittent drill chatter. Intermitteant poor WR
214	96						IF							
	97	19		30		7	NR		no recovery					Water loss ~450 gal
212	98													
	99													
210	100								fragments less weathered			0.0	[60]	Intermittent poor WR
	101													
208	102	20	10	24		0	NR		no recovery					Water loss ~450 gal
	103													Tag bottom of the hole to 105' bgs
206	104													
	105								grades with traces of very pale yellow (2.5Y 9.5/2) clay on fragments			0.0	[15]	Intermittent poor WR
204	106								grades without clay					Drill string binding up. Higher rotation pressure. Driller suspects worn bit. Pull casing, bit fine. Send back down hole. Casing goes back down smooth. Drill string still binding up but becomes free around 108.5'
	107	21		60		0								
202	108						NR		no recovery					
	109													

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Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	SAMPLES: PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	109								no recovery					Water loss ~450 gal
200	110		10				1		**BASALT Massive a'a** Very dark gray (Gley1 3/N), slightly weathered, strong, 5% elongate vesicles 1-3mm, 5% plagioclase			0.0	[100]	Poor WR
	111						M 2 3		becomes moderately weathered, moderately strong, vesicles 2-10mm					
198	112	22		92		62	4		1. 75°, J, VN, Cl, Pa, Pl, S 2. 0°, B, N, No, No, Ir, R 3. 0°, B, N, No, No, Ir, R 4. 45°, J, VN, Fe+Mn, Su, St, VR 5. 90°, J, VN, Fe+Mn+Cl, Sp, Pl, SR 6. 75, J, VN, Fe+Mn+Cl, Sp, Ir, VR 7. 60, J, VN, Fe+Mn+Cl, Pa, Ir, VR Clay on joints is yellowish red (5YR 4/6)					Water loss ~300 gal
	113						5							
196	114						6 7							
	115		11				IF		**BASALT a'a Clinker** Very dark reddish brown (2.5YR 4/3) with very dark gray (Gley1 3/N) clasts, welded, moderately weathered, weak, clasts are angular, fine to coarse gravel size 1. 45, J, N, No, No, Ir, VR 2. 0, J, No, No, Ir, VR no recovery			0.0	[60]	Poor WR
194	116													
	117	23		100		70			**BASALT Massive a'a** Very dark gray (Gley1 3/N), fresh, strong to very strong, 20% 1-10mm elongate vesicles 3. 50, J, No, No, Ir, VR					Water loss ~300 gal
192	118													
	119						IF							
190	120											0.0	[50]	Intermittent poor WR
	121						1 2		1. Mechanical 2. 85°, J, N, Fe+Mn+Cl, Pa, Pl, S-SR 3. 10°, J, VN, Fe+Mn+Cl, Sp, St, S 4. 15°, J, VN, Fe+Mn, Su, Pl, S					
188	122	24	12	100		96	3							Water loss ~300 gal
	123						4							
186	124								large vesicles up to 1/4" with walls coated with traces of white secondary minerals (zeolites?)					Take WL readings. WL fell from 108.75' btoc to 112.81' btoc in 50 mins
	125													

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184	125						1					0.0	[60]	Intermittent poor WR
	126						2							
							3		1. 60°, J, N, Fe+Mn+Cl, Pa, Ir, SR					
							4		2. 90°, J, N, Fe+Mn+Cl, Sp, Pl, S					
							8		3. 0°, J, VN, Fe+Mn+Cl, Su, Pl, S					
							5		4. 75°-90°, J, VN, Fe+Mn+Cl, Pa-Fi, Pl, S					
	127						6		5. 0°, J, VN, Fe, Su, Pl, S					
		25		100		70			6. 0°-5°, J, N, Fe, Sp, Wa, SR					
							7		7. 0°-5°, J, N, Fe+Mn+Cl, Wa, SR					
									8. 90°, J, N, Mn+Cl, Wa, SR					
									9. 60°, J, N, Fe, Sp-Pa, Wa, SR					
									10. 20°, J, N, Fe+Mn+Cl, Pa, Pl, S					
182	128													Water loss ~300 gal
							9		becomes 5% vesicles ~1mm					
	129													
							10							
180	130											0.0	[100]	Intermittent poor WR
							1		**BASALT a'a Clinker**					
	131		13				2		Dark reddish brown (2.5YR 3/4) with very dark gray (Gley1 3/N) clasts, welded, moderately weathered, moderately strong					
									grades with brown (7.5YR 4/3), becomes moderately to highly weathered, weak, sand to gravel size fragments, non-welded					
178	132													
		26		70		12			1. 60, J, MW, Fe+Mn+Cl, Sp, Ir, SR					Water loss ~300 gal
									2. 75, J, ?, Fe+Mn+Cl, Sp, Wa, S					
	133													
														Measured WL inside casing. WL fell from 111.1' btoc to 113.25' btoc in 65 mins
176	134						NR		no recovery					End of drilling 11/030/17; begin 12/01/17
	135								coarse gravel size fragments			0.0	[50]	
174	136						NR							Water level at 136.68' btoc at start of shift (133.68' bgs)
	137													
		27		18		0								No WR. Water loss ~250 gal
172	138		14						no recovery					
	139													
170	140											0.0	[18.8]	
	141													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
168	141						NR		no recovery					
	142							IF	**BASALT Massive a'a** Reddish black (10R 2.5/1), slightly weathered, strong, 15% vesicles 3-10mm, intensely fractured to gravel and cobble size fragments					No WR. Water loss ~600 gal
		28		58		0			becomes very dark gray (Gley1 3/N), slightly weathered to fresh, strong to very strong, 15% vesicles 1-10 mm, some elongate, some metalic gold flecks on core. Driller says it is from brass fittings on core barrel and bit					
166	144													
	145						NR					0.0	[23.1]	High H2O pressure. Pull up inner barrel to make sure it is adjusted correctly to latch. Core barrel adjusted correctly. Pull out casing. Recovered additional 2' of core. Driller suspects it came from run 28. No WR. Water in casing fell from 150.6' btoc to 152.59' btoc in 10 mins. End of drilling 12/01/17; begin 12/04/17. Hole dry at start of shift. Borehole tagged to 150' bgs.
164	146								no recovery					
	147													
		29	14	52		33		IF						
162	148								becomes fresh, very strong, 10% vesicles <1mm					
								M	1. 15°, J, T, Fe, Su, Pl, SR					
	149							1						
160	150								zone of 30% vesicles 1-5mm					
									BASALT a'a Clinker Red (2.5YR 3/6) to black (Gley1 2.5/N), gravel to cobble size, subangular fragments, moderately to highly weathered, weak, permeable			0.0	[45]	
	151													
		30		47		0								No WR. Water loss ~150 gal
158	152						NR							
	153								no recovery				[60]	No WR. Water loss ~150 gal
								IF						
156	154	31		65		17			**BASALT Massive a'a** Very dark gray (Gley1 3/N), slightly weathered, strong to very strong, 30% vesicles 2-5mm 1. 15°, J, VN, Fe, Sp, Ir, R 2. 15°, J, T, Fe, Su, Wa SR 3. 15°, J, T, Fe+Mn, Su, Wa, SR					
	155												[42.9]	No WR. Water loss ~350gal
			15					M	1. 5°-30°, J, VN, Fe+Mn, Su, Ir, SR 2. 30°, J, VN, Fe+Mn, Su, Ir, SR					
154	156							1	becomes 15% vesicles 1-3mm					
								M						
	157													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 12/2/2019 RHMW15

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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
157	157						M 2 3 4		grades with vesicles up to 10mm 3. 45°, J, VN, Fe+Mn, Su, Pl, SR 4. 10°, J, T, Fe+Mn, Su, Pl, SR 5. 60°, J, T, Fe+Mn, Su, Pl, SR 6. 30°, J, T, Fe+Mn, Su, Pl, S 7. 80°, J, VN, Fe+Mn, Su, Pl, SR 8. 0°, J, N, Fe+Mn+Uk, Sp, Ir, VR 9. 60°, J, N, Fe+Mn+Uk, Sp, Pl, R Uk: pale yellow (5Y 7/4)					
		32		106		72								
152	158						M 5 6 7							
	159		15				8 9							
150	160						1		some vesicles filled with pale yellow mineral				[50]	No WR. Water loss ~350 gal
	161													
							2 3 4		1. 45°, T, N, Fe+Mn+Uk, Pa, Ir, VR 2. 85°, J, N, Fe+Mn+Uk, Sp, Ir, VR 3. 0°, J, N, Fe+Mn+Uk, Pa, Ir, VR 4. 5°, J, VN, Fe+Mn, Su, Pl, S					
148	162						5 6		5. 80°, J, N, Fe+Mn+Uk, Pa, Wa, R 6. 45°, J, T, Fe+Mn, Su, St, R					
		33		92		56	M		7. Mechanical 8. 50°, J, N, Fe+Uk1+Uk2, Pa, Ir, R 9. 45°, J, T, Fe+Mn, Su, Pl, SR					
	163						8		10. 60°, J, VN, Fe+Mn+Uk, Pa, Pl, S 11. 30°, J, VN, Fe+Mn+Uk, Pa, Pl, S Uk2: white (5Y 8/1), waxy (halloysite?)					
146	164						9 11 10		no recovery					
	165						NR						[50]	No WR. Water loss ~350 gal
									1. 30°, J, T, No, No, Pl, S 2. 45°, J, T, Fe+Mn, Pl, S 3. 80°, J, N, Fe+Mn+Uk, Pa, Wa, SR 4. 0°, J, N?, No, No, Pl, SR 5. 90°, J, N, Fe+Mn+Uk, Pa, Wa, SR 6. 30°, J, N, Fe+Mn+Uk, Pa, Pl, SR 7. 5°, J, N, Fe+Mn+Uk, Pa, Pl, SR 8. 0°, void, Fe+Mn+Uk, Su, Pl, SR					
144	166		16				1							
	167						2 3							
		34		84		64	4 5							Drill string drops. Driller says 2' void: 167.5'-169.5' bgs. Pause for WL readings at 170'. WL fell from 169.56'-169.75' bgs
142	168						6 7							
	169						8 Void 9							
140	170						NR		no recovery				[37.5]	No WR. Water loss ~500 gal
	171								**BASALT a'a Clinker** Red (10R 4/6) to very dark gray (Gley1 3/N), angular, coarse gravel size clinker fragments, moderately weathered, weak, with Uk mineral/ clay coating on some surfaces, permeable					
							IF							
138	172		17											
		35		70		28	1		**BASALT Massive a'a** Dusky red (2.5YR 3/2), moderately weathered, medium					
	173													

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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	SAMPLES: PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	173								strong to strong, 20% 1-3mm vesicles					
136	174						IF		at 173.4 ft bgs becomes intensely fractured with Uk mineral coating on some fractures, broken to sand in some zones					
	175						4						[75]	No WR. Water loss ~350 gal
							1		becomes very dark gray (Gley1 3/N), slightly weathered, strong					
134	176						2		1. 45°, J, VN, No, No, Pl, R					
			17				3		2. 30°-60, J, VN, Fe+Mn, Su, Pl, SR					
	177						5		3. 50°, J, VN, Fe+Mn, Su, Pl, S					
									4. 50°, J, VN, Fe+Mn, Su, Pl, S					
									5. 45°, J, T, No, No, Pl, S					
							6		6. 5°, J, VN, Fe+Mn+Uk, Pa, Pl, S					
		36		100		72	7		7. 45°, J, VN, Fe+Mn, Su, Pl, SR					
							8		8. 60°, J, VN, Fe+Mn, Su, Wa, SR					
132	178						M		9. 10°, J, VN, Fe+Mn+Uk, Pa, Pl SR					
									10. 30°, J, VN, Fe+Mn+Uk, Pa, Pl R					
	179													
							9							
130	180						10						[60]	No WR. Water loss ~350 gal
							1		becomes fresh, strong to very strong, 7% elongate vesicles					
	181								1. 20°, J, T, Fe+Mn, Su, Ir, SR					
									2. 0°, J, VN, Fe+Mn+Uk, Su, Ir, R					
									3. 0°, J, VN, Fe+Mn+Uk, Su, Ir, R					
									4. 0°, J, VN, Fe+Mn+Uk, Su, Ir, R					
									5. Mechanical					
128	182						2		6. 5°, J, T, Fe+Mn+Cl, Su, Pl, SR					
							3		7. 0°, J, T, Fe+Mn, Su, Pl, SR					
		37		100		85	4		8. 0°, J, T, Fe+Mn, Su, Pl, SR					
	183								9. 5°, J, T, No, No, Wa, Sr					
							6		10. 0°, J, T, Fe+Mn, Ir, R					
							5							
							7							
126	184						8							
			18				9							
	185						IF		**BASALT Pahoehoe**				[75]	No WR. Water loss ~500 gal
									Dusky red (2.5YR 3/2), moderately weathered, medium strong, 50% vesicles up to 1mm, intensely fractured (mostly mechanical)					
124	186													
	187													
		38		50		0			**BASALT a'a Clinker**					
							10		Red (10R 4/6), dusky red (2.5YR 3/2), and very dark gray (Gley1 3/N), angular gravel size clinker fragments, moderately weathered, weak, permeable					
122	188													
	189													

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Log of Boring RHMW15

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	189						NR									
120	190								no recovery					0.0	[36]	No WR. Water loss ~250 gal
	191	39	18	40		13										
118	192								clinker (as above) 1. 5°, J, Fe+Mn, Su, Ir, SR 2. 10°, J, VN, Fe+Mn, Su, Ir, SR							
	193						1 2		**BASALT Massive a'a** Very dark gray (Gley1 3/N), slightly weathered, strong, 20% vesicles 1-3mm 193-193.5' bgs 40% vesicles 1. 0°-90°, J, VN, Fe+Mn, Su, Wa, SR 2. 20°, J, VN, Fe+Mn, Su, Pl, S 3. 30°, J, VN, Fe+Mn, Su, Ir, R					0.0	[30]	No WR. Water loss ~100 gal
116	194	40		100		75	M 1 2									
	195						3		becomes 15% vesicles 1-10 mm					0.0	[26.3]	No WR. Water loss ~200 gal
114	196						1 2 3 IF		vesicles become very elongate							
	197	41	19	100		40	4 5		1. 70°, J, VN, Fe+Mn, Su, Pl, S 2. 70°, J, VN, Fe+Mn, Su, Wa, SR 3. 70°, J, VN, Fe+Mn, Su, Wa, SR 4. 0°, J, VN, Fe+Mn+Uk, Su, Ir, R 5. 0°, J, VN, Fe+Mn, Su, Wa, SR IF zone: fracture surfaces coated with Fe+Mn+Uk							Driller says core barrel stuck. Recovered additional 1.7' of core which was dropped from run 40. Add to run 40. Pause to collect WL readings. WL fell from 198.1' bgs to completely dry in 5 mins. No WR. Water loss ~100 gal No WR. Water loss ~700 gal
112	198						IF		IF zone mechanically fractured							
	199	42		53		0	IF NR		**BASALT a'a Clinker** Dusky red (2.5YR 3/2) to very dark gray (Gley1 3/N), subangular gravel size clinker fragments, moderately weathered, permeable					0.0	[45]	
110	200													0.0	[30]	
	201								becomes very dark gray (Gley1 3/N) coarse sand size, very angular, possibly mechanically pulverized							
108	202	43		30		0	NR									
	203		20						no recovery							
106	204															Drill string binding up. Difficult drilling
	205															

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	205						NR					0.0	[15]	No WR. Water loss ~1000 gal. Slower drilling
104	206	44		28		0			no recovery					
	207								clinker (as above)					
								1	**BASALT Massive a'a**			0.0	[18.8]	No WR. Water loss ~350 gal
102	208	45		100		96			Very dark gray (Gley1 3/N), slightly weathered, strong, 20% vesicles 1-3mm, vesicles partially filled with clay from 208'-208.2' bgs					
	209							2	1. 0, B, W?, Cl, Sp, Ir, R 2. 30, J, VN, Fe+Mn, Su, St, SR 3. 70, J, VN, Uk, Pa, Ir, R					
								M						
100	210		20					IF				0.0	[30]	No WR. Water loss ~1500 gal
								1	becomes fresh, very strong					
	211							2	1. 10°, J, N, Fe+Mn, Su, Wa, SR 2. 45°, J, VN, Fe+Mn, Su, Pl, SR 3. 40°, J, VN, Fe+Mn+Uk, Sp, Pl, S 4. 75°, J, N, Fe+Mn, Su, Ir, R					
								M	5. 50°, J, N, Fe+Mn, Su, Ir, R					
98	212								6. 45°, J, VN, Fe+Mn, Su, Pl, SR 7. 45°, J, VN, Fe+Mn, Su, Pl, SR					
		46		90		54		3	8. 85°, J, VN, Fe+Mn, Su, Ir, R 9. 85°, J, VN, Fe+Mn, Su, Ir, R					
	213							5 4						Driller says hole is very tight. Squeezing drill string
96	214							6 7 9						
								8	no recovery					
	215						NR	1				0.0	[23.1]	No WR. Water loss ~800 gal
								2	1. 60°, J, VN, Fe+Mn, Su, Wa, R 2. 50°, J, VN, Fe+Mn, Su, Wa, R					
								3	3. 45°, J, VN, Fe+Mn, Su, Pl, SR					
								5	vesicles elongate, up to 20mm					
94	216							4	4. Mechanical 5. 5°, J, N, Fe+Mn, Su, St, R 6. 30°, J, VN, Fe+Mn, Sp, Pl, SR					
	217							6	7. 75°, J, VN, Fe+Mn, Sp, Wa, S 8. 15°, J, VN, Fe+Mn, Sp, Ir, R					
								7	9. 25°, J, VN, Fe+Mn, Sp, Ir, R					
		47	21	100		54		8	10. 15°, J, VN, Fe+Mn, Sp, Pl, SR					
92	218							9 10	5% vesicles 1-2mm					Record WL inside casing. WL fell from 203.9' bgs to 210.92 bgs in 30 mins End of drilling 12/04/17; begin 12/05/17
								11	11. 5°, J, VN, No, No, Wa, SR					
								12	12. 60°, J, T, Fe, Su, Pl, S					
	219							13	13. 60°, J, T, Fe, Su, Pl, S					
								14	14. 70°, J, VN, Fe+Mn, Su, Ir, R					
									BASALT a'a Clinker					
90	220							IF	Dusky red (2.5YR 3/2) to black (Gley1 2.5/N), angular gravel to cobble size clinker fragments, moderately to highly weathered, weak, permeable				[60]	Record WL at start of shift. DTW=214.57' bgs and falling slowly
									BASALT Pahoehoe					
	221								Dusky red (2.5YR 3/2) to very dark gray (Gley1 3/N),					

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221	221								slightly to moderatel weathered, strong, 40% vesicles 1-3mm, some bentonite on fractures and in vesicles from 220'-222' bgs					Driller added ~150 lbs bentonite powder and 120 gal H2O before start of run.
88	222	48	21	100		34								
	223								1. 0°, J, VN, No, No, Pl, R 2. 0°, J, VN, No, No, Pl, R 3. 75°, J, N, Fe+Mn, Su, Wa, R 4. 0°, J, N, Fe+Mn, Su, Pl, R 5. 90°, J, VN, Fe+Mn, Su, Wa, R 6. 0°, J, VN, Fe+Mn, Su, Wa, R					No WR. Water loss ~250 gal
86	224													
	225												[60]	No WR. Water loss ~350 gal
84	226								vesicles increase to 2-6mm, very dark gray (Gley1 3/N) 1. 5°, J, N, Fe, Su, Wa, R 2. 5°, J, N, Fe+Cl, Sp, Pl, R 3. 50°, J, N, Fe+Cl, Sp, Wa, R IF zone: partial red (2.5YR 4/8) clay fill on fractures					
	227	49	22	100		48			vesicles 1-3mm 4. 30°, J, N, Fe+Mn, Su, Ir, R 5. 30°, J, Vn, Fe+Mn, Su, Pl, SR 6. 30°, J, VN, Fe+Mn, Su, Pl, R 7. 45°, J, VN, Fe+Mn,Cl, Pa, Wa, SR 8. 40°, J, VN, Fe+Mn+Cl, Pa, Wa, SR					
82	228													
	229													
80	230								becomes dusky red (2.5YR 3/2) to very dark gray (Gley1 3/N), moderately weathered 1. 70°, J, N, Fe+Mn+Cl, Sp, Wa, R IF zone: Fe+Mn+Cl 2. 10°, J, N, Fe+Mn+Cl, Pa, Ir, VR 3. 30°, J, VN, Fe+Mn+Cl, Sp, Pl, SR 4. 45°, J, N, Fe+Mn+Cl, Su, Wa, SR 5. 45°, J, N, Fe+Mn+Cl, Su, Wa, SR				[100]	No WR. Water loss ~350 gal
	231													
78	232	50		100		22			moderately to slightly weathered, very dark gray (Gley1 3/N) 6. 45°, J, N, Fe+Mn+Cl, Su, Wa, SR 7. 45°-80°, J, N, Fe+Mn+Cl, Su, Wa SR 8. 15°, J, VN, Fe+Mn+Cl, Su, Ir, R 9. 50°, J. VN, Fe+Mn+Cl, Su, Ir, VR 10. 5°, J, W, Fe+Mn, Su, Ir, R 11. 30°, J, N, Fe+Mn+Cl, Sp, Ir R					
	233													
76	234								becomes dusky red (2.5YR 3/2) to very dark gray (Gley1 3/N), with ropey pahoehoe structure					
	235								IF zone contains clay on fractures				[150]	Driller says possible void ~236'-237'
74	236		23						vesicles 0.5-1mm very dark gray (7.5YR 3/1) to dusky red (2.5YR 3/2) and red (2.5YR 4/8), moderately to highly weathered, weak, friable, intensely fractured, ropey pahoehoe fragments, possible flow margin no recovery/possible void					
	237													

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	SAMPLES PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	237															No WR. Water loss ~350 gal
		51		66		38			no recovery/possible void							
72	238							1	1. 5°, B, W, Cl, Pa, Ir, VR 2. 45°, J, VN, Fe+Mn, Su, Wa, SR very dark gray (Gley1 3/N), slightly weathered, strong, 30-40% vesicles 0.5-2mm							
	239		23					2 3	3. 45°, J, VN, Fe+Mn+Cl, Pa, Pl, SR 20%vesicles 1-4mm, some elongate							
70	240								abrupt change to 50% vesicles 0.5-1mm						[75]	No WR. Water loss ~350 gal
								1 2	1. 0°, J, N, Fe+Mn+Cl, Su, Pl, SR 2. 0°, J, N, Fe+Mn+Cl, Su, Pl, SR 3. 0°, B, N, Fe+Mn+Cl, Pa, St, R 4. 10°, J, N, Cl, Fi, Pl, SR 5. 45°, J, N, Cl, Fi, Ir, SR IF zone contains thick clay							
	241							3	black (Gley1 2.5/N) to dark reddish brown (2.5YR 3/4) flow boundary							
68	242							4 IF 5	dusky red (2.5YR 3/2) to very dark gray (Gley1 3/N), moderately weathered, moderately strong 6. 5°, J, VN, Fe+Mn+Cl, Sp, Wa, R 7. 0°-30°, J, VN, Fe+Mn, Su, Pl, SR							
		52		90		60		6 7								
	243								very dark gray (Gley1 3/N), slightly weathered, vesicles 1-3mm 8. 30°, J, VN, Fe+Mn, Su, Pl, SR 9. 90°, J, VN, Fe+Mn+Cl, Sp, Wa, R							
66	244							8 9								
								NR	no recovery							
	245														[75]	No WR. Water loss ~350 gal
			24					1 2 3	1. 0°, J, VN, Fe+Mn, Su, Pl, SR 2. 90°, J, VN, Fe+Mn, Su, Pl, Sr 3. 0°, J, VN, Fe+Mn, Su, Ir, R							
64	246							M	vesicles 3-15mm							
									large vug							
	247															
		53		100		86		4	vesicles 0.5-2mm 4. 10°, J, VN, No, No, Pl, SR							
62	248															Pause to record DTW inside casing. See field log for details.
								IF	IF zone contains clay on joint surfaces, surfaces highly irregular and rough, possible vug							
	249															
								M								
60	250							M							[150]	No WR
								1	very dark gray (Gley1 3/N), slightly weathered, strong, 40% vesicles grade to 0.5-1mm							
	251							M	gray (Gley1 5/N) flow/alteration boundary							
								2	1-3mm vesicles							
			25					M	50% vesicles, 5mm with yellowish red (5YR 5/8) clay infill, moderately weathered, moderately strong 1. 70°, J, N, Fe+Mn+Cl, Pa, Pl, SR 2. 90°, J, N, Fe+Mn+Cl, Sp, Wa, R 3. 0°, J, T, Fe+Mn, Su, Wa, R							Lost bottom 3' core upon core barrel retrieval. Then recovered rest of core.
58	252															
		54		100		78		3 4	vesicles grade to 0.5mm, slightly weathered, strong							
	253															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 12/2/2019 RHMW15

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
253	253						5							
							6		30% 3-5mm vesicles					
56	254								4. 0°, J, VN, Fe+Mn, Su, Wa, R 5. 0°, J, VN, Fe+Mn, Su, Ir, R 6. 70°, J, T, Fe+Mn, Su, Pl, R 7. 70°, J, T, Fe+Mn, Su, Pl, R					
	255		25				M		no recovery 40% 0.5-1mm vesicles				[100]	
							NR							
54	256						IF		IF zone consists of natural fractures with Fe+Mn surface stains and yellowish red (5YR5/8) clay spotty fill on fracture planes, grayish olive (10Y 5/2) alteration on many fracture planes					
							M		30% 1-5mm vesicles					
	257						1		1. 70°-45°, J, N, Fe+Mn, Su, Wa, SR 2. 45°, J, VN, Fe+Mn+Cl, Sp, Pl, SR 3. 20°-45°, J, T, Fe+Mn, Su, Wa, SR 4. 70°, J, MN, Fe+Mn+Cl, Pa, Ir, SR 5. 45°, J, MN, Fe+Mn+Cl, Pa, Ir, SR 6. 20°, J, VN, Fe+Mn+Cl, Sp, Pl, R					
		55		88		62	2							
52	258						3							
							4							
	259						5		40% 0.5-1mm vesicles					
							M		30% 1-3mm vesicles					
50	260		26				6						[60]	
							M		10% 2-5mm vesicles 40% 0.5-1mm vesicles 25% 1-5mm vesicles					
	261						1		5% 3-10mm vesicles					
48	262								30% 1-3mm vesicles					
		56		100		78								
	263								40% 0.5-1mm vesicles					Measure DTW. WL fell from 255.93' bgs to 256.06' bgs in 45 mins
							2							
46	264						3		40% 1-3mm vesicles					End of drilling 12/05/17
							4							
							5		1. 90°, J,V N, Fe+Mn+Cl, Pa, SR 2. 20°, J, T, Fe+Mn+Cl, Sp, Pl, R 3. 70°, J, N, Fe+Mn+Cl, Pa, Pl, R 4. 45°, J, VN, Fe+Mn+Cl, Sp, Pl, R 5. 90°, J, VN, Fe+Mn+Cl, Pa, Wa, R 6. 5°, J, N, Fe+Mn+Cl, Pa, Pl, R 7. 10°, J, N?, Fe+Mn+Cl, Pa, Pl, R IF. 0°-90°, J, VN, Fe+Mn+Cl, Pa, Pl-Ir, R					
							IF							
							6							
							7							
	265												[60]	Resume coring 7/1/19, clear out bentonite plug 255' to 265' bgs from 0851 - 0916
44	266								**BASALT - a'a' Clinker** partially cemented clasts, very dark gray (5YR 3/1) reddish brown (5YR 4/3), clay - reddish yellow (5YR 6/8) moderately weathered, medium strong. 1. 0°, J, VN, No, No, Wa, SR 2. 0°, J, VN, No, No, Wa, SR 3. 10°, J, VN, No, No, Wa, R 4. 20°, J, VN, No, No, Wa, R					
			27				1							WL = ~500 gals, No WR, Lost circulation.
	267						2							
		57		100		66	3							Reamed to 265' bgs with 9 7/8" on 2/11/18, set 5" steel conductor casing to 265' and grout on 2/12/18.
42	268						4		becomes loose clinker, rounded to subrounded clasts					
			28				IF							
	269						5							

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
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Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269															
40	270		28				6 M 1 2		**BASALT - Massive a'a'** very dark gray (5YR 3/1), moderately to slightly weathered, strong, 5% 1-10mm irregular, some elongate vesicles, partially infilled with reddish yellow (5YR 6/8) clay. 5. 45°, J, VN, Clay, Sp, Wa+St, SR 6. 0°, J, VN, Clay, Sp, Pl, S 1. 45°, J, VN, Mn+Fe+Clay, Sp, Wa, SR 2. 20°, J, VN, Mn+Fe, Sp, Clay, Su, Wa, S						[21.82]	WL = 1000 gals pause to dredge out mud pan. Ran out of water. Pause at 0938, resume at 0954. WR light gray only go to 274'
	271															
38	272	58		100		12.5			**BASALT - a'a' Clinker** loose, subangular to subrounded clasts, very dark gray (5YR 3/1), clay - reddsh yellow (5YR 6/6) moderately to highly weathered, medium strong, clay coating on most clasts.							
	273															Pause to monitor WL (4ft run per driller)
36	274		29						**BASALT - Massive a'a'** black (GLEY1 2.5/N) slightly weathered, strong, 5% 1-5mm subrounded, elongate vesicles. 1. 50°, J, VN, Mn+Fe+Clay, Sp, Wa, S 2. 30°, J, VN, Mn+Fe+Clay, Sp, Wa, S 3. 30°, J, VN, Mn+Fe+Clay, Sp + Su, Wa, S 4. 30°, J, VN, Mn+Fe+Clay, Sp + Su, Wa, S						[21.82]	
	275						M IF 1		← · becomes 10% 2-35mm subrounded irregular, elongate vesicles							Disconnect GAC, light grayish brown WR + WL
34	276	59		100		82.5										
	277						M 2		← vug ~ 35mm x 50mm, partially infilled with reddish yellow (5YR 6/8) clay							
32	278		30				3 4 M									
	279	60		100		20	M		**BASALT - a'a' Clinker** loose, very dark gray (GLEY1 3/N) clay - yellowish red (5YR 3/8), moderately weathered, medium strong, mostly clay coated rounded to subangular.						[20]	WL = 1000 gal - light gray brown WR
30	280						NR		no recovery						[37.5]	
	281		31						← becomes highly weathered, very weak, very broken up							
28	282	61		94		26	1		**BASALT - Pahoehoe** very dark gray (GLEY1 3/N), slightly weathered, strong, 10% 1-10mm rounded to subangular vesicles, paritally infilled with clay. heat alteration, possible flow contact, brown (7.5YR 5/3) and yellow (10YR 7/6) at 282.4' very dark gray (7.5YR 3/1) slightly to moderately weathered, medium to strong, 15% <2mm rounded vesicle at 282.5'. IF pieces: Mn+Fe, Sp, clay, Su 1. 45°, J, VN, Mn+Fe Sp, Clay, Su, St, SR 2. 20°, J, VN, Mn+Fe+Clay, Sp, Wa, SR 3. 50°, J, VN, Mn+Fe+Clay, Sp, St, SR							
	283						IF IF									
26	284		32				2 1		← heat alteration, black (GLEY N/1), yellow (10YR 7/6)							
	285						4									

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
24	285								dark brown (7.5YR 4/3), slightly weathered moderate strength, 20% <2mm rounded vesicles				[50]	High pressure water came out when pulling drill rod up. Drilling paused 1340 barrel came loose.
	286		33				M IF		· very dark gray (7.5YR 3/1), slightly weathered moderate strength, 15% <2mm rounded vesicles M+IF pieces angled and rounded from mechanical					
22	287	62		60		8	M IF							WR, WL = 100 gal Could not get WL because pulled casing - drilling paused WL-170-38 @288 ft bgs.
	288													
20	289						M + IF		· becomes yellowish red (5YR 4/6), black (5YR 2.5/1), moderate strength, 20% <1mm rounded vesicles.					
	290		34						1. 90°, J, VN, Mn+Fe, Sp, Wa, SR 2. 5°, J, VN, No, No, St, R				[42.86]	Resume on 7/2/19 at 0647, 288ft bgs 288-390 WL = 500gal, no WR
	291						M + IF							
18	292	63		100		40	1		flow contact, dark reddish browh (2.5YR 3/4) · 40% 2-10mm subrounded vesicles black (7.5YR 2.5/1), slightly weathered strong, 10% <2mm subrounded vesicles					
	293								becomes 20% <2mm subrounded vesicles					WL = 500gal, No WR, Lost circulation
16	294						2							
	295						IF		·dark reddish brown (5YR 3/3) and black (5/YR 2.5/1) ropey texture, moderately weathered, moderate strength, 15% <2mm subrounded vesicles.					
			35						· black (7.5YR 2.5/1), slightly weathered strong, 10%, 1-5mm subrounded vesicles.				[100]	
14	296						1							
	297	64		76		26			· ropey texture visible near end of core. Highly weathered, very weak, broken up pieces dark reddish brown (5YR 3/4), dark reddish brown (5YR 3/2), black (2.5YR 2/1), ground up, angled and rounded pieces. 1. 90°, J, VN, Mn+Fe+clay, Sp, Pl, SR					Void - per driller, WL = 300 gals
12	298						IF							
	299		36				NR		no recovery					
10	300												[20]	
	301						IF							

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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	301															
8	302	65	36	86		0										WL = 300gal, No WR for rest of log
	303						IF									
6	304															
	305														[42.86]	
4	306						IF									
	307															WL = 400 gal
2	308	66	37	44		0										
	309						NR		no recovery							
0	310							1	ropey texture, possible flow contact yellowish brown (10YR 5/4), becomes black (7.5YR 2.5/1), slightly weathered, strong, 5% 2-20mm subrounded to subangular, elongate vesicles, 2% weathered olivine						[75]	
	311							2								
-2	312	67		100		0		3	· becomes intensely fractured/broken up, black (7.5YR 2.5/1), dark reddish brown (5YR 3/4), highly weathered, weak							WL = 300 gal
	313						IF		1. 0°, J, VN, Mn< Fe, SP, St, SR 2. 80°, J, VN, Mn, Fe, Sp, Wa, SR 3. 5°, J, VN, Mn, Fe, Sp, Wa, SR							
-4	314		38													
	315								·black (7.5YR 2.5/1), slightly weathered, strong, 5% 1-5mm rounded to subrounded vesicles						[150]	
							IF		·reddish brosh (5YR 4/1), moderately weathered, medium strong, 10% <2mm rounded vesicles							
-6	316							1	· black (7.5YR 2.5/1), slightly weathered, strong, 15% <4mm rounded vesicles, 2% weathered olivine							WL = 300 gal
	317							2	1. 40°, J, VN, Mn, Fe, Sp, Wa, SR 2. 0°, J, VN, No, No, Wa, R							

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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	317								3. 80°, J, VN, Mn, Fe, Sp, Wa, R					
		68		100		30			· 10% 2-10mm subrounded to subangular vesicles					
							3		· 15% <4mm rounded vesicles					
-8	318		39				4							
							IF		4. 5°, J, VN, clay, Sp, Wa, R					
	319													
									· intensely fractured ropey textured pieces, becomes black (7.5YR 2.5/1), brown (7.5YR 4/2), moderately weathered, medium strong, 10% <2mm rounded vesicles					
-10	320						IF							
									no recovery				[100]	
							NR		black (10YR 2.5/1), moderately weathered, strong, 15% 2-10mm subangular vesicles partially infilled with yellowish red (5YR 5/8) clay, slightly weathered, strong, 10% 1-15mm rounded to subrounded vesicles at 321.5					
	321						1							
			40						1. 5°, J, VN, clay, Sp, Wa, SR					
-12	322								5% <4mm rounded vesicles					WL = 300 gal
		69		88		62	2							
							IF		IF pieces: covered with yellowish red (5YR 5/8) clay					
	323								2. 90°, J, VN, Mn+Fe+clay, Sp, St, SR					
									becomes very dusly red (2.5YR 2.5/2)					
							3							
									possible flow contact red (2.5YR 4/6)					
-14	324								black (10YR 2.5/1) unweathered, strong, 20% <1mm rounded vesicles					
									5% 1-4mm rounded to subrounded vesicles					
									15% 2-5mm rounded to subrounded vesicles partially infilled with yellowish red (5YR 5/6) clay					
	325												[50]	
			41				1		2% 3-10mm subrounded vesicles					
									5% 1-4mm rounded vesicles					
-16	326								2% 3-10mm subrounded vesicles					
									1. 75°, J, VN, clay, Sp, Wa, SR					
									2. 65°, J, VN, clay, Sp, Wa, SR					
	327						M							
							M		black (7.5YR 2.5/1), slightly weathered, strong, 2% <2mm rounded to subrounded vesicles, 1% unweathered olivine					WL = 300 gal - High pressure when retrieving barrel, water release.
		70		100		94								
-18	328													
									black (10YR 2.5/1), slightly weathered, strong, 5% 2-10mm rounded to subrounded vesicles					
							2							
	329		42											
									15% 4mm rounded vesicles partially infilled with clay					
-20	330						IF		yellowish red (5YR 5/8)				[50]	
									dark reddish brown (2.5YR 3/4), unweathered, strong, 15% <2mm subrounded to subangular vesicles					
							1							
	331								possible flow contact/heat alteration red (2.5YR 4/6)					
									black (10YR 2.5/1) unweathered, strong, 15% <2mm rounded vesicles					
			43				2							
							3							WL = 400 gal
-22	332						4		10% 2-8mm subrounded vesicles					
							5							
		71		102		66	6							
							7		red (2.5YR 4/6) slightly weathered, strong, 10% <1mm rounded vesicles					
	333													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 12/2/2019 RHMW15

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
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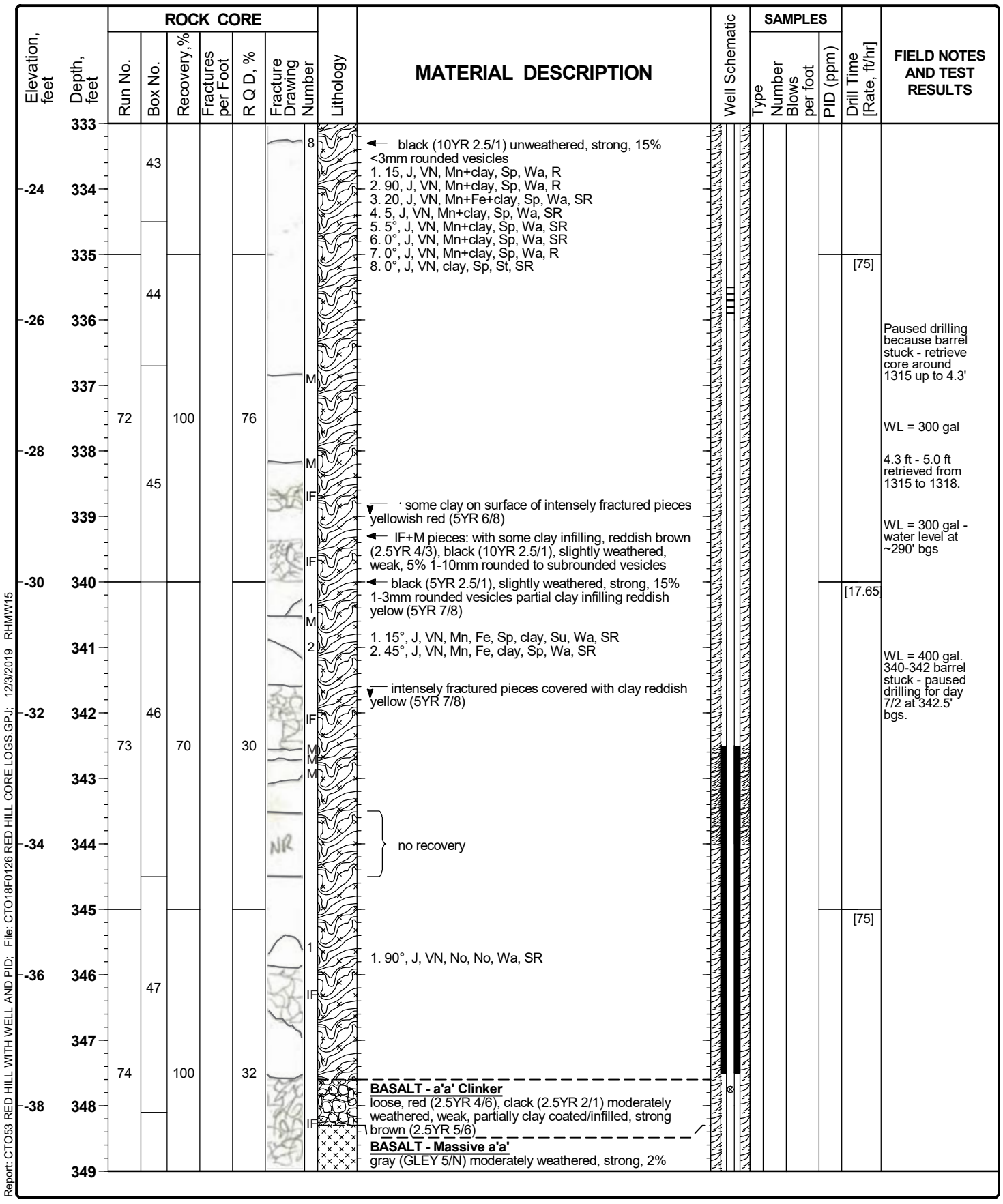
Log of Boring RHMW15



Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 12/3/2019 RHMW15

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	349						IF		irregular, elongate vesicles, yellowish red (5YR 5/8) clay coating on some pieces					
-40	350		48										[30]	
	351													WL = 450 gal
							1		1. 40°, J, VN, clay, Su, Wa, SR					
-42	352	75		60		10	M							
	353													
							NR		no recovery					
-44	354		49											
	355								same as above				[42.856]	
-46	356						IF							
	357						IF & M							WL = 450 gal - high pressure release when barrel pulled out.
-48	358	76		100		56			becomes 10% 1-10mm elongate irregular vesicles becomes 5% 6mm elongate irregular vesicles, some 10x10mm					
							1		1. 85°, J, VN, Mn+clay, Sp, Pl, S 2. 5°, J, VN, MN, clay, Sp, Wa, S IF pieces: yellowish red (5YR5/8) clay on most pieces					
	359		50				IF & M		becomes black (7.5YR 2.5/1), slightly weathered, strong, 10% 2-20mm subrounded to elongate vesicles					
-50	360						M						[42.86]	
							2							
	361						1		1. 10°, J, VN, clay, Sp, St, SR 2. 0°, J, VN, Mn, Sp, St, SR 3. 5°, J, VN, Mn+clay, Sp, St, S 4. 0°, J, Vn, Mn+clay, Sp, St, S 5. 45°, J, Vn, Mn+Fe, Sp, Wa, S 6. 45°, J, VN, Mn+Fe+clay, Sp, St, S 7. 85°, J, VN, Mn+Fe+clay, Sp, St, S					
							2							
							3							
-52	362		51				M							
		77		100		52	4							WL = 450 gal
							5							
	363						6							
							M		10x70mm vug					
-54	364						7							
			52				M							
	365													

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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	365						IF		IF pieces: Fe+Mn+clay, Sp				[37.5]	
-56	366		52											
	367	78		104		28	IF							WL = 450 gal
-58	368								IF pieces: yellowish red (5YR 6/8) clay Sp, Su, Mn+Fe, Sp					
	369		53				IF							
-60	370						1		becomes gray (GLEY1 5/N) slightly weathered, very strong, 2% 1-5mm subrounded - subangular vesicles. 1. 20°, J, VN, clay+Mn, Sp, Wa, SR				[60]	
	371						M		**BASALT - a'a' Clinker** loose, red (2.5YR 4/6), black (2.5YR 2/1) dark reddish brown (2.5YR 3/4), clay coating on most pieces, reddish yellow (5YR 7/6) moderately weathered, medium strong.					
-62	372						1		**BASALT - Pahoehoe** black (5YR 2.5/1) dark reddish brown (5YR 3/4) along fractures, moderately weathered,medium strong, 10% 3/20mm subrounded to subangular vesicles.					WL = 450 gal
	373	79	54	100		10	2 3 4		dark gray (5YR 4/1) moderately to slightly weathered, moderate strength, 5% 2-20mm subrounded vesicles					DTW - 289.7 ft bgs, drilling paused on 7/3/19 at 375' bgs.
-64	374						5 6		1. 85°, J, VN, clay+Mn+Fe, Sp, Su, Wa, SR 2. 45°, J, VN, Fe+Mn, Sp, Wa, SR					
	375						IF		dark reddish brown (5YR 3/3) moderately weathered, medium strong, 20%<2mm rounded vesicles, partially infilled with reddish yellow (7.5YR 6/6) clay				[60]	Resume coring on 7/8/19 - DTW = 290.01' bgs.
-66	376						1		3. 45°, J, NV, Fe+Mn, Sp, Wa, SR 4. 10°, J, VN, Mn+Fe, Sp, Wa, S 5. 5°, J, VN, Mn+Fe, Sp, clay, Su, Wa, S 6. 20°, J, VN, Mn+Fe+clay, Sp, Wa, S					
	377		55				2		becomes very dusky red (2.5YR 2.5/1) moderately weathered, moderate strength					
		80		100		50			becomes very dark brown (10YR 2/2) slightly weathered, strong, 18% 2-15mm rounded vesicles					WL = 300 gals, paused to replace piece that connects barrel.
-68	378						IF		becomes black (2.5YR 2.5/1) slightly weathered, strong, 15% <10mm irregular vesicles					
	379						3 4		becomes 10% 2-15mm rounded vesicles, 2% >30mm rounded vesicles. reddish yellow (5YR 7/8) clay infill. 1. 75°, J, VN, Clay, Fe, Su, St, R 2. 5°, J, VN, Clay, Sp, Wa, SR 3. 5°, J, VN, Clay, Fe, Sp, St, VR 4. 60°, J, VN, No, Wa, SR					
-70	380		56										[75]	
	381													

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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	381								becomes 25% <2mm rounded vesicles					
							1		possible flow contact - becomes very dark gray (5YR 3/1) moderately weathered, medium strong, 25% <2mm rounded vesicles					
-72	382						2		becomes very dark gray (10YR 3/1) slightly weathered, strong 15% 1-5mm subrounded to rounded vesicles					
		81		100		56	3							WL = 250 gal, slight pressure release when lifting barrel out.
	383						IF		1. 20°, J, VN, Clay, Sp, Wa, SR 2. 0°, J, VN, Clay, Su, Wa, S 3. 90°, J, VN, Clay, Sp, Wa, S					
			57											
-74	384								becomes 20% <3mm rounded to subrounded vesicles					
									becomes slightly weathered, moderate strength, 20% 2-8mm rounded to subrounded vesicles					
	385						1		1. 85°, J, VN, Clay, Sp, St, SR 2. 30°, J, VN, Clay, Sp, Wa, SR 3. 5°, J, N, Clay, Sp, St, SR 4. 90°, J, VN, Mn, Clay, Sp, Wa, S 5. 20°, J, VN, Clay, Sp, Wa, SR 6. 0°, J, VN, Clay, Sp, Wa, S				[21.43]	
							2							
-76	386						3							
	387		58						becomes dark reddish gray (2.5YR 2/1) slightly weathered, moderate strength, 20% <2mm rounded vesicles					WL = 200 gal
		82		102		64	IF							
-78	388								becomes very dark gray (10YR 3/1) slightly weathered, strong 15% 2-5mm subrounded vesicles					
							4							
	389						5		becomes 5% 3-5mm rounded to subrounded vesicles, 2% 20-28mm vugs					
							6							
-80	390												[75]	
			59				M		becomes 10% 1-4mm rounded vesicles partially infilled with red (2.5YR 5/5) clay					
	391						1 M							
-82	392						2		becomes reddish black (2.5YR 2.5/1) slightly weathered, strong, 20% <2mm rounded vesicles					WL = 200 gal
		83		90		64	3							
	393								1. 40°, J, VN, Mn, Fe, Sp, Clay, Su, Wa, S, Clay = (2.5YR 5/8) 2. 0°, J, VN, Clay, Sp, Wa, SR 3. 45°, J, VN, Clay, Sp, Wa, SR 4. 5°, J, VN, Clay, Sp, Wa, SR					
-84	394		60				4							
							NR		no recovery					
	395						IF		black (10YR 2/1) moderately weathered, strong, 15% 5-10mm subrounded vesicles, partially infilled with reddish yellow (7.5YR 6/8) clay				[75]	
							1							
-86	396								1. 90°, J, VN, Clay, Su, Wa, SR 2. 5°, J, Vn, Clay, Sp, Wa, SR 3. 10°, J, VN, Clay, Sp, Wa, SR 4. 65°, J, VN, Clay, Sp, Wa, SR					WL = 200 gal
			61				2							
	397						3							

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	397													
		84		66		0	4		**BASALT - a'a' Clinker** loose, dark reddish brown (5YR 2.5/1) reddish brown (2.5YR 5/4), dark reddish gray (5YR 4/2) some clay coated pieces reddish yellow 5YR 6/8) moderately weathered, medium strong, subangular to subrounded.					
-88	398													Driller notes presence of voids
	399													
-90	400		61										[50]	
	401						NR		no recovery					Driller notes presence of voids
-92	402													WL = 250 gal
		85		24		0								
	403													
-94	404													
	405								**BASALT - Massive a'a'** very dark gray (10YR 3/1), slightly weathered, strong, 3% <1mm - 25mm angular to subrounded, elongate vesicles.				[50]	
-96	406		62				IF							
							1		1. 5°, J, VN, No, No, Wa, SR					
							2		2. 0°, J, VN, No, No, Wa, SR					
	407													WL = 300 gal
		86		92		8	IF							
-98	408						IF		· becomes 5% 1-30mm subrounded, irregular, elongate vesicles.					
							M							
	409						M							
									no recovery					
-100	410		63										[27.27]	High pressure release when barrel comes up
							IF		1. 10°, J, VN, No, No, Wa, S 2. 0°, J, VN, No, No, Wa, S 3. 0°, J, VN, Mn, Sp, Wa, S					
	411						M		4. 30°, J, VN, Mn, Su, Wa, S					
							M		5. 0°, K, VN, No, No, Wa, SR					
-102	412						M							
							1							
		87		96		52			· becomes 3% 1-15mm elongate irregular vesicles					
	413						2							

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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	413						IF							
-104	414		64				3 4 5							
	415						M		no recovery				[50]	WL = 300 gal, change shoe - very high pressure release. Barrel stuck, trip pipe 20' to retrieve core.
-106	416						M							
	417	88		60		30			**BASALT - a'a' Clinker** loose, reddish black (2.5YR 2.5/1) reddish brown (2.5YR 4/4) subrounded/smooth pieces, weathered, weak, some peices 10% olivine slightly weathered, 3mm. 1. 5°, J, VN, No, No, St, SR					
-108	418		65				NR		no recovery					
	419													
-110	420						1		**BASALT - Pahoehoe** dark reddish brown (5YR 3/3), moderately weathered, medium strong, 5% <10mm subrounded - subangular vesicles, 10% 3-8mm, moderately weathered olivine phenocrysts.				[60]	
	421						IF 1		very dark gray (10R 3/1) slightly weathered, medium strong, 5% 1-5mm subangular to subrounded vesicles, partially infilled.					WL = 300 gal, some clinker pieces from above fell down from when tripping the pipe 20' in IF zone at top
-112	422						2 3		1. 15°, J, VN, Clay, Sp, Wa, SR 2. 60°, J, VN, Clay, Sp, Wa, SR 3. 20°, J VN, Mn, Fe, Sp, Clay, Su, Wa, SR					
	423	89		94		62	4 5		4. 90°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 5. 0°, J, VN, Mn, Sp, St, SR 6. 10°, J, VN, Mn, Sp, Wa, R 7. 5°, J, VN, Mn, Clay, Sp, Wa, R					
-114	424						6 7		very dusky red (2.5YR 2.5/2) moderately weathered, medium strong, 10% 1-5mm irregular, subrounded, subangular vesicles, 15% 1-4mm unweathered olivine					
	425		66				IF		very dark gray (10YR 3/1) slightly weathered, medium strong, 5% 2-10mm subrounded to subangular vesicles. 10% 3-8mm unweathered olivine				[42.86]	
-116	426						NR		no recovery					
	427								1. 5°, J, VN, No, No, St, S 2. 90°, J, VN, Mn, Sp, Wa, S 3. 50°, J ,VN, Mn, Fe, Sp, Pl, S					
		90		74		8	IF		IF pieces: dark reddish gray (2.5YR 3/1) dark reddish brown (2.5YR 3/4) very dark gray (10YR 3/1) slightly weathered, medium strong, 5% 1-4mm subangular to subrounded vesicles.					WL = 300 gal
-118	428								becomes black (GLEY1 2.5/N) slightly weathered, strong 5% 1-12mm vesicles, 2% 1-8mm slightly weathered olivine.					
	429		67				1 2							

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Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	429															
-120	430						M 3								[75]	Pull pipe to switch but and adjust setup, pause drilling 7/8/19
	431		67				NR		no recovery							Resume coring on 7/9/19 at 0657. Jaws stuck, trip pipe, core retrieved on 7/10/19
-122	432	91		34		16										
	433															WL = 300 gal
-124	434								**BASALT - a'a' Clinker** subrounded fracgments, black (GLEY 2.5/N), dark reddish brown (5YR 3/4) reddish brown (2.5YR 4/4) some pieces 10% 4mm, unweathered olivine phenocrysts.							
	435								**BASALT - Massive a'a'** black (GLEY1 2.5/N) slightly weathered, strong to v.strong 2% <1mm vesicles, 2%, 1-4mm weathered olivine phenocrysts						[27.27]	Resume coring 7/10/19 at 1050
-126	436								**BASALT - a'a' Clinker** loose, subrounded fragments reddish brown (5YR 3/4) dark reddish brown (5YR 3/2), black (?2.5 Y/1), some reddish yellow (5YR 6/8) clay coated pieces							
			68				1		**BASALT - Massive a'a'** gray (GLEY1 5/N) slightly weathered, strong, 3% <3mm subrounded to subangular vesicles. 1% weathered olivine phenocrysts							
	437						2 3 4 5 6 7 8		1. 0°, J, VN, Clay, Sp, St, S 2. 0°, J, VN, Clay, Sp, St, S 3. 90°, J, VN, Mn, Fe, Sp + Su, Pl, S becomes 5% <1mm to 18mm elongate subrounded and irregular vesicles, with 1% weathered olivine. 4. 25°, J, VN, Mn, Clay, Sp, Wa, S 5. 45°, J, VN, Mn, SP, Wa, S 6. 90°, J, VN, Clay, Sp, Wa, S 7. 10°, J, VN, Clay, Mn, Sp, St, S 8. 5°, J, VN, Mn, Clay, Sp, Wa, S							WL = 500 gal
-128	438	92		100		10										
	439						IF									
-130	440		69						1. 0°, J, VN, Mn, Sp, Clay, Su, St, SR 2. 0°, J, VN, Mn, Sp, St, R 3. 90°, J, VN, Mn, Fe, Sp, Wa, SR 4. 5°, J, VN, Mn, Fe, Sp, Clay, Su, Wa, SR 5. 90°, J, VN, Clay, Sp, Wa, S 6. 0°, J, VN, Clay, Sp, Wa, SR					[21.43]	
	441						IF 1									
-132	442						2 3 4 5 6									
	443	93		100		42										WL = 500 gal
			70						**BASALT - a'a' Clinker** some loose some welded, brown (7.5 YR 4/3), black (7.5YR 2.5/1), reddish yellow (5YR 6/8)							
-134	444						IF 1		**BASALT - Pahoehoe** possible heat alteration/flow contact. red (10R 5/8) 5mm wide 1. 20°, J, VN, No, No, Wa, SR							
	445															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	445						1		reddish brown (5YR 4/3) slightly weathered, strong, 20% <2mm rounded to subrounded vesicles.				[60]	
							2		1. 5°, J, VN, Mn, Sp, Wa, SR 2. 0°, J, VN, Mn, Clay, Sp, Wa, SR					
-136	446						3		3. 20°, J, VN, Clay, Mn, Fe, Sp, Wa, SR					
							4		4. 0°, J, VN, Clay, Mn, Fe, Sp, IR, SR					
			71				5		becomes black (7.5YR 2.5/1) slightly weathered to unweathered, strong to very strong, 15% <1-6mm subrounded vesicles					
	447								5. 20°, J, VN, Clay, Mn, Fe, Sp, St, SR					WL = 500 gal
		94		106		32			becomes 20% <2mm rounded to subrounded vesicles.					
-138	448						IF		6. 50°, J, VN, Clay, Sp, Wa, R 7. 90°, J, VN, Clay, Sp, Wa, R 8. 0°, J, VN, Clay, Sp, Wa, R 9. 5°, J, VN, Clay, Halloysite, Mn, Fe, St, SR					
	449								becomes dark reddish gray (2.5YR 3/1) slightly weathered, strong to very strong 15% 1-3mm rounded vesicles					
							6							
							7							
							8							
-140	450		72				9		1. 5°, J, VN, Mn, Fe, Sp, St, SR 2. 20°, J, VN, Mn, Fe, Clay, Sp, Wa, SR 3. 15°, J, VN, Mn, Clay, Sp, Pl, SR				[37.5]	
							M							
	451						1		alteration - yellowish red (5YR 4/6)					
							2							
-142	452								black (5YR 2.5/1) and yellowish red (5YR 4/6) slightly weathered, strong, 10% <2mm rounded vesicles					WL = 500 gal
		95		100		70	IF		4. 30°, J, VN, Mn, Sp, Pl SR 5. 45°, J, VN, Mn, Fe, Sp, Wa, SR					
	453						3							
			73						very dark gray (10YR 3/1) unweathered, very strong 15% <1mm subrounded to rounded vesicles. becomes 10% 2-6mm subrounded to rounded vesicles at 453.5'.					
-144	454													
							4							
							5		· reddish black (2.5YR 2.5/1) unweathered, very strong 20% <2mm rounded to subrounded vesicles					
	455						IF		1. 20°, J, VN, No, No, St, R 2. 10°, J, VN, No, No, St, R				[75]	
-146	456								gray (5YR 5/1) slightly weathered, strong, 25% 1-5mm subrounded vesicles. black (5YR 2.5/1) slightly weathered, strong, 20% 1-4mm rounded vesicles at 456.1'.					
			74						gray (GLEY 5/1) slightly weathered, strong 15% <3mm subrounded vesicles, some reddish yellow (7.5YR 7/8) clay infill. becomes very dark gray (10YR 3/1) slightly weathered, strong, 5% 3-18mm subrounded vesicles at 456.9'. becomes 15% 2-4mm rounded vesicles at 457.4'.					
	457						1							WL = 500 gal
		96		96		66								
-148	458						2		dark reddish gray (2.5YR 3/1) and reddish brown (2.5YR 4/4) slightly weathered, strong, 20% <3mm rounded to subrounded vesicles					
	459													
							IF		IF pieces: reddish brown (5YR 4/3) Mn+Fe, Su, pale brown (3.5Y 8/4) clay, Sp, white (2.5YR 5/1) halocite, Sp					
			75											
-150	460						NR		no recovery				[60]	
							IF							
	461								**BASALT - a'a' Clinker**					

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Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	461								loose, red (2.5YR 4/6), dark reddish brown (2.5YR 3/4) subrounded clasts.					
-152	462						IF		**BASALT - Massive a'a'** gray (GLEY 5/1) slightly weathered, strong, 5% 1-6mm rounded - subrounded vesicles.					WL = 500 gal
		97	75	70		8			**BASALT - a'a' Clinker** loose dark reddish brown (5YR 3/3) reddish black (2.5YR 2.5/1) dark gray (5YR 4/1) subrounded to subangular clasts.					
	463													
-154	464						NR							
	465								no recovery				[37.5]	
-156	466													
	467													WL = 500 gal
		98	76	76		12								
-158	468													Paused coring on 7/10/19 - DTW =290.51' bgs.
	469						1		**BASALT - Massive a'a'** gray (GLEY 5/1) moderately to slightly weathered, strong, 10% 3-10mm irregular, elongate, subrounded vesicles. 2% 15-60mm vugs.					
							2		1. 30°, J ,VN, Fe, Mn, Sp, Wa, SR					
							3		2. 20°, J, VN, Fe, Mn, Sp, Wa, SR					
									3. 10°, J, VN, Fe, Mn, Sp, Wa, SR					
-160	470								**BASALT - a'a' Clinker** welded, dark reddish brown (2.5YR 3/4) dark reddish gray (2.5YR 4/1)				[100]	Resume coring on 7/11/19
							1		**BASALT - Pahoehoe** yellowish red (5YR 4/6), slightly weathered, strong, 20% <1mm round vesicles at 470'. becomes dark reddish brown (5YR 3/1) slightly weathered, very strong, 20% 1-3mm rounded to subrounded vesicles at 472'. heat alteration / possible flow contact, brown (7.5YR 5/4) and very dark gray (GLEY1 3/N) at 470.7'. at dark reddish brown (5YR 3/2) slightly weathered, strong, 20% 1-4mm rounded to subrounded vesicles 470.8'. becomes 15% 2-6mm rounded to subrounded vesicles at 471.6'. becomes black (7.5YR 2.5/1) unweathered, very strong 15% <2mm rounded vesicles at 471.8'. becomes dark reddish brown (2.5YR 3/4) unweathered, very strong, 20% <2mm rounded to subrounded vesicles at 472.9'.					
	471						2							
							3							
-162	472		77				4							WL = 400 gal
		99		100		50	5							
	473						6							
-164	474						IF		IF pieces: flow texture present 1. 45°, J, VN, Mn, Sp, Wa, SR 2. 5°, J, VN, Clay, Sp, Wa, R 3. 0°, J ,VN, Clay, Sp, IR, R 4. 15°, J, VN, Clay, Sp, Wa, SR 5. 50°, J, VN, No, No, Wa, SR 6. 0°, J, VN, Mn, Fe, St, SR					
	475								black (7.5YR 2.5/1) moderately weathered, moderate strength, 5% 2-10mm subrounded to rounded vesicles, oxidized faces Mn				[37.5]	
-166	476		78				IF							WL = 500 gal - high water pressure release when pulling inner
	477													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	477													barrel out.
		100		100		0			black (5YR 2.5/1) slightly weathered, moderate strength, 5-10% <4mm rounded vesicles. very shark angled fragments					
-168	478						IF							
	479		79											
-170	480												[100]	
	481								**BASALT - a'a' Clinker** loose, dark reddish brown (5YR 3/2), very dark gray (5YR 3/1) moderately weathered, halloysite SP +Su on some clasts.					
									BASALT - Massive a'a' black (GLEY1 2.5/N) slightly weathered, strong, 15% 1-10mm subangular, irregular vesicles. clay on IF pieces surfaces					
-172	482						IF		becomes very dark gray (GLEY 3/N) unweathered, very strong, 10% 1-8mm subrounded to subangular, irregular/elongate vesicles, no clay on IF pieces/ surfaces					WL = 500 gal - high water pressure release when pulling inner barrel out.
		101		106		24								
	483		80											
-174	484								**BASALT - a'a' Clinker** loose, reddish brown (5YR 4/3), dusky red (10R 3/4), dark reddish brown (5YR 3/2), black (5YR 2.5/1), moderately weathered, subrounded, some ground up.					
	485						IF		**BASALT - Pahoehoe** very dark gray (5YR 3/1) moderately weathered, medium strong, 2% 1-5mm subrounded vesicles, halocite infilling some vesicels.				[37.5]	
							IF							
-176	486		81						becomes very dark gray (5YR 3/1) slightly weathered, strong, 15% <2mm rounded to subrounded vesicles					
							1		1. 0°, J, VN, No, No, St, SR 1. 25°, J, VN, No, No, Wa, R					
	487								thermal alteration / flow contact					WL = 500 gal - high water pressure release when pulling inner barrel out.
		102		100		32			**BASALT - a'a' Clinker** loose, red(10R 4/8), reddish black (10R 2.5/1), dark reddish brown (2.5YR 3/4)					
-178	488								becomes welded dark reddish gray (5YR 4/2) very dark gray (5YR 3/1), black (10YR 2/1) moderately weathered, medium strong to weak, yellowish red (5YR 5/8) clay infilling voids and vesicles					
	489													
-180	490		82				1		1. 5°, J, VN, Clay, Sp, Wa, SR				[27.27]	
							2		2. 0°, J, VN, Clay, Sp, IR, SR					WL = 500 gal - bentonite from old rod that had bentonite in it?
							3		3. 0°, J, VN, Clay, Sp, Wa, SR					
	491								4. 0°, J, VN, Clay, Sp, Wa, SR					
							4		5. 5°, J, VN, Clay, Sp, IR, SR					
									6. 0°, J, VN, Clay, Sp, Wa, SR					
							5		7. 10°, J, VN, Clay, SP, Wa, SR					
-182	492						6							
		103		94		60			basalt boulder, very dark gray (10YR 3/1) slightly weathered, medium strong					
	493						7							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	493													
-184	494		83						← become loose clasts · becomes welded clasts dark gray (GLEY1 4/N) moderately weathered, strong, 5% 1-8mm subrounded, elongate, irregular vesicles, partially infilled with yellowish red (5YR 6/8) clay and dark reddish gray (5YR 4/2) pieces no recovery					
	495												[27.27]	
-186	496							1	1. 0°, J, VN, Clay, SP, IR, SR 2. 90°, J, VN, Clay, Sp, Su, Wa, S 3. 10°, J, VN, Mn, Clay, Sp, Wa, SR 4. 80°, J, VN, Mn, Sp, Wa, S 5. 0°, J, VN, Mn, Sp, Clay, Sp, Su, Wa, S					
	497	104		100		80		2						WL = 600 gal
-188	498		84					3 4 5	**BASALT - Massive a'a'** gray (GLEY1 5/N) moderately weathered, strong, 5% 1-18mm elongate, irregular vesicles.					
	499													
-190	500								← IF pieces: surface covered in reddish yellow (5YR 6/3) clay, some oxidation on fracture surfaces				[20]	
	501							IF	1. 5°, J, VN, Clay, Sp, Wa, S 2. 0°, J, VN, Mn, Sp, Wa, S 3. 0°, J, VN, Clay, Sp, Su, Mn, Sp, Wa, S					
-192	502		85											
	503	105		96		44		1 2 3						WL = 600 gal - high water pressure release when pulling inner barrel out.
-194	504													
	505								**BASALT - a'a' Clinker** welded, dark reddish brown (5YR 3/3) matrix gray (GLEY 5/1), clay infilling - reddish yellow (5YR 5/8), weathered, moderate strength no recovery				[21.43]	
-196	506		86						← becomes loose clinker dark reddish brown (5YR 3/3), red (2.5YR 4/6), reddish black (2.5YR 2.5/1) moderately to slightly weathered, coated with reddish yellow (5YR 6/6) clay					
	507	106		90		0			**BASALT - Pahoehoe** red (2.5YR 5/6) moderately weathered, medium strong, 2% <3mm rounded vesicles. IF pieces: Mn Sp, clay Su - reddish yellow (5YR 6/8)					WL = 600 gal - add bentonite as drilling mud, 55 gallon drum with 1 bag bentonite.
-198	508							IF	· becomes reddish brown (5YR 4/3), slightly weathered, strong, 10% 1-4mm rounded to subrounded vesicles. IF pieces: partially infilled with reddish yellow (5YR 7/8) clay, other pieces Mn Sp, clay Sp & Su					
	509													

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Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	509															
							IF		becomes 15% <1mm rounded vesicles							
-200	510		87												[33.33]	Pause to allow bentonite to settle. Resume coring at 1342
							1									WL = 500 gal - no core retrieved by inner barrel. Change shoe and redrill 1518 - 1520. Barrel still empty. NR - like due to drilling issues. Paused drilling for 7/11/19 DTW = 289.9ft bgs
							2									
	511						M		· becomes black (7.5YR 2.5/1), slightly weathered, strong, 10% <3mm rounded vesicles							
							IF		· IF pieces: clay Sp Su - reddish yeloow (5YR 7/8)							
-202	512															
		107		50		34										
	513						NR		no recovery							
-204	514		88													Retrieve 510-512.2 on 7/12/19 Resume coring from 512.2 on 7/12/19 fill casing to surface with water, 189.2 gals. WL = 300 gals. Change shoe
									1. 45°, J, VN, clay, Sp Su, Wa, SR 2. 10°, J, VN, clay, Sp, Wa, SR							
	515														[75]	
							1									
-206	516															
							2		·becomes 15% < 2mm rounded vesicles							
	517						3									
		108		100		88			1. 5°, J, VN, clay, Su, Mn, Sp, St, SR 2. 0°, J, VN, Mn+Fe, Sp, Wa, SR 3. 85°, J, VN, clay, Su, Mn, Fe, Sp, Wa, SR 4. 80°, J, VN, clay+Mn+Fe, Sp, Wa, SR							
-208	518						IF									
							IF									
	519		89													
							4									
-210	520								same as above						[75]	
							1									
							2									
	521						3									
							4		1. 5°, J ,VN, clay, Sp, Wa, R 2. 90°, J, VN, clay, Sp, Wa, SR 3. 50°, J, VN, clay, Sp, Wa, SR 4. 5°, J, VN, No, No, Wa, R							
			90				5		5. 0°, J, VN, No, No, Wa, SR6. 0°, J, VN, clay, Sp, Wa, SR							
-212	522															WL = 400 gal
		109		104		72	6		7. 90°, J, VN, clay+Mn+Fe, Sp, Wa, SR- oxidation evident8. 20°, J, VN, clay, Sp, St, SR9. 20°, J, VN, clay, Mn+Fe, Sp, Wa, SR- oxidation evident							
	523						7									
							8		10. 5°, J, VN, clay, Mn+Fe, Sp, St, SR- oxidation evident							
							9									
-214	524		91				10									
	525															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	525								partial reddish yellow (5YR 7/8) clay infilling of vesicles 1. 90°, J, VN, clay, Su, Me+Fe, Sp, IR, SR 2. 5°, J, VN, clay, Mn+Fe, Sp, Wa, S 3. 0°, J, VN, clay, Mn+Fe, Sp, IR, SR 4. 90°, J ,VN, clay, Mn+Fe, Sp, Wa, SR IF pieces: reddish yellow (5YR 7/8) clay Su, Mn Sp				[60]	
-216	526		91					1 2	black (5YR 2.5/1), slightly weathered, strong, 15% <2mm rounded to subrounded vesicles partially infilled with reddish yellow (5YR 7/8) clay					
	527	110		100		92		3 4	very dark gray (10YR 3/1), slightly weathered, very strong, 15% 2-6mm subrounded vesicles partially infilled with reddish yellow (5YR 7/8) clay. becomesunweathered, very strong, 10% 2-10mm subrounded vesicles at 527.8'.					WL = 500 gal - high water pressure release when pulling inner barrel out.
-218	528		92					IF	dark gray (10YR 4/1), slightly weathered, strong, 5% 2-10mm subrounded vesicles partially infilled with reddish yellow (5YR 7/8). becomes 15% 1-6mm subrounded to subangular vesicles at 529'.					
	529								5% 4-14mm subdounded vesicles					
-220	530							1 2 3	slightly weathered, very strong, 20% <1mm rounded to subrounded vesicles				[60]	
	531							M	unweathered, very strong, 20% <2mm rounded vesicles 1. 85°, J, VN, Mn, Sp, Wa, S2. 85°, J, VN, Mn+Fe, Sp, Wa, S3. 10°, J, VN, Mn+ Fe, Sp, Wa, SR 4. 0°, J ,VN, No, No, Wa, SR 5. 50°, J, VN, Mn+Fe, Sp, Wa, SR 6. 10°, J, Vn, Mn+Fe+clay, Sp, St, S 7. 45°, J, VN, clay+Mn, Sp, Wa, SR 8. 10°, J, VN, clay+Mn+Fe, Sp, Wa, SR					
-222	532	111	93	100		92		5 6	15% <5mm rounded to subrounded vesicles					WL = 400 gal - high water pressure release when pulling inner barrel out.
-224	534							7 8	5% 3-15mm subrounded to subangular vesicles 15% <5mm rounded to subrounded vesicles					
	535							1	20% <4mm rounded vesicles				[50]	
-226	536		94					2	15% 1-6mm rounded to subrounded veiscles					
	537								15% <1mm rounded vesicles					
		112		100		56		3						WL = 400 gal - high water pressure release when pulling inner barrel out.
-228	538							4						
	539		95					IF	very dusky red (2.5YR 2.5/2), unweathered, very strong, 15% <2mm rounded vesicles 1. 0°, J, VN, Mn+Fe, Sp, Wa, S 2. 90°, J, VN, Mn+Fe, Sp, Wa, SR3. 5°, J, VN, No, No, Wa, SR 4. 5°, J, VN, Mn+Fe, Sp, IR, S					
-230	540							1	pipe vesicles				[50]	
	541								20% 1-3mm rounded to subrounded vesicles					WL = 400 gal

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	541								becomes 10% 2-6mm rounded to subrounded vesicles 1. 50°, J, VN, Mn+Fe, Sp, St, S- oxidation evident					
-232	542						2		← 20% <1mm rounded vesicles					
		113	96	106		106	2		← 15% 1-8mm subrounded vesicles					
	543						3		← 15% <4mm subrounded vesicles					
							4		2. 0°, J, VN, Mn+Fe+clay, Sp, Wa, SR 3. 75°, J, VN, Mn+Fe+clay, Sp, Wa, SR 4. 90°, J, VN, Mn+Fe, Sp, Wa, R					
-234	544								← 20% <1mm rounded vesicles					
	545												[50]	
			97											
-236	546						1		1. 80°, J, VN, Mn+Fe, Sp, Wa, SR 2. 0°, J, VN, Mn+Fe, Sp, St, SR					
							2							
	547								← slightly weathered, strong, 20% <1mm rounded vesicles partially infilled with clay					WL = 400 gal - high water pressure release when pulling inner barrel out for remaining runs unless otherwise noted.
		114		100		68	IF		IF pieces: Mn+Fe, Sp, yellow (2.5YR 7/6) clay, Sp+Su, flow textures present, reddish brown (2.5YR 5/4) faces					
-238	548		98											
							IF		← reddish black (2.5YR 2.5/1), slightly weathered, strong, 10% <2mm subrounded vesicles					
	549								← becomes slightly weathered, very strong, 5% 1-10mm subrounded vesicles					
									← becomes 20% <2mm rounded vesicles					
-240	550								← becomes 5% <8mm rounded to subrounded vesicles				[60]	
							1		1. 15°, J, VN, Mn+Fe, Sp, IR, SR					
							2		2. 90°, J, VN, Mn+Fe, Sp, Wa, SR					
	551						3							
							4		← heat alteration black (GLEY1 2.5/N) 10mm wide, dark reddish brown (2.5YR 3/3), slightly weathered, very strong, 15% <3mm rounded to subrounded vesicles					
			99				IF		IF pieces: Mn+Fe, Sp					
-242	552								← becomes reddish black (2.5YR 2/1), 20% <2mm rounded vesicles					WL = 400 gal
		115		100		66								
	553								3. 20°, J, VN, Mn+Fe, clay, Sp, Wa, S 4. 0°, J, VN, Mn+Fe, Sp, clay, Su, Wa, S					
							IF		← pipe vesicles IF pieces: Mn+Fe, Sp, faces red (2.5YR4/6) - oxidation evident					
-244	554													
									← pipe vesicles					
	555		100				IF		IF pieces: Mn+Fe, Sp, faces red (2.5YR4/6) - oxidation evident				[50]	
							1		← becomes very dark gray (10YR 3/1), unweathered, very strong, 15% 1-9mm rounded to subrounded vesicles					
							2		1. 85°, J, VN, Mn+Fe+clay, Sp, Wa, SR					
-246	556								2. 0°, J, VN, Mn+Fe+clay, Sp, Wa, SR 3. 85°, J, VN, Mn+Fe, Sp, Wa, S4. 10°, J, VN, Mn+Fe, Sp, SR- oxidation evident5. 70°, J ,VN, Mn+Fe, Sp, Wa, SR6. 0°, J, VN, Mn+Fe, Sp, Wa, S- oxidation evident"					WL = 600 gal
	557													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 12/3/2019 RHMW15

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	557								5% <1mm rounded vesicles 15% 1-4mm subrounded vesicles 25% <1mm rounded vesicles 15% 1-19mm subrounded vesicles					
		116		104		76								
-248	558		101				2	M						
	559						3		reddish black (2.5YR 2.5/1), unweathered, very strong, 25% <1mm rounded vesicles					
							4							
							5							
-250	560						1						[50]	
							2							
								IF	IF pieces: Mn Fe Sp, red (2.5YR 4/6) faces					
	561		102						20% 1-5mm rounded vesicles					
-252	562													WL = 400 gal
		117		104		70	3		15% <2mm rounded vesicles					
	563													
							4		1. 90°, J, VN, Mn+Fe, Sp, Wa, SR2. 0°, J, VN, Mn+Fe, Sp, Wa, SR 3. 15°, J, VN, Mn+Fe, Sp, Wa, R4. 5°, J, VN, Mn+Fe, Sp, Wa, SR					
-254	564													
			103											
	565								1. 10°, J, VN, Mn+Fe, Sp, Wa, S				[33.33]	
-256	566						1							
									BASALT - a'a' Clinker loose, dark brownish red (2.5YR 3/4) very dusky red (2.5YR 2.5/2) reddish black (2.5YR 2.5/1) moderately weathered, clasts covered with clay - reddish yellow (5YR 7/6), subrounded clasts					
	567													WL = 500 gal
		118		72		32								
-258	568		104											
							NR		no recovery					
	569													
-260	570								**BASALT - Massive a'a'** dark gray (10YR 4/1) slightly weathered, strong, 5% 1-9mm subangular - subrounded, elongate, irregular vesicles.				[25]	
								IF						
	571													WL = 600 gal
-262	572						1		IF pieces: Mn, Fe, Sp 1. 5°, J, VN, Mn+Fe, Sp, Wa, S2. 10°, J, VN, Mn+Fe+clay, Sp, Wa, SR 3. 90°, J, VN, Mn+Fe, clay, Sp, Wa, SR					
		119	105	90		28								
	573						2							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 12/2/2019 RHMW15

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	573						3 4		4. 20°, J, VN, Mn+Fe, clay, Wa, SR					
-264	574		105						**BASALT - a'a' Clinker** loose, dark reddish brown (5YR 3/3), very dark gray (5YR 3/1) slightly weathered - clay on some clasts, reddish yellow (7.5YR 7/6) no recovery					
	575												[50]	
-266	576								**BASALT - Pahoehoe** dark reddish gray (5YR 4/2) uneathered, very strong, 20% <2mm rounded to subrounded vesicles.					
			106				1 2		reddish black (2.5YR 2.5/1), unweathered, very					
	577						3		strong, 20% <2mm rounded vesicles					
		120		102		58	4		becomes slightly weathered					WL = 500 gal
-268	578						5							
							IF		IF pieces: Mn, Fe, Sp, brownish yellow clay (10YR 5/5) Su 1. 90°, J, VN, Mn+Fe, Sp, Wa, R 2. 30°, J, VN, Mn+Fe, Sp, Wa, SR 3. 20°, J, VN, Mn+Fe, Sp, Wa, SR 4. 90°, J, VN, Mn+Fe, Sp, Wa, SR 5. 10°, J, VN, Mn+Fe+clay, Sp, Wa, SR					
	579													
							IF		very dusky red (2.5YR 2.5/2), slightly weathered, very strong, 20% <1mm rounded to subrounded vesicles IF pieces: Mn, Fe, Sp, brownish yellow (10YR 6/6) clay, Su, some faces dark reddish brown (2.5YR 3/4)					
-270	580												[42.86]	
			107				1		clay partially infilling some vesicles					
	581													
							2 3 4		1. 5°, J, VN, Mn+Fe+clay, Sp, Pl, S 2. 20°, J, VN, Mn+Fe+clay, Sp, Wa, SR- oxidation evident 3. 85°, J, VN, Mn+Fe+clay, Sp, Wa, SR- oxidation evident					
-272	582						5							
		121		100		68			4. 5°, J, T, clay, Wa 5. 10°, J, VN, Mn+Fe+clay, Sp, Wa, SR					WL = 500 gal
	583						6		6. 5°, J, VN, Mn+Fe+clay, Sp, Wa, SR- oxidation evident 7. 10°, J, VN, clay, Sp, Wa, SR 8. 5°, J, VN, clay, Sp, Wa, SR 9. 90°, J, VN, clay+Mn+Fe, Sp, Wa, SR					
			108											
-274	584						7 8 9		1. 85°, J, VN, Mn+Fe+clay, Sp, Wa, SR 2. 5°, J, VN, clay, Sp, Wa, SR 3. 90°, J, VN, Mn+Fe+clay, Sp, Wa, SR 4. 20°, J, VN, Mn+Fe, Sp, Wa, S- oxidation evident 5. 5°, J, VN, Mn+Fe, Sp IR, SR- oxidation evident 6. 20°, J, VN, Mn+Fe, Sp, IR, SR					
	585						IF		7. 30°, J, VN, Mn+Fe+clay, Wa, SR 8. 0°, J, VN, Mn+Fe+clay, Sp, Wa, S 9. 0°, J, VN, Mn+Fe, Sp, Wa, R				[33.33]	
							1 2 3							
-276	586						4 5							
	587						IF							WL = 500 gal
		122	109	108		0								
-278	588						6 7							
	589						IF							

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	589															
			110				8		← dusky red (2.5YR 3/2), slightly weathered, very strong, 15% <2mm subrounded vesicles							
-280	590						9									Completed coring on 7/12/19
	591								RHMW15 was cleared from ground surface to 2.5 feet below ground surface (bgs) hand. The borehole was then drilled using 10 inch O.D. hollow stem auger from 2.5 to 5 feet bgs. Hollow stem augering was abandoned at 5 ft bgs due to gravel obstructions preventing advancement. The borehole was then drilled using HQ wireline coring to 265 feet bgs. The borehole was reamed with a 20 inch tricone bit using air rotary methods from 0 feet bgs to 20 feet bgs and a 16 inch steel surface casing was installed to 10 feet bgs and grouted in place with cement-bentonite grout. The borehole was subsequently reamed with a 14¾ inch hammer bit using air rotary methods to 265 feet bgs. Ten inch steel conductor casing was installed from ground surface to 259 feet bgs and grouted in place with cement-bentonite grout. The borehole from 259 feet bgs to 265 feet bgs was then reamed with a 9 7/8 inch tri-cone bit using air rotary methods. Five inch steel casing was then installed from ground surface to 265 feet bgs and grouted in place with cement-bentonite grout. PQ wireline coring was then used from 265 feet bgs to the completion depth at 590 feet bgs. Clean water filtered through a granulated activated carbon filter was used as the only drilling fluid during coring. Three (3) 50 lb bags of max gel bentonite powder were used while HQ coring borehole from 220 ft bgs to 225 ft bgs to help lubricate core barrel. One (1) 50 lb bag of max gel bentonite powder was used while PQ coring borehole from 505 ft bgs to 510 ft bgs to prevent caving. Upon completion of drilling, the borehole was developed using a Grundfos pump placed at selected depths. A total of approximately 4790 gallons of water were removed at a rate of 6.25 gallons per minute prior to the Westbay well installation. A gyroscopic survey was performed followed by caliper and acoustic televiewer logging. The total depth of the borehole was measured at 583.2 feet bgs. PQ rods remained downhole at 538.2 feet bgs as a temporary guide while the Westbay tubing was lowered.						
-282	592															
	593															
-284	594															
	595															
-286	596															
	597															
-288	598															
	599															
-290	600															
	601															
-292	602															
	603															
-294	604															
	605															

~~For Red Hill AOC Party Use Only~~

Acoustic Televiewer

COLOG
borehole geophysics / hydrophysics

COMPANY: Valley Well Drilling	PROJECT: Red Hill CTO
DATE LOGGED: 23 July 2019	WELL: RHMW - 15

Colog, Inc.
810 Quail Street, Suite E, Lakewood, CO 80215
Phone: (303) 279-0171, Fax: (303) 278-0135
www.colog.com

Tilt ATV
0 deg 8

3-Arm Caliper
2 in 16

Depth
1in:10ft

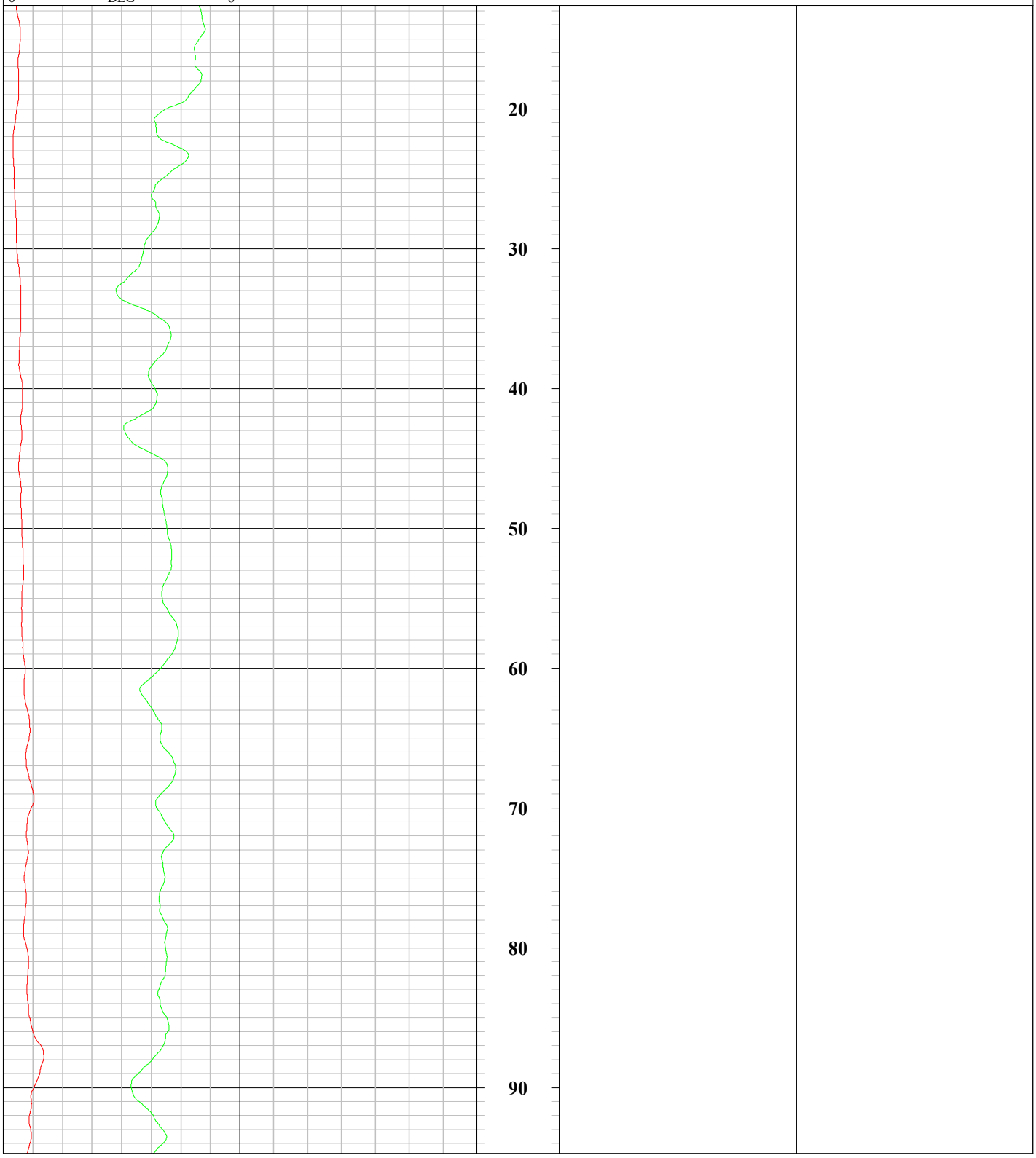
Acoustic Travel Time-NM
0° 90° 180° 270° 0°

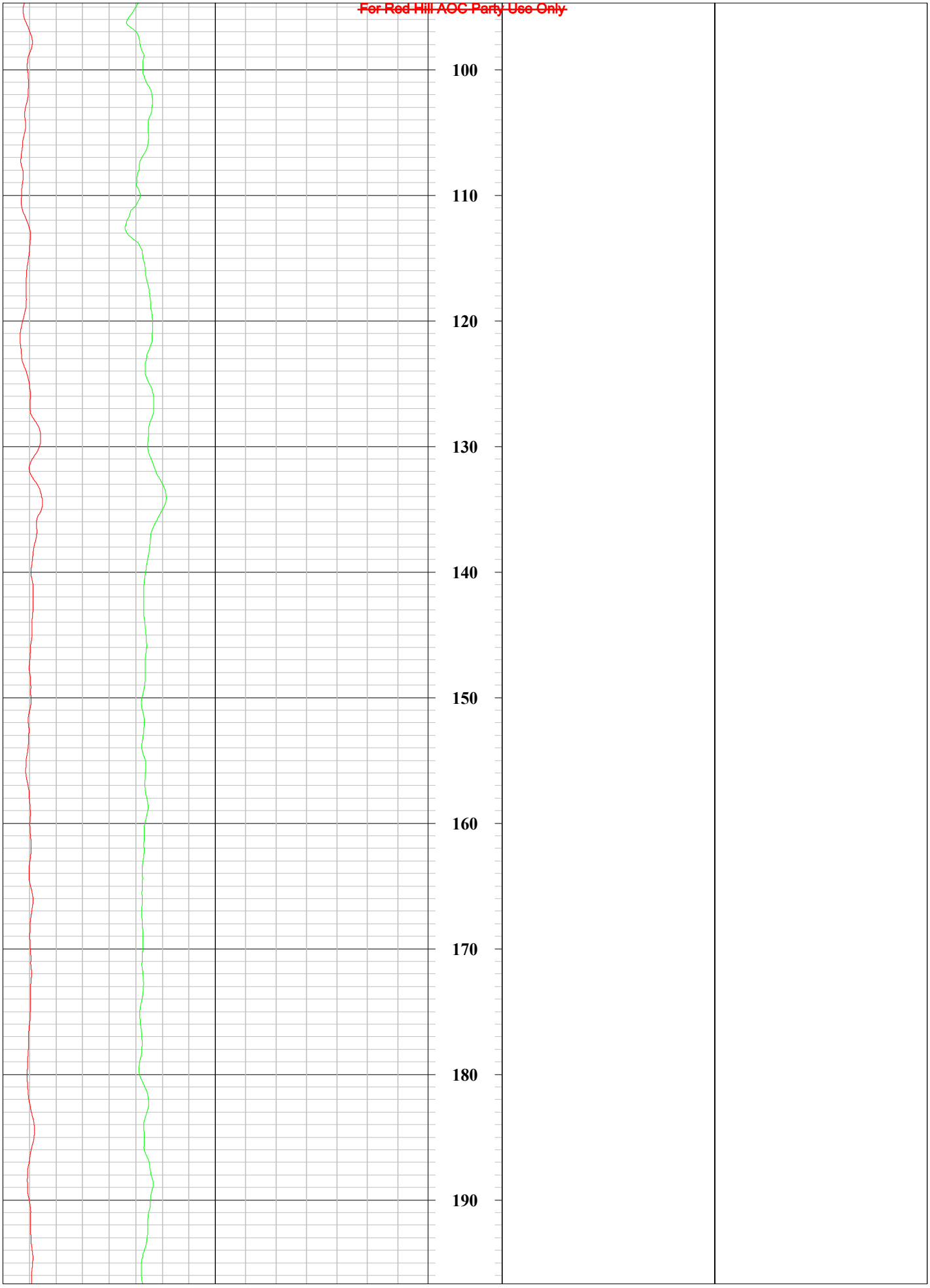
Acoustic Amplitude-NM
0° 90° 180° 270° 0°

Azimuth ATV TN
0 360

Azimuth Gyro TN
0 DEG 360

Tilt Gyro
0 DEG 8





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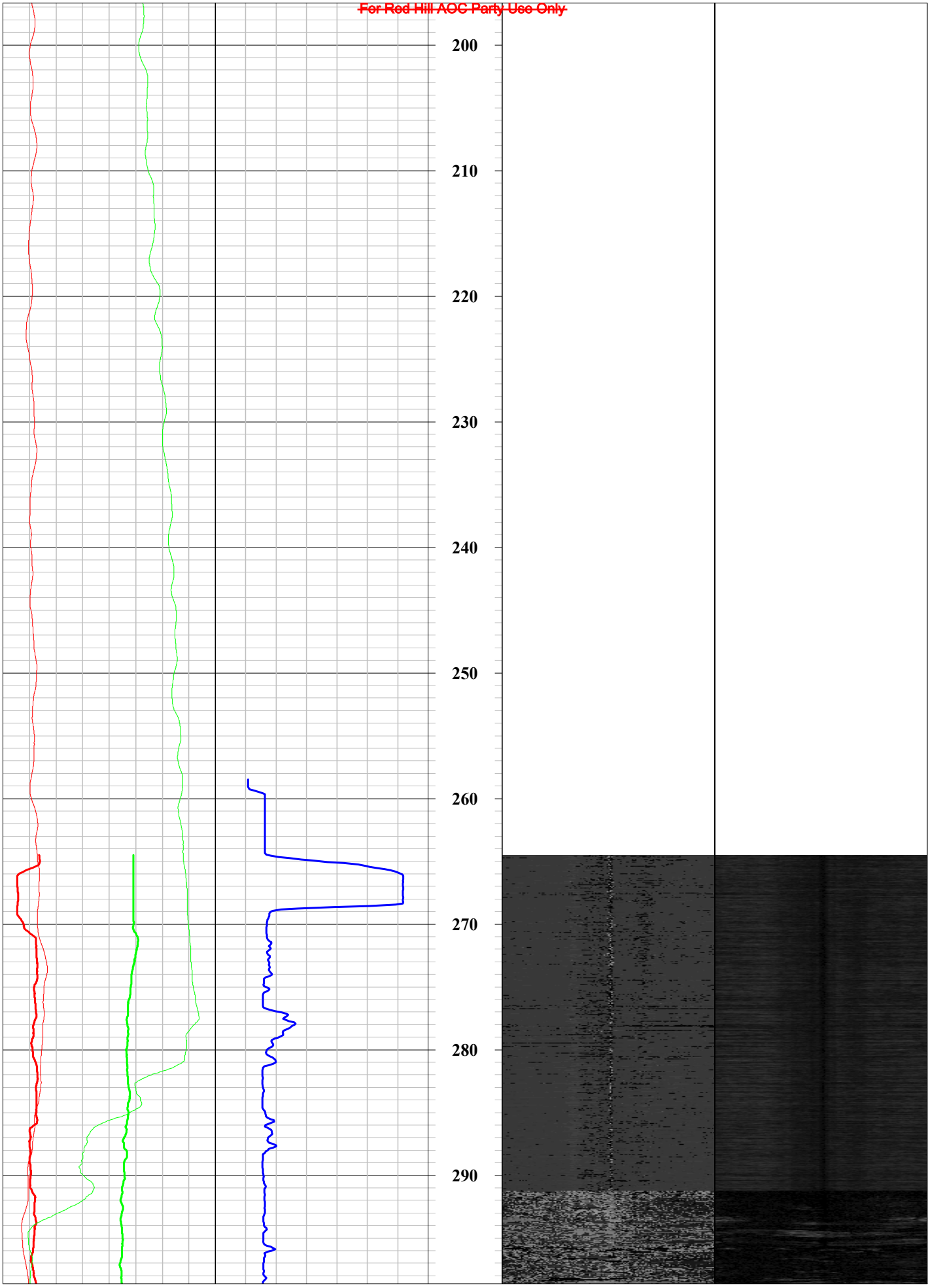

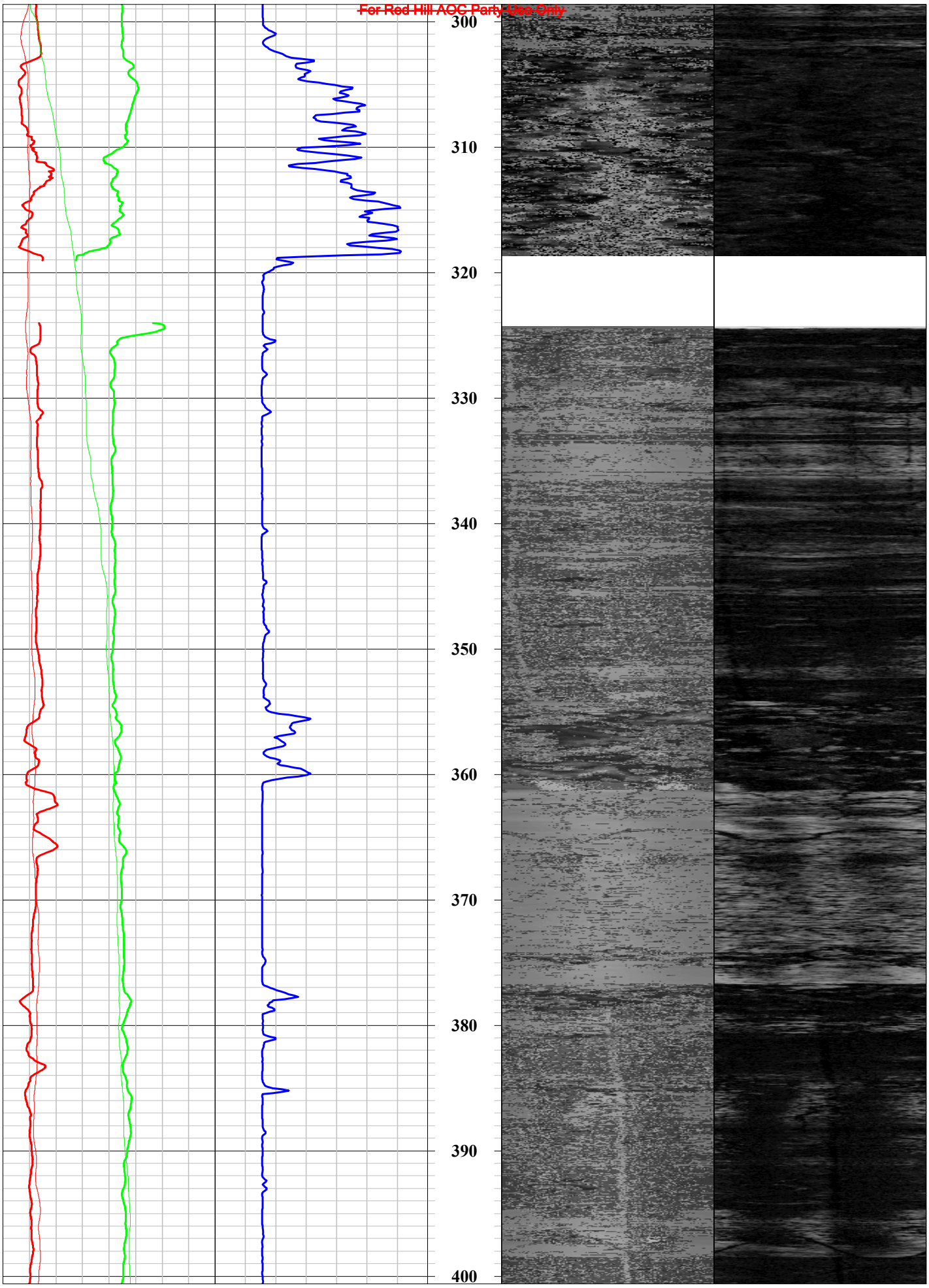
For Rod Hill AOC Party Use Only
300
310
320
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380
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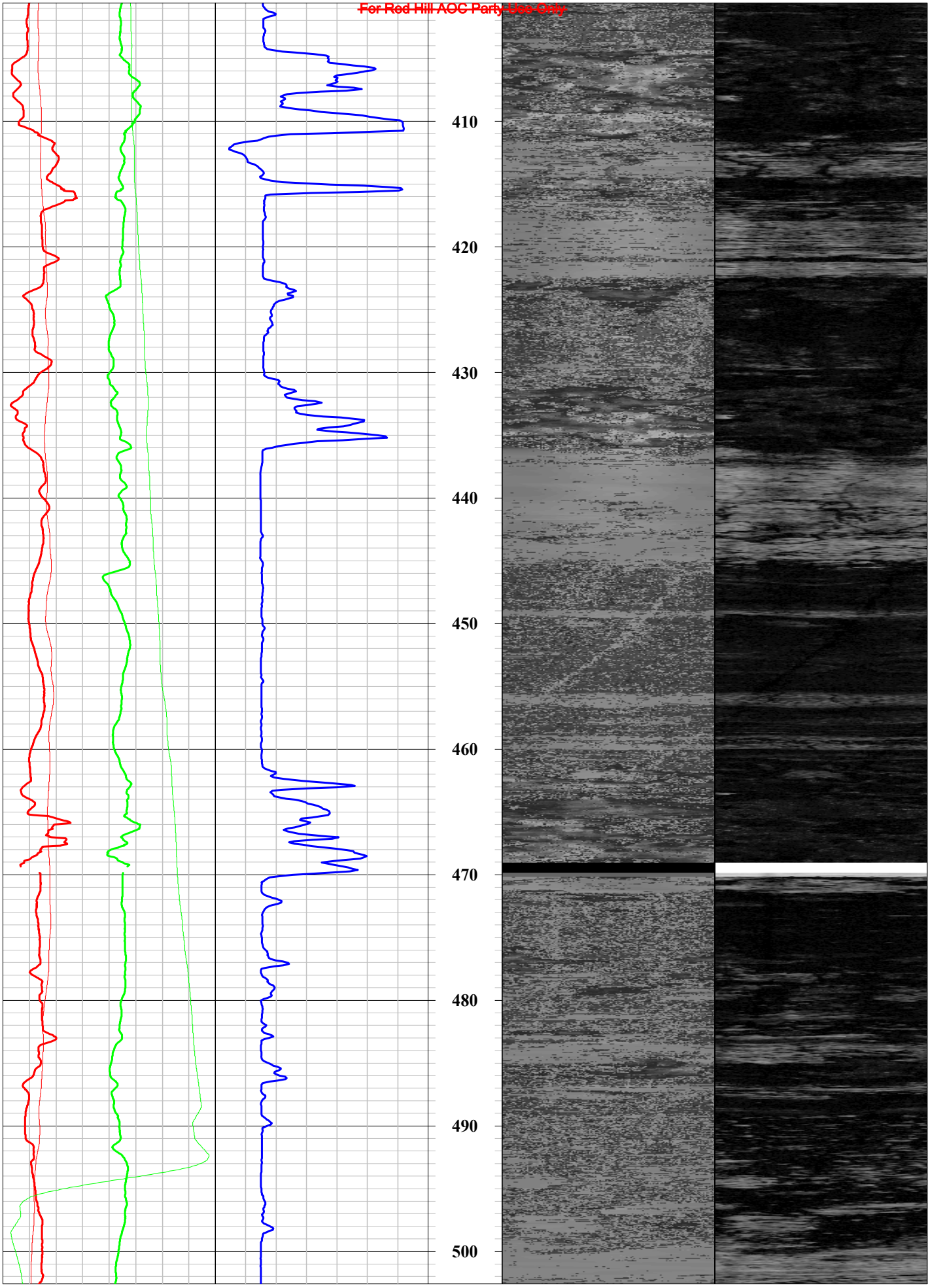
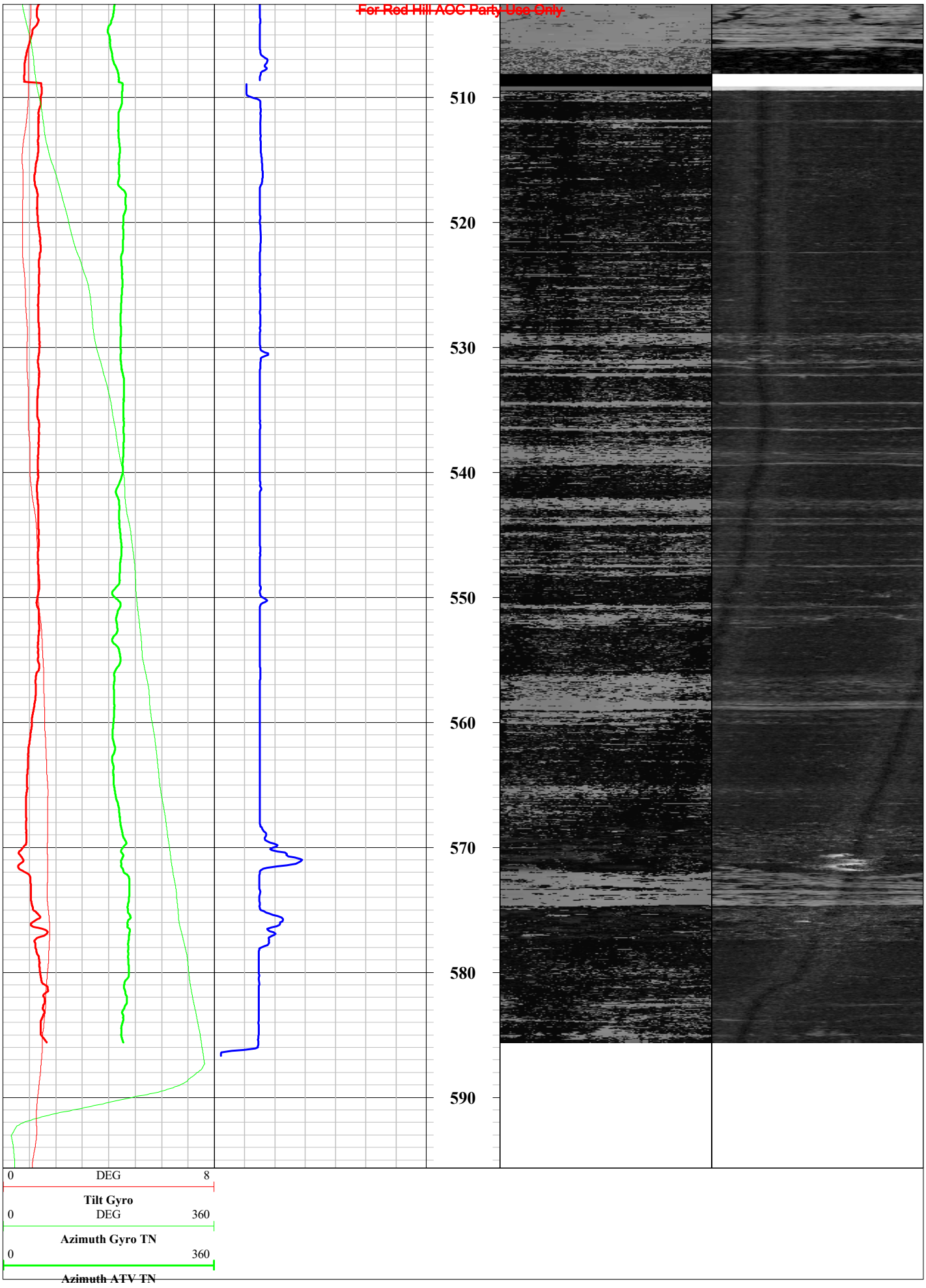
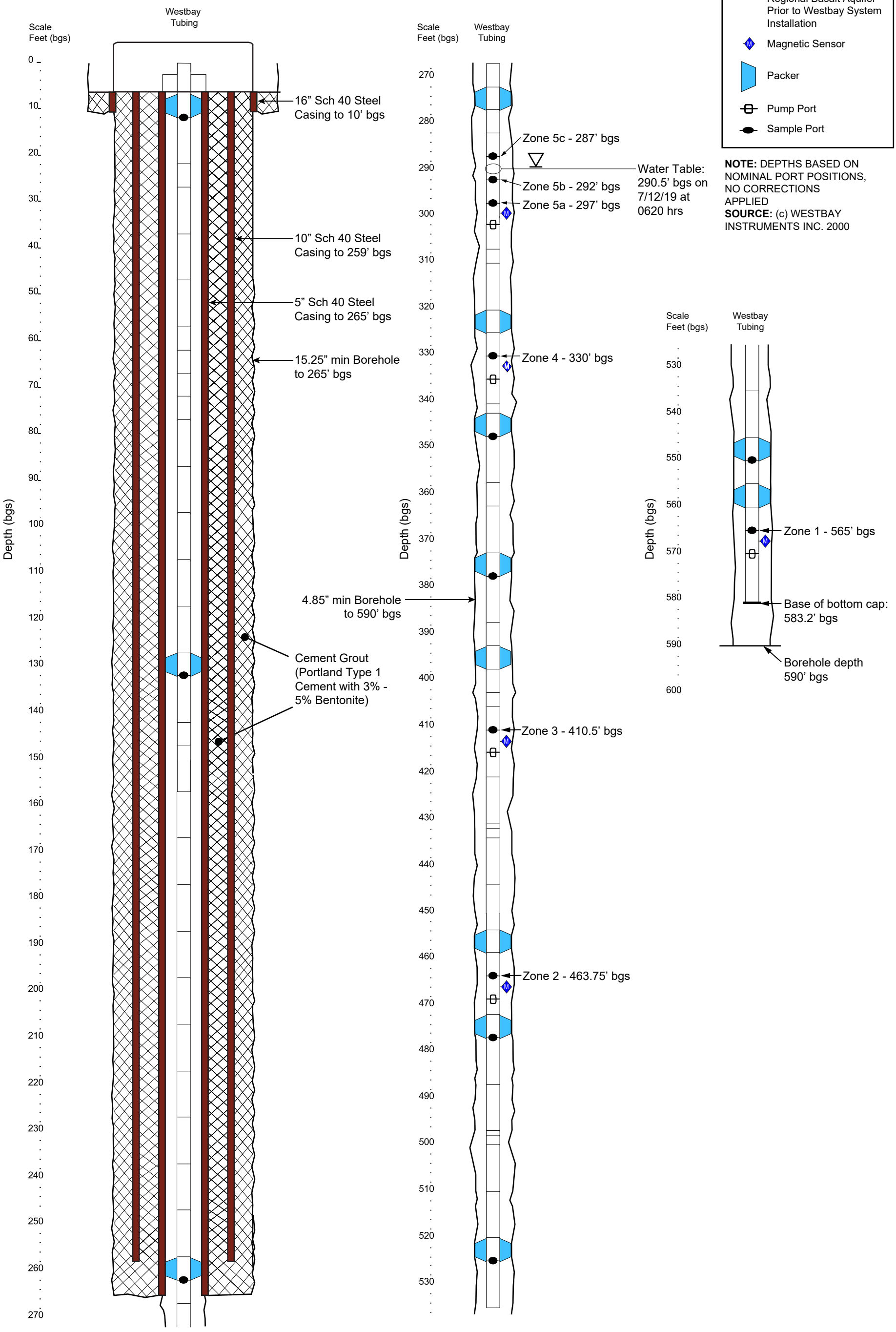



~~For Red Hill AOC Party Use Only~~
510
520
530
540
550
560
570
580
590
0
DEG
8
Tilt Gyro
0
DEG
360
Azimuth Gyro TN
0
360
~~Azimuth ATV TN~~

~~For Red Hill AOC Party Use Only~~

B:\60571032-HNL1\900-Work\921 Graphics\Well Logs\RHMW15\RHMW15_SummaryCompLog.ai

RHMW15 Monitoring Well



Legend

- Approximate Depth to Water in the Open Borehole within the Regional Basalt Aquifer Prior to Westbay System Installation
- Magnetic Sensor
- Packer
- Pump Port
- Sample Port

NOTE: DEPTHS BASED ON NOMINAL PORT POSITIONS, NO CORRECTIONS APPLIED
SOURCE: (c) WESTBAY INSTRUMENTS INC. 2000

Cross Section RHMW15 Monitoring Well
Red Hill Bulk Fuel Storage Facility
JBPHH, O‘ahu, Hawaii

WELL DEVELOPMENT LOG

PROJECT	WELL ID	SITE	PREPARED BY
Red Hill 60571032	RHMW15	Red Hill	(b) (6)

METHOD
- OVERPUMPAGE ☒
- BAILER ☐
- SURGE BLOCK ☐
- AIR LIFT ☐
- OTHER

Grundfoss submersible – 6.25 gpm

INITIAL WATER LEVEL: 293.90' btoc
INITIAL TOTAL DEPTH: Not Measured'

FINAL WATER LEVEL: 293.60' btoc
FINAL TOTAL DEPTH: Not Measured

REMARKS:

*CAPACITY OF CASING (GALLONS/LINEAR FOOT)

1" - 0.012
2" - 0.16
4" - 0.65
6" - 0.1.47

*VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

1" CASING AND 2" HOLE - 0.013
2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

*The two volumes for the saturated portion of the well must be added together to obtain one unit well volume.

DEVELOPMENT LOG:

DATE	TIME	COMMENTS	ELAPSED TIME	FLOW RATE (gpm)	CUMULATIVE WATER REMOVED GALLONS	WATER QUALITY pH	TEMP (°C)	SP. COND (mS/cm)	DO (mg/L)	ORP (mV)	TURBIDITY (ntu)	SALINITY (ppt)	WATER LEVEL (ft btoc)
Zone 1: pump intake at 310' bgs, casing bit at 565' bgs													
7/15	1129	Start Purge											
7/15	1133		4	6.25	25	9.33	22.99	0.5	1.28	133.5	112.4	0.2	293.9
7/15	1138		9	6.25	56.25	9.35	23.21	0.49	0.16	31.8	114.8	0.2	293.88
7/15	1144		15	6.25	93.75	9.33	23.61	0.49	0.12	7.8	124.8	0.2	293.88
7/15	1149		20	6.25	125	9.33	23.74	0.48	0.09	61.8	148	0.2	293.87
7/15	1155		26	6.25	162.5	8.7	23.62	0.41	3.25	177.3	151.7	0.2	293.87
7/15	1200		31	6.25	193.75	8.6	23.63	0.41	4.43	182.5	31.2	0.2	293.9
7/15	1205		36	6.25	225	8.57	23.67	0.4	5.16	186.2	15.9	0.2	293.91
7/15	1210		41	6.25	256.25	8.55	23.74	0.4	5.48	188.8	99.7	0.2	293.91
7/15	1215		46	6.25	287.5	8.54	23.7	0.4	5.86	189.7	8.3	0.2	293.91
7/15	1220		51	6.25	318.75	8.52	23.62	0.4	6.1	189.2	6.6	0.2	293.91
7/15	1225		56	6.25	350	8.51	23.6	0.4	6.13	189.2	6.2	0.2	293.91
7/15	1230		61	6.25	381.25	8.49	23.7	0.4	6.14	187.6	4.3	0.2	293.92
7/15	1235		66	6.25	412.5	8.46	23.54	0.42	6.42	184.7	5.5	0.2	293.92
7/15	1240		71	6.25	443.75	8.43	23.92	0.42	6.66	184.8	-	0.2	-
7/15	1245		76	6.25	475	8.42	23.48	0.42	6.57	183.9	4	0.2	293.92

7/15	1250		81	6.25	506.25	8.41	23.42	0.42	6.45	181.4	3.4	0.2	293.92
7/15	1255		86	6.25	537.5	8.4	23.38	0.42	6.43	179.9	3.5	0.2	293.92
7/15	1300		91	6.25	568.75	8.39	23.41	0.42	6.44	179.4	3.7	0.2	293.92
7/15	1305		96	6.25	600	8.38	23.42	0.42	6.48	177.5	3.4	0.2	293.93
7/15	1310		101	6.25	631.25	8.37	23.34	0.42	6.6	175	3.4	0.2	293.92
7/15	1315		106	6.25	662.5	8.36	23.42	0.42	6.81	175.8	3.3	0.2	293.92
7/15	1320		111	6.25	693.75	8.35	23.47	0.42	6.68	174.5	3.7	0.2	293.93
7/15	1325		116	6.25	725	8.34	23.44	0.42	6.73	166.2	3.3	0.2	293.92
7/15	1330		121	6.25	756.25	8.33	23.35	0.41	6.87	168.3	3.3	0.2	293.92
7/15	1335		126	6.25	787.5	8.33	23.39	0.41	6.73	165.7	3.6	0.2	293.93
7/15	1340		131	6.25	818.75	8.32	23.39	0.41	6.69	163.2	3.3	0.2	293.93
7/15	1345		136	6.25	850	8.32	23.43	0.41	6.68	160.5	3.5	0.2	-
		Stop pumping, pull pump/casing up			Zone 1 total: 850								

Zone 2: pump intake at 310' bgs, casing bit at 465' bgs													
7/15	1455	Start pumping											
7/15	1500		5	6.25	31.25	8.46	25.47	0.39	6.41	176.9	61.1	0.2	293.93
7/15	1505		10	6.25	62.5	8.37	23.04	0.42	5.1	159.2	54.3	0.2	293.97
7/15	1510		15	6.25	93.75	8.36	23.09	0.42	4.92	159	62.1	0.2	293.97
7/15	1515		20	6.25	125	8.35	22.98	0.42	6.94	156.2	28.7	0.2	293.96
7/15	1520		25	6.25	156.25	8.35	22.99	0.42	7.28	148.7	14.5	0.2	293.96
7/15	1525		30	6.25	187.5	8.34	22.91	0.42	7.34	149.3	9.2	0.2	293.96
7/15	1530		35	6.25	218.75	8.32	22.9	0.41	7.34	138.7	7.4	0.2	293.93
7/15	1535		40	6.25	250	8.31	22.82	0.41	7.46	133.5	5.47	0.2	293.92
7/15	1540		45	6.25	281.25	8.3	22.85	0.41	7.55	131.1	5.1	0.2	293.91
7/15	1545		50	6.25	312.5	8.29	22.8	0.4	7.34	128	4.5	0.2	293.91
7/15	1550		55	6.25	343.75	8.28	22.8	0.4	7.35	125.1	4.6	0.2	293.91
7/15	1555		60	6.25	375	8.27	22.76	0.4	7.54	121.1	4.1	0.2	293.90
7/15	1600		65	6.25	406.25	8.27	22.8	0.4	7.56	119.6	4.1	0.2	293.88
7/15	1605		70	6.25	437.5	8.26	22.8	0.4	7.62	116.6	4.3	0.2	293.88
7/15	1610		75	6.25	468.75	8.26	22.71	0.4	7.47	113	4	0.2	293.88

7/15	1615		80	6.25	500	8.25	22.82	0.4	7.45	112	3.9	0.2	293.87
7/15	1620		85	6.25	531.25	8.25	22.73	0.39	7.51	109.6	4	0.2	293.86
7/15	1625		90	6.25	562.5	8.24	22.77	0.39	7.48	107.5	4.3	0.2	293.86
7/15	1630		95	6.25	593.75	8.24	22.76	0.39	7.7	105.2	4.2	0.2	293.86
7/15	1635		100	6.25	625	8.24	22.71	0.39	7.6	99.8	4.2	0.2	293.85
7/15	1640		105	6.25	656.25	8.23	22.62	0.39	7.53	100.5	4.2	0.2	293.85
7/15	1645		110	6.25	687.5	8.23	22.62	0.4	7.52	98.9	4.1	0.2	293.84
7/15	1650		115	6.25	718.75	8.23	22.58	0.4	7.6	95.7	3.8	0.2	293.84
7/15	1655		120	6.25	750	8.22	22.65	0.4	7.49	95.7	4.1	0.2	293.84
7/15	1700		125	6.25	781.25	8.22	22.66	0.39	7.35	96.3	3.8	0.2	293.95
		End purging			Zone 2 total: 781								
Zone 3: pump intake at 310' bgs, casing bit at 365' bgs													
7/16	0736	Start purging											
7/16	740		4	6.25	25	7.41	22.67	0.43	4.29	24.9	151.3	0.2	293.64
7/16	745		9	6.25	56.25	7.53	22.4	0.41	3.85	13.8	147.6	0.2	293.65
7/16	750		14	6.25	87.5	7.64	22.22	0.41	6.88	99.7	32.9	0.2	293.64
7/16	755		19	6.25	118.75	7.07	22.52	0.41	7.07	112.4	17.5	0.2	293.63
7/16	800		24	6.25	150	7.71	22.57	0.41	7.08	127.4	11.3	0.2	293.63
7/16	805		29	6.25	181.25	7.11	22.63	0.41	7.10	141.8	8.7	0.2	293.62
7/16	810		34	6.25	212.5	7.72	22.64	0.41	7.01	149.3	6.25	0.2	293.62
7/16	815		39	6.25	243.75	7.72	22.64	0.40	7.06	156.6	5.04	0.2	293.62
7/16	820		44	6.25	275	7.72	22.68	0.40	7.04	165.3	5.4	0.2	293.62
7/16	825		49	6.25	306.25	7.08	22.61	0.40	7.07	150.3	4.83	0.2	293.62
7/16	830		54	6.25	337.5	7.72	22.63	0.40	7.11	139.6	4.87	0.2	293.62
7/16	835		59	6.25	368.75	7.73	22.64	0.40	7.12	128.2	4.72	0.2	293.62
7/16	840		64	6.25	400	7.33	22.62	0.40	7.31	125.4	10.8	0.2	293.62
7/16	845		69	6.25	431.25	7.73	22.59	0.41	7.54	107.3	5.74	0.2	293.63
7/16	850		74	6.25	462.5	7.73	22.62	0.41	7.52	104.6	4.73	0.2	293.62
7/16	855		79	6.25	493.75	7.73	22.63	0.41	7.44	101.8	-	0.2	293.62
7/16	900		84	6.25	525	7.73	22.67	0.41	7.39	96.6	4.03	0.2	293.62
7/16	905		89	6.25	556.25	7.73	22.62	0.40	7.29	103.4	3.77	0.2	293.62
7/16	910		94	6.25	587.5	7.73	22.63	0.40	7.35	100.3	3.25	0.2	293.61
7/16	915		99	6.25	618.75	7.72	22.85	0.40	7.65	96	-	0.2	-
7/16	920	Switched tanks	104	6.25	650	7.74	22.83	0.30	8.37	92.3	6	0.2	293.63

7/16	925		109	6.25	681.25	7.78	22.56	0.36	8.27	146.3	5.94	0.2	293.62
7/16	930		114	6.25	712.5	7.75	22.54	0.41	8.18	62.6	3.8	0.2	293.63
7/16	935		119	6.25	743.75	7.75	22.53	0.28	8.17	56.5	3.55	0.2	293.63
7/16	940		124	6.25	775	7.75	22.45	0.41	8.19	52	3.85	0.2	293.61
7/16	945		129	6.25	806.25	7.74	22.49	0.4	8.2	47.2	3.52	0.2	293.61
7/16	950		134	6.25	837.5	7.74	22.71	0.42	8.26	50.2	2.87	0.2	293.61
7/16	955		139	6.25	868.75	7.75	22.8	0.38	8.3	50.8	3.19	0.2	293.62
7/16	1000		144	6.25	900	7.75	22.72	0.41	8.31	53	2.75	0.2	293.62
7/16	1005		149	6.25	931.25	7.75	22.63	0.44	8.28	50.5	3.52	0.2	293.62
7/16	1010		154	6.25	962.5	7.74	22.67	0.38	8.23	52.5	3.55	0.2	293.61
7/16	1015		159	6.25	993.75	7.74	22.74	0.44	8.26	50.7	3.09	0.2	293.6
7/16	1020		164	6.25	1025	7.75	22.67	0.41	8.22	49.1	2.92	0.2	293.6
		End purging			Zone 3 total: 1025								
Zone 4: pump intake at 310' bgs, casing bit at 300' bgs													
7/16	1222	Start purging											
7/16	1225		3	6.25	18.75	7.88	22.1	0.36	5.24	135.9	4.08	0.2	293.35
7/16	1230		8	6.25	50	7.81	24.89	0.41	8.2	197.3	3.01	0.2	293.36
7/16	1235		13	6.25	81.25	7.79	24	0.4	8.04	198.1	1.97	0.2	293.39
7/16	1240		18	6.25	112.5	7.77	23.53	0.41	8.07	192.8	2.64	0.2	293.4
7/16	1245		23	6.25	143.75	7.77	23.25	0.41	8.01	187.3	2.41	0.2	293.39
7/16	1250		28	6.25	175	7.76	23.44	0.39	7.9	177.5	2.04	0.2	293.39
7/16	1255		33	6.25	206.25	7.76	22.97	0.4	8.05	182.2	1.89	0.2	293.39
7/16	1300		38	6.25	237.5	7.76	22.95	0.4	8.06	180.7	1.61	0.2	293.4
7/16	1305		43	6.25	268.75	7.75	22.94	0.4	8.03	179.7	2.23	0.2	293.42
7/16	1310		48	6.25	300	7.75	22.84	0.4	8.06	178	2.48	0.2	293.44
7/16	1315		53	6.25	331.25	7.75	22.85	0.4	8.04	177	5.54	0.2	293.46
7/16	1320		58	6.25	362.5	7.74	22.84	0.4	8.04	171.8	6.34	0.2	293.48
7/16	1325		63	6.25	393.75	7.73	22.8	0.4	8	169.6	6.35	0.2	293.5
7/16	1330		68	6.25	425	7.73	22.76	0.4	8.04	168.6	5.4	0.2	293.51
7/16	1335		73	6.25	456.25	7.72	22.8	0.4	8.05	167	4.38	0.2	293.52
7/16	1340		78	6.25	487.5	-	-	-	-	-	4.06	-	293.53
7/16	1345		83	6.25	518.75	-	-	-	-	-	3.74	-	293.54
7/16	1350		88	6.25	550	7.71	22.8	0.39	8.06	113.3	3.43	0.2	293.55
7/16	1355		93	6.25	581.25	7.71	22.73	0.39	8.06	166.1	3.53	0.2	293.55

7/16	1400		98	6.25	612.5	7.71	22.76	0.39	8.09	164.4	2.86	0.2	293.56
7/16	1405		103	6.25	643.75	7.7	22.72	0.39	8.09	163.4	2.97	0.2	293.57
7/16	1410		108	6.25	675	7.7	22.71	0.39	8.07	163.1	2.53	0.2	293.58
7/16	1415		113	6.25	706.25	7.7	22.69	0.39	8.12	160.9	2.94	0.2	293.58
7/16	1420		118	6.25	737.5	7.7	22.67	0.39	8.17	159.5	2.07	0.2	293.58
7/16	1425		123	6.25	768.75	7.7	22.58	0.39	8.13	158.9	2.00	0.2	293.59
7/16	1430		128	6.25	800	7.69	22.61	0.39	8.14	157.8	1.83	0.2	293.59
7/16	1435		133	6.25	831.25	7.69	22.57	0.39	8.19	155.1	1.97	0.2	293.59
7/16	1440		138	6.25	862.5	7.69	22.53	0.39	8.19	154.8	2.07	0.2	293.6
7/16	1445		143	6.25	893.75	7.69	22.54	0.39	8.22	153.8	1.91	0.2	293.6
7/16	1450		148	6.25	925	7.69	22.59	0.39	8.1	152.8	2.45	0.2	293.6
		End purging			Zone 4 total: 925								
					All zones total: 3581								

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Date(s) Drilled	**5/15/2020 - 8/18/2020**	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	**HSA / HQ core / air rotary / mud rotary**	Drill Bit Size/Type	**HQ diamond bit / 8.5" tricone bit**	Total Depth of Borehole	**525.0 feet**
Drill Rig Type	**Mobile B-59 / Atlas Copco T-3 / Mobile B-90**	Drilling Contractor	**Valley Well Drilling**	Approximate Surface Elevation	**215.0**
Groundwater Level	**El. 17.64' (2/22/2021)**	Location	**RHSF**	Inclination from Horizontal/Bearing	**90°**
Borehole Completion	**4-inch diameter monitoring well**			Hammer Data	**140 lbs/30-inch drop**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
215	0								**VALLEY FILL** Silty Gravel (GW) with sand, subrounded gravel, fine to coarse sand.							
214	1															
	2															
212	3															
	4								← Basalt boulder, 0.3-2 mm vesicles, iron staining in vesicles.			1		0.0	[10]	No recovery in first sampler run due to boulder; observations made from auger cuttings and driller comments
210	5															
	6															
208	7		1													
	8								no recovery.			2			[5]	
206	9															
	10															No recovery due to boulder
204	11															
	12															
202	13															

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
202	13															
	14								**VALLEY FILL** SANDY SILT (ML) with minor clay and gravel, dark brown (10YR 3/3), dry, stiff, medium angular sand, pale brown (10YR 6/3) coarse rounded basalt gravel, some yellow (10YR 7/8) 5 mm sand nodules, low plasticity, root fragments.			3		[9]	
200	15								no recovery.							
	16															
198	17															
	18															
									VALLEY FILL SANDY CLAY (CL), very dark gray (10YR 3/1) and dark brown (10YR 3/3), dry, stiff, medium angular sand, some 5-8 mm yellow (10YR 7/8) sand nodules, moderate plasticity.			4		[5]	
196	19															
	20		1													End of drilling 5/15/2020
									VALLEY FILL CLAY (CH), high plasticity, no sand nodules.					[90]		Resume drilling on 5/16/20 using HQ coring bit
194	21								**BASALT A'a Clinker** loose, dark gray (40YR 4/1), slightly weathered, 1"-2" diameter, subangular.						
		5		23					no recovery.							
	22															Add 200 gallons water to borehole and drilling pan
192	23								**VOLCANIC SAPROLITE or VALLEY FILL** highly weathered basalt, SANDY CLAY (CH), brown (7.5 YR 4/3), stiff, with reddish yellow (7.5YR 6/6) and gray (7.5YR 5/1) sand nodules, high plasticity.					[30]	
	24															Water loss = 0 gallons
190	25	6		100					becomes completely weathered.							
	26								subrounded basalt cobble, 4" diameter. becomes yellowish red (5YR 4/6).							
188	27						M		**BASALT Massive A'a** boulder, dark gray (5YR 4/1), slightly weathered, very strong, 30% 0.5 mm rounded vesicles, 5% 3-4 mm rounded vesicles, 20% 1-3 mm plagioclase phenocrysts.					[20]	
		7		100												
	28														[24]	Pause drilling to remove and replace core barrel
186	29								**VOLCANIC SAPROLITE or VALLEY FILL** highly to completely weathered basalt, weak to						

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
186	29								extremely weak, weathers into sandy, gravelly clay (CH), reddish brown (5YR 4/3), yellowish red (5YR 5/6), and dark reddish gray (5YR 4/2), high plasticity.					
184	31	8		63					no recovery.					Water loss 0 gallons
182	33	9		100			M M		**BASALT Massive A'a** boulder, dark gray (5YR 4/1), slightly weathered, very strong, 30% 0.5 mm rounded vesicles, 5% 3-4 m rounded vesicles, 5% <1 mm plagioclase phenocrysts.				[1] [60]	
180	35	10	2	100					**VOLCANIC SAPROLITE or VALLEY FILL** SANDY CLAY (CH), brown (7.5 YR 4/4), black (7.5 YR 2.5/1, and gray (7.5 YR 5/1), fine angular sand, medium stiffness, high plasticity.					Water loss 0 gallons
178	37													
176	39	11		76									[100]	Water loss 0 gallons
174	41													
172	43						IF		**VOLCANIC SAPROLITE** Reddish brown (5YR 5/4), highly weathered basalt, extremely weak, 40% <1 mm rounded vesicles.				[7.89]	
170	45		3				M 1 IF		1. 0°, J, N, Cl, Su, Pl, SR					Water loss 50 gallons

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
170	45															
		12		56		28										
168	47															
	48						IF								[43]	
166	49		3													
	50						M									Water loss < 1 gallon
		13		86		38	M									
164	51								becomes completely weathered.							
	52								no recovery.							
162	53														[150]	
	54						IF									
							1		1. 0°, J, N, No, No, Wa, SR							
160	55						2		2. 30°, J, N, Mn, Sp, Wa, SR							Water loss < 1 gallon
		14	4	84		40			becomes intensely fractured, moderately weathered.							
	56						IF									
									becomes completely weathered, extremely weak.							
158	57															
	58								no recovery.					0.0	[6]	
156	59								becomes highly weathered, very weak.							
									becomes completely weathered, extremely weak.							
	60															
		15		50		0										
154	61															

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
154	61								no recovery.					
	62								becomes intensely fractured, dark gray (5YR 4/3).					
152	63								**BASALT Massive A'a** boulder, gray (5YR 5/1), slightly weathered, very strong, 10% <1 mm vesicles.					
	64		4				M		**VALLEY FILL** Fat CLAY (CH) with cobbles, mottled dark gray (7.5YR 4/1) and brown (7.5 YR 5/3), very stiff, high plasticity, 1-2 cm rounded cobbles.				[38]	
150	65	16		100		0	M							
	66													
148	67						1		**BASALT Massive A'a** boulder, gray (5YR 5/1), slightly weathered, very strong, 10% 1-5 mm vesicles. 1. 45°, J, VN, Su, Mn+Fe, Ir, SR				[16]	
	68	17		100		0			**VALLEY FILL** Fat CLAY (CH) with cobbles, mottled dark gray (5YR 5/1) and brown (7.5 YR 5/3), very stiff, high plasticity, 1-5 cm rounded to angular basalt cobbles.					
146	69		5											End of drilling 5/16/2020
	70											0.0	[19]	Resume drilling on 5/18/2020
144	71	18		100		0			**BASALT Massive A'a** boulder, gray (5YR 5/1), slightly weathered, strong, 10% 1-7 mm subrounded to subangular vesicles. **VALLEY FILL** Fat CLAY (CH) with cobbles, mottled brown (7.5 YR 5/3), strong brown (7.5YR 4/6) and gray (5YR 5/1), stiff, high plasticity, 1-8 cm subangular cobbles. becomes more mottled, larger cobbles.					Add 500 gallons water
	72													
142	73											0.0	[6]	Light brown water return on 5/18/2020 unless otherwise noted
	74													
140	75	19	6	80		0								
	76													
138	77								**BASALT Massive A'a**					

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
138	77						NR		boulder, dark greenish gray (GLEY 1 4/10G), slightly weathered, strong, 5% <2 mm rounded vesicles. no recovery.					
	78								**VALLEY FILL** Fat CLAY (CH), brown (7.5YR 4/3), stiff, high plasticity, minor black (7.5YR 2/1) mottling.			0.0	[30]	
136	79													
	80		6											
		20		100		0								
134	81								**BASALT Massive A'a** boulder, dark gray (5YR 4/1), slightly weathered, moderate strength, 10% 1-4 mm subrounded vesicles.					
	82						IF							
									VALLEY FILL Fat CLAY (CH), brown (7.5YR 4/3), stiff, high plasticity, minor black (7.5YR 2/1) and yellowish red (5YR 4/6) mottling.					
132	83								**BASALT Massive A'a** boulder, dark gray (5YR 4/1), slightly weathered, moderate strength, 10% 1-4 mm subrounded vesicles. 1. 60°, J, VN, Mn, Sp, Wa, SR 2. 45°, J, VN, Mn, Sp, Wa, SR			0.0	[16]	Pause drilling to clean out mud pan. Borehole too muddy to measure depth to water.
	84						1							
							2							
130	85								**VALLEY FILL** Fat CLAY (CH), brown (7.5YR 4/3), stiff, high plasticity, minor black (7.5YR 2/1) and yellowish red (5YR 4/6) mottling.					Rig chattering at ~85'-86'
		21		100		30								
	86		7				IF		**BASALT Massive A'a** boulder, dark gray (GLEY 1 5/N), moderately weathered, medium strength, 5% 4 mm subrounded elongate vesicles, Mn staining in fractures, **fat CLAY (CH)** between pieces as described above.					
128	87								**BASALT Pahoehoe** pieces, reddish brown (5YR 4/3), moderately to highly weathered, weak, 10% < 2mm rounded vesicles, with clay between pieces as described above.					
	88								**BASALT Massive A'a** boulder, pieces, as described above.			0.0	[30]	
									BASALT Pahoehoe pieces with **fat CLAY (CH)** as above between pieces.					
126	89								**BASALT Massive A'a** boulder, very dark gray (10 YR 3/1), moderately weathered, strong, 5% 1-4 mm rounded vesicles.					
	90								**VALLEYF ILL** Fat CLAY (CH), brown (7.5YR 4/3) with black (5YR 2.5/1) mottling, stiff, high plasticity.					
		22		100		36	IF		**BASALT Pahoehoe** dark gray (7.5 YR 4/1), moderately weathered, medium strong, 5% 3-9 mm rounded vesicles.					
124	91						1		1. 30°, J, N, Mn+Fe+Cl, Sp, Su, Wa, SR					
							2		2. 5°, J, VN, Mn+Fe+Cl, Sp, St, R					
							3		3. 0°, J, VN, Mn+Fe+Cl, SP, Wa, R					
	92						4		4. 90°, J, VN, Mn+Fe+Cl, Sp, Wa, SR					Pause to gauge water levels, book #19, page 37
							IF		IF. Mn+Fe+Cl, Sp					
122	93													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
122	93								1. 45°, J, N, Mn Sp, Cl Su, Wa, SR 2. 0° J, MW, Mn Sp, Cl Sp+Su, IR, R 3. 45°, J, N, Mn+Fe+Cl, Sp, Wa, SR			0.0	[33]	
	94							1						
120	95		8						**CLAYEY SAND (SC)**, medium to coarse, reddish brown (5YR 4/3) and reddish yellow (7.5YR 4/6), angular.					
		23		90		64			**BASALT Pahoehoe** Brown (7.5 YR 4/2), moderately weathered, weak to medium strong, 5% 1-4 mm rounded to subrounded vesicles.					
	96							2	4. 45°, J, VN, Mn, Fe, Cl, Sp, Wa, SR 5. 5° J, N, Mn+Fe+Cl, Sp, Wa, SR					
								3						
118	97							4	becomes highly weathered, very weak.					
								5						
							NR		no recovery.					
	98								becomes moderately weathered, medium strong, 10% 2-5 mm rounded to subrounded vesicles.			0.0	[38]	
								1	1. 0°, J, N, Mn+Fe+Cl, Sp, Wa, SR					
116	99							2	2. 0°, J, VN, Mn Sp, Cl Sp+Su, Wa, SR 3. 5°, J, N, Mn Sp, Cl Sp+Su, Wa, SR 4. 30°, J, VN, Mn Sp, Cl Su, Wa, SR					10" sch. 40 steel conductor casing installed to 99' bgs.
								3	becomes dark reddish gray (5YR 4/2), highly					
					IF				weathered, weak, 3% <2mm rounded to subrounded vesicles partially infilled with clay, 2% highly weathered olivine crystals.					
	100							4						
		24		100	IF	76			becomes completely weathered.					
114	101								becomes dark reddish brown (2.5 YR 3/3), moderately weathered, medium strong, 5% 1-3 mm subrounded to rounded vesicles.					
								5	becomes highly weathered, weak to medium strong.					
	102		9					6						
									becomes moderately weathered, medium strong.					
								7	5. 0° J, N, Mn+Fe+Cl, Sp, Wa, R					
								8	6. 10° J, VN, Mn+Fe+Cl, Su+Sp, Wa, SR 7. 10° J, VN, Mn Sp, Cl Su, Wa, SR					
112	103								8. 5° J, N, Mn+Cl, Sp, IR, R becomes 5% <2 mm rounded to subrounded vesicles.			0.0	[38]	
								1						Add 70 gallons water
	104							2						
								3	1. 45°, J, VN, Mn+Cl, Sp+Su, Wa, SR 2. 45°, J, VN, Mn+Sp, Cl, Pa, Wa, SR 3. 5°, J, VN, Mn+Fe+Cl, Sp, Wa, SR					
								4	4. 0°, J, VN, Mn,+Fe, Cl, Sp, Wa, SR					
110	105							5	5. 20°, J, VN, Mn+Fe Sp, Cl Su+Sp, Wa, SR					
								6	6. 20°, J, VN, Mn+Fe+Cl, Sp, W					
		25		92		70		7						
									becomes very dark gray (7.5 YR 2/1), moderately weathered, medium strong, 5% <2 mm rounded vesicles.					
	106							8						
								9						
								10	7. 0°, J, VN, Mn+Fe+Cl, Sp, Wa, SR					
								11	8. 90°, J, VN, Mn, Fe+Cl, Sp+Su, Wa, SR					
								12						
108	107								becomes 15% <4 mm rounded vesicles.					Pause to gauge water levels
									9. 0°, J, VN, Mn+Cl, Sp, Pl, SR 10. 5°, J, MW, Cl, Pa, Wa, SR					
							NR		no recovery.					
	108								11. 60°, J, VN, Mn+Cl, Su, Wa, SR 12. 60°, J, VN, Mn+Cl, Sp+Su, Wa, SR			0.0	[43]	
106	109													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/5/2021 RHMW16

~~For Red Hill AOC Party Use Only~~

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
106	109								becomes 5% <1 mm subrounded vesicles, infilled with clay.					
							1		becomes 10% 1-3 mm rounded to subrounded vesicles, partially infilled with clay.					
105	110		9				M							
		26		100		82	2		1. 0°, J, N, Mn Sp, Cl Su, Wa, SR					
							3		2. 0°, J, N, Mn+Fe+Cl, Sp, Pl, SR					
104	111						M		3. 0°, J, N, Mn+ Fe+Cl+Sp, Pl, SR					
							4		4. 45°, J, VN, Mn+Fe Sp, Cl Sp+Su, Wa, SR					
103	112								5. 10°, J, VN, Mn+Fe+Cl, Sp+Su, Pl, S					
									6. 80°, J, VN, Mn+Sp, Cl Pa, Wa, S					
									7. 0°, J, N, Mn Sp, Cl Pa, Wa, S					
							6		becomes 5% <3 mm rounded to subrounded vesicles, infilled with red (2.5 YR 5/8) clay.					
							7							
							M		becomes 10% 1-6 mm rounded to subrounded vesicles, partially infilled with clay, medium strong to strong.					End of coring on 5/18/2020
102	113											0.0	[6]	
									becomes dark brown (7.5 YR 3/2), moderately weathered, medium strong, 5% <2 mm subrounded vesicles, mostly infilled with clay.					Resume coring on 5/19/2020
101	114								1. 45°, J, VN, Mn Sp, Cl Pa, St, R					Add 20 gallons water
									2. 0°, J, VN, Mn+Fe Sp, Cl Sp+Pa, Wa, SR					Void at 114'-116' per driller
							NR		3. 85°, J, VN, Mn+Cl, Sp, Wa, SR					
100	115		10						no recovery.					
		27		84		350	1		becomes very dark gray (7.5 YR 3/1), moderately weathered to medium strong, 7% 1-4 mm rounded to subrounded vesicles, partially infilled with clay.					Add 30 gallons water
99	116						2		becomes 10% 2-9 mm rounded to subrounded vesicles, partially infilled with clay.					Light brown water recovery resumes after 116' and for remainder of drilling on 5/19 unless otherwise stated.
							3		becomes medium strong, 10% 1-4 mm rounded to subrounded vesicles, partially infilled with clay.					
98	117						4							
							M		4. 60°, J, VN, Mn+Cl, Sp, Wa, SR					
							5		5. 90°, J, VN, Mn+Fe Sp, Cl Sp+Pa, Wa, SR					
97	118						6		6. 0°, J, VN, Mn+Fe Sp, Cl Su, Wa, SR					
							7		7. 0°, J, VN, Mn+Fe Sp, Cl Su, Wa, SR					
												0.0	[38]	Pause to gauge water levels and collect DOH sample
							1		becomes very dark gray (7.5 YR 3/1), slightly weathered, strong, 15% 1-8 mm rounded to subrounded vesicles.					
96	119						2		becomes 5% 1-12 mm rounded to subrounded vesicles.					
							M							
95	120													
									becomes 10% 1-3 mm rounded to subrounded vesicles.					Add 30 gallons water, light brown water recovery
		28		90		62	M		1. 45°, J, VN, Mn+Fe Sp, Cl Sp+Su, St, SR					
							3		2. 45°, J, VN, Mn+Fe Sp, Cl Su+Pa, Wa, S					
94	121								3. 0°, J, VN, Mn+Fe+Cl, Sp, IR, R					
							IF		IF. Mn, Fe Sp, Cl Sp, Su, Pa, light red (2.5YR 7/6) clay					
93	122													
							IF		becomes completely weathered, extremely weak, ground up.					
							NR		no recovery.					
92	123								becomes very dark gray (7.5YR 3/1), moderately weathered, strong, 5% <3 mm subrounded irregular vesicles, mostly infilled with clay.			0.0	[50]	
							1		possible flow contact, becomes dark reddish brown (5YR 3/4), moderately weathered, strong, 5% 1-4 mm subrounded vesicles					
							2							
91	124		11				IF		IF. Infilled with clay					
									becomes dark reddish gray (5YR 4/2), slightly weathered, strong, 10% 2-7 mm rounded to subrounded vesicles.					
							3							
90	125													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
90	125														
		29		102		72			1. 0°, J, VN, Mn+Fe Sp, Cl Pa, Wa, S 2. 45°, J, VN, Mn+Fe Sp, Cl Pa, Wa, S becomes 15% <4 mm rounded vesicles, 1% weathered olivine phenocrysts.						
	126							4	3. 45°, J, VN, Mn+Fe Sp, Cl Sp+Su, Wa, SR flow contact, black (GLEY 1 2.5/N) becomes reddish gray (5YR 5/2), moderately weathered, weak to medium strong, 2% <3 mm irregular subrounded vesicles.						Add 12 gallons water, light brown water recovery
88	127							5 6 7	becomes dark reddish brown (5 YR 3/2), slightly weathered, strong to very strong, 15% 1-7 mm rounded to subrounded vesicles.						
	128												0.0	[43]	Pause to water monitor levels, book #19
86	129		11					1	4. 10°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 5. 5°, J, VN, Mn+Fe+Cl, Sp, St, S 6. 45°, J, VN, Mn+Fe Sp, Cl Su+Pa, Wa, S 7. 45°, J, VN, Mn+Fe Sp, Cl Su, Wa, R						
								2	becomes very dark gray (7.5 YR 3/1), moderately weathered, strong, 15% 2-6 mm rounded to subrounded vesicles, partially infilled with clay.						Add 12 gallons water, light brown water recovery
	130	30		100		72			1. 5°, J, VN, Mn+Fe Sp, Cl Sp+Su, Wa, SR 2. 0°, J, VN, Mn+Fe Sp, Cl Pa, Wa, SR						
84	131							IF	**BASALT A'a Clinker** welded, very dark gray (7.5 YR 3/1) and black (7.5 YR 2.5/1), highly weathered, very weak, with reddish yellow (5YR 6/6) clay covering and filling most of rock.						
	132							3	becomes moderately weathered, medium strong. 3. 0°, J, N Mn Sp, Cl Pa, Wa, S						
82	133												0.0	[33]	
								1 2	1. 0°, J, VN, Mn+Fe Sp, Cl Pa, Wa, SR 2. 5°, J, VN, Mn+Fe+Cl, Sp, St, SR						
	134							3	**BASALT Massive A'a** dark gray (5YR 4/1), moderately weathered, medium strength, 2% <2mm irregular vesicles, infilled with clay.						Add 12 gallons water, light brown water recovery
80	135	31		100		54		4 5 6	becomes gray (2.5 Y 5/1), slightly to moderately weathered, strong, 5% 1-4 mm subrounded irregular vesicles.						
	136		12					7 8	3. 90°, J, VN, Mn+Fe Sp, Cl Pa, St, SR, reddish yellow (5YR 6/6) clay 4. 0°, J, VN, Mn+Fe Sp, Cl Pa, St, SR 5. 0°, J, N, Mn+Fe+Cl, Sp, Wa, SR 6. 60°, J, VN, Mn+Fe Sp, Cl Pa, Wa, SR 7. 10°, J, VN, Mn+Fe+Cl, Sp, Pl, S 8. 80°, J, VN, Mn+Fe Sp, Cl Pa, Wa, Sr						Pause to gauge water levels, graph B
78	137							IF	IF. light red (2.5 YR 6/8) clay in fractures						End of coring on 5/19/2020
	138												0.0	[38]	
								1 2 3	1. 50°, J, VN, Mn Sp, Cl Su, Wa, S 2. 35°, J, VN, Mn+Fe+Cl, Sp, Wa, S 3. 25°, J, VN, Mn+Fe+Cl, Sp, Wa, S 4. 90°, J, VN, Mn+Fe Sp, Cl Sp+Su, Wa, SR 5. 0°, J, N, Mn+Fe Sp, Cl Pa, Wa, SR						Resume coring on 5/20/2020 after gauging water levels.
76	139							4	becomes 5% 2-35 mm subrounded elongate vesicles, partially infilled with clay.						
	140							5							Add 10 gallons water, light brown water recovery
		32		100		66									
74	141														

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
74	141						6 7 8		6. 5°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 7. 90°, J, VN, Mn+Fe Sp, Cl+Su, Wa, S 8. 20°, J, VN, Mn+Fe Sp, Cl+Pa, IR, SR 9. 0°, J, VN, Mn+Fe+Cl, Sp, Pl S					
	142						9		becomes very dark gray (10YR 3/1), slightly weathered, very strong, 3% <2 mm rounded to subrounded vesicles.					
72	143								irregular >30 mm vugs.			0.0	[38]	Add 10 gallons water, light brown water recovery Pause to gauge water levels, graph C
	144						1							
							2		becomes dark gray (10YR 4/1), moderate to slightly weathered, strong to very strong, 10% 2-30 mm subrounded to subangular irregular elongate vesicles.					
70	145		13				3							
		33		100		86								
	146													
									1. 50°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 2. 80°, J, N, Mn+Fe Sp, Cl Su, Wa, SR 3. 90°, J, VN, Mn+Fe+Cl, Sp, St, R 4. 0°, J, VN, Mn+Fe+Cl, Sp, IR, R 5. 10°, J, VN, Mn+Fe+Cl, Sp, Wa, SR					
68	147						4 5							
														End of coring on 5/20/2020
	148								becomes slightly weathered, strong, 10% 1-20 mm subrounded elongate irregular vesicles.				[30]	Resume coring on 5/21/2020
66	149						1							
							2							
	150													
									1. 0°, J, VN, Fe, Su, Wa, S 2. 5°, J, VN, Cl Pa, Mn Su, Wa, S IF. 0° and 85°, W, Cl Pa, Mn Su. 3. 10°, J, N, Cl Pa, Mn Su, IR, R					Water loss 100 gallons
64	151						IF							
	152						3							
		34		100		78								
62	153		14						becomes mottled very dark gray (GLEY 1 4/10G) and gray (GLEY 1 3/10G), slightly weathered, strong, 7-10% 1-2 mm elongate vesicles, xenoliths of 10% vesicles.			0.0	[33]	
	154													Water loss 400 gallons
							IF		IF. 75°-30°, J, N, Fe+Mn, Su, Pl, S 1. 75°, J, N, Mn Su, Cl Pa, Pl, S					
60	155						1 M							
		35		100		86								
	156													
							IF		IF. high angle, J, N, Fe+Mn Su, Cl Pa, Pl, S					
58	157								becomes slightly weathered, strong, 25% 2-10 mm					

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
158	157								vesicles. becomes slightly weathered, strong, 5-7% 1-2 mm vesicles.					Pause to gauge water levels
			14				2		2. 5°, J, VN, Mn, Su, Wa, S			0.0	[6]	
156	159						1 2 M		transitions to **BASALT A'a Clinker** welded, dark gray (5YR 4/1) mottled with yellowish red (5YR 4/6), moderately weathered, medium strong. 1. 60°, J, W, Mn+Fe Su, Cl Pa, Wa, SR 2. 60°, J, N, Mn+FE Su, Cl Pa, Wa R					Water loss 300 gallons
160							IF		becomes black (5YR 2.5/1), and reddish yellow (5YR 7/4), highly weathered, weak, with reddish brown (5YR 4/3) and dark red (2.5 YR 3/6) clay infill and					
			36	92		92								
154	161						IF NR		clasts of unweathered black (5YR 2.5/1) a'a with 5-15 mm elongate vesicles. no recovery.					
162							M M M		mechanical fractures show no different mineralogy of staining than highly weathered rock.					
152	163						IF 1		**BASALT Massive A'a** very dark gray (5YR 3/1), slightly weathered, medium strong to strong, 15% 1-15 mm slightly elongate vesicles.			0.0	[25]	
164			15				M		1. 45°, J, VN, Mn+Fe Su, Cl+Pa, Pl, S					Water loss 300 gallons
150	165						IF		becomes reddish gray (5YR 5/2) to reddish brown (5YR 5/3), moderately weathered, medium strong to strong.					
			37	88		22								
166							IF		IF. becomes high angle, VN, Mn+Cl Su, Pl, S					
148	167						NR		**BASALT A'a Clinker** loose, black (5YR 2.5/1), dark reddish brown (5YR 3/4), highly weathered, weak, reddish yellow (5YR 7/8) clay infill in clast vesicles, Mn Su staining throughout. no recovery.					End of coring on 5/21/2020, transducer deployed on 5/22/2020
168														
							IF		**BASALT Massive A'a** very dark gray (GLEY 1 3/N), slightly to moderately weathered, medium strong to strong, 5% 1-22 mm subrounded to subangular irregular vesicles, partially filled with clay. IF. Filled with reddish yellow (5YR 7/6) clay 1. 10°, J, VN, Mn+Cl, Sp, Wa, SR 2. 5°, J, VN, Mn+Fe+Cl, Sp, IR, SR 3. 5°, J, VN, Mn+Fe+Cl+Sp, Wa, SR 4. 60°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 5. 10°, J, N, Mn+Fe+Cl, Sp, Wa, SR		0.0	[5]	Resume coring on 5/27/2020 after retrieving transducer. Pause at 0918 for maintenance, resume coring at 0946 Add 300 gallons water, light brown water recovery
146	169						1							
			38	100		27								
170							2 3 4 5							
144	171		16				IF		becomes slightly weathered, very strong, 10% 1-25 mm subrounded elongate vesicles and vugs, partially infilled with clay. IF. Mn+Fe Sp, Cl Pa+Su, reddish yellow (5YR 7/6) 1. 0°, J, N, Mn+Fe Sp, Cl Pa, St, SR 2. 5°, J, N, Mn+Fe+Cl, SP, IR, SR		0.0	[8]	
172			39	100		60	IF 1 2							Rig chattering at ~172', possible washed out clinker per
142	173								**BASALT Pahoehoe**					

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
42	173								dark brown (7.5 YR 3/2), moderately weathered, medium strong, 10% 1-4 mm rounded to subrounded, partially infilled with clay.			0.0	[33]	driller
	174		16											Add 100 gallons water, light brown water recovery
40	175	40		96		38			becomes dark grayish brown (10YR 4/2), moderately weathered, medium strong, 5% 2-12 mm subrounded partially elongate vesicles.					
	176								1. 5°, J, VN, Mn+Fe+Cl, Sp, Wa, R IF. Partially coated with clay 2. 0°, J, N, Mn+Fe+Cl, Sp, Wa, R 3. 0°, J, VN, Mn+Fe+Cl, Sp, Wa, R 4. 90°, J, VN, Mn+Fe Sp, Cl Su, St, R					
38	177													
	178								no recovery.					
									becomes very dark gray (10YR 3/1), slightly weathered, very strong, 7% 2-20 mm rounded to subrounded vesicles.			0.0	[6]	Rig chattering at ~178', pause to bail and gauge water level (logbook #19, page 62)
36	179								becomes dark gray (10YR 4/1), moderate to slightly weathered, medium strong to strong, 10% 1-10 mm rounded to subrounded vesicles.					
	180	41		100		80			1. 0°, J, N, Mn+Fe Sp, Cl Su, Wa, SR 2. 5°, J, N, Mn+Fe+Cl, Sp, Wa, SR 3. 45°, J, VN, Mn+Fe+Sp, Cl Su, Wa, SR 4. 0°, J, VN, Mn+Fe+Cl Su, St, SR					Add 400 gallons water, light brown water recovery
34	181								becomes strong, 5% 2-30 mm subrounded vesicles and vugs, partially infilled with clay					
	182													
32	183		17						becomes gray (GLEY 1 6/N), unweathered, extremely strong, massive, 3% 2-22 mm rounded to subrounded vesicles, 5% plagioclase phenocrysts.			0.0	[38]	
	184								1. 45°, J, VN, Mn+Fe Sp, Cl+Su, Wa, S 2. 0°, J, N, Mn+Fe+Cl, Sp, Wa, SR 3. 20°, J, VN, Mn+Fe, Sp, Pl, S 4. 20°, J, VN, Mn+Fe, Su+Sp, Pl, S					Add 400 gallons water, light brown water recovery
30	185								becomes <1% 4 mm rounded vesicles.					
		42		100		100								
	186													
28	187													Pause to bail and gauge water level (logbook #19)
	188													End coring on 5/27/2020
													[16]	Begin coring on 5/28/2020, rig chattering
26	189													

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
26	189								1. 65°, J, N Cl Pa, Mn+Fe Su, Wa, S					
	190	43		94		76			becomes dark gray (7.5YR 4/1), slightly weathered, strong, 15% 3-35 mm spherical and large irregular vesicles, 5% plagioclase phenocrysts, 2% slightly weathered olivine phenocrysts.					Add 400 gallons to fill hole, 50 gallons lost
24	191								becomes moderately weathered, strong to medium strong, 5% plagioclase phenocrysts.					
	192								2. 10°, J, W, Cl+Fe+Mn, Su becomes dark reddish brown (2.5 YR 4/4/), moderately weathered, medium strong, 30% 1-2 mm spherical vesicles, minor partial infill of light reddish brown (5YR 6/4) clay.					
22	193		18						no recovery.				[27]	
	194								**BASALT A'a Clinker** welded, dark reddish brown (2.5YR 4/4) and very dusky red (2.5YR 2.5/2), highly weathered, medium strong, reddish yellow (5YR 6/6) partial clay infill, minor halloysite and Mn+Fe on most clasts.					Water loss 50 gallons
20	195								becomes highly weathered, weak, minor clay infill, fine 2-5 mm clinker clasts.					
	196	44		92		14			becomes larger clasts in welded clinker, clay infill is pervasive, 3-35 mm clasts. no recovery. 1. 10°, J, W, Fe+Mn, Su, Wa, SR 2. 80°, J, W, Cl Pa, Fe+Mn Su, IR, R 3. 80°, J, N, Cl Su, Fe+Mn, Su Wa, R					
18	197								becomes very dark gray (5YR 3/1), moderately weathered, weak, with clay on fracture faces and not throughout core, 10% 1-3 mm irregular vesicles.					
	198								becomes dark gray (5YR 4/3) clasts in reddish brown (5YR 4/3) and reddish yellow (5YR 7/6) clay, highly weathered, weak to medium strong, 3-100 mm clay fragments.				[23]	
16	199													Water loss 50 gallons
	200	45		100		74			1. 60° J, VN, Cl Pa, Mn+Fe Su, St, R 2. 45°, J, N, Cl, Mn+Fe Su, Pl, R 3. 60°, J, VN, Cl Pa, Mn+Fe Sp, IR, R 4. 80°, J, W, Cl Pa, Mn+Fe Sp, Wa, S 5. 45°, J, W, Cl Pa, Mn+Fe Sp, Wa, S 6. 5°, J, N, Cl Pa, Mn+Fe Sp, Wa, S					
14	201													
	202								vertical 3 mm thick clay seam.					
12	203		19						yellowish red (5YR 5/8) clay, highly weathered, weak, thick halloysite clay-pervasive.			0.0	[13]	
	204								becomes dark reddish gray (5YR 3/2), moderately to highly weathered, less clay infill than above. 1. 20°, J, N, Cl Fi, Mn+Fe Sp, IR, SR 2. 75°, J, W, Cl Pa, Mn+Fe Sp, Pl, S					
10	205													

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
10	205															
		46		80		33			no recovery. dark gray (5YR 3/1), moderately weathered, medium strong.							
	206								3. 75°, J, N, Cl Pa, Mn+Fe Sp, Pl, S 4. 85°, J N, Cl Fi, Mn+Fe Sp, Wa, S 5. 5°, J, VN, Mn+Fe Su, Pl, S gradual transition to massive a'a							Paused from 1457-1509 due to blockage.
8	207								**BASALT Massive A'a** dark gray (5YR 3/1), moderately weathered, medium strong, 5-10% 1-3mm elongated vesicles, thick halloysite clay on fracture faces. 6. 5°, J, VN, Mn+Fe, Cl Su, Pl, S 7. 75°, J, N, Cl Fi, Mn+Fe Sp, Wa, S 8. 90°, J, N, Cl Fi, Mn+Fe, Sp, Wa, S							
	208		19													End of coring on 5/28/20
		47		100		0			1. 10°, J, W, Cl Su, Mn+Fe Sp, Pl, S 2. 75°, J, N, Cl Pa, Mn+Fe Su, Wa, S 3. 75°, J, N, Cl Pa, Mn+Fe Su, Wa, S					0.0	[8]	Resume coring on 5/29/20
6	209								1. 80°, J, W, Cl Fi, Mn+Fe Su, Wa, S 2. 60, J, W, Cl Fi, Mn+Fe Su, Wa, S						[5]	Add 500 gallons to fill hole, 50 gallons lost
	210								IF. moderately weathered, medium strong, all fractures partially filled with yellowish red (5YR 7/6) clay, becomes slightly weathered, medium strong to strong, 5% 1-8 mm elongate flattened vesicles.							
4	211	48		100		11.9			IF. Fracture faces show no alteration, mechanical							Very low recovery, driller pauses to change bit 1400-1405
	212								3. 5°, J, W, Mn+Fe Sp, Wa, S 4. 5°, J, W, Cl Su, Mn+Fe, Wa, S							Water loss 3500 gallons
2	213								becomes unweathered to slightly weathered, strong, 10% 1-20 mm elongate flattened vesicles						[50]	
	214		20						1. 45°, J, W, Cl Su, Mn+Fe Sp, Wa, S 2. 5°, J, W, Cl Su, Mn+Fe Sp, St, R 3. 5°, J, N, Cl SU, Mn+Fe Sp, Wa, R							Water loss 300 gallons
0	215	49		84		50										
	216								**BASALT A'a Clinker** loose, dark gray (5YR 4/1), highly to extremely weathered, weak, with yellowish red (5YR 7/6) halloysite clay throughout granular texture. becomes red (2.5YR 4/6), black minerals with distinct elongate cleavage visible (pyroxene), see photo log. no recovery.							Install 10" casing to 99' bgs on 7/31/2020
-2	217															
	218															End coring on 5/29/2020
									BASALT Pahoehoe dark gray (10YR 4/1), slightly weathered, strong, 15% 2-20 mm subrounded vesicles with large 50 mm irregular vugs, 5% olivine crystals.						[43]	Resume coring on 8/7/20, ~400 gallons added to trip in pipe
-4	219															
	220								1. 20°, J, N, No, No, Pl, R 2. 50°, J, N, Mn+Fe, Su, St, SR 3. 60°, J, N, Su, Mn+Fe, St, R 4. 0°, J, VN, Su, Mn+Fe, Pl, S							250 gallons water loss, light brown water return
		50		78		40										
-6	221															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-6	221								**BASALT A'a Clinker** loose, dark reddish brown (5YR 3/2), very dark gray (5YR 3/1), extremely weathered, very weak, reddish yellow (5YR 7/8) mottling, some subrounded clasts.					
	222						NR							End of coring on 8/7/2020
-8	223											0.0	[100]	Resume coring on 8/8/2020
	224								no recovery.					40 gallons water loss, brown water return
-10	225	51		40		8								
	226		21						1. 0°, J, VN, No, No, Pl, SR, weathered olivine 2. 0°, J, N, No, No, Pl, SR, weathered olivine 3. 0°, J, VN, No, No, Pl, SR, weathered olivine					
-12	227							1	**BASALT Massive A'a** very dark greenish gray (GLEY 3/10Y), moderately weathered, strong, 5% <1-10 mm irregular subrounded vesicles, 3% weathered olivine.					
	228							2				0.0	[38]	
								3	1. 85°, J, VN, Mn+Fe+Ol+Cl, Sp, St, SR 2. 5°, J, VN, Mn+Fe+Ol+Cl, Sp, Wa, SR 3. 0°, J, N, Mn+Fe+Ol+Cl, Sp, Wa, SR 4. 45°, VN, Mn+Fe+Ol+Cl, Sp, Wa, R					
-14	229							4	becomes slightly weathered, very strong, 3% <2 mm subrounded elongate vesicles, 2% weathered olivine					Rig chattering from 229' to 233'
	230							5	becomes 5% subrounded irregular vesicles, 10-15% slightly weathered olivine.					
		52		100		76								
-16	231							6	5. 5°, J, VN, Mn+Fe+Ol+Cl, Sp, Wa, R 6. 0°, J, VN, Mn+Ol, Sp, Pl, SR 7. 10°, J, VN, Mn+Fe+Ol Sp, Cl Su, St, SR					Water loss 40 gallons, light brown water return
	232							7	becomes greenish black (GLEY 1 2.5/10Y), 5% <5 mm elongate irregular vesicles, 5% weathered olivine.					
-18	233		22					1				0.0	[20]	
							NR	0	**BASALT A'a Clinker** no recovery.					
	234							M	loose, red (2.5YR 5/6), dark reddish brown (5YR 5/2), extremely weathered, weak, broken clasts, weathered olivine.					25 gallons water loss, light brown water return
								IF	**BASALT Pahoehoe** dark reddish brown (5YR 3/2), moderately weathered, medium strong, 3% 2-8 mm, rounded to subrounded vesicles, 2% weathered olivine.					
-20	235	53		94		32			becomes extremely weathered, very weak. becomes moderately weathered, medium strong to weak.					
	236							2	becomes slightly weathered, strong, 10% 4-15 mm rounded to subrounded vesicles.					
								3						
-22	237							4						

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-22	237								becomes brown (2.5YR 4/2), slightly weathered, strong, 15% 2-4 mm rounded vesicles.					
							5		1. 20°, J, N, Mn+Fe Sp, Cl Su, St, SR 2. 0, J, MW, Mn, Sp, IR, SR 3. 0°, J, VN, Mn, Sp, Wa, SR 4. 0°, J, VN, Mn+Fe, Sp, Wa, SR 5. 0°, J, VN, Mn+Fe, Sp, Wa, SR IF. Cl Sp + Su, Mn, Fe					
	238						IF					0.0	[25]	Lost partial circulation per driller
-24	239								no recovery.					
	240		22											Water loss 30 gallons, light brown water return
		54		50		0			Dark gray (10YR 4/1), moderately weathered, medium strong, 5% 1-2 mm subangular irregular vesicles, halloysite infill.					
-26	241						IF		IF. Mn+Cl, Su throughout					
	242						IF M		becomes 15% 2-5 mm subrounded to rounded vesicles, halloysite clay that becomes dark reddish brown (5YR 3/2) clay.					Pause to monitor water levels, logbook #19
-28	243								becomes very dark gray (10YR 3/1), slightly weathered, medium strong, 5% 2-10 mm rounded to subrounded vesicles.			0.0	[9]	
	244								becomes extremely weathered, weak.					Water loss 20 gallons, light brown water return
									becomes slightly weathered, medium strong, 5% <2mm rounded vesicles.					
-30	245	55		70		0			becomes moderately weathered, medium strong, 5% <1 mm vesicles infilled with clay.					
	246		23											
-32	247													Pause 1453-1515 high pressure release
	248								no recovery.				[50]	
-34	249													Water loss 60 gallons, light brown water return
	250													
		56		46		0								
-36	251						IF M		becomes reddish brown (10YR 4/4), moderately weathered, very weak, 40% 1-2mm rounded vesicles.					
	252						IF M		becomes dark gray (10YR 3/1), highly to completely weathered, moderately strong to very weak, with dark grayish brown (10YR 4/2) and white (10YR 8/1) clay in vesicles.					
-38	253													End of coring on 8/8/2020

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-38	253											0.0	[33]	Resume coring on 8/10/2020
	254													Added 200 gallons water to refill borehole, light brown water return
							NR		no recovery.					
-40	255		23											
		57		30		0								
	256													
									reddish brown (5YR 4/3), moderately weathered, weak, 30% 1-2 mm rounded vesicles.					
-42	257						IF		becomes 25% 0.5-1 mm vesicles.					
							M		IF. dark gray (5YR 4/1) Cl, Sp					
	258											0.0	[43]	
							NR		no recovery.					Water loss 20 gallons, some drilling foam in water return
-44	259													
	260													
		58		54		8.8	IF		becomes moderately weathered, weak, 30% 1-2 mm rounded vesicles.					
							M		IF. 'biscuit' fractures.					
-46	261								becomes dark reddish brown (5YR 3/2), 25% 0.5-1 mm vesicles.					
							IF		IF. fracture density increases					
	262													
									25% 0.5 mm vesicles.					
									IF. 'biscuit' fractures.					Resume coring on 8/13/2020
-48	263											0.0	[10]	
							NR		no recovery.					
	264		24											Rig chattering at 264'
							IF		IF. 'biscuit' fractures.					
							M							
-50	265								reddish brown (5YR 4/3), slightly weathered, strong, 15% 0.5-1 mm rounded vesicles.					
		59		84		33.2			1. 85°, J, MW, Cl+Mn, Su+Sp, Pl, SR					Water loss 20 gallons
	266						1		2. 0°, J, VN, Cl, Su+Sp, Pl, S					
									3. 10°, J, N, No, No, Wa, SR					
							2		transitions to 25% 0.5-1 mm subrounded irregular vesicles.					
-52	267								20% 1-5 mm rounded to elongate vesicles.					
									15% 3-7 mm subrounded irregular vesicles.					
									25% 1-5 mm subrounded irregular vesicles.					
	268						3							
							NR		**BASALT A'a Clinker** loose, reddish brown (5YR 4/4) and dark reddish brown (5YR 3/4), slightly weathered, strong, pinkish white (5YR 8/2) clay on clast exterior.			0.0	[20]	
-54	269													

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Log of Boring RHMW16

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-54	269						MR		no recovery. 1. 5°, J, MW, Cl, Su/Sp, Wa, SR 2. 0°, J, N, Mn+Cl, Su, Wa, SR 3. 15°, J, N, Mn+Cl, Su, Wa, SR 4. 0°, J, VN, Mn+Cl, Su, Wa, SR no recovery.					Water loss 20 gallons, light brown water return
	270	60		70		16	IF		**BASALT Massive A'a** dark gray (5YR 4/1), slightly weathered, very strong, 5% 0.5-1 mm elongate irregular vesicles.					
-56	271						1 2 3 4 5		5. 0°, J, VN, Mn+Cl, Su, Wa, SR becomes 25% 1-5 mm rounded vesicles, 20 mm vugs.					
	272		24				6 7 8 9 10 11		6. 0°, J, VN, Cl, SP, Wa, SR becomes 20% 0.5-3 mm rounded vesicles. 7. 45°, J, VN, Cl, Su, Wa, SR 8. 0°, J, VN, No, No, Pl, S 9. 80°, J, N, Cl,+Mn, Su, Wa, SR 10. 60°, J, N, Cl+Mn, Su/Sp, Pl, SR					
-58	273						1 3 4 IF		becomes 15% 0.5-10 mm elongate irregular vesicles. 11. 10°, J, N, Cl+Mn, Su/Sp, IR, SR				[6]	
	274						5 6 7 8		1. 10°, J, N, No, No, Wa, S 2. 45°, J, VN, Mn+Cl, Wa, SR 3. 0°, J, VN, Mn, Su, Wa, SR 4. 0°, J, N, Cl, Su, Pl, SR					Rig chattering at ~274'
-60	275	61	25	80		8	9 10 IF 11		becomes 5% 0.5-1 mm elongate irregular vesicles. 5. 20°, J, N, Mn+Cl, Su, Wa, SR 6. 15°, J, N, Mn Su, Cl Sp, St, SR 7. 5°, J, N, Mn, Sp, Wa, SR 8. 20°, J, N, Mn, Sp, Wa, SR					Water loss 500 gallons with ~50% circulation, light brown water return
	276						12		becomes 20% <1 mm irregular vesicles.					
-62	277						IVR		**BASALT A'a Clinker** loose, reddish brown (5YR 4/4) and yellowish red (5YR 6/4), highly weathered, weak, white (10YR 8/1) clay in vesicles. 9. 20°, J, N, Mn, Su, Wa, SR 10. 80°, J, N, Mn Su, Cl Sp, IR, SR 11. 5°, J, N, No, No, Wa, SR 12. 80°, J, N, Mn, Su, St, R no recovery.					
	278												[33]	
-64	279						1 IF		**BASALT Pahoehoe** reddish brown (5YR 4/4), yellowish red (5YR 6/4), and dark reddish gray (5YR 4/2), moderately weathered, very weak, 40% <1mm rounded vesicles, flow contact becomes dark reddish brown (5YR 3/2), medium strong, 40% 1-3 mm rounded vesicles.					Rig chattering at 279'
	280	62		92		20	2 3 4 5		30% 2-3 mm irregular vesicles, strong. 20% 1-3 mm elongate vesicles. 1. 0°, B, MW, No, No, IR, R (flow contact) 2. 0°, J, MW, No, No, Wa, R 3. 0°, J, N, No, No, Wa, SR					Water loss 400 gallons, 50% circulation
-66	281						6 IF		becomes dark reddish gray (5YR 4/2), 50% <1mm rounded vesicles.					
	282						7 8 9 10 11		4. 0°, J, N, No, No, Wa, SR 5. 0°, J, N, No, No St, R becomes 25% 1-3 mm subrounded vesicles. 6. 0°, J, VN, No, No, Pl, SR becomes 45% <1 mm subrounded vesicles, flow contact.					
-68	283						1		45% <1mm subrounded vesicles.			0.0	[30]	
	284		26				2 3 4 5 6 7		7. 5°, J, N, No, No St, VR 8. 10°, J, N No, No, Wa, VR 9. 5°, J, MW, No, No, IR, R 10. 0°, J, N, No, No, Pl, SR 11. 0°, J, N, No, No Pl, SR 25% 0.5-1 mm irregular vesicles with 5% 3-10 mm rounded vesicles.					
-70	285													

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Log of Boring RHMW16

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-70	285													
		63		100		30			1. 0°, J, N, No, No, Wa, SR 2. 5°, J, N, No, No, Wa, SR 3. 0°, J, N, No, No, Pl, SR					Water loss 400 gallons, 50% circulation
	286								large 30 mm vug.					
									becomes 45% <1 mm irregular, elongate vesicles with 1% 20 mm vugs.					
									becomes 25% 0.5-3 mm irregular vesicles.					
-72	287		26						4. 5°, J, VN, Cl, Sp, Wa, SR 5. 15°, J, N, Cl, Sp, Wa, R					
									45% <1 mm subrounded vesicles 6. 0°, J, N, No, No, Wa, R 7. 10°, J, MW, Cl, Sp, Wa, SR					
	288								45% 1-3 mm elongate rounded vesicles.			0.0	[43]	
									30% 1-5 mm irregular vesicles with 10-20 mm vugs.					
-74	289								8. 10°, J, VN, Cl, SP, St, SR 9. 5°, J, VN, No, No, Wa, SR 10. 0°, J, VN, No, No, Pl, SR 11. 15°, J, VN, No, No, Wa, SR					Water loss 400 gallons, 50% circulation
	290								20% 2-10 mm irregular vesicles.					
		64		88		42			40% 0.5-1 mm subrounded vesicles.					
									45% <1 mm rounded vesicles. 12. 5°, J, N, No, No, Wa, SR 13. 10°, J, VN, Mn, Sp+Su, Wa, SR 14. 0°, J, VN, Mn, Sp+Su, Wa, SR					
-76	291								no recovery. 15. 15°, J, VN, Mn, Sp+Su, Wa, SR 16. 50°, J, N, Mn, Su, St, SR 17. 0°, J MW, No, No Wa, SR					
	292								discoloring around joint, strong brown (7.5 YR 5/6), possible flow contact. 18. 0°, J, MW, No, No, Wa, SR 19. 0°, J, N ,No, No, Pl, SR 20. 15°, J, N, No, No, Wa, SR					
-78	293								1. 0°, J, N, No, No, Wa, SR 2. 20°, J, N, Cl, Sp, IR, SR			0.0	[20]	
	294								**BASALT A'a Clinker** welded, dark reddish brown (5YR 3/2), yellowish red (5YR 4/6), and very dark gray (5YR 3/1), moderately weathered, very weak. 3. 0°, J, VN, Mn, Su+Sp, Wa, R 4. 5°, J, MW, Mn, Su+Sp, Wa, R 5. 0°, J, MW, No, No, IR, R 6. 0°, J, N, No, No Wa, SR 7. 10°, J, N, No, No Wa, SR 8. 10°, J, MW, Mn, Sp+Su, IR, SR					Water loss 400 gallons, 50% circulation
-80	295													
		65		62		22								
	296		27						**BASALT A'a Clinker** loose, dark reddish brown (5YR 3/2), yellowish red (5YR 4/6), and very dark gray (5YR 3/1), moderately weathered, strong, subangular clasts. no recovery. 1. 70°, J, N, No, No, St, SR 2. 0°, J, VN, No, No, Wa, SR 3. 0°, J, N, Cl, Su, Wa, SR 4. 0°, J, N, Cl, Su, Pl, SR 5. 60°, J, N, Mn, Su, Wa, SR 6. 20°, J, MW, No, No, IR, SR					
-82	297													
	298											0.0	[13]	End of coring on 8/10/2020 Resume coring on 8/11/2020
									BASALT A'a Clinker welded, dark reddish brown (5YR 3/2) and very dark gray (5YR 3/1), slightly weathered, medium strong.					Add 200 gallons to refill borehole
-84	299								**BASALT A'a Clinker** loose, dark gray (10YR 4/1), slightly weathered, strong, subrounded clasts. no recovery.					
	300													Water loss 600 gallons, light gray water return
		66		82		0			**BASALT A'a Clinker** welded, dark reddish brown (5YR 3/2), very dark gray					
-86	301													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	SAMPLES: PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-86	301						IF M		(5YR 3/1), moderately weathered, medium strong, yellowish red (5YR 5/6) clay between clasts. **BASALT Massive A'a** dark gray (5YR 4/1), slightly weathered, strong, 15% <1 mm irregular elongate vesicles.					Per driller - lost circulation in first 4' of run, water dropped significantly at 3', and returned in final 1' of run
	302						IF M							
-88	303						1		becomes 10%, 0.5-2 mm irregular elongate vesicles.				[13]	
							2		1. 45°, J, MW, Fe+Mn, Su, Wa, SR					
							3		2. 35°, J, N, Mn+Cl, Su/Sp, Wa, SR					
	304		27				4		3. 0°, J, N, Mn, Sp, Wa, SR					
							5		4. 70°, J, N, Mn+Cl, Su+Sp, Pl, S					Added 600 gallons, 50% return
							IF		5. 10°, J, N, Cl, Pa, St, R					
							6		6. 10°, J, VN, Mn, Sp/Su, Pl, S					
-90	305						IF		7. 20°, J, N, Cl+Mn, Su, Pl, SR					
									8. 15°, J, N, Mn, Su/Sp, Wa, R					
		67		100		0			9. 5°, J, VN, Mn, Su/Sp, Pl, R					
									10. 35°, J, VN, Mn, Sp/Su, St, R					
									becomes 10% 1-5 mm elongate irregular vesicles with 5% 10-20 mm elongate vesicles and vugs.					
	306						7							
							8							
							9							
-92	307						10							
							IF		IF. pinkish white (5YR 8/2) clay on fracture surfaces.					
	308												[16]	
							1		becomes 3% <1 mm subrounded elongate vesicles.					
-94	309		28				2							Added 600 gallons, 50% return
									1. 5°, J, MW, Mn+Cl, Sp/Su, Wa, S					
									2. 85°, J, N, Mn+Cl, SU, Wa, S					
	310					MR								
		68		16		10								
-96	311								no recovery.					Per driller - unrecovered section most likely a'a clinker or intensely fractured massive a'a.
	312													
-98	313								**BASALT A'a Clinker** loose, dark gray (5YR 4/1), slightly weathered, strong, subrounded clasts.			0.0	[17]	
							1		**BASALT Massive A'a** very dark gray (5YR 3/1), dark reddish gray (5YR 4/2) and reddish brown (5YR 4/4), moderately weathered, strong, with pink (5YR 7/4) clay on weathered surfaces, 10% <1 mm irregular elongate vesicles.					
	314								becomes completely weathered.					Added 500 gallons, intermittent water loss
-100	315						IF		highly weathered.					
		69		100		8	IF		becomes 15% 0.5-2 mm irregular elongate vesicles.					
									1. 0°, J, MW, Mn+Cl, Sp, Pl, SR					
	316						IF		highly weathered.					
							IF		becomes 30% <1 mm subrounded and rounded					
-102	317													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-102	317								vesicles. becomes 20% 1-10 mm irregular and elongate vesicles with 5% 20-40 mm vugs. 2. 5°, J, N, Mn, Sp/Su, Wa, SR 3. 5°, J, N, No, No, Wa, SR 4. 95°, J, VN, No, No, Pl, R					
	318								1. 0°, J, VN, No, No, Wa, SR 2. 5°, J, N, Mn, Su, Wa, R 3. 10°, J, N, Mn, Su, Wa, R 4. 15°, J, N, No, No, St, SR 5. 50°, J, N, No, No, Wa, SR 6. 80°, J, VN, Mn, Su Wa, SR			0.0	[23]	Rig chattering at start of run
-104	319													
	320	70		40		0	NR		**BASALT A'a Clinker** loose, dark gray (5YR 4/1) and reddish brown (5YR 4/4), moderately weathered, strong, angular clasts. 1. 0°J, N, No, No, Wa, R 2. 45°, J, MW, Mn/Cl, Su, IR, R 3. 5°, J, N, Cl, SP, Wa, SR 4. 0°, J, N, Cl, SP, Pl, SR 5. 20°, J, VN, No, No, Wa, R 6. 0°, J, MW, Mn+Cl, Sp, Wa, R 7. 0°, J, N, Cl, SP, Pl, SR 8. 0°, J, Mn+Cl, Sp+Su, Pl, SR no recovery.					Added 400 gallons, high return
-106	321													Per driller - bottom 3' of run washed out
	322		28											
-108	323								**BASALT Pahoehoe** reddish gray (5YR 5/2), slightly weathered, moderately strong, 40% 1-9 mm rounded vesicles. 9. 0°, J, VN, Cl, SP, Pl, SR 10. 0°, J, VN, Cl, Sp, Pl, SR 11. 0°, J, VN, Cl, Sp, Pl, SR					[30]	
	324								becomes 40% 0.5-3 mm rounded vesicles.					Added 200 gallons, mostly returned
-110	325								becomes moderately weathered, yellowish red (5YR 4/6).					
	326	71		100		22.5			becomes reddish gray (5YR 5/2), slightly weathered, 20% <1 mm irregular vesicles. becomes moderately weathered.					
-112	327								becomes slightly weathered, 50% 1-3 mm rounded vesicles. 12. 0°, J, N, No, No, Pl, SR 13. 0°, J, N, Cl, Su, Wa, R becomes 50% 2-5 mm rounded vesicles.					
	328						NR		no recovery.				[30]	
									IF. pinkish gray (5YR 7/2) clay on some fracture surfaces. 14. 0°, J, N, No, No, Pl, SR 15. 0°, J, N, Cl, Sp, Wa, SR 16. 5°, J, N, No, No Wa, SR					
-114	329													Added 200 gallons, mostly returned
	330						NR							
-116	331	72	29	76		8			large 600 mm vug with partial white (5YR 8/1) halloysite clay infill. becomes dark gray (5YR 4/1), 40% <1 mm irregular vesicles. becomes 40% 1-2 mm subrounded vesicles. 1. 10°, J, MW, Cl Su, Mn Sp, Wa, SR 2. 0°, J, N, Cl, Sp, Wa, SR 3. 5°, J, N, Cl, Sp, Wa, R 4. 75°, J, N, Cl+Mn, Su+Sp, St, R 5. 45°, J, N, Cl, Sp, Wa, R					
	332													
-118	333													End coring on 8/11/2020

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-118	333						IF		reddish brown (5YR 4/3 and 5YR 4/4), moderately weathered, medium strong, 30% 1-4 mm subrounded vesicles, reddish yellow (5YR 7/6) clay in some vesicles.			0.0	[4]	Resume coring on 8/12/20
			29				M		becomes 35% <1 mm subrounded vesicles.					
	334						1		1. 10°, J, MW, Cl, Sp, Wa, SR					Apparent loss of circulation at 335'
							2		2. 90°, J, N, Cl+Mn, Sp, Wa, SR					
							3							
							4							
-120	335						IF		highly weathered.					
							5		3. 0° J, VN, Cl, SP, Pl, SR					Water loss 1200 gallons
		73		100		28	IF		becomes slightly weathered, reddish yellow (5YR 7/6) clay in vesicles, 30% <1-5 mm subrounded vesicles.					
	336								4. 20°, J, N, Cl, SP, Wa, SR					Pause for maintenance 1046-1143
									5. 0°, J, N Cl, SP, Pl, SR					
							6		becomes 20% 0.5-1 mm subrounded vesicles.					
-122	337		30						6. 45°, J, VN, Cl+Mn, Su, Pl, SR					
							IF		becomes yellowish red (5YR 5/6), moderately weathered, weak, 40% < 1mm rounded vesicles.					
							7		7. 0°, J, N, Cl+Mn, Sp, Pl, SR					
							8		8. 5°, J, VN, Cl+Mn, Sp, Wa, SR					
	338								becomes very weak.			0.0	[30]	
							1		becomes dark gray (5YR 4/1) and dark reddish gray (5YR 4/2), slightly weathered, moderately strong, 30% 1-3 mm subrounded vesicles.					
-124	339						2		1. 10°, J, N, Mn+Cl, Sp, Wa, R					
							3		2. 5°, J, N, Cl, SP/Su, Wa, R					Water loss 600 gallons
									35% 0.5-1 mm subrounded vesicles.					
	340						IF		becomes yellowish red (5YR 5/6) and reddish brown (5YR 4/3), moderately weathered, weak.					
		74		100		45			becomes dark gray (5YR 4/1), slightly weathered, moderately strong, 20% 0.5-1 mm subrounded vesicles					
							4		3. 5°, J, N, Cl, Sp/Su, Wa, SR					
-126	341						5		4. 0°, J, VN, Cl, Sp/Su, Pl, S					
									becomes 40% <1 mm subrounded vesicles.					
							6		5. 0°, J, VN, Cl, Sp/Su, Pl, S					
	342								6. 35°, J, VN, No, No, Wa, SR					
							IF		becomes reddish brown (5YR 4/3) and dark gray (5YR 4/1), moderately weathered, flow contact with heat alteration.					
-128	343								becomes very dark gray (5YR 3/1), slightly weathered, medium strong10% rounded to subrounded vesicles.			0.0	[18]	
							1		1. 15°, J, N, Mn, Sp, Wa, SR					
							2		2. 5°, J, N, Mn+Fe+Cl Sp, St, SR					
	344						3		3. 5°, J, N, Mn+Fe+Cl, Sp, St, R					
							4		4. 0°, J, N, Mn+Cl, Sp, St, R					Water loss 500 gallons
							5							
							6		becomes dark grayish brown (10YR 4/2), moderately weathered, medium strong, 20% < 1 mm					
-130	345						7		rounded vesicles.					
							IF		becomes very dark gray (5YR 3/1), moderately weathered, medium strong, 5% <2 mm rounded to subrounded vesicles.					
		75		60		44	8							
	346		31				9		slightly weathered, strong, 15% 1-4 mm rounded to subrounded vesicles.					
							10		becomes 5% 2-7 mm subrounded vesicles.					
							11		becomes medium strong, 10% <3 mm rounded to subrounded vesicles.					
-132	347						M		becomes moderately weathered, medium strong, 5% <3 mm rounded to subrounded vesicles.					
							12		5. 5°, J, VN, Mn+Fe, Sp, Wa, Sr					
							13		6. 10°, J, Vn, Mn+Fe, Sp, Wa, S					
	348						IF		7. 20°, J, N, Mn, Sp, IR, R			0.0	[33]	
							1		8. 0°, J, MW, Mn+Fe, Sp, IR R					
									brown (2.5YR 5/2), moderately weathered, medium strong, 7% <1 mm rounded to subrounded vesicles.					
							2							
-134	349						3							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-134	349								becomes weak. 9. 0°, J, VN, Mn+Fe, Sp, Wa, SR 10. 0°, J, VN, Mn+Fe, Cl, Sp, Wa, SR 11. 0°, J, VN, Mn+Fe, Sp, Wa, SR					Per driller ~3.5' void encountered
	350	76		80		0			becomes black (5YR 2.5/1), slightly weathered, strong, 10% <1-3 mm rounded vesicles. 12. 5°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 13. 0°, J, VN, Mn+Fe, Sp, Pl, SR					Water loss 500 gallons
-136	351								1. 5°, J, N, Mn+Fe+Cl, Sp, IR, SR becomes very dark gray (5YR 3/1), moderately weathered, medium strong, 5% <1-4 mm rounded to subrounded vesicles.					Per driller - some water was returned, but not enough to fill mud pan; water came up when core barrel was removed.
	352		31				NR		2. 0°, J, VN, Mn+Fe, Sp, Pl, SR 3. 0°, J, N, Mn+Cl, SP, Pl, S 4. 0°, J, VN, Mn+Fe+Cl, SP, Wa, S 5. 0°, J, VN, Mn+Fe, Cl, Sp, Wa, S 6. 0°, J, VN, Mn+Cl, Sp, Wa, S 7. 0°, J, VN, Mn+Fe+Cl, Sp, Wa, S 8. 80°, J, VN, Mn+Fe, Sp, Wa, SR IF. Cl, Sp no recovery.					
-138	353												[27]	
	354								**BASALT A'a Clinker** loose, very dark gray (5RY 3/1) and dark reddish gray (5YR 4/2), slightly weathered, strong, 30% <1 mm subrounded vesicles, 10-20 mm subangular clasts.					Water loss 400 gallons
									BASALT Massive A'a dark gray (5YR 4/1) and very dark gray (5YR 3/1), slightly weathered, strong, 30% 0.5-7 mm irregular, elongate vesicles. becomes moderately weathered, with dark gray (5YR 4/1) clay on fracture surfaces.					
-140	355	77		60		7								
	356													
-142	357		32				M2		no recovery.					
	358												[14]	
									BASALT A'a Clinker loose, reddish brown (5YR 4/4), moderately weathered, strong, 20-30 mm subangular clasts.					
-144	359								**BASALT Pahoehoe** very dark gray (5YR 3/1) and dark gray (5YR 4/1), slightly weathered, moderately strong, 50% 0.5-7 mm rounded vesicles. 7% <1 mm angular vesicles. 3% 0.5-2 mm subrounded vesicles.					
	360	78		100		22.2			45% 0.5-1 mm subrounded vesicles.					Pause to replace core barrel 1534-1542
									becomes dark gray (5YR 4/1) and dark reddish gray (5YR 4/2), moderately weathered.					
-146	361								1. 20°, J, MW, Cl, SP, Wa, SR 2. 50°, J, N, Cl, SP, Wa, SR becomes highly weathered.					
	362								3. 5°, J, VN, No, No, Wa, SR 4. 45°, J, VN, Cl, Sp, St, SR					
									dark gray (5YR 4/1), slightly weathered, strong, 30% 1-5 mm irregular vesicles.			0.0	[21]	
-148	363								50% 1-2 mm subrounded vesicles.					End coring on 8/12/2020 Pause for maintenance 1035-1040
	364								50% <1 mm subrounded vesicles.					Rig chattering at 364'
-150	365													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW16

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
									ROCK CORE					
-150	365	79		100		43.64	IF		1. 0°, J, VN, No, No, Wa, R 2. 0°, J, VN, No, No, Pl, SR					
							9		becomes dark gray (5YR 4/1) and dark reddish gray (5YR 4/2), moderately weathered.					
	366								slightly weathered 15% <1-2 mm subrounded vesicles 40% 1-3 mm subrounded vesicles.					Water loss 800 gallons
-152	367		32						20% 2-5 mm rounded vesicles.					
									50% <1 mm subrounded vesicles. 3. 20°, J, N, No, No, Wa, SR 4. 25°, J, N, No, No, Pl, SR 5. 10°, J, VN, No, No, Wa, SR 6. 0°, J, N, Cl, Sp, Wa, SR					
	368						10		7. 5°, J, N, No, No, Wa, SR			0.0	[30]	
							1		becomes 25% 2-12 mm rounded to subrounded vesicles.					
-154	369						2		becomes dark gray (5YR 4/1), moderately weathered, medium strong 5% <2 mm subrounded vesicles.					Water loss 500 gallons
							3		8. 70°, J, VN, Mn, Sp/Su, St, SR 9. 15°, J, N, Cl, Sp, Wa, R 10. 20°, J, N, Mn, Sp, IR, R					
	370						IF							
		80		76		16	4		becomes reddish brown (5YR 4/2), moderately weathered, medium strong, 15% <3 mm subrounded vesicles.					
-156	371													
							IF		1. 5°, J, MW, Mn+Cl, Sp, IR, R 2. 15°, J, N, Mn+Fe+Cl, Sp, IR, SR 3. 50°, J, VN, Mn+Fe+Cl, Sp, IR, R 4. 35°, J, MW, Mn+Fe, Sp, IR, R					
	372								no recovery.					
							NR							
-158	373								becomes slightly weathered, strong, 15% 2-6 mm rounded to subrounded vesicles.				[30]	
							1							
							2		becomes 5% <2 mm rounded to subrounded vesicles.					
							3							
	374						4		becomes 10% 1-4 mm rounded to subrounded vesicles.					Water loss 400 gallons
							5		becomes 30% <2 mm rounded vesicles.					
-160	375						6		1. 0°, J, VN, Mn, Sp, Wa, SR 2. 0°, J, VN, Mn, Sp, Pl, S					
							7		3. 5°, J, VN, Mn+Fe, Sp, Wa , S					
		81		100		42			becomes dark reddish brown (5YR 4/2), slightly weathered, strong, 15% 3 mm rounded vesicles.					
							IF		becomes black (5YR 2.5/1), yellowish red (5YR 5/6) reddish yellow (5YR 7/8), moderately weathered, medium strong, possible flow contact.					
	376		33											
									4. 0°, J, VN, Mn, Sp, Pl, S					
							IF		5. 0°, J, VN, Mn+Fe+Sp, Wa, S					
-162	377						M		6. 0°, J, VN, Mn, Sp, Pl, SR 7. 10°, J, VN, Mn+Fe, Sp, Wa, S					
									becomes dark reddish brown (5YR 4/2), slightly to moderately weathered, strong, 15% 2-5 mm rounded to subrounded vesicles.					
	378						M		50% < 1mm rounded vesicles.			0.0	[30]	
							1							
							2		1. 5°, J, N, No, No, Wa, R 2. 5°, J, VN, No, No, Wa, SR					
							3		3. 10°, J, N, Cl, Sp, Wa, SR					
-164	379						IF		4. 0°, J, VN, Mn+Cl, Sp, Pl, SR					
									becomes 20% 1-3 mm subrounded vesicles.					
							4							
	380		34											
							IF		becomes moderately weathered, 50% <1 mm rounded vesicles.					Water loss 400 gallons
		82		100		58			becomes slightly weathered, 15% 1-2 mm subrounded vesicles. 50 mm void.					
-166	381													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-166	381								5. 20°, J, VN, Mn+Cl, Sp, Wa, R 6. 70°, J, VN, Mn, Sp, Wa, R					
								5	40% 2-5 mm rounded vesicles.					Rig chattering ~381'-382'
	382							6	20% 3-5 mm irregular vesicles.					
								7	7. 5°, J, VN, Mn+Cl, Sp, Wa, R					
-168	383								40% 1 mm vesicles.					
								1				0.0	[28]	
								2						
								3	becomes 20% <2 mm, rounded to subrounded vesicles.					
									5% 1-3 mm subrounded vesicles.					
	384							4	3% <3mm subrounded vesicles.					Rig chattering at 384'
								5						
								6	becomes very dark gray (5YR 3/1), slightly weathered, strong, 25% <2 mm rounded to subrounded vesicles, some spotty clay in vesicles.					
-170	385		34					IF	becomes moderately weathered, medium strong.					Water loss 700 gallons
		83		80		26								
	386								becomes moderately to slightly weathered, medium strong to weak, some red (2.5YR 4/6) iron oxide staining.					
								IF	1. 90°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 2. 0°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 3. 0°, J, VN, Mn, Sp, Wa, SR 4. 0°, J, VN, Mn+Fe+Sp, Wa, SR 5. 10°, J, N, Mn+Sp, Wa, SR 6. 0°, J, N, Mn+Sp+Cl, Sp, Wa, R					
-172	387								no recovery					
							NR							
	388								very dark gray (5YR 3/1) and dark reddish gray (5YR 4/2), moderately weathered, weak, 45% rounded vesicles.			0.0	[25]	Rig chattering 388'-389'
								IF						
								1						
								2	7% <1 mm vesicles.					
								M						
-174	389								20% 1-2 mm subangular vesicles.					
									30% 1-5 mm subangular vesicles.					
								3						
	390													
								4	25% 1-10 mm irregular vesicles, large vugs.					
								IF						
		84		90		42		5	20% 1-2 mm subangular vesicles.					
								M						
-176	391		35						10% <1 mm irregular vesicles.					
								6						
								7	becomes yellowish red (5YR 5/6) and reddish brown (5YR 4/3), highly weathered, weak.					
								IF	1. 0°, J, VN, Cl, Sp, Wa, SR 2. 0°, J, No, Cl+Mn, Wa, SR 3. 0°, J, VN, Cl, Sp, Pl, S 4. 10°, J, VN, Mn, Sp, IR, R					
	392							8						
								9						
								10	5. 5°, J, VN, Mn+Cl, Sp, Pl, SR					
							NR	11	6. 0°, J, N, Cl, SP, Wa, SR					End of coring on 8/13/2020
-178	393								no recovery.				[20]	
								1	dark grayish brown (5YR 4/2), moderately to slightly weathered, weak, 40% 0.5-1 mm subrounded vesicles.					Resume coring on 8/14/2020
								IF	7. 0°, J, VN, Cl, Sp, Pl, S 8. 10°, J, VN, Cl, Sp, Wa, SR					
	394							2	dark gray (5YR 4/1) slightly weathered, strong, 30% 1-4 mm irregular vesicles.					Rig chattering at 394'
								3						
								4	9. 5°, J, MW, Cl, SP, Wa, R 10. 5°, J, MW, Mn+Cl, SP, Wa, R					
-180	395							5	11. 5°, J, MW, Cl, Sp, Wa, R					
		85		100		47		6	50% <1 mm subrounded vesicles. 1. 0°, J, VN, Cl, Sp, Pl, S					Pause to to replace kelly bar driver 1056-1258
								7	2. 90°, J, W, Mn, Sp, Pl, SR					
	396								20% 2-5 mm irregular vesicles with vugs.					
								8	3. 0°, J, VN, Mn+Cl, Sp, Pl, SR 4. 5°, J, N, Mn+Cl, Sp, Wa, SR					
								9						
-182	397								very strong, 15% 5-10 mm irregular vesicles with					Water loss 700 gallons

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-182	397								vugs. 5. 0°, J, N, Cl, SP, Pl, SR IF. 0°, J, MW, Cl, Sp, Wa, SR 'biscuit' fractures. 40% 1-2 mm rounded vesicles.						
	398		35						6. 0°, J, N, Cl, Su, Pl, SR 30% 2-10 mm irregular vesicles. 7. 0°, J, N, Mn+Cl, Sp, Pl, SR					[23]	
-184	399							1 IF 2	50% <1 mm rounded vesicles. 8. 10°, J, VN, Mn, Sp, Wa, SR 9. 10°, J, VN, Mn, Sp, Wa, SR						Water loss 800 gallons
	400							3 4 5	1. 0°, J, N, Mn, Sp, Pl, SR 2. 0°, J, VN, Cl, SP, Pl, SR reddish brown (5YR 4/3), yellowish red (5YR 5/6) and very dark gray (5YR 3/1), moderately weathered, medium strong.						
		86		56		26		6 7 8	dark reddish gray (5YR 4/2), slightly weathered, medium strong, 40% 1-3 mm rounded vesicles.						
-186	401		36					9 10 11	3. 10°, J, VN, Cl, Su, Pl, SR 4. 20° J, MW, Cl+Mn, Su, IR, SR						
	402								yellowish red (5YR 5/6), moderately weathered. 5. 25°, J, N, Cl+Mn, Su, St, SR 6. 5°, J, N, Cl, Sp, Wa, SR 7. 80°, J, N, Cl, Sp, Pl, SR 8. 0°, J, N, No, No, Pl, SR 9. 0°, J, N, Mn+Cl, Sp, Pl, SR						
-188	403							IF	no recovery. very dark gray (5YR 3/1) and dark gray (5YR 4/1), moderate weathered, weak, pinkish white (5YR 5/2) clay weathering. 10. 0°, J, Vn, Cl, Su, Pl, S 11. 15°, J, MW, Cl+Mn, Su, Wa, SR					[27]	
	404								**BASALT A'a Clinker** loose, very dark gray (5YR 3/1), reddish brown (5YR 4/3 and 5YR 5/4), slightly weathered, strong, 25% 1-6 mm irregular vesicles, subangular 10-30 mm clasts.						Water loss 400 gallons, with return at 407'
-190	405														
		87		32		0									
	406														
-192	407								no recovery.						
	408								**BASALT Pahoehoe** dark gray (5YR 4/1), slightly weathered, strong, 40% 1-4 mm rounded vesicles.					[150]	
								1 2 3 4	30% 2-5 mm irregular vesicles.						
-194	409							5 6	50% <1-2 mm rounded vesicles. 1. 0°, J, N, No, No, Wa, SR 2. 45°, J, VN, Mn< SP, Wa, SR 3. 20°, J, N, Mn+Cl, SP, Wa, SR 4. 10°, J, N, Mn+Cl, SP, Pl, SR 5. 0°, J, N, Mn, Sp, Wa, SR						Water loss 400 gallons
	410							7 IF	IF. Cl, Sp in some fractures. 6. 0°, J, N, Mn, SP, Wa, SR						
		88		100		34			50% 1-2 mm rounded vesicles.						
-196	411							8 9 10	7. 30°, J, VN, Mn+Cl, Sp, Wa, SR 8. 30°, J, N, Mn, Sp, St, SR 9. 5°, J, N, Mn+Cl, Wa, R 10. 45°, J, Mn, Mn+Cl, St, R						
	412							11	50% <1-2 mm rounded vesicles.						
								12	yellowish red (5YR 4/6) flow contact.						
-198	413														

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Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-198	413								very dark gray (5YR 3/1), slightly weathered, medium strong, 50% 1-3 mm irregular vesicles. 11. 10°, J, N, Cl, Sp, Wa, SR 12. 70°, J, MW, Cl, SP, Wa R			0.0	[38]	
	414						IF		1. 5°, J, VN, No, No, Pl, SR 2. 0°, J, VN, Mn, Sp, Pl, SR strong, 10% 2-8 mm subrounded vesicles					Water loss 500 gallons
-200	415						1		30% <1-3 mm irregular vesicles.					
		89		100		62	2							
	416		37				3		becomes moderately weathered. 3. 5°, J, N, Mn, Cl, SP, Wa, SR 4. 10°, J, VN, Cl, Su, Wa, R					
							4		becomes slightly weathered, strong 10% 2-8 mm subrounded vesicles.					
-202	417						IF		becomes 40% 1-8 mm irregular vesicles.					
							5							
							6		becomes 30% 2-10 mm irregular vesicles.					
							7		<5% 1-2 mm subangular olivine phenocrysts.					End of coring on 8/14/2020
	418								5. 70°, J, VN, Mn+Cl, Sp, Pl, R 6. 20°, J, N, Mn, Sp, St, SR 7. 0°, J, VN, Mn+Cl, SP, Pl, SR			0.0	[30]	
							1		yellowish brown (10YR 5/6), black (5YR 2.5/1), and red (2.5YR 4/6), heat alteration, possible flow contact					Resume coring on 8/15/2020
-204	419		38				2		becomes dark reddish gray (5YR 4/2), moderately weathered, medium strong, 3% <2 mm subrounded vesicles.					
							3		1. 20°, J, N, Mn, Cl, SP, Wa, SR 2. 5°, J, N, Mn, Sp, IR, R 3. 20°, J, VN, Mn+Fe, Sp, SR 4. 0°, J, N, Mn+Cl, Sp, Wa, SR 5. 45°, J, N, Mn+Cl, Sp, Wa, R					Water loss 600 gallons
	420						4							
		90		88		48	5							
							6							
-206	421						7		becomes slightly weathered, strong, 10% 1-4 mm rounded to subrounded vesicles, some clay in vesicles.					
							IF		becomes 5% <2 mm subrounded vesicles.					
	422													
							8		becomes black (7.5YR 2.5/1), slightly weathered, strong, 5% 1-5 mm rounded to subrounded vesicles, IF iron oxide staining.					Rig chattering at 422'-423'
							9		becomes 15% <2 mm subrounded to rounded vesicles.					
-208	423		39				NR		no recovery.			0.0	[30]	
							1		becomes very dark gray (7.5YR 3/1), slightly weathered, strong, 30% <2 mm subrounded vesicles.					
							2		7. 5°, J, N, Mn+Fe+Cl, Sp, Wa, R 8. 5°, J, VN, No, No, Wa, R					
	424						3		9. 10°, J, VN, Mn+Fe+Cl, Sp, Wa, R					Water loss 600 gallons
							IF		becomes 15% 2-3 mm subrounded vesicles.					
-210	425						4		1. 60°, J, N, No, No, IR, S 2. 0°, J, VN, No, No, Pl, S 3. 0°, J, VN, No, No, Pl, S					
		91		100		46	5							
							IF							
	426		40						becomes 10% <1 mm elongated vesicles.					
							6		becomes 30% <2 mm rounded vesicles. 4. 0°, J, N, No, No, Pl, S 5. 0°, J, N, No, No, Pl, S 6. 0°, J, VN, Fe+Mn, Wa, SR 7. 45°, J, N, Cl+Fe+Mn, SP, Wa, SR					
-212	427						7							
							IF		becomes dark reddish brown (2.5 YR 2.5/4) and black (3.5YR 2.5/1), moderately weathered, medium strong, 40% 2 mm rounded vesicles.					
	428								becomes black (GLEY 1 2.5/N), slightly weathered, strong, 25% 1-4 mm rounded to subrounded vesicles.			0.0	[50]	
			41				1							
-214	429													

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-214	429								becomes black (5YR 2.5/1), slightly weathered, very strong, 25% <1 mm rounded to subrounded vesicles.					
	430							IF	← IF. Iron oxide staining					
		92		90		74		2 3	becomes slightly weathered, strong, 15% 1-3 mm rounded to subrounded vesicles.					Water loss 600 gallons
-216	431		41					4 5 6	1. 0°, J, VN, Mn+Sp+Pl, S 2. 20°, J, N, Mn+Fe+Cl, Sp, IR, SR 3. 0°, J, VN, Mn+Fe, Sp, Wa, SR 4. 60°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 5. 5°, J, VN, Mn+Fe, Sp, Wa, SR 6. 15°, J, VN, Mn+Fe,Sp, Wa, S					
	432						NR	IF	becomes black (5YR 2.5/1), reddish brown (5YR 4/4), and brown (10YR 4/3), moderately weathered, medium strong, Mn, flow textures and heat alteration, possible flow contact.					
-218	433								**BASALT A'a Clinker** loose, very dark grayish brown (10YR 3/2), black (5YR 2.5/1), and reddish brown (5YR 5/3), slightly to moderately weathered, mediums strong, some welded clasts, transitions from pahoehoe, some pahoehoe clasts.			0.0	[11]	
	434		42					IF						Water loss 600 gallons
-220	435								**BASALT Massive A'a** very dark greenish gray, moderately weathered, strong, 3% <3 mm subrounded elongated vesicles.					
		93		42		0	NR							
	436													Rig chattering at 436', per driller - some water return at 437'
-222	437								no recovery.					
	438								becomes gray (GLEY 1 5/N), unweathered to slightly weathered, very strong, 5% 1-25 mm subrounded elongate vesicles.			0.0	[23]	
-224	439							1 2 3 IF	1. 30°, J, VN, Mn+Fe Su, Cl Sp, Wa S 2. 5°, J, VN, Mn+Fe, Su, St, S 3. 5°, J, VN, Mn, Sp, Wa, S 4. 85°, J, VN, Mn, Sp, Wa, S 5. 0°, J, VN, Mn, Sp, Wa, S 6. 45°, J, VN, Mn, Sp, Wa, S 7. 5°, J, VN, Mn+Fe, Sp, wa, S 8. 5°, J, VN, Mn+Fe+Cl, Sp, Wa, S 9. 10°, J, N, Mn+Cl, Sp, Wa, S 10. 10°, J, VN, Mn+Fe+Cl, Sp, Wa, S 11. 10°, J, VN, Mn+Fe+Cl, Sp, Wa, S					
	440							4 5 6 7 8 9 10						Water loss 600 gallons
		94		86		22			becomes slightly weathered, very strong, 5% 2-3 mm elongate vesicles.					
-226	441													
	442						NR	11	**BASALT A'a Clinker** loose, black (5YR 2.5/1), red (2.5YR 5/8), and dark reddish gray (5YR 4/2), highly weathered, extremely weak, some medium strong clasts.					Per driller - some water return at end of run
-228	443		43						1. 5°, J, VN, Mn+Cl, Sp, IR, SR 2. 10°, J, N, Mn, Sp, Wa, SR no recovery.			0.0	[20]	
	444													
-230	445							IF	**BASALT Pahoehoe** thickly bedded, dark gray (10YR 4/1), slightly					

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-230	445								weathered, very strong, 5% 1-7 mm rounded to subrounded vesicles.					
		95		74		24			becomes 5% 1-12 mm rounded to subrounded vesicles.					Water loss 600 gallons
	446		43						becomes slightly to moderately weathered, strong, 3% 1-4 mm irregular subrounded to subangular vesicles.					Rig chattering at 446', per driller - some water return at 446'
-232	447								3. 5°, J, VN, Mn+Fe, Sp, Wa, SR 4. 0°, J, VN, Mn+Fe, Sp, Wa, SR 5. 0°, J, MW, No, No, IR, R 6. 90°, J, VN, Mn+Fe+CL, Sp, Slk, S					
	448											0.0	[17]	
									becomes 5% 1-3 mm subrounded vesicles.					
-234	449													Water loss 350 gallons
	450		44						vesicles become more elongate.					
		96		64		30			becomes 3% 1-6 mm subrounded elongate vesicles.					
-236	451								IF. Mn+Fe+Cl, Sp					
	452						NR		1. 0°, J, MW, Mn+Fe+Cl, SP, IR, S 2. 0°, J, VN, Mn+Fe+Cl, SP, Wa, S 3. 45°, J, VN, Mn, Sp, Wa, S 4. 65°, J, VN, Mn+Fe, Sp, Wa, S no recovery.					Per driller - some water return at 452'
-238	453								**BASALT A'a Clinker** loose, dark grayish brown (5YR 4/2), slightly weathered, strong, rounded to subangular clasts.			0.0	[23]	
	454								**BASALT Massive A'a** dark gray (GLEY 2.5/N), unweathered, extremely strong, 5% 1-10 mm subrounded elongate vesicles.					Water loss 400 gallons
-240	455								1. 0°, J, VN, No, No, IR, SR 2. 5°, J, VN, Mn+Cl, Sp, Wa, S 3. 0°, J, VN, Mn+Fe+Cl, Sp, Wa, S 4. 90°, J, VN, Mn+Fe+Cl, Sp, Wa, S, fibrous clay 5. 90°, J, VN, Mn Sp, Cl Sp, Wa, S, fibrous clay 6. 85°, J, VN, Mn+Cl Sp, Wa, S 7. 80°, J, VN, Mn+Cl Sp, Wa IF. Mn+Fe Sp, fibrous clay 8. 0°, J, VN, Mn+Fe, Sp, Wa, S					
		97		100		40								
	456													Per driller - some water return at 457'
-242	457		45						becomes 1% <1 mm irregular vesicles.					
	458													End of coring on 8/15/2020
												0.0	[23]	
									1. 90°, J, VN, Mn+Fe, Sp, Wa, S 2. 45°, J, VN, Mn+Fe, Sp, Wa, S 3. 90°, J, VN, Mn+Fe, Sp, Wa, S 4. 35°, J, VN, Mn+Fe, Sp, St, S IF. Mn+Fe, Sp 5. 80°, J, VN, Mn+Fe, Sp, Wa, S 6. 45°, J, VN, Mn+Fe, Sp, St, SR 7. 45°, J, N, MN+Fe, Sp, IR, SR					Resume coring on 8/17/2020
-244	459													
	460													Water loss 600 gallons
		98	46	68		18								
-246	461													

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-246	461						NR		**BASALT A'a Clinker** loose, very dark gray (GLEY 1 3/N) and dark reddish gray (5YR 4/2), moderately weathered to slightly weathered, medium strong, subrounded clasts.					
	462								no recovery.					
-248	463											0.0	[17]	Some rig chattering at 463'
	464						1 2		**BASALT Massive A'a** dark gray (GLEY 1 2.5/N), unweathered, extremely strong. some welded clinker clasts present. 1. 5°, J, N, Mn+Fe, Sp, Wa, SR 2. 10°, J, VN, Mn+Fe, Sp, Wa, SR some welded clinker clasts present.					
-250	465	99	46	84		28			**BASALT A'a Clinker** loose, red (5YR 4/6) and black (2.5YR 2.5/1), moderately weathered medium strong, subrounded clasts.					Water loss 800 gallons
	466						IF							
-252	467						NR		no recovery.					
	468						IF		**BASALT Pahoehoe** dark reddish brown (2.5YR 3/4), slightly weathered, strong, 5% 1-8 mm subrounded elongate vesicles. becomes brown (7.5YR 4/2), slightly weathered, strong, 10% 2-5 mm rounded vesicles, possible flow contact. becomes very dark gray (7.5YR 3/1), slightly weathered, very strong, 10% 1-4 mm rounded vesicles. IF. Mn+Fe, Sp, 1% olivine 1. 60°, J, N, Mn, Sp, Wa, SR becomes reddish grown (5YR 4/4), slightly weathered, strong, 10% <4 mm rounded vesicles.			0.0	[18]	
-254	469						1							Water loss 700 gallons
	470	100	47	90		10	IF							
-256	471								IF. Mn, Sp becomes very dark gray (5YR 3/1), moderately weathered, medium strong, 5% <3 mm subrounded vesicles.					
	472						IF							
-258	473						Nh					0.0	[27]	
	474								no recovery.					
-260	475	101	48	68		12			becomes very dark gray (10YR 3/1), slightly weathered, strong, 10% 1-4 mm rounded to subrounded vesicles.					Water loss 800 gallons
	476						IF		IF. Iron oxide on faces, Mn+Fe, Sp					
-262	477													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-262	477						1		1. 10°, J, N, Mn+Fe, Sp, IR, SR 2. 0°, J, N, No, No, IR, SR					
							2		becomes highly weathered, weak, IF fracture faces yellowish brown (10YR 5/6).					
	478						IF		becomes black (5YR 2.5/1, slightly weathered, strong, 10% 1-4 mm subrounded to rounded vesicles.			0.0	[38]	
-264	479		48						IF. some fracture faces reddish brown (5YR 4/3).					Water loss 800 gallons
							IF		1. 0°, J, N, Fe, Sp, Wa, R 2. 0°, J, N, Mn+Fe, Sp, Wa, R 3. 20°, J, N, Mn+Fe, SP, St, SR 4. 0°, J, N, Mn+Fe, Sp, Wa, SR					
	480	102		90		8								
							1							
-266	481						2		becomes 15% 1-7 mm subrounded to rounded elongate vesicles					Per driller - some water return
							3							
							4							
	482						IF							Per driller - void encountered
							NR							
-268	483		49						no recovery.			0.0	[14]	
	484								becomes black (5YR 2/1), slightly weathered, strong, 15% 1-3 mm rounded to subrounded vesicles.					Water loss 600 gallons
							IF		becomes highly weathered, weak.					
-270	485								becomes slightly weathered, very strong.					
		103		78		18	1		1. 0°, J, VN, No, No, Wa, SR 2. 90°, J, T					Pause to replace drill rod 1541-1552
	486						2		becomes black (5YR 2/1) and reddish brown (5YR 4/4), slightly weathered, strong, 20% 1-3 mm rounded to subrounded vesicles.					
-272	487						IF							
														End of coring on 8/17/2020
	488												[33]	Resume coring on 8/18/2020
							IF							
-274	489								becomes dark reddish brown (5YR 3/2), unweathered, very strong, 10% 2-20 mm subrounded elongate vesicles, 1% unweathered olivine.					Rig chattering from 488'-490'
	490		50				1		1. 80°, J, VN, Mn+Fe, Sp, Wa, SR 2. 10°, J, VN, Mn+Fe, Sp, Wa, SR					
		104		86		12	IF							
							2							
-276	491								becomes dark gray (5YR 4/1), slightly weathered, strong, 5% 3-28 mm subrounded vesicles.					Water loss 800 gallons
							IF							
	492													
							IF							
							NR		no recovery.					
-278	493													

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-278	493								becomes red (2.5 YR 5/8), slightly weathered, strong, 20% 1-4 mm rounded to subrounded vesicles.					[20]	
							IF		becomes dark yellowish brown (10YR 4/6), slightly weathered, strong, 5% <2 mm rounded to subrounded vesicles, possible flow contact/heat alteration.						
	494		51				1		1. 45°, J, VN, Mn, Sp, Wa, S						Water loss 1000 gallons
-280	495								**BASALT A'a Clinker** loose, black (5YR 2.5/1), reddish brown (5YR 4/4), dark gray (5YR 4/1), slightly weathered, strong, rounded clasts.						
		105		40		0	NR								
	496														Rig chattering 497'-498'
-282	497								no recovery.						
	498														End of coring on 8/18/2020, total depth = 498' bgs
-284	499								RHMW16 was hand cleared from ground surface to 2.5 ft below ground surface (bgs) with refusal on basalt boulders. The borehole was then drilled using 8.5" OD hollow stem auger to 20 ft bgs. HQ coring commenced from 20 ft to 218 ft bgs. Reamed borehole with a 17.5" tricone bit from ground surface to 17 ft bgs. Installed 10" Schedule 40 steel conductor casing to 17 ft bgs. Borehole was reamed from 17 ft to 185 ft bgs with a 9 7/8" tricone bit. Overwashed and removed 17 feet of 10" conductor casing. Reamed borehole with a 17.5" tricone bit from 17 ft to 100 ft bgs. Installed 10" Schedule 40 steel conductor casing to 99 ft bgs. Borehole was reamed from 185 ft to 218 ft bgs with a 9 7/8" tricone bit. Installed temporary 5" steel conductor casing to 218 ft bgs. HQ coring continued from 218 ft to 498 ft bgs total coring depth. Removed temporary 5" steel conductor casing. Borehole was reamed from 218 ft to 525 ft bgs total reaming depth with a 9 7/8" tricone bit.						
	500														
-286	501														
	502														
-288	503														
	504														
-290	505														
	506														
-292	507														
	508														
-294	509														

RHMW16 well was installed with 4 inch diameter Schedule 80 polyvinyl chloride (PVC) well casing. The well was screened between ~488 and 508 ft bgs (~ -273 and -293 ft msl); with fill from 514' to 525' bgs; #3 Monterey sand filter pack from 441' to 514' bgs; bentonite slurry jetted into filter pack from 431' to 441' bgs; bentonite slurry from 90' to 431' bgs; and cement bentonite grout from ground surface to 100'. The well surface completion consists of a steel monument riser set in a concrete foundation designed to secure and lock the well.

Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 29,561 gallons of water were used during drilling and rock coring. The borehole was developed using the drill rig bailer; a total of 3,166 gallons of development water were removed.

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Log of Boring RHMW16

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-294	509															
	510															
-296	511															
	512															
-298	513															
	514															
-300	515															
	516															
-302	517															
	518															
-304	519															
	520															
-306	521															
	522															
-308	523															
	524															
-310	525															Total Depth = 525 feet BGS

~~For Red Hill AOC Party Use Only~~

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16A

Sheet 1 of 15

Date(s) Drilled	**09/22/2020 - 10/02/2020**	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	**HSA / HQ core / air rotary / mud rotary**	Drill Bit Size/Type	**HQ diamond bit / 8.5" tricone bit**	Total Depth of Borehole	**220.0 feet**
Drill Rig Type	**Mobile B-59 / Atlas Copco T-3 / Mobile B-90**	Drilling Contractor	**Valley Well Drilling**	Approximate Surface Elevation	**215.0**
Groundwater Level	**El. 40.41' (12/02/2021)**	Location	**RHSF**	Inclination from Horizontal/Bearing	**90°**
Borehole Completion	**4-inch diameter monitoring well**			Hammer Data	**140 lbs/30-inch drop**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
215	0								**GRAVEL FILL**, well graded-drill pad.						[12]	
214	1								**VALLEY FILL** GRAVELLY CLAY (GC) Boulder and cobble sized rocks							Hand auger refusal at 1'
212	3											1		0.6		No material recovered from 0-3.5' Log from cuttings observations and driller remarks
210	5								**VALLEY FILL** GRAVELLY CLAY (CL) with sand, brown (10YR 4/3) and very dark grayish brown (10YR 3/2), moist, stiff, medium angular sand, fine rounded gravel, low plasticity (70% fines, 20% gravel, 10% sand)							
	6		1													
208	7													0.1		
	8											2				
206	9															At 9.0' , Hollow stem auger grinding on boulder
	10															Continued grinding at 10.0'
204	11								**VALLEY FILL** SILT WITH CLAY AND GRAVEL (ML-CL) light brown (7.5YR 6/3) to light gray (7.5 YR 7/1). Predominantly unconsolidated with very firm to firmly friable gravel size fragments. Dry to slightly moist, low plasticity, occasional light gray coarse size a'a fragments, a'a cuttings are subrounded to angular							
	12											3		0.5		
202	13															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16A

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Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
202	13															
	14	4		60		60			**BASALT Massive A'a** Boulder, gray (5YR 5/1), slightly to moderately weathered, very strong, 15% 1-6mm subrounded vesicles, very large vug >10cm with Cl+Fe surface staining inside at 14'-14.5'							09/22/2020 End hollow stem auger drilling at 14'
200	15						1		1. 5°, J, VN, Sp, Wa, S							09/23/2020 Begin coring 150 gallons water added to begin coring
	16						2		2. 40°, J, N, Cl, Su, Wa, SR							
198	17	5		60		24			**VALLEY FILL** SILTY CLAY (CL) with gravel and sand, yellowish red (5YR 4/6), wet, medium stiff clay, fine rounded gravel, medium to fine coarse sand, some large 1-5cm rounded cobbles, low plasticity, (60% fines, 30% gravel and cobbles, 10% sand)					0.1	[33]	
	18								very stiff, high plasticity							No observable water loss
196	19		1													
	20								basalt cobble, 3" diameter							
194	21								becomes dark yellowish brown (5YR 4/6), soft							
	22								no gravel, reddish brown (5YR 4/3), stiff							100 gallons of water added
192	23	6		50		0			no recovery					0.1	[30]	
	24															
190	25								**BASALT Massive A'a** Boulder, gray (5YR 5/1), slightly to moderately weathered, very strong, 10% 1-8mm rounded vesicles							
	26															No observable water loss
188	27	7	2	60		24			**VALLEY FILL** Silty Clay with Gravel (CL) Brown (7.5YR 5/4) wet, very soft, fine rounded gravel, low plasticity (80% fines, 20% gravel)						[38]	
	28								no recovery							
186	29															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16A

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Log of Boring RHMW16A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
186	29													
	30						IF		**BASALT Massive A'a** Boulder, intensely fractured, highly weathered, very weak, 7% 1-3mm rounded vesicles, Mn surface staining, with heat alteration					
184	31													No observable water loss
	32	8	2	100		0			**VALLEY FILL** SILTY CLAY (CL) with sand, gray (7.5YR 5/1) and strong brown (7.5YR 5/8) mottled, moist, moderately stiff, low plasticity, (90% fines, 10% sands)			0.1	[38]	
182	33								Becomes stiff, gray becomes light gray (7.5 YR 7/1)					
	34													
180	35								Becomes SANDY CLAY (CL), gray (7.5YR 5/1), mottled with strong brown (7.5YR 4/6) and dark gray (2.5YR 4/1), wet, very soft, moderate to low plasticity, trace fine rounded gravel (60% fines, 35% sand, 5% gravel)					
	36													
178	37	9		70		0			Becomes SILTY CLAY (CL-ML), dark gray (5YR 4/1), wet, very soft, moderate plasticity			0.1	[50]	50 gallons of water added
	38													
176	39						NR		no recovery					
	40								**SAPROLITE** Highly weathered basalt, extremely weak. reddish brown (5YR 5/4), 40% <1mm rounded vesicles					
174	41		3				M							
	42	10		60		14	M					0.1	[300]	50 gallons of water added
172	43						M							
	44						NR							
170	45													

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Log of Boring RHMW16A

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
170	45															
	46						M M									
168	47						IF		becomes completely weathered							
									no recovery							50 gallons of water added
	48	11		40		24	NR							0.1	[42.86]	
166	49															
164	50		3						basalt boulder fragments mixed with completely weathered saprolite							
	51						M M M M M M									
	52								becomes completely weathered							50 gallons of water added
		12		40		24			no recovery					0.1	[300]	
162	53						NR									
	54															
160	55								**BASALT A'a Clinker** Loose, dark gray (5YR 4/1), loose, possibly fractured boulder, moderately weathered, weak, Mn and Iron Oxide staining, large 30-130mm clasts							Pause to tag borehole depth
	56								no recovery							
158	57						NR									
		13	4	50		0								0.1	[27]	
	58															100 gallons of water added
156	59															
	60															
154	61															

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Log of Boring RHMW16A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
154	61															
	62	14		100		26	1 2 3		**BASALT Massive A'a** Boulder, dark gray (5YR 4/1), slightly weathered, very strong, 20% <1-5mm irregular with some elongate vesicles, 1-2mm vugs					0.1	[21]	
152	63		4				4 5 6		1. 20° J, MW, Mn+Fe+Cl, Su+Sp, Wa, SR 2. 70°, J, N, Mn+Fe+Cl, Sp, Ir, SR 3. 20°, J, MW, Fe+Cl, Sp, IR, R 4. 70°, J, N, Fe+Cl, Sp+Su, Pl, SR 5. 90°, J, N, Mn+Cl+Fe, Su, Wa, SR 6. 30°, J, N, Fe+Cl, Sp, Ir, R							
	64															
150	65								**VALLEY FILL** SILTY CLAY (CL), dark gray (5YR 4/1) and brown (10YR 5/3), moist, medium stiff, moderate plasticity							
	66								fractured basalt cobbles							Brown water returns
148	67	15		92		0			fractured basalt cobbles					0.1	[13]	
	68															
146	69						IF		**BASALT Massive A'a** Boulder, dark gray (5YR 4/1), moderately weathered, strong, 15% 1-2mm rounded vesicles, IF, Cl infill in fractures							
	70						N/D		no recovery							
144	71						IF		**VALLEY FILL** SILTY CLAY (CL), dark gray (5YR 4/1) to reddish brown (5YR 3/4) low to moderate plasticity, low to moderately moist, occasional interbedded angular basalt fragments							100 gallons of water added
	72		5													
	73	16		66		0			**BASALT Massive A'a** Boulder, light gray (7.5YR 7/1) to gray (7.5YR 6/1), slight to moderate weathering, very strong, intensely fractured					0.1	[21]	
142									**VALLEY FILL** same as previous							
	74						NR		no recovery							
140	75								**BASALT Massive A'a** Boulder, light gray (7.5YR 7/1) slightly weathered, very strong, 5% angular to subrounded 1-20mm vesicles, occasional vugs							
	76								**SAPROLITE** Dark reddish brown (5YR 3/4), highly weathered basalt, very weak to extremely weak, 30% 1-2mm							
138	77															

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Log of Boring RHMW16A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
138	77								rounded vesicles							
		17	5	78		52			**BASALT Massive A'a** Boulder, light gray (7.5YR 7/1) slightly weathered, very strong, 25% elongated and angular vesicles 1-25mm					0.1	[50]	2000 gallons total water used on 09/23/2020
	78								**SAPROLITE** Dark reddish brown (5YR 3/4), highly weathered basalt, very weak, waxy fresh surfaces, 1% 1mm rounded vesicles							
136	79						NR		no recovery							
	80															End of coring 09/23/2020 at 80'
																Resume coring 09/24/2020
134	81															
																200 gallons of water added
	82								**VALLEY FILL** SILTY CLAY (CL) with sand, dark reddish gray (5YR 4/2) and yellowish red (5YR 5/6), wet, very soft, very fine sand, low plasticity (90% fines, 10% sand)							
		18		60		0								0.1	[23]	
132	83		6						becomes stiff, no sand, dark reddish gray (5YR 4/2)							
	84															
							M		**BASALT Massive A'a** Boulder, light gray (7.5 YR 4/2), fractured, slightly weathered, very strong, 25% elongated and irregular vesicles 1-25mm							
130	85						M		**VALLEY FILL** SILT (ML) with minor clay and trace sand (10YR 4/2), moist, medium stiffness, fine sand, non-plastic (95% fines, 5% sand)							
	86								boulder fragment							
128	87								**BASALT Pahoehoe** Reddish brown (5YR 4/3), moderately weathered, medium strong to strong, 50% <1-2mm rounded vesicles							
		19		100		54		1	1. 45°, J, N, Mn+Cl, Su+Sp, St, SR					0.1	[23]	
								2	2. 0°, J, N, Mn+Cl, Su+Sp, Pl, SR							
	88							3	3. 5°, J, N, Mn Sp, Cl Pa, Pl, SR							
									4. 30°, J, N, Mn Sp, Cl Sp, St, SR							
126	89							4	becomes dark reddish brown (5YR 3/3) slightly weathered, 1-3mm rounded vesicles							10" sch. 40 steel conductor casing installed to 89' bgs.
	90							1	1. 15°, J, N, Mn+Cl, Su-Sp, Ir, SR							
								2	2. 20°, J, N, Cl+Mn, Su, Pa, Pl, R							
								3	3. 90°, J, VN, Cl+Mn, Su, Pa, Pl, SR							
								4	4. 80°, J, VN, Cl+Mn, Su+Sp, Pl, SR							
124	91							5	5. 90°, J, VN, Cl+Mn, Su+Sp, Pl, SR							
			7					6	6. 45°, J, VN, Cl, Sp+Pa, Pl, SR							
								7	7. 40°, J, VN, Cl+Mn, Sp, Wa, SR							
									8. 30°, J, N, Cl, Su+Pa, Pl, SR							
	92								9. 30°, J, N, Cl+Mn, Su+Pa, SR							
								8	10. 0°, J, N, Cl+Mn, Su+Sp, S-SR							
									11. 0°, J, N, Cl, Fi, Pl, S-SR							
		20		88		48		9	12. 0°, J, N, Cl, Pa, Pl, SR					0.0	[50]	
122	93								13. 75°, VN, Cl+Mn, Pl, SR							

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Log of Boring RHMW16A

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
122	93						10							
							11		becomes completely weathered for ~1.5"					
	94								vesicles decrease to 10% for 3"					
							12							
							13							
120	95						1							Pause coring activities: See log book #20
			7				2							
	96						3							
							4		1. 30°, J, N, Cl, Sp, Pl, SR 2. 85°, J, N, Cl+Mn, Su+Sp, Ir, S-SR 3. 10°, J, VN, Cl, Sp, Ir, SR					
							5		4. 5°, J, VN, Cl+Mn, Su+Pa, Pl, S-SR 5. 50°, J, VN, Cl+Mn, Sp+Pa, Pl, SR					
118	97						M		6. 0°, J, VN, Cl, Pa, Pl, S 7. 0°, J, VN, Cl, Fi, Pl, S					
		21		96		72			8. 0°, J, VN, Cl, Fi, Pl, S 9. 60°, J, VN, Cl+Mn, Su-Sp, Wa, SR			0.0	[30]	
	98						6		10. 80°, V, T, Cl, Fi, Wa, S					
							7							
							8		becomes completely weathered					
116	99						9							
							10							
	100						M		becomes highly weathered, vesicles decrease to 10%					
							M							
							1							
114	101						2		1. 10°, N, Cl+Mn, Su, Pl, S 2. 30°, N, Cl+Mn, Su+Sp, Pl, SR					
							3		3. 50°, VN, Cl+Mn, Su+Sp, Wa, SR					
	102						4		4. 10°, VN, Cl+Mn, Su+Sp, Wa, SR 5. 10°, VN, Cl+Mn, Su+Pa, Ir, SR					
		22		100		64			6. 0°, J, VN, Cl+Mn, Pa, Pl, S-SR 7. 5°, J, VN, Cl+Mn+K-spar, Pa, Ir, SR			0.0	[43]	
112	103		8				5		8. 30°, J, N, Cl+Mn, Su, Pl, SR 9. 45°, J, MW, Cl+Mn, Fi, Pl, SR					
							6							
	104						7							
							8							
							9							
110	105						1		1. 35°, VN, Cl+Mn, Su-Pa, Wa, SR 2. 10°, T, Cl+Mn, Su, Wa, SR					
									3. 45°, T, Cl+Mn, Su-Pa, SR 4. 10°, T, Cl+Mn, Su, Ir, SR					
	106						2		5. 10°, N, Cl+Mn, Pa-Fi, Ir, SR 6. 15°, VN, Cl, Sp, Pl, SR					
									7. 10°, N, Cl, Pa, Pl, SR					Bail 65 gallons of water, measure depth to water, and deploy transducer after coring
108	107						3							
		23		100		100						0.0	[43]	
	108						4							
							5		becomes highly weathered					
			9											
106	109						6							

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Log of Boring RHMW16A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
106	109								becomes highly weathered							800 gallons of water used over 30' of drilling End coring 09/24/2020 Resume coring 09/25/2020
104	111								becomes highly weathered 1. 10°, J, VN, Cl+Mn, Su-Sp, R 2. 45°, J, VN, Cl+Mn, Su-Sp, R 3. 45°, J, VN, Cl+Mn, Su, Pl, R 4. 15°, J, N, Cl, Pa, Pl, R 5. 15°, J, N, Cl, Pa, Pl, SR 6. 80°, J, VN, Cl+Mn, Su-Fi, Pl, SR 7. 25°, J, VN, Cl+Mn, Su-Fi, Pl, SR 8. 25°, J, VN, Cl+Mn, Su-Pa, Pl, SR 9. 20°, J, MW, Cl+Mn, Fi-Sp, Su, Ir, R							150 gallons of water added to fill borehole
102	113	24	9	100		92			becomes highly weathered					0.0	[75]	
100	115								1. 5°, J, N, Cl+Mn, Sp-Pa, Pl, R 2. 5°, J, N, Cl+Mn, Su, Wa, SR 3. 35°, J, N, Cl+Mn, Su, Wa, SR							
98	117								vesicles increase in diameter to 10-15mm. becomes vuggy							50 gallons of water added
96	119	25	10	100		64			4. 0°, J, N, Cl, Pa, Pl, SR 5. 0°, J, N, Cl, Pa, Pl, SR 6. 40°, J, N, Cl+Mn, Sp-Fi, SR 7. 30°, J, N, Cl, Pa, Pl, SR 8. 35°, J, MW, Cl, Su, Ir, SR 9. 40°, J, MW, Cl+Mn, Sp-Pa, Ir, R 10. 45°, J, MW, Cl, Pa, Wa, SR					0.0	[75]	
94	121								1. 15°, J, VN, Cl+Mn, Fi, Wa, S 2. 15°, J, N, Cl+Mn, Pa, Ir, R 3. 90°, VN, T, Cl, Fi, Pl, S 4. 80°, J, VN, VN, Cl+Mn, Fi, Wa, S 5. 30°, J, VN, Cl+Mn, Fi, Ir, S 6. 90°, J, VN, Cl+Mn, Pa, Wa, SR 7. 15°, J, MW, Cl+Mn, Fi, Ir, SR 8. 25°, J, VN, Cl+Mn, Su, Pl, SR 9. 70°, J, T, Cl, Su, Pl, SR 10. 10°, J, N, Cl+Mn, Fi-Su, Pl, S							
92	123	26	11	96		90			vesicles increase in diameter to 5-10mm					0.0	[50]	Driller notes change at 123': Water becomes reddish gray
90	125								no recovery							

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Log of Boring RHMW16A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
90	125															
	126								1. 5°, J, MW, Cl, Pa, Ir, R 2. 5°, J, N, Cl+Mn, Pa, Pl, R 3. 25°, J, MW, Cl, Pa, Ir, R 4. 30°, J, VN, Cl+Fe, Pl, S 5. 0°, J, VN, Cl, Su, Ir, SR 6. 0°, J, N, Cl, Pa, Ir, R						
88	127	27	12	96		78								0.0	[43]	50 gallons of water added
	128															
86	129								**BASALT A'a Clinker** Welded, gray (10YR 6/1) to dark gray (10YR 4/1) with reddish brown clay infilling, moderately weathered, medium strong to strong, abundant loose angular to subrounded pebble sized clasts (10-30mm) reddish brown to yellowish red (5YR 5/6) moderately weathered, vesicles subrounded to elongated 1-5mm, 10%						
	130															
84	131															
	132								loose clinker, medium strong, dark gray (10YR 4/1) with spotted reddish brown clay 1. 20°, J, MW, Cl, Pa, W, SR 2. 15°, J, W, Cl+Fe, Ir, SR 3. 0°, J, Cl+Mn, Pa, Ir, SR					0.0	[28]	
		28	13	100		34	IF									Core blockage in shoe
82	133								**BASALT A'a Clinker** Loose, very dark gray (10YR 3/1), highly to completely weathered, extremely weak							Bail down test at 135' and transducer deployed
	134								**BASALT Massive A'a** Very dark gray (10YR 3/1) with reddish yellow clay infilling in fractures and voids, moderately weathered, strong, 3% vesicles stretched and elongated 0.1-2mm						[7]	
									4. 0°, J, MW, Cl+Mn, Pa, Wa, SR 5. 60°, J, N, Cl+Mn, Fi, Pl, SR							End of coring 09/25/20
80	135															Perform 50 gallon slug test before coring 09/26/2020 Resume coring 09/26/2020
	136								becomes 10% vesicles, irregular, elongated, 1-10mm 1. 0°, J, N, Cl+Mn, Sp, Pl, SR 2. 50°, J, MW, Mn, Sp, Wa, SR 3. 15°, J, MW, Mn, Sp, Pl, SR 4. 0°, J, W, Cl+Mn, Sp, Wa, SR 5. 0°, J, MW, Cl+Mn, Pa, Wa, SR							
78	137								becomes 10-15% vesicles elongated 1-2mm							50 gallons of water added
		29	14	100		58			6. 5°, J, MW, Mn, Sp, Wa, SR 7. 5°, J, N, MN, Pa, Ir, R 8. 90°, J, N, Mn, Pa, Cl, Sp, Ir, SR 9. 70°, J, W, Mn+Cl, Pa, Ir, SR 10. 90°, J, W, Mn+Cl, Sp, Wa, SR					0.0	[43]	
76	139								becomes 1.5mm subrounded Intensely fractured Cl+Mn infilling							
							IF		becomes 20% vesicles, 1-20mm, stretched to subrounded							
	140		15						decreases to 5% vesicles, elongated, 1-5mm 1. 0°, J, VN, Mn+Cl, Pa, Ir, R 2. 65°, J, VN, Mn, Pa, Cl, Sp, Ir, R becomes longer 1-10mm vesicles, subrounded							No observable water loss
74	141															

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74	141													
									vesicles decrease to 5-10%					
	142		15						becomes subrounded, 10% vesicles 1-20mm					
		30		100		50	3 4 5 6 7 8 9 IF 10 11 12		3. 0°, J, N, Mn+Cl, Sp, Pa, Pl, SR 4. 60°, J, VN, Mn, Sp, Wa, SR 5. 75°, J, VN, Mn+Cl, Sp, Wa, SR 6. 0°, J, MW, Mn+Cl, Sp, Ir, R 7. 75°, J, MW, Mn+Cl, Pa, Wa, SR 8. 75°, J, MW, Mn+Cl, Sp, Wa, SR 9. 85°, J, W, Mn+Cl, Sp, Wa, SR 10. 0°, J, VN, No, No, Ir, R 11. 90°, J, N, Mn+Cl, Pa, Pl, SR 12. 10°, J, VN, No, No, Ir, R			0.0	[50]	
72	143													
	144													
70	145		16				1		1. 5°, J, MW, No, No, Ir, R 2. 25°, J, W, Cl+Mn, Pa, Ir, R					No observable water loss
	146								vesicles decrease to 1%, stretched 1-2mm					
							2							
									3. 45°, J, N, No, No, Wa, SR 4. 25°, J, VN, Mn, Sp, Ir, R					
68	147						3							
		31		100		95						0.0	[50]	
	148		17						changes to 5% vesicles, 1-10mm stretched					
							4							
66	149								change to 3% vesicles, 1-5mm elongated					
							5		5. 45°, J, VN, Mn, Sp, Ir, R 6. 5°, J, VN, Mn, Pa, Wa, SR					
	150						6							
									larger vesicles, very elongated 30-40mm					
64	151						1		1. 5°, J, N, Mn, Sp, Wa, R 2. 10°, J, N, Cl, Pa, Mn, Sp, Ir, R 3. 0°, J, W, Cl+Mn, Pa, Wa, SR 4. 20°, J, VN, Cl, Pa, Wa, SR					
	152						2							
		32	18	100		98	3		becomes <1% vesicles, 1-2mm, subrounded			0.0	[38]	No observable water loss
62	153													
	154						4							
														End coring 09/26/2020
60	155						1		Gray (10YR 5/1), slight weathering, very strong, 1% subangular <1mm vesicles, occasional 5-10mm subangular vesicles 1. 75°, VN, Cl+Mn, Su+Sp, Pl, Sm 2. 45°, J, MW, Cl, Su, Ir, SR 3. 90°, VN, Cl+Mn+Fe, Su+Sp+Pa, Pl, S 4. 20°, MW, Cl-Su, Mn-Sp, Pl, S 5. 10°, VN, Cl, Su, Pl, S 6. 10°, VN, Cl, Su, Wa, S					Resume coring
							2 3 4							
	156		19											
							5 6							No observable water loss
58	157													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
58	157								7. 35°, J, VN, Cl+Fe - Su, Mn-Sp, Pl, S							
		33		80		46								0.0	[33]	
	158		19													No observable water loss
									BASALT A'a Clinker							Bail down test completed
56	159								Loose, reddish brown (2.5YR 4/4) with gray (5YR 6/1) clasts, highly to completely weathered, extremely weak, highly unconsolidated, abundant 5-30mm subangular to subrounded clasts							
							NR		no recovery							End coring 09/28/2020
	160															Resume coring 09/29/2020
54	161								**BASALT A'a Clinker**							
									Loose, same as previous							
			20						**BASALT Pahoehoe**							
	162								Gray (10YR 5/1) to dark gray (10YR 4/1) slight to moderate weathering, strong to very strong, 25% 1-25mm subrounded vesicles, occasional vugs							
		34		92		48								0.0	[75]	
52	163								1. 5°, J, N, Cl, Pa, Ir, R 2. 40°, J, MW, Cl+Mn, Su+Sp, Ir, SR 3. 25°, J, MW, Cl, Pa, Ir, R 4. 90°, J, VN, Cl+Mn, Sp, Ir, R 5. 35°, J, VN, Cl, Sp, Ir, R 6. 40°, J, VN, Cl+Mn, Sp, Pl, SR 7. 80°, J, VN, Cl+Mn, Sp+Su, SR 8. 45°, J, MW, Cl+Mn, Su+Sp, SR 9. 45°, J, VN, Cl+Mn, Fi+Sp, S 10. 25°, J, N, Cl+Mn, Sp, Ir, R							No observable water loss
	164															
50	165								vesicles become larger (5-40mm) and elongated							
	166		21													Void noted by driller
									void from 166.4' - 166.8'							
48	167								1. 15°, J, N, Cl+Fe, Su, Wa, SR 2. 30°, J, N, Cl, Su, Wa, R 3. 80°, J, VN, Cl, Sp, Pl, SR 4. 20°, J, N, Cl+Fe, Sp+Su, SR 5. 10°, J, N, Cl, Sp, Ir, SR 6. 10°, J, N, Cl+Fe, Sp, Ir, R 7. 20°, J, N, Mn, Sp+Pa, Pl, R 8. 20°, J, N, Mn, Sp, Pl, R 9. 90°, J, VN, Mn+Cl, Sp, Wa, R 10. 15°, J, VN, Cl, Sp, Wa, R 11. 40°, J, VN, Cl+Mn, Pa+Sp, Ir, SR 12. 45°, J, N, Cl+Mn, Sp+Pa, Ir, S 13. 15°, J, N, Cl+Mn, Su, Pa, Ir, SR 14. 50°, J, N, Cl+Mn, Sp+Pa, Wa, SR							
		35		92		48								0.0	[75]	
	168															50 gallon slug test completed. See log book #20
46	169															
																End coring 09/29/20
	170								Dark reddish gray (5YR 4/2), slightly weathered, strong, 5% 4-15mm rounded and irregular vesicles, some reddish brown clay (5YR 5/4) in vesicles							Resume coring 09/30/20
			22													
44	171								becomes dark gray (5YR 4/1), unweathered to slightly weathered, very strong, 1-2mm plagioclase and/or quartz crystals, 5% 1-10mm rounded vesicles, no clay in vesicles, 1-2mm olivine crystals							
																30 gallons of water added
	172															
		36		100		66			1. 80°, J, MW, Cl+Fe+Mn, Sp, Wa, SR 2. 30°, J, N, Cl+Mn, Sp, Ir, R 3. 0°, J, VN, Cl, Sp, Pl, S 4. 5°, J, N, Mn, Cl, Sp+Su, Wa, SR					0.0	[150]	
42	173		23													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 11/1/2021 RHMW16A

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
42	173								1% 2-7mm vesicles, rounded					
	174						M 4							
40	175		23						1. 10°, J, N, Mn+Cl, Sp, St, R 2. 80°, J, VN, Mn+Cl, Sp, Pl, SR 3. 5°, J, VN, Cl, Sp, Wa, SR					
	176						1		becomes <0.5-1mm, rounded vesicles 50% 4. 70°, J, N, Cl+Mn, SP, Pl, SR 5. 45°, J, MW, Cl, Fi, Ir, R 6. 90°, J, N, Cl, Sp, Ir, R					
							2 3 4		7. 0°, J, MW, Cl, Sp, Pl, VR 8. 80°, J, N, Mn,Sp, Cl, Su, Pl, SR					30 gallons of water added
38	177						5 6		9. 80°, J, N, Mn+Cl, Sp, Pl, SR becomes dark reddish gray (5YR 4/2), moderately					
		37		96		54	7 NR		weathered, weak, 50%, 0.5-1mm rounded vesicles filled with pink (5YR 8/4) clay no recovery			0.0	[75]	
	178								becomes slightly weathered, strong, 40% 1-3mm rounded vesicles, no clay					Void observed by driller at 178'
36	179		24				IF 8		15% 5-15mm irregular and rounded vesicles, plagioclase crystals					
							9							
	180						M 1		intensely fractured pink (5YR 8/4) clay in vesicles and fracture surfaces, 30% 0.5-1mm irregular vesicles 1. 0°, J, N, Mn, Sp, Cl, Su, Ir, R 2. 50°, J, MW, Mn+Cl, Sp, Ir, SR					
34	181						IF		30% 0.5-1mm irregular vesicles					
							2		becomes dark reddish gray (5YR 4/2)					
	182						3		3. 45°, J, MW, Mn Sp, Cl Su, Ir, Sr				[26]	30 gallons of water added
		38		100		52	IF		slightly weathered, strong, 5% 0.5-2mm elongated and rounded vesicles			0.0	[10]	
32	183		25				IF		becomes 30% 1-3mm rounded vesicles becomes 50% <1mm rounded vesicles					
									4. 20°, N, Mn Sp, Cl Su, H, S 5. 60°, V, MW, Cl, Fi, Pl, NH 6. 40°, J, N, Cl, Fi, Pl, SR 7. 10°, J, N, Mn Sp, Cl Su, Wa, SR					
	184						4 5							
							6		becomes 25% 1-5mm rounded vesicles					Second attempt made to recover last foot of Run 38
30	185						7 1		becomes 10-15% vesicles, 1-2mm rounded, dark gray (5YR 4/1)					
							2		1. 5°, J, MW, Cl+Mn, Pa, Wa, SR 2. 80°, J, N, Cl+Mn, Sp, Wa, SR 3. 0°, J, N, No, No, Wa, SR 4. 0°, J, W, Cl+Mn, Sp, Ir, R 5. 5°, J, MW, Cl, Sp, Wa, R 6. 0°, J, N, Cl, Pa, Ir, R					
	186						3							
28	187		26				4 5		becomes 30-40% vesicles, 1-5mm rounded					
		39		100		74	IF		becomes 15-20% vesicles, 1mm rounded becomes highly weathered, very weak, reddish brown (5YR 4/3), vesicles filled with pink clay (5YR 8/4), 0.5-1mm rounded vesicles. Intensely fractured			0.0	[18]	
	188						6		becomes 25-30% vesicles, 1-2mm rounded becomes 5-10% vesicles, 2-3mm rounded					
26	189													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
26	189						7		vesicles become larger, 1-5mm, 10-15%, subrounded						Water level testing performed upon completion of coring
			26				8								End coring 09/30/2020
	190						9		7. 10°, J,N, Cl+Mn, Pa, Ir, SR 8. 60°, J, N, Cl, F, Mn, Sp, Ir, SR 9. 70°, J, N, Cl, F, Mn, Sp, Ir, SR						Completed 40 gallon slug test prior to coring on 10/01/2020
24	191						1		1. 0°, J, N, Mn Sp, Cl+Fe Su, Wa, SR 2. 45°, J, MW, Mn Sp, Cl+Fe Su, Wa, SR 3. 10° J, N, Mn Sp, Fe Su, Wa, SR						Resume coring 10/01/2020
							2		becomes 30% 2-8mm rounded vesicles						
	192						3		becomes 40% 0.5-3mm rounded vesicles						
		40	27	100		56	4								
							5		4. 20°, J, N, Mn Sp, Fe Su, Wa, SR 5. 45°, J, MW, Cl, Fi, Wa, SR IF reddish yellow (5YR 6/6) and pink (5YR 7/4) clay on fracture surfaces				0.0	[25]	
22	193						IF		**BASALT A'a Clinker** Welded, dark reddish brown (5YR 3/2), very dark grey (5YR 3/1), and reddish brown (5YR 4/3), with reddish yellow (5YR 3/1), clay between clinker clasts, moderately weathered, weak, 2-20mm subangular clinker clasts						
	194						IF								
20	195						1		1. 10°, J, N, Cl+Mn, Su+Sp, Wa, SR 2. 40°, J, N, Cl+Mn, Pa, Ir, R 3. 5°, J, MW, Cl+Mn, Sp+Pa, Ir, SR 4. 5°, J, MW, Cl+Mn, Su, Ir, SR 5. 90°, J, VN, Cl+Mn, Su, Wa, SR						
							2								
							3								
	196						4								
							5		**BASALT A'A Clinker** Loose, gray (5YR 5/1) to dark gray (5YR 4/1), moderate weathering, medium strong to strong individual clasts, abundant reddish yellow (5YR 6/8) clay surface staining, 1-50mm clasts.						
18	197														No observable water loss
		41	28	76		24							0.0	[43]	
	198								no recovery						
16	199														
									BASALT Massive A'a Dark gray (5YR 4/1), slightly weathered, very strong, 20% 1-10mm elongated and angular vesicles						
	200														reamed to 200' bgs total depth
14	201						1								
							2								
	202						3		1. 45°, J, N, CL+Mn, Su+Sp, Pl, SM 2. 45° J, N, Cl+Mn, Sp, Wa, SR 3. 40° , J, N, Cl+Mn, Sp+Su, Ir, SR 4. 40°, J, VN, Cl+Mn, Su+Sp, Ir, R 5. 90°, J, VN, Cl+Mn, Su+Sp, Pl, S 6. 45° , J, N, Cl+Mn, Su+Sp, Ir, SR 7. 35° , J, N, Cl+Mn, Su+Sp, Wa, R 8. 30°, J, VN, Cl+Mn, Sp, Ir, R 9. 30°, J, N, Cl+Mn, Sp, Ir, R						No observable water loss
		42	29	100		84	4						0.0	[50]	
12	203						5								
							IF								
							6								
	204						7								
							8								
10	205						9								End coring 10/01/2020

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
10	205		29													Completed 45 gallon slug test prior to coring on 10/02/2020 Resume coring 10/02/2020
									1-5mm vesicles, elongated, 20% 1. 75°, J, N, Mn, Sp, Ir, SR 2. 75°, J, MW, Mn, Sp, Ir, SR 3. 5°, J, W, Mn+Cl, Sp, Ir, SR 4. 0°, J, N, Mn, Sp, Cl, Pa, Ir, SR						[30]	
	206								presence of larger very elongated vesicles (width of core) and 1% 10mm elongated vesicles							
8	207	43	30	96		46			fractures completely filled with reddish yellow clay (5YR 6/8) 1-5mm thick, 2% vesicles elongated 0.5-1mm					0.0		
	208						NR		no recovery becomes 3-5% vesicles, 1-10mm elongated and angular 5. 5°, J, N, Mn+Cl, Sp, Wa, SR 6. 5°, J, N, Mn, Sp, Cl, Pa, Ir, SR 7. 5°, J, MW, Cl, Fi, Mn, Su, Ir, SR 8. 80°, J, MW, Cl, Fi, Mn, Su, Ir, SR 9. 90°, J, W, Cl, Fi, Wa, SR 10. 0°, J, W, Mn+Cl, Sp, Ir, R 11. 10°, J, W, Cl, Pa, Mn+Cl, Su, Ir, SR 12. 5°, J, N, Mn, Sp, Wa, SR							
6	209														[30]	
	210								3% vesicles, 1-3mm elongated with 1% longer stretched vesicles 10-30mm, visible olivine crystals 13. 10°, J, MW, Mn, Sp, Fe, Su, Ir, R 14. 10°, J, MW, Mn+Fe, Sp, Cl, Pa, Wa, SR 15. 15°, J, W, Mn+Cl, Pa, Wa, SR 1. 5°, J, W, Mn, Sp, Ir, SR 2. 15°, J, MW, Mn, Sp, Ir, SR 3. 15°, J, MW, Mn, Sp, St, SR 4. 5°, J, W, Mn+Cl, Pa, St, R 5. 0°, J, W, Mn, Sp, Ir, R 6. 0°, J, W, Mn, Su, Ir, R becomes 10-15% vesicles, 1-10mm elongated and subrounded 7. 0°, J, W, Fe, Su, Wa, SR 8. 0°, J, W, Mn+Fe, Pa, Wa, SR 9. 15°, J, W, Mn+Fe, Su+Sp, Ir, R + Cl Su becomes 1-3% vesicles, 1-5mm subrounded to elongated 10. 0°, J, W, Fe+Mn, Sp, Wa, SR dark reddish brown splatter (2.5YR 2.5/4) within flow 11. 25°, J, N, Mn+Fe+Cl, Pa, Ir, R becomes moderately weathered, strong, dark reddish brown with reddish yellow clay (5YR 7/8), potential transition to welded clinker 12. 0°, J, W, Mn+Fe+Cl, Pa, Wa, SR 13. 0°, J, W, Mn+Fe+Cl, Pa, Ir, SR							
4	211															
	212	44	31	100		74								0.0	[38]	
2	213															
	214															
0	215															
	216		32				NR		**BASALT A'a Clinker** Loose, dark grey (5YR 4/1) to dark red (2.5YR 3/6) clasts, moderately to highly weathered, moderately strong with reddish yellow (5YR 7/8) to pink (5YR 8/3) clay, clasts range from 5-50mm, subangular no recovery							
-2	217	45		44		6								0.0	[25]	
	218						NR									
-4	219						IF		**BASALT Pahoehoe** Dark olive brown (2.5YR 3/3), 25-30% 1-5mm olivine crystals, moderate to slightly weathered, medium strong, 1-2% 0.5-2mm subrounded vesicles 1. 40°, J, MW, Mn+Fe, Su, Wa, SR							
	220								Borehole total depth: 220ft							
-6	221															

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW16A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-6	221								RHMW16A was hand cleared from ground surface to 1.5 ft below ground surface (bgs) with refusal on basalt boulders. The borehole was then drilled using 8.5" OD hollow stem auger to 14 ft bgs, where there was refusal on a basalt boulder. HQ coring commenced from 15 ft to 220 ft bgs total coring depth. Reamed borehole with a 17.5" tricone bit from 14 ft to 93 ft bgs. Installed 10" Schedule 40 steel conductor casing to 89 ft bgs. Borehole was reamed from 89 ft to 200 ft bgs total reaming depth with a 9 7/8" tricone bit. RHMW16A well was installed with 4 inch diameter Schedule 80 polyvinyl chloride (PVC) well casing. The well was screened between ~162 and 192 ft bgs (~ 53 and 23 ft msl); with fill from 198' to 200' bgs; bentonite seal from 193' to 198'; #3 Monterey sand filter pack from 157' to 193' bgs; bentonite seal from 152' to 157' bgs; bentonite slurry from 87' to 157' bgs; and cement bentonite grout from ground surface to 87'. The well surface completion consists of a steel monument riser set in a concrete foundation designed to secure and lock the well. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 3,190 gallons of water were used during drilling and rock coring. The borehole was developed using the drill rig bailer; a total of 295 gallons of development water were removed.						
	222														
-8	223														
	224														
-10	225														
	226														
-12	227														
	228														
-14	229														
	230														
-16	231														
	232														
-18	233														
	234														
-20	235														
	236														
-22	237														

~~For Red Hill AOC Party Use Only~~

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW19

Sheet 1 of 29

Date(s) Drilled	**04/08/2020 - 04/24/2020**	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	**HSA / HQ core / Air Rotary**	Drill Bit Size/Type	**HQ diamond bit / 8.5" tricone bit.**	Total Depth of Borehole	**455.0 feet**
Drill Rig Type	**Mobile B-59 / Atlas Copco T-3**	Drilling Contractor	**Valley Well Drilling**	Approximate Surface Elevation	**~443**
Groundwater Level	**El. 19.6' (4/24/2020)**	Location	**RHSF**	Inclination from Horizontal/Bearing	**90°**
Borehole Completion	**4-inch diameter monitoring well**			Hammer Data	**140 lbs/30-inch drop**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								**GRAVEL FILL**, well graded-drill pad.				[40]	Augered through gravel fill
442	1													
	2								**FAT CLAY (CH)**, dark reddish brown (2.5YR 3/3),moist, low to medium plasticity, with fine basaltic fine gravel, angular to subrounded gravel, trace sand, (25% gravel, 5% sand, 70% fines).			0.9		Hand augered to 5' below native ground
440	3											7.1		
	4								**SILTY SAND (SM)**, dark red (2.5YR 2.5/4), with fine subrounded basaltic gravel, moist, low plasticity (20% gravel, 20% sand, 60% fines).			0.1		
438	5											0.1	[10]	End of day Start of 4/9/2020
	6								**FAT CLAY (CH)**, dark red (2.5YR 2.5/4), wet, weak, trace gravel and sand, coarse subangular gravel.			0.1		
436	7								becomes drier with increase in fine angular gravel (20% gravel).			0.1		
									no recovery				[15]	End of hand clearing Begin HSA
	8													
434	9													
	10								**FAT CLAY (CH)** with gravel, red (2.5YR 4/8), moist, stiff, low to medium plasticity, very angular gravel (20%-30% gravel).					
432	11								end of sample, cobble of very weathered saprolite basalt, light reddish brown (2.5YR 6/3), weak, well graded.		16 16 30	0.3		
									no recovery					
	12													
430	13													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 10/19/2021 RHMW19

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW19

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
430	13						NR									
	14															
428	15						IF									
							1		**BASALT Massive A'a** boulder, greenish gray (GLEY 1 5/N), strong, slightly weathered, 5% 2mm elongated irregular vesicles.				50 / 2"	0.4		Sounds like augering on rock
	16	1	1	100		0	2		1. 75°, J, N, Fe+Mn, Su, Wa, SR 2. 10°, J, Fe+Mn+Cl, Su, Wa, SR							Light gray water return Core barrel stuck in rod, expanded
426	17						IF									End of drilling 4/10/2020 Begin drilling 4/13/2020
									BASALT A'a Clinker loose, strong, unweathered, rounded clasts, variable vesicles.							
	18						IF									
		2		50		0			**VOLCANIC SAPROLITE** angular, moderately weathered clasts in red (2.5YR 4/8) sandy fat clay matrix, subangular clasts, <20mm (30% lager clasts, 5% trace or highly weathered clinker.							Light brown water return
424	19								no recovery							
							NR									
	20															
422	21															Variable circulation
							NR									
	22															Light brown water return Water loss = 500 gallons
		3	2	40		0										
420	23								**BASALT A'a Clinker** loose, reddish brown (5YR 4/4), moderately to slightly weathered, medium strong, some clay on fracture planes, Fe+Mn staining, dark black breccia within clinker clasts.						
	24															
									BASALT Massive A'a boulder, very dark gray (5YR 3/4) strong, slightly weathered, 5-10% elongated vesicles.						
418	25														[20]	
									no recovery							
	26						NR									
																Light gray water return Water loss = 700 gallons
416	27								**BASALT A'a Clinker** loose, dark red (2.5YR 3/6), reddish brown (5YR 4/3), and black (5YR 2.5/1), moderately weathered, medium strong to strong, subrounded clasts.						
		4		70		30										
	28															
									becomes **BASALT a'a Clinker** welded, dark red (2.5YR 3/6) and white (2.5YR 8/1),						
414	29															

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
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Log of Boring RHMW19

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
414	29								well graded, strong, slightly to moderately weathered, halloysite clay infill in rounded welded clasts. 1. 65°, J, N, Mn+halloysite Cl, Su, P/Wa, S							Water loss = 700 gallons
							1 IF		**BASALT Pahoehoe** boulder, very dark gray (5YR 3/2), medium strong, slightly weathered, 10-20% round, 1-6 mm vesicles.							
412	30						1 2		**TUFF** yellowish red (5YR 5/6), highly weathered, weak, clay infill with Mn+Fe staining on joints, very fine grained.						[17]	10" sch. 40 steel conductor casing installed to 30' bgs.
	31								no recovery 1. 0°, J, N, No, St, S 2. 20°,J, W, No, Pl, S 3. 0°, J, W Cl, Su, Wa, S 4. 70°, J, N Cl, Su, IR, R 5. 50°, J, N, No, Pl, R							Water loss = 700 gallons Light Brown water return
410	32	5	2	60		0	NR									
	33								**BASALT Pahoehoe** dark gray (5YR 4/1), moderately weathered, medium strong, 10% <3mm spherical vesicles. Grades to 30% 5-10mm elongated vesicles.							
	34						3 4									
408	35						5		grades to 5% 1-2 mm angular vesicles.							
									no recovery						[60]	
	36						NR									
406	37	6	3	70		0			**BASALT A'a Clinker** loose, dark reddish brown (5YR 3/2) clasts, moderately weathered, strong, with yellowish red (5YR 4/6) clay.							Water loss = 700 gallons Light brown water return
	38								**BASALT Pahoehoe** dark reddish brown (5YR 3/2), highly weathered, extremely weak, 30% 2-5 mm rounded vesicles filled with reddish yellow (5YR 7/8) and pink (5YR 8/4) halloysite clay.							
404	39															
	40								grades to 20% 3-5 mm rounded vesicles, slightly to moderately weathered, strong to medium strong.						[30]	
402	41						1		1. 20°, J, N, halloysite Cl, Pa, Wa, S 2. 20°, J, N, W, no, no, Ir, R 3. 65°, J, N, Mn, Su, Pl, R 4. 20°, J, N, Halloysite, Pa, St, R							
	42						2		**TUFF** reddish brown (5YR 5/4), strong, slightly weathered.							Water loss = 800 gallons
		7		100		50			**BASALT Pahoehoe** dark reddish brown (5YR 3/3), highly weathered, weak to medium strong, 50% 1mm vesicles, some halloysite infill.							
400	43								**TUFF** strong brown (7.5YR 5/6), moderately weathered, weak to medium strong, Mn surface stain and halloysite clay infill in fractures, heat altered.							Min 10 gallons water return
	44						3 4		transitions to dark brown (7.5YR 3/3), Mn and Fe staining on fractures.							
398	45															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
398	45								**BASALT A'a Clinker** loose, brown (7.5 YR 4/3), slightly weathered, strong					0.0	[23]	
							1		**BASALT A'a Clinker** welded, very dark brown (7.5YR 2.5/2) and black (7.5YR 2.5/1), moderately weathered, strong, with white (7.5YR 8/1) to pinkish gray (7.5YR 7/2) halloysite clay matrix.							
396	46		3				2									
	47						3		grades to highly weathered, medium strong to weak, finer grained welded clasts, increase in halloysite matrix.							
		8		100		50	IF									
	48						4		**BASALT Massive A'a** boulder, dark gray (7.5YR 4/1), moderately weathered, medium strong, 5% 1-2 mm irregular to elongate vesicles.							Light gray water return Water loss = 400 gallons
394	49						IF									
	50								**BASALT A'a Clinker** loose, reddish brown (5YR 4/3), moderately weathered, medium strong.						[38]	
392	51															
	52	9	4	60		10			no recovery							Water loss = 400 gallons
390	53								becomes very dark gray (5YR 3/1) to yellowish red (5YR 4/6), moderately weathered, medium strong, subangular.							
	54															
							1		**BASALT Massive A'a** dark reddish gray (5YR 4/2), moderately weathered, strong, 5% 2-4 mm irregular and elongated vesicles.							
388	55													0.0	[18]	
							1		1. 45°, J, VN, Mn, Su, Pl, SR							
							1 2 3		1. 0°, J, N, Mn, Sp, Wa, SR 2. 20°, J, Vn, Mn, Sp, P, SR 3. 20°, J, Vn, Mn, Sp, P, SR							Water loss = 500 gallons
	56								no recovery							
386	57								**BASALT A'a Clinker** variably welded, very dark brown (7.5 YR 2.5/2) and black (7.5YR 2.5/1) subangular clasts in reddish brown (5YR 5/3) matrix, moderately weathered.							Water run Continue run
		10		90		42										
	58															Water loss = 700 gallons
							IF		Intensely fractured, minor halloysite and manganese infill.							
384	59															
									strongly welded							
	60		5												[25]	
							IF									
382	61															

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~~For Red Hill AOC Party Use Only~~

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
382	61															
	62								**BASALT Massive A'a** very dark gray (5YR 3/1), slightly weathered, strong, 10% 1-5 mm irregular elongate vesicles.							No water loss
		11	5	100		74	1									
380	63						2		1. 60°, J, VN, Fe+Mn, Wa, SR 2. 80°, J, VN, Mn+Cl, Wa, Sr 3. 50°, J, VN, Mn, St, SR 4. 70°, J, VN, Mn, Pl, S							
	64						3									
							4									
378	65													0.0	[30]	
	66						1		1. 45°, J, VN, Mn, Sp, Pl, S 2. 10°, J, VN, Mn, Sp, Wa, SR 3. 20°, J, N, Mn+halloysite Cl, Sp, Pl, R 4. 20°, J, N, Mn+halloysite Cl, Sp, Pl, R 5. 40°, J, MW, Mn+Cl+Fe, Sp, Wa, R							Light grayish brown water return
376	67						2									
							3									Water loss = 400 gallons
		12		100		62	4									
	68						5									
374	69								**BASALT A'a Clinker** loose, yellowish brown, (10YR 5/8), very dark gray (5YR 3/1), black (5Y 2.5/1), angular, highly weathered, minor clay, partially welded.							
	70													0.0	[18]	
372	71								no recovery							
	72															
		13	6	76		38	1		**BASALT Massive A'a** very dark gray (5YR 3/1), slightly weathered, strong, 10% 1-5 mm irregular elongate vesicles.							Stop Resume after tightening swivel top
370	73						2									
	74								1. 40°, J, MW, Cl+Mn, Sp, St, SR 2. 70°, J, MW, Cl+Mn, Sp, St, SR 3. 10°, J, N, Cl+Mn+Fe, Sp, Wa, SR							
							3									End of 4/13/2020 Stop to monitor water after losing circulation Begin drilling 4/14/2020
368	75						M		becomes slightly to moderately weathered, medium strong, 10% 5-15 mm elongated vesicles.					0.0	[25]	
									BASALT A'a Clinker variably welded, dark reddish brown (5YR 3/2) clasts with reddish yellow clay (5YR 6/8), moderately weathered, medium strong to weak, Mn+Fe staining in all fractures, subrounded clasts, clay pervasive.							
	76															Pause to remedy GAC failure
366	77															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
366	77	14		50		0			no recovery					resume drilling
364	79						NR							Water loss = 500 gallons No water return
362	81						NR					0.0	[38]	
360	83	15		80		0	1 2 IF		**BASALT Massive A'a** dark gray (7.5YR 4/1), moderately weathered, medium strong to strong, reddish yellow (5YR 6/8) clay and Mn+Fe on all fractures and vesicles, 40% 5mm elongated vesicles indicating flow, high angle natural jointing. 1. 70°, J, W, halloysite Cl+Mn+Fe, Pa, Wa, R 2. 15°, J, N, Mn+Fe, Su, Pl, S					Water loss = 500 gallons No water return
358	85								**BASALT A'a Clinker** loose, dark brown (7.5YR 3/3) clay matrix, angular fractures, fine gravel.			0.0	[50]	
356	87	16	7	30		10	NR		no recovery					Water loss = 500 gallons No water return
354	89								**VOLCANIC BRECCIA** dark gray (7.5YR 4/1), moderately weathered, medium strong to weak, <40 mm subangular clasts, reddish brown (7YR 5/4) stiff clay matrix. ↓ transitions to loose clinker, reddish brown (5YR 4/3), weak, highly weathered, sand size clasts in clay.					
352	91						IF 1 2 3		↓ becomes welded clinker or volcanic breccia, large well graded subrounded clasts, yellowish red (5YR 5/6) and reddish brown (5YR 4/3) matrix. 1. 30°, N, Mn+Fe, Su, Cl, Pa, Ir, R 2. 20°, W, heat alteration, no, Wa, R 3. 50°, N, Fe+Mn Su, Cl Pa, Ir, R 4. 20° N, Cl, Pa, Wa, R			0.0	[43]	Water loss = 500 gallons No water return
350	93	17		100		64	4		↓ becomes smaller fragments, more rounding, yellowish red (5YR 5/6) clay infill in fractures and voids.					

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
350	93													No water return unless otherwise noted
							5		5. 50°, J, W, Mn+Fe Su, Cl Pa, Wa, S 6. 80°, J, W, Mn+Fe Su, Cl Pa, Wa, R					
349	94		7				6		becomes darker reddish brown (5YR 3/4), moderately weathered, weak, well graded clasts of vesicular pahoehoe, some halloysite infill.					
348	95						IF		**BASALT Massive A'a** dark gray (7.5YR 4/1), unweathered to slightly weathered, strong to very strong, 5% 1mm irregular vesicles, Fe+Mn staining.			0.0	[50]	
	96								becomes 15% 3-5 mm elongate vesicles.					
							1							
346	97								becomes 15 mm stretched vesicles.					Water loss = 500 gallons
		18	8	100		90	2		1. 0°, J, N, Mn Su, Minimal CL Su, Pl, S 2. 20°, J, N, Ch, Mn Su, Pl, S 3. 20°, J, N, Mn, Su, Pl, S 4. 65°, J, N, Mn, Su, Pl, S 5. 20°, J, N, Mn, Su, Pl, S					
	98						3							
344	99						4							
							5		some minimal clay infill in larger vesicles.					
	100											0.0	[38]	
									becomes 10% 1-3 mm irregular vesicles, sparse <40 mm voids.					
342	101						M M							Water loss = 500 gallons
	102						IF		IF Fe+Mn Su, Pl, S					
		19		100		70	M							
							1							
340	103						2		becomes 5% elongated 10 mm vesicles with 5% 1mm subrounded vesicles. 1. 10°, J, N, Mn, Su, halloysite Pa, Wa, S 2. 10°, J, N, Mn, Su, halloysite Pa, St, S 3. 0°, J, N, Mn, Su, Wa, S 4. 10°, J, N, Mn+Fe, Su, Ir, R 5. 60°, J, N, Mn+Fe, Su, halloysite Pa, Wa, S					
							M M							
	104						4							
							5							
338	105						1		1. 25°, J, N, Mn+Fe, Sp, St, R			0.0	[27]	
	106								**BASALT A'a Clinker** loose, dark gray (7.5YR 4/1) and strong brown (7.5YR 5/6) moderately weathered.					
									BASALT Massive A'a dark gray (7.5YR 4/1), strong brown (7.5YR 5/6), and dark grayish brown (10YR 4/2), highly weathered, weak to medium strong.					
336	107													Water loss = 500 gallons
		20		48		0								
	108						NR							
									no recovery					
334	109													

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
334	109						NR									End of drilling 4/14/2020
	110								**VOLCANIC BRECCIA** very dark gray (5YR 3/1) and dark reddish brown (5YR 2.5/2), <10 mm subrounded clasts, moderately to highly weathered, medium strong to weak, reddish brown (5YR 4/4) fine grained clayey matrix.					0.0	[20]	Begin drilling 4/15/2020
332	111						M									
							M									Water loss = 600 gallons
	112								1. 55°, J, W, Fe+Mn, Su, Wa, S 2. 60°, J, N, Fe+Mn+Cl, Su, Wa, S							
		21	9	100		60	M									GAC failure Resume drilling
330	113						IF									
							1		becomes slightly weathered, strong.							
							2		becomes moderately weathered, medium strong to weak, reddish yellow (5YR 6/6) clay in fractures.							Water heard when weighted rod was lowered into hole
	114															
							IF									
328	115													0.0	[33]	
							1		**BASALT Massive A'a** very dark gray (7.5YR 3/1), slightly weathered, strong, 5% large <10 mm irregular vesicles.							
	116						2		1. 90°, J, N, Fe+Mn+Cl Su, Wa, S 2. 75°, J, N, Mn, Su, Wa, S 3. 20°, J, N, Mn+Fe, Su, Pl, S 4. 10°, J, N, Mn+Fe+Cl, Su, Pl, S							
326	117						3									Water loss = 700 gallons
		22	10	100		0			becomes unweathered, strong, 20% 2-3 mm irregular vesicles.							
	118								becomes 5% 1-10 mm vesicles, slightly weathered.							
324	119						4									
							IF		IF Mn+Fe surface stain on all fracture faces.							
	120													0.0	[38]	Paused to monitor WL
							1		1. 85°, J, W, Fe+Mn Su, Cl Pa, Wa, Sr yellowish red (5YR 5/8) clay 2. 60°, J, N, Mn+Fe+Cl, Su, Wa, S 3. 30°, J, N, Mn+Fe+Cl, Su, Pa, Wa, R 4. 45°, J, N, Mn+Fe+Cl, Su, Pl, S							
322	121						M									
							2									
	122						3									
							M									
		23		100		60			becomes 25% 1-3 mm stretched vesicles, unweathered, strong, very dark blueish gray (GLEY 2 3/10G).							Water loss = 600 gallons
320	123															
	124						4									
			11													
318	125															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
318	125													0.0	[33]	
	126								1. 0°, J, N, No, No, Wa, SR 2. 30°, J, N, No, No Wa, SR 3. 30°, J, N, Cl+Mn+Fe, Sp, Pl, R 4. 5°, J, N, Cl, Sp, Pl, R 5. 25°, J, Vn, No, No, Pl, SR							
316	127	24	11	100		96										Water loss = 600 gallons
	128								becomes 15% 1-4 mm vesicles with slight irregularity, <1% 5-10 mm elongate vesicles.							
314	129															
	130													0.0	[38]	
312	131								1. 5-10°, J, N, No, No, Wa, SR 2. 10°, J, N, No, No Wa, SR 3. 10°, J, N, Cl, Sp, Pl, SR 5. 0°, J, N, Cl, Sp, Wa, SR 6. 2°, J, N, No, No, Wa, SR 7. 5°, J, VN, No, No, Wa, SR 8. 45°, J, N, Ca+Cl+Fe, Su, Pl, S							
	132	25		100		82										Water loss = 500 gallons
310	133															
	134															
308	135													0.0	[50]	
	136								1. 10°, J, MW, Cl+Mn, Sp, Ir, R 2. 10°, J, VN, Mn, Su, Pl, SR 3. 20°, J, VN, Mn+Fe, Sp, Pl, SR 4. 5°, J, N, Cl, Pa, Pl, SR							
306	137	26	12	100		58			**BASALT A'a Clinker** loose, dark reddish gray (5YR 4/2), very dark gray (5YR 3/1), moderately weathered, halloysite clay on clast surfaces.							Water loss = 500 gallons
	138								**BASALT A'a Clinker** welded, reddish brown (5YR 4/3) and dark reddish brown (5YR 3/2), moderately weathered, medium strong, halloysite matrix.							
304	139															
	140								5. 60°, J, VN, Mn, Sp, Pl, S					0.0	[38]	
302	141															

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
302	141								**BASALT Pahoehoe** reddish brown (5YR 5/3) and very dark grayish brown (10YR 3/2), slightly weathered, weak, 20% 0.5-2 mm vesicles.					
	142	27	13	100		8	IF		**BASALT A'a Clinker** loose, subangular, reddish brown (5YR 5/3), very pale brown (10YR 8/4), strong brown (7.5YR 5/6), moderately weathered, halloysite infill.					
300	143						1		**BASALT Massive A'a** dark gray (5YR 4/1), slightly weathered, strong, <1% 0.5-1 mm vesicles.					Water loss = 500 gallons
	144						M							
							2		1. 80°, Sh, MW, Mn+Fe, Su, Pl, Slk 2. 0°, J, N, Mn, Sp, St, SR					
298	145								becomes 20% 1-5 mm vesicles.			0.0	[38]	
							1							
	146								becomes 5% 1-2 mm vesicles. 1. 5°, J, N, Mn+Cl, Sp, Pl, SR 2. 80°, Sh, MW, Mn+Fe+Cl, Sp, Pl, Slk 3. 30°, J, N, Mn, Sp, Pl, SR					
296	147						2		becomes 15% 1-10 mm vesicles, elongated, with long axis vertical.					Water loss = 600 gallons
		28		106		95	3							
	148						4		4. 50°, J, N, Mn+Cl, Sp, Pl, SR					
							M							
294	149													
							M		10% 10-15 mm vesicles.					
292	150						M					0.0	[33]	
	151						1		<1% 0.5 mm vesicles.					
							2							
	152													
		29	14	100		66	3		3 large 40-70 mm elongated vesicles, spotty clay surface stains in vesicles.					Water loss = 600 gallons
290	153													
							4		1. 30°, J, N, Mn+Fe, Sp, Pl, SR 2. 45°, J, VN, Mn, Su, Wa, SR 3. 20°, J, N, Mn, Su, Wa, SR 4. 20, J, N, Mn+Fe+Cl, Sp, Pl, SR 5. 70°, J, N, Mn+Cl, SP, Pl, R 6. 85°, J, N, Mn+Cl, Sp, Pl, R					
	154						5							
							6							
288	155						IF							
							1		1. 80°, J, N, Mn+Ca, Su, Pl, S			0.0	[23]	
	156													
									partially melted xenolith, highly vesicular. becomes 10-20% 1-5 mm elongated vesicles.					
286	157													

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
286	157													
		30	14	96		96			2. 45/80°, J, N, Mn+Cl, Su+Sp, St, S 3. 35°, J, N, Mn+Fe, Su, Wa, SR					
	158						2		becomes 25% 1mm vesicles, rounded.					Water loss = 600 gallons
284	159						3		becomes 10% 1-10 mm elongate, irregular vesicles. becomes 5% 1-2 mm, elongate, regular vesicles.					
	160											0.0	[38]	
							1		becomes 15% 1-5 mm vesicles, elongated, irregular.					
282	161						2		becomes 10% 0.5-1 mm vesicles, regular, very strong.					
	162						3 4		becomes 20% 1 mm-20 mm vesicles, regular, large vesicles have halloysite infill.					Water loss = 600 gallons
		31		100		91								
280	163								becomes 35% 1-5 mm vesicles, regular.					
	164						5		becomes <1% 0.5-1 mm vesicles, regular, very strong. 1. 10°, J, N, Cl+Mn, Su, Wa, SR 2. 80°, J, N, Cl+Mn, Sp, Pl, S 3. 0°, J, N, Mn, Su, Pl, S 4. 10°, J, N, Mn+Fe+Cl, Sp, Wa, SR 5. 50°, J, N, Mn, Sp, St, R 6. 60°, J, N, Mn+Cl, Sp, Pl					
278	165						6					0.0	[49]	
	166						1							
							2							
276	167						3		becomes 15% 1-5 mm vesicles, irregular. 1. 60°, J, VN, Mn, Su, Pl, SR 2. 30°, J, VN, Mn, Su, Pl, SR 3. 80°, J, N, Mn+Cl+Fe, Sp, Pl, R 4. 40°, J, MW, Mn+Cl, Sp, IR, Ir, VR 5. 10°, J, N, Mn, Sp, Wa, R 6. 50°, J, VN, Mn+Cl, Sp, Wa, SR					Water loss = 600 gallons
		32		100			4							
	168						5							
							6							
274	169								becomes 10% 1-5 mm vesicles, irregular.					
							IF							End on 4/15/2020
	170						1		becomes dark gray (5YR 4/1), unweathered to slightly weathered, very strong, 3% <1-4 mm subangular to subrounded vesicles.			0.0	[38]	Resume coring on 4/17/2020 at 1007, water levels in field book #17
272	171						2							
							3		1. 10°, J, VN, Mn+Fe, Cl, Sp, Wa, SR 2. 30°, J, VN, Mn+Fe, CL, Sp, Wa, SR 3. 50°, J, VN, Mn+Fe, Cl, Sp, Wa, SR 4. 90°, J, T, sealed, no clay in situ 5. 20°, J, N, Mn+Fe, Sp, Wa, SR 6. 50°, J, N, Mn+Fe, Sp, Wa, SR					
	172						4							
							5							Water loss = 600 gallons
		33		100		46	6							
270	173						IF		becomes slightly weathered, strong, 10% 1-20 mm					

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
270	173								elongate subangular to subrounded vesicles.					
	174						IF							
268	175								← IF partially infilled with clay, reddish yellow (5YR 6/1), Mn+Sp			0.0	[43]	
							IF							
	176						1		1. 45°, J, N, Mn+Fe+Cl, Sp+Su, Wa, SR 2. 80°, J, VN, Mn, Fe+Cl, Sp+Su, Wa, SR					
							2		3. 90°, J, T, sealed, no clay in situ					
266	177						IF		becomes 1% <3 mm subrounded vesicles.					
							3							
		34	17	100		24	4							Water loss = 600 gallons
	178						5		4. 5°, J, VN, Mn+Cl, Sp, P, S 5. 0°, J, VN, Mn+Cl, Sp, P, S 6. 50°, J, N, Mn+Cl, Sp+Su, Wa, S 7. 20°, J, N, Mn+Cl, Sp, Wa, SR 8. 90°, J, N, Mn Sp, Cl Su, Wa+St, SR					
264	179						6							
							7							
							8		becomes 10% 2-12 mm subrounded irregular elongate vesicles, partially infilled with yellowish red (5YR 6/8) clay.					
262	180											0.0	[38]	
	181								becomes 5% 1-11 mm subrounded elongate vesicles. ← IF. Mn+Cl, Sp+Su					
	182													Water loss = 600 gallons
		35		100		26								
260	183						IF		becomes unweathered to slightly weathered, very strong, 5% 1-8 mm subrounded, very elongate vesicles.					
	184						1		1. 0°, J, VN, Mn, Sp, Wa, SR 2. 0°, J, VN, Mn, Sp, Pl, SR 3. 0°, J, VN, No, No, Wa, SR					
							2							
258	185						3							
							1					0.0	[33]	
							2							
	186						3		becomes 3% 1-8 mm elongate subrounded vesicles.					
							4							
							5		1. 20°, J, N, Mn+Cl, Sp, St+Wa, SR 2. 90°, J, N, Mn Sp, Cl Su, Wa, SR 3. 0°, J, VN, Mn Sp, Cl Su, Wa+St, SR 4. 60°, J, N, Mn Sp, Cl Su, Wa, SR 5. 45°, J, VN, Mn+Cl, Sp, Wa+St, SR 6. 0°, J, N, Mn+Cl, Sp, Pl, SR IF. weathered Mn, Cl, Fe, all Su					
256	187						6							Water loss = 600 gallons
		36	18	100		46								
	188													
							IF							
254	189													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
254	189						IF		1. 20°, J, N, Mn, Sp, IR, SR 2. 20°, J, VN, Mn, Sp, Wa, SR 3. 45°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 4. 90°, J, N, Mn+Fe+Cl, Sp+Su, Wa, SR 5. 10°, J, Mn+Cl, Sp, IR, R			0.0	[43]	
	190													
252	191						1		becomes 5% 1-20 mm subrounded elongate vesicles.					
	192						2 3							Water loss = 600 gallons
		37	19	56		71	4 5		**BASALT A'a Clinker** loose, dark reddish brown (5YR 3/2), reddish brown (5YR 5/3), highly weathered, weak, some yellowish red (5YR 5/6) clay, some subrounded clasts.					
250	193						NR							
	194													Paused to bail and monitor water levels: book #17
248	195								becomes dark reddish brown (5YR 3/2), reddish brown (2.5YR 4/3), red (2.5YR 5/6), black (5YR 2.5/1), moderately to highly weathered, weak, some yellow (2.5Y 8/6) clay.			0.0	[43]	Resume coring at 1448
	196								becomes highly weathered, very weak.					Water loss = 900 gallons
246	197													
		38		32		0								
	198						NR							
244	199													
	200								becomes moderately to highly weathered, weak, some subrounded clasts.			0.0	[18]	
242	201													Water loss = 1200 gallons
	202	39		24		0	NR							
240	203													
	204													End coring for 4/17/2020, water levels in book #17 Resume coring
238	205						IF		**BASALT Massive A'a** dark greenish gray (GLEY 1 4/10Y), moderately			0.0	[21]	

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 10/19/2021 RHMW19

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
238	205								weathered, strong, 1% <3 mm subrounded vesicles.					on 4/18/2020, water levels in book #17
	206						IF		← IF. VN, Mn, Su, Fe+Cl, Sp					
236	207	40		100		23	1 2		← becomes slightly weathered, strong.					Water loss = 800 gallons
	208						3 4 IF		1. 10°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 2. 10°, J, VN, Mn Su, Fe+Cl, Sp, Pl, S 3. 20°, J, N, Mn+Fe, Sp, Wa, SR 4. 0°, J, VN, Mn+Fe+Cl, Sp, Pl, S IF. N, Mn+Fe, Cl, Sp					
234	209						IF							
	210						1 2		← core altered by rig.			0.0	[39]	
							3 4		← becomes 5% 1-34 mm subrounded vesicles, subangular, elongate vugs. 1. 0°, J, N, Mn, Sp, Wa, SR 2. 0°, J, VN, Mn Sp, Cl Su, Pl, S 3. 10°, J, VN, Mn+Fe+Cl, Sp, Pl, S					
232	211						5		4. 10°, J, N, Mn+Fe, Sp, St, S 5. 20°, J, MW, Mn+Cl, Sp, Wa, SR 6. 20°, J, MW, Mn, Sp+Su, Wa, SR 7. 5°, J, VN, Mn+Fe+Cl, Sp+Su, Pl, SR 8. 0°, J, VN, Mn+Fe+Cl, Sp, Pl, S 9. 45°,J, VN, Mn+Fe+Cl, Sp, St, SR					
	212	41	20	100		69	6 7 8							Water loss = 600 gallons
230	213						9 10		← becomes dark gray (5YR 4/1), moderately weathered, strong, 3% 2-20 mm subrounded elongate vesicles. 10. 10°, J, MW, Mn+Fe+Cl, Sp, IR, SR 11. 5°, J, VN, Mn Sp, Fe Su, Cl Sp, Wa, SR 12. 0°, J, VN, Mn, Sp, Pl, SR					
	214						11 12							
228	215						1		1. 30°, J, VN, Mn+Fe Su+Sp, Cl Sp, Pl, Sr 2. 45°, J, N, Mn Su, Fe+Cl Sp, IR, SR 3. 5°, J, VN, Mn+Fe, Sp, Wa, SR 4. 0°, J, VN, Mn+Fe, Sp, Wa, SR			0.0	[20]	
	216						2 3 4 M		← becomes black (5YR 2.5/1) and dark reddish brown (5Y R3/2), moderately weathered, strong, 5% 2-12 mm subrounded, elongate vesicles.					
226	217	42		36		72			**BASALT A'a Clinker** welded reddish brown (5YR 4/4) and black (5YR 2.5/1), moderately weathered, medium strong, 5% 1-6 mm subrounded irregular vesicles.					Water loss = 1200 gallons
	218						NR		no recovery					Rig chattering ~2' into run
224	219													
	220											0.0	[11]	Drill string jumping Water loss = 600 gallons
222	221						IF M							

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 10/19/2021 RHMW19

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW19

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
																1019- paused about half way, out of water 1038- resume coring Water loss = 400 gallons
222	221	43	21	100		0	IF M 1 2 3 4		becomes black (5YR 2.5/1), strong, welded lasts, 5% 1-12 mm rounded to subrounded irregular vesicles. 1. 60°, J, VN, Mn, Su+Sp, Pl, S 2. 0°, J, N, Mn, Su+Sp, IR, R 3. 0°, J, N, Mn, Su+Sp, IR, SR 4. 85°, J VN, Mn, Sp, Wa, SR							
220	223								**BASALT Massive A'a** black (7.5YR 2.5/1), moderately weathered, medium strong, 5% 1-13 mm subrounded irregular elongate vesicles, 3 mm olivine crystals.					0.0	[12]	1047- pause to check string
	224	44		100		0	IF M		IF+M. Vn, Mn+Fe+Cl, Sp+Su							Water loss = 200 gallons
218	225						IF M							0.0	[20]	pause to check bit-trip pipe
	226								becomes slightly weathered, strong, 5% 1-20 mm subrounded elongate vesicles. 1. 30°, J, VN, Mn+Fe, Sp, Wa, SR 2. 45°, J, VN, Mn+Fe, Sp, St, SR 3. 90°, J, VN, Mn+Fe+Cl, Sp, Wa, R 4. 0°, J, VN, Mn+Fe, Sp, Pl, S 5. 5°, J, VN, Mn+Fe+Cl, Sp, Pl, S							
216	227	45	21	96		52	1 2 IF									Water loss = 800 gallons
	228								becomes dark gray (GLEY 1 4/N), slightly weathered, very strong, 1% <1 mm vesicles, 1% 3 mm weathered olivine crystals.							
214	229						3 4 5		becomes dark gray (7.5YR 4/1), moderately weathered, medium strong, 3% 1-3 mm subrounded irregular vesicles.							
	230								**BASALT A'a Clinker** welded, reddish brown (5YR 4/3) and black (5YR 2.5/1), moderately weathered, medium strong, reddish yellow (5YR 7/6) clay. Heat altered contact, paleosol, red (2.5YR 4/6)					0.0	[33]	Paused to monitor water levels, book #17
212	231						1 2 3		**BASALT Pahoehoe** very dark grayish brown (10YR 3/2), moderately weathered, strong, 20% 2-8 mm, rounded to subrounded vesicles. becomes 25% <2 mm rounded vesicles. 1. 90°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 2. 5°, J, VN, Mn, Fe, Cl, Sp, Wa, SR							
	232															Water loss = 700 gallons
		46	22	100		36	IF									
210	233						4		becomes black (5YR 2.5/1) and dark reddish brown (5YR 3/3), moderately weathered, medium strong, 30% <1mm rounded vesicles.							
									flow contact, black (GLEY 1 2.5/N)							
	234						IF		becomes 10% <3 mm rounded to subrounded vesicles.							
							4		becomes 20% <2 mm rounded vesicles. 3. 0°, J, VN, Mn, Sp, Pl, SR 4. 0°, J, VN, Mn+Fe+Cl, Wa, R 5. 90°, J, VN, Mn+Fe, Wa, SR IF. Cl+Mn+Fe, Sp+Su							
208	235						5							0.0	[43]	
									IF. Mn+Cl, Sp, reddish yellow (5YR 6/6) clay.							
	236						IF									
206	237								becomes black (7.5YR 2.5/1), moderately weathered, medium strong, 15% 1-3 mm subrounded							

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
206	237								vesicles					
		47		100		38			1. 90°, J, VN, Mn+Fe+Cl, Sp, Wa, SR 2. 0°, J, VN, Mn+Fe, Cl, Sp, Wa, R becomes dark gray (7.5YR 4/1), slightly weathered, strong, 25% <2 mm rounded vesicles.					
	238						IF		becomes very dark greenish gray (GLEY 1 3/10G), slightly weathered, very strong, 15% <2 mm rounded to subrounded vesicles.					Water loss = 500 gallons
204	239								3. 0°, J, N, Mn+Fe+Cl, Sp, Wa, SR becomes 10% 1-10 mm rounded to subrounded vesicles.					
	240								4. 0°, J, VN, Mn+Fe, Sp, Wa, S 5. 90°, J, VN, Mn+Fe+Cl, Sp, Pl, S 6. 0°, J, VN, Mn+Fe, Sp, Pl, S 7. 5°, J, VN, Mn+Fe, Sp, Wa, S			0.0	[75]	End coring for 4/18/2020, water levels in book #17 Resume on 4/20/2020
202	241								becomes 20% 5-30 mm rounded vesicles					
									transitions to 50% 0.3-1mm rounded vesicles, very dark bluish gray (GLEY 2 3/5B) and dark gray (7.5YR 4/1).					
	242								becomes 30% 1-4mm rounded vesicles.					
		48	23	100		74								Water loss = 400 gallons
									becomes 30% 1-4 mm rounded vesicles, dark gray (7.5YR 4/1).					barrel run twice to retrieve core
200	243								1. 0°, J, N, Mn+Fe, Sp, Wa, R 2. 0°, J, N, Mn+Cl, Sp, Wa, R 3. 45°, J, VN, Mn, Sp, Pl, SR					
	244						M		becomes 20% 5-30 mm rounded vesicles. reverts to 30% 1-4 mm vesicles					
									4. 50°, J, VN, Mn+Fe, Sp, Pl, SR 5. 85°, J, N, Mn+Fe+Cl, Sp, St, SR 6. 0°, J, N, Cl, Sp, Wa, R 7. 5°, J, N, Fe, Sp, Wa, R			0.0	[15]	
198	245													
	246						IF		becomes moderately weathered, dark reddish brown (5YR 3/2), 50% 0.5-1 mm rounded vesicles.					Water loss = 400 gallons
196	247	49	24	100		90								
	248								becomes dark gray (7.5YR 4/1), slightly weathered, strong, 35% 1-5 mm rounded vesicles.					
194	249								1. 5°, J, MW, Mn/Fe/Cl/Su, Pl, S 2. 0°, J, N, Mn/Cl, Sp, Wa, SR 3. 15°, J, N, No, No, Wa, R					barrel run twice to retrieve core
	250								1. 85°, J, MW, Cl, Sp, St, VR			0.0	[50]	drill rate estimated
192	251								becomes yellowish red (5YR 5/6), moderately weathered.					
							IF		becomes dark gray (7.5YR 4/1), slightly weathered, 20 % 2-5 mm rounded vesicles.					
	252	50		100		72								
190	253													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
190	253								2. 20°, J, VN, Mn+Cl+Fe, Sp, Pl, SR 3. 35°, J, VN, Mn+Cl, Su, Pl, S					
	254								becomes dark gray (7.5 YR 4/1), strong, 50% 0.5-1 mm rounded vesicles.					
188	255								1. 20°, J, N, Mn+Fe+Cl, Sp, Pl, SR 2. 15°, J, N, No, No, Wa, R 3. 0°, J, MW, Fe+Cl, Sp, Ir, VR 4. 20°, J, N, Cl+Mn, Sp, Pl, SR			0.0	[60]	
	256								IF. moderately weathered.					
186	257													Water loss = 400 gallons
		51	25	90		52			becomes 20% 1-10 mm rounded vesicles.					
	258								becomes 40% 1-2 mm rounded vesicles.					
184	259								5. 35°, J, N, Fe+Mn+Cl, Sp, Wa, R reddish yellow (5YR 6/6) discoloration band along fracture 6. 90°, J, VN, halloysite Cl+Mn+Fe, Su, Wa, SR 7. 0°, J, N, Mn+halloysite, Cl, Sp, Wa, SR					
	260								becomes very strong, 20% 1-7 mm vesicles.			0.0	[60]	
182	261													
	262								becomes 40% 1-4 mm irregular vesicles.					Water loss = 400 gallons
		52		100		42			1. 70°, J, VN, Mn+Cl+Fe, Sp, Pl, S 2. 85°, J, N, Mn+Cl, Sp, St, SR 3. 45°, J, VN, Fe, Sp, Pl, SR 4. 0°, J, N, Mn+Fe, Sp, Wa, R 5. 75°, J, N, Cl, Sp, Pl, SR 6. 0°, J, MW, Cl, Su, Ir, VR 7. 45°, B, N, No, No, IR, R, ropy texture 8. 0°, J, VN, Fe, Pl, SR					
180	263								vesicles become rounded.					
	264													
178	265								becomes dark reddish brown (5YR 3/2), slightly weathered, strong.			0.0	[100]	
	266													
176	267								IF. moderately weathered.					Water loss = 400 gallons
		53	26	100		64								
	268								1. 35°, J, VN, Cl+Mn, Sp, Pl, SR 2. 0-60°, J, N, Cl+Fe, Sp, St, R becomes 40% 1-4 mm rounded vesicles.					
174	269													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOG_10_14_21.GPJ; 10/19/2021 RHMW19

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
174	269								3. 45-80°, J, VN, Cl+Mn, Sp, St, VR							
	270		26											0.0	[60]	
172	271						IF		← IF. moderately weathered, medium strong, very pale brown (10YR 8/3) clay surface staining.							Water loss = 400 gallons
	272	54		100		46	1		1. 50°, J, VN, Cl+Mn, Sp, Wa, SR 2. 45°, J, MW, Mn+Fe+Cl, Su, R 3. 50°, J, VN, Mn+Fe+Cl, Su, Pl, SR							
170	273						2									
	274						IF									
168	275						3		← becomes dark gray (7.5YR 4/1), slightly weathered, strong, 50% 0.5-1 mm rounded vesicles.					0.0	[50]	Measure water level at 1128, see logbook #17
	276						1		1. 45°, J, N, Mn+Cl+Fe, Sp, Pl, SR 2. 45-60°, J, N, Cl, Sp, St, SR 3. 0°, J, VN, Mn, Sp, Wa, SR							Water loss = 400 gallons
166	277						2		← becomes 40% 1-7 mm vesicles.							
	278	55	27	100		66	3		← becomes very dark gray, 50% 0.5-1 mm rounded vesicles.							
							4		4. 15°, J, N, Mn+Fe, Sp, Pl, SR 5. 85°, J, N, Mn+Fe+Cl, Sp, Wa, SR 6. 25°, J, VN, Mn+Fe, Su, Pl, S							
164	279						IF									
							5		**BASALT A'a Clinker** welded, dark gray (7.5YR 4/1), brown (7.5YR 5/3), reddish yellow (7.5 YR 6/8), slightly weathered, medium strong.							
							6		**BASALT A'a Clinker** loose, dark gray (7.5YR 4/1), brown (7.5YR 5/3), subangular, moderately weathered, medium strong.							
	280						1		**BASALT Massive A'a** Very dark gray (7.5YR 3/1), unweathered to slightly weathered, very strong, 10% 1-5 mm elongated vesicles.					0.0	[30]	
162	281						IF									
							1									
	282						2									Water loss = 400 gallons
		56		72		36	3		1. 10°, J, MW, Mn+Fe+Cl, Sp, Wa, SR 2. 50°, J, N, Mn+Fe, SP, Wa, SR 3. 10°, J, VN, Mn+Fe, SP, Pl, S 4. 0°, J, VN, Mn+Fe, Sp, Wa, S							
160	283						4									
							IF									
							5		**BASALT A'a Clinker** loose, dark gray (7.5 YR 4/1), fine, angular, moderately weathered, medium strong.							
	284		28				6		no recovery							
158	285															

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
158	285								becomes brown (7.5YR 4/2) and dark gray (7.5 YR 4/1), subangular, moderately weathered, medium strong.			0.0	[25]	
	286								**BASALT Massive A'a** very dark gray (7.5YR 3/1), unweathered to slightly weathered, very strong, 10% 1-10 mm elongated vesicles. 1. 45°, J, N, Mn+Fe, Sp, St, R 2. 70°, J, MW, Mn+Fe, Sp, Wa, R 3. 80°, J, N, Mn+Fe, Sp, Pl, SR 4. 45°, J, N, Mn+Fe, Sp, W, SR 5. 20°/90°, J, N, No, No, St, Sr 6. 10°, J, Mw, Cl, Sp, Wa, SR 7. 20°, J, N, Mn+Fe+Cl, Sp, Wa, R 8. 15°, J, N, Mn+Fe+Cl, Sp, Wa, SR					
156	287	57	28	100		36	1 2 M M 3 4 M 5 6 7							Water loss = 1000 gallons
154	289						8							
	290						M					0.0	[25]	drill rate estimated
152	291						1		vesicles become more elongated, 10 - 20 mm on long axis 1. 45°, J, N, Mn+Cl, Sp, Wa, SR 2. 45° - 85°, J, N, Mn+Cl, Sp, Wa, SR 3. 0°, J, MW, Mn+Cl, Sp, Wa, R 4. 0°, J, MW, Cl, Su, St, R; broke across very large vesicle 5. 0°, J, VN, Mn, Sp, Wa, SR 6. 5°, J, VN, Mn, Sp, Wa, SR 7. 45°, J, VN, Mn, Sp,Wa, SR 8. 45°, J, VN, Mn, Sp, Pl, SR 9. 5°, J, N, Mn+Fe+Cl, Sp, Wa, R 10. 5°, J, N, Mn+Fe, Sp, Wa, R					
	292	58		100		64	2							Water loss = 400 gallons
150	293						3 4							
	294						5 6 7 8 9 10							
148	295											0.0	[33]	
	296						1							
146	297	59	29	100		73	2 3		15% 0.5-5 mm vesicles, rounded 1. 10°, J, N, Mn+Fe, Sp, Wa, SR 2. 0°, J, N, Mn, Sp, Wa, SR 3. 0°, J, N, Mn+Fe, Sp, Wa, SR 4. 0°, J, MW, Mn, Su, IR VR					
	298						4							Water loss = 400 gallons
144	299						IF		**BASALT Pahoehoe** reddish brown (2.5YR 4/4) with white (2.5Y 8/1) halloysite clay, moderately weathered, medium strong, shows signs of heat alteration.					
	300								becomes reddish brown (2.5RY 4/4), slightly weathered, 40% 1-0.5 mm rounded vesicles.			0.0	[100]	
142	301						1							

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
142	301													
	302	60	30	100		70			becomes 50% 0.5-1 mm rounded vesicles.					Water loss = 700 gallons
140	303								becomes brown (7.5YR 5/4), 50% 1 mm rounded vesicles. 1. 0°, J, N, halloysite Cl, Sp, Ir, R 2. 50°, J, N, halloysite Cl, Sp, Wa, R 3. 0-90°, J, N, Mn+Fe+Cl, Su, St, Sr 4. 0°, J, N, halloysite Cl+Mn+Fe, Sp, Wa, SR 5. 85°, J, N, Mn, Su, Wa, SR 6. 60°, J, N, Mn+Cl, Su, Pl, Sr 7. 0°, J, N, Mn+Fe+Cl, Sp, Ir, R					
	304								becomes 50% 0.5-1 mm rounded vesicles. heat alteration, strong brown (7.5YR 5/6) light gray (7.5YR 7/1) and dark gray (7.5YR 4/1).					
138	305											0.0	[43]	
	306								becomes dark gray (7.5 YR 4/1), 30% 1-10 mm irregular vesicles.					
									becomes 50% 0.5-1 mm vesicles. 1. 0°, J, VN, Cl, Sp, Ir, VR 2. 0°, J, N, Cl, Sp, Wa, VR 3. 0°, J, MW, Cl, Sp, IR, VR 4. 0°, B, N, N, Fe, Sp, Wa, SR flow contact					
136	307	61		100		44								Water loss = 400 gallons
	308								20% 1-2 mm rounded vesicles.					
134	309								5. 5°, J, N, Mn, Sp, Wa, SR 6. 0°, J, N, Mn< Sp, Wa, SR 7. 60-80°, J, N, Mn+Fe, Sp, Wa, SR 8. 30°, J, N, Mn+halloysite Cl, Sp, Ir, R					
	310													Final run on 4/20/2020
									halloysite in vesicles, dark reddish brown (2.5YR2.5/3), strong, slightly weathered 1. 35°, J, N, Cl/Mn, Pd, Ir, R 2. 20°, J, N, Cl/Mn/Fe, Sp, Wa, R 3. 0°, J, N, Cl/Mn/Fe, Sp, Wa, R 4. 50°, J, VN, Mn/Fe/Cl, Su, Pl, SR 5. 5°, J, N, Cl, Sp, Wa, R			0.0	[75]	Resume on 4/21/2020
132	311								large 1 - 7 mm round vesicles					
	312	62	31	100		56								Water loss = 350 gallons
130	313													
	314								becomes yellowish red (5YR4/6) and dark reddish brown (5YR3/3), moderate weathering, medium strong, 50% <1 mm rounded vesicles					
128	315											0.0	[43]	
	316								becomes 15% 1 - 3 mm vesicles, irregular dark gray (5YR 4/1), slight weathering, strong, reddish brown spots (5YR 4/3) 1. 60°, J, N, No, No, Pl, SR					
126	317													

Project: CTO18F0126 - Red Hill Bulk Fuel Storage Facility
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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
126	317	63	31	90		66			becomes 2 - 8 mm rounded vesicles, 10%					
	318								2. 45°, J, NV, Mn, Su, Pl, S 3. 10°, J, VN, Mn/Cl, Sp, Wa, SR becomes 40% 0.5 mm - 2 mm rounded vesicles 4. 50°, J, N, Fe/Cl, Sp, St, R 5. 60°, J, N, Fe/Cl, Sp, IR					Water loss = 600 gallons
124	319								discolored around joint, yellowish red (5YR 5/6) and black (5YR 2.5/1)					
	320								becomes 40% 1 - 4 mm rounded vesicles			0.0	[100]	
122	321								1. 10°, J, N, Mn/Cl, Sp, Wa, SR 2. 45°, J, MW, Mn/Cl, Su, Wa, SR (halloysite clay, white) 3. 50°, J, N, Mn/Fe/Cl, Sp, St, SR (halloysite clay, white) 4. 90°, J, N, Mn/Cl/Fe, Sp, Wa, SR (halloysite clay, white) 5. 65°, J, N, Mn/Cl/Fe, Sp, Wa, SR (red clay) 6. 65°, J, N, Fe, Sp, Wa, Sp 7. 60°, J, MW, Cl/Mn, Pa, Wa, SR (White clay) 8. 90°, J, N, Cl/Mn/Fe, Su Pl, SR 9. 70°, J, VN, Mn/Fe/Cl, Sp, Pl, SR 10. 80°, J, VN, Mn/Fe, Su Pl, SR					
	322	64	32	100		46								Water loss = 500 gallons
120	323													
	324													
118	325								becomes 30% 2 - 10 mm rounded vesicles			0.0	[75]	
	326								becomes 45% 0.5 - 1 mm rounded vesicles, multicolored, black (5YR 2.5/1), and reddish brown (5YR 4/4)					
116	327								1. 45°, J, N, Mn/Cl, Sp, Wa, R becomes Reddish brown (5YR4/4)					Water loss = 500 gallons
	328	65		100		30								
114	329													
	330											0.0	[75]	
112	331								1. 0°, J, N, Fe, Sp, Wa, VR 2. 50°, Sh, VN, Mn/Cl Su, Pl, S 3. 20°, J, N, Mn/Cl, Sp, Wa, R 4. 20°, J, N, Mn/Cl, Sp, Wa, R					Water loss = 800 gallons
	332													
110	333	66	33	100		50								

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
110	333													
	334		33					IF 5 6	5. 30°, J, N, Cl/Mn, Sp, Wa, R 6. 20°, J, N, Cl/Mn/Fe, Sp, Wa, R (Halloysite clay)					
108	335							IF	staining in fractured zone, yellowish red (5YR 5/6) and dark gray (5YR 4/1)			0.0	[43]	
	336													
106	337	67	34	100		48		1 2 3	1. 60°, J, N, Mn/Cl, Sp, Wa, SR 2. 45°, J, N, Mn/Cl/Fe, Pa, Wa, R 3. 85 - 90°, J, N, Mn, Fe, Cl, Su, Wa, SR 4. 70°, J, VN, Mn/Cl, Sp, Pl, SR					Water loss = 500 gallons
	338							4						
104	339							IF						
102	340							1	becomes dark gray (5YR 4/1), slight weathering, strong, 40% 1 - 3 mm vesicles, rounded			0.0	[33]	Water loss = 500 gallons
	341													
	342	68		100		92		2	becomes 20% 2 - 8 mm vesicles, rounded, <1% olivine crystals, ~ 0.1 - 0.5 mm 60 mm void/vug becomes 40% 1 - 3 mm vesicles, rounded					
100	343							3	1. 0°, J, N, No, No, Wa, R 2. 5°, J, VN, Mn, Sp, Pl, SR 3. 45°, J, VN, No, No, Pl, SR 4. 0°, J, N, No, No, Wa, SR					
	344							4						
98	345											0.0	[100]	Measured water level, see book #17
	346							1	no olivine					
96	347	69	35	96		58		IF 2	moderate weathering at IF zone, brown (10YR 4/3) and dark gray (5YR 4/1) 1. 25°, J, N, No, No Wa, SR 2. 25°, J, N, Fe, Sp, Wa, SR 3. 30°, J, N, Cl, Sp, Wa, SR 4. 30°, B, N, Fe, Sp, Pl, SR (flow contact-- ropy texture)					Water loss = 1500 gallons
	348							3	moderate weathering at joint, brown (10YR 4/3) and dark gray (5YR 4/1)					
94	349							4						

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
94	349													
	350						IF					0.0	[50]	drill rate estimated; 30 minute pause 2 feet into run
92	351						1		1. 20°, J, N, Fe, Su, Wa, SR 2. 0°, J, VN, Fe, Sp, Wa, SR 3. 0°, J, N, Fe, Sp, Wa, SR 4. 0°, J, N, No, No, Wa, SR 5. 5°, J, N, Fe, Sp, Pl, SR					
	352						2		moderate weathering in fracture zone					Water loss = 800 gallons
		70		94		54	IF							
90	353						IF							
	354						3							
							4							
88	355						5		becomes dark gray (5 YR 4/1), slightly weathered, strong, olivine crystals, <0.5 mm, 40% 1 - 7 mm rounded vesicles 1. 65°, J, N, Mn, Sp, Wa, SR 2. 45°, J, N, Fe, Sp, Wa, SR 3. 40°, J, Vn, Mn, Sp, Wa, SR 4. 0°, J, VW, No, No, IR, R 5. 20°, J, N, No, No, Wa, SR 6. 80°, J, VN, Mn, Sp, Pl, SR			0.0	[15]	drill rate estimated
	356						1							Water loss = 600 gallons
							2							
86	357						3							
		71	36	96		80								
	358						4		becomes 45% 0.5 - 5 mm rounded vesicles					Water loss = 700 gallons
84	359						5							
							6							
	360											0.0	[38]	
82	361						1		1. 0°, J, N, Fe, Sp, Wa, SR 2. 90°, J, VN, Mn/Cl, Su, Pl, SR 3. 10°, J, VN, Mn/Cl, Sp, Wa, SR 4. 10°, J, VN, Mn, Sp, Wa, SR 5. 0°, J VN, No, No, Pl, SR					
							2							
	362						3							Water loss = 700 gallons
		72		100		88								
80	363						4							
							5							
	364		37						becomes 50% 1 - 2 mm vesicles					
78	365													

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
78	365											0.0	[100]	
							1		1. 45°, J, N, Cl/Mn, Sp, Pl, SR 2. 45°, J, N, No, No, Pl, SR					
	366						2							Water loss = 200 gallons
76	367		37				IF		IF, moderately weathered, reddish brown (5YR 4/3), dark gray (5YR 4/1)					
		73		100		44								
	368						3		3. 90°, J, N, Cl/Mn, Sp, Wa, SR					
74	369						IF		minor halloysite clay in IF 4. 50°, J, VN, Mn, Sp, Wa, SR 5. 60°, J, VN, Mn, Sp, Wa, SR 6. 0°, J, N, Fe, Sp, Wa, R					
							4 5							
	370						6		becomes very dusky red (2.5YR 2.5/2), moderately weathered, strong to medium strong, 40% 1 - 7 mm rounded vesicles			0.0	[75]	Final depth on 4/21/2020 Begin drilling on 4/22/2020
72	371						IF							
							1		becomes very strong, slightly weathered, 20% 5 - 10 mm round vesicles, dark reddish dark (2.5YR4/1) 1. 85°, J, N, Mn/Fe, Su, Clay, Su, Pl, S 2. 45°, J, N, Mn Su, Cl Pa, Pl, S					
	372						2 IF							Water loss = 1000 gallons
		74		60		10	M							
70	373													
	374						NR		void per driller					Driller mentions 2 foot void
68	375								becomes 50% 1 - 5 mm round vesicles IF "hockey pucks", 0 - 5°, J, N, Mn Su, Cl, Pa, Pl, S			0.0	[50]	
	376						IF							
									becomes 25% 5 - 50 mm rounded vesicles, slightly weathered, strong					
66	377													
		75	38	100		75								
	378													Water loss = 800 gallons
64	379													
							M							
	380						1		1. 75°, J, N, Mn/Fe, Su, Clay Su, Wa, S			0.0	[43]	
							M							
							M							
62	381						M							Water loss = 1000 gallons

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
62	381								becomes 10% 7 - 10 mm round vesicles, slightly weathered, strong 1. 20°, J, VN, Fe SU, Wa, R 2. 60°, J, N, Mn/Fe SU, Clay Pa, Wa, S 3. 10°, J, N, No, IR, R					
	382	76	38	90		60								
60	383													
	384								becomes 40% 1 - 5 mm vesicles, dark reddish brown (5YR 3/3), slight to moderate weathering, medium strong					
58	385						NR		becomes red (2.5YR4/6), slightly weathered, strong, 25% 1 - 10 mm round vesicles			0.0	[12]	Inner barrel stuck in bottom casing End of drilling for 4/22/2020 Begin drilling for 4/23/2020
	386								1. 10°, J, W, halloysite, Pa, Wa, S 2. 45°, J, N, No, IR, R 3. 60°, J, N, No, Wa, R 4. 0°, J, N, No, Pl, S 5. 45°, J, W, Mn, Su, Wa, S					
56	387	77	39	88		10								
	388								IF variably clay filled vesicles on fracture planes, IR faces, R, light red (2.5YR 6/8), clay veinlets 6. 90, J, VN, Mn/Fe, Su, minimal clay, Wa, S 7. 0°, J, VN, No, Wa, S					Water loss = 800 gallons 50 gallons of max gel added
54	389						NR							
	390								becomes 40% 1 - 2 mm round vesicles, red (2.5YR 4/6), slight to moderate weathering, medium strong to strong			0.0	[25]	
52	391								IF variably clay filled faces, IR, R 1. 70°, J, N, Mn/Fe, Su, Pl, S 2. 45°, J, N, Clay Pa, Mn/Fe Su, W, S 3. 80°, J, VN, Mn/Fe/Clay, Su, Pl, SR 4. 45°, J, VN, Mn Su, IR, R 5. 0°, J, VN, No, St, R					
	392	78		100		30								Water loss = 1000 gallons
50	393								becomes slightly weathered, very strong, 40% 5 - 7% round vesicles, dark red (2.5YR 3/4) 6. 10°, J, VN, minimal Cl, Su, Pl, S					
	394													
48	395								1. 45°, J, W, Clay Pa, Mn/Fe Su, IR, R 2. 20°, J, W, Mn/Fe, Clay Su, St, S					water truck run
									becomes 25% 1 - 2 mm round vesicles and 10% 10 mm round vesicles, slightly to moderate weathering, very dark brown (10YR 2/2)			0.0	[75]	
	396		40						becomes 40% 3 mm round vesicles, unweathered, strong, black (5YR 2.5/1) 3. 10°, J, N, No, Pl, S 4. 90°, J, N, Mn/Fe Su, Clay Fe, Wa, S 5. 45°, J, N, W, Mn/Fe Su, IR, R					
46	397													

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
46	397													
		79	40	80		18								
	398							IF	IF angular fragments, partially infilled vesicles with white clay, some Fe staining, moderately weathered, weak to medium strong.					Water loss = 900 gallons
44	399						NR		no recovery					
	400							IF 1	becomes slightly weathered to unweathered, strong, 40% 2 - 7 mm round vesicles, dark gray (5YR 3/1) 1. 25°, J, W, Halloysite Pa, Clay Pa, Mn/Fe Su, Wa, R			0.0	[43]	
42	401													
	402	80		106		77								Water loss = 800 gallons
40	403							M						
	404								becomes 45% 1 mm round vesicles, very dusky red (10YR 2.5/2), moderately weathered, weak to medium strong 2. 45°, J, N, Mn/Fe, Su, Pl, S					
38	405							2	IF all high angle fractures, variable surface coating of clay and Fe staining 1. 90°, J, N, Clay, Pa, Mn/Fe Su, Wa, S 2. 45°, J, N, Mn/Fe Su, Pl, S 3. 10°, B, W, No, IR, R			0.0	[60]	
	406							IF 1 2 3	Heat alteration / flow contact, 40% 1 - 2 mm round vesicles, flow texture, red (10YR 4/6), dusky red (10YR 3/2), strong slightly weathered					
36	407	81	41	100		8		IF 4	IF variable halloysite infill and Mn dendrites					Water loss = 800 gallons
	408							5	becomes 35% 2 - 5 mm round vesicles, strong, unweathered to slightly weathered, dark gray (5YR 4/1) 4. 45°, J, N, No, IR, R 5. 55°, J, N, Mn/Fe Su, Clay Pa, Pl, S 6. 80°, J, N, Mn/Fe Su, Pl, S 7. 90°, J, N, Mn/Fe Su, Pl, S					
34	409							6 7 M						
	410							M M				0.0	[50]	
32	411							M	becomes 15% 3 - 7 mm round vesicles					
	412								becomes 30% 2 - 5 mm round vesicles					
		82	42	104		81								Water loss = 800 gallons
30	413													

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Log of Boring RHMW19

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
30	413														
	414								1. 45°, J, N, Mn/Fe, Su, Wa, S becomes 40% 1 - 3 mm rounded vesicles, slightly weathered, strong, very dark gray (5YR 3/1)						
28	415								potential flow contact, reddish brown (5YR 4/3)				0.0	[38]	End in 4/23/2020 Resume on 4/24/2020
	416								becomes 30% 1 - 8 mm rounded vesicles, slightly weak, dark reddish brown (5 YR 3/2) becomes 50% 0.5 - 1 mm rounded vesicles						
26	417	83	42	100		64									Water loss = 800 gallons
	418								becomes 40% 1 - 3 mm rounded vesicles, slightly weathered, strong, very dark gray (5YR 2/1) 1. 10°, J, N, Mn, Sp, Wa, SR 2. 65°, J, N, Mn/Fe, Su, Pl, SR 3. 50°, J, N, Mn/Fe, Su, IR, SR 4. 90°, J, MW, Mn/Fe, Sp, Pl, VR						
24	419														
	420								becomes dark reddish gray (5YR 4/2)				0.0	[75]	Measured depth to water = 397.64, dropping rapidly
22	421								Possible flow contact, yellowish red (5YR 5/6) at joint						
	422	84	43	100		60			becomes dark reddish gray (5YR4/2), slightly weathered, strong 1. 0°, J, N, Fe, Sp, Wa, VR 2. 50°, J, N, Cl/Mn Su, St, R 3. 50°, J, N, Cl/Mn Su, St, R 4. 65°, J, N, Mn/Cl, Sp, Wa, R 5. 5°, J, N, Cl/Fe, Su, Wa, SR 6. 70°, J, Mn/Cl, Sp, Pl, SR						Water loss = 500 gallons
20	423														Measure DTW ~423.4' bgs on 4/24/20
	424								becomes black (5YR 2.5/1) and dark reddish gray (5YR4/2), slightly weathered, strong, 50% 0.5 - 1 mm rounded vesicles 1. 45°, J, N, Fe/Cl, Sp, IR, SR 2. 0°, J, N, Fe/Cl, Sp, Wa, SR 3. 90°, J, VN, Mn/Fe, Su, Wa, SR 4. 0°, J, N, Mn/Cl/Fe, Sp, SR 5. 0°, J, N, Cl/Fe, Sp, R						
18	425												0.0	[43]	Measured depth to water = drained to dry
	426														
16	427	85		100		56			IF interval moderately weathered, weak rock						Water loss = 500 gallons
	428														
14	429														

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
14	429								becomes 45% 2 - 8 mm rounded vesicles, dark gray (5YR 4/1), slightly weathered, strong rock 6. 70°, J, VN, Mn/Fe, Su, Wa, SR					
	430								becomes 50% 1 - 4 mm rounded vesicles			0.0	[60]	
12	431													
	432	86	44	100		72	IF		IF zone contains red iron oxide surface staining, ropy texture, possible flow contact					
10	433													Water loss = 700 gallons
	434						1		1. 10°, J, VN, Mn/Fe, Su, Wa, SR becomes 30% 2 - 8 mm rounded vesicles					
8	435						1		becomes 50% 0.5 - 2 mm, dark reddish brown (5YR 3/2), slightly weathered, strong 1. 30°, J, VN, Fe/Mn, Su, Pl, S 2. 0°, J, N, No, No, Wa, SR 3. 0°, J, N, Fe, Sp, Wa, SR 4. 45°, J N, Fe, Sp, Pl, SR 5. 40°, B, MW, Fe, Pa, Slk, possible flow contact			0.0	[50]	
	436						IF							
6	437	87		90		44	2 3							Water loss = 700 gallons
	438						IF		no recovery					
4	439						4 IF							
	440						5 1		becomes 30% 1-5 mm irregular vesicles; vesicles of similar size grouped into layer/bands			0.0	[30]	
2	441						M 2 3							
	442	88	45	100		23	4 5		becomes 40% 1 - 2 mm rounded vesicles 1. 0°, J, MW, No, No, Wa, SR 2. 20°, J, No, No, No, St, SR 3. 20°, J, N, No, No, Wa, SR 4. 0°, J, N, No, No, Wa, SR 5. 15°, J, N, No, No, Wa, SR					Water loss = 800 gallons
0	443						IF		6. 0°, J, N, No, No, IR, R 7. 0°, J, N, No, No, Wa, R 8. 0°, J, N, Cl/Fe, Sp, Wa, SR 9. 5°, J, N, No, No, St, SR becomes 30% 1 - 5 mm irregular vesicles, vesicles of similar size grouped into layers/bands					
	444						6 7 8 9							
-2	445													

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Log of Boring RHMW19

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	SAMPLES: PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-2	445						IF IF 1		becomes 50% 0.5 - 1 mm rounded vesicles, dark reddish brown (5YR 3/2) and very dark orange yellow (5YR 4/1)			0.0	[43]	
	446		45				IF		1. 90°, J, N, Fe, Su, Wa, SR 2. 10°, J, N, Fe, Su, Wa, SR					
-4	447	89		100		38								Water loss = 600 gallons
	448						IF							
-6	449		46				2		becomes 40% 1 - 5 mm rounded vesicles					End of 4/24/2020
	450						M							
-8	451								RHMW19 was hand cleared from ground surface to 7.5'below ground surface (bgs). The borehole was then drilled to 15' bgs using an 8.5" OD hollow stem auger, where refusal from basalt was met. HQ diamond bit coring commenced from 15' bgs to 450' bgs. The borehole was then reamed to 32' bgs using a 17" hole opener. 10" conductor casing was set to 30' bgs and sealed with 270 gallons of cement-bentonite grout. The borehole was reamed with an 8.75" tricone bit from 32' bgs to 455' bgs.					
	452													
-10	453													
	454								RHMW19 well was installed with 4" diameter Schedule 80 polyvinyl chloride (PVC) well casing. The well was screened between 415' and 445' bgs (28' to -2' msl). Well construction was completed with fill from 454' to 455' bgs, #3 Monterey Sand filter pack between 408' and 454' bgs, a bentonite seal from 403' to 408' bgs, a bentonite slurry from 30' to 403' bgs, and cement-bentonite grout from ground surface to 30' bgs. The well surface completion consists of a steel monument riser set in a concrete foundation designed to secure and lock the well.					
-12	455													Total Depth = 455 feet BGS
	456								Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 54,050 gallons of water were used during drilling of rock coring. At 388' bgs, approximately 50 gallons of bentonite max gel was added for lubrication. The borehole was developed using a combination of the drill rig bailer and a Grundfoss submersible pump. A total of 385 gallons was removed during development.					
-14	457													
	458													
-16	459													
	460													
-18	461													

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHTB01

Date(s) Drilled	03/06/19 - 3/22/19	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Hand auger, HSA, HQ core, PQ core	Drill Bit Size/Type	8" OD HSA, HQ/PQ core diamond bit	Total Depth of Borehole	281.0 feet
Drill Rig Type	Mobile B-59/ Mobile B-90	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	224.84
Groundwater Level	El. ~20.17' (3/22/19)	Location	Halawa Correctional Facility	Inclination from Horizontal/Bearing	90°
Borehole Completion	Nested set of four grouted in vibrating wire piezometers	#	Zone Identifier	Hammer Data	140 lbs/30-inch drop

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
224	0								**FILL** Gray, well-graded GRAVEL (GW), gravel drill pad (FILL)							Hand auger to 5 ft bgs
	1								Moist, dark reddish brown (2.5YR 2.5/4) to (2.5YR 3/3) Sandy Fat CLAY (CH) with gravel, basaltic, fine to coarse, angular to subrounded, 15% gravel, 25% sand, 60% fines (FILL)							
222	2															
	3															
	4															
220	5								becomes dark brown (7.5YR 3/4), moist, less gravel Sandy Fat CLAY (CH), 5% gravel, 25% sand, 70% fines							Begin drilling with 8"0D HSA at 5 ft bgs
	6															
218	7															
	8								grades with more gravel, probable slightly weathered basalt boulder, angular, dark greenish gray (10Y 4/1)							Augers grinding at 8 - 9.5 ft bgs
216	9															
	10								very dark greenish gray (10Y 3/1), fragmented, slightly weathered basalt boulder			1		0.0		
214	11								Moist, dark brown (10YR 3/3) with strong brown (7.5YR 4/6) mottles and dark greenish gray (10YR 4/1), Clayey GRAVEL with Sand (GC), hard, 40% basalt gravel, 15% sand, 45% fines, angular basaltic (FILL).							Augers grinding hard at 10.33 ft to 12 ft. Softer at 12 ft
	12								**ALLUVIUM** Dark brown (10YR 3/3) Sandy Fat CLAY (CH), rounded to subrounded, moderate to highly weathered, fine to coarse, basaltic (Alluvium), 30%			2		0.0		
212	13															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13								sand, 70% fines							
	14															
210	15								very dark greenish gray (10Y 2/1) basalt boulder, slightly to moderately weathered, intensely fractured					0.0	[75	HSA to 15 ft bgs Begin coring with HQ core at 15 ft on 3/09/19
	16															
208	17	1		100		C			dark gray (N4) to dark brown (10YR 3/3) matrix Clayey GRAVEL (GC) with sand. Sand and gravel are highly weathered, rounded to subrounded, dark yellowish brown (10YR 3/6), fine to coarse, with some highly to completely weathered basalt cobbles, high plasticity. 35% gravel, 20% sand, 45% fines							Brown water return, no water loss
	18															
206	19								grades with less clay							
	20								grades with more cobbles, slightly to highly weathered, strong to very weak					0.0	[50	
204	21															
	22															Brown water return
202	23	2		100		C										
	24															
200	25													0.0	[75	
	26								very dark gray (N3), basalt boulder, slightly weathered, very hard							
198	27								dark yellowish brown (10YR 3/6), strong brown (7.5YR 4/6) and very dark greenish gray (10Y 3/5) Clayey GRAVEL (GC) with sand, basaltic, rounded to subangular, highly to slightly weathered, fine to coarse, with some cobbles, 40% gravel, 30% sand, 30% fines							
	28	3		70		15										
196	29															

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Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29								no recovery							
	30								loose basalt gravel and cobbles, clay matrix likely washed away, rounded to subangular					0.0	[100]	
194	31															Brown water return, no water loss
	32	4		60		C			dark olive gray (5Y 3/2) basalt pahoehoe boulder, moderately weathered, weak, 30-40% vesicles							
192	33															
	34								no recovery							
190	35								Very dark greenish gray (10Y 3/1) with strong brown (7.5YR 5/8) veins and staining, massive a'a basalt boulders and cobbles, moderately to slightly weathered, intensely fractured with thick Mn+Fe surface coating on fractures					0.0	[60]	
	36															Brown water return, no water loss
188	37	5		80		C										
	38								dark yellowish brown (10YR 3/4) matrix with very dark greenish gray (10Y 3/1) gravel. Clayey GRAVEL with Sand (GC), angular, moderately weathered, fine to coarse with cobbles (highly to completely weathered basalt boulder), 50% gravel, 25% sand, 25% fines							
186	39								no recovery							
	40								dark yellowish brown (10YR 4/6) to very dark greenish gray (10Y 3/1), loose basalt GRAVEL (GC) mostly rounded with some subangular, and cobbles, moderate to highly weathered, weak to strong, traces of clay but most washed away					0.0	[37.5]	
184	41															Brown water return, water loss ~300 gal. Driller notes paper holes squeezing preventing full water return
	42	6		60		C			more angular, less weathered, likely basalt boulder fragmented by drilling, some clay							
182	43															
	44								no recovery							
180	45															

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Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45													0.0	[42.9]	
	46								Dark gray (N4), dark brown (10YR 3/3) and yellowish brown (10YR 5/8), Fat CLAY (CH) with sand, coarse, rounded, highly weathered and friable, fine to coarse, 5% gravel, 25% sand, 70% fines							Brown water return, water loss ~300 gal
178	47	7		60		C			Grades with more GRAVEL and cobbles (GC), subrounded to subangular, moderately weathered 40% gravel, 20% sand, 40% fines							
	48															
176	49															After run 7 drilled to flush cuttings by pumping water, very high back pressure suggesting line is squeezing
	50								very dark greenish gray (10Y 3/1) basalt GRAVEL (GC) to boulders, rounded to subangular, mostly rounded, moderately weathered					0.1	[33.3]	Full brown water return, no water loss
174	51															
	52	8		96		C			Dark brown (10YR 3/3) with very dark gray (N4) and yellowish brown (10YR 5/8) mottling, Sandy Fat CLAY with Gravel (SC), rounded, highly to moderately weathered, fine to coarse, 20% gravel, 25% sand, 55% fines							After run is complete and core barrel is retrieved water and cuttings flow out of drill pipe and annulus for ~10 min. Drilled suspects it is his drill water that pressurized line to formation and is now depressurizing
172	53															
	54															
170	55								very dark greenish gray (10Y 3/1), basalt cobbles, slightly to moderately weathered, Fe+Mn staining on fractures					0.0	[37.5]	Water loss 4e from 10.55 ft [illegible] to 10.75 ft [illegible] Stick up is 3.75 ft Hard slow drilling.
	56															
168	57								dark brown (10YR 3/3) with very dark gray (N4) and yellowish brown (10YR 5/8) mottling, Sandy Fat CLAY (CH), fine to coarse, highly weathered sand, 30% sand, 5% gravel, 65% fines							
	58	9		66		C			Very dark greenish gray (10Y 3/1), basalt boulder, moderately weathered, hard, intensely fractured with Fe+Mn staining on fractures, traces of clay							Brown water return, water loss ~200 gal
166	59								no recovery							At 58 ft fast drilling ~30sec/ft Increased water loss
	60								dark yellowish brown (10YR 4/6) to very dark greenish gray, Clayey GRAVEL (GC), moderately to highly weathered, fine to coarse, rounded to subangular, with moderately to highly weathered basalt cobbles					0.0	[21.4]	
164	61															

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Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
162	61															
	62															
	63	10		34		0			no recovery							Brown water return, water loss ~100 gal Driller says water pump is on, owell setting ~0.75 ps
	64															
160	65								same as above, clay matrix likely washing away					0.0	[100]	
	66															
158	67															
	68	11		34		0			no recovery							Brown water return, water loss ~50 gal Water flows out of monitoring and casing (HQ) for ~10 min after extracting core barrel. This was observed on runs 8 through 11. Volume per min ~15-30 gallons Driller says formation is soft with hard zones
156	69															
	70													0.0	[100]	Water fell from 0 ft to 2.25 ft in 55 min
154	71															
	72	12		34		0			no recovery							Brown water return, water loss ~100 gal
152	73															
	74															
150	75								grades with less clay and cobbles, more gravel size fragments					0.0	[37.5]	
	76															
148	77															

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Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
146	77	13		34					no recovery							
	78															
	79															Boring paused at 80.1 ft bgs on 3/7/19 at 1318. Water level at 20.21
144	80								dark brown (10YR 3/3), very dark greenish gray (10Y 3/1) and yellowish brown (10YR 5/8) Clayey GRAVEL (GC) with cobbles, basaltic, moderately to highly weathered, rounded to angular, mixture of pahoehoe and massive a'a					0.0	[75]	Water level on 3/8/19 at 23.88 ft. Resume drilling on 3/8/19. Bailed water to check for recharge. Submersible pump set at 130 bgs.
	81															
142	82	14		50		C			dark brown (10YR 3/3) and yellowish brown (10YR 5/8) gravelly Fat CLAY with Sand (CH), basaltic, highly weathered, angular to rounded							
	83															Brown water return, no water loss
	84								no recovery							
140	85								dark yellowish brown (10YR 3/4), yellowish brown (10YR 5/8) and very dark greenish gray (10Y 3/1), Clayey GRAVEL (GC), rounded to subangular, moderately to highly weathered, mix of pahoehoe and a'a					0.0	[60]	
	86															Brown water return, no water loss
138	87	15		44		C			no recovery							
	88															
136	89								**SAPROLITE** Very dark greenish gray (10Y 3/1), basalt cobbles and boulders, moderate to highly weathered, weak to very weak with layers of Clayey GRAVEL (GC) to Gravelly Fat CLAY with Sand (CH), very weak, friable, highly weathered, angular to rounded							
	90								At 89.2 ft dark brown (10YR 3/3) Clayey GRAVEL with Sand (GC), basaltic, angular, highly weathered, fine to coarse, 40% gravel, 20% sand, 40% fines					0.0	[42.9]	
134	91								At 89.7 ft very dark greenish gray (10Y 3/1) with yellowish brown (10YR 4/6) oxidation in vesicles basalt a'a cobble, very weak, highly weathered, intensely fractured with Fe/Mn on fractures							Brown water return, no water loss
	92								At 91 ft dark yellowish brown (10YR 3/4) to dark greenish gray (10Y 3/1) Clayey GRAVEL with Sand (GC), rounded to angular, fine to coarse, basaltic, highly weathered, weak							
132	93	16		60												

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Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
130	93								At 91.8 ft grades with highly weathered, very weak massive a'a basalt cobbles with Fe+Mn on fractures At 92.3 ft less clay, more gravel, gravel moderately weathered with strong brown (7.5YR 5/8) oxidation no recovery							
	94															
	95													0.0	[42.9]	
	96								no recovery							Brown water return, no water loss
128	97	17		70		R			very dark greenish gray (10Y 3/1), massive a'a basalt boulder, highly to moderately weathered, very weak, intensely fractured with Fe+Mn partially filling, ~10% vesicles, 2-15 mm, some filled with clay (probably from coring), ~8% weathered olivine phenocrysts							
	98															Boring paused at 100 ft bgs on 3/8/19 at 0858. Hole reamed to 17.5" diameter. Prepare to install 16" steel casing. 16" steel casing installed to 100 ft bgs. Begin PQ coring on 3/10/19 at 1245 from 100 ft
126	99															
124	100	18		80		C			no recovery					0.0	[30]	
	101								no recovery Strong brown (7.5YR 4/6) with very dark gray (N3), basalt completely weathered, very weak to extremely weak, weathered to Clayey SAND with Gravel (SC), rounded core stones visible; vesicles 0.1-1.5 mm					0.0	[100]	
	102															
122	103	19		48		C										No water return, 100-101 and 101-106
	104								no recovery							
120	105															
	106								strong brown (7.5YR 4/3) to brown (7.5YR 4/2) Clayey SAND with Gravel (SC), basaltic subangular to angular, highly to completely weathered, friable, weak to extremely weak with highly weathered basalt cobbles					0.0	[75]	
118	107								highly weathered basalt cobble (107.2-107.7 ft)							Light brown water return
	108															
116	109	20		84		C										

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
114	109													
	110													
	111								dark gray (10YR 4/1) GRAVEL (GC), subrounded to subangular, Fe, Mn			0.0	[23.1]	
	112								Dark gray (10YR 4/1) massive a'a basalt boulder, moderately weathered, intensely fractured with Fe and Mn on surfaces (111.7-112.5 ft)					Light brown water return
112	113	21	10	100		0			Strong brown (7.5YR 4/3) to brown (7.5YR 4/2) Clayey GRAVEL with Sand (GC), subrounded to angular gravel, friable, weak to extremely weak, Mn, Fe on surfaces, highly to completely weathered basalt					
	114													
110	115													
	116													End drilling at 116 ft bgs, 3/19/19
												0.0	[75]	Resume drilling at 116 ft bgs 3/20/19. Water level is 0 ft bgs at 0800
108	117		11						dark greenish gray (4/5 GY), massive a'a basalt boulders, highly to moderately weathered, extremely weak, no vesicles					
	118								completely weathered basalt, Clayey SAND with Gravel (SC), fines 50%, sand 30%, gravel 20%, yellowish brown (10YR 5/4), angular gravel					Light brown water return, no water loss
106	119	22		88		0			intensely fractured, Fe+Mn staining	4				
	120													
104	121		12				NR		no recovery			0.0	[23.1]	
	122							IF	Massive a'a basalt boulder, intensely fractured, greenish black (2.5/10GY), moderate to highly weathered, very weak, no vesicles. IF. J, VN, Mn, Fe, Su, Wa, S					Hard slow drilling at 122-124 ft
102	123	23	13	100		0								Light brown water return, no water loss
	124								At 124.4 ft Clayey GRAVEL with Sand (GC), dark yellowish brown (10YR 5/4), angular gravel, basaltic, highly weathered, some cobbles, fines 50%, sand 20%, gravel 30%					
100	125													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	RQD, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	125								124.6-124.8 ft increase in angular gravel and cobbles							
	126								very dark gray (2.5Y 3/1) massive a'a basalt boulder, very weathered, Fe Mn Su stains					0.0	[100]	
98	127								intensely fractured, pahoehoe basalt boulder, very dark gray (10YR 3/1), highly weathered, extremely weak, 15% rounded vesicles, <2 mm, infilled with Mn-Fe, clay matrix washed out, loose							Light brown water return, no water loss
	128								grayish brown (2.5Y 5/2), massive a'a basalt boulder, intensely fractured, Mn-Fe surface stains							
		24	14	94		C			At 127.5 ft Clayey GRAVEL with Sand (GC), dark yellowish brown (10YR 5/4), Mn staining, fines 45%, sand 15%, gravel 40%							
96	129								massive a'a basalt boulder, yellowish red (5YR 4/6), completely to highly weathered, very weak, 15% vesicles, 1-5 mm, irregular elongate, Mn infilled							
	130								Dark yellowish brown (10YR 5/4), black (10YR 2/1), gray (5Y 5/1) Clayey SAND with Gravel (SC), relic structures still evident, fines 50%, sand 35%, gravel 15%, vesicles and fractures preserved, highly weathered basalt, extremely weak, Mn staining							
94	131						NR		no recovery					0.0	[300]	Faster drilling extremely easy, rods falling for whole run
	132															
92	133						NR									
		25	15	28		C										
	134								no recovery							Light brown water return, no water loss
90	135															
	136								same as above, mechanical fractures.					0.0	[300]	Faster drilling, rods dropping
									relic vesicles 10%, rounded-irregular, 1-5 mm infilled with Mn							
88	137															
	138															Light brown water return, no water loss
		26	10	60		C										
86	139								reddish brown (5YR 4/4) with prominent infilled relic fractures and relic vesicles infilled with Mn							
	140															Per driller "3 in dropped down hole when core barrel was retrieved"
84	141															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	141													0.0	[300]	Light brown water return, no water loss
	142															
82	143	27	17	120		0										Fast drilling, rods dropping quick. Extra foot recovered from run 27 was likely from run 26 and was added to that run
	144															
80	145															
	146									3				0.0	[300]	
78	147															Light brown water return, no water loss
	148	28	18	100		0			relic massive a'a basalt boulder, dark grayish brown (2.5YR 4/2), heavily weathered, very weak							Fast drilling, rods dropping
76	149															
	150															
74	151		19						same as above but contains relic massive a'a boulders/cobbles in clay matrix, olive gray (5Y 5/2), highly weathered, very weak, relic structures (fractures)					0.0	[75]	
	152															Light brown water return, no water loss
72	153	29	20	100		0			becomes light brown (7.5YR 6/4) with olive gray (5Y 5/2), relic massive a'a basalt, highly weathered basalt, irregular-angular cobbles, relic structures, extremely weak, fines 40%, sand 45%, gravel 15%							
	154															
70	155								becomes dark brown (10YR 3/3), Sandy Lean CLAY with Gravel (SC), fines 60%, sand 20%, gravel 20%, highly weathered basalt, rounded gravel, relic structures present							
	156													0.0	[75]	
68	157								relic massive a'a basalt boulder, olive gray (5Y 5/2), highly weathered, in clay matrix, extremely weak							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157								At 156.6 ft becomes dark yellowish brown (10YR 5/2), brown (10YR 4/3), dark reddish gray (10YR 4/2), highly weathered, relic structures fractures and vesicles infilled with Mn, rounded-irregular gravel size clasts in clay matrix, extremely weak							Light brown water return, no water loss
	158	30		100		C										
-66	159															
	160								subrounded-angular cobbles/gravels							
-64	161													0.0	[300]	Fast drilling, rods dropping
	162															
-62	163	31		100		C										Light brown water return no water loss
	164															
-60	165															Bagged 9' of core for possible geotech sample
	166		23											0.0	[60	Light brown water return, no water loss
-58	167								dark reddish brown (5YR 3/4), relic massive a'a basalt, highly weathered extremely weak, elongate vesicles 1-8 mm, irregular, infilled with Mn, Fe white secondary mineralization (possibly calcite), subrounded to angular gravel size clasts in a clay matrix							
	168	32		94		C										
-56	169															
	170															
-54	171													0.0	[37.5]	Light brown water return, no water loss
	172								At 172.6 ft intensely fractured and mechanically fractured basalt massive a'a boulder, very dark greenish gray (10Y 3/1), highly weathered very weak Mn+Fe staining							
-52	173															

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/6/2019 RHTB01

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	173													
	174	33	25	100		0			Very dark grayish brown (10YR 3/2) and yellowish red (10YR 5/6) Clayey GRAVEL with Sand (GC), highly weathered, extremely weak, basaltic, subrounded gravel, fines 50%, sand 20%, gravel 30%					
-50	175						IF		massive a'a basalt boulder, intensely fractured, weak, highly weathered, Mn+Fe staining, dark greenish gray (10Y 4/1) IF. J, VN, Mn, Fe, Su, Pl, S					
	176											0.0	[50]	First hard drilling, then easy, then hard
-48	177								dark greenish gray (10Y 4/1) and strong brown (5.5YR 4/6), completely weathered massive a'a basalt, weathers to Clayey Gravel (GC), subangular to angular gravel with cobbles, friable					
	178	34	26	88		0								Light brown water return, no water loss
-46	179								Dark greenish gray (10Y 4/1) and strong brown (5.5YR 4/6) Clayey SAND with Gravel (SC), completely weathered basalt					
	180								grades with more gravel, highly weathered, friable, strong brown (7.5YR 5/6) and dark gray (7.5YR 4/1), completely to highly weathered basalt, weathers to Clayey SAND with Gravel (SC), gravel is highly weathered, friable					
-44	181						WR		no recovery			0.0	[75]	
	182									2				
-42	183								grades with highly weathered basalt cobbles, fines 50%, sand 30%, gravel 20%					
	184	35		100		0								
-40	185													Boring paused at 185 ft on 3/20/19
	186											0.0	[60]	Resume drilling at 0645 on 3/21/19. Water level equals 63.08 ft btoc
-38	187								187.4-187.8 ft massive a'a basalt boulder, dark greenish gray (10Y 4/1), moderate to highly weathered, extremely weak, Mn+Fe staining					
	188	36	28	94		0								Light brown water return, no water loss
-36	189								Dark yellowish brown (10YR 4/5) Clayey GRAVEL					

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	189								with Sand (GC), clay matrix, highly weathered, weak, basalt gravel pieces dark greenish gray (5GY 4/1), angular, weak, moderate to highly weathered, Mn+Fe staining, large gravel/cobbles, possible boulder in clay matrix, fines 40%, sand 20%, gravel 40%							
	190						MIF		massive basalt a'a boulder, black (10YR 2/1), mechanically intensely fractured moderate to high y weathered, extremely weak							
34	191								no recovery					0.0	[50]	Light brown water return, no water loss
	192								At 190.4 ft becomes Clayey SAND with Gravel (SC), dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6), highly to completely weathered extremely weak, angular gravel, fines 50%, sand 30%, gravel 20%							Difficult drilling
32	193								At 191.2 ft massive a'a basalt boulder, yellowish brown (10YR 5/4), highly weathered weak, 0% vesicles, irregular and subrounded, <1 mm, partial y infilled with Mn+Fe, secondary mineralization possibly calcite							
		37	29	72		C			At 192 ft: Clayey GRAVEL with SAND (GC), dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6), highly weathered, extremely weak, subrounded to angular gravel, fines 50%, sand 25%, gravel 25% no recovery							
30	195						M M M		massive a'a basalt boulder, dark greenish gray (10Y 4/1), highly weathered, very weak, rounded to subrounded							
							1 2 3		At 195 ft gravel sized pieces 1 10. J. VN. Mn. Fe. Su. Wa. SR 2 0. J. VN. Mn. Fe. Su. Wa. S 3 0. J. VN. Mn. Fe. Su. Wa. SR							
	196						M M M		small scale fractures throughout					0.0	[60]	
28	197								Strong brown (7.5YR 4/6) Clayey SAND with Gravel (SC), highly weathered, extremely weak, relic structures preserved, highly weathered dark greenish gray (10Y 4/1) basaltic gravel with Mn+Fe staining, subrounded to angular gravel, fines 40%, sand 40%, gravel 20%							Light brown water return, no water loss Difficult drilling
	198															
		38	30	72					massive a'a basalt boulder, very dark gray (10YR 3/2), moderate to highly weathered, very weak, intensely and mechanically fractured, 1% olivine phenocryst, 5% vesicles, irregular, 1-6 mm, some Mn+Fe staining, secondary mineralization (possibly calcite)							
26	199															
	200								no recovery							
24	201								massive a'a basalt, dark greenish gray (10Y 4/1) moderate to highly weathered, very weak, intensely fractured, fractures have Mn+Fe surface staining, smooth					0.0	[100]	
	202															Light brown water return, no water loss
22	203						IF									Difficult drilling
		38	31	80		C			becomes more broken up and fractured, Mn+Fe clay staining on fractures (surface and spotting), intensely fractured, some mechanica fractures towards the end of the run							
	204		32													
20	205															

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	205								no recovery							
	206								Brown (10YR 4/3) Clayey GRAVEL with Sand (GC), moderate to highly weathered, extremely weak gravel sized/cobble sized basalt fragments, fines 40%, sand 25%, gravel 35%					0.0	[27.3]	Light brown water return, no water loss Difficult drilling
-1E	207															
	208								massive a'a basalt, dark greenish gray (10Y 4/1), 3% vesicles, <1 mm, partially infilled with Mn, moderate to highly weathered, very weak							
-1E	209	40	32	60		C			At 208.1 ft becomes intensely fractured massive a'a basalt, dark greenish gray (10Y 4/1) and black (2.5/N), highly weathered, very weak, rounded to subangular cobbles, Mn+Fe+clay staining/ spalling							Dropped core could not latch inner barrel. Tripped out PQ casing to recover core. Will be coring out casing inner barrel attached. Core key fell down hole
	210								no recovery							
-1A	211													0.0	[50]	
	212							M	Brown (10YR 4/3) Clayey GRAVEL with Sand (GC), moderate to highly weathered, extremely weak gravel/cobble sized basalt fragments, some Mn+Fe+secondary minerals (calcite?) staining on gravel fragments, fines 40%, sand 25%, gravel 35%							Light brown water return, no water loss
-12	213							M IF	At 212.1 ft basalt pahoehoe boulder, very dark grayish brown (10YR 3/2), moderate to highly weathered, weak, mechanically fractured, 15% vesicles, rounded <3 mm, partially infilled with clay, Mn, Fe							Faster drilling for middle ~2 ft
	214	41	33	100		C		M IF	At 212.4 ft massive a'a basalt boulder brown (7.5YR 5/4), moderate to highly weathered, weak, 10% vesicles, irregular/subrounded, 1-20 mm partially infilled with Mn+Fe, intensely fractured, fractures have Mn staining, some mechanical fractures							
-1C	215								Brown (10YR 4/3) Clayey SAND with Gravel (SC), highly to completely weathered, extremely weak, some secondary mineral staining (calcite?), fines 50%, sand 35%, gravel 15%							
	216		34						At 214 ft becomes more fractured and broken up, more intensely fractured					0.0	[42.9]	
-8	217								massive a'a basalt, dark greenish gray (10Y 4/1), moderately weathered, weak, Mn+Fe staining							
	218							M	Brown (10YR 4/3) Lean CLAY with Gravel (CL), moderate to highly weathered, very weak, gravel pieces are dark greenish gray (10Y 4/1) a'a and very dark grayish brown (10YR 3/2) pahoehoe with secondary calcite mineralization, reddish brown (5YR 5/3) basalt, fines 55%, sand 15%, gravel 30%							Light brown water return, no water loss
-6	219	42	35					M M M M M IF	massive a'a basalt, dark greenish gray (10Y 4/1), highly weathered, weak, intensely fractured and mechanically fractured Mn+Fe+clay staining on fracture surfaces							
	220								becomes more intensely fractured and more broken up							
-4	221							1	Lean CLAY with Gravel (CL) as above							
									At 220.3 ft pahoehoe basalt boulder very dark gray (10YR 3/1), moderately weathered, weak, 5% vesicles, rounded to subrounded, 1-5 mm, partially infilled with clay							

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	221								1. 0, J, VN, Cl, Sp, Wa, SR At 220.6 ft Lean CLAY with Gravel (CL) as above					0.0	[30]	
	222															Light brown water return, no water loss
-2	223						1		massive a/a basalt; dark greenish gray (10Y 4/1) moderately weathered, weak Lean CLAY with Gravel (CL) as above 1. 50 J, VN, Mn, Su, Pl, VS							
		43	36	100		30			massive a/a, greenish gray (5GY 6/1), moderately weathered, weak to medium strong, 5% vesicles, subrounded irregular and elongate, 1-25 mm, partially infilled with clay							
	224						2		2. 10 J, VN, Mn, Cl, Sp, Wa, SR							
							3		3. 20 J, VN, Mn, Sp, ST, SR							
-0	225						4		4. 20 J, VN, Mn, Sp, ST, SR							
							5		5. 5. J, VN, Mn, Sp, Wa, SR							
							M									
							IF		For Run Number 44 1. 0, J, VN, Mn, Fe, Su+Sp, Wa, SR							
	226						M		2. 45 J, VN, Mn, Fe, Su+Sp, Wa, SR					0.0	[33.3]	
							1		3. 5. J, VN, calcite, Sp, Wa, R							
							M		4. 90 J, VN, Mn, Su, Cl, Sp, Wa, SR							
-2									5. 0. J, VN, Mn, Fe, Cl, Sp, Wa, SR							
	227		37				?		6. 0. J, VN, Cl, Sp, Wa, SR							
							IF		7. 0. J, VN, Cl, Sp, Wa, SR							Light brown water return, no water loss
							M									
	228						M		brown (10YR 4/3), Lean CLAY with Sand (CL) (completely weathered pahoehoe), fines 60%, sand 25%, gravel 15%, includes relic pahoehoe basalt, very dark gray (10YR 3/1), completely weathered, extremely weak, <2 mm rounded vesicles partially infilled with secondary mineral (calcite?)							
		44		80		26										
-4	229						3		Pahoehoe basalt, very dark gray (10YR 3/1), moderate to highly weathered, medium strong to weak, 5% vesicles, rounded, <2 mm, partially infilled with clay							
							4									
							5									
							6									
							7									
	230						IF		becomes 20% vesicles, subrounded to subangular, 2-8 mm, partially infilled with clay At 229.8 ft becomes 25% vesicles, rounded, 5 mm, uniform, partially infilled with clay no recovery 230' 231' bgs							
-6	231		38				M		5% vesicles, rounded to subrounded, 1-4 mm					0.0	[50]	
							M									
							M									
							M									
	232						M		becomes brown (10YR 5/3), moderate to highly weathered, medium strong to weak, 30% vesicles, rounded, 1 mm, infilled with clay pinkish white (10YR 8/3)							Light brown water return, no water loss
							M									
							M									
-8	233						IF									
							M									
		45	39	100		20	M		becomes very dark gray (10YR 3/1), moderate to highly weathered, medium strong to weak, 20% vesicles subrounded, <2 mm, infilled with clay pinkish white (10YR 8/3)							Intermittent hard and soft drilling
							M									
	234						M									
							M									
							M									
-10							IF		possible flow contact, heat alteration, yellowish red (5YR 5/6), ~30 mm wide							
	235						M		A: 234.8 ft becomes reddish brown (5YR 4/3), highly weathered, weak, 10% vesicles, <1 mm, partially infilled with Mn and clay pinkish white (10YR 8/3)							
							M									
							IF		A: 236.2 ft becomes gray (10YR 5/1), moderately weathered, medium strong, 5% vesicles, <1 mm, partially infilled with clay							
	236						M							0.0	[75]	
							M									
							M									
-12							M		A: 236.4 ft becomes very dark gray (10YR 3/1) 20% vesicles, rounded, <4 mm, infilled with clay							
	237						1		1. 0, J, Vn, Cl, Sp, Wa, SR							

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	237						M M		becomes reddish brown (5YR 4/3), possible flow contact/alteration					
	238						IF							
		46	4C	102		42			becomes black (10YR 2/1), moderately weathered, medium strong, 20% vesicles, rounded, 1-5 mm, partially infilled with clay 2. 0, J, VN, Mn, Cl, Sp, Wa, SR 3. 45 J, VN, Mn, Sp, Wa, SR					
-14	239						M							
							IF		includes heat alteration, strong brown (7.5YR 5/5)					
	240						2 3							
							M		heat alteration, strong brown (7.5YR 5/6) becomes strong brown (7.5YR 5/6), highly weathered, very weak, 10% ves cles, irregular, <1 mm, partially infilled with clay and Mn					
-16	241						M M					0.0	[42.9]	
							1		1. 0, J, VN, Mn, Fe, Cl, Sp, Wa, SR					
	242						2 IF		**BASALT Pahoehoe** Greenish gray (5Y 6/1), moderately weathered, medium strong, 5% vesicles, subrounded, 5-25 mm, Mn spotting in some vesicles, partially clay filled vesicles, grading to no clay in vesicles					Water loss ~50 gal
-18	243						3 4		2. 5, J, VN, Mn, Fe, Cl, Sp, Wa, SR 3. 5, J, VN, No, No, Wa, SR 4. 0, J, VN, Mn, Sp, Wa, SR					
		47	41	100		52	5		5. 15, J, VN, Mn, Sp, Wa, SR					
	244						6		6. 50, J, VN, Mn, Sp, Wa, SR 7. 0, J, VN, Mn, Sp, Cl, Su, Wa, SR vesicles infilled with yellow (10YR 8/6) clay					
-20	245						7		8. 0, J, VN, Mn, Fe, Cl, Sp, Wa, R vesicles infilled with yellow (10YR 8/6) clay band of 30% vesicles, subrounded, <1 mm 15% vesicles, subrounded, <2 mm					
	246		42				8		becomes black (10YR 2/1), moderate to slightly weathered, medium strong to strong, 5-20% vesicles rounded, 1-4 mm			0.0	[42.9]	
-22	247						1 2 3		heat alteration (possible contact), red (2.5YR 5/6)					
							4		becomes reddish brown (5YR 4/3), highly weathered, weak, 10% vesicles, irregular, <2 mm, partially infilled with clay					
	248						IF		At 248 ft becomes moderate to highly weathered, medium strong to strong, no vesicles					Water loss ~50 gal
-24		48	43	100		78	5							
	249						6		5% vesicles, 2-10 mm, subrounded 20% vesicles, 1-2 mm, rounded to subrounded					
	250						7		becomes very dark gray (7.5YR 3/1), moderately weathered, medium strong, 10% vesicles, subrounded, partially infilled with clay 1. 0, J, VN, Mn, Fe, Sp, Wa, SR 2. 45, J, VN, Mn, Fe, Sp, Wa, SR					
-26	251						IF		3. 5, J, VN, Mn, Sp, Wa, SR 4. 0, J, VN, Mn, Sp, Wa, R 5. 0, J, VN, Mn, Sp, Wa, SR			0.0	[60]	
							IF		6. 5, J, VN, Mn, Sp, Wa, SR 7. 0, J, VN, Mn, Sp, Wa, SR					
	252						1		At 252 ft becomes gray (5Y 6/1), slightly weathered, medium strong to strong rock, 5% vesicles, 3-15 mm, subangular, partially infilled with clay					Water loss ~100 gal
-28			44				2							
	253													

Report: CTO53 RED HILL WITH WELL AND PID; File: CTO18F0126 RED HILL CORE LOGS.GPJ; 6/6/2019 RHTB01

Project: CTO1830126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60371042

Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	253								becomes 15% vesicles, subrounded, 1-3 mm 1. 10, J, T, filled with brownish yellow (10YR 6/6) clay 2. 20, J, VN, Mn, Sp, Wa, SR					
	254	49	44	100		64		3	becomes very dark gray (10YR 3/1), slightly weathered, medium strong to strong with 20% vesicles, rounded, 1-5 mm					
								4	becomes 25% vesicles, rounded, 1-5 mm					
-30	255							IF 5	3. 0, J, VN, No, No, Wa, SR 4. 45, J, VN, Mn, Fe, Su, Wa, SR 5. 15, J, VN, Mn, Sp, Wa, SR					
	256											0.0	[42.9]	
								IF						
-32	257							1	becomes 15% vesicles, subrounded, 3-5 mm, infilled with clay At 257.1 ft becomes 10% vesicles, rounded, <1 mm					Water loss ~200 gal
	258								At 257.4 ft heat alteration, possible flow contact, yellowish red (5YR 5/6), 25 mm thick					
		50	45	110		76		2 3	At 257.6 ft becomes dark reddish brown (5YR 3/3), highly weathered, weak, 3% vesicles, <1 mm, partially infilled with clay yellow (10YR 8/6)					
-34	259								At 258 ft becomes gray (10YR 5/1), moderately weathered, medium strong, 15% vesicles, subrounded, 2-6 mm, partially infilled with clay					Lost water circulation at ~260 ft No water return for remainder of boring unless otherwise noted Boring paused on 3/21/19 at 261 ft
	260							4	1. 0, J, VN, Mn, Cl, Sp, Wa, R 2. 30, J, VN, Mn, Cl, Sp, Wa, SR					
								IF	3. 25, J, VN, Mn, Sp, Wa, R 4. 50, J, VN, Mn, Cl, Sp, Wa, SR					
-36	261		46					1	At 260.4 ft becomes dark gray (10YR 4/1), slightly weathered, very strong, 20% vesicles, rounded, 1-5 mm			0.0	[20]	Resume coring on 3/22/19 at 0814. DTW = 207.54 ft btoc (204.67 ft bgs)
								2	1. 10, J, VN, Mn, Sp, Wa, SR 2. 5, J, VN, Mn, Sp, Wa, SR					
	262							M	becomes 10% vesicles, rounded to subrounded, 2-12 mm	1				
-38	263							3	evidence of core grinding becomes very dark gray (7.5YR 3/1), slightly weathered, very strong, 25% vesicles, rounded, 2 mm					High water pressure causing the pressure relief value on GAC filter to activate
		51	47	84		52		IF						
	264							M	no recovery evidence of core grinding.					Drilling paused partway through to adjust pressure relief valve on GAC
-40	265							4 5	Becomes black (5YR 2.5/1), slightly weathered, strong to very strong, 10% vesicles, rounded, <2 mm 3. 60, J, VN, Mn, Fe, Cl, Sp, Wa, R 4. 0, J, VN, Mn, Sp, Fe, Su, Wa, R 5. 25, J, VN, Mn, Sp, Wa, R					
								M	becomes 25% vesicles, rounded to subrounded, 1-5 mm					
	266											0.0	[100]	Top 0.5 ft from run 52 likely dropped from run 51
								1 IF	becomes red (2.5YR 4/8), possible heat alteration? slightly weathered, very strong, 30% vesicles, rounded, <2 mm					
-42	267							2	At 266.9 ft becomes black (2.5/N), slightly weathered, very strong, 30% vesicles, rounded, <2 mm					
								IF						
	268							3 4	becomes very dark gray (10YR 3/1), slightly weathered, very strong, 30% vesicles, rounded, 1-5 mm					
		52	48	110		50		5	1. 0, J, VN, No, No, Wa, R 2. 10, J, VN, Cl, Sp, ST, R					
-44	269													

Project: CTO1850126 - Red Hill Bulk Fuel Storage Facilty
Project Location: CTO18F0126
Project Number: 60571032

Log of Boring RHTB01

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	269								3. 45. J, VN, Mn, Cl, Sp, Fe, Su, Wa, SR 4. 5, J, VN, Mn, Cl, Sp, Wa, SR 5. 50 J, VN, Mn, Cl, Sp, Wa, SR 6. 0, J, VN, No, No, Sp, Wa, R 7. 5. J, VN, Mn, Cl, Sp, Wa R							
-46	270															
	271		49											0.0	[60]	
	272								becomes 15% vesicles, subrounded, 1-5 mm							
-48	273	53		100		88			becomes 10% vesicles, submunded, 1-15 mm 1. 35. J, VN, No, No, Wa, R 2. 0, J, VN, No, No, Wa, R 3. 10 J, VN Cl, Sp Wa, R 4. 0, J VN, Mn, Fe, Sp Wa SR 5. 45 J, VN Mn, Fe, Sp, Wa, SR 6. 0, J VN, Mn Fe Sp Wa SR 7. 80. J, VN Mn, Sp, Wa, SR 8. 0. J VN, Fe, Sp, Wa, SR							
	274		50													
-50	275								At 273.9 ft becomes 25% vesicles, rounded to subrounded, 1-5 mm becomes 20% vesicles, rounded, 1-10 mm							
	276													0.0	[60]	
-52	277								At 277.1 ft becomes 25% vesicles, rounded to subrounded, 1-4 mm At 277.7 ft becomes 10% vesicles, submunder, <2 mm At 278.1 ft possible flow contact, becomes dark reddish brown (5YR 3/4), moderately weathered, medium strong to strong, 15% vesicles, subangled infilled with clay very pale brown (10YR 8/4)							
	278	54		86		0			At 278.8 ft becomes reddish brown (5YR 5/3) moderate to slightly weathered, strong, 10% vesicles irregular, subrounded to subangular, 1-5 mm, Mn spotting in vesicles							
-54	279								At 279.5 ft becomes 5% vesicles, subrounded, 3-25 mm, partially infilled with Mn+Sp, partially infilled with clay, very pale brown (10YR 8/4) (halloysite) 1. 50 J, VN, Mn, Cl, Sp, Wa, SR 2. 5, J, VN, Mn, Sp, Fe, Su, Wa, SR 3. 0, J, VN, Mn, Sp, Wa, SR 4. 0, J, VN, Mn, Sp, Wa, SR 5. 0, J, VN, Mn, Cl, Sp, Wa, SR							
	280		52						no recovery							Boring complete on 3/22/19 at 281 ft. 0.8 ft of cord dropped downhole
-56	281								Bottom of boring total depth is 281 ft bgs							
	282								Used a total of approximately 1,450 gallons of circulation water Hand cleared from 0-5 ft bgs. Drill with 8" OD HSA from 5-15 ft bgs. HQ core from 15-100 ft bgs. Hole reamed to 17.5". Install 10" steel casing to 100 ft bgs. PQ core from 100 ft to 281 ft bgs. Installed nested set of 4 vibrating wire piezometers and grouted in place.							
-58	283															
	284															
-60	285															

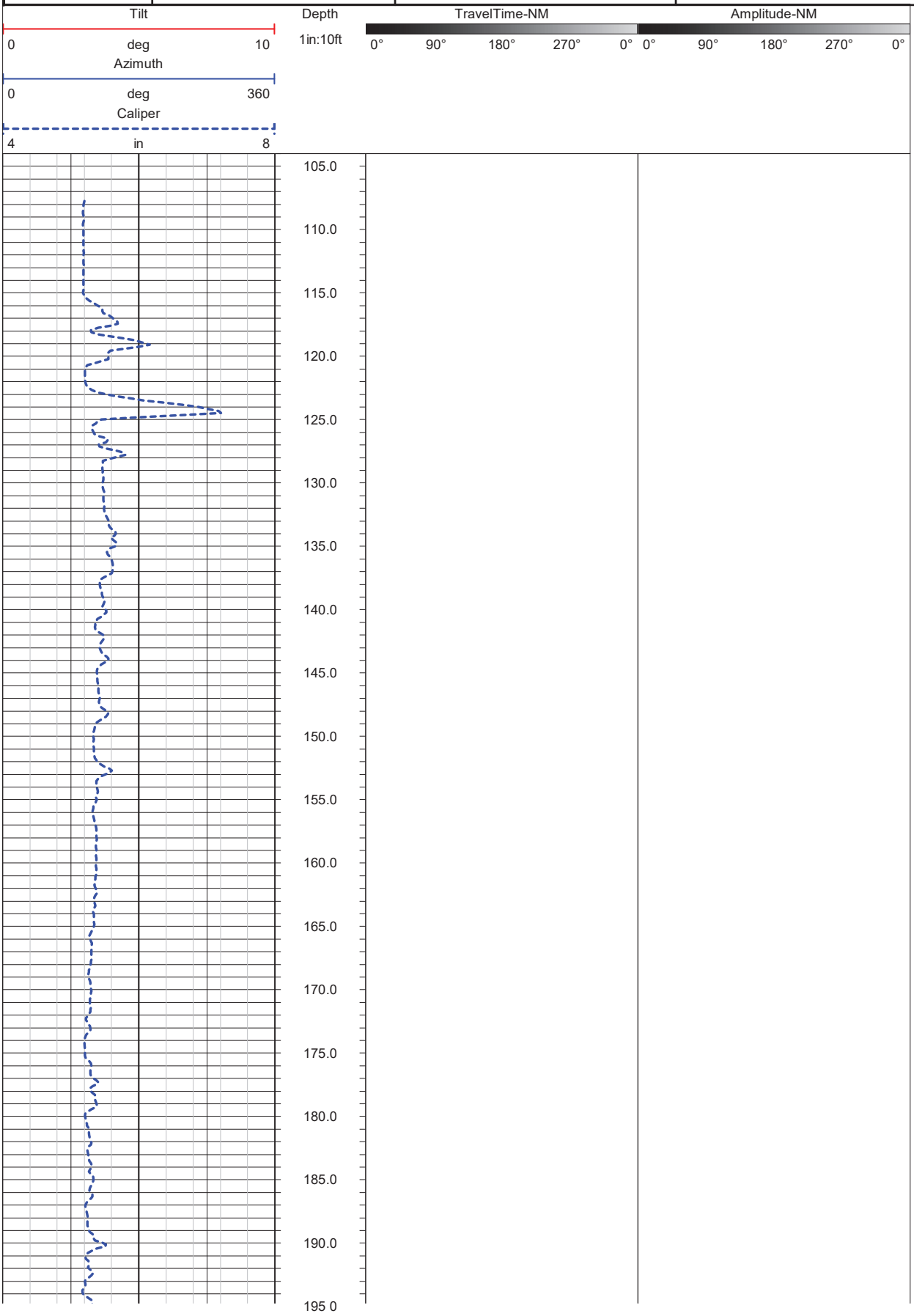
~~For Red Hill AOC Party Use Only~~

ACOUSTIC TELEVIEWER

borehole geophysics / hydrophysics

COMPANY: VALLEY DRILLING	PROJECT: RED HILL
DATE LOGGED: 26-MAR-2019	WELL: RHBT 01

Colog, Inc. - Arizona
116 N. Roosevelt Ave, Suite 121, Chandler, AZ 85226
Phone: (480) 236-6815
www.colog.com



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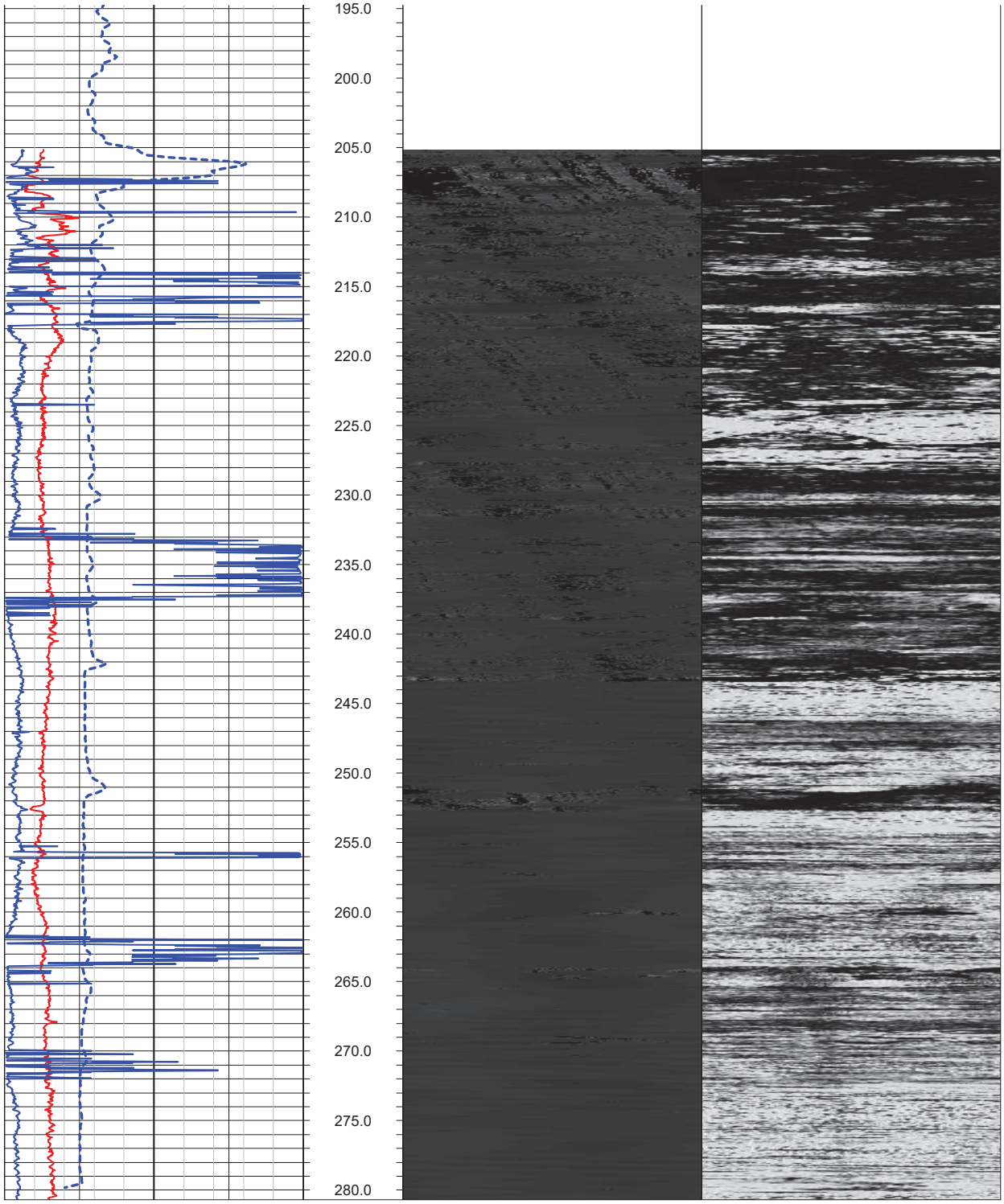
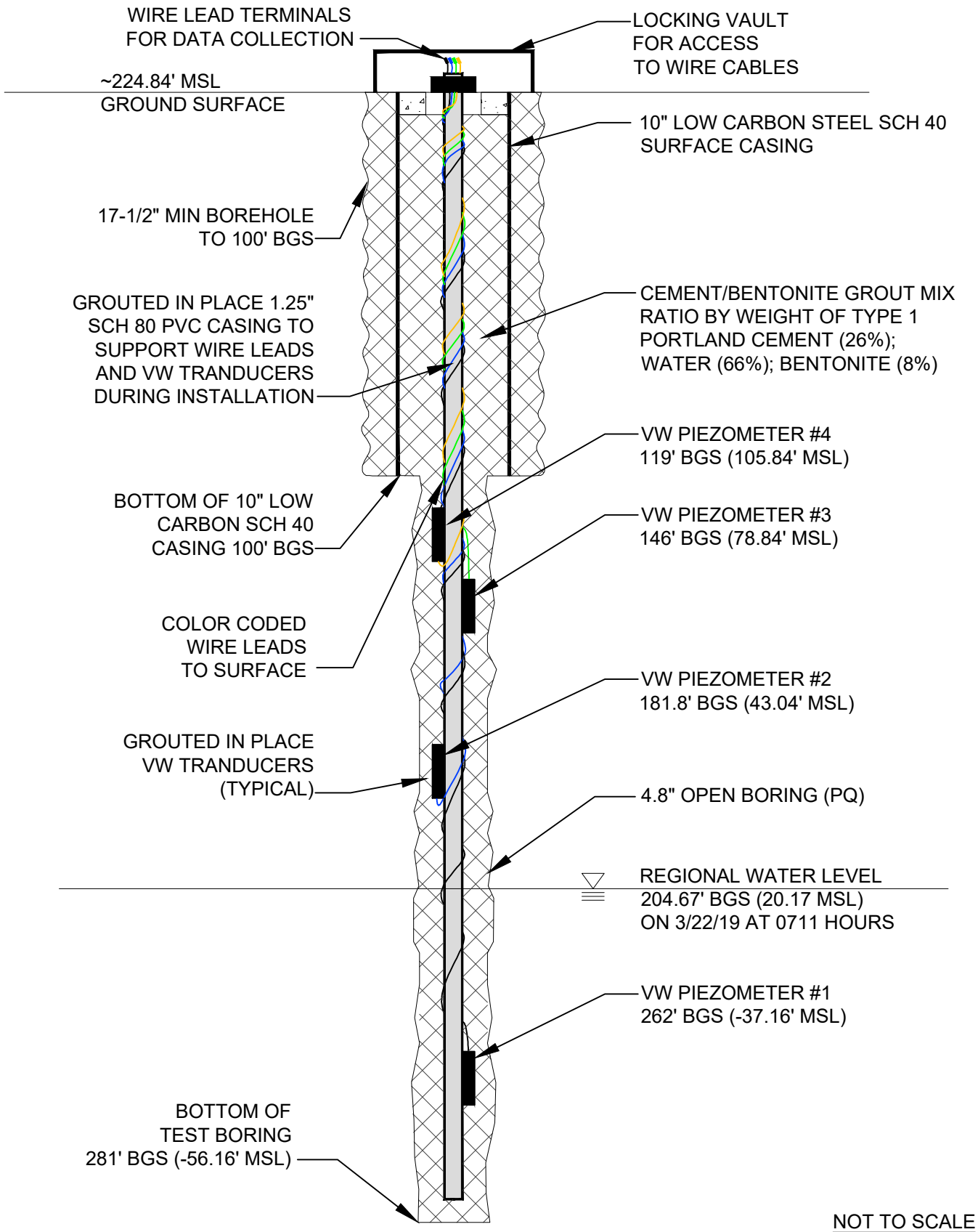
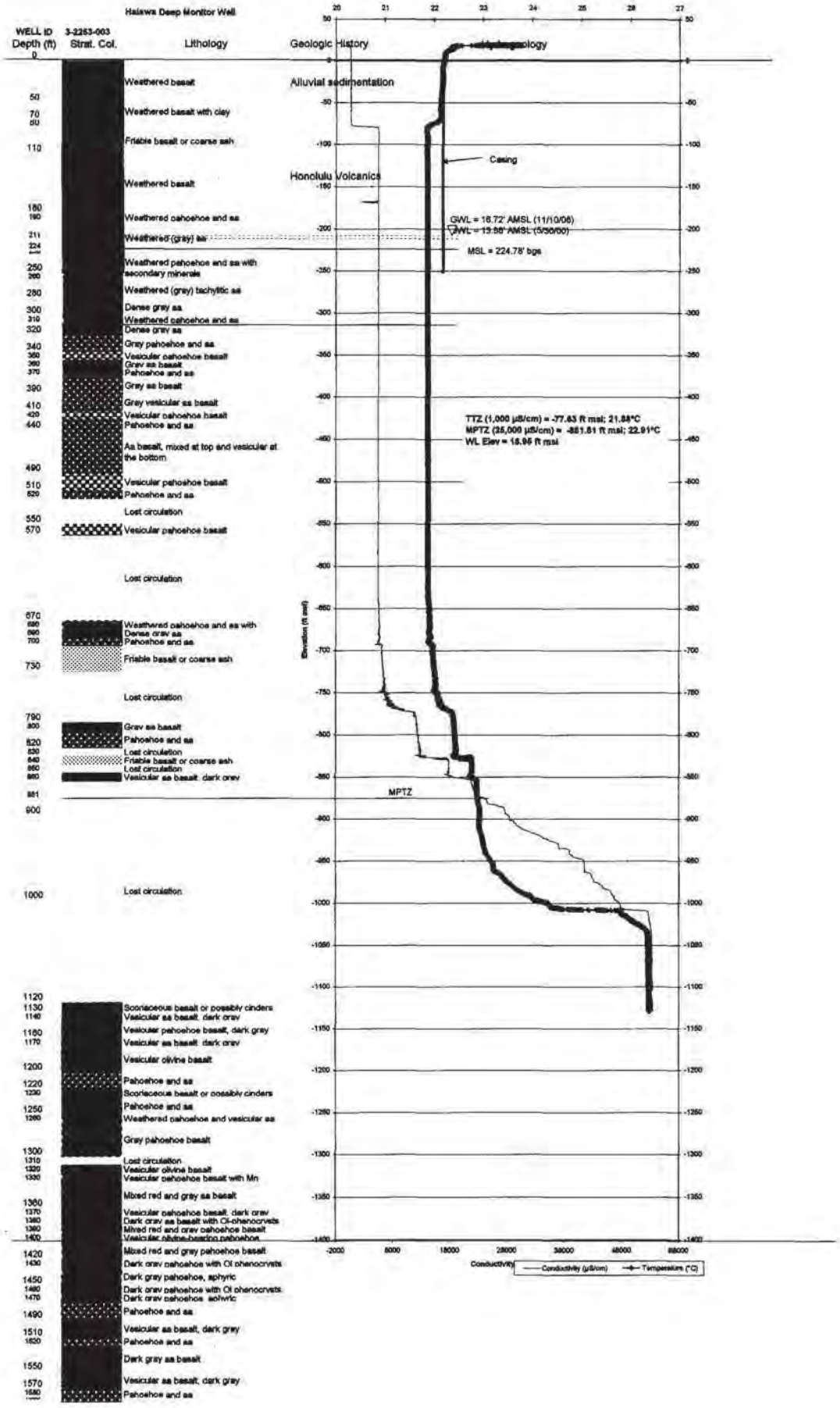


RHTB01 Test Boring



B:\60571032-HNL1\900-Work\910 C-D\20-SHEETS\Packer Figures\GenCrossSec_RHTB01_VWT.dwg 03/12/20 3:03 PM NamocL

General Cross Section of RHTB01
with Grout in place VW Transducers
Red Hill Bulk Fuel Storage Facility
JBPHH, Oʻahu, Hawaiʻi



DRILLERS REPORT 2253-03

WELL NAME: Hawaii Deep Monitor Well #16-6C JOB NO. 4524

DRILLER: (b) (6) [redacted]

SUBSURFACE FORMATION

DRILLERS LOG:

Depth, ft.		Rock description & Remarks	Water level ft.
0 to 18'		DIRT SOFT AUGER BIT. Cond. Pipe Depth	
18 to 56'	6 K	HARD TO MED SOFT DIRT & ROCK	
56' to 60'	2-6 K	HARD SECTION MIXED DIRT & ROCK	
60' to 122'	2-4 K	SOFT DIRT	
122' to 150'	2-4 K	SOFT TO MED SOFT MIXED DIRT	
150' to 169'	2-4 K	SOFT DIRT AGAIN	
169 to 203'	2-6 K	MED TO MED HARD MIXED DIRT & ROCK	
203' to 226'	6 K	MED HARD	
226' to 346'	4-6 K	MED SOFT LOG DEPTH	
346' to 271'	6-8 K	MED HARD TO HARD	
271' to 280'	4-8 K	HARD TO MED ROCK & CINDER	
280' to 285'	4-6 K	MED SOFT " "	
285' to 289'	6-8 K	" HARD LOST CIRC @ 285'	
289' to 297'	4-K	SOFT BEGIN BEGIN CIRC. PARTIAL @ 289'	
297' to 320'	6-8 K	MED TO MED HARD BULK ROCK LOST CIRC @ 320'	
320' to 325	2-4 K	SOFT 325 BEGIN CIRC. 50%	
325' to 330'	4 K	MED SOFT RED CINDER	
330' to 342'	4 K	SOFT " "	
342' to 345'	2-4	MED SOFT LOST CIRC @ 351' STOOD UP PUMP 20 PSI CAVEN AGAIN	
345' to 378'	2 K	SOFT	
378' to 391'	2-4 K		

DRILLERS REPORT 2253-03

WELL NAME: Hawk Deep Monitor Well 16-06 BOB NO. 4854

DRILLER: (b) (6)

SUBSURFACE FORMATION

DRILLERS LOG:

Depth, ft.		Rock description & Remarks	Water level ft.
403' to 417'		HARD	
417' to 428'	8 K	MED HARD BLK ROCK SOME ROD CHATTER	
428' to 436'	8 K	MED - BLK " "	
436' to 483'	8-10 K	BLK ROCK HARD	
483' to 449'	4 K	SOFT BLK ROCK	
449' to 464'	10 K	HARD BLK ROCK	
464' to 468'	2 K	BROKE " "	
468' to 478'	8 K	BLK ROCK HARD	
478' to 496'	4 K	MED SOFT BLK ROCK	
496' to 501'	8-10 K	HARD	
501' to 505'	6-8 K	MED	
505' to 521'	6-10 K	HARD BLK ROCK	
521' to 550'	6-8 K	MED SOFT (NO CORE)	
550' to 557'	10 K	HARD	
557' to 573'	6-8 K	MED TO MED HARD	
573' to 583'	10 K	HARD	
583' to 591'	4-8 K	SOFT	
591' to 602'	6-10 K	HARD	
602 to 609	6-10 K	MED HARD	
609' to 643'	10 K	HARD	
643' to 646'	6-8	SOFT	
646' to 650'	10 K	HARD	

DRILLERS REPORT (2293-03)

WELL NAME: Halawa Deep Monitor Well #1606-F JOB NO. 4854

DRILLER: (b) (6)

SUBSURFACE FORMATION

DRILLERS LOG:

Depth, ft.		Rock description & Remarks	Water level ft.
650' to 657'	10 K.	MED HARD	REVERSE AIR @ 657'
657' to 664'	10 K	" " BLK ROCK	
664' to 690'	10-12K	HARD - BLK	
690' to 700'	8-10K	MED HARD FINE CUTTINGS BLK	
700' to 706'	10 K	HARD AGGR BLK	
706' to 722'	8-10 K	MED HARD	
722' to 752'	8-10 K	MED BLK	
752' to 760'	10 K	" HARD BLK	
760' to 766'	12 K	HARD RED & BLK	
766' to 792'	8-10 K	MED HARD BIG CUTTINGS BLK & RED	
792' to 799'	10 K	HARD	
799 to 801'	12K	SUPER HARD	
801 to 815'	10-12 K	HARD & BIG CUTTINGS OBSERVED I/D OF PIPE PLUGGED	
815 to 825'	8-10 K	HARD (NO CORE) (SQUIRT DRILL @ 815)	
825' to 827'	8-10 K	MED	
827' to 834'	8-10K	MED HARD	
834' to 852'	6-10 K	MED SOFT TO MED	
852' to 867'	10 K	HARD	
867' to 882'	6 K	SOFT	
882' to 887'	10 K	HARD	
887' to 896'	10 K	" STILL SQUIRT DRILL	
896' to 934'	4-8 K	SOFT TO MED	

DRILLERS REPORT 2293-03

WELL NAME: Hawaii Dept Health Well #16-OC-F JOB NO. 464

DRILLER: (b) (6)

SUBSURFACE FORMATION

DRILLERS LOG:

Depth, ft.		Rock description & Remarks	Water level ft.
924' to 935'	8 K	MED HARD (No Core) (Squirt Daily)	
935' to 952'	6 K	SOFT	
952' to 956'	10 K	MED HARD	
956' to 975'	6 K	SOFT	
975' to 983'	10 K	MED HARD	
983' to 1010'	4-6	SOFT	
1010' to 1022'	8-10-12	HARD	
1022' to 1028'	10 K	HARD	
1028' to 1069	6-8 K	SOFT	
1069' to 1080'	10-12 K	HARD	
1080' to 1090'	SAME	MED - HARD	Rose to 1120'
1090' to 1132'	4-10 K	MED - SOFT SWIT BACK TO BLK CUTTINGS	
1132' to 1145'	10 K	MED - HARD BLK	
1145' to 1165'	8-10 K	MED BLK W/ SOME RED	
1165' to 1175'	8-10 K	MED - SOFT " "	
1175' to 1179	10 K	HARD RED ROCK	
1179' to 1182'	10 K	MED BLK	
1182' to 1186'	15-18 K	SUPER HARD BLK & RED ROCK	
1186' to 1216'	8-10 K	MED SOFT BLK & GREY	
1216' to 1225'	6-10 K	SOFT SOME RED & BRN	
1225' to 1237'	10-18 K	HARD ABRA (BIG CUTTINGS 1/4-3/4" RED. BLK.	
1237' to 1255'	8-10 K	MED TO SOFT BLK & SOME RED	

DRILLERS REPORT 2253-03

WELL NAME: Navy Deep Monitor Well # 1 JOB NO. 454

DRILLER: (b) (6)

SUBSURFACE FORMATION

DRILLERS LOG:

Depth, ft.		Rock description & Remarks	Water level ft.
1255' to 1258'	20K	Super Hard Blk & Gray Rock	
1258' to 1314'	6-12K	Steady Med to Med Soft Blk & some Red	
1314' to 1340'	8-10K	Med Blk - Red Rock	
1340' to 1356'	15-20K	Hard Blk & Red Rock	
1356' to 1368'	6-8K	Med Soft Blk	
1368' to 1378'	15-20	Hard Red & Blk Rock	
1378' to 1382'	10 K	Med	
1382' to 1390'	10-15K	Med Hard Red & Blk	
1390' to 1398'	15 K	Med Soft Blk	
1398' to 1402'	15 K	Hard	
1402' to 1421'	10-15K	Med-Soft Blk	
1421' to 1426'	10-20 K	Med	
1426' to 1429'	10 K	Soft Still Blk	
1429' to 1435'	20-10 K	Med Hard Blk & Red	
1435' to 1465'	8-10 K	Soft Still Blk	
1465' to 1468'	10-15 K	Hard	
1468' to 1488'	"	Soft	
1488' to 1501'	8-10 K	Med Blk & Red Rock	
1501' to 1518'	8-10 K	Soft Some Red Cinder	
1518' to 1530'	8-12 K	Med Hard Blk	
1530' to 1538'	10-15 K	Soft Blk & Red	
1538' to 1546'	10-15K	Hard " "	

DRILLERS REPORT 2253-03.

WELL NAME: Halawa Deep Monitor Well #16-OCUF JOB NO. 454

DRILLER: [redacted] (b) (6)

SUBSURFACE FORMATION

DRILLERS LOG:

Depth, ft.		Rock description & Remarks	Water level ft.
1546' to 1558'	10-15K	Soft BLK & RED & BRN	
1558' to 1563'	10-18K	HARD BLK	
1563' to 1570'	10 K	MED SOFT BLK	
1570' to 1585' KB	10-18K	HARD BLK & RED ROCK	
to		TOTAL DEPTH @ 1585 K.B.	
to		1575 G.L.	
to			
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Halawa Deep Monitor Well No. 2253-02 03
Geologic Log by [redacted]

Depth (ft.)	Description
0-50	Very weathered gray, tan, and red rock; cuttings are rounded and angular
50-70	Same as above, however cuttings are redder and clay present
70-80	Weathered tan cuttings, some of the vesicles lined with Mn
80-100	Weathered reddish-brown friable cuttings
100-110	Same as above, though cuttings are redder
110-130	Weathered tan cuttings
130-140	Weathered red cuttings with clay
140-150	Weathered light brown cuttings
150-170	Weathered brown aa basalt with angular vesicles some coated with Mn
170-180	Weathered dense brown, tan, and gray cuttings
180-190	Mixture of weathered brown pahoehoe and aa basalt
190-210	Weathered gray aa basalt
210-230	Friable brown-gray aa basalt
230-250	Mixture of weathered aa and pahoehoe basalt; some of the pahoehoe has secondary minerals in the vesicles.
250-260	Weathered pahoehoe basalt with secondary minerals in the vesicles
260-270	Mixture of light gray and dark gray aa basalt with a few tachylitic cuttings present
270-280	Weathered gray aa basalt with tachylite
280-290	Dense light gray aa basalt
290-300	Mixture of dense non-vesicular light gray and dark gray aa basalt
300-310	Mixture of weathered gray pahoehoe and non-vesicular aa basalt
310-320	Dense dark gray non-vesicular aa basalt
320-340	Mixture of light and dark gray pahoehoe and aa basalt
340-350	Slightly weathered reddish brown pahoehoe basalt with many small round vesicles

350-360	Slightly weathered gray aa basalt
360-370	Mixture of dark gray and gray-brown pahoehoe and aa basalt
370-380	Dark gray aa basalt with angular vesicles
380-390	Same as above, except some light gray and red cuttings mixed in
390-400	Dark gray vesicular aa basalt
400-410	Mixture of dark gray vesicular aa dense light gray non-vesicular aa basalt
410-420	Gray pahoehoe basalt with small round vesicles < 1.0 mm in diameter
420-440	Mixture of vesicular gray pahoehoe and aa basalt with vesicles < 1.0 mm in diameter; minor amount of dense light gray aa basalt
440-450	Mixture of dark gray and tan aa basalt; secondary minerals filling the vesicles
450-460	Reddish dark gray vesicular aa basalt
460-480	Dense gray aa basalt
480-490	Slightly vesicular gray aa basalt
490-510	Vesicular dark gray pahoehoe basalt; vesicles are round and large > 2mm in diameter
510-520	Mixture of glassy dark gray aa and pahoehoe basalt
520-550	**NO SAMPLE COLLECTED (LOST CIRCULATION)**
550-570	Brown-gray pahoehoe basalt with small round vesicles <1.0 mm in diameter
570-670	**NO SAMPLE COLLECTED (LOST CIRCULATION)**
670-680	Mixture of gray aa and weathered brown aa and pahoehoe basalt; some vesicles filled with secondary minerals
680-690	Dense non-vesicular dark gray aa basalt
690-700	Mixture of vesicular dark gray aa and pahoehoe basalt; vesicles < 1.0 mm diameter
700-730	Dark gray sand-size cuttings
730-790	**NO SAMPLE COLLECTED (LOST CIRCULATION)**
790-800	Fresh dark gray aa basalt
800-810	Mixture of dark gray aa and pahoehoe basalt
810-820	Fresh dark gray pahoehoe basalt
820-830	**NO SAMPLE COLLECTED (LOST CIRCULATION)**

830-840	Dark gray sand-size cuttings
840-850	**NO SAMPLE COLLECTED (LOST CIRCULATION)**
850-860	Dark gray vesicular aa basalt
860-1120	**NO SAMPLE COLLECTED (LOST CIRCULATION)**
1120-1130	Glassy black scoriaceous pahoehoe basalt (cinder?)
1130-1140	Dark gray/black vesicular aa basalt
1140-1160	Dark gray/black vesicular pahoehoe basalt
1160-1170	Fresh dark gray vesicular aa basalt
1170-1200	Fresh dark gray vesicular aa basalt with minor phenocrysts and microphenocrysts of olivine
1200-1220	Mixture of dense dark gray aa basalt and vesicular dark gray pahoehoe basalt
1220-1230	Dark gray brown scoriaceous pahoehoe basalt
1230-1250	Mixture of dense dark gray/black aa and vesicular pahoehoe basalt
1250-1260	Mixture of weathered reddish-black scoriaceous pahoehoe and dark gray vesicular aa basalt
1260-1270	Dark gray pahoehoe basalt
1270-1300	Reddish dark gray pahoehoe basalt
1300-1310	**NO SAMPLE COLLECTED (LOST CIRCULATION)**
1310-1320	Fresh dark gray aa basalt with microphenocrysts of olivine
1320-1330	Weathered vesicular pahoehoe basalt with Mn lining vesicles
1330-1360	Mixture of red-brown and dark gray aa basalt
1360-1370	Dark gray pahoehoe basalt with small round vesicles
1370-1380	Dark gray aa basalt with minor phenocrysts of olivine < 1.0mm across
1380-1390	Mixture of red and gray pahoehoe basalt
1390-1400	Dark gray highly vesicular pahoehoe basalt with phenocrysts of olivine about 5% volume of the rock
1400-1410	Same as above, but less vesicular and fewer olivine phenocrysts
1410-1420	Mixture reddish brown and dark gray pahoehoe basalt
1420-1430	Dark gray pahoehoe basalt with phenocrysts of olivine
1430-1450	Same as above except rock is aphyric

1450-1460	Dark gray pahoehoe basalt with red glass lining vesicles and minor phenocrysts of olivine
1460-1470	Same as above except rock is aphyric
1470-1490	Mixture of dense gray aa and pahoehoe basalt
1490-1510	Dark gray vesicular aa basalt
1510-1520	Mixture of dark gray aa and pahoehoe basalt
1520-1550	Dark gray aa basalt
1550-1570	Dense slightly vesicular dark gray aa basalt
1570-1580	Mixture of vesicular gray aa and pahoehoe basalt
1580-1585	Same as above, except some glassy pahoehoe and dense aa basalt present

State of Hawaii
COMMISSION ON WATER RESOURCE MANAGEMENT
Department of Land and Natural Resources

WELL COMPLETION REPORT

3/20/96 WCR Form

(Check Appropriate Box) ☒ Well Construction ☐ (Permanent) Pump Installation

Instructions: Please print or type and submit completed report within 30 days after well completion to the Commission on Water Resource Management, P.O. Box 621, Honolulu, Hawaii 96809. An as-built drawing of the well and chemical analysis should also be submitted. For assistance call the Commission Regulation Branch at 587-0225, or 1-800-468-4644 Extension 70225.

1. State Well No.: 2253-03 Well Name: Oahu (Halawa) Deep Monitor Well Island: Oahu
2. Location/Address: Honolulu, Hawaii Tax Map Key: 9-9-10:28

PART I. WELL CONSTRUCTION REPORT

3. Drilling Company: Water Resources International, Inc.
4. Name of driller who performed work: (b) (6)
5. Type of rig/construction: Spencer Harris 3500 Rotary Rig
6. Date(s) Well Construction and pump tests (if any) completed: 5-30-00
7. GROUND ELEVATION (referenced to mean sea level, msl): 224.78 ft.
   Well Bench Mark (description/location): concrete base Elevation(msl): 224.98 ft.
8. DRILLER'S LOG: *Please attach geologic log (if available or if required by permit)*

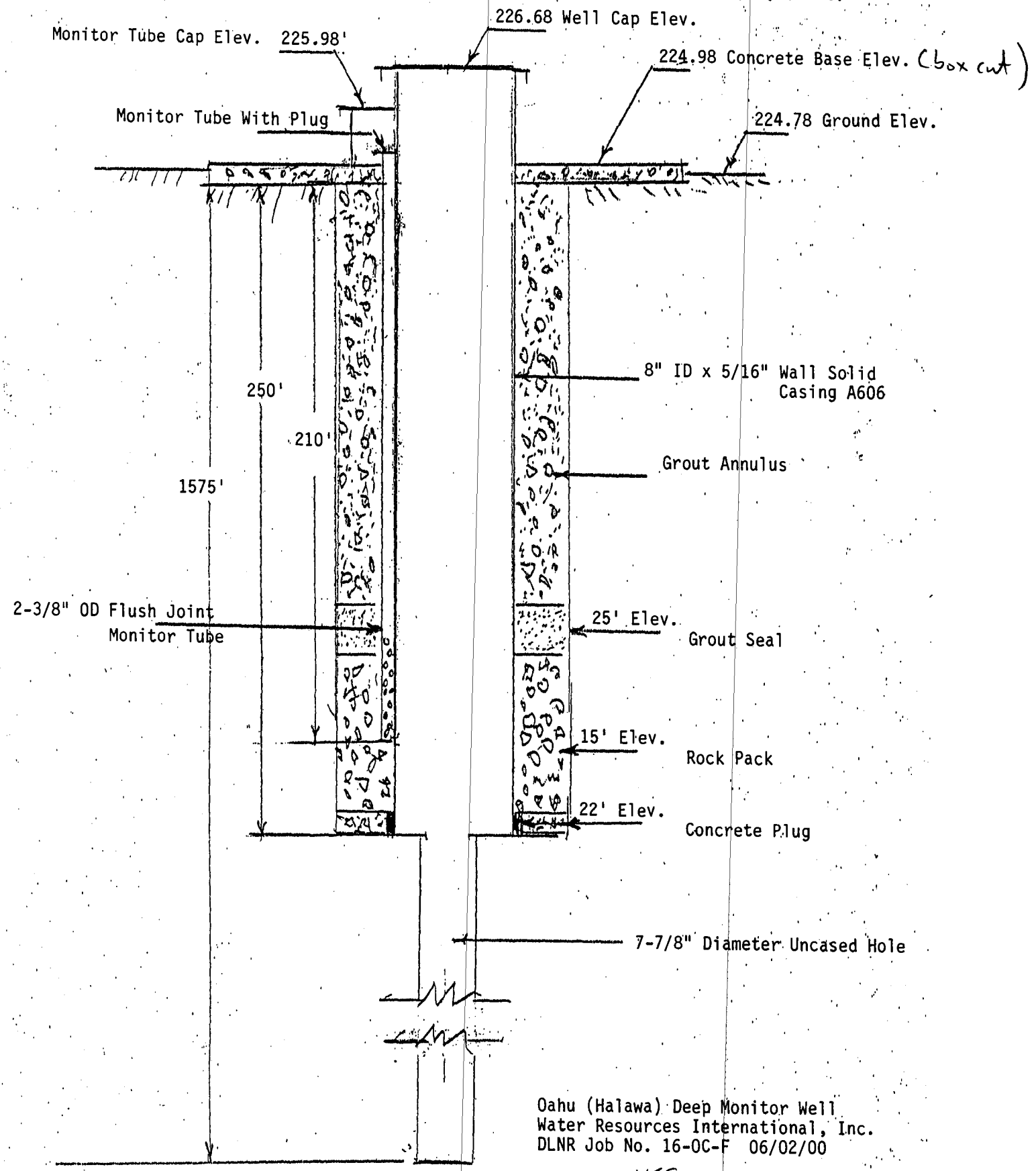
Depths (ft.)	Rock Description, Water Level, Dates, etc.	Depths (ft.)	Rock Description, Water Level, Dates, etc.
____ to See attached		____ to ____	
____ to ____		____ to ____	

(If more space is needed, continue on back.)

9. Total depth of well below ground: 1575 ft.
10. Hole size: 15 inch dia. from -0- ft. to 250.00 ft. below ground
    7 7/8 inch dia. from 250 ft. to 1325 ft. below ground
    ____ inch dia. from ____ ft. to ____ ft. below ground
11. Casing Installed: 8 in. I.D. x 5/16 in. wall solid section to 250 ft. below ground
    NA in. I D x ____ in. wall perforated section to ____ ft. below ground
    Casing Material/Slot Size. NA
12. Annulus: Grouted from -0- ft. below ground to 210 ft. below ground
    Gravel packed from 210 ft. below ground to 250 ft. below ground
13. Initial water level: 210.90 ft. below ground. Date and time of measurement: 2-14-00
14. Initial chloride: NA ppm Date and time of sampling: NA
15. Initial temperature: NA °F Date and time of measurement: NA
16. PUMPING TESTS: Reference Point (R.P.) used: NA, which elevation is ____ ft.
    (1) Step-Drawdown Test Date ____ (2) Long-term Aquifer Test Date ____
    Start water level ____ ft. below R.P. Start water level ____ ft. below R.P.
    End water level ____ ft. below R.P. End water level ____ ft. below R.P.
17. Aquifer Pump Test Procedures data & graphs *(1/9/96 LTAT Form)* attached? ☐ Yes ☐ No
18. As-built drawings attached attached? ☐ Yes ☐ No
19. Other remarks/comments: *(On back of this form)*

Well Drilling Contractor (print) Water Resources Int'l Inc C-57 Lic. No. AC 05058
Signature (b) (6) Date June 2, 2000
Surveyor (print) [illegible] Corporation Lic. No. HI 4729
Signature (b) (6) Vice Pres. Date June 26, 2000
Applicant (print) (b) (6)
Signature Date 10/11/01

HALAWA DEEP MONITOR 2293-03, OAHU



Oahu (Halawa) Deep Monitor Well
Water Resources International, Inc.
DLNR Job No. 16-0C-F 06/02/00

NTS

~~For Red Hill AOC Party Use Only~~

EARTH TECH

Borehole/Well Construction Log

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	**Borehole Number:** MW08	
Borehole Location: Near AST	*Northing:* (b) (3) (A) *Easting:* (b) (3) (A)	Sheet *1* of *9*	
Drilling Agency: Valley Well Drilling	Driller: (b) (6)		
Drilling Equipment: B59, Jaswell 3000	Date & Time Started: 4/7/98	Total Depth (feet): 142.8	
Drilling Method: Air Rotary, Hollow Stem Auger	Top of Casing Elevation (feet msl): 138.06	Date & Time Finished: 4/24/98	Depth to Water (feet): See remarks
Size and Type of Bit: -	Borehole Diameter (in): 10	Sample Type: *Bulk:* NA *Drive:* x *SS:* 16 *Grab:* NA	*Sample Length (ft):* 1.5' or 5' *Driving Weight:* NA *Drop Length:* NA
Drilling Fluid: Air	Drilling Angle: (degrees) 90	Number of Samples: 16	
Completion Information: See remarks	Logged By: (b) (6)	Checked By: (b) (6)	

Depth (feet)	Samples: Number	Type	Blow Count	Percent Recovery	Time	Estimated %: Gravel	Sand	Fines	Log: Graphic	USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
0											Topsoil		Ground surface elevation: 135.67 feet msl
1			50/5"	40	1352	5	TR	95		CL	**LOW PLASTIC INORGANIC CLAY**; black, 5YR 2.5/1; dry; hard; CL; 95% low plastic inorganic clay; 5% fine, subangular gravel; trace amount of sand and roots.		
2													Steel casing (12 inch diameter)
3													PVC Casing
4													Grout
5			50/5"	35	1359	TR	80	20		SC	**CLAYEY SAND**; dark yellowish brown, 10YR 4/6; dry; dense; SC; 80% fine, medium, coarse, subrounded sand; 20% low plastic inorganic clay; trace amount of fine, subangular gravel.		
6													
7													
8													
9													
10			50/6"	15	1410	-	-	-		IE	**EXTRUSIVE**; basalt; gray, 10YR 6/1; vesicular basalt; fresh; hard; dry; IE.		
11													
12													
13													
14													
15													

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EARTH TECH

Borehole/Well Construction Log (Continuation Sheet)

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	Borehole Number: MW08
Borehole Location: Near AST		Sheet 2 of 9

Depth (feet)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Percent Recovery	Samples: Time	Estimated %: Gravel	Estimated %: Sand	Estimated %: Fines	Log: Graphic	Log: USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
16			NA	5	1420	-	-	-		IE	Same as above		
18			50/3"	0		-	-	-			No Recovery Called off at 1435, 4/7/98		
20			NA	70	1300	-	-	-			No recovery		
22						-	-	-			No Recovery		
25			NA	0	1442	40 -	- -	60 -		CL	**GRAVELLY CLAY**; strong brown and dark gray, 7.5YR 5/6, 4/1; dry; soft; CL; 60% high plastic inorganic clay; 40% fine, subrounded basalt gravel. No Recovery Called off at 1442, 4/13/98		
30													Bottom of steel casing
32			NA	80	1430	-	TR	100		CH	**HIGH PLASTIC INORGANIC CLAY**; dark		

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EARTH TECH

Borehole/Well Construction Log (Continuation Sheet)

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	Borehole Number: MW08
Borehole Location: Near AST		Sheet 3 of 9

Depth (feet)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Percent Recovery	Samples: Time	Estimated %: Gravel	Estimated %: Sand	Estimated %: Fines	Log: Graphic	Log: USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
33											brown, 7.5YR 3/3; moist; soft; CH; 100% high plastic inorganic clay; trace amount of sand. Logged at 1439, 4/14/98.		
34													
35													
36						30	TR	70		CL	GRAVELLY CLAY; very dark gray and brown, 10YR 3/2; moist; stiff; CL; 30% subrounded gravel; 70% low plastic inorganic clay; trace amount of sand; extensive mottling.		
37			NA	60		-	-	-		IE	EXTRUSIVE; basalt; light gray, 5YR 7/2; vesicular basalt; highly weathered; friable; dry; IE.		
38						-	-	-		IE	Same as above		
39						100	TR	-		GP	POORLY GRADED GRAVEL; pale olive gray, 5YR 6/2; dry; GP; 100% coarse, subrounded gravel; trace amount of coarse sand.		
40						-	-	-		IE	EXTRUSIVE; basalt; pale olive, 5YR 7/2; lightly weathered; massive; friable; dry; IE.		
41													
42			NA	70		80	10	10		GC	CLAYEY GRAVEL; strong brown, 7.5YR 4/6; moist; GC; 80% fine, medium and coarse subrounded gravel; 10% coarse subrounded sand; 10% high plastic inorganic clay.		
43													
44						100	-	-		GW	WELL GRADED GRAVEL; brown, 7.5YR 4/3; moist; GW; 100% medium coarse subrounded gravel.		
45										IE	EXTRUSIVE; basalt; brown, 7.5YR 4/3; highly weathered; vesicular basalt; fractured; moist; IE.		
46						90	5	5		GP	POORLY GRADED GRAVEL; strong brown, 7.5YR 4/6; moist; GP; 90% fine, medium, coarse subrounded gravel; 5% coarse, subrounded sand; 5% high plastic inorganic clay.		
47			NA	80		-	-	-		IE	EXTRUSIVE; basalt; brown, 7.5YR 4/3; highly weathered; vesicular basalt; fractured; moist; IE.		
48						-	-	100		CH	HIGH PLASTIC INORGANIC CLAY; brown, 7.5YR 4/2; moist; firm; CH; 100% medium plasticity inorganic clay.		
49						-	-	-		IE	EXTRUSIVE; basalt; olive gray, 5YR 5/2; fresh; vesicular; moist; IE.		
50													

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EARTH TECH

Borehole/Well Construction Log (Continuation Sheet)

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	Borehole Number: MW08
Borehole Location: Near AST		Sheet 4 of 9

Depth (feet)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Percent Recovery	Samples: Time	Estimated %: Gravel	Estimated %: Sand	Estimated %: Fines	Log: Graphic	Log: USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
51													
52			NA	100	1700	-	-	-		IE	Same as above		
53													
54						-	-	-		IE	**EXTRUSIVE**; basalt; gray, 10YR 5/1; most massive basalt with some vesicular fabric; fresh; hard; moist; IE.		
55													
56						-	-	-		IE	**EXTRUSIVE**; basalt; olive gray, 5YR 5/2; fresh; vesicular; moist; IE.		
57			NA	80	0917	-	-	-		IE	No Recovery		
58						-	-	-		IE	Grading to faintly weathered; well developed fracture in basalt.		
59													
60											Color changes to brown (7.5YR 4/4); grading to highly weathered and soft.		
61						70	10	20		GC	**CLAYEY GRAVEL**; dark gray, 5YR 4/1; dry; dense; GC; 70% fine, subangular and subrounded gravel; 20% low plastic, inorganic clay; 10% fine, subangular sand.		
62			NA	85	0947	-	-	-		IE	**EXTRUSIVE**; basalt; brown, 7.5YR 4/4; massive basalt; highly weathered; medium hard; moist; IE.		
63										IE	**EXTRUSIVE**; volcanic breccia; gray, 5YR 5/1; 60% basalt clast; 20% matrix; 20% porosity; faintly weathered; hard; dry; IE.		
64													
65													
66													
67			NA	80	1040	-	-	-			No recovery		

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EARTH TECH

Borehole/Well Construction Log (Continuation Sheet)

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	Borehole Number: MW08
Borehole Location: Near AST		Sheet 5 of 9

Depth (feet)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Percent Recovery	Samples: Time	Estimated %: Gravel	Estimated %: Sand	Estimated %: Fines	Log: Graphic	Log: USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
68						-	-	-		IE	**EXTRUSIVE**; volcanic breccia; gray, 7.5YR 5/1; 40% basalt clast; 40% matrix; 20% porosity; faintly weathered; hard; wet; IE.		
69						-	-	-		IE	**EXTRUSIVE**; basalt; dark gray, 7.5YR 4/1; massive basalt; fresh; hard; wet; IE.		
70													
71													
72			NA	90	1130	-	-	-		IE	Same as above		
73													
74													
75													
76													
77						-	-	-		IE	Same as above		
78											Switch to Jaswell, no sample taken after 77 feet. Lithology was estimated from blown hole.		
79													
80													
81													
82													
83													
84													
85													

~~For Red Hill AOC Party Use Only~~

EARTH TECH

Borehole/Well Construction Log (Continuation Sheet)

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	Borehole Number: MW08
Borehole Location: Near AST		Sheet 6 of 9

Depth (feet)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Percent Recovery	Samples: Time	Estimated %: Gravel	Estimated %: Sand	Estimated %: Fines	Log: Graphic	Log: USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
86						-	-	-		IE	Same as above (Basalt)		
87													
88													
89													
90													
91													
92													
93													
94													
95													
96													
97													
98													
99													
100													
101													
102													Top of Bentonite seal

~~For Red Hill AOC Party Use Only~~

EARTH TECH

Borehole/Well Construction Log (Continuation Sheet)

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	Borehole Number: MW08
Borehole Location: Near AST		Sheet 7 of 9

Depth (feet)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Percent Recovery	Samples: Time	Estimated %: Gravel	Estimated %: Sand	Estimated %: Fines	Log: Graphic	Log: USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
103						-	-	-		IE	Same as above (basalt)		
104													
105													
106													
107													
108													
109													
110													
111													
112													
113													
114													
115													
116													
117													
118													
119													
120													

~~For Red Hill AOC Party Use Only~~

EARTH TECH

Borehole/Well Construction Log (Continuation Sheet)

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	Borehole Number: MW08
Borehole Location: Near AST		Sheet 8 of 9

Depth (feet)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Percent Recovery	Samples: Time	Estimated %: Gravel	Estimated %: Sand	Estimated %: Fines	Log: Graphic	Log: USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
121						-	-	-		IE	Same as above (basalt)		
122													Approximate static basal groundwater level (122.2 feet bgs); top of filter pack
123													
124													
125													
126													
127													
128													
129													
130													
131													
132													Top of screen
133													0.02 inch stainless steel screen
134													
135													
136													
137													

~~For Red Hill AOC Party Use Only~~

EARTH TECH

Borehole/Well Construction Log (Continuation Sheet)

Project Name: Red Hill Phase II RI/FS	Project Number: CTO-0034	Borehole Number: MW08
Borehole Location: Near AST		Sheet 9 of 9

Depth (feet)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Percent Recovery	Samples: Time	Estimated %: Gravel	Estimated %: Sand	Estimated %: Fines	Log: Graphic	Log: USCS or Rock Type	Lithologic Description	Well Construction Diagram	Remarks
138						-	-	-		IE	Same as above (basalt)		First encountered depth of basal groundwater (138.5 feet bgs)
139													
140													
141													
142													Bottom of well
											Boring finished at 143 feet on 4/24/98.		Total depth of borehole

WELL COMPLETION RECORD

JOB NO.: CTO 0034 WELL NO. MW-08 HYDROGEOLOGIST: (b) (6)

CLIENT: PACNAVFACENGCOM DRILLER: Valley Well Drilling

WELL LOCATION: Near AST DATE/TIME: 4/24/98 10:50

DETAILS OF CONSTRUCTION

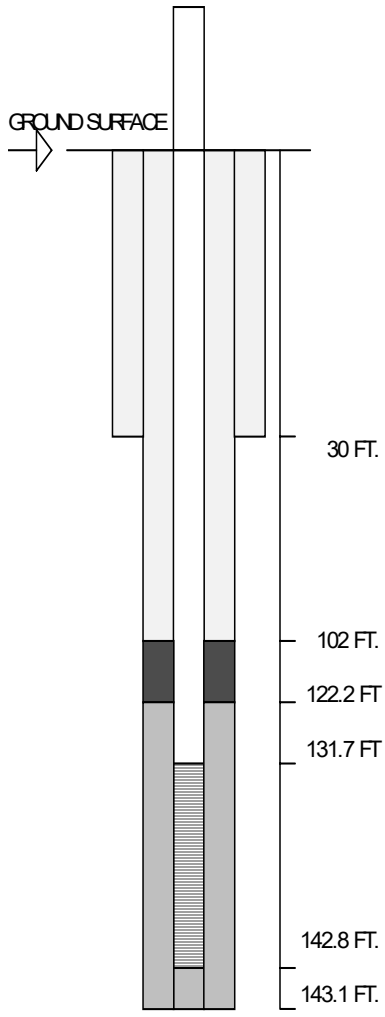
Date Completed	4/24/98
Borehole Diameter (in.)	10
Type and Size of Casing (in.)	PVC; 4
Type and Size of Screen (in.)	Stainless Steel; 4
Screen Perforation Diameter (in.)	0.02
Screen Length (ft.)	11.1
Centralizer Depths (ft.)	N/A

Completion Technique

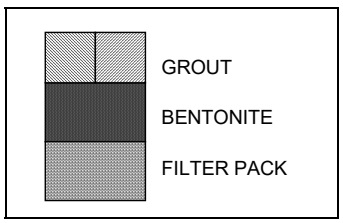
1. Type of Filter Pack and Placement Method
   Lonestar #3
2. Type of Bentonite and Placement Method
   Pellets, chips
3. Type of Grout Mixture and Placement Method
   Portland; tremmie pipe

Description of Potential Problems With Well:
Perched Water

Development Technique
Surge with block during construction; surge with bailer during development



NOTE: ALL DEPTHS ARE REFERENCED TO GROUND SURFACE



Well Head Elevation	138.06 ft (MSL)
Ground Surface Elev.	135.67 ft (MSL)
Well Head Completion Method	Manual crash hole
Drilling Method/Rig Type	B-59; Jaswell

Surface Casing: Type PVC; Diameter 4 in.; Length 2.39 ft.

MATERIALS

Cement (bags)	NA
Filter Pack Material (sand bags)	10
Casing Material (ft.)	131.66
Bentonite (buckets/bags)	1 (pellets) 7 (chips)

Top of Bentonite Seal	102	ft.
Top of Filter Pack	122.2	ft.
Top of Screen	131.66	ft.
Bottom of Screen	142.76	ft.
Bottom of Hole	143.1	ft.

WELL DEVELOPMENT LOG

PROJECT	WELL NO.	SITE	PREPARED BY
CTO 0034	MW08	AST, Red Hill	(b) (6)

METHOD
- OVERPUMPAGE ☐
- BAILER 3
- SURGE BLOCK 3
- AIR LIFT ☐
- OTHER _____

INITIAL WATER LEVEL 117.42' (DTW)

FINAL WATER LEVEL

REMARKS:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)

2" - 0.16
4" - 0.65
6" - 0.1.47

VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

HOLE DIAMETER d_h = _____

WELL CASING INSIDE DIAMETER d_wID = _____

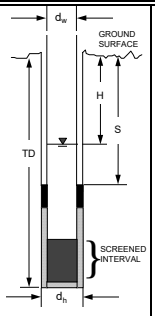
OUTSIDE DIAMETER d_wOD = _____

DEPTH TO: WATER LEVEL H = _____

BASE OF SEAL S = _____

BASE OF WELL TD = _____

EST. FILTER PACK POROSITY P = _____



WELL VOLUME CALCULATION :

$$\text{CASING VOLUME} = V_c = \Pi\left(\frac{d_wID}{2}\right)^2 (TD - H) = 3.14\left(\frac{\quad}{2}\right)^2 (\_\_\_\_ - \_\_\_\_) = \_\_\_\_\_$$

$$\text{FILTER PACK PORE VOLUME} = V_f = \Pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_wOD}{2}\right)^2\right](TD - (S \text{ or } H^*)(P) = \_\_\_\_\_$$

(* if S > H, use S; if S < H, use H)

$$= 3.14\left[\left(\frac{\quad}{2}\right)^2 - \left(\frac{\quad}{2}\right)^2\right](\_\_\_\_ - \_\_\_\_)(\_\_\_\_) = \_\_\_\_\_$$

TOTAL WELL VOLUME = VT = Vc + Vf = ____ + ____ = _____ $ft.^3$ x 7.48 = ____ gal.

DEVELOPMENT LOG:

DATE	TIME BEGIN/END	METHOD	ELAPSED TIME	FLOW RATE (gpm)	CUMULATIVE WATER REMOVED GALLONS	WATER QUALITY pH	TEMP (°F)	CONDUC - TIVITY (mS)	D.O.* (mg)	REDOX (mV)	TURBID- ITY	COMMENTS
5/4/98	1355	bailed			2.5	10.10	88.9	3.01	4.9		muddy	Start 1355
5/4/98	1440	bailed			5	9.85	87.0	3.00	6.8		muddy	Est. volume of bail incorrectly
5/4/98	1442	bailed			7.5	10.04	87.9	2.9	6.4		muddy	
5/4/98	1445	bailed			10	9.92	86.3	3.03	7.3		muddy	
5/4/98	1506	bailed			12.5	9.38	92.3	2.9	6.1		muddy	
5/4/98	1515	bailed			15	9.33	89.2	2.92	7.0		muddy	
5/4/98	1518	bailed			17.5	9.32	87.4	3.07	8.1		muddy	
5/4/98	1520	bailed			20	9.18	87.8	2.87	8.2		muddy	
5/4/98	1550	bailed			22.5	9.15	88.3	3.01	7.7		muddy	
5/4/98	1552	bailed			26.5	9.09	87.1	3.02	8.6		muddy	
5/4/98	1555	bailed			30.5	9.09	86.4	3.02	8.6		muddy	
5/4/98	1557	bailed			33.5	9.12	85.7	3.01	8.5		muddy	
5/4/98	1559	bailed			36	9.00	85.4	3.09	9.4		muddy	
5/4/98	1603	bailed			40	9.07	87.0	3.01	9.2		muddy	
5/4/98	1605	bailed			43	8.99	85.1	3.06	9.4		muddy	
5/4/98	1607	bailed			47	8.98	85.0	3.06	9.2		muddy	
5/4/98	1610	bailed			51	8.78	83.8	3.15	10.1		muddy	
5/4/98	1613	bailed			53	8.78	84.3	3.24	9.5		muddy	
5/4/98	1616	bailed			55	8.88	84.3	3.18	9.2		muddy	

WELL DEVELOPMENT LOG

PROJECT	WELL NO.	SITE	PREPARED BY
CTO 0034	MW08	AST, Red Hill	(b) (6)

METHOD
- OVERPUMPAGE ☐
- BAILER 3
- SURGE BLOCK 3
- AIR LIFT ☐
- OTHER _____

INITIAL WATER LEVEL 117.42' (DTW)

FINAL WATER LEVEL

REMARKS:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)

2" - 0.16
4" - 0.65
6" - 0.1.47

VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

HOLE DIAMETER d_h = _____

WELL CASING INSIDE DIAMETER d_wID = _____

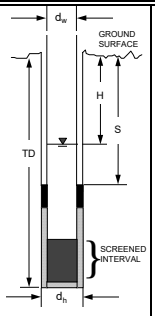
OUTSIDE DIAMETER d_wOD = _____

DEPTH TO: WATER LEVEL H = _____

BASE OF SEAL S = _____

BASE OF WELL TD = _____

EST. FILTER PACK POROSITY P = _____



WELL VOLUME CALCULATION :

$$\text{CASING VOLUME} = V_c = \Pi\left(\frac{d_wID}{2}\right)^2 (TD - H) = 3.14\left(\frac{\quad}{2}\right)^2 (\quad - \quad) = \quad$$

$$\text{FILTER PACK PORE VOLUME} = V_f = \Pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_wOD}{2}\right)^2\right](TD - (S \text{ or } H^*)(P) = \quad$$

(* if S > H, use S; if S < H, use H)

$$= 3.14\left[\left(\frac{\quad}{2}\right)^2 - \left(\frac{\quad}{2}\right)^2\right](\quad - \quad)(\quad) = \quad$$

TOTAL WELL VOLUME = VT = Vc + Vf = ____ + ____ = _____ $ft.^3$ x 7.48 = ____ gal.

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY						COMMENTS
DATE	TIME BEGIN/END	METHOD	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP (°F)	CONDUC - TIVITY (mS)	D.O.* (mg)	REDOX (mV)	TURBID- ITY	
5/4/98	1620	bailed			56	8.69	83.6	3.2	10.7		muddy	New drum
5/4/98	1621	bailed			59.5	8.63	84.1	3.1	10.2		muddy	
5/4/98	1623	bailed			63.5	8.69	83.7	3.15	10.4		muddy	Settling faster
5/4/98	1626	bailed			67	8.68	83.8	3.16	10.9		muddy	
5/4/98	1627	bailed			68.5	8.29	83.7	3.04	9.8		muddy	
5/4/98	1629	bailed			70	8.33	83.5	3.04	11		muddy	
5/4/98	1631	bailed			73.5	8.36	83.2	3.0	10.1		muddy	
5/4/98	1633	bailed			77	8.39	83.0	3.08	10.6		slightly less muddy	
5/4/98	1635	bailed			80	8.44	82.4	2.99	10.4		slightly less muddy	
5/4/98	1637	bailed			82	8.43	82.7	3.00	10.3		clearer	
5/4/98	1639	bailed			85	8.47	82.5	2.97	10.1		clearer	
5/4/98	1641	bailed			87	8.32	82.6	3.01	11.3		clearer	
5/4/98	1643	bailed			90	8.38	82.6	2.99	10.3		clearer	
5/4/98	1645	bailed			92	8.26	82.3	2.95	10.5		clearer	
5/4/98	1648	bailed			95	8.12	82.1	2.94	11.1		clearer	
5/4/98	1651	bailed			98	8.02	81.9	2.99	10.5		clearer	
5/4/98	1654	bailed			101.5	8.33	82.0	3.07	10		clearer	
5/4/98	1656	bailed			104.5	8.07	81.8	2.93	10.8		clearer	

WELL DEVELOPMENT LOG

PROJECT	WELL NO.	SITE	PREPARED BY
CTO 0034	MW08	AST, Red Hill	(b) (6)

METHOD
- OVERPUMPAGE ☐
- BAILER 3
- SURGE BLOCK 3
- AIR LIFT ☐
- OTHER _____

INITIAL WATER LEVEL 117.42' (DTW)

FINAL WATER LEVEL

REMARKS:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)

2" - 0.16
4" - 0.65
6" - 0.1.47

VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)

2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE - 1.37
4" CASING AND 12" HOLE - 2.09

HOLE DIAMETER d_h = _____

WELL CASING INSIDE DIAMETER d_wID = _____

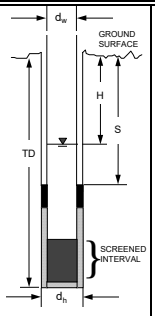
OUTSIDE DIAMETER d_wOD = _____

DEPTH TO: WATER LEVEL H = _____

BASE OF SEAL S = _____

BASE OF WELL TD = _____

EST. FILTER PACK POROSITY P = _____



WELL VOLUME CALCULATION :

$$\text{CASING VOLUME} = V_c = \Pi\left(\frac{d_wID}{2}\right)^2 (TD - H) = 3.14\left(\frac{\quad}{2}\right)^2 (\_\_\_\_ - \_\_\_\_) = \_\_\_\_\_$$

$$\text{FILTER PACK PORE VOLUME} = V_f = \Pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_wOD}{2}\right)^2\right](TD - (S \text{ or } H^*)(P) = \_\_\_\_\_$$

(* if S > H, use S; if S < H, use H)

$$= 3.14\left[\left(\frac{\quad}{2}\right)^2 - \left(\frac{\quad}{2}\right)^2\right](\_\_\_\_ - \_\_\_\_)(\_\_\_\_) = \_\_\_\_\_$$

TOTAL WELL VOLUME = VT = Vc + Vf = ____ + ____ = _____ $ft.^3$ x 7.48 = ____ gal.

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY						COMMENTS
DATE	TIME BEGIN/END	METHOD	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP (°F)	CONDUC - TIVITY (mS)	D.O.* (mg)	REDOX (mV)	TURBID- ITY	
5/4/98	1659	bailed			90	8.05	81.8	2.97	10.5		clearer	Overestimated bail volume corrected
5/4/98	1702	bailed			92	8.17	81.1	2.94	11.4		clearer	
5/4/98	1705	bailed			94.5	8.17	81.4	2.98	11.2		clearer	
5/4/98	1707	bailed			96.5	8.12	81.5	2.94	12.9		clearer	
5/4/98	1711	bailed			91	8.12	81.2	2.96	10.5		clearer	
5/4/98	1714	bailed			93	7.97	80.8	2.94	11.5		clearer	
5/4/98	1716	bailed			95	7.95	81.1	2.92	11.3		clearer	
5/4/98	1718	bailed			91	7.86	81.2	2.88	11.5		clearer	Underestimated bail volume corrected
5/4/98	1720	bailed			92	7.92	81.0	2.96	11.6		clearer	
5/4/98	1722	bailed			93	7.91	81.0	2.92	10.9		clearer	
5/4/98	1725	bailed			95	7.86	80.7	2.91	11.2		clearer	
5/4/98	1727	bailed			97	7.9	80.7	2.95	11.2		clearer	Last bail
5/5/98	1357	bailed				10.07	86.5	2.72	7.5		clearer	
5/5/98	1412	bailed				10.15	86.6	2.72	8.2		clearer	
5/5/98	1418	bailed				10.18	86.1	2.68	9.3		clearer	

* = Dissolved Oxygen

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW02A

Sheet 1 of 12

Date(s) Drilled	07/12/21 to 08/03/21	Logged By	(b) (6) (b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Hand clear / HQ	Drill Bit Size/Type	17.5" rotary / 12.5" pilot bit / HQ diamond bit	Total Depth of Borehole	179.0 feet
Drill Rig Type	Mobile B-59 / Mobile B-80	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	136.1
Groundwater Level	118.59 ft bgs / 17.41 ft msl 9/28/2021	Location	OWDFMW02A	Inclination from Horizontal/Bearing	90 degrees
Borehole Completion	4-inch diameter monitoring well			Hammer Data	not applicable

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
136	0								**Gravel and Fill**						Start with production auger 7/12/21
134	2														
132	4								No recovery				0	[50]	Start HQ coring from 4 ft bgs
130	6	1		26		0									Light brown WR
128	8		1						**Pahoehoe** Black (2.5Y 2.5/1), reddish brown (5YR 4/4), reddish black (2.5YR 2.5/1), moderately weathered, moderately strong to strong, 20% vesicles, rounded to subrounded, irregular, <33 mm 1. 45, J, VN, Mn Fe Sp, St, SR						
126	10								**Massive A'a** Dark gray (2.5Y 4/1), moderately weathered, moderately strong, subround to subangular pieces, clay in clasts / covering clasts, Mn and Fe staining, 1% vesicles, irregular elongate, <5 mm				0	[50]	
124	12	2		48		0			No recovery						Light brown WR
	13														

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW02A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
122	13								Subangular to subrounded pieces, dark gray (2.5Y 2.5/1), dark gray (10YR 4/1), yellowish brown (10YR 5/6), saprolite and clay between fractures, relic rock texture. Rock pieces moderately weathered, moderately strong to weak							
	14						IF							0	[43]	
	15								same basalt as above, some clay and saprolite in between fractures at 14 ft bgs							Approx. 200 gal WL, some brown WR, less than WL
120	16	3		80		0	IF									
	17								becomes greenish gray (GLEY1 5/10Y), slightly weathered, very strong, no vesicles							
118	18		2				NR		No recovery							
	19								becomes dark gray (2.5Y 2.5/1), yellowish brown (10YR 5/6), moderately weathered, moderately strong to weak, clay and saporolite between pieces, Mn and Fe staining					0	[43]	
116	20															
	21	4		58		0			**Saprolite** Relic rock texture, dark gray (2.5Y 2.5/1), black (5Y 2.5/1), reddish yellow (5YR 6/6)							Approx. 200 gal WL, some WR, less than WL
114	22															
	23						NR		No recovery							
112	24													0	[50]	
	25															
	26	5		66		0			becomes relic rock texture, mottling gray (2.5Y 5/1), strong brown (7.5YR 5/6), black (7.5YR 2.5/1), very pale brown (10Y 3/2) CH, fat clay and saprolite from 25.6 ft bgs to 26.6 ft bgs							Approx. 200 gal WL, some WR, less than WL
110	27								becomes only saprolite at 26.5 ft bgs							
108	28															
	29															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW02A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
106	30		3				1 2		**Pahoehoe** Dark reddish brown (5YR 3/3), moderately weathered, weak, 10% vesicles, rounded to subrounded, <2 mm 1. 55, J, VN, Mn Fe clay Su, Wa, SR 2. 5, J, N, clay Pa, Wa, SR 3. 0, J, MW, clay Su, Wa, SR			0	[50]	Approx. 200 gal WL, some WR. More WL than WR.
	31	6		48		50	3							
104	32						NR		No recovery					
	33													
102	34											0	[50]	
	35						NR							Approx. 200 gal WL, some WR. More WL than WR
100	36	7		56		0								
	37						IF		**Saprolite** Brown (7.5YR 5/3), black (5YR 2.5/1), gray (GLEY1 5/N), some silt (ML), and clay (CH), rounded basalt pieces, relic rock texture					
98	38		4				1		**Pahoehoe** Dark brown (7.5YR 3/2), moderately weathered, moderately strong to weak, 15% vesicles, subrounded to rounded, 2-5 mm 1. 80, J, VN, Mn Fe clay Su and Sp, Wa, SR					
	39						IF		**Massive A'a** Very dark gray (7.5YR 3/1), moderately weathered, moderately strong, 2% vesicles, elongate to angular, subangular, subrounded, 2-6 mm, rounded to subrounded clasts of basalt			0	[60]	
96	40								**Welded A'a Clinker** Dark gray (10YR 4/1), yellowish red (5YR 4/6), very dark brown (10YR 2/2), highly weathered, very weak, saprolite present					Approx. 200 gal WL, some WR. More WL than WR
	41								**Massive A'a** Very dark gray (10YR 3/1), slightly weathered, very strong					
		8		90		18	IF		**Pahoehoe** Dark reddish brown (5YR 3/2), moderately weathered, moderately strong, 10% vesicles, subrounded, < 5 mm, broken pieces - rounded, subrounded IF: Mn Fe staining					
94	42								**Massive A'a** Very dark gray (10YR 3/1). Slightly weathered, very strong					
	43						IF							
							NR		No recovery same as above					
92	44		5									0	[30]	
	45						IF							

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW02A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
90	45						IF		becomes greenish gray (GLEY1 6/10Y), moderately weathered, strong IF: Mn Su, Fe Sp, clay Sp							
	46	9		80		0										Less than 50 gal WL, some WR
	47						IF		inner clay content covering fractures, Pa fractures							
88	48						NR		No recovery							
	49								**Fat Clay (CH)** high plasticity, very dark brown (7.5YR 2.5/2), moist inside, some basalt pieces in clay					0	[38]	
86	50															Light gray brown WR
	51	10	6	100		16										
84	52								**Massive A'a** Very dark gray (10YR 3/1), moderately weathered, strong, 3% vesicles, irregular, elongate, subangular, 5-15 mm							
	53						IF									
82	54								same as above					0	[38]	
	55						IF		IF: clay Pa, strong brown (7.5YR 5/6)							
80	56		7				IF									Light gray WR
	57	11		84		21			IF: clay Su, brown (7.5YR 4/3)							
78	58						IF									
	59						NR		No recovery					0		
76	60						IF		**Welded A'a Clinker** clasts - reddish black (7.5R 2.5/1), dusky red (5R 3/5) matrix - white (5R 8/1), yellowish red (5YR 6/6), moderate to slight weathering, moderately strong, some clay in fractures							Light gray WR
	61															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
74	61	12	8	100		0										
	62						IF									
	63															
72	64								← same as above IF: clay in fractures Pa, red (2.5YR 5/6)					0	[43]	End coring 7/12/21 Resume coring 7/13/21
	65															
70	66	13	9	100		64	IF									Light gray WR
	67															
	68															
69									← same as above IF: less clay in fractures, more halloysite					0	[50]	
66	70						IF									
71		14	10	100		54										Light gray WR
64	72						IF									
	73															
62	74													0	[30]	
	75						1		**Massive A'a** Dark gray (GLEY1 4/1), slightly weathered, very strong, 10% vesicles, irregualr elongate, subangular, subrounded, <4 mm 1: 10, J, VN, Mn Fe Sp and Su, Wa, SR 2: 60, J, N, Mn Fe Sp, St, SR 3: 20, J, MW, Mn Fe clay Sp, Wa, SR 4: 10, J, VN, Mn Fe Sp, Wa, SR							Light gray WR
60	76						2									
							3									
		15	11	100		72	4									
	77															

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Log of Boring OWDFMW02A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
77																
							5		5: 75, J, VN, Mn Fe Sp, Wa, SR							
							6		6: 30, J, VN, Mn Fe Sp, Wa, SR							
									7: 5, J, VN, Mn Fe Sp, Wa, SR							
58	78						7		8: 5, J, VN, Mn Fe Sp, Ir, SR							
							8		← same as above							
79							IF		1: 5, J, MW, none, none, Wa, SR					0	[30]	
									2: 5, J, VN, none, none, Wa, SR							
									3: 60, J, VN, Mn Sp, clay Su, Wa, SR							
							1		4: 5, J, VN, Mn Sp, clay Su, Wa, SR							
56	80						2									
							3		← some vugs - 22x12 mm							
							4									
81			12				5									Light gray WR
		16		100		62	6		5: 5, J, N, Mn Fe Sp, clay Su, Wa, IR							
							7		6: 5, J, N, Mn Fe clay Sp, Wa, SR							
54	82						8		7: 5, J, VN, Mn Fe clay Sp, Wa, SR							
							9		8: 0, J, N, Mn Fe Sp, clay Su, Wa, SR							
							10		9: 20, J, N, Mn Fe Sp, Wa, SR - halloysite							
									10: 5, J, N, Mn Fe Sp, clay Su, Wa, SR - halloysite							
83									IF: Mn Fe clay Sp and Su, some halloysite							
							IF									
84									← same as above					0	[43]	
52							1		1: 10, J, N, Mn Fe Sp, clay Su, Wa, SR							
									2: 5, J, N, Mn Fe Sp, Wa, SR							
									3: 50, J, N, Mn Fe Sp, Wa, SR							
									4: 10, J, VN, Mn Fe Sp, Wa, SR - halloysite							
85			13						5: 5, J, N, Mn Fe Sp, Wa, SR - halloysite							
							2		6: 45, J, VN, Mn Su, Fe Sp, Wa, SR - halloysite							
							3		7: 5, J, VN, No, No, Wa, SR							
86																
50		17		100		56	4									Light gray WR
							5									
							6									
87							IF									
							7									
							8		**Welded A'a Clinker**							
							9		clasts - reddish black (2.5YR 2.5/1), dark reddish brown (2.5YR 2.5/4), dark reddish brown (5YR 3/3),							
48	88								clay - reddish yellow (5YR 6/6), moderately weathered, moderately strong, matrix clasts/rock, strong							
							IF		8: 30, J, MW, No, No, Ir, R							
									9: 10, J, N, No, No, Wa, R							
89														0	[43]	
							1									
			14						← same as above							
46	90						2		starting at 89.1 ft bgs, increasing clay content between clasts and fractures, reddish yellow (5YR 6/6)							
							3		1: 30, J, MW, No, No, Ir, SR							
									2: 15, J, N, No, No, Wa, SR							
91									3: 30, J, N, No, No, Wa, SR							
		18		100		62	M		4: 5, J, N, No, No, Ir, SR							Light gray WR
							4									
44	92															
							IF									
	93															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
42	93													
	94								No recovery same as above (90 ft bgs)			0	[50]	
	95		15											
40	96	19		80		25								Light gray WR
	97								decreasing clay content					
38	98								grades to Massive A'a, some clasts included, weak red (5R 4/2) 1: 20, J, N, No, No, Ir, R 2: 10, J, VN, No, No, Ir, R 3: 10, J, N, No, No, Ir, R					
	99								**Massive A'a** Very dark greenish gray (GLEY1 3/1), moderately weathered, very strong, 3% vesicles, irregular, elongate, <2 mm 1: 5, J, VN, Fe, Sp, Wa, R 2: 5, J, VN, Fe Sp, Wa, SR 3: 45, J, VN, Mn, Fe clay Sp, Wa, SR 4: 80, J, VN, Mn Fe Sp, Wa, SR 5: 60, J, VN, Mn Fe Sp, Wa, SR 6: 40, J, VN, Mn Fe Sp, Wa, SR IF: Mn Sp IF: Mn Fe Sp, clay Su IF: Mn Fe clay halloysite Sp			0	[19]	
36	100		16											
	101	20		100		34								Light gray WR Set 10" conductor casing at 101.5 ft bgs
34	102													
	103													
32	104								same as above 1: 0, J, N, Mn Sp, Fe Su, Wa, SR 2: 0, J, VN, Fe Su, Wa, SR 3: 5, J, VN, Mn Fe Sp, Wa, SR 4: 0, J, VN, Mn Fe Sp, Wa, SR 5: 0, J, Mn Fe Sp, Wa, SR 6: 45, J, VN, Mn Sp, Wa, SR 7: 0, J, VN, No, No, Wa, SR 8: 0, J, VN, Mn Su, Wa, SR 9: 0, J, VN, Mn Sp, Wa, SR 10: 0, J, VN, Mn Sp, Wa, SR 11: 5, J, VN, No, No, Wa, SR 12: 20, J, VN, Mn Sp, Wa, SR 13: 10, J, VN, Mn Sp, Wa, SR 14: 10, J, N, Mn Fe Sp, Wa, SR 15: 45, J, MW, clay Pa, Wa, SR			0	[30]	
	105		17											
30	106	21		100		8								Light gray WR
	107													
28	108													
	109													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
109	0													0	[14]	End coring 7/13/21 Resume coring from approx. 109 ft bgs on 7/30/21
110	1		18						same as above 1: 5, J, VN, No, No, Wa, SR 2: 20, J, VN, No, No, Wa, SR 3: 5, J, VN, Mn Fe Sp, Wa, SR 4: 0, J, N, Mn Fe Sp, Wa, SR							
111	2	22		80		22	IF		**Welded A'a Clinker** Clasts, reddish black (7.5R 2.5/1), dusky red (7.5R 3/3), matrix - clay, light pink (7.5R 8/3), reddish yellow (5YR 4/6), halloysite, Mn present, moderately weathered, moderately strong							Light gray WR
112	3															
113	4						NR		No recovery							
114	5								same as above					0	[43]	End coring 7/30/21 Resume coring 8/2/21
115	6	23	19	88		48	IF									
116	7															Light brown WR
117	8						IF		**Massive A'a** Dark gray (GLEY1 4/N), moderately weathered, moderately strong, clay covering pieces and fractures, reddish yellow (5YR 6/6)							
118	9															
119	10								same as above					0	[25]	
120	1								gray (GLEY1 6/N), slightly weathered, very strong, 3% vesicles, <5 mm, subrounded, irregular, elongate 1: 35, J, N, Mn Sp, clay Su, Wa, SR 2: 10, J, MW, Mn Fe Sp, Wa, R 3: 20, J,MW, Mn Fe clay Sp, St, R 4: 40, J, VN, Mn clay Sp, Wa, SR 5: 40, J, VN, Mn Fe Sp, Wa, SR 6: 80, J, N, Mn Sp, Wa, SR 7: 15, J, N, Mn Sp, Wa, SR 8: 50, J, VN, Mn clay Sp, Wa, SR 9: 20, J, N , Mn clay Sp, Wa, SR - halloysite 10: 25, J, MW, Mn clay Sp, Wa, SR							
121	2	24	20	100		48										Light brown WR
122	3															
123	4															
124	5						M		same as above					0	[38]	
125	6								becomes 3% vesicles, elongate, subrounded, <17							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
10	125								mm 1: 0, J, N, Mn Fe Sp, Wa, SR 2: 20, J, VN, Mn Fe Sp, Ir, SR 3: 0, J, VN, Mn Fe Sp, Wa, SR 4: 20, J, VN, Mn Fe Sp, Wa, SR 5: 90, J, VN, Mn Fe Sp, St, SR 6: 60, J, VN, Mn Fe Sp, St, SR IF: clay Pa reddish yellow (5YR 7/6), Mn Sp					
	126	25	21	100		62								Light brown WR
	127								← becomes 3% vesicles, <3 mm, elongate, irregular, subrounded					
8	128													
	129											0	[33]	
6	130								← becomes 5% vesicles, irregular, subrounded, 2-20 mm 1: 5, J, MW, Mn Fe clay Sp, Ir, R 2: 10, J, VN, Mn Fe, clay Su, Wa, SR 3: 0, J, VN, Mn Fe Su, Wa, SR 4: 10, J, VN, Mn Sp, Wa, SR 5: 60, J, VN, Mn Fe clay Sp, Wa, SR 6: 5, J, N, clay Sp, Wa, SR 7: 5, J, VN, clay Sp, Wa, SR 8: 15, J, VN, Mn Fe Sp and Su, Wa, SR 9: 5, J, VN, Mn Fe Sp and Su, Wa, SR 10: 10, J, VN, Mn Fe clay Sp, Wa, R 11: 5, J, VW, Mn Fe clay Sp, Wa, R					
	131	26	22	100		50								Light brown WR
4	132													
	133								← some vugs present					
2	134								← same as above 1: 0, J, W, Mn Sp, Wa, SR 2: 5, J, W, Mn Sp, Wa, SR 3: 0, J, W, Mn Fe Sp, clay Pa, Ir, SR 4: 60, J, N, Mn Fe Sp, Ir, R			0	[21]	
	135													
0	136	27	23	68		47								Light brown WR
	137								**Pahoehoe** Dark reddish brown (2.5YR 3/4), pink (5YR 7/4), reddish black (2.5YR 5/1), moderately strong, moderately weathered, 10-15% vesicles, subrounded, 1-5 mm IF: clay in fractures/vesicles					
-2	138								No recovery					Per driller, lost some water but water then came back
	139											0	[27]	
-4	140								IF: clay in fractures/vesicles ← becomes strong, slightly to moderately weathered, dark reddish brown (2.5YR 3/4) 1: 5, J, W, Mn clay Pa, Ir, SR 2: 70, J, W, clay Pa, Mn Sp, Wa, SR					Paused at 13:04, approx. 141 ft bgs, drill bit clogged
	141													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	141													
		28		90		18			← becomes larger vesicles, 2-20 mm, subrounded to elongate 3: 45, J, W, Mn Su, Wa, SR 4: 30, J, W, Mn clay Sp, Wa, SR 5: 30, J, W, clay Pa, Mn Sp, Ir, R					
-6	142								IF: clay, Mn Sp in fractures 6: 0, J, W, clay Pa, Ir, SR 7: 5, J, W, Mn Sp, Wa, SR 8: 0, J, W, Mn Sp, Ir, R					Light brown WR
	143		24											
							NR		No recovery					
-8	144								← becomes 7-10% vesicles, reddish black (2.5YR /1), subrounded, 1-20 mm 1: 0, J, W, clay Mn Fe Pa, Ir, SR 2: 15, J, W, clay Mn Fe Pa, Wa, SR			0	[33]	
	145								← becomes 5-7% vesicles, 1-10 mm, subrounded to elongate 3: 15, J, N, Fe Sp, Wa, SR 4: 10, J, VN, clay Sp, Pl, SR 5: 0, J, N, clay Sp, St, R					
-10	146	29		100		24								Light brown WR
	147		25											
-12	148								IF: clay Fe Pa 6: 10, J, W, clay Mn Sp, Ir, R 7: 45, J, W, clay Pa, Mn Sp, Ir, R					
	149								← same as above 1: 5, J, W, Mn Sp, Wa, SR 2: 25, J, W, Mn Sp, clay Pa, Ir, R			0	[23]	
-14	150								← becomes 2% vesicles, elongated, 1-2 mm 3: 25, J, W, clay Pa, Ir, R					
	151	30		68		15			← becomes dark reddish brown (2.5YR 3/4), slightly weathered, moderately strong, 25-30% vesicles, subrounded, 1-2 mm					
-16	152		26											
	153						NR		No recovery					Lost circulation at approx 153 ft bgs per driller
-18	154								← same as above			0	[50]	Stop coring 8/2/21 Start coring 8/3/21
	155								← becomes red (2.5YR 5/8), very dusky red (2.5YR 2.5/2), moderately strong to weak, moderately weathered, 2% vesicles, <2 mm, clay infilling IF: clay infilling, Mn Sp, 1% halloysite					
-20	156								← becomes reddish black (2.5YR 2.5/1), clay infilling light reddish brown (2,5YR 7/3), dark reddish brown (2.5YR 3/4), strong to moderately strong, moderately weathered, 5% vesicles, 1-5 mm 1: 15, J, VN, Mn Fe Su, Wa, SR 2: 10, J, MW, Mn Fe Sp, clay Pa, IR, R					
	157	31		94		0								

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157								3: 15, J, N, Mn Su, clay Pa, IR, R							
-22	158															Approx. 300 gal WL
	159						WR							0	[23]	
-24	160		27						No recovery							
	161	32		56		39			← same as above, Pahoehoe, possible flow contact dark reddish brown (5YR 2.5/2), black (5YR 2.5/1), moderately strong, moderately weathered, 3% vesicles, 1-4 mm 1: 5, J, VN, clay Pa, Mn Su, Fe Sp, Ir, R 2: 10, J, MW, clay Pa, Mn Su, Fe Sp, Ir, R 3: 30, J, N, clay Pa, St, SR							Approx. 300 gal WL
-26	162															
	163								← becomes slightly weathered, strong, less clay 4: 10, J, VN, halloysite Sp, Mn Su, Wa, SR 5. 50, J, VN, Mn Fe Su, Wa, SR							
-28	164								**Massive A'a** Very dark gray (7.5YR 3/1), strong, slightly weathered, 3% vesicles, 1-10 mm, vugs present 35mm x 14mm 1: 40, J, VW, Mn Sp, trace halloysite Fe Sp, Wa, SR 2: 10, J, MW, Mn Sp, Wa, SR 3: 0, J, N, halloysite Sp, Wa, SR 4: 5, J, N, IR, SR 5: 5, J, N, IR, SR 6: 80, J, VN, Mn Sp, clay Pa, Wa, SR 7: 5, J, VN, clay Pa (reddish yellow 5YR 7/6), Wa, SR 8: 40, J, VN, No, No, St, R 9: 45, J, VN, No, No, St, SR 10: 15, J, VN, No, No, Wa, SR 11: 15, J, MW, clay Sp, Wa, SR					0	[30]	
	165															
-30	166	33		100		52										Approx. 300 gal WL
	167		28													
-32	168															
	169								← same as above, very strong, slightly weathered, 1% vesicles, 1-5 mm IF: Mn Fe Sp, clay Pa, halloysite Su 1: 0, J, VN, none, none, Wa, SR 2: 10, J, VN, Mn Sp, halloysite Su, Wa, SR 3: 25, J, VN, Mn Sp, halloysite clay Su, Wa, SR 4: 5, J, N, Mn Fe Sp, Wa, SR IF: clay Pa, pinkish white (5YR 8/2)					0	[27]	
-34	170															
	171	34		72		44			← becomes strong, 2% vesicles, 1-5 mm							Approx. 300 gal WL
-36	172						NR									
	173															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	173															
-38	174								No recovery					0	[50]	
	175								**Welded A'a Clinker** Broken up, dusky red (10R 3/4), dark reddish gray (10R 3/1), moderately strong, slightly weathered							
-40	176	35		76		29			**Pahoehoe** Dark reddish brown (5YR 2.5/2), moderately strong, slightly weathered, 20% vesicles, 1-10 mm IF: Mn Fe Sp, clay Pa 1: 5, J, VN, clay Pa (light red 2.5YR 6/6), Mn Sp, Ir, R 2: 10, J, VN, Mn Sp, clay Pa, Wa, SR 3: 5, J, VN, Mn Sp, clay Pa, Wa, R							Approx. 300 gal WL
	177															
-42	178		29						← becomes black (5YR 2.5/1), smaller vesicles, <5 mm IF: Mn Sp, clay Pa 4: 45, J, MW, clay Pa, Ir, R							End coring on 8/3/21 TD = 179 ft bgs
	179								OWDFMW02A was started with a production auger from ground surface to 4 ft bgs (136.14 ft msl to 132.14 ft msl). HQ coring commenced from 4 ft bgs to 109 ft bgs (132.14 ft msl to 27.14 ft msl). The borehole was reamed with a 17.5-inch tricone bit from ground surface to 58 ft bgs (136.14 ft msl to 78.14 ft msl) where refusal was encountered. The hole was reamed with a 12.5-inch pilot bit from 58 ft bgs to 109 ft bgs (78.14 ft msl to 27.14 ft msl), followed by the 17.5-inch tricone bit from 58 ft bgs to 109 ft bgs (78.14 ft msl to 27.14 ft msl) to set a conductor casing. A 10-inch diameter steel conductor casing was installed to 101.5 ft bgs (34.64 ft msl). HQ coring continued from 109 ft bgs to 179 ft bgs (27.14 ft msl to -42.86 ft msl). HQ coring terminated at a total depth of 179 ft bgs (-42.86 ft msl). The borehole was reamed with 9 7/8-inch tricone bit from 58 ft bgs to 179 ft bgs (78.14 ft msl to -42.86 ft msl) for well construction. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 2,750 gallons of water were used during drilling and rock coring. OWDFMW02A well construction was completed on August 13, 2021. The well was completed with 4-inch diameter Schedule 80 polyvinyl chloride (PVC) blank well casing from approximately 3.5 ft above ground surface to 153 ft bgs (139.58 ft msl to -16.86 ft msl) and a 0.020-inch slotted screen between 153 ft bgs to 173 ft bgs (-16.86 ft msl to -36.86 ft msl). The casing was stabilized with centralizers placed at the top and bottom of the screened section, and then spaced every 40 ft up from the top of the screen. The filter pack extended from 179 ft bgs to 147 ft bgs (-42.86 ft msl to -10.86 ft msl). The bentonite seal was placed from 147 ft bgs to 142 ft bgs (-10.86 ft msl to -5.86 ft msl). A 100% bentonite slurry was placed from 142 ft bgs to 94 ft bgs (-5.86 ft msl to 42.14 ft msl [into the 10-inch conductor casing]). Cement/grout was placed to the ground surface. The surface completion consists of an approximately 3.5-foot stick up monument inside of an 8-inch diameter protective steel casing set on a concrete well pad approximately 1 ft above round surface. A total of approximately 1,970 gallons of development water was removed after well construction.							
-44	180															
	181															
-46	182															
	183															
-48	184															
	185															
-50	186															
	187															
-52	188															
	189															

Report: CTO53 RED HILL WITH WELL AND PID; File: OWDF_BORINGLOGS.GPJ; 6/7/2022 OWDFMW02A

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW03A

Sheet 1 of 11

Date(s) Drilled	03/12/21 to 03/26/21	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Hand clear / HSA / HQ	Drill Bit Size/Type	17.5" rotary / 9.875" rotary / HQ diamond bit	Total Depth of Borehole	163.0 feet
Drill Rig Type	Mobile B-59 / Mobile-B90 / Mobile-B80	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	115.9
Groundwater Level	97.47 ft bgs / 18.53 ft msl 9/28/2021	Location	OWDFMW03A	Inclination from Horizontal/Bearing	90 degrees
Borehole Completion	4-inch diameter monitoring well			Hammer Data	140lb auto-hammer

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								**Fill**						[7.1]	Hand clear to 2 ft to refusal
	1															
114	2	1														Start HSA from 2 ft Smooth drilling
	3															
112	4														[51.7]	
	5															
110	6		1													Chattering
	7	2														
108	8															
	9															
106	10			80					**Silt with Gravel (ML)** Brownish yellow (10YR 6/8), very dark grayish brown (10YR 5/2), G 20 S 10 F 70				38 46		[26.7]	Grinding
	11								Weathered basalt boulder with lean clay (CL), light gray (10YR 7/1), dark yellowish brown (10YR 3/1), brownish yellow (10YR 6/8), G 30 S 10 F 60				5			
104	12	3														
	13															

Report: CTO53 RED HILL WITH WELL AND PID; File: OWDF_BORINGLOGS.GPJ; 6/7/2022 OWDFMW03A

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW03A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
102	13															
	14								**Lean Clay (CL)** Dark grayish brown (10YR 4/2) and light gray (2.5Y 7/2), G 10 S 5 F 85, some silt, more clay			4		0.0	[40]	
				100								6				
100	15								**Silt (ML)** Dark grayish brown (10YR 4/2) and light gray (2.5Y 7/2), G 10 S 5 F 85			8				Chattering
	16	4														
	17															
98	18								← becomes wet, very dark gray (2.5Y 3/1), G 0 S 10 F 90, some clay, more silt			27		0.0	[24.1]	Paused drilling at ~18 ft
				13								4				
	19	5														HSA to 20 ft bgs on 03/12/21
96	20								**Pahoehoe** Very dark gray (2.5Y 3/1), highly weathered, very weak, 2% weathered olivine, weathered clay Sp, 2% vesicles, subrounded, <2 mm, mostly weathered			10		0.0	[100]	Start HQ coring on 03/15/21
	21															
94	22						IF									Light grayish brown WR
		6		40		0										
	23															
92	24						NR		No recovery							
	25								← same as above						[100]	
90	26								IF - clay on faces, yellowish red (5YR 5/6)							Light brown WR
	27						IF									
		7		100		26	M									
88	28		2													
	29						IF									

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Log of Boring OWDFMW03A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
86	30						M IF		**TUFF** Dark olive gray (5Y 3/2), moderately weathered, very weak, laminations evident, 10% lithics and <2 mm					0.0	[312.5]	
	31						IF		IF - clay on fractures, Su, reddish yellow (5YR 6/8)							Light brown WR
84	32	8		56		0			Mn, Su on IF fractures							
	33						NR									
82	34								No recovery							
	35								same as above					0.0	[100]	
80	36						IF		**Massive A'a** Very dark grayish brown (2.5Y 3/2), highly to moderately weathered, weak to very weak, 5% vesicles, subrounded to elongate, 2-12 mm							
	37						IF		IF - Mn clay yellowish red (5YR 5/6), Su							Light brown WR
78	38	9		44		0										
	39						NR		No recovery							
76	40								same as above					0.0	[151.5]	
	41								some rounded clinker clasts, possibly slough							
									becomes moderately weathered, moderate strength							
74	42						IF		IF - Mn Fe clay dark reddish brown (5YR 3/4), Su							Light brown WR
	43	10		56		0										
72	44						NR		No recovery							
	45															

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Log of Boring OWDFMW03A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
70	45													0.0	[100]	
	46								No recovery							
	47	11		60		13			**Pahoehoe** Black (2.5Y 2.5/1), moderately weathered, moderate strength, 10% vesicles, subrounded, 2-25 mm							Light brown WR
68	48						IF		Loose clinker with clay, possibly fell from above, rounded clasts							
									Saprolite Dark olive brown (2.5Y 3/3), very dark brown (7.5YR 2/3), gray (2.5Y 6/1), black (5YR 2.5/1), relic rock structure / mottling, highly weathered texture, some basalt lithics, some lean clay (CL), dry inside							
	49		3				IF									
66	50													0.0	[100]	
									Gravelly Lean Clay (CL) Brown (10YR 4/3), low plasticity, gravel angular to subangular basalt, <0.5 to 3 cm, G 30 S 10 F 60							
	51															
64	52	12		30		0										Light brown WR
	53															
62	54								No recovery							
	55													0.0	[151.5]	
60	56															
	57	13		50		0										Light brown WR
58	58								Broken highly weathered, weak basalt, black (2.5Y 2.5/1), dark olive brown (2.5Y 3/1), Mn Su, clay Su							
									Saprolite Dark yellowish brown (10YR 3/4), relic rock structures, Mn, Sp, some lean clay (CL), dry inside							
	59						IF		**Pahoehoe** dark yellowish brown (10YR 3/4), completely weathered, extremely weak basalt, Mn clay Su becomes light yellowish brown (2.5Y 6/4), highly weathered, very weak pahoehoe, Mn Su, clay Su							
56	60													0.0	[151.5]	
									moderately weathered, weak, 25% vesicles, rounded, 1-2 mm							
	61															

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Log of Boring OWDFMW03A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
54	61								same as 59.4 to 60.2 ft bgs							
	62	14		75		0		IF	becomes moderately weathered, weak, 15% vesicles, rounded to subrounded, 1-3 mm							~300 gal WL
52	63								becomes completely weathered, extremely weak							
	64						VR		No recovery							
50	65								same as 59.4 to 60.2 ft bgs, and 61 to 62.6 ft bgs					0.0	[151.5]	
	66							IF	moderately weathered, weak to moderately strong, 7% vesicles, rounded to subrounded, 1-3 mm							50 gal WL, some light brown WR
48	67	15	4	70		0			**Saprolite** Reddish brown (5YR 4/4), relic rock structure, some lean clay (CL) dry inside, Mn, Sp, some basalt gravel, lithics							
	68															Paused to bail and monitor water level. See Book #1 pg. 37.
	69						WR		No recovery							
46	70															End coring on 03/15/21
	71							IF	**Lean Clay (CL)** Dark brown (7.5YR 3/3), coating broken pahoehoe, light olive brown (2.5Y 5/3), Mn staining, highly weathered, weak to very weak					0.0	[312.5]	Resume coring on 03/17/21
44	72	16		24		0	WRm									
	73															Minor, light brown WR
42	74								No recovery							
	75														[312.5]	
40	76						NQ									
	77															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
38	77						NR									
	78	17		46		0			**Loose A'a Clinker** Dark red (10YR 3/6), yellowish red (5YR 5/6), black (7.5YR 2.5/1), gray (2.5Y 5/1), rounded clinker clasts, moderate to highly weathered, weak, clay in and around clasts							Light brown WR
	79								← clasts become more angular							
36	80								**Saprolite** Relic clinker clasts, light olive brown (2.5Y 5/4), dark reddish brown (5YR 3/4), dark gray (5Y 4/1), some lean clay (CL), dry inside					0.0	[312.5]	
	81															
34	82															Light brown WR
	83	18		54		0	IF		**Massive A'a** Greenish gray (GLEY1 5/10Y), moderately weathered, moderate strength, 2% vesicles, subrounded to elondate, 2-10 mm							
32	84						NR		No recovery							
	85													0.0	[187.5]	Set 10" conductor casing at 85 ft bgs
30	86		5				1		← same as above							Light brown WR
	87	19		67		20	2 3 4		1. 45, J, VN, Mn Fe clay, Sp, Wa, SR 2. 50, J, MW, Mn Fe clay, Sp, St, SR 3. 60, J, N, Mn Fe Sp, clay Su, Wa, SR 4. 5, J, N, Mn Fe Sp, clay Pa, Wa, SR ← becomes highly weathered, very weak, clay coating pieces, lean clay (CL) is dark brown (7.5YR 3/4)							
28	88						IF		← same as above					0.0	[151.5]	End coring on 03/17/21 Resume coring on 03/26/21 from 88 ft bgs
	89								← becomes very dark gray (10YR 3/1), moderately strong, moderately weathered, 1% vesicles, subrounded to elongate, 2-3 mm. Lean clay (CL), brown (10YR 5/3), in between broken up pieces							
26	90															Light brown WR
	91	20		70		0										
24	92						NR		No recovery							
	93															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
22	93						1		becomes very dark gray (7.5YR 3/1), moderately strong, moderately weathered, 10% vesicles, subrounded to elongate, 2-8 mm			0.0	[151.5]	
	94						2		same as above from 89.1 ft bgs 1. 30, J, N, clay Mn Sp, Wa, SR 2. 45, J, N, clay Mn Sp, Wa, SR					
	95	21		66		18	IF							Light brown WR
20	96													
	97						NR		No recovery					
18	98								becomes 1% vesicles, elongate, 1-5 mm IF - Mn staining and clay			0.0	[151.5]	
	99						IF							
16	100		6											Light brown WR
		22		58		0								
	101													
14	102						NR		No recovery					
	103								same as above, moderately weathered, clay in fractures and Mn staining			0.0	[151.5]	
12	104						IF							
	105													Light brown WR
		23		78		0								
10	106						1		becomes dark gray (7.5YR 4/1), strong to very strong, slightly weathered, 1% vesicles, elongate, <2 mm 1. 5, J, MW, No, No, Wa, SR					
	107						NR		No recovery					
8	108								becomes highly to completely weathered, very weak, covered in lean clay (CL), brown (7.5YR 4/3) IF- very dark gray (7.5YR 3/1)			0.0	[100]	
	109						IF							

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
6	109															
	110	24		96		0										Light brown WR
	111															
4	112															
	113						NR		No recovery					0.0	[75.7]	
							1		very dark gray (GLEY1 3/N), strong, sligthly weathered, 5% vesicles, 2-6 mm, subrounded to elongate							
2	114		7				2									
							3		1. 5, J, W, Mn, Sp, Clay, Su, Wa, SR							
							4		2. 30, J, MW, Mn+clay, Su, Wa, SR							
							5		3. 40, J, N, Mn+clay, Sp, Wa, SR							
	115								4. 5, J, W, Mn, Sp, Clay, Su, Wa, SR							
									5. 10, J, W, Mn, Su, Wa, SR							
		25		86		30	IF		IF - Mn and clay in fractures, reddish yellow (7.5YR 7/6)							Light brown WR
0	116						6		becomes very strong, 2% vesicles, subrounded, <1 mm, one 4 mm olivine phenocryst							
									6. 25, J, W, Mn+clay, Su, Wa, SR							
							7		7. 0, J, N, No, No, Ir, SR							
	117						8		8. 5, J, W, Mn+Fe, Sp, Wa, SR							
							9		9. 80, J, MW, Mn+clay+Fe, Sp, Wa, SR							
							NR		No recovery							
-2	118								same as above, 7% vesicles, elongate to subangular / irregular, 3-16 mm					0.0	[75.7]	
							1		becomes 2% vesicles, elongate to subangular / irregular, 1-6 mm							
	119								1. 5, J, N, No, No, Pl, S							
							2		2. 0, J, W, Mn Su, Wa, SR							
-4							3		3. 0, J, W, No, No, Pl, S							
	120								4. 5, J, MW, Mn Fe Sp, Wa, SR							
		26		92		63	4		5. 5, J, W, Mn Sp, Wa, SR							Light brown WR
							5		6. 10, J, W, Mn Fe Sp, Wa, SR							
									7. 30, J, W, Mn Fe clay Sp, Wa, SR							
	121						6		8.50, J, MW, Mn Fe Sp, Wa, SR							
							7									
							8		becomes 7% vesicles, <7 mm, elongate to subrounded							
-6	122						M									
							9									
							NR		No recovery							
	123						1		same as above, 3% vesicles, <5 mm, subrounded to elongate					0.0	[100]	
									1. 5, J, MW, Mn clay Su, Wa, S							
-8							2		2. 5, J, W, Mn Fe clay Su, Wa, SR							
	124		8													Light brown WR
							IF		IF with clay, Mn, Fe							
	125															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-10	125	27		74		35	IF		3. 45, J, N, clay Mn Sp, Wa, SR 4. 5, J, W, Fe Sp, Pl, SR					
	126						3							
							4							
	127						NR		No recovery					
-12	128											0.0	[60.2]	
	129													
-14	130	28		60		0			**Loose and Welded A'a clinker** Reddish brown (2.5YR 4/3), dusky red (10R 3/4), brown (7.5YR 4/4), moderately strong, moderately weathered, some clay in fractures, brownish yellow (10YR 6/6)					Light brown WR
	131													
-16	132													
	133						1		**Massive A'a** Dark gray (7YR 4/1), strong, slightly to moderately weathered, 5% vesicles, elongate, 1-10mm. 1. 0, J, W, clay Pa, Fe Sp, Wa, SR 2. 5, J, MW, Mn Fe clay Sp, Wa, SR			0.0	[75.7]	
							2							
-18	134						1		← becomes very strong, slightly weathered, 2% vesicles, <3mm, subrounded. 1. 0, J, MW, Mn Su, Fe clay Sp, Pl, S 2. 20, J, N, Mn Su, Fe clay Sp, Wa, S					
							2							
	135						IF		← becomes 5% vesicles, subrounded to elongate, 1-10mm 3. 10, J, MW, Mn Fe Sp, clay Su, Wa, SR					
-20	136	29	9	86		0	3							Light brown WR
							IF							
	137													
-22	138						NR		No recovery ← same as above, some clay - reddish yellow (7.5YR 10/6) 1. 0, J, W, Mn Fe Sp, clay, Su, Wa, S 2. 0, J, MW, Mn Sp, Wa, S			0.0	[151.5]	
							1							
							2							
	139						M		**Loose A'a Clinker** Reddish brown (2.5YR 4/3), dusky red (10R 3/4), black (7.5YR 2.5/1), slightly weathered, moderately strong					Lost circulation at ~139 ft bgs. Paused to tag water. Book #1 pg. 104.
-24	140						IF		**Pahoehoe** Dark brown (7.5YR 3/3), moderate to slightly weathered, strong, 20% vesicles, rounded, 2-4 mm, some clay in vesicles, reddish yellow (7.5YR 6/6) IF - Mn Fe Sp, clay Su, reddish yellow (7.5YR 6/6)					
		30		90		13								
	141													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-26	141															
	142															
-28	143						NR		No recovery same as above 1. 5, J, N, clay Sp, Wa, R 2. 60, J, VN, Mn clay Sp, Wa, R 3. 0, J, Mn Sp, clay Pa, Wa, SR 4. 90, J, VN, Mn Sp, clay Su, Wa, R 5. 5, J, VN, Mn Fe clay Sp, Wa, R					0.0	[100]	
	144															
-30	145	31	10	100		34			becomes very dark gray (7.5YR 3/1), slightly weathered, strong, 2% vesicles, rounded, <3 mm							200 gal WL
	146						IF									
	147															
-32	148								1. 60, J, N, Mn Fe clay Sp, Wa, SR					0.0	[312.5]	
	149								**Loose and Welded A'a Clinker** Red (2.5YR 4/6), brown (7.5YR 4/2), black (7.5YR 2.5/1), clay is reddish yellow (7.5YR 6/6), moderately weathered, moderately strong							
-34	150	32		52		0										200 gal WL
	151															
-36	152						NR		No recovery							
	153													0.0	[100]	
-38	154								**Massive A'a** Very dark gray (7.5YR 3/1), slightly weathered, very strong, 5% vesicles, subangular, elongate, irregular, <5 mm, clay in vesicles. 1. 20, J, MW, Mn Sp, clay Su, Wa, S 2. 0, J, VN, No, No, Pl, S IF - clay yellowish red (5YR 5/8)							
	155	33		100		48			becomes 15% vesicles, subrounded, elongate, 1-4 mm, clay in vesicles							300 gal WL
-40	156						IF		becomes 3% vesicles, subrounded, <5 mm 3. 0, J, MW, Mn Fe, Sp, clay Pa, Wa, SR 4. 5, J, MW, clay Su, St, SR							
	157															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-42	157						5		5. 20, J, MW, Mn Fe Sp, clay, Pa, Wa, SR 6. 0, J, MW, Mn Sp, clay Pa, Wa, SR							
	158		11				6		← becomes 5% vesicles, subrounded, elongate, 1-4mm, vug = 30 x 5mm IF - clay Su, Mn Sp, clay is olive yellow (2.5Y 6/6), clay in vesicles					0.0	[75.7]	
							IF									
	159						IF									
-44	160															300 gal WL
		34		26		0	NR									
	161								No recovery							Monitor water levels, Book #1 pg. 104-105.
-46	162															
	163															End coring on 3/26/21 TD = 163 ft bgs
-48	164								OWDFMW03A was hand cleared from ground surface to 2 ft bgs (115.85 ft bgs to 113.85 ft msl). The borehole was then drilled using hollow stem auger from ground surface to 20 ft bgs (115.85 ft msl to 95.85 ft msl). HQ coring commenced from 20 ft bgs to 85 ft bgs (95.85 ft msl to 30.85 ft msl). The borehole was reamed with a 17.5-inch tricone bit from ground surface to 85 ft bgs (115.85 ft msl to 30.85 ft msl). A 10-inch diameter steel conductor casing was installed to 85 ft bgs (30.85 ft msl). HQ coring continued from 85 ft bgs to 163 ft bgs (30.85 ft msl to -47.15 ft msl). HQ coring terminated at a total depth of 163 ft bgs (-47.15 ft msl). The borehole was reamed with a 9 7/8-inch tricone bit from 85 ft bgs to 163 ft bgs (30.85 ft msl to -47.15 ft msl) for well construction. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 1,250 gallons of water were used during drilling and rock coring. OWDFMW03A well construction was completed on June 16, 2021. The well was completed with 4-inch diameter Schedule 80 polyvinyl chloride (PVC) blank well casing from approximately 2.8 ft above ground surface to 138.5 ft bgs (118.64 ft msl to -22.65 ft msl) and a 0.020-inch slotted screen between 138.5 to 158.5 ft bgs (-22.65 ft msl to -42.65 ft msl). The casing was stabilized with centralizers placed at the top and bottom of the screened section, and then spaced every 40 ft up from the top of the screen. The filter pack extended from 127.8 ft bgs to 159 ft bgs (-43.15 ft msl to -11.95 ft msl). The bentonite seal was placed from 127.8 ft bgs to 121.1 ft bgs (-11.95 ft msl to -5.25 ft msl). A 100% bentonite slurry was placed from 121.1 ft bgs to 85 ft bgs (-5.25 ft msl to 30.85 ft msl [into the 10-inch conductor casing]). Cement/grout was placed to the ground surface. The surface completion consists of an approximately 2.8-foot stick up monument inside of an 8-inch diameter protective steel casing set on a concrete well pad approximately 1 ft above ground surface. A total of approximately 1,890 gallons of development water was removed during development, after well construction.							
-50	165															
	166															
	167															
-52	168															
	169															
-54	170															
	171															
-56	172															
	173															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW04A

Date(s) Drilled	08/16/21 to 09/17/21	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Hand clear / HQ	Drill Bit Size/Type	17.5" rotary / 9.875" rotary / HQ diamond bit	Total Depth of Borehole	175.0 feet
Drill Rig Type	Mobile B-59 / Mobile B-80 / Mobile T-3	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	163.7
Groundwater Level	145.69 ft bgs / 18.31 ft msl 9/28/2021	Location	OWDFMW04A	Inclination from Horizontal/Bearing	90 degrees
Borehole Completion	4-inch diamter monitoring well			Hammer Data	not applicable

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								**Fill** Gravel fill, drill pad						Hand auger to approx. 3 ft bgs until refusal. Used production auger to set mud pan.
	1								← becomes soil / fill						
162	2														
	3														
160	4		1												
	5								**Massive A'a** Grayish brown (2.5Y 5/2), moderately weathered, moderate strength, iron oxide staining, 3% vesicles, 1-6 mm, subrounded, irregular				0.0	[33.3]	
158	6								← becomes gray (10YR 5/1), moderately weathered, moderate strength to strong, 5% vesicles, 1-16 mm, subrounded, elongate, irregular						Light brown/tan WR
	7	1		100		0	IF		IF: Mn Fe, Su Sp						
156	8														
	9														
154	10								← same as above				0.0	[27.3]	
	11		2												Light brown WR
152	12														
	13	2		80		0			← becomes very dark gray (10YR 3/1), strong, 5% vesicles, subrounded, elongate, 2-9 mm						

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
150	13								IF: Mn Fe Su and Sp, clay Sp light red (2.5YR 6/8)							
	14															
	15								No recovery					0.0	[40]	
148	16								Massive A'a pieces, likely slough							Light brown WR
	17	3		63		0			**Pahoehoe** Black (5YR 2.5/1), moderately weathered, moderate strength, vesicles weathered away							Approx. 50 gal WL, partial circuation
146	18		3						IF: clay Pa and Su, light red (2.5YR 6/4)							
	19													0.0	[60]	
144	20								**Massive A'a** Gray (GLEY1 5/N), slightly weathered, very strong, 2% vesicles, subrounded, <1 mm							
	21							IF								
142	22	4		100		30		1	becomes 10% vesicles, elongate, irregular, subangular, subrounded, vugs present, 1-40 mm							Light brown WR
								2	1: 5, J, VN, No, No, Ir, SR 2: 5, J, VN, No, No, Ir, SR							Approx. 100 gal WL, partial circulation
	23		4					3	3: 20, J, VN, Mn Sp, clay Su, St, SR							
								4	4: 10, J, VN, No, No, Ir, SR							
								5	5: 50 J, VN, Mn Sp, Ir, SR							
140	24							IF	becomes 5%, subrounded, rounded, <2 mm same as above					0.0	[27.3]	
									IF: Mn Fe Su and Sp, clay Su light red (2.5Y 6/8)							Light brown WR
	25															
138	26	5		100		18										Approx. 100 gal WL, partial circulation
	27															
136	28		5						IF: clay Pa light yellowish brown (2.5Y 6/3)							End coring 8/16/21
	29															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
134	29						IF					0.0	[15]	Resume coring 8/17/21
		6		100		50	1		1: 5, J, MW, Mn Sp, clay Pa, Ir, SR					
	30								← same as above			0.0	[25]	Light brown/tan WR
							1							
							2		1: 5, J, N, Mn Fe clay Su, Wa, SR 2: 5, J, N, Mn Sp, Fe Su, Wa, SR 3: 5, J, VN, Mn Sp, Wa, SR					
132	31						IF		IF: Mn Fe Sp, clay Su					
							3		←becomes gray (GLEY1 G/1), slightly weathered, very strong, 2% vesicles, elongate, subrounded, subangular, 1-5 mm					
	32	7		100		60	4		4: 45, J, N, Mn Fe Sp, Wa, SR 5: 60, J, N, Mn Fe clay Sp, Wa, SR 6: 60, J, N, Mn Fe Sp, clay Pa, Wa, SR 7: 5, J, VN, Fe clay Sp, Wa, SR					Light tan/brown WR lost less than 20 gal, partial circulation
	33		6				5							
130							6							
	34													
							7							
	35								← same as above			0.0	[15]	
							IF		IF: Mn Fe Sp, clay Su, Sp, Pa					
128	36													Light brown/tan WR
	37	8	7	100		32								
126							IF		IF: Mn Fe clay Sp, halloysite					Minor WL, partial circulation
	39													
124	40											0.0	[8.6]	
	41													Light brown/tan WR
122	42		8				IF		**A'a Clinker** Very dark gray (10YR 3/2), moderate weathering, moderate strength, clay covering pieces					
		9		90		31			**Massive A'a** Gray (10YR 5/1), slightly weathered, strong, 5% vesicles, elongate, subrounded, 3-40 mm, 1% weathered olivine No recovery ←becomes very dark gray (10YR 3/2), moderately weathered, moderate strength, clay covering pieces red (2.5YR 5/6)					Approx. 50 gal WL, partial circulation
120	43													
	44													Rods dropped ~43 ft bgs, WR turned brown
	45													

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Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
118	45								increasing clay content, more clay than rock					0.0	[15]	"clay present" as per driller
	46						IF									
							NR									Brown WR
	47	10		38		0			No recovery							Lost approximately 200 gal, partial circulation
116	48															
	49								becomes very dark gray (7.5YR 3/1), moderate weathering, strong							
114	50													0.0	[9.1]	
							NR									
	51								No recovery							Brown WR
112	52	11		36		61										Lost approx. 200 gal, partial circulation
	53								becomes very dark grey (GLEY1 3/N), slightly weathered, very strong, 3% vesicles, elongate, irregular, subrounded, 1-5 mm, 2% weathered olivine							
110	54															
							IF		becomes strong, clay covering pieces IF: clay Pa, red (2.5YR 5/8)							
	55								becomes dark gray (GLEY1 4/N), slightly weathered, very strong, 3% vesicles, elongate, irregular, 1-33 mm, 2% unweathered olivine					0.0	[11]	
108	56						1		1: 5, J, VN, Mn Fe clay Sp, Wa, SR 2: 90, J, VN, Mn Fe clay Sp, Wa, SR							Brown WR
							2		3: 0, J, VN, No, No, Wa, SR							
	57						3		4: 0, J, VN, Fe Su, Mn Sp, Wa, SR 5: 5, J, N, Fe Su, Mn Sp, Wa, SR							Lost approx. 200 gal, partial circulation
		12		88		45	4		6: 0, J, N, Fe clay Su, Wa, SR							
106							5		7: 5, J, N, Mn Fe clay Sp, Wa, SR							
	58		9				6		IF: clay pa, Mn Sp, halloysite							
							IF									
	59						7									
104							NR									
	60								No recovery					0.0	[18.8]	
							NR									
	61															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
102	61													Per driller, rods dropped from 60-61 ft bgs
	62	13		30		33	NR		No recovery					
	63													Brown WR Approx. 30 gal WL, partial circulation
100	64								**A'a Clinker** Very dark gray (10YR 3/1), dark grayish brown (10YR 4/2), some clay on clasts red (2.5YR 5/8), pale brown (2.5Y 8/3), moderate weathering, moderate strength					
							IF		**Massive A'a** Dark gray (GLEY1 4/N), slightly weathered, very strong, 1% vesicles, irregular, elongate, <4 mm					
	65						NR		← becomes moderately weathered, strong, increasing clay with depth			0.0	[18.8]	
98							1		IF: clay Pa - red (2.5 YR 5/8)					Per driller, easier to drill 65-67.5 ft bgs
	66								**Welded A'a Clinker** clasts - very dark gray (10YR 3/1), moderate weathering, moderate strength matrix - brown (7.5YR 5/3), clay - red (2.5YR 5/8) 1: 10, J, MW, Mn Sp, clay Su, Ir, R					Brown WR Approx. 400 gal WL, partial circulation
	67						2		2: 5, J, MW, Mn Sp, clay Su, Ir, R					
							3		3: 5, J, MW, Mn Sp, clay Su, Ir, R					
		14		90		42	4		4: 5, J, MW, Mn Sp, clay Su, Ir, R					
96	68								**Massive A'a** Very dark gray (GLEY 3/N), slightly weathered, very strong, 2% vesicles, elongate irregular, <6 mm					
	69								← becomes 7% vesicles, irregular, elongate, subrounded, 3-5 mm					
							IF							
94	70								← becomes very dark gray (10YR 3/1), slightly weathered, very strong, 10% vesicles, elongate, irregular, subrounded, 4-25 mm			0.0	[18.8]	
							1		1: 5, J, VN, Mn Sp, Wa, SR					
	71						2		2: 10, J, VN, Mn Sp, Wa, SR					Brown WR
			10				3		3: 5, J, N, Mn Sp, Ir, SR					
92									4: 10, J, VN, Mn Sp, Wa, R					Approx. 50 gal WL, partial circulation
	72						IF		5: 25, J, VN, Mn Sp, Wa, R					
							4		6: 15, J, VN, Mn Sp, Wa, SR					
		15		100		60	5		7: 25, J, VN, Mn Sp, Wa, SR					
	73						6		8: 5, J, VN, Mn Sp, Wa, SR					
							7		9: 0, J, VN, Mn Sp, Wa, SR					
							8		10: 0, J, VN, Mn Sp, Wa, SR					
90							9		11: 0, J, VN, Mn Sp, Wa, SR					
	74						10		12: 5, J, N, Mn Sp, Wa, SR					
							11		13: 5, J, N, Mn clay Sp, Wa, SR					
							12		IF: clay halloysite Pa					
	75						13		← same as above			0.0	[17.6]	
							1		1: 5, J, VN, Mn Sp, Wa, SR					
88							2		2: 10, J, VN, Mn Sp, Wa, SR					Brown WR
	76						3		3: 5, J, VN, Mn Sp, clay Su, Wa, SR					Approx. 200 gal WL, partial circulation
							4		4: 0, J, VN, Mn Sp, Wa, SR					
	77													

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW04A

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
77 / 86	16		92		30	IF		becomes 5% vesicles, subrounded, elongate, <7 mm					
78 / 79						IF		IF: Mn Fe Sp, clay Su					
84 / 80						NR					0.0	[20]	
81 / 82		11						No recovery					Brown WR Approx. 300 gal WL, partial circulation
82 / 83	17		22		0								
80 / 84								**A'a Clinker** Black (5YR 2.5/1), reddish brown (5YR 5/2), moderate weathering, moderate strength, Mn Sp, clay Pa red (2.5YR 5/8)					
85 / 78						IF		**Massive A'a** Dusty red (2.5YR 3/2), moderate weathering, strong, 2% vesicles, elongate, irregular, <4 mm, clay on pieces reddish yellow (5YR 6/5)			0.0	[27.3]	
86 / 87													Brown WR Approx. 20 gal WL, partial circulation
76 / 88	18		18		44	NR		No recovery					
89 / 74													
90 / 91						1		becomes gray (GLEY1 5/N), slightly weathered, very strong, 3% vesicles, elongate, subrounded, 1-11 mm 1: 0, J, VN, clay Sp, Wa, SR			0.0	[12.5]	Brown WR
72 / 92						IF							Approx. 20 gal WL, partial circulation
19 / 93	19		90		15			IF: Mn Fe Sp, clay Su					

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Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
70	93								IF: Mn Fe Sp, clay Su							
	94						IF									
	95								← same as above					0.0	[10.3]	
68							IF		1: 20 J, VN, Mn Sp, Wa, SR 2: 5, J, VN, Mn Sp, Wa, SR 3: 10, J, VN, Mn Sp, Wa, SR 4: 0, J, N, Mn clay Sp, Wa, SR 5: 50, J, N, Mn clay Sp, Wa, SR 6: 5, J, N, Mn clay Sp, Wa, SR 7: 5, J, N, Mn Sp, Wa, SR 8: 5, J, N, Mn Sp, Wa, SR						Brown WR Approx. 30 gal WL., partial circulation
	96						1									
	97						2 3 IF		IF: clay Pa							
66		20		100		36										
	98		12				4									
	99						5 6 7 8									
64																End coring 8/17/21
	100								← same as above					0.0	[13]	Resume coring 8/18/21
							IF		IF: Mn Fe Sp, clay Su 1: 0, J, N, Mn Sp, Wa, SR 2: 5, J, VN, Mn Sp, Wa, SR 3: 0, J, N, Mn Sp, Wa, SR 4: 20, J, VN, Mn Sp, Wa, SR 5: 10, J, MW, No, No, Ir, R						
	101						1 2									
62																Brown WR
	102						3 4 5									Approx. 10 gal WL, partial circulation
		21		70		17										
	103						IF		**Welded A'a Clinker** clasts - very dark gray (10 YR 3/1), slightly to moderately weathered, strong to moderate strength matrix - brown (7.5YR 4/3), reddish yellow (7.5YR 6/8)							
							IF									
60	104						NR									
	105													0.0	[27.3]	
58	106								No recovery							Brown WR
	107						NR									Approx. 300 gal WL, partial circulation
56		22		10		0										
	108															
	109															

Report: CTO53 RED HILL WITH WELL AND PID; File: OWDF_BORINGLOGS.GPJ; 6/7/2022 OWDFMW04A

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
54	109						NR		same as above 102.5-103.4 ft bgs, loose and welded A'a Clinker							
	110								same as above					0.0	[100]	
	111															Brown WR Approx. 500 gal WL, partial circulation
52	112	23		12		0	NR		No recovery							
	113															
50	114															
	115								same as above 109.4-110 ft bgs, welded A'a Clinker					0.0	[7.9]	
48	116						1 2 3									Brown WR Approx. 100 gal WL, partial circulation
	117								**Massive A'a** Dark gray (GLEY1 3/N), slightly weathered, very strong, 5% vesicles, elongate, subrounded, subangular, <25 mm							
46	118	24	13	100		50	4 5 6 IF 7		1: 5, J, MW, Mn Fe clay Sp, Wa, R 2: 10, J, MW, Mn Fe clay Sp, Wa, R 3: 0, J, N, clay Sp, Wa, SR 4: 75, J, N, Mn Sp, clay Su, Wa, SR 5: 45, J, VN, Mn clay Sp, St, SR 6: 15, J, N, Mn Sp, Wa, SR 7: 60, J, MW, Mn clay Sp, Wa, SR							
	119						8 9		8: 35, J, N, Mn Sp, Wa, SR 9: 5, J, VN, Mn Sp, St, SR IF: clay Su, Mn Fe Sp							
44	120								same as above IF: Mn Fe Sp, clay Su					0.0	[11.5]	
	121						IF									Brown WR
42	122	25		72		0										Approx. 200 gal WL, partial circulation
	123						NR		No recovery. Potentially washed out A'a Clinker							
40	124						IF		**Massive A'a** Transitional zone, A'a Clinker clasts present, very dark gray (10YR 3/1), dusky red (2.5YR 3/2), reddish yellow (2.5YR 7/6), moderate weathering, strong, some loose							
	125															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	125						1		A'a Clinker clasts possibly slough			0.0	[27.3]	End coring 8/18/21
38									← same as above					Resume coring on 9/10/21
	126						2		1: 5, J, MW, Mn clay Sp, Pa, Pl, SR 2: 60, J, VN, Mn Fe clay Sp, Wa, R 3: 30, J, N, clay Su, St, S					
							3		4: 60, J, N, Mn clay Su, Pl, SR 5: 15, J, N, clay Su, St, R					No water added
	127						4		6: 10, J, N, Mn clay Su, Wa, VR 7: 20, J, W, Mn clay Su, Wa, VR					
							5		← color change, dark yellowish brown (10YR 4/4), dark reddish brown (5YR 3/4)					
36		26		86		67								
	128		14				6							
							7							
	129													
34							NR		**Loose A'a Clinker** Dark reddish brown (5YR 3/3), gravel < 2in No recovery					
	130											0.0	[8.6]	
							1		**Massive A'a** Very dark gray (5YR 3/1), with reddish yellow (5YR6/8) staining on fractures, moderately to heavily weathered, strong, 1% vesicles, 1-3 mm, rounded, fine ground up basalt mixed with rock, slough					
	131						2							Approx. 20 gal WL
32														Light brown WR
	132						3		← becomes moderately weathered, strong, 3% vesicles 1-12 mm 1: 60, J, W, Mn clay Su, St, VR					
		27		100		66	4		2: 60, J, W, Mn clay Su, Wa, VR 3: 50, J, W, clay Pa, Wa, VR					
							5		4: 30, J, VN, Mn clay Sp St, VR 5: 20, J, VN, Mn clay Sp, Wa, S					
	133						6		6: 20, J, VN, Mn clay Sp, Pl, S 7: 45, J, VN, Mn clay Sp, Pl, S					
							7		8: 30, J, VN, Mn clay Sp, Pa, Pl, S 9: 30, J, VN, Mn clay Sp, Pl, S					
30														
	134						8		← vesicles increase to about 5%					
							9							
	135								← same as above			0.0	[7.3]	
							1		1: 5, J, N, clay Mn Fe Sp, Wa, SR 2: 85, J, VN, clay Mn Fe Sp, IR, S					
28									3: 80, J, VN, clay, Mn Fe Sp, IR, S 4: 20, J, N, clay Mn Fe Sp, Pl, S					
	136						2		5: 15, J, N, clay Mn Fe Su, Wa, S 6: 85, J, N, clay Mn Fe Sp, Pl, S					Approx. 10 gal WL
							3							Light brown WR
	137	28		100		85								
							4							
							5		← increased vesicles, about 10%, elongated, 1-15 mm 7: 10, J, MW, clay Pa, Wa, R					
26							6		8: 15, J, VN, clay Mn Fe, Wa, R 9: 15, J, VN, clay Mn Fe, Wa, R					
	138		15				7							
							8							
							9							
	139								← same as above, vesicles decrease to approximately 1%, 1-5 mm			0.0	[6]	Push only to 139 feet bgs
		29		100		70	1		1: 30, J, N, Mn Su, Wa, S 2: 10, J, MW, clay Mn Fe Su, Wa, S					
24							2							No WL, light brown WR
	140								← same as above			0.0	[21.8]	
							1		1: 70, J, VN, clay Fe Mn Su, Pl, S 2: 5, J, MW, Mn clay Pa, Wa, R					
							2							
	141													

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
22	141						3		← increased vesicles, 10%, 1-300 mm					
							4		3: 5, J, Mn clay Pa, Wa, SR					
							5		4: 10, J, clay Mn Fe Sp, St, VR					
							6		5: 15, J, clay Mn Su, Wa, SR					
							7		6: 15, J, clay Mn Pa, Ir, VR					
							8		7: 10, J, clay Mn Pa, Wa, SR					
							9		8: 5, J, clay Mn Pa, Pl, SR					
							10		9: 5, J, clay Mn Pa, St, SR					
20	142	30		95		71			10: 15, J, clay Mn Sp, St, VR					30 gal WL
							NJR							Light brown WR
	143													
	144								← same as above			0.0	[3.3]	
		31		100		50	1		1: 10, J, N clay Fe Mn Sp, Wa, SR					
							2		2: 10, J, N, clay Mn Sp, Wa, SR					
							3		3: 20, J, MW, Mn Su, Wa, SR					
							4		4: 20, J, N, Mn Su, Wa, SR					End of coring 9/10/21
18	145						5		5: 85, J, N, clay Mn Su, Pl, S			-	[9.1]	Resume coring 9/13/21
							1		← same as above, about 5% vesicles, 1-5 mm					
							2		1: 20, J, W, clay Mn Fe Sp, Ir, R					
							3		2: 50, J, W Mn Sp, Ir, R					
	146						4		3: 50, J, W, Mn Fe Pa, Ir, R					
							5		4: 15, J, MW, clay Mn Sp, Ir, R					PID malfunction 145-155 ft bgs
							6		5: 10, J, VN, clay Su, Pl, R					
	147								6: 10, J, VN, Mn Fe Pa, Ir, R					
									7: 5, B, W, clay Mn Fe, Ir, VR					
16	148	32	16	100		46	7		← becomes highly weathered Massive A'a, yellowish red (5YR 4/6), highly weathered, weak					
									IF: reddish yellow (7.5YR 6/8) staining					
	149						IF							
14	150								← same as above			-	[10.3]	Lost circulation at 150 ft bgs.
									← becomes dusky red (5YR 4/6), highly weathered, strong, 10% vesicles, 1-4 mm					
	151						IF		IF: Mn, Fe, clay present					
									1: 45, B, W, clay Fe Mn Pa, W, R					
									2: 20, J, VN, clay Fe Mn Pa, St, R					
12	152								3: 20, J, VN, clay Fe Mn Pa, St, R					Over 300 gal WL
		33		64		13								
	153						NJR		No recovery					
10	154						1		← becomes very dark gray (7.5YR 3/1), slightly weathered, extremely strong, 1% vesicles, 1-15 mm					
							2							
							3							
	155								← becomes 3% vesicles, 1-7 mm, vugs present up to 25 mm			0.0	[11.1]	
8	156						1							100 gal WL
							2		1: 15, J, N, clay Mn Fe Su, Pl Wa, S					
	157								2: 15, J, N, clay Mn Fe Su, Wa St, SR					

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Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
6	157													
	158	34		100		56			3: 45, J, N, Mn, Wa, SR 4: 25, J, VN, No, No, Wa, R 5: 20, J, VN, clay Pa, Mn Sp, Wa, SR 6: 45, J, VN, clay Mn Su, Wa, S 7: 35, J, VN, clay Mn Su, St, R					200 gal WL, light brown water
	159								IF					
4	160		17						1: 5, J, VN, Mn Su, Sp, clay Pa, Wa, R 2: 30, J, W, Mn Sp, clay Pa, IR, R, highly fractured 3: 45, J, Mn clay Su, Wa, R 4: 70, J, clay Su, Mn Pa, Wa, R 5: 70, J, clay Su, Mn Pa, Wa, R 6: 45, J, Mn Fe Pa, Wa, SR 7: 10, J, clay Su, Ir, VR			0.0	[14.1]	
	161													50 gal WL
2	162	35		90		11								
	163								← becomes weathere Massive A'a, dark yellowish brown (10YR 3/6), highly weathered, moderately strong					
0	164						NR		No recovery					
		36		100		40			**Pahoehoe** Dark reddish brown (7.5YR 3/4), clay Pa reddish yellow (2.5YR 7/6), slightly weathered, very strong, 30% vesicles, rounded, subrounded, 2-4 mm 1: 10, J, N, clay Mn Pa, Wa, R 2: 10, J, MW, clay Mn Pa, Wa, R 3: 30, J, N, clay Mn Pa, Ir, R			0.0	[20]	10 gal WL
	165											0.0	[25]	
-2	166								← becomes dark brown (7.5YR 3/2), 40% vesicles, 3 mm					
	167	37		100		74			1: 10, J, MW, clay Mn Su, Wa Ir, R 2: 15, J, MW, clay Mn Su, Pa, Wa, R 3: 5, J, N, clay Mn Su, Wa, R 4: 5, J, W, Mn clay Pa, Wa, R 5: 15, J, VN, Mn Fe,Su, Ir, R					60 gal WL
-4	168													
	169		18											
-6	170								← becomes 2% vesicles, 1-2 mm ← same as above			0.0	[15]	
	171								← becomes 20% vesicles, 1-3 mm 1: 30, J, N, clay Mn Pa, Ir, R 2: 30, J, N, clay Su, Mn Fi, Wa Ir, R 3: 10, J, W, clay Mn Su, Wa, R - IF 4: 30, J, clay Mn Pa, St Ir, VR 5: 65, J, clay Mn Pa, St Ir, VR 6: 75, J, clay Mn Sp, Wa, SR 7: 30, J, clay Mn Sp, Wa, SR					
-8	172						IF							60 gal WL
		38		5		52								
	173													

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW04A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-10	173						4									
	174						5		← increased vesicles size, 2-5 mm							End coring on 9/13/21 TD = 175 ft bgs
	175						6									
-12	176						7									
	177															
-14	178															
	179															
-16	180															
	181															
-18	182															
	183															
-20	184															
	185															
-22	186															
	187															
-24	188															
	189															

OWDFMW04A was hand cleared from ground surface to 3 ft bgs (163.73 ft msl to 160.73 ft msl). HQ coring commenced from 3 ft bgs to 120 ft bgs (160.73 ft msl to 43.73 ft msl). The borehole was reamed with a 17.5-inch tricone bit from ground surface to 120 ft bgs (163.73 ft msl to 43.73 ft msl) to set a conductor casing. A 10-inch diameter steel conductor casing was installed to 119 ft bgs (44.73 ft msl). HQ coring continued from 120 ft bgs to 175 ft bgs (43.73 ft msl to -11.27 ft msl). HQ coring terminated at a total depth of 175 ft bgs (-11.27 ft msl). The borehole was reamed with a 9 7/8-inch tricone bit from 120 ft bgs to 175 ft bgs (43.73 ft msl to -11.27 ft msl) for well construction. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 3,380 gallons of water were used during drilling and rock coring.

OWDFMW04A well construction was completed on September 17, 2021. The well was completed with 4-inch diameter Schedule 80 polyvinyl chloride (PVC) blank well casing from approximately 3.1 ft above ground surface to 148.95 ft bgs (166.84 ft msl to 14.78 ft msl) and a 0.020-inch slotted screen between 148.95 to 168.95 ft bgs (14.78 ft msl to -5.22 ft msl). The casing was stabilized with centralizers placed at the top and bottom of the screened section, and then spaced every 40 ft up from the top of the screen. The filter pack extended from 171 ft bgs to 144.5 ft bgs (-7.27 ft msl to 19.23 ft msl). The bentonite seal was placed from 144.5 ft bgs to 139.5 ft bgs (19.23 ft msl to 24.23 ft msl). A 100% bentonite slurry was placed from 139.5 ft bgs to 119 ft bgs (24.23 ft msl to 44.73 ft msl [into the 10-inch conductor casing]). Cement/grout was placed to the ground surface. The surface completion consists of an approximately 3.1-foot stick up monument inside of an 8-inch diameter protective steel casing set on a concrete well pad approximately 1 ft above ground surface. A total of approximately 1,890 gallons of development water was removed during development, after well construction.

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Log of Boring OWDFMW05A

Date(s) Drilled	02/26/21 to 03/11/21	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Hand clear / HSA / HQ	Drill Bit Size/Type	17.5" rotary / 9.875" rotary / HQ diamond bit	Total Depth of Borehole	145.0 feet
Drill Rig Type	Mobile B-59 / Mobile-B90 / Mobile-B80	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	115.6
Groundwater Level	97.39 ft bgs / 18.61 ft msl 9/28/2021	Location	OWDFMW05A	Inclination from Horizontal/Bearing	90 degrees
Borehole Completion	4-inch diameter monitoring well			Hammer Data	140lb auto-hammer

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								**Fill** Fill and weathered broken up basalt						[40]	Hand clear to 2 ft gs
114	1															
	2	1														HSA from 2ft bgs. Smooth to start, chattering at ~3 ft bgs
112	3															
	4												18	0.0	[34.5]	End 02/26 Resume 03/01
	5			67									16 9			Chattering
110	6	2														
	7															
108	8								**Poorly Graded Sand with Clay and Gravel (SP-SC)** Dark grayish brown (10YR 4/2), wet, G 25 weathered basalt, S 65 fine to medium sand, F 10				10	0.0	[20]	
	9			100					Dry weathered basalt, gray (5Y 5/1)				28			
106	10	3							Same as 8-8.5 ft bgs				12			Smooth drilling
	11															
104	12								**Fat Clay (CH)** Dark brown (10YR 3/3), G 5, S 5, F 90, dry, coarsens with depth				10 9		[18.8]	
	13			80												

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Log of Boring OWDFMW05A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
102	13								No recovery				16			
	14	4														Smooth drilling
	15															
100	16			100					**Gravelly Silt (ML)** Dark grayish brown (10YR 4/2), G 25 weathered basalt, S 5, F 70, some man-made fill				50		[80]	Split spoon refusal at 16.5 ft bgs
	17															
98									**Gravelly Lean Clay (CL)** Dark grayish brown (10YR 4/2), G 30 weathered basalt, S 5, F 65, some man-made fill							Chattering
	18	5														
	19															
96	20								Pahoehoe basalt boulder, very dark gray (5Y 3/1), moderately weathered, moderate strength, 3% vesicles, subrounded, 1-11 mm					0.0	[75.7]	Start HQ coring
	21						IF M									
94	22															Light brown WR
	23	6		20		40	NR		No recovery							
92	24															
	25		1						same as above, basalt boulder, angled broken pieces and very dark grayish brown (10YR 3/2), moderately weathered, moderate strength, 3% rounded vesicles, <2 mm						[151.5]	
90	26						IF M									Light brown WR
	27															
88	28	7		30		0	NR		No recovery							Mud pan filling with soil cuttings
	29															

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Log of Boring OWDFMW05A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
86	29								No recovery							
	30								same as above					0.0	[100]	
	31															Light gray brown WR
84	32	8		60		0	IF M		**Tuff** Very dark grayish brown (10YR 3/2), very weak, moderate to highly weathered, sand, clay, lithics, some possible lamination							
	33															
82	34		2				NR		No recovery							
	35													0.0	[100]	
80	36	9		80		43	IF M 1 2 3 4 5		1. 45, J, N, Mn, Clay, Sp, Fe, Su, Ir, SR 2. 10, J, MW, Clay, Sp, Fe, Su, Wa, S 3. 50, J, MW, Mn, Fe, Clay, Sp, Wa, S 4. 0, J, N, Clay, SP, Wa, S 5. 45, J, N, Mn, Fe, Clay, Sp, Wa, S							Same as above
78	37															Depth to water measured (see Book #1, pg. 57).
	38															
	39								**Lean Clay (CL)** Dark brown (7.5YR 3/2), G 0, S 10, F 90							
76							NR		No recovery							
	40								same weathered tuff (from 31.6 to 38.8 ft bgs)					0.0	[100]	
	41								**Massive A'a** Dark gray (5Y 4/1), moderately weathered, moderate strength to very weak, 2% vesicles, irregular, elongate, partially weathered, 2-6 mm							Light brown WR
74	42	10		68		0	IF									
	43															Per driller increasing WL, still WR
72	44						NR		No recovery							
	45															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
70	45								same as above					0.0	[151.5]	
	46						IF									No WR, 200-250 gal WL
	47															
68	48	11		30		0	NR		No recovery							Measure water level, Book #1 pg. 57
66	49															
	50								**Pahoehoe** Brown (10YR 4/3), gray (5Y 6/2), black (GLEY1 2.5/N), highly weathered, weak to very weak, multiple broken pieces from different flows, 2-15% vesicles, round to subrounded to subangular vesicles, 1-8 mm, some clay in vesicles and fractures					0.0	[60.2]	
	51		3													No WR, 400-450 gal WL
64	52	12		60		0	IF									
	53															Measure water levels Book #1 pg. 58
62	54						NR		No recovery							
	55								same as above					0.0	[100]	
60	56						IF									No WR, 100 gal WL
	57															
58	58	13		60		0										
	59						NR		No recovery							
56	60								same as above					0.0		
	61															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
61														
54									**Lean Clay (CL)** Brown (10YR 4/3), G 0, S 10, F 90					
62									same as above					
		14		50		0								
63							NR							Light brown WR, 50 gal WL
52									No recovery					
64														
65									same as above			0.0	[151.5]	
50								M	becomes dark grayish brown (10YR 4/2), moderate strength, moderately weathered, 15% vesicles, rounded to subrounded, 2-4 mm					
66								1	1. 5, J, VN, Mn, Fe, Sp, Wa, SR					
								2	2. 75, J, VN, Mn, Fe, Sp, Wa, SR					
								3	3. 5, J, VN, Mn, Fe, Sp, St, R					
67								4	4. 80, J, N, Mn, Fe, Sp, Wa, SR					Light brown WR, no WL
48		15		86		0			becomes 3% vesicles, subrounded, 3-15mm					
68			4					IF						
69									**Lean Clay (CL)** Gray (2.5Y 5/1), G 0, S 5, F 95					
46									**Massive A'a** Gray (2.5Y 5/1), slightly weathered, strong, 5% vesicles, rounded to subrounded, some elongate, <6 mm					
70							NR					0.0	[75.7]	
								1	1. 40, J, VN, Mn, Clay, Sp, Wa, SR					
								2	2. 0, J, VN, Mn, Sp, Clay, Su, Pl, S					
71									**Lean Clay (CL)** Dark grayish brown (10YR 4/2), G 5, S 5, F 90					
44							NR							
72														Light brown WR, no WL
		16		28		57			No recovery					
73														
42														
74									same as above (from 69 to 71 ft bgs)					
75													[50]	
40														
76														Light brown WR, no WL
77														

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
38	77															
		17		58		0										
78									**Lean Clay (CL)** Brown (7.5YR 4/2), G 5, S 5, F 90							Per driller "in clay" at ~78 ft bgs
							NR		No recovery							
79																
36																End coring on 03/01/21
80									**Fat Clay (CH)** Brown (10YR 4/3), G 5, S 5, F 90, stiff, dry inside					0.0	[50]	Resume coring on 03/02/21
81																10-inch diameter steel conductor casing installed at 80 ft bgs Collect HU039 (80-83 ft bgs) Light brown WR
34																
82		18		94		0										
83																
32			5						**Massive A'a** Greenish gray (GLEY1 6/5GY), moderately weathered, moderate strength							
84									**Fat Clay (CH)** Brown (10YR 4/3), G 5, S 5, F 90, stiff, dry inside same as 83.2-83.4 ft bgs							
							NR		No recovery							End coring on 03/02/21
85									**Fat Clay (CH)** Brown (10YR 4/3), G 5, S 5, F 90, stiff, dry inside					0.0	[25]	Resume coring on 03/11/21
30																
86							1		**Massive A'a** Dark gray (2.5Y 4/1), slightly weathered, very strong, 3% vesicles, subrounded, elongate, 2-6 mm 1. 5, J, VN, Mn, Sp, Fe, Su, Wa, SR							
							2		2. 0, J, N, Mn, Sp, Fe, Su, Wa, S							
87							3		3. 45, J, N, Mn, Fe, Clay, Sp, Wa, SR some clay bits and broken up massive a'a							
28		19		60		13										
88							NR		No recovery							Light brown WR
89																
26									abecomes moderately weathered, strong, 2% vesicles, subrounded, 1-12 mm IF - Mn, Fe, Clay, Sp same as above IF - same as above, Mn, Fe, Clay, Sp							
90							IF								[75.7]	
									Loose A'a Clinker Dark gray (7.5YR), rounded clasts, some clay							
91									**Massive A'a** Gray (2.5Y 5/1), moderately weathered, strong, 1-5% vesicles, subrounded, irregular, elongate, <1-30 mm, some clay yellowish red (5YR 5/8)							Light brown WR
24																
92																
		20		60		0	IF									
93																

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
22	93															Rods drop "voids" around 93 ft bgs
	94						NR		No recovery							
	95								**Loose and Welded A'a Clinker** Reddish brown (5YR 4/3), black (5YR 2.5/1), dark red (2.5YR 3/6), reddish yellow (7.5YR 6/0), moderate to highly weathered, weak to very weak, subrounded to angular clasts, loose and welded					0.0	[75.7]	
20	96								← becomes dark reddish brown (2.5YR 3/4), extremely weak, completely weathered, some clasts evident, loose							
	97															Light brown WR
18	98	21		100		0										
	99								← becomes reddish brown (5YR 4/3), yellowish red (5YR 5/6), dark reddish gray (5YR 4/2), moderately weathered, moderate strength, welded							
16			6						← becomes dark brown (7.5YR 3/2), black (7.5YR 2.5/1), brown (7.5YR 5/3), moderately weathered, moderate strength, loose and welded							
	100								← same as above					0.0	[60.2]	
									← becomes highly weathered, extremely weak							
	101								← increasing clay, reddish yellow (75YR 6/6), moderate to highly weathered, weak							
14																
	102	22		24		0										Light brown WR
	103								No recovery							
12							NR									
	104															
	105								← becomes dark reddish brown (5YR 3/2), light brown (7.5YR 6/4), black (5YR 2.5/1), rounded to subrounded, moderate to slightly weathered, moderate strength, loose and welded					0.0	[27.3]	
10	106															
	107															Light brown WR
8		23		64		19	NR		No recovery							
	108															
	109						1		**Massive A'a**							

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Log of Boring OWDFMW05A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
6	109								Very dark gray (10YR 3/1), slightly weathered, moderately strong to strong, 2% vesicles, subrounded to subangular, elongate, 1-10 mm 1. 20, J, MW, Mn, Clay, Sp, Wa, SR							
	110						1		← same as above, 1% olivine phenocrysts 1. 0, J, N, Mn, Sp, Wa, SR						[75.7]	
	111								**Loose and Welded A'a Clinker** Brown (7.5YR 4/3), black (5YR 2.5/1), reddish yellow (5YR 6/6), yellow (10YR 7/6), clay, moderate to slightly weathered, moderate strength to weak							
4	112	24		50		0										Light brown WR
	113						NR									
2	114								No recovery							
	115														[60.2]	
0	116								← reddish brown (5YR 5/3), black (5YR 2.5/1), dark reddish gray (5YR 4/2), reddish yellow (7.5YR 6/6), rounded clasts, moderate to slightly weathered, moderate strength							
	117															Light brown WR
-2	118	25	7	76		32	1 2 3		**Massive A'a** Very dark gray (7.5YR 3/1), slightly to moderately weathered, moderate strength to strong, 5% vesicles, subrounded, elongate, 1-12 mm, some clay in vesicles 1. 15, J, W, Mn Fe clay, Su, Ir, SR 2. 0, J, MW, Clay Sp, Ir, S 3. 40, J, VN, Mn Su, Fe clay Sp, Wa, S							
	119						4		4. 10, J, W, Mn Su, Fe clay Sp, Ir, SR							
-4	120														[75.7]	Lost circulation at 120 ft bgs
	121								**Welded Clinker** Reddish brown (5YR 4/9), black (5YR 2.5/1), gray (7.5YR 5/1), reddish yellow (7.5YR 9/6), some clay, slightly weathered, moderate strength							
-6	122															150 gal WL
	123	26		66		0										
-8	124						NR		No recovery							
	125															

Report: CTO53 RED HILL WITH WELL AND PID; File: OWDF_BORINGLOGS.GPJ; 6/7/2022 OWDFMW05A

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW05A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	125													0.0	[37.6]	
-10	126															
	127						NR		No recovery							
-12		27		32		0										
	128								same as above, mostly welded, some loose clasts							150 gal WL
	129															
-14																
	130								same as above					0.0	[75.7]	
	131								**Massive A'a** Dark gray (GLEY1 4/N), unweathered, very strong, 10% vesicles, subrounded, elongate, 3-14 mm							
-16									vug - 30 x 50mm becomes 1% vesicles, irregular, elongate, <4 mm							
	132						1									150 gal WL
		28		100		60			becomes 5% vesicles, irregular, elongate, subrounded, 1-6 mm 1. 60, J, MW, Mn, Sp, Wa, SR 2. 50, J, W, Mn, Sp, Wa, S							
	133		8													
-18							2									
	134						IF		becomes 1% vesicles, elongate, 3 mm							
							IF		**Welded A'a Clinker** Reddish brown (5YR 5/4), black (5YR 2.5/1), reddish yellow (7.5YR 6/6), moderate to slightly weathered, moderate strength							
	135													0.0	[60.2]	
-20									becomes dark reddish brown (2.5YR 3/4), black (10YR 2/1), yellow (10YR 7/6), moderate to slightly weathered, moderate strength							
	136															
	137															
-22		29		100		50										
	138						1		**Massive A'a** Very dark gray (2.5Y 3/1), unweathered, strong, 5% vesicles, elongate, 1-10 mm 1. 30, J, VN, Mn, Sp, Wa, SR 2. 0, J, VN, Mn, Fe, Sp, Wa, SR 3. 90, J, VN, Mn, Sp, Wa, SR 4. 10, J, VN, Mn, Clay, Sp, Wa, SR							150 gal WL
	139						2 3									
-24																
	140						4		becomes very dark gray (2.5YR 5/1), unweathered, strong, 1% vesicles, elongate, 1-2 mm 1. 10, J, W, Mn, Sp, Clay, Su, Wa, SR 2. 0, J, W, Mn, Sp, Clay, Su, Wa, SR 3. 90, J, W, Mn, Sp, Clay, Su, Wa, R					0.0	[60.2]	
	141						1 2 3									

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW05A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	141						45		4. 45, J, N, Mn, Sp, St, R 5. 45, J, N, Mn, Sp, Clay, Su, SR							
-26	142	30		40		50			**Loose A'a Clinker** Yellowish red (5YR 5/6), black (10YR 2/1), dark brown (7.5YR 3/2), moderate to highly weathered, very weak with clay							
	143						NR		No recovery							
-28	144															End coring on 03/11/21 TD = 145 ft bgs
	145								OWDFMW05A was hand cleared from ground surface to 2 ft bgs (115.57 ft msl to 113.57 ft msl). Hollow-stem auger drilling commenced from ground surface to 20 ft bgs (115.57 ft msl to 95.57 ft msl), until reaching refusal. HQ coring commenced from 20 ft bgs to 85 ft bgs (95.57 ft msl to 30.57 ft msl). The borehole was reamed with a 17.5-inch tricone bit from ground surface to 84 ft bgs (115.57 ft msl to 32 ft msl) to set a conductor casing. A 10-inch diameter steel conductor casing was installed to 80 ft bgs (36 ft msl). HQ coring continued from 85 ft bgs to 145 ft bgs (30.57 ft msl to -29.43 ft msl). HQ coring terminated at a total depth of 145 ft bgs (-29.43 ft msl). The borehole was reamed with a 9 7/8-inch tricone bit from 85 ft bgs to 145 ft bgs (30.57 ft msl to -29.43 ft msl) for well construction. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 1,450 gallons of water were used during drilling and rock coring. OWDFMW05A well construction was completed on June 14, 2021. The well was completed with 4-inch diameter Schedule 80 polyvinyl chloride (PVC) blank well casing from approximately 3.2 ft above ground surface to 119.9 ft bgs (118.78 ft msl to -4.33 ft msl) and a 0.020-inch slotted screen between 119.9 ft bgs to 139.9 ft bgs (-4.33 ft msl to -24.33 ft msl). The casing was stabilized with centralizers placed at the top and bottom of the screened section, and then spaced every 40 ft up from the top of the screen. The filter pack extended from 140.5 ft bgs to 114.70 ft bgs (-24.93 ft msl to 0.87 ft msl). The bentonite seal was placed from 114.70 ft bgs to 108 ft bgs (0.87 ft msl to 7.57 ft msl). A 100% bentonite slurry was placed from 108 ft bgs to 80 ft bgs (7.57 ft msl to 35.57 ft msl [into the 10-inch conductor casing]). Cement/grout was placed to the ground surface. The surface completion consists of an approximately 3.2-foot stick up monument inside of an 8-inch diameter protective steel casing set on a concrete well pad approximately 1 ft above ground surface. A total of approximately 1,270 gallons of development water was removed during development, after well construction.							
-30	146															
	147															
-32	148															
	149															
-34	150															
	151															
-36	152															
	153															
-38	154															
	155															
-40	156															
	157															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Date(s) Drilled	03/29/21 to 04/07/21	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Hand clear / HSA / HQ	Drill Bit Size/Type	17.5" rotary / 9.875" rotary / HQ diamond bit	Total Depth of Borehole	215.0 feet
Drill Rig Type	Mobile-B90 / Mobile-B80	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	116.3
Groundwater Level	97.07 ft bgs / 18.93 ft msl 9/28/2021	Location	OWDFMW06A	Inclination from Horizontal/Bearing	90 degrees
Borehole Completion	4-inch diameter monitoring well			Hammer Data	140lb auto-hammer

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
116	0								**FILL**						[50]	Hand auger to 5 ft bgs
115	1	1														
114	2															
113	3															
112	4															
111	5			100									10	0.0	[75.7]	HSA starting at 5 ft bgs
110	6												11			
109	7	2											10			Smooth drilling
108	8		1													
107	9															
106	10			67					**Sandy Silt (ML)** Very dark grayish brown (10YR 3/2), G 10 S 30 F 60, fines have some clay but predominantly silt				6	0.0	[13.7]	
105	11								Broken basalt boulder, light gray (GLEY1 7/N)				25			
104	12	3							No recovery				18			Smooth drilling Chattering at ~12 ft bgs
103	13															

~~For Red Hill AOC Party Use Only~~

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Sheet 2 of 15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
102	13															
	14															Smooth towards ~14 ft bgs
	15								**Silt with Sand (ML)** Dark brown (7.5YR 3/2), G 5 S 15 F 80				8	0.0	[75.7]	
				100									9			
100	16												19			
	17															
		4														Smooth drilling
98	18															
	19		1													
96	20								**Massive A'a** Basalt boulder, black (5YR 2.5/1), completely weathered, extremely weak, 10% very weathered olivine phenocrysts					0.0	[301.2]	
	21															
	22															Light brown WR
94		5		70		0	IF									
	23															
	24						NR		No recovery							
92									same as above							
	25													0.0	[151.5]	
	26															
90							IF									
	27															Light brown WR
		6		60		0										
	28															
88							NR		No recovery							
	29															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Sheet 3 of 15

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29						NR		No recovery							
86	30								same as above					0.0	[301.2]	
	31						IF		becomes olive (5YR 5/3), moderate to highly weathered, weak to very weak, 5% vesicles, subrounded to subangular, 3 - 7 mm IF - Mn Fe clay, Sp Su							
84	32	7		40		0										Light brown WR
	33						NR		No recovery							
82	34															
	35								same as above					0.0	[151.5]	
	36		2				IF									
80	37	8		18		0										Light brown, red WR
	38						NR		No recovery							
78	39															
	40								same as above					0.0	[301.2]	
76	41						IF									
	42	9		60		0										Light brown WR
74	43						NR									
	44								No recovery							
72	45															End coring for 03/29/21

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
45								same as above			0.0	[151.5]	Resume coring on 03/30/21
46 / 70						IF		becomes highly weathered, very weak with more lean clay (CL), dark reddish brown (5YR 3/3)					
47	10		30		0								Light brown WR
48 / 68						NR		No recovery					
49													
50 / 66								becomes olive (5YR 5/3), dark brown (10YR 3/3), moderate to highly weathered, weak to very weak, 5% vesicles, subrounded to subangular, 2-5 mm, very small amount of lean clay (CL), dark brown (10YR 3/3) IF - Mn Fe clay, Sp Su			0.0	[301.2]	
51						IF							
52 / 64	11		56		0								Light brown WR
53													
54 / 62						NR		No recovery					
55								same as above			0.0	[151.5]	
56 / 60						IF							
57	12		60		0	IF							Light brown WR
58 / 58		3											
59						NR		No recovery					
60 / 56								same as above				[75.7]	
61													

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW06A

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
61								No recovery					
62						NR							
54	13		54		0								Light brown WR
63								**Fat Clay with Sand (CH)** Dark brown (10YR 3/3), G 0, S 15, F 70, moderate to high plasticity, dry inside					
64								Collect HU046 (62.8-65 ft bgs)					
52													Note less material in box because some was taken for samples HU046 and HU047.
65								← same as above, some weathered basalt "disks" in clay towards the end of run			0.0		
66								Collect HU047 (65-70 ft bgs)					
50													
67	14		100		0								Light brown WR
68													
48													
69													End coring on 03/30/21. 10" casing set ~70 ft bgs.
70											0.0	[151.5]	Resume coring on 04/06/21
46													
71						NR							
72													Brown WR
44	15		0		0			No recovery					
73													
74													
42													
75								Broken basalt Massive A'a and Pahoehoe pieces, very dark gray (10YR 3/1), brown (7.5YR 4/3), moderate weathered, moderately strong to strong, some lean clay (CL) staining, reddish yellow (5YR 6/6), Mn staining			0.0	[301.2]	
76						IF							Brown WR
40													
77													

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
77																
		16		50		0										
78																
38																
	79						NR									
	80													0.0	[301.2]	
36																
	81								No recovery							
	82															Brown WR
34		17		14		0										
	83															
	84															
32																
	85								**Loose and Welded A'a Clinker** Black (10YR 2/1), dark reddish brown (5YR 3/2), reddish yellow (5YR 7/6), moderate to highly weathered, moderate strength to weak					0.0	[301.2]	
	86		4													
30																
	87						IF		**Massive A'a** Very dark grayish brown (10YR 3/2), moderately weathered, moderate strength, 2% vesicles, subrounded, 2-20 mm							Brown WR
		18		46		0										
28	88															
	89						NR									
									No recovery							
26	90													0.0	[301.2]	
	91															Brown WR
							NR									
24	92								◄ same as above, Mn staining on fractures							
		19		60		0										
	93															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
22	93															
	94						IF		**Loose A'a Clinker**, brown (7.5YR 4/4), highly weathered, weak							
	95								**Pahoehoe** Very dark grayish brown (10YR 3/2), moderately weathered, moderate strength, 15% vesicles, subrounded, 1-5 mm					0.0	[151.5]	
20	96						NR		No recovery							
	97	20		36		0										Light brown WR, some WL, partial circulation
18	98								**Loose A'a Clinker**, dark grayish brown (10YR 4/2), moderately weathered, moderate strength, Mn staining							
	99								← Lean clay (CL) present among clinker clasts, dark grayish brown (10YR 4/2), clasts covered in clay							
	100													0.0	[151.5]	
16							1		**Pahoehoe** Dark brown (10YR 3/2), moderately weathered, moderate strength, 10% vesicles, subrounded, 2-10 mm							
	101						2		1: 0, J, MW, Mn Fe, Sp Su, clay Pa, Pl, SR 2: 0, J, MW, Mn Fe, Sp Su, clay Pa, Pl, SR							
							IF		**Loose A'a Clinker** Very dark gray (10YR 3/1), moderately weathered, moderate strength							
14	102						NR		**Massive A'a** Black (10YR 2/1), moderately weathered, moderate strength, Mn and clay in fractures							Light brown WR
		21		34		24										
	103								No recovery							
12	104															
	105								← same as above					0.0	[301.2]	
							IF									
10	106															
	107								← becomes dark yellowish brown (10YR 4/6), moderately weathered, moderate strength, some lean clay (CL), Mn staining on fractures							Light brown WR
		22		50		0										
8	108						NR									
	109															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
6	109															
	110								No recovery					0.0	[151.5]	
	111						NR									
4	112	23		40		0										Light brown WR
	113								**Loose A'a Clinker** Brown (10YR 4/3), yellowish brown (10YR 5/4), moderately weathered, moderate strength, Mn staining ← becomes highly weathered, very weak to extremely weak							
2	114		5													
	115						IF		**Massive A'a** Dark gray (7.5YR 4/1), moderately weathered, moderate strength, Mn and clay staining, 1% vesicles, elongate, 2-10 mm					0.0	[301.2]	
0	116								**Loose A'a Clinker** Dark brown (10YR 3/3), very pale brown (10YR 7/3), strong brown (7.5YR 4/6), moderately weathered, moderate strength to strong, Mn staining							
	117															Light brown WR, slight WL
	118	24		44		0										
-2							NR									
	119															
	120								No recovery					0.0	[50]	
-4	121															
	122															Light brown WR, slight WL
-6	123	25		52		15			← same as above							
	124						IF		**Massive A'a** Very dark grayish (10YR 3/2), moderately weathered, strong, lean clay (CL) in fractures 1: 20, J, VN, Mn Su, clay Pa, Ir, SR 2: 10, J, N, Mn Su, clay Pa, Ir, SR							
-8	125						1 2									

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	125													0.0	[75.7]	
-10	126								**Saprolite** Black (10YR 2/1), brown (7.5YR 4/4), pale brown (10YR 6/3), rounded clasts covered in clay, relic A'a Clinker clasts							
									Pahoehoe Very dark gray (10YR 3/1), slightly weathered, strong, 25% vesicles, rounded to subrounded, 1-3 mm							
	127						NR		No recovery							Light brown WR
		26		68		35										
-12	128								**Massive A'a** Grayish brown (2.5Y 5/2), slightly weathered, strong, 3% vesicles, subrounded, elongate, 1-5 mm, fractures filled with clay							
	129						IF		← becomes 10% vesicles, subrounded, elongate, 1-2 mm, some >20 mm							
	130						IF							0.0	[60.2]	
-14									**Saprolite** A'a Clinker/Saprolite/Clay, rounded A'a Clinker clasts covered in clay, relic A'a Clinker clasts, saprolite structure, lean clay (CL), brown (7.5YR 4/3)							
	131		6						**Massive A'a** Dark gray (10YR 4/1), moderately weathered, strong, 2% vesicles, subrounded, irregular, 2-20 mm, lean clay (CL) infilling fractures							
	132						IF									
-16		27		40		0										Light brown WR
	133						NR									
	134															
-18									No recovery							
	135													0.0	[50]	
	136															
-20																
	137															Light brown WR
		28		50		0										
	138								**Loose A'a Clinker** Dark gray (7.5YR 4/1), reddish yellow (7.5YR 6/6), moderately weathered, moderate strength, rounded clasts, Mn staining							
-22																
	139															
	140								**Massive A'a** Very dark gray (7.5YR 3/1), slightly to moderately weathered, moderate strength to strong, 1% vesicles, irregular, 2-6 mm, covered and completely infilled with lean clay (CL), very dark brown (7.5YR 2.5/2)							
-24							IF							0.0		
	141															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	141							IF	IF - clay infilling					
-26	142	29		30		0								Light brown WR
	143													
-28	144								No recovery					End coring for 04/06/21
	145											0.0	[25]	Resume coring on 04/07/21
-30	146													Light brown WR
	147	30		60		0			**Silt (ML)** Very dark brown (7.5YR 2.5/2), G 0 S 0 F 100					1 ft of saprolite, ~2 ft of silt - hard to tell based on recovery, see photos
-32	148													
	149								**Saprolite** Very dark brown (7.5YR 2.5/2), dark reddish brown (5YR 3/2), relic rock structures, rounded relic A'a Clinker clasts, very dark grayish brown (10YR 3/2)					
-34	150								**Loose A'a Clinker** Very dark gray (5YR 3/1), reddish brown (5YR 4/1), yellowish red (5YR 3/6), moderate to slightly weathered, strong			0.0	[60.2]	
	151								**Massive A'a** Very dark gray (5YR 3/1), slightly weathered, very strong, 3% vesicles, subrounded to subangular, <4 mm					Chattering
-36	152	31		80		18		IF	IF - Mn clay Sp 1. 20, J, N, Mn clay, Sp, Ir, R 2. 30, J, Mn, Fe clay, Sp, Wa, SR					
	153							IF	IF - Mn Sp, clay infilling					Brown WR
-38	154								No recovery					
	155								← becomes 5% vesicles, elongate, subrounded, 1-15 mm 1: 5, J, N, Mn Fe Sp, Ir, SR 2: 5, J, N, Mn Fe Sp, Wa, SR 3: 0, J, W, Mn Sp, St, SR 4: 10, J, VN, Mn Sp, Wa, SR ← becomes 1% vesicles, elongate, subrounded, <3 mm			0.0	[75.7]	
	156		7											Light brown WR
-40	157													

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157								← becomes 3% vesicles, subrounded, elongate, irregular, 2-18 mm 5: 0, J, MW, Mn Fe clay Sp, Wa, SR 6: 0, J, N, Mn Fe Sp, Wa, SR 7: 0, J, MW, Mn Fe Sp, St, SR 8: 0, J, N, Mn Fe Sp, clay Su, St, SR 9: 0, J, MW, Mn Fe Sp, Wa, SR 10: 0, J, VN, Mn Fe Sp, Wa, SR IF - Mn Fe clay Sp						
		32		96		27										
-42	158															
	159								← vug - 50 mm x 18 mm							
	160													0.0	[33.3]	
-44							NR		} No recovery							
	161															
	162								1: 5, J, W, Mn Su, Fe clay Sp, Wa, SR 2: 10, J, VN, Mn Fe Sp, clay Su, St, SR 3: 0, J, N, Mn Fe clay Sp, Wa, SR 4: 0, J, N, Mn Fe Sp, clay Su, Wa, S 5: 60, J, N, Mn Fe clay Sp, Wa, SR IF - Mn Su, clay Fe Sp						Slight chattering, light brown WR
-46		33		70		40										
	163								← becomes 3% vesicles, elongate, 6-30 mm							
	164															
-48																
	165													0.0	[100]	
							NR		} No recovery							
	166															
-50									**Loose and Welded A'a Clinker** Dark reddish brown (2.5YR 3/3), red (2.5YR 5/6), black (2.5YR 2/1), moderately weathered, strong ← becomes completely weathered, very weak							
	167															
							IF		**Pahoehoe** Dark gray (5YR 4/1), slightly weathered, strong, 10% vesicles, rounded to subrounded, 2-9 mm							Light brown WR
		34		76		58	M									
	168		8				1		← becomes 15% vesicles, subrounded to rounded, some clay in vesicles, 3-30 mm							
-52							2		← becomes 20% vesicles, rounded to subrounded, 1-13 mm 1: 0, J, VN, Mn Sp, Wa, SR 2: 5, J, VN, Mn Sp, clay Pa, Wa, SR 3: 20, J, N, Mn Fe clay Sp, Ir, SR 4: 0, J, N, Mn Fe clay Sp, Ir, SR 5: 45, J, VN, Mn Fe Sp, clay Pa, Ir, SR						
	169						3									
							4									
							5									
	170													0.0	[100]	
-54									} No recovery							
	171						NR									Light brown WR
	172								**Loose and Welded A'a Clinker** Black (5YR 2.5/1), dark reddish brown (5YR 3/2), moderately weathered, moderately strong, clay coating clasts, yellowish red (5YR 5/6)							
-56		35		62		0										
	173															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	173															
	174															
-58																
	175						IF		**Massive A'a** Dark gray (5YR 4/1), slightly weathered strong, 1% vesicles, <4 mm; vug - 35 x 17 mm at 175.2 ft bgs IF - Mn clay Su 1: 60, J, VN, Mn Fe clay Sp, Wa, R 2: 20, J, VN, Mn Fe Su, Wa, SR 3: 5, J, MW, Mn clay Su, Ir, SR					0.0	[100]	
	176						1									
-60							2									
	177						3 M M									Light brown WR
	178	36		40		0			No recovery							
-62																
	179															
	180								becomes 10% vesicles, elongate, subrounded, 2-20 mm 1: 0, J, VN, Mn Fe Sp, Wa, SR 2: 0, J, VN, Mn Fe Sp, Ir, SR 3: 40, J, VN, Mn Fe Sp, Wa, SR						[301.2]	
-64																
	181						1 2 3									
	182								No recovery, possibly loose A'a Clinker							
-66		37		96		54	IF		**Pahoehoe** Black (5YR 2.5/1), moderately weathered, moderately strong, 20% vesicles, rounded to subangular, 1-15 mm, partially infilled with clay, reddish yellow (5YR 6/6) 4: 90, J, N, Mn clay Sp, Wa, SR							Light brown WR, 40 gal WL, partial circulation
	183		9				M		5: 80, J, MW, Mn clay Sp, Ir, SR							
							4									
	184						5									
-68									← becomes highly weathered, very weak ← becomes weak, clay in fractures, reddish yellow (5YR 6/8)							
	185						IF							0.0	[151.5]	
	186															
-70									**Massive A'a** Dark gray (5YR 4/1), slightly weathered, very strong, 10% vesicles, subrounded, elongate, 1-18 mm 1: 45, J, MW, clay Pa, Wa, SR							
	187						1 2 3 4		2: 30, J, N, Mn Fe clay Sp, Wa, SR 3: 20, J, N, Mn Fe clay Sp, Wa, SR 4: 10, J, N, Mn Fe clay Sp, Wa, SR							Light brown WR, 60 gal WL, partial circulation.
	188	38		66		0			5: 45, J, N, Mn clay Sp, Wa, SR ← becomes very dark gray (5YR 3/1), moderately weathered, strong, 15% vesicles, 2-15 mm							
-72							5									
	189															

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Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	189						NR		No recovery					
-74	190								**Pahoehoe** Black (5YR 2.5/1), moderately weathered, weak to moderately strong, broken pieces are covered / filled with clay, reddish yellow (5YR 5/8)			0.0	[151.5]	
	191						IF		IF - clay infilling					
-76	192	39		60		13			**Massive A'A** Very dark gray (5YR 3/1), moderately weathered, strong, 5% vesicles, subrounded, elongate, <1-12 mm					Lost circulation at start of run, approx. 100 ft bgs, ~100 gal WL
	193						IF		IF - clay infilling, reddish yellow (5YR 5/8)					
-78	194						NR		No recovery					
	195								← becomes very dark gray (10YR 3/1), slightly weathered, very strong, 25% vesicles, subrounded, elongate, 1-11 mm, partially infilled with clay, yellow (10YR 8/6)			0.0	[75.7]	
	196		10				1 2		1: 0, J, N, Mn Fe clay Sp, Wa, SR 2: 0, J, N, Mn Fe clay Sp, Wa, SR					
-80							IF		3: 0, J, N, Mn Fe Sp, clay Su, Wa, SR 4: 60, J, VN, Mn Fe clay Sp, Wa, SR					
	197						3		← becomes dark gray (10YR 4/1), slightly weathered, extremely strong, 10% vesicles, subrounded, 1-13 mm, vuggy (34 mm x 17 mm), some clay in vesicles, reddish yellow (5YR 7/6)					100 gal WL
		40		100		28	4		IF - clay Pa Su, Mn Fe Sp 5: 0, J, VN, Mn Su, clay Sp, Wa, SR 6: 0, J, VN, Mn Fe clay Sp, Wa, SR 7: 0, J, VN, Mn Fe Su, clay Su Sp, Wa, SR					
-82	198						5							
	199						6 7							
							IF							
-84	200								← becomes 3% vesicles, subrounded, <1 mm			0.0	[60.2]	
	201						IF		← becomes moderately weathered, very strong. IF - clay in fractures, partially infilled, reddish yellow (5YR 7/6)					100 gal WL Chattering
	202								**Saprolite** Red (10YR 4/6), relic rock texture, lean clay (CL) present					
-86		41		80		0	NR		No recovery					
	203								**Welded A'a Clinker** Dark brown (7.5YR 3/2), dusky red (10R 3/4), black (5YR 2.5/1), moderately weathered, moderately strong, covered / voids filled with clay, reddish yellow (5YR 6/6)					Rods dropped from approximately 202 to 203 ft bgs
	204						1 2 3		**Massive A'a** Very dark gray (5YR 3/1), slightly weathered, very strong, 3% vesicles, subrounded, irregular, 2-13 mm, partially infilled with clay, reddish yellow (5YR 6/6)					
-88							IF							
	205													

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	205								No recovery			0.0	[75.7]	
-90	206								1. 0, J, N, clay Su Pa, Wa, SR 2. 5, J, MW, clay Sp, Wa, SR 3. 5, J, MW, clay Mn Sp, Wa, SR					
	207								**Loose A'a Clinker** Dark brown (7.5YR 3/2), moderately weathered, moderately strong					
		42		86		0			**Silty Sand (ML)** Black (7.5YR 2.5/1), G 5 S 15 F 80, lithics present, wet					100 gal WL
-92	208													
	209													
	210											0.0	[100]	
-94	211		11						No recovery					
	212								**Massive A'a** Dark gray (7.5YR 4/1), moderately weathered, strong, 15% vesicles, subrounded to subangular, irregular, 2-15 mm					100 gal WL
-96		43		60		13	IF							
	213						1		IF - fractures and vesicles infilled with clay, reddish yellow (7.5YR 7/6) 1: 5, J, VN, Mn Fe clay Sp, Wa, SR					
							IF		2: 5, J, VN, Mn clay Sp, Wa, SR					
-98	214						2							End coring on 04/07/21 TD = 215 ft bgs
	215								OWDFMW06A was hand cleared from ground surface to 5 ft bgs (116.28 ft msl to 111.28 ft msl). Hollow-stem auger drilling commenced from ground surface to 20 ft bgs (116.28 ft msl to 96.28 ft msl), until reaching refusal. HQ coring commenced from 20 ft bgs to 70 ft bgs (96.28 ft msl to 46.28 ft msl). The borehole was reamed with a 17.5-inch tricone bit from ground surface to 84 ft bgs (116.28 ft msl to 32.28 ft msl) to set a conductor casing. A 10-inch diameter steel conductor casing was installed to 70 ft bgs (46.28 ft msl). HQ coring continued from 70 ft bgs to 215 ft bgs (46.28 ft msl to -98.72 ft msl). HQ coring terminated at a total depth of 215 ft bgs (-98.72 ft msl). The borehole was reamed with a 9 7/8-inch tricone bit from 70 ft bgs to 215 ft bgs (46.28 ft msl to -98.72 ft msl) for well construction. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 600 gallons of water were used during drilling and rock coring. OWDFMW06A well construction was completed on June 18, 2021. The well was completed with 4-inch diameter Schedule 80 polyvinyl chloride (PVC) blank well casing from approximately 3.2 ft above ground surface to 190 ft bgs (119.51 ft msl to -73.72 ft msl) and a 0.020-inch slotted screen between 190 ft bgs to 210 ft bgs (-73.72 ft msl to -93 ft msl). The casing was stabilized with centralizers placed at the top and bottom of the screened section, and then spaced every 40 ft up from the top of the screen. The filter pack extended from 211 ft bgs to					
-100	216													
	217													
-102	218													
	219													
-104	220													
	221													

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW06A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	221								184 ft bgs (-94.72 ft msl to -67.72 ft msl). The bentonite seal was placed from 184 ft bgs to 179 ft bgs (-67.72 ft msl to -62.72 ft msl). A 100% bentonite slurry was placed from 179 ft bgs to 68 ft bgs (-62.72 ft msl to 48.28 ft msl [into the 10-inch conductor casing]). Cement/grout was placed to the ground surface. The surface completion consists of an approximately 3.2-foot stick up monument inside of an 8-inch diameter protective steel casing set on a concrete well pad approximately 1 ft above ground surface. A total of approximately 5,670 gallons of development water was removed during development, after well construction.							
-106	222															
	223															
-108	224															
	225															
-110	226															
	227															
-112	228															
	229															
-114	230															
	231															
-116	232															
	233															
-118	234															
	235															
-120	236															
	237															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW07A

Sheet 1 of 17

Date(s) Drilled	05/11/21 to 06/02/21	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Air Knife / HSA / HQ	Drill Bit Size/Type	17.5" rotary / 9.875" rotary / HQ diamond bit	Total Depth of Borehole	247.0 feet
Drill Rig Type	Mobile-B80	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	120.1
Groundwater Level	99.51 ft bgs / 17.99 ft msl 9/28/2021	Location	OWDFMW07A	Inclination from Horizontal/Bearing	90 degrees
Borehole Completion	4-inch diameter monitoring well			Hammer Data	not applicable

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
120	0								**FILL**						Air knife to refusal at 4 ft bgs and HSA to 5 ft bgs on 5/11/21
	1	1													HSA to refusal at 6 ft bgs. Use production auger to set mudpan on 5/12/2021
118	2								← Fill and bentonite from setting the mudpan						Start HQ coring from 2 ft bgs on 5/13/21
	3														
116	4	2	1												Light gray WR
	5														HSA refusal at 6 ft bgs on 05/12/21
114	6														Resume on 05/13/21 at 6 ft bgs
	7												0.0	[50]	
112	8														
	9	3		20		0	NR		No recovery						Light gray WR
110	10														
	11						IF		Massive a'a basalt boulder, very dark gray (GLEY1 3/N), slightly weathered, strong, 20% vesicles, elongate, subrounded, irregular, <4 mm, some clay in fractures						
108	12						NR		No recovery				0.0	[100]	
	13														

Report: CTO53 RED HILL WITH WELL AND PID; File: OWDF_BORINGLOGS.GPJ; 6/7/2022 OWDFMW07A

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
106	13								**Saprolite** Brownish yellow (10YR 6/8), yellowish brown (10YR 5/6), very dark brown (10YR 2/2), very pale brown (10YR 8/2), black (10YR 2/1). Relic rock structure, mottling, dry inside (some basalt rounded to subrounded weather pieces fallen to top of run)							Light gray/brown WR
	14	4		80		0										
	15															
104	16															
	17						NR		No recovery					0.0	[60.2]	
102	18								same as above							
	19	5		80		0										Light brown WR
100	20		1													
	21															
98	22								same as above					0.0	[75.7]	
	23															
96	24	6		100		0										Light gray/brown WR
	25								**Massive A'a** Broken up basalt pieces, black (10YR 2/1), highly weathered, weak, clay and saprolite in fractures							
94	26						IF									
	27								becomes olive brown (2.5YR 4/3) highly weathered to completely weathered, very weak to extremely weak Mn and Fe in fractures					0.0	[43.1]	
92	28		2				IF									Light gray/brown WR
	29															

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
90	29															
	30	7		90		0			M							
	31								IF heat alteration/potential flow contact, dark reddish brown (2.5YR 3/4)							~100 gal partial circulation loss
88	32						NR							0.0	[43.1]	
	33						NR		No recovery							
86	34	8		50		0			becomes moderately weathered and moderate strength							Light brown WR
	35								M							~100 gal partial circulation loss
84	36								IF							
	37								**Lean Clay with Sand (CL)** Dark grayish brown (10YR 4/2). Low plasticity, G 10 basalt fragments, S 15, F 75 some silt, mostly clay, dry inside					0.0	[151.5]	
82	38								**Pahoehoe** Dark grayish brown (10YR 4/2), moderately weathered, very weak, 10% vesicles up to 26 mm, subrounded, rounded, Mn and Fe staining in vesicles							
	39	9		20		0										Light brown WR
80	40						NR		No recovery							~100 gal partial circulation loss
	41															
78	42								**Loose A'a Clinker** Subrounded to rounded, dark brown (7.5YR 3/2), moderately weathered, moderately strong to weak, some lean clay with sand (CL)					0.0	[100]	
	43		3						**Massive A'a** Dark grayish brown (7.5Y 4/2), moderately weathered, weak Mn Sp, Fe Su on fractures							~50 gal partial circulation loss
76	44								IF M							
	45	10		40		0	NR		No recovery							Light gray WR

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
74	45															
	46						NR		No recovery							
	47								same as above (Massive A'a) with rounded to subrounded clinker clasts mixed in (assumed slough from above) some lean clay with sand (CL)					0.0	[43.1]	
72	48							IF								~50 gal partial circulation loss
	49	11		30		0										Light brown WR
70	50						NR									
	51								No recovery							
68	52													0.0	[75.7]	
	53															~50 gal partial circulation loss
66	54	12		56		0										Light brown WR
	55								**Loose A'a Clinker** Subrounded to rounded, very dark gray (2.5Y 3/1), strong brown (7.5YR 5/8), moderately weathered, moderately strong							
64	56								**Saprolite** Mottling, dark reddish brown (5YR 3/2), gray (5YR 5/1), reddish yellow (5YR 6/8), some weathered basalt fragments subangular to subrounded, dry inside							
	57													0.0	[151.5]	
62	58						NR									~50 gal partial circulation loss
	59								No recovery							
	60	13		20		0										Light brown WR
60	61															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
61	61															
							IF		**Massive A'a** Subrounded to subangular pieces. Dark gray (7.5YR 4/1), highly weathered, very weak to extremely weak, some lean clay (CL) in pieces, Fe and Mn staining on pieces					0.0	[75.7]	
58	62															
	63						NR		No recovery							~50 gal partial circulation loss
56	64								same as above							Light brown WR
		14		58		0										
	65								**Saprolite** Reddish yellow (5YR 6/6), dark reddish brown (5YR 3/3), black (5YR 2.5/1), relic rock structure, some sand, some basalt gravel (subrounded), dry inside							
54	66															
	67													0.0	[60.2]	
52	68		4				NR		No recovery							~200 gal partial circulation loss
	69															Light brown WR
		15		24		0										
50	70															
	71						M IF		**Massive A'a** Broken pieces, some subrounded CL interclasts mixed together, black (5YR 2.5/1), yellowish red (5YR 5/8), dark reddish gray (5YR 4/2), highly weathered, weak							
48	72								**Saprolite** Dark reddish brown (5YR 3/2), black (5YR 2.5/1, yellowish red (5YR 4/6), gray (GLEY1 5/N), mottling, dry inside, some basalt gravel, subrounded / basalt pieces					0.0	[33.3]	
	73															~200 gal partial circulation loss
46	74															Light brown WR
		16		86		0										
	75															
44	76						NR		No recovery							
	77															

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
42	77								same as above					0.0	[60.2]	
	78															~100 gal partial circulation loss
	79	17		84		0										Light brown WR
40	80							IF	**Massive A'a** Subangular to subrounded broken pieces, brown (7.5 YR 4/4), black (7.5 YR 2.5/1), moderately to slightly weathered, very weak, some sandy fat clay (CH) in between pieces							
	81							M								
							NR		No recovery							
38	82								**Saprolite** Dark reddish brown (5YR 3/2), black (5YR 2.5/1), yellowish red (5YR 4/6), gray (GLEY1 5/N), mottling, dry inside, some basalt gravel					0.0	[100]	
	83															~100 gal partial circulation loss
36	84	18	5	50		0		IF	**Pahoehoe** Subrounded, weathered pieces, yellowish red (5YR 5/8), dark reddish gray (5YR 4/2), black (5YR 2.5/1), highly weathered, very weak, 2% subrounded vesicles, <2 mm on some pieces							Light brown WR
	85															
34	86						NR									End coring on 05/13/21
	87														[100]	
	88								No recovery							Resume coring on 05/14/21
32	89						NR									
		19		0		0										~150 gal partial circulation loss
30	90															Light brown WR
	91															
28	92							IF	**Massive A'a** Subangular to subrounded broken pieces, brown (7.5YR 4/4), black (7.5YR 3/1), moderately to highly weathered, very weak, sandy fat clay (CH) on pieces					0.0	[60.2]	~150 gal partial circulation loss
	93															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
26	93															Light brown WR
	94	20		40		0	M		increasing clay (CH) content, G 10 S 20 F 70							~100 gal partial circulation loss
	95						NR									
24	96															
	97													0.0	[100]	
22	98								No recovery							
	99	21		0		0	NR									~50 gal partial circulation loss
20	100															Light brown WR
	101															
18	102						M		Broken massive a'a, subangular to subrounded pieces, brown (7.5YR 4/4), black (7.5YR 2.5/1), strong brown (7.5YR 5/6), highly weathered to completely weathered, very weak to extremely weak, some sandy fat clay (CH) in between pieces, G 10 S 20 F 70 Mn and Fe Su on fractures						0.0	[151.5]	
	103						IF									<50 gal partial circulation loss
16	104	22		34		0										Light brown WR
	105						NR		No recovery							
14	106															
	107								same as above, some red coloring (2.5YR 4/6) on fractures					0.0	[151.5]	
12	108						IF M									<50 gal partial circulation loss
	109						NR		No recovery							Light brown WR

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
10	109	23		30		0										
	110						NR		No recovery							
	111															
8	112								same as above					0.0	[312.5]	
	113						IF M									Light brown WR, no WL
6	114	24		36		0	NR									
	115															
4	116															
	117								No recovery					0.0	[100]	
2	118						NR									
	119															Light brown WR, no WL
0	120	25		50		0			same as above							
	121								**Saprolite** Relic pahoehoe vesicle structures, relic rock fabric, red (2.5YR 4/6), brown (7.5YR 4/3), black (7.5YR 2.5/1), subrounded basalt gravel, some clay (CH)							
-2	122		6						**Massive A'a** Subangular to subrounded broken pieces, brown (7.5YR 4/4), black (7.5YR 2.5/1), strong brown (7.5YR 5/6), highly weathered to completely weathered, very weak to extremely weak, some sandy fat clay (CH) on pieces, G 10 S20 G 70					0.0	[60.2]	
	123						IF M NR		IF - Mn Fe, Su							Light brown WR, no WL
-4	124	26		24		0			No recovery							
	125															

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-6	125															
	126						NR									
	127													0.0	[100]	
-8	128															Light brown WR, ~100 gal partial circulation loss
	129						NR									
		27		0		0										
-10	130								No recovery							
	131															
-12	132													0.0	[60.2]	
	133															Light brown WR, ~100 gal partial circulation loss
-14	134															
		28		20		0	NR									
	135															
-16	136							M	**Pahoehoe** Subrounded to rounded clasts, brown (7.5YR 4/3), moderately weathered, weak, 5% vesicles, 1-4 mm, rounded to subrounded							
								IF	**Loose A'a Clinker** Subrounded clasts, strong brown (7.5YR 5/6), black (7.5YR 5/6), black (7.5YR 2.5/1), moderately weathered, weak, Mn staining						[43.1]	
	137															
							NR		**Massive A'a** Dark gray (10YR 4/1), moderately weathered, moderate strength, Mn and Fe staining on fractures, 2% vesicles, elongate, subrounded, 5-19 mm, Mn and Fe in vesicles No recovery							
-18	138															
	139															
		29		40		0		IF	IF: Mn and Fe Su							
-20	140								←becomes brown (7.5YR 4/2), black (7.5YR 2.5/1), strong brown (7.5YR 5/8), highly to completley weathered, very weak, some sandy fat clay (CH)							
	141															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	141															
-22	142								**Saprolite** Brown (7.5YR 4/2), black (7.5YR2.5/1),gray (2.5Y 6/1), strong brown (7.5YR 5/8), relic Massive A'a structure, Mn and Fe staining on relic structures evident					0.0	[37.6]	
	143		6						**Pahoehoe** Subrounded clasts, black (7.5YR 2.5/1), moderately weathered, moderate strength, 7% vesicles, 1-9 mm, subrounded, Mn, Fe and halloysite in vesicles, clay on surface							Light brown WR, ~100 gal partial circulation loss
-24	144								**Massive A'a** Brown (7.5YR 4/2), black (7.5YR 2.5/1), highly weathered, weak to moderate strength, some saprolite, some sandy fat clay (CH)							
		30		100		0			**Fat Clay (CH)** Dark gray (7.5YR 4/8), G 5 S 5 F 90, high plasticity, becomes stiffer with depth, dry inside							
	145															
-26	146		7													End coring on 05/14/21
	147								← same as above with some basalt pieces included moderate weathering, moderate strength					0.0	[37.6]	Resume coring on 05/28/21
-28	148															
	149															Light grayish brown WR
		31		100		0										
-30	150															
	151															
-32	152								← same as above, more basalt, very dark gray (10YR 3/1), moderate weathering, moderate strength						[27.3]	
	153															Light brown WR
-34	154															Chattering at the beginning of run, smooth for the rest of the run
		32		40		0	NR									
	155															
-36	156								No recovery							
	157															

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157								Fat clay with sand (CH), G 5 S 15 F 80					0.0	[30.1]	Light brown WR
	158															
-38	159	33	8	80		0										
-40	160								**Massive A'a** Very dark gray (10YR 3/1), moderately weathered, strong							Slight grinding with ~2 ft of run left
	161															
-42	162								No recovery					0.0	[50]	
	163															
-44	164	34		70		29			**Loose and Welded A'a Clinker** Dark reddish gray (2.5YR 3/1), reddish brown (2.5YR 4/4), red (2.5YR 5/6), moderate to heavy weathering, weak							Light brown WR
	165															
-46	166						1		1: 30, J, N, clay Pa, Wa, SR							
	167								**Massive A'a** Very dark gray (7.5YR 3/1), moderate weathering, moderate strength, 10% vesicles, elongate, subrounded, 3-12 mm					0.0	[43.1]	
-48	168								**Pahoehoe** Black (7.5YR 2.5/1), moderately to highly weathered, 10% vesicles, <3 mm, subrounded to rounded IF - clay in fractures							
	169								**Welded A'a Clinker** Black (7.5YR 2.5/1), dark brown (7.5YR 3/3), moderately weathered, moderately strong to weak							Light brown WR
-50	170	35		100		20	IF									
	171								**Massive A'a** Very dark gray (7.5YR 3/1), moderate weathering, moderate strength, 5% vesicles, subrounded, elongate, 1-10 mm							
-52	172								**Pahoehoe** Possible flow contact, black (7.5YR 2.5/1), moderate weathering, moderate strength, 20% vesicles, rounded to subrounded, <5 mm					0.0	[60.2]	
	173								becomes 5% vesicles, rounded to subrounded, 1-6							

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-54	173		9					IF	mm							
	174	36		100		60		1								Light brown WR, ~30 gal WL
								2	←becomes 7% vesicles, rounded to subrounded, <3 mm							
	175							3								
								4	←becomes 10% vesicles, rounded to subrounded, <3 mm							
-56	176							5	1: 90, J, MW, Mn Sp, clay Pa, Wa, SR 2: 80, J, N, Mn Sp, clay Pa, Wa, SR 3: 5, J, N, Mn Sp, clay Pa, Ir, SR 4: 5, J, MW, Mn Sp, clay Su, Ir, SR							
								IF	5: 5, J, MW, Mn clay Sp, Ir, SR							End coring on 05/28/21
	177													0.0	[100]	Resume coring on 06/01/21
								1								
								2								
-58	178							3	←becomes brown (7.5YR 4/3), reddish yellow (5YR 6/6), highly weathered, weak, Mn and clay covering pieces							
								4								
								5	←becomes dark gray (7.5YR 4/1), moderately weathered, moderate strength, 10% vesicles, subrounded to rounded, 3-22 mm							
	179	37		100		52		6	1: 70, J, N, Mn Sp, clay Su, Wa, SR							Light brown WR
								7	2: 70, J, N, Mn Sp, clay Su, Wa, SR 3: 30, J, MW, Mn Sp, clay Su, Ir, R 4: 45, J, N, Mn Sp, clay Su, Wa, SR							
-60	180							8	5: 10, J, N, Mn clay Su, Ir, R 6: 45, J, N, Mn clay Sp, Wa, R							
								9	←becomes 5% vesicles, rounded to subrounded, 1-6 mm							
	181							10	7: 5, J, N, Mn Sp, clay Su, Wa, R 8: 20, J, VN, Mn Sp, clay Su, Wa, R 9: 50, J, VN, Mn clay Sp, Wa, SR							
								11	10: 30, J, N, Mn Sp, clay Su, Wa, R 11: 60, J, VN, Mn, Sp, clay,Su, Ir, SR							
-62	182													0.0	[151.5]	
			10					1	1: 0, J, W, Mn Sp, clay Su, Ir, SR ←becomes 20% vesicles, subrounded to rounded, 3-17 mm							
								2	2. 5, J, W, Mn Fe Sp, Wa, SR							
	183							3	← becomes 10% vesicles, subrounded to rounded, 1-13 mm, vugs present 30 x 5 mm							
								4								
								M	← possible heat alteration, red (10R 4/6)							
-64	184								3. 0, J, N, Mn Su, Fe Sp, Wa, SR							Light brown WR
		38		100		32		IF	← becomes dusky red (10R 3/2), reddish brown (2.5YR 4/3), moderately weathered, moderate strength, 5% vesicles, rounded to subrounded, <1-10 mm IF - clay Mn, Su Sp							
	185								← becomes dark brown (7.5YR 3/2), moderately weathered, moderate strength, 10% vesicles, subrounded to rounded, 1-6 mm							
								5								
-66	186							6	← heat alteration from 185.7 to 186.3 ft bgs, dark yellowish brown (10YR 3/4), becomes 5% vesicles, subrounded to rounded, <1-4 mm							
									4. 5, J, N, Mn clay Sp, Wa, SR 5. 60, J, MW, Mn clay Su, Fe Sp, ST, SR 6. 60, J, MW, Mn Fe Sp, clay Su, Wa, SR							
	187							IF						0.0	[75.7]	
									Massive A'A Very dark gray (GLEY1 3/N), slightly weathered, very strong, 5% vesicles, subrounded, irregular, elongate, <10 mm, 2% halloysite, some vugs 50 x 30 mm							Light brown WR
-68	188							1	1: 5, J, VN, Mn Fe clay Sp, Wa, R							
	189															

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	189								2: 60, J, N, Mn Fe clay Sp, Wa, SR							
		39		100		60										
-70	190						2									
	191		11													
-72	192								← same as above 1: 10, J, N, Mn, Sp, Wa, SR 2: 5, J, N, Mn, Sp, Clay, Pa, IR, R 3: 5, J, MW, Mn, Sp, Clay, Sp+Pa, IR, R 4: 5, J, VN, Mn, Clay, Sp, Wa, SR 5: 5, J, MW, Mn, Clay, Sp, IR, R 6: 5, J, MW, Mn, Clay, Sp, Wa, R					0.0	[100]	
	193															
-74	194						1									Light brown WR
		40		100		78			← becomes very dark gray (10YR 3/1), moderately weathered, moderate strength to weak, 2% vesicles, irregular, subangular to subrounded, 1-5 mm, clay filling vesicles, light red (2.5YR 6/8)							
	195						2 3									
							4									
-76	196						5 M 6									
	197								← becomes very dark gray (GLEY 3/N), slightly weathered, 5% vesicles, subrounded, elongate, <2 mm, 2% halloysite mineral phenocrysts, some vugs 45 x 80 mm IF - clay in fractures					0.0	[60.2]	
-78	198						IF									
	199								← becomes very dark gray (5YR 3/1), moderately weathered, moderate strength to weak, 5% vesicles, subrounded, <6 mm IF - clay in fractures, partially infilling, red (2.5YR 5/8), reddish yellow (5YR 3/8), Mn Fe, Sp							Light brown WR
		41		100		40										
-80	200						IF									
	201		12													
-82	202								← same as above IF - clay Mn Fe, Sp					0.0	[75.7]	
	203						IF									Light brown WR
-84	204															
		42		90		0			← becomes weak							
	205															

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-86	205															
	206															
	207						NR		No recovery same as above					0.0	[60.2]	
-88	208								increasing clay content, light red (2.5YR 6/8), clay coating/covering IF pieces							
	209	43		80		0	IF		becomes highly weathered, very weak, clay covering pieces, light red (2.5YR 6/8)							Light brown WR, ~60 gal WL partial circulation loss
-90	210															
	211		13				NR		No recovery							
-92	212								**Pahoehoe** Dark brown (7.5YR 3/2), dusky red (2.5YR 3/2), reddish black (2.5YR 2.5/1), moderate weathering, weak					0.0	[100]	
	213						IF		becomes highly weathered, weak							
-94	214	44		60		0			becomes weak, red (10R 4/4), black (5YR 2.5/1), clasts included, moderately weathered, moderate strength							Light brown WR, ~60 gal WL partial circulation loss
	215															
-96	216						NR		No recovery							
	217								same as above					0.0	[37.6]	
-98	218															Light brown WR, ~150 gal WL partial circulation loss
	219	45		40		0										
-100	220						NR		No recovery							
	221															

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	221						NR							End coring on 06/01/21
-102	222								**Massive A'a** Dark gray (GLEY1 4/N), slightly weathered, very strong, 5% vesicles, 1-3 mm, 1% unweathered olivine phenocrysts			0.0		Resume coring on 06/02/21
							IF		IF - clay Su, Mn Fe Sp					
	223						1		1: 70, J, VN, Mn clay Sp, Wa, SR					Fully lost circulation at ~223 ft bgs, ~300 gal WL
							2		2: 60, J, VN, Mn Fe Sp, Wa, SR					
-104	224	46		84		60								
	225													
-106	226		14				IF		No recovery					
							NR							
	227								same as above			0.0	[30.1]	
									becomes moderately weathered, moderate strength					
-108	228						IF		IF - clay, Pa Su, reddish yellow (5YR 6/6), Mn Fe, Sp					
	229								becomes dark reddish gray (5YR 4/2), reddish brown (5YR 5/4), reddish yellow (5YR 6/6), slightly weathered, very to extremely weak					~400 gal WL
		47		54		30	IF							
-110	230													Per driller "can feel water ~100 ft down barrel = basal"
	231						NR		No recovery					
-112	232								becomes dark gray (7.5Y 4/1), moderately weathered, moderately strong to strong, 2% vesicles, < 5 mm				[50]	
	233								IF - clay Pa Sp, reddish yellow (5YR 6/8), Mn, Fe, Sp					
							IF							
-114	234						M							~400 gal WL
		48		90		0								
	235													
-116	236													
	237													

Report: CTO53 RED HILL WITH WELL AND PID; File: OWDF_BORINGLOGS.GPJ; 6/7/2022 OWDFMW07A

Project: Site Assessment Red Hill Oily Waste Disposal Facility
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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	237						NR		No recovery					0.0	[60.2]	
-118	238						1		becomes dark gray (7.5YR 4/1), slightly weathered, very strong, 3% vesicles, subrounded, elongated, irregular, 1-16 mm 1: 5, J, MW, Mn Su Sp, clay Su, Wa, SR 2: 5, J, MW, Mn clay Sp Su, Wa, SR 3: 5, J, MW, Mn Fe clay Sp, Ir, SR 4: 10, J, VN, Mn Fe Sp, Wa, SR							
	239	49		88		39	2 3 4		**Welded A'a Clinker** Black (7.5YR 2.5/1), brown (7.5YR 5/3), reddish yellow (7.5YR 7/6), moderate to slightly weathered, strong, clay							~400 gal WL
-120	240						5 6 7 M		**Pahoehoe** Possible flow contact, heat alreration, weak red (10R 5/4)							
	241		15						becomes reddish brown (2.5YR 5/4), moderate weathering, moderate strength to weak, 15% vesicles, subrounded to rounded, up to 3 mm, Mn clay in vesicles 5: 50, J, VN, Mn Sp Pl, S (surface oxidized) 6: 0, J, MW, Mn clay Fe Sp, Wa, R 7: 5, J, MW, Mn clay Fe Sp, Wa, R							
-122	242														[312.5]	
	243						IF		becomes highly to completely weathered, extremely weak							
-124	244	50		70		14			becomes moderate to highly weathered, moderate strength to weak							
	245															
-126	246						NR		No recovery							End coring on 6/2/21 TD = 247 ft bgs
	247								OWDFMW07A was cleared with an air knife from ground surface to 4 ft bgs (120.11 ft msl to 116.11 ft msl). The borehole was drilled using hollow stem auger from ground surface to refusal at 6 ft bgs (120.11 ft msl to 114.11 ft msl). HQ coring commenced from 2 ft bgs to 145 ft bgs (118.11 ft msl to -24.89 ft msl). The borehole was reamed with a 17.5-inch tricone bit from ground surface to 145 ft bgs (120.11 ft msl to -24.89 ft msl) to set a conductor casing. A 10-inch diameter steel conductor casing was installed to 118 ft bgs (2.11 ft msl). HQ coring continued from 145 ft bgs to 247 ft bgs (-24.89 ft msl to -126.89 ft msl). HQ coring terminated at a total depth of 247 ft bgs (-126.89 ft msl). The borehole was reamed with a 9 7/8-inch tricone bit from 143 ft bgs to 247 ft bgs (-22.89 ft msl to -126.89 ft msl) for well construction. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 3,250 gallons of water were used during drilling and rock coring. OWDFMW07A well construction was completed on June 7, 2021. The well was completed with 4-inch diameter Schedule 80 polyvinyl chloride (PVC) blank well casing from ground surface to 224 ft bgs (120.11 ft msl to -103.89 ft msl) and a 0.020-inch slotted screen between 224 ft bgs to 243.60 ft bgs (-103.89 ft msl to -123.49 ft msl). The casing was stabilized with centralizers placed at the top and bottom of the screened section, and then spaced every 40 ft up from the top of the screen. The							
-128	248															
	249															
-130	250															
	251															
-132	252															
	253															

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Log of Boring OWDFMW07A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
-134	253								filter pack extended from 247 ft bgs to 218 ft bgs (-126.89 ft msl to -97.89 ft msl). The bentonite seal was placed from 218 ft bgs to 210 ft bgs (-97.89 ft msl to -89.89 ft msl). A 100% bentonite slurry was placed from 210 ft bgs to 118 ft bgs (-89.89 ft msl to 2.11 ft msl [into the 10-inch diameter conductor casing]). Cement/grout was placed to the ground surface. The surface completion consists of flush mount completion. A total of approximately 2,670 gallons of development water was removed during development after well construction.						
	254															
	255															
-136	256															
	257															
-138	258															
	259															
-140	260															
	261															
-142	262															
	263															
-144	264															
	265															
-146	266															
	267															
-148	268															
	269															

Report: CTO53 RED HILL WITH WELL AND PID; File: OWDF_BORINGLOGS.GPJ; 6/7/2022 OWDFMW07A

Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW08A

Sheet 1 of 12

Date(s) Drilled	04/09/21 to 04/22/21	Logged By	(b) (6)	Checked By (Date)	(b) (6)
Drilling Method	Hand clear / HSA / HQ	Drill Bit Size/Type	17.5" rotary / 9.875" rotary / HQ diamond bit	Total Depth of Borehole	168.0 feet
Drill Rig Type	Mobile-B80	Drilling Contractor	Valley Well Drilling	Approximate Surface Elevation	134.0
Groundwater Level	115.90 ft bgs / 17.50 ft msl 9/28/2021	Location	OWDFMW08A	Inclination from Horizontal/Bearing	90 degrees
Borehole Completion	4-inch diameter monitoring well			Hammer Data	140lb auto-hammer

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								Asphalt						[75]	4/19/21 Hand cleared to about 5ft bgs. HSA from 0 ft bgs
	1		1						**FILL**							
132	2	1														Smooth drilling
	3															
130	4															
	5														[2.9]	
128	6	2														Smooth drilling
	7								← Dark grayish brown (10YR 4/2) fill				>50			Sampled 7.5-9.0 ft bgs. Refusal for blow counts
126	8								Massive A'a boulder, very dark gray (5YR 3/1), slightly weathered, strong, 5% vesicles, subrounded, elongate, 1-8 mm					0.0	[100]	HSA refusal at 8 ft bgs 4/9/21
	9						IF		**Gravelly Lean Clay (CL)** Dark reddish brown (5YR 2.5/2), G 25 S 15 F 60, low plasticity							Resume HQ coring on 4/12/21
124	10	3		68		0										
	11						IF		Massive A'a boulder, very dark gray (5YR 3/1), moderately weathered, strong, Mn staining							Light brown WR
122	12						WR		No recovery							
	13															

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Log of Boring OWDFMW08A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
120	13								**Saprolite** Dark yellowish brown (10YR 4/4), light gray (10YR 7/1), black (10YR 2/1), yellow (2.5Y 7/6), strong brown (7.5YR 5/8), extremely weak, rock texture/fabric, mottling evident, lean clay (CL) present					0.0	[100]	
	14															
	15	4		100		0										Light brown WR
118	16															
	17															
116	18								← same as above					0.0	[300]	
	19															
114	20	5	2	100		0										Light brown WR
	21															
112	22															
	23								← same as above					0.0	[150]	
110	24															
	25															Light brown WR
	26	6		60		0										
108	27						NR		No recovery							
	28								← same as above					0.0	[150]	
106	29															

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Log of Boring OWDFMW08A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
104	30	7		100		0			slightly stronger/stiffer, relic vesicles, Mn, weak to moderate strength							Light brown WR
102	32		3						becomes weak to moderately strong, slightly more "rock-like" but still overall saprolite					0.0	[100]	
100	34	8		90		0										Light brown WR
98	36						NR		No recovery					0.0	[150]	
96	38							IF	**Massive A'a** Dark brown (7.5YR 3/2), highly weathered, weak, Mn Fe Sp, Clay Sp (reddish yellow (7.5YR 7/6))							
94	40	9		74		0			becomes dark grayish brown (2.5Y 4/2), moderately weathered, moderate strength, 2% vesicles, elongate, irregular, <12 mm							Light brown WR
92	42							IF	IF - Mn Su, clay, yellow (10YR 7/8), Su					0.0	[75]	
90	44								No recovery							Light brown WR
	45															

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Log of Boring OWDFMW08A

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES Type Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45														
		10		20		0									
88	46						NR								
	47														
86	48								No recovery. Clinker and/or Massive A'a pieces per drill rig sound/motion, and per driller rods did not "drop"				0.0	[75]	
	49		4												Light brown WR
84	50						JR								"hard rock" per driller
		11		0		0									
	51														Chattering
82	52														
	53								No recovery. Clinker and/or Massive A'a pieces per drill rig sound/motion, and per driller rods did not "drop"				0.0	[37.5]	
80	54														Light brown WR
	55						NR		← 04/14/21 - sample collected during reaming. Broken up basalt Massive A'a fragments and A'a Clinker, lean clay with sand (CL), very broken from reaming						"hard rock" per driller
		12		0		0									
78	56														Chattering
	57														
76	58								No recovery. Clinker and/or Massive A'a pieces per drill rig sound/motion, and per driller rods did not "drop"				0.0	[42.9]	
	59														Light brown WR
74	60						NR								"hard rock" per driller
		13		0		0									
	61														

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Log of Boring OWDFMW08A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
72	61															Chattering
	62						NR									
	63								No recovery. Clinker and/or Massive A'a pieces per drill rig sound/motion, and per driller rods did not "drop"					0.0	[8.6]	
70	64															Light brown WR
	65						NR									
		14		0		0										
68	66															Chattering
	67															
66	68								No recovery. Clinker and/or Massive A'a pieces per drill rig sound/motion, and per driller rods did not "drop"					0.0	[30]	
	69															Light brown WR
64	70															
		15		0		0	NR									
	71								No recovery. Some Massive A'a fragments obtained from drill bit after tripping out pipe, dark gray (7.5YR 4/1), moderately weathered, strong, Mn clay Su, IF and broken rock fragments							Chattering
62	72															
	73													0.0	[33.3]	
60	74															
	75								**Gravelly Fat Clay with Sand (CH)** Dark brown (7.5YR 3/2), G 20 basalt fragments, S 10, F 70							Light brown WR
		16		70		40										
58	76						1		**Massive A'a** Very dark gray (10YR 3/1), moderately weathered, moderate strength to strong 1: 5, J, MW, Mn clay Su, Ir, SR							
	77						IF									

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Log of Boring OWDFMW08A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
77	77								IF - Mn clay, Su 2: 5, J, N, Mn Sp, clay Pa, Wa, SR							10" diameter conductor casing set at 77 ft bgs
56	78						2 IF		← becomes dark gray (7.5YR 4/1), slightly weathered, very strong, 5% vesicles, elongate, subrounded to subangular, 1-10 mm IF - clay Mn Fe, Su 1: 0, J, N, Mn Su, Wa, SR 2: 10, J, MW, Mn clay Sp, Wa, SR					0.0	[25]	
54	79															Light brown WR
	80	17		60		57	1									Significant chattering
	81						2									
52	82						NR		No recovery							End coring 4/12/21
83	83						1		← becomes very dark gray (7.5YR 3/1), slightly weathered, extremely strong, 5% vesicles, elongate, subrounded, 2-12 mm, some vugs 1: 45, J, VN, Mn Fe clay Su, Wa, SR 2: 5, J, N, Mn Fe Sp, Wa, SR 3: 60, J, MW, Mn Fe Sp, Wa, SR 4: 30, J, VN, Fe Su, Mn clay Sp, Wa, SR 5: 50, J, VN, Fe Su, Mn clay Sp, Wa, SR 6: 5, J, VN, No, No, Wa, SR 7: 5, J, N, Mn Sp, Wa, SR 8: 0, J, N, Mn Sp, Wa, SR					0.0	[37.5]	Resume coring 4/20/21
50	84						2									
	85		5				3 IF									Chattering
		18		100		50										
48	86						4 5 6 7									Light brown WR
	87						8									
46	88						1		← clay in fractures, light red (2.5YR 6/8) 1: 10, J, N, Mn, Fe, Clay, Su, Wa, SR 2: 5, J, MW, Mn Fe clay Sp, Wa, SR 3: 15, J, N, Mn Fe clay Sp, Wa, SR 4: 0, J, VN, Mn Fe Sp, Wa, SR 5: 5, J, VN, Mn Fe Sp, clay Su, Wa, SR 6: 5, J, MW, Mn clay Su, Wa, SR 7: 5, J, N, Mn Fe Sp, clay Su, Wa, SR 8: 0, J, W, Mn Sp, clay Su, Wa, SR 9: 5, J, MW, Mn Fe, clay Sp, Wa, SR 10: 5, J, N, clay Su, Wa, SR 11: 10, J, MW, Mn Su, Fe Sp, Wa, SR 12: 30, J, W, Mn clay Su, Fe Sp, Wa, SR					0.0	[23.1]	
	89						2 3 4 5 6 7 8 9 10 11									
44	90															Light brown WR
		19		80		43										
	91						12									Chattering
42	92						NR		No recovery							
	93															

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Log of Boring OWDFMW08A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
93	93								← same as above partial fracture face recovered, clay Su red (2.5YR 4/6), Mn Sp			0.0	[50]	Chattering at 93 ft bgs
40	94													
	95	20		10		0								Light brown WR
38	96						NR							
	97								No recovery					Rods dropped void 94-98 ft bgs
36	98											0.0	[18.8]	Resume coring 4/21/21
	99		6											Light brown WR
34	100	21		40		0	NR							End coring at 100 ft bgs on 4/20/21
	101								**Loose and Welded A'a Clinker** Very dark gray (7.5YR 3/1), very dark brown (7.5YR 2.5/2), dusky red (10R 3/2), moderately weathered, moderate strength					
32	102								← becomes highly weathered, weak to extremely weak					
	103											0.0	[30]	
30	104								← becomes moderately weathered, moderate strength					
	105	22		100		36								Light brown WR
28	106								**Massive A'a** Very dark gray (10YR 3/1), slightly weathered, extremely strong to very strong, 3% vesicles, elongate, subrounded to subangular, 1-13 mm 1: 0, J, VN, Mn Fe Sp, Wa, SR 2: 90, J, VN, Mn Sp, clay Su, Wa, SR 3: 30, J, N, Mn Fe Sp, Wa, SR 4: 40, J, VN, Mn Fe Sp, Wa, SR 5: 45, J, VN, Mn Fe clay Sp, Wa, SR 6: 60, J, N, Mn clay Sp, Wa, SR					
	107													
26	108								← 1% unweathered olivine phenocrysts			0.0	[16.7]	
	109								← becomes 5% vesicles, elongate, subrounded to					

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
24	109								subangular, some vugs, 1-19 mm 1: 80, J, VN, Mn, Sp, Clay, Su, Wa, SR 2: 60, J, VN, Mn Sp, clay Su, Wa, SR 3: 5, J, VN, Mn Sp, St, SR 4: 5, J, VN, Mn clay Sp, Wa, SR 5: 10, J, MW, Mn Fe clay Sp, Ir, SR 6: 5, J, N, Mn Fe clay Sp, Ir, SR 7: 20, J, VN, Mn Sp, Wa, SR 8: 5, J, VN, Mn Sp, Wa, SR 9: 5, J, VN, Mn Sp, Wa, SR 10: 5, J, VN, Mn Sp, Wa, SR 11: 5, J, VN, Mn Sp, Wa, SR 12: 5, J, N, Mn Sp, clay Su, Wa, SR						
	110	23	7	100		60										Light brown WR
22	111															
	112															End coring 4/21/21
	113								1: 5, J, VN, Mn Fe Sp, clay Su, Wa, SR 2: 5, J, VN, No, No, Wa, SR 3: 5, J, VN, Mn Sp, Wa, SR 4: 15, J, VN, Mn Sp, Wa, SR 5: 5, J, VN, Mn clay Sp, Wa, SR 6: 5, J, VN, Mn Sp, clay Pa, Wa, SR 7: 5, J, VN, Mn, clay Sp, Wa, SR 8: 5, J, VN, Mn Sp, clay Pa, Wa, SR 9: 5, J, VN, Mn Sp, clay Su, Wa, SR 10: 85, J, VN, Mn Sp, clay Su, Wa, SR 11: 0, J, VN, Mn Sp, clay Su, Wa, SR IF - clay infilling fractures, light red (2.5YR 6/0), red				0.0	[18.8]	Resume coring 4/22/21
20	114															
	115															Light brown WR
	116	24		100		42										
18	117															
	118						IF		**Welded A'a Clinker** Very dark gray (7.5YR 3/1), dark reddish brown (7.5YR 3/4), clay, reddish yellow (7.5YR 8/6), moderately weathered, strong					0.0	[50]	
16	119		8						← becomes dark reddish brown (2.5YR 2.5/3), highly weathered, weak to moderate strength							
	120						IF		← becomes dark reddish brown (5YR 3/4), highly weathered, weak							Light brown WR
14	121	25		60		0										
	122						NR		No recovery							
12	123													0.0	[16.7]	
	124						IF		**Massive A'a** Dark gray (5YR 4/1), slightly weathered, very strong, 10% vesicles, elongate, subrounded, 1-13 mm 1: 90, J, N, Mn Fe clay Sp, Wa, SR							Chattering
10	125															

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Log of Boring OWDFMW08A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
8	125															
		26		80		50			2: 5, J, MW, No, No, Ir, SR 3: 5, J, N, Mn Fe Sp, Wa, R 4: 5, J, N, Mn Fe Sp, Wa, R							Light brown WR
	126						3 4 M M M M									
	127															
6	128													0.0	[25]	
		27	9	100		34			1: 5, J, N, Mn, Sp, Wa, SR 2: 0, J, N, Mn, Sp, St, SR 3: 10, J, N, Mn Sp, Wa, SR 4: 0, J, N, Mn Fe Sp, Wa, SR 5: 5, J, N, Mn Fe Sp, Wa, SR 6: 10, J, No, No, Wa, SR 7: 15, J, N, Mn Fe Sp, Ir, SR 8: 0, J, N, No, No, Wa, SR 9: 5, J, N, Mn Sp, Ir, SR 10: 0, J, VN, No, No, Wa, SR 11: 20, J, N, clay Su, Wa, SR 12: 0, J, N, No, No, Pl, SR 13: 5, J, N, Mn Su, Wa, SR							Light brown WR Significant chattering throughout About 50 gal water added
4	129						1 2 3 4 5 6 7 8 9 10 11 12 13									
	130															
	131															
2	132															
	133						IF M		**Welded A'a Clinker** Dark reddish brown (2.5YR 3/4), dark reddish gray (2.5RY 3/1), red (2.5YR 5/6), moderately weathered, moderately strong **Pahoehoe** Very dusky red (2.5YR 2.5/2), reddish brown (2.5YR 4/4), moderately weathered, moderate strength, 15% vesicles, rounded to subrounded, <2 mm; at 133.5 ft bgs, becomes dark reddish brown (5YR 2.5/2), slightly weathered, strong, 25% vesicles, rounded, <4 mm					0.0	[100]	
0	134															
	135						IF		← some clay in vesicles, reddish yellow (7.5YR 7/1) 1: 5, J, VN, Mn Fe clay Sp, Wa, R 2: 0, J, VN, No, No, Wa, R 3: 0, VN, No, No, Wa, R IF - clay in fractures							Light brown WR
		28		100		30										
-2	136						1 2 3									Significant chattering
	137															About 50 gal water added
							IF									
-4	138													0.0	[15.7]	
							1 2 3 4		1: 10, J, VN, clay Sp, Wa, R 2: 0, J, N, Mn Fe clay Sp, Wa, R 3: 60, J, VN, Mn clay Sp, Fe Su, Wa, SR 4: 60, J, VN, Mn clay Fe Sp, Wa, SR							Light brown WR
	139															
-6	140						IF									
		29		84		0			← becomes 15% vesicles, subrounded to rounded, 1-13 mm, partially filled with clay, reddish yellow (7.5YR 8/6)							Lost circulation at 140.5 ft bgs
	141															

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Log of Boring OWDFMW08A

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type / Number / Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	141		10					IF	← clay in fractures, Mn Fe Sp					110 gal WL
-8	142						NR							
	143							IF	1: 45, J, N, Mn Sp, clay Pa, Wa, SR - reddish yellow (7.5YR 6/8) 2: 5, J, VN, Mn clay Sp, Ir, R 3: 0, J, MW, Mn clay Sp, Wa, SR 4: 5, J, N, Mn Sp, Wa, SR 5: 5, J, N, Mn Sp, clay Su, Wa, SR			0.0	[75]	
-10	144							1						
	145							2	← becomes very strong, 10% vesicles, subrounded, 2-15 mm, partially infilled with clay, pinkish white (7.5YR 8/2)					300 gal WL
		30		100		35								
-12	146							3 4	← becomes strong 20% vesicles, rounded 2 mm					
	147							5	IF - clay infilling fractures, Mn, Fe, Sp					
-14	148							IF	← becomes 15% vesicle, rounded, subrounded, <2 mm			0.0	[42.9]	
	149							1 IF	1: 20, J, VN, None, None, Wa, SR IF - clay reddish yellow (7.5YR 7/6) Pa, Mn Sp					
-16	150								**Loose and Welded A'a Clinker** Dark reddish brown (2.5YR 2.5/3), dark reddish gray (2.5YR 3/1), pink (4.5YR 8/5), moderately weathered, moderately strong to weak, clay is reddish yellow (7.5YR 2/6); at 150.2 ft bgs becomes highly weathered, weak					400 gal WL
		31		60		13								
	151		11				NR							
-18	152								No recovery					
	153											0.0	[30]	
-20	154								**Massive A'a** Dark gray (7.5YR 4/1), slightly weathered, very strong, 5% vesicles, elongate, irregular, 1-9 mm IF - clay reddish yellow (7.5YR 6/8) Pa, Mn Sp					
	155													400 gal WL
		32		80		0		IF						
-22	156													
	157													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	157								IF - partially infilled with clay, reddish yellow (7.5YR 6/8), Mn Sp							
-24	158						IF		1: 0, J, N, Mn clay, Sp, Wa, SR 2: 60, J, MW, Mn Fe clay Sp, Wa, SR 3: 60, J, MW, Mn Fe clay Sp, Wa, SR 4: 10, J, VN, Mn clay Sp, Wa, Wa, SR 5: 10, J, VN, Mn Sp, Wa, SR 6: 0, J, VN, Mn Sp, Wa, SR					0.0		
	159						1 2 3 4		7: 10, J, VN, Mn clay Sp, Wa, SR 8: 0, J, VN, Mn Fe Sp, Wa, SR 9: 90, J, VN, Mn Sp, clay Su, Wa, SR 10: 45, J, VN, Mn Sp, clay Su, Wa, SR 11: 90, J, VN, Mn Sp, clay Pa, Wa, SR							
-26	160	33		100		34	5 6 7									500 gal WL
	161						8 9									
-28	162		12				10 11 IF									
	163								IF - clay Su, Mn Sp					0.0	[37.5]	
-30	164						IF									500 gal WL
	165						1 2 3		**Welded A'a Clinker** Very dark brown (7.5YR 2.5/2), black (7.5YR 2.5/1), slightly weathered, strong **Pahoehoe** flow contact, heat alteration, dusky red (10R 3/1); at 164.8 ft bgs becomes dusky red (10R 3/6), slightly weathered, strong 20% vesicles, rounded to subrounded, 1-8 mm, some clay in vesicles							
	166	34		100		0	4 5 6		IF - Mn Sp, some clay in fractures Su Sp, reddish yellow (5YR 6/8) 1: 30, J, MW, clay Sp, Ir, R 2: 30, J, W, clay Mn Sp, Wa, SR 3: 10, J, Vn, Mn clay Sp, Wa, SR							
-32	167						IF		4: 80, J, VN, Mn clay Sp, Wa, SR 5: 5, J, N, Mn clay Sp, Wa, R 6: 0, J, N, Mn clay Sp, Wa, R							End coring on 4/22/21 TD = 168 ft bgs
-34	168								OWDFMW08A was hand cleared from ground surface to 5 ft bgs (133.96 ft msl to 128.96 ft msl). The borehole was drilled using hollow stem auger from ground surface to refusal at 8 ft bgs (133.96 ft msl to 125.96 ft msl). HQ coring commenced from 8 ft bgs to 77 ft bgs (125.96 ft msl to 56.96 ft msl). The borehole was reamed with a 17.5-inch tricone bit from ground surface to 77 ft bgs (133.96 ft msl to 56.96 ft msl) to set a conductor casing. A 10-inch diameter steel conductor casing was installed to 77 ft bgs (56.96 ft msl). HQ coring continued from 77 ft bgs to 168 ft bgs (56.96 ft msl to -34.04 ft msl). HQ coring terminated at a total depth of 168 ft bgs (-34.04 ft msl). The borehole was reamed with a 9 7/8-inch tricone bit from 77 ft bgs to 168 ft bgs (56.96 ft msl to -34.04 ft msl) for well construction. Clean water filtered through a granulated activated carbon (GAC) filter was used for drilling fluid. Approximately 2,200 gallons of water were used during drilling and rock coring. OWDFMW08A well construction was completed on June 24, 2021. The well was completed with 4-inch diameter Schedule 80 polyvinyl chloride (PVC) blank well casing from approximately ground surface to 140.5 ft bgs (133.96 ft msl to -6.54 ft msl) and a 0.020-inch slotted							
	169															
-36	170															
	171															
-38	172															
	173															

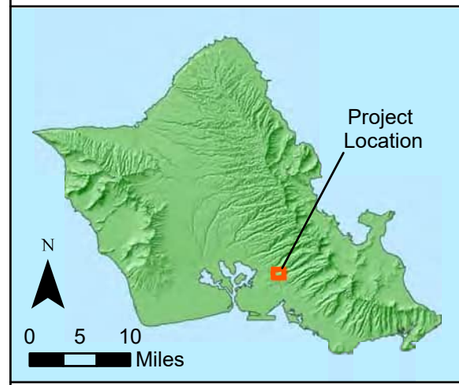
Project: Site Assessment Red Hill Oily Waste Disposal Facility
Project Location: JBPHH, Oahu, HI
Project Number: 60513348 (CTO 0063)

Log of Boring OWDFMW08A

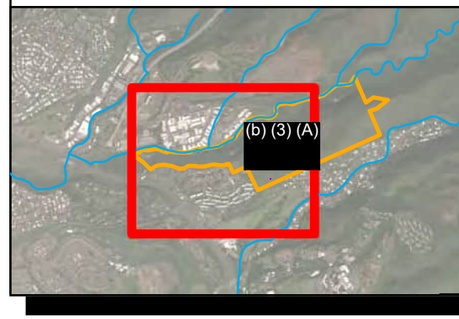
Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Well Schematic	SAMPLES: Type	Number	Blows per foot	PID (ppm)	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	173								screen between 140.5 to 160.5 ft bgs (-6.54 ft msl to -26.54 ft msl). The casing was stabilized with centralizers placed at the top and bottom of the screened section, and then spaced every 40 ft up from the top of the screen. The filter pack extended from 163 ft bgs to 133 ft bgs (-29.04 ft msl to 0.96 ft msl). The bentonite seal was placed from 133 ft bgs to 128 ft bgs (0.96 ft msl to 5.96 ft msl). A 100% bentonite slurry was placed from 128 ft bgs to 75 ft bgs (5.96 ft msl to 58.96 ft msl [into the 10-inch diameter conductor casing]). Cement/grout was placed to ground surface. The surface completion consists of flush mount completion. A total of approximately 970 gallons of development water was removed during development after well construction.							
-40	174															
	175															
-42	176															
	177															
-44	178															
	179															
-46	180															
	181															
-48	182															
	183															
-50	184															
	185															
-52	186															
	187															
-54	188															
	189															

~~For Red Hill AOC Party Use Only~~

Location Map



Site Location Map



Legend

- Boring Location
- Stream
- Red Hill Facility Boundary

Notes

1. Map projection: NAD_1983_StatePlane_Hawaii_3_FIPS_5103_Feet
2. Base Map:DigitalGlobe, Inc. (DG) and NRCS. Publication_Date:2015
3. Location of Former Slop Tank features are estimated from U.S. Navy Supply Center Conversion of POL Storage Facility, Red Hill Storage 5000 BBL Slop Tank Plan dated June 28, 1960.
4. Source: PGE (2013, 2015)

N

0 225 450 900 Feet

Boring Locations, Red Hill Fire Suppression and Ventilation System Study
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

\\Honolulu.na.aecomnet.com\Honolulu\Projects\NAVFAC PAC\CLEAN V\60571032_CTO18F0126900-Work\920GIS\ 02_Maps\IRR\AppB2_PGE_BoringLocs.mxd 2019-0 7-29

APPENDIX C

PREVIOUS BORINGS BY PGE

PGE's borings, Borings B-1, B-2, B-3, and B-3A, drilled in 2012 for the planning phase of this project are presented in this appendix. The borings logs are taken from PGE's September 20, 2012 final letter report. The locations of the borings are shown on the Plot Plans, Plates 3.1 through 3.3.

Plates 4.1.1 through 4.4.3 - Borings B-1, B-2, B-3, and B-3A.

Project *Fire Protection and Ventilation System* Job No. *3773-006*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

Date Started *8/1/2012* Date Ended *8/1/2012*

Drilling Method *102 mm Augers, Rotary Wash* Drilling Equipment *Mobile B-53*

Logged By (b) (6) Water Level (depth) *N/A*

BORING B-1 (Page 1 of 2)

Surface Elevation *+176.6* ± meters

Datum *Mean Sea Level*

Northing (b) (3) (A)

Easting (b) (3) (A)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (kg/m³)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/300mm	Blows/300mm	Depth (m)	Samples	Graphic Log	Soil Class	Description
													SURFACE
5	1547							90				GM	Light brown silty coralline gravel, dense, with coralline sand and basaltic gravel, damp (fill)
47								13	1			MH	Mottled reddish brown and dark yellowish red elastic silt, stiff, moist (saprolite)
48	1164	85	42					18	2				grades mottled olive gray and dark yellowish red
40	1302							39					grades very stiff
									3				grades hard
31	1454							75/127mm					Gray and dark yellowish red basalt, soft, highly weathered
									4			MH	Mottled dark reddish gray, dark yellowish red, and light yellowish brown elastic silt, very stiff, moist (completely weathered clinker)
47								20	5				
									6				
40	1281							25/25mm					grades mottled dark gray, dark red, and yellowish brown, and hard
									7				
47								31					grades mottled dark gray, dark reddish brown, and yellowish brown
									8				

Notes:

- ☒ 84 mm O.D. split barrel sampler
- ◪ 51-mm O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 63.5 kg dropping 760 mm

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 4.1.1

Project *Fire Protection and Ventilation System* Job No. *3773-006*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-1 (Page 2 of 2)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (kg/m³)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/300mm	Blows/300mm	Depth (m)	Samples	Graphic Log	Soil Class	Description
												MH	Gray basalt, hard, highly fractured, moderately weathered
								15/0mm	9				
				NX	100	0							grades highly to moderately fractured
									10				
				NX	98	18							
								10/0mm	11				grades highly fractured
				NX	91	0							
									12				
								10/0mm					
									13			GM	Gray, reddish brown, and yellowish brown silty basaltic gravel, dense, highly weathered, with basaltic sand, moist (clinker)
				NX	60	0							
41								36	14				
				NX	80	0							
									15				grades very dense
38								83					

Boring completed at 15.5 meters on 8/1/2012.

Ground water not encountered.

Notes:

- ☒ 84 mm O.D. split barrel sampler
- ◪ 51-mm O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 63.5 kg dropping 760 mm

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 4.1.2

Project *Fire Protection and Ventilation System* Job No. *3773-006*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

Date Started *8/2/2012* Date Ended *8/2/2012*

Drilling Method *102 mm Augers, Rotary Wash* Drilling Equipment *Mobile B-53*

Logged By (b) (6) Water Level (depth) *N/A*

BORING B-2 (Page 1 of 2)

Surface Elevation *+77.2* ± meters

Datum *Mean Sea Level*

Northing (b) (3) (A) [redacted]

Easting (b) (3) (A)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (kg/m³)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/300mm	Blows/300mm	Depth (m) Samples	Graphic Log	Soil Class	Description
												SURFACE
7	1396							44			GC	Dark grayish brown clayey basaltic gravel, medium dense, with basaltic sand, damp to moist (fill)
15								23	1			grades with basaltic cobbles
36	1329							26			CH	Mottled dark grayish brown fat clay, very stiff, with basaltic gravel, moist (alluvium)
43	1219	98	64					24	2			grades without gravel
42	1264							35	3			grades with some basaltic cobbles
44	1212							53	4			
40	1315							33	5			
39	1313							43	6			
									7			
									8			

Notes:

- ☒ 84 mm O.D. split barrel sampler
- ◪ 51-mm O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 63.5 kg dropping 760 mm

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 4.2.1

Project *Fire Protection and Ventilation System* Job No. *3773-006*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-2 (Page 2 of 2)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (kg/m³)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/300mm	Blows/300mm	Depth (m)	Samples	Graphic Log	Soil Class	Description
												CH	
35	1259							53/76mm	9			GM	Dark grayish brown, yellowish brown, and grayish red silty basaltic gravel, very dense, highly weathered, with elastic silt and basaltic sand, moist, with slight hydrocarbon odor (saprolite)
								91/127mm	10				grades brownish gray, yellowish brown, and reddish brown
								11/0mm	11				
									12				Boring completed at 12.2 meters on 8/2/2012.
													Ground water not encountered.

Notes:

- ☒ 84 mm O.D. split barrel sampler
- ◪ 51-mm O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- ⌶ Core run
- ⌶ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 63.5 kg dropping 760 mm

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 4.2.2

~~For Red Hill AOC Party Use Only~~

Project *Fire Protection and Ventilation System* Job No. *3773-006*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

Date Started *8/3/2012* Date Ended *8/3/2012*

Drilling Method *102 mm Augers, Rotary Wash* Drilling Equipment *Mobile B-53*

Logged By (b) (6) Water Level (depth) *N/A*

BORING B-3 (Page 1 of 1)

Surface Elevation *+35.7* ± meters

Datum *Mean Sea Level*

Northing (b) (3) (A)

Easting (b) (3) (A)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (kg/m³)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/300mm	Blows/300mm	Depth (m)	Samples	Graphic Log	Soil Class	Description
													SURFACE
												GM	Grayish brown silty asphaltic concrete gravel fill, fine, with basaltic sand, damp (fill)
												AC	51 mm of asphaltic concrete
15	1626							52				GM	White silty coralline gravel, dense, with coralline sand, moist (fill)
									1			GM	Gray and reddish brown silty basaltic gravel, medium dense, with some basaltic sand, moist (fill)
								21					
9	1492							31					grades gray and brown, and with some basaltic cobbles
									2			MH	Dark grayish brown, black, and yellow elastic silt, very stiff, with completely weathered tuffaceous sand, moist (water-laid tuff)
								29					
									3				Boring stopped at 3.0 meters due to crooked hole with numerous cobbles in sidewalls protuding into borehole on 8/3/2012.
													Ground water not encountered.
													Relocated to Boring B-3A.

Notes:

- ☒ 84 mm O.D. split barrel sampler
- ◪ 51-mm O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 63.5 kg dropping 760 mm

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 4.3

~~For Red Hill AOC Party Use Only~~

Project *Fire Protection and Ventilation System* Job No. *3773-006*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

Date Started *8/3/2012* Date Ended *8/3/2012*

Drilling Method *102 mm Augers, Rotary Wash* Drilling Equipment *Mobile B-53*

Logged By (b) (6) Water Level (depth) *9.4 m*

BORING B-3A (Page 1 of 3)

Surface Elevation *+35.2* ± meters

Datum *Mean Sea Level*

Northing (b) (3) (A) (b)

Easting (b) (3) (A)

Lab Data				Core Info				Blows/300mm	Depth (m)	Samples	Graphic Log	Soil Class	Description
Moisture Content (%)	Dry Density (kg/m³)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/300mm						SURFACE
												AC	76 mm of asphaltic concrete
												GM	White silty coralline gravel, moist (fill)
												GM	Gray and reddish brown silty basaltic gravel and cobbles, moist (fill)
									1				
												MH	Mottled dark grayish brown, yellow, and yellowish red elastic silt, very stiff, with completely weathered tuffaceous sand, moist (water-laid tuff)
52	1070	85	44					39	2				
42	1218							38	3				
									4				
59	948							48	5				
									6				grades moist to wet
60	1019							44					
									7				
61	1047							36	8				grades mottled dark olive gray, dark gray, yellow, and yellowish red, sandy, with highly weathered tuffaceous sand

Notes:

- ☒ 84 mm O.D. split barrel sampler
- ◪ 51-mm O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 63.5 kg dropping 760 mm

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 4.4.1

Project *Fire Protection and Ventilation System* Job No. *3773-006*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-3A (Page 2 of 3)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (kg/m³)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/300mm	Blows/300mm	Depth (m)	Samples	Graphic Log	Soil Class	Description
39	1222							70	9			MH	grades hard and weakly to moderately cemented (Water level at 0845 hours on 8/7/12)
37	1299							91/152mm	10			GM	Grayish brown, yellowish brown, and reddish yellow silty basaltic gravel and cobbles, very dense, highly weathered, subrounded, with basaltic sand, wet (alluvium)
									11				grades with some basaltic boulders
								62/102mm	12				basaltic boulder from approximately 12.4 to 12.8 meters
40	1340	66	31					77	13			MH	Mottled brown, yellowish brown, and gray elastic silt, hard, with highly to completely weathered, rounded, basaltic sand, and gravel, saturated (alluvium)
52	1153							76/254mm	14				
									15				
									16			GM	Brown silty basaltic gravel, dense, highly to completely weathered, subrounded, with basaltic sand, saturated (alluvium)

Notes:

- ▣ 84 mm O.D. split barrel sampler
- ◪ 51-mm O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 63.5 kg dropping 760 mm

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 4.4.2

Project *Fire Protection and Ventilation System* Job No. *3773-006*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-3A (Page 3 of 3)

Lab Data				Core Info								Description
Moisture Content (%)	Dry Density (kg/m^3)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/300mm	Blows/300mm	Depth (m) Samples	Graphic Log	Soil Class	
53	1136							75	17		GM	
									18			
47	1256							70/152mm				grades very dense

Boring completed at 18.4 meters on 8/3/2012.

Notes:
- ☒ 84 mm O.D. split barrel sampler
- ◪ 51-mm O.D. SPT (split-spoon sampler)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 63.5 kg dropping 760 mm

LOG OF BORING
PGE Pacific Geotechnical Engineers, Inc.

PLATE 4.4.3

Project Red Hill Fire Suppression and Ventilation System | Job No. 3773-008

Location Red Hill Fuel Storage Facility, Oahu, Hawaii | Drawn By (b) (6)

Date Started 5/8/2013 | Date Ended 5/10/2013

Drilling Method 4-inch Augers, Rotary Wash | Drilling Equipment Mobile B-59

Logged By (b) (6) | Water Level (depth) Not Encountered

BORING B-4 (Page 1 of 4)

Surface Elevation +580.0 ± feet

Datum Mean Sea Level

Northing (b) (3) (A)

Easting (b) (3) (A)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class	Description
													SURFACE
7								14				SM	Brown silty coralline sand, medium dense, with coralline gravel, moist (fill)
11	100											SP	Light brown poorly graded coralline sand, loose, moist (fill)
40	83							33	4			MH	Mottled dark yellowish red, yellowish brown, and dark gray elastic silt, very stiff, moist (saprolite)
								9					grades stiff
45	77							18	8				
								24					grades mottled gray and dark yellowish red and very stiff
									12				
34	85	55	16					66	16				grades mottled dark gray, red, and yellowish brown, slightly vesicular, and hard
								14					grades mottled dark yellowish red, dark gray, yellowish brown, and yellow, and stiff
									20				
								15					grades mottled dark yellowish red and yellowish brown, and stiff to very stiff
									24				
47	66							68					grades mottled brown, red, and gray, and hard
								21	28				grades mottled dark red, yellow, and dark gray, and very stiff

DRAFT

Notes:

- 3.3-inch O.D. split barrel sample
- 2-inch O.D. SPT (split-spoon sample)
- Disturbed sample
- Core run
- Piston sample
- Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE A-1.1.1

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-4 (Page 2 of 4)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
											MH	
47								29				grades mottled dark gray, dark reddish brown, and yellowish brown
									32			
46	76							66	36			grades mottled gray, yellowish gray, and yellow, and hard
								23				grades very stiff
37								20/1"	40			Gray basalt, medium hard to hard, highly fractured, moderately to slightly weathered, slightly vesicular
				HQ	98	0	1/5"					
							4.5					
							5.7					
							6.1		44			
							3.1					
				HQ	100	34	11.5					
							2.5					grades moderately fractured
							4		48			
							4					grades occasionally fractured
							3.3					
				HQ	90	52	6.1					
							4		52			
							4.8					grades highly fractured
							2.0					grades intensely fractured
							3					grades highly fractured
				HQ	100	80	2.7		56			grades occasionally to slightly fractured
							3					
							4					

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ☒ Disturbed sample
- ☐ Sample lost during extraction
- ◪ 2-inch O.D. SPT (split-spoon sample)
- I Core run
- I Piston sample

DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.1.2

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-4 (Page 3 of 4)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
							4.7					grades hard to very hard
							5.8					
				HQ	100	28	3	10/0"	60			
							2.5					Dark gray, reddish brown, and light yellow cemented clinker, soft, highly fractured, highly weathered, moderately cemented
							2.5					
							2.5					
							2		64			Reddish brown and dark gray basalt, soft, moderately fractured, highly weathered, highly vesicular
				HQ	100	35	0.8/10"	20/2"				
							1.2					grades gray, medium hard, and highly to moderately fractured
							1.3					
							1.3		68			
							2					grades medium hard to hard and moderately vesicular
				HQ	98	0	2					
							1.9					Gray, reddish brown, and light yellow cemented clinker, soft to medium hard, highly fractured, highly weathered, weakly to moderately cemented
							2.4		72			
							2.7					
							2					
							2.4/2"	40/4"				Dark gray basalt, soft to medium hard, highly fractured, highly weathered, slightly vesicular
				HQ	88	0	5.8		76			
							4.2					
							5					grades reddish brown and soft
							5.8		80			
							3	43/6"				
				HQ	89	9	3.5					
							1.7					Reddish gray, dark gray, and yellow cemented clinker, soft, highly fractured, highly weathered, weakly to moderately cemented
							2		84			
							2.3					
								63				grades dark gray and yellowish brown
				HQ	86	12	1.8/6"					
							3.7		88			

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.1.3

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-4 (Page 4 of 4)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
							2.3					
							2.8	40/5"				Gray basalt, soft, highly fractured, highly weathered, slightly vesicular
				HQ	100	35	5/7"					
							8.0		92			grades medium hard, moderately fractured, and moderately weathered
							14					
							6.5					grades hard and slightly fractured
							1.2					
				HQ	90	56	2.5		96			
							2.5					grades occasionally fractured
							2.5					
							2.5					grades soft to medium hard, and highly fractured
							4	40/6"	100			

Boring completed at 100.5 feet on 5/10/2013.

Ground water not encountered.

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- I Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE A-1.1.4

Project Red Hill Fire Suppression and Ventilation System Job No. 3773-008
Location Red Hill Fuel Storage Facility, Oahu, Hawaii Drawn By (b) (6)
Date Started 5/10/2013 Date Ended 5/13/2013
Drilling Method 4-inch Augers Drilling Equipment Mobile B-59
Logged By (b) (6) Water Level (depth) Not Encountered

BORING B-5 (Page 1 of 2)

Surface Elevation +253.7 ± feet
Datum Mean Sea Level
Northing (b) (3) (A) [redacted]
Easting (b) (3) (A) [redacted]

Lab Data: Moisture Content (%)	Lab Data: Dry Density (pcf)	Lab Data: Liquid Limit	Lab Data: Plasticity Index	Core Info: Core Type	Core Info: Recovery (%)	Core Info: RQD (%)	Core Info: Drill Rate min/ft	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class	Description
													SURFACE
17								4/2"				MH	Dark reddish brown elastic silt, soft to medium stiff, with basaltic gravel, moist (fill)
													10 inches of concrete
												CH	Mottled dark grayish brown and yellowish brown fat clay, medium stiff, moist (alluvium)
42	74							9	4				
51	69							12					grades with basaltic gravel and cobbles
43	77							21	8				grades stiff
39	79	85	53					17					
									12				grades gravelly
31	83							64	16			GC	Mottled dark grayish brown, reddish brown, and yellowish brown clayey basaltic gravel and cobbles, medium dense, rounded, moist (alluvium)
25	101												possible basaltic boulder from 19 to 20 feet
									20				
29								99/9"					grades very dense
									24				
								12/2"					grades with basaltic boulders
									28			SM	Dark grayish brown silty basaltic sand, medium dense, moist, with strong hydrocarbon odor (highly to completely weathered clinker)

DRAFT

Notes:
- 3.3-inch O.D. split barrel sample
- 2-inch O.D. SPT (split-spoon sample)
- Disturbed sample
- Core run
- Piston sample
- Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING
Pacific Geotechnical Engineers, Inc.

PLATE
A-1.2.1

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-5 (Page 2 of 2)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class	Description
												SM	
17	109							4/3"					possible basaltic boulder from 31 to 32 feet
									32			GM	Dark grayish brown, dark gray, and reddish yellow silty basaltic gravel, very dense, moist, with strong hydrocarbon odor (clinker)
36	76							40/3"					
									36				
									40				
19	105							150					Dark brownish gray and reddish yellow basalt, soft, highly weathered, highly vesicular, with strong hydrocarbon odor

Boring completed at 41.5 feet on 5/13/2013.

Ground water not encountered.

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.2.2

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

Date Started *5/13/2013* Date Ended *5/13/2013*

Drilling Method *4-inch Augers* Drilling Equipment *Mobile B-59*

Logged By (b) (6) Water Level (depth) *Not Encountered*

BORING B-6 (Page 1 of 1)

Surface Elevation *+257.8* ± feet

Datum *Mean Sea Level*

Northing (b) (3) (A)

Easting (b) (3) (A)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
												SURFACE
10	103										AC	1.5 inches of asphaltic concrete
29	86	73	46					43			GM CH	Dark brownish gray and yellowish red silty basaltic gravel, loose, moist (fill)
											CH	Mottled dark brown, reddish brown, and gray fat clay, very stiff, with basaltic gravel, moist (fill)
12								69	4			Mottled dark brown and gray fat clay, hard, with some basaltic gravel and cobbles, moist (alluvium)
								8				grades dark brown, gray, and dark yellowish brown, and medium stiff to stiff
37	84							19	8			grades stiff
39	79							55				grades very stiff

Boring completed at (b) (3) (A) feet on 5/13/2013.

Ground water not encountered.

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- I Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE A-1.3

Project Red Hill Fire Suppression and Ventilation System | Job No. 3773-008
Location Red Hill Fuel Storage Facility, Oahu, Hawaii | Drawn By (b) (6)
Date Started 5/14/2013 | Date Ended 5/15/2013
Drilling Method 4-inch Augers, Rotary Wash | Drilling Equipment Mobile B-59
Logged By (b) (6) | Water Level (depth) 46.0 ft

BORING B-7 (Page 1 of 4)

Surface Elevation +120.0 ± feet
Datum Mean Sea Level
Northing (b) (3) (A) [redacted]
Easting (b) (3) (A) [redacted]

Lab Data: Moisture Content (%)	Lab Data: Dry Density (pcf)	Lab Data: Liquid Limit	Lab Data: Plasticity Index	Core Info: Core Type	Core Info: Recovery (%)	Core Info: RQD (%)	Core Info: Drill Rate min/ft	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class	Description
													SURFACE
												MH	Dark brown elastic silt, soft to medium stiff, with wood chips and grass debris and some coralline sand and gravel, moist (fill)
												GM	
3	103							29					Reddish brown silty basaltic gravel, medium dense, with some coralline sand and gravel, moist (fill)
												MH	Dark brown and reddish brown elastic silt, medium stiff, with some basaltic gravel and coralline sand, moist (fill)
								7	4				
17	99											GM	Dark brown silty basaltic gravel, dense, with some basaltic and coralline sand, moist (fill)
10	121							87					
												CH	Mottled grayish brown and black fat clay, very stiff, with some basaltic sand and angular basaltic gravel, moist (fill)
24	89							39	8				
								13					grades stiff and with trace of shells
									12				
													grades with trace of coralline gravel
28	88	77	44					51	16			CH	Mottled dark brown, black, and yellowish brown fat clay, very stiff, moist (alluvium)
28	94												
								34					grades hard and with rounded highly weathered basaltic gravel
27													
									20				
								32					grades mottled dark brown, dark yellowish brown, and dark gray
									24				
												SM	Dark olive gray and dark gray silty tuffaceous sand, medium dense, highly weathered, wet (water-laid tuff)
65	59							58					
								27				MH	Mottled dark brown and dark gray elastic silt, very stiff, wet
54									28				

DRAFT

Notes:
- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING
PGE Pacific Geotechnical Engineers, Inc.

PLATE
A-1.4.1

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-7 (Page 2 of 4)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
											MH	(water-laid tuff)
42								42/5"				grades mottled dark brown, dark yellowish brown, and dark gray, and hard
									32			
41	69							140	36			
								19				grades very stiff
											MH	Dark yellowish brown, reddish yellow, and grayish brown elastic silt, very stiff, with rounded, completely weathered basaltic sand and gravel, wet (alluvium)
									40			
44								21				
									44		GM	Dark yellowish brown and gray silty basaltic gravel and cobbles, medium dense, rounded, highly to completely weathered, with elastic silt, and completely weathered basaltic sand, saturated (alluvium)
46	77							62				(Water level at 1250 hours on 5/14/2013)
								36				grades dense
									48			
											CH	Mottled dark yellowish brown, grayish brown, and gray fat clay, stiff, with highly to completely weathered rounded basaltic sand and gravel, saturated (alluvium)
								12				
									52			
40	80											grades very stiff and with some basaltic gravel
38	85	72	38					35	56			
								19				

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ☒ Disturbed sample
- ☐ Sample lost during extraction
- ◪ 2-inch O.D. SPT (split-spoon sample)
- I Core run
- I Piston sample
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

A-1.4.2

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-7 (Page 3 of 4)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
									60		CH	
								22				grades with basaltic gravel and cobbles
									64			
46	76							31				grades mottled dark brown, gray, and dark yellowish red
								37				grades mottled dark brown, gray, dark yellowish brown, and dark gray, and hard
									68			
											CH	Mottled dark brown, gray, dark yellowish brown, and dark gray fat clay, hard, with highly to moderately weathered, rounded basaltic gravel, saturated (alluvium)
								38				
									72			
												grades grayish brown, reddish brown, and gray, and very stiff to hard
35	91	72	38					60	76			
								44				grades hard
											MH	Mottled dark grayish brown and dark yellowish red elastic silt, hard, saturated (completely weathered clinker)
								52	80			
									84			Gray basalt, hard, highly fractured, slightly weathered, slightly vesicular
				HQ	98	24		25/0"				
									88			

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE A-1.4.3

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

BORING B-7 (Page 4 of 4)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class	Description
				HQ	78	35			92			GM	Gray, dark gray, and dark reddish brown silty basaltic gravel, very dense, with some basaltic sand, saturated (clinker)
				HQ	91	43		54	96				Dark gray and yellowish red cemented clinker, soft to medium hard, highly fractured, moderately to highly weathered, moderately cemented grades occasionally fractured
								15/2"	100				Boring completed at 100.2 feet on 5/15/2013.

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE A-1.4.4

~~For Red Hill AOC Party Use Only~~

Project Red Hill Fire Suppression and Ventilation System | Job No. 3773-008
Location Red Hill Fuel Storage Facility, Oahu, Hawaii | Drawn By (b) (6)
Date Started 5/13/2013 | Date Ended 5/13/2013
Drilling Method 4-inch Augers | Drilling Equipment Mobile B-59
Logged By (b) (6) | Water Level (depth) Not Encountered

BORING B-8 (Page 1 of 1)

Surface Elevation +146.9 ± feet
Datum Mean Sea Level
Northing (b) (3) (A)
Easting (b) (3) (A)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class	Description
													SURFACE
												AC	1 inch of asphaltic concrete
4	113							14				GM	Mottled gray and black silty basaltic gravel, medium dense, moist, (fill)
												CH	
												CH	Mottled dark brown, dark yellowish red, and black fat clay, stiff, with basaltic gravel, moist (fill)
37	84	92	64					14	4				Mottled dark brown, black, and yellowish red fat clay, stiff, with some highly weathered, rounded basaltic sand and fine gravel, moist (alluvium)
													grades very stiff
40	79							57					Dark yellowish brown and dark gray volcanic tuff rock, soft, highly weathered
								50/3"	8				
								50/3"					

Boring completed at 9.8 feet on 5/13/2013.

Ground water not encountered.

DRAFT

Notes:
- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING
PGE Pacific Geotechnical Engineers, Inc.

PLATE
A-1.5

Project Red Hill Fire Suppression and Ventilation System | Job No. 3773-008

Location Red Hill Fuel Storage Facility, Oahu, Hawaii | Drawn By (b) (6)

Date Started 5/16/2013 | Date Ended 5/16/2013

Drilling Method 4-inch Augers | Drilling Equipment Mobile B-59

Logged By (b) (6) | Water Level (depth) Not Encountered

BORING B-9 (Page 1 of 1)

Surface Elevation +277.1 ± feet

Datum Mean Sea Level

Northing (b) (3) (A) [redacted]

Easting (b) (3) (A) [redacted]

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
												SURFACE
											GM	Reddish brown silty basaltic gravel, with elastic silt, moist (fill)
13	77							29			MH	Mottled dark yellowish red and reddish brown elastic silt, very stiff, moist (residual soil)
49	69							10	4		MH	Mottled dark yellowish red and dark yellowish brown elastic silt, medium stiff, moist (saprolite)
												grades mottled dark yellowish red and brownish gray
33	81							39				Gray basalt, hard, highly to moderately fractured, moderately weathered, slightly vesicular
				HQ	52	9		37/4"	8			

Boring completed at 10.0 feet on 5/16/2013.

Ground water not encountered.

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE A-1.6

Project *Red Hill Fire Suppression and Ventilation System* Job No. *3773-008*

Location *Red Hill Fuel Storage Facility, Oahu, Hawaii* Drawn By (b) (6)

Date Started *5/13/2013* Date Ended *5/13/2013*

Drilling Method *4-inch Augers* Drilling Equipment *Mobile B-59*

Logged By (b) (6) Water Level (depth) *Not Encountered*

BORING B-10 (Page 1 of 1)

Surface Elevation *+308.3* ± feet

Datum *Mean Sea Level*

Northing (b) (3) (A)

Easting (b) (3) (A)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
												SURFACE
15		71	42					32			CH	Mottled reddish brown, gray, and yellowish brown fat clay, very stiff, with highly weathered basaltic gravel, moist (fill)
27	82							23	4			grades mottled dark reddish brown, yellowish red, and dark gray, and without gravel
23	83	49	20					34			ML	Mottled dark reddish brown, dark yellowish red, and black silt, very stiff, moist (residual soil)
30	86							48	8			grades with completely weathered basaltic gravel
32	87							63			CH	Mottled dark grayish brown, dark gray, dark yellowish red, and yellow fat clay, hard, with highly to completely weathered basaltic gravel, moist (clinker)
												Boring completed at 10.5 feet on 5/13/2013.
												Ground water not encountered.

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE A-1.7

Project Red Hill Fire Suppression and Ventilation System Job No. 3773-008
Location Red Hill Fuel Storage Facility, Oahu, Hawaii Drawn By (b) (6)
Date Started 5/13/2013 Date Ended 5/15/2013
Drilling Method 4-inch Augers, Rotary Wash Drilling Equipment Mobile B-59
Logged By (b) (6) Water Level (depth) Not Encountered

BORING B-11 (Page 1 of 1)

Surface Elevation +308.3 ± feet
Datum Mean Sea Level
Northing (b) (3) (A)
Easting (b) (3) (A)

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class	Description
													SURFACE
												GM	Dark brown, gray, and yellowish red silty basaltic gravel, medium dense, moist (fill)
								46				GP	Dark brown, dark gray, and yellowish red poorly graded basaltic gravel and cobbles, medium dense, with basaltic sand, moist (clinker)
								10/0"					Gray basalt, hard, moderately fractured, slightly weathered, slightly vesicular
									4				
				HQ	89	20		10/0"					
									8				

Boring completed at 10.0 feet on 5/15/2013.

Ground water not encountered.

DRAFT

Notes:
- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING
PGE Pacific Geotechnical Engineers, Inc.

PLATE
A-1.8

Project Red Hill Fire Suppression and Ventilation System Job No. 3773-008
Location Red Hill Fuel Storage Facility, Oahu, Hawaii Drawn By (b) (6)
Date Started 5/16/2013 Date Ended 5/16/2013
Drilling Method 4-inch Augers, Rotary Wash Drilling Equipment Mobile B-59
Logged By (b) (6) Water Level (depth) Not Encountered

BORING B-12 (Page 1 of 1)

Surface Elevation +319.6 ± feet
Datum Mean Sea Level
Northing (b) (3) (A) [redacted]
Easting (b) (3) (A) [redacted]

Lab Data				Core Info								
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft)	Samples	Graphic Log	Soil Class	Description
													SURFACE
11								41				GM	Gray and reddish brown silty basaltic gravel, with basaltic sand, moist (fill)
												GM	Dark gray, reddish brown, and brown silty basaltic gravel, medium dense, with some basaltic sand, moist (clinker)
								17/4"					
				HQ	100	61			4				Gray basalt, hard, moderately fractured, slightly to moderately weathered, slightly vesicular
				HQ	100	28							
									8				Gray and yellowish red cemented clinker, soft to medium hard, highly fractured, highly weathered, weakly to moderately cemented
													Boring completed at 10.0 feet on 5/16/2013.
													Ground water not encountered.

DRAFT

Notes:
- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- I Core run
- I Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING
PGE Pacific Geotechnical Engineers, Inc.

PLATE
A-1.9

Project Red Hill Fire Suppression and Ventilation System Job No. 3773-008

Location Red Hill Fuel Storage Facility, Oahu, Hawaii Drawn By (b) (6)

Date Started 5/13/2013 Date Ended 5/13/2013

Drilling Method 4-inch Augers Drilling Equipment Mobile B-59

Logged By [redacted] (b) (6) Water Level (depth) Not Encountered

BORING B-13 (Page 1 of 1)

Surface Elevation +269.9 ± feet

Datum Mean Sea Level

Northing (b) (3) (A) [redacted]

Easting [redacted] (b) (3) (A)

Lab Data				Core Info							
Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	Core Type	Recovery (%)	RQD (%)	Drill Rate min/ft	Blows/ft	Depth (ft) Samples	Graphic Log	Soil Class	Description
												SURFACE
											AC	1 inch of asphaltic concrete
9	111							28			GM GC	Mottled black and brownish gray silty basaltic gravel, loose, with basaltic sand, moist (fill)
											CH	Dark reddish brown, yellowish red, and dark gray clayey basaltic gravel, medium dense, moist (fill)
29								20/0"	4			Mottled dark brown, dark gray, and dark yellowish red fat clay, very stiff, with some rounded, moderately weathered basaltic cobbles, moist (alluvium)
38								14/3"				grades hard
												grades stiff
47	74	78	48					17	8		MH	Mottled bluish gray, brownish yellow, reddish yellow, and dark brown elastic silt, stiff, with fat clay, moist (completely weathered clinker)
50	69							25				grades mottled yellowish brown, dark brown, gray, and reddish yellow and very stiff

Boring completed at 10.5 feet on 5/13/2013.

Ground water not encountered.

DRAFT

Notes:

- ☒ 3.3-inch O.D. split barrel sample
- ◪ 2-inch O.D. SPT (split-spoon sample)
- ☒ Disturbed sample
- ⌶ Core run
- ▮ Piston sample
- ☐ Sample lost during extraction
- DRIVING ENERGY: 140 lb dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE A-1.10

UNIFIED SOIL CLASSIFICATION SYSTEM – (ASTM D2487)

MAJOR DIVISIONS			LETTER SYMBOL	GRAPHIC SYMBOL	GROUP NAMES
COARSE–GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS LESS THAN 5% FINES	GW		WELL–GRADED GRAVEL, WELL–GRADED GRAVEL WITH SAND
			GP		POORLY–GRADED GRAVEL, POORLY–GRADED GRAVEL WITH SAND
		GRAVELS WITH MORE THAN 12% FINES	GM		SILTY GRAVEL, SILTY GRAVEL WITH SAND
			GC		CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND
	SANDS 50% OR MORE OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND LESS THAN 5% FINES	SW		WELL–GRADED SAND, WELL–GRADED SAND WITH GRAVEL
			SP		POORLY–GRADED SAND, POORLY–GRADED SAND WITH GRAVEL
		SANDS WITH MORE THAN 12% FINES	SM		SILTY SAND, SILTY SAND WITH GRAVEL
			SC		CLAYEY SAND, CLAYEY SAND WITH GRAVEL
FINE–GRAINED SOILS 50% OR MORE PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML		SILT, SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY SILT
			CL		LEAN CLAY, LEAN CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY LEAN CLAY
			OL		ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE		MH		ELASTIC SILT, ELASTIC SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY ELASTIC SILT
			CH		FAT CLAY, FAT CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY FAT CLAY
			OH		ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
HIGHLY ORGANIC SOILS			PT		PEAT

NOTE:
DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE CLASSIFICATIONS. REFER TO ASTM D2487 FOR BORDERLINE CLASSIFICATIONS GW–GM, GW–GC, GP–GM, GP–GC, SW–SM, SW–SC, SP–SM, AND SP–SC.

UNIFIED SOIL CLASSIFICATION SYSTEM

(SHEET 1 OF 2)

Pacific Geotechnical Engineers, Inc.

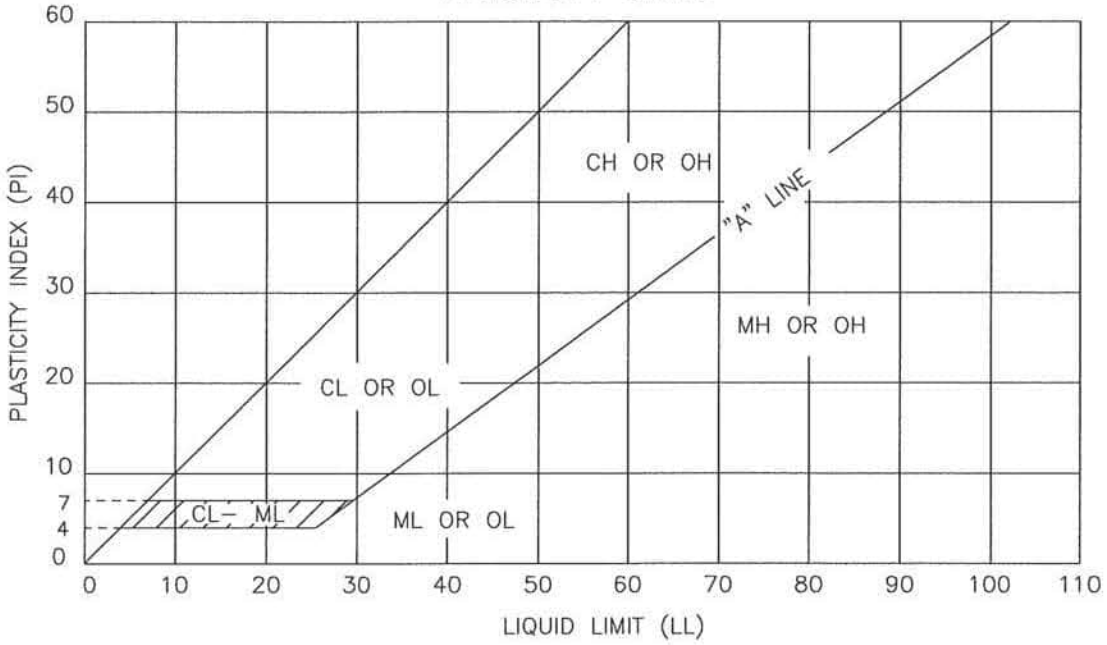
PLATE A-2.1

GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE			
	LOWER LIMIT		UPPER LIMIT	
	MILLIMETERS	SIEVE SIZE **	MILLIMETERS	SIEVE SIZE **
SAND				
FINE	0.075	#200 **	0.425	#40 **
MEDIUM	0.425	#40 **	2.00	#10 **
COARSE	2.00	#10 **	4.75	#4 **
GRAVEL				
FINE	4.75	#4 **	19.0	3/4" *
COARSE	19.0	3/4" *	75.0	3" *
COBBLES	75.0	3" *	300	12" *
BOULDERS	300	12" *	---	---

** U.S. STANDARD SIEVE * SQUARE OPENINGS

PLASTICITY CHART



FOR CLASSIFICATION OF FINE-GRAINED SOILS AND FINE-GRAINED FRACTION OF COARSE-GRAINED SOILS

NOTE:
WHEN SHOWN ON THE BORING LOGS, THE FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF FINE-GRAINED SOILS AND COARSE-GRAINED SOILS.

FINE-GRAINED SOILS

APPROXIMATE SHEAR STRENGTH IN KSF

VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.5
MEDIUM STIFF	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

COARSE-GRAINED SOILS

VERY LOOSE	THESE ARE USUALLY
LOOSE	BASED ON AN EXAMINATION
MEDIUM DENSE	OF SOIL SAMPLES, AND
DENSE	PENETRATION RESISTANCE.
VERY DENSE	

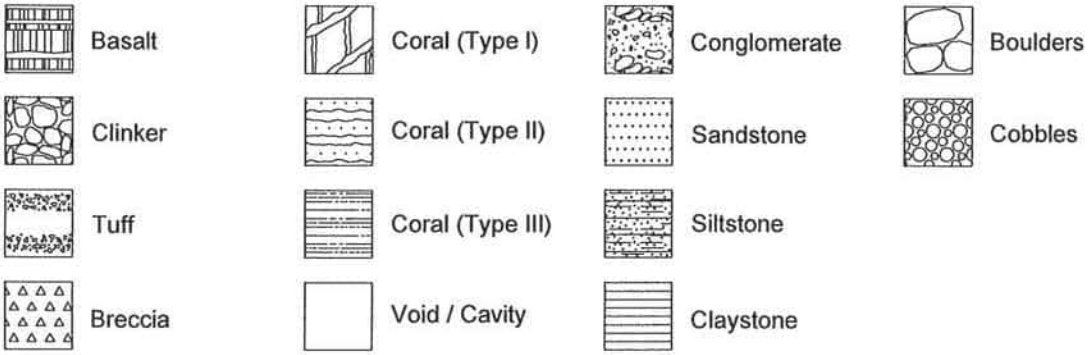
UNIFIED SOIL CLASSIFICATION SYSTEM

(SHEET 2 OF 2)

Pacific Geotechnical Engineers, Inc.

PLATE A-2.2

GRAPHIC SYMBOLS



A. DEGREE OF WEATHERING

The following terms describe the chemical weathering of a rock:

Fresh: No visible sign of decomposition or discoloration. Rings under hammer impact.

Slightly Weathered: Slight discoloration inwards from open fractures, otherwise similar to Fresh.

Moderately Weathered: Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered: Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric preserved.

Completely Weathered: Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil: Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change relative to fresh rock.

B. HARDNESS

The following terms describe the resistance of a rock to indentation or scratching:

Very Soft: Can be peeled with a knife, material crumbles under firm blows with the sharp end of a geologic pick.

Soft: Can just be scraped with a knife, indentations of 2 to 4 mm with firm blows of the pick point.

Medium Hard: Cannot be scraped or peeled with a knife but can be scratched with knife point. Hand held specimen breaks with firm blows of the pick.

Hard: Difficult to scratch with knife point, cannot break hand held specimen.

Very Hard: Cannot be scratched with pocket knife.

C. ROCK FRACTURE CHARACTERISTICS

The following terms describe general fracture spacing of a rock:

Crushed: Less than 5 microns (mechanical clay) to 0.05 foot.

Intensely Fractured: 0.05 to 0.1 foot (contains no clay).

Highly Fractured: 0.1 to 0.5 feet.

Moderately Fractured: 0.5 to 1.0 feet

Occasionally Fractured: 1.0 to 3.0 feet

Slightly Fractured: Greater than 3.0 feet.

ROCK DESCRIPTION SYSTEM	
PGE Pacific Geotechnical Engineers, Inc.	PLATE A-3

~~For Red Hill AOC Party Use Only~~

TRANSMITTAL/REVIEW/APPROVAL
ROICC PEARL R220 (10-98)

DATE: 12/20/2013

CONTRACT NO.	TITLE	TASK ORDER NO.	WORK REQUEST NO.
N62742-09-D-1174	FY11 SRM Repair of Red Hill Fuel Tunnel	HC-01	

FROM (Contractor)	TO	SUBMITTAL NO.	FOR SPEC. SECTION
URS Group	(b) (6) (NavFac)		

ENCL. NO.	NO. OF COPIES	DESCRIPTION	SPEC. PARA. NO.	CQC CODE
1	1	Surface Boring Abandonment Reports	SECTION 02 32 00-3.11	APP

Transmitted for: ☐ APPROVAL ☐ CLARIFICATION ☐ SELECTION ☑ RECORD ☐ OTHER

It is hereby certified that the material submitted herein conforms to contract requirements and can be installed in the allocated spaces.

CONTRACTOR'S SIGNATURE (b) (6)

FROM	SIGNATURE	DATE
	(b) (6)	

TO	
	*For review/comment. **RETURN WITHIN 5 WORKING DAYS**, unless submittal is for record/info purposes only and there are no adverse comments.*

FROM	TO	DATE

RECOMMEND:

☐ APPROVAL / ☐ ACCEPT *(subject to contract requirements)*

☐ APPROVAL / ☐ ACCEPT *(as noted, subject to contract requirements)*

☐ REVIEWED AND PROCEED

☐ RETURN *(for correction and resubmission)*

☐ DISAPPROVE / ☐ NOT ACCEPT

☐ OTHER _____

REMARKS:

( ) copies of enclosures retained

SIGNATURE _____
REVIEWER

FROM	TO (CONTRACTOR)	DATE

ENCLOSURE(s) IS (are):

☐ APPROVED / ☐ ACCEPTED *(subject to contract requirements)*

☐ APPROVED / ☐ ACCEPTED *(as noted, subject to contract requirements)*

☐ REVIEWED AND PROCEED

☐ RETURNED *(for correction and resubmission)*

☐ DISAPPROVED / ☐ NOT ACCEPTED

☐ RECEIVED FOR RECORD

☐ OTHER _____

REMARKS:

( ) copies of enclosures returned

Copy to: Contract File (w/enclosures)
QAE (w/enclosures)
Engineer/Engineering Tech (w/enclosures)
Submittal File

SIGNATURE _____
BY DIRECTION OF THE CONTRACTING OFFICER

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-01 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Edge of Pavement	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	3/12/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	66.2ft	Screen Material: Slot Size:	PVC/.010in
Depth to Water:	11.9ft	Screen Length: Screen Depth:	26ft-66ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	19.5'-66ft

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Borehole consumed 3.5bags

Well Abandonment Information	
Date of Abandonment: 11/26/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Borehole consumed 3.5bags	
Driller's Signat (b) (6)	Date: 12-4-13
Consultant's S	Date: 12/5/13

~~For Red Hill AOC Party Use Only~~

Boring Designation B-01

DRILLING LOG

DIVISION

NOTES

SHEET 1 OF 5 SHEETS

1. PROJECT
Red Hill Tunnel Repair Project Pearl Harbor

9. COORDINATE SYSTEM HI State Plane Zone 3 | HORIZONTAL NAD83 | VERTICAL NAVD88

10. SIZE AND TYPE OF BIT
HQ3 Diamond Bit

2. HOLE NUMBER
B-01

LOCATION COORDINATES
(b) (3) (A) [redacted]

11. MANUFACTURER'S DESIGNATION OF DRILL
CME 55 Track Rig

3. DRILLING AGENCY
Taber Drilling Company

12. TOTAL SAMPLES 9 | DISTURBED 9 | UNDISTURBED 0

4. NAME OF DRILLER
(b) (6)

13. TOTAL NUMBER CORE BOXES 3

5. DIRECTION OF BORING
☒ VERTICAL
☐ INCLINED

DEG FROM VERTICAL ---

BEARING

14. ELEVATION GROUND WATER
INITIAL -11.9 3/14/12 STATIC

15. DATE STARTED 3/12/12 | DATE COMPLETED 3/12/12

6. THICKNESS OF OVERBURDEN 12.0 ft

16. ELEVATION TOP OF BORING 20.0

7. DEPTH DRILLED INTO ROCK 24.6 ft

17. TOTAL CORE RECOVERY FOR BORING N/A

8. TOTAL DEPTH OF BORING 66.2 ft

18. LOGGED BY
(b) (6)

CHECKED BY

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
19.6	0.4				PAVEMENT 4-in thick Asphalt.								6-inch solid stem auger
					FILL CLAYEY SAND (SC); moist; brown; with asphalt and other debris.								
													SPT Sample 1 (2.5 ft - 4 ft) Blows: 8,9,8 (N=17) 5-inch ID Casing driven to 10.5 bgs prior to coring
													SPT Sample 2 (8.5 ft - 10 ft) Blows: 12,16,14 (N=30) LL=44, PI=18
8.0	12.0				TUFF, gray, highly weathered, very weak, fine to coarse grained, Ash to Lapili Tuff (interbedded).								Driller reports weathered rock at 12 feet

0 1 2 3 4 5 6 7 8 9 10 11 12 13

FOR OFFICIAL USE ONLY

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 5 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 20.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					TUFF, gray, highly weathered, very weak, fine to coarse grained, Ash to Lapili Tuff (interbedded). *(continued)*								
6.0	14.0	NR					1				1030		SPT Sample 3 (13.5 ft - 13.83 ft) Blows: 50 blows/4 inches
					TUFF, light brown to brown, moderately to slightly weathered, coarse to fine grained, moderately strong to strong.				0				Begin HQ3 coring using #10 bit Begin 3/12/2012
			M			1		71	0	57	(70)		
		NR			Becomes coarse grained (Lapilli Tuff, highly weathered.				NA		1033		Driller reports "last foot dropped down". Possible void.
		NR							NA		1039		
			M						0				
			M										
			M		Becomes fine grained (Ash Tuff).	2		84	0	80	(27)		
			M						0				
			M						0		1050		
			M								1055		
			M						0				
			M			3		75		75	(17)		At 23.0-23.2 ft: PL Is(50)=159 psi At 23.0-23.4 ft: PL Is(50)=131 psi
-3.5	23.5		M						NA				
		NA			ALLUVIUM SILT (ML); moist; reddish brown; very stiff.						1102		
											1107		
-5.0	25.0				LEAN CLAY (CL); moist; reddish brown; very stiff.	4		100			(60)		
											1110		No recovery. Push core barrel to 28 feet to recover soil.
-7.5	27.5				SANDY ELASTIC SILT (MH); moist; reddish brown; high plasticity fines; very stiff.	5		100					
							2						SPT Sample 4 (28 ft - 29.5 ft) Blows: 7,9,10 (N=19) recovered 5 feet of silt/clay, more than 100% recovery
						6		0					

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 5 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 20.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					SANDY ELASTIC SILT (MH); moist; reddish brown; high plasticity fines; very stiff. *(continued)*		2						
											1209		Driller increased water pressure while coring
					Becomes medium stiff.	7		0			(69)		
											1211		SPT Sample 5 (32 ft - 33.5 ft) Blows: 7,6,7 (N=13) LL=65, PI=27
						8		100					
											1225		
-15.0	35.0												
					LEAN CLAY (CL); moist; reddish brown; stiff.	9		0			(105)		
											1227		
					Becomes hard.								SPT Sample 6 (37 ft - 38.5 ft) Blows: 13,13,18 (N=31) At 37.0-40.0 ft: UCS=7718 psf TUW=116.7 pcf
						10		100					
											1238		
						11		0			(68)		
-21.0	41.0												
					SANDY SILT (ML); moist; reddish brown; very dense.								
											1241		SPT Sample 7 (42 ft - 43.5 ft) Blows: 13,9,7 (N=16) SA: G=13% S=30% F=57%
						12		0					
											1245		
											(42)		

Boring Designation B-01

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 5 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 20.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					SANDY SILT (ML); moist; reddish brown; very dense. *(continued)*	13	2	0			(42)		
					Becomes loose.	14		100			1250		SPT Sample 8 (47 ft - 48.5 ft) Blows: 4,3,2 (N=5)
-29.0	49.0				LEAN CLAY (CL); moist; reddish brown; hard.	15		0			1320		
						16		125			(42)		SPT Sample 9 (52 ft - 53.17 ft) Blows: 12,25,50 blows/2 inches
-33.0	53.0				BEDROCK **BASALT**, gray, moderately weathered, weak, intensely to highly fractured, fine grained. 1: 10, V, Vn, Ca, Pa, Pl, Sr 2: 15, V, Vn, Ca, Pa, Pl, Sr	17		100	>12	50	1325		
			M 1						1		1329		At 54.5-55.0 ft: UCS=1341 psi TUW=116.4 pcf
			2						1		(21)		At 55.3-55.6 ft: PL Is(50)=122 psi
			M M						0		1340		
			M M										
			M M										
			M M										
			M M		1: 60, V, Vn, Ca, Pa, Pl, Sr 2: 65, V, Vn, Ca, Fl, Pl, Sr		3		0		1346		
			M						1				
-39.0	59.0		1 M		BEDROCK **BASALT**, gray, slightly weathered, strong, intensely to highly fractured, fine grained.	18		100	0	100	(30)		
									0				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 5 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 20.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BEDROCK **BASALT**, gray, slightly weathered, strong, intensely to highly fractured, fine grained. *(continued)*		3		1		(30) 1356		
			1 2 3 4 4 4 4 4 M M M M		1: 60, V, Vn, Ca+h, Fl, Pl, Sr 2: 75, V, Vn, Ca+h, Fl, Pl, Sr 3: 10, V, Vn, Ca+h, Fl, Pl, Sr 4: 0, V, T, Ca+h, Fl, Pl, Sr Bundle of thin veinlets between 62.7-ft to 63.5-ft.				4 3		1400		
						19		100	0	100	(13)		
			M M M						0				
-46.2	66.2		M								1419		

61 62 63 64 65 66

Boring terminated at 66.2-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-26 feet and
0.010-inch slotted screen 26-66 feet with end cap; annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 24.5-66 feet, bentonite pellets 19.5-24.5 feet, and neat cement grout tremied 2-19.5 feet; redimix concrete 0-2 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-02 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Grass area next to road	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	3/13/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	90.0ft	Screen Material: Slot Size:	PVC/.010in
Depth to Water:	1.5ft	Screen Length: Screen Depth:	40ft-88ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	40ft-90ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Borehole consumed 4.0 bags

Well Abandonment Information	
Date of Abandonment: 11/26/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Borehole consumed 4.0 bags	
Driller's Signat[redacted] (b) (6)	Date: 12-4-13
Consultant's Si[redacted]	Date: 12/5/13

~~For Red Hill AOC Party Use Only~~

Boring Designation B-02

DRILLING LOG

DIVISION

NOTES

SHEET 1 OF 6 SHEETS

1. PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

9. COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

10. SIZE AND TYPE OF BIT: HQ3 Diamond Bit

2. HOLE NUMBER: B-02 | LOCATION COORDINATES: (b) (3) (A) [redacted]

11. MANUFACTURER'S DESIGNATION OF DRILL: CME 55 Track Rig

3. DRILLING AGENCY: Taber Drilling Company

12. TOTAL SAMPLES: 6 | DISTURBED: 6 | UNDISTURBED: 0

4. NAME OF DRILLER: (b) (6)

13. TOTAL NUMBER CORE BOXES: 4

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: --- | BEARING:

14. ELEVATION GROUND WATER: INITIAL 1.5 3/15/12 | STATIC

15. DATE STARTED: 3/13/12 | DATE COMPLETED: 3/13/12

6. THICKNESS OF OVERBURDEN: 8.0 ft

16. ELEVATION TOP OF BORING: 59.0

7. DEPTH DRILLED INTO ROCK: 50.6 ft

17. TOTAL CORE RECOVERY FOR BORING: N/A

8. TOTAL DEPTH OF BORING: 90.0 ft

18. LOGGED BY: (b) (6) | CHECKED BY:

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					FILL SILTY, CLAYEY SAND (SC-SM); moist; brown; to reddish brown with concrete and asphalt debris.								6" solid stem auger 5" ID casing driven to 10 feet
					3-6 in diameter concrete clast.								
													SPT Sample 1 (5 ft - 6.5 ft) Blows: 21,28,7 (N=35)
51.0	8.0				**TUFF**, gray, highly weathered, weak, fine to coarse grained, Lapili to Ash Tuff (interbedded).								Driller reports bedrock at 8 feet below groud surface
							1		NA		1110		SPT Sample 2 (10 ft - 10.4 ft) Blows: 50 blows/5 inches Begin HQ3 coring using #2 bit Begin 3/13/2012
			M		Becomes moderately weathered, strong.	1		40	0	40	(24) 1115		
					Highly weathered from 12.1-ft to 12.3-ft.				NA		1123 (24)		Change coring to #10 bit
46.0	13.0		M										Decrease in circulation

FOR OFFICIAL USE ONLY

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 59.0

ELEV	DEPTH	FIELD CLASSIFICATION OF MATERIALS (Description)	Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	REMARKS
	13	**TUFF**, gray, moderately weathered, strong, fine to coarse grained, Lapili to Ash Tuff (interbedded) *(continued)*.		1		0			
	14		2		85	0	75	(24)	Lose circulation
	15					NA		1133	
	16					0		1139	
	17					0			
	18	Large cobble sized clasts incorporated into matrix (18 ft - 19.7 ft).	3		100	0	80	(25)	
	19					NA			
	20	Mechanical breakage along highly weathered bedding planes.				NA		1151	
	21					0		1157	
	22					0			
	23	Mechanical breakage along highly weathered bedding planes.	4		100	NA	63	(23)	
	24	Mechanical breakage along highly weathered bedding planes.				NA			
	25	Mechanical breakage along highly weathered bedding planes.				NA		1210	
	26			2		0		1214	
	27					0		(30)	
	28		5		100	0	100		
30.0	29.0								

Boring Designation B-02

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 59.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, gray, moderately weathered, strong, fine to coarse grained, Lapili to Ash Tuff (interbedded); with highly weathered zones.		2		0				
			M										
			M								(30)		
					Becomes gray with a cinderlike texture.				0				
			M								1224		
			M										
					Highly weathered, weak, loosely consolidated from 30.8-ft to 34.1-ft.						1229		
									NA				
									NA				
						6		90	NA	40	(50)		
									0				
			M										
			M						0				
					Becomes moderately weathered, strong, interbeded Ash/Lapilli tuff.						1235		
											1241		
									0				
									0				
						7		95	0	60	(33)		
									NA				
					Highly weathered from 39.4-ft to 40.2-ft.								
			M						0				
			M										
			M		Becomes brown.						1250		
			M				3				1256		No circulation return since 14.2 feet
			M						0				
			M										
									0				
											(19)		
			M			8		100	0	100			
			M										
			M						0				
			M										
14.0	45.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 59.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, brown, moderately weathered, strong, fine to coarse grained, Lapili to Ash Tuff (interbedded).		3		0		(19)		
											1312		
									0		1320		
									0				At 47.0-47.2 ft: PL Is(50)=121 psi
									0				
10.6	48.4				ALLUVIUM	9		100	NA	50	(27)		
					SILT (ML); moist; reddish brown; very stiff with trace fine sand.				NA				At 49.0-49.6 ft: TX-UU: Max. deviator stress=12325 psf, confining pressure=4320 psf
									NA				
									NA		1331		
									NA		1341		
									NA				
						10			NA		(60)		
									NA				
									NA				
									NA		1346		
						11			NA				SPT Sample 3 (56 ft - 57.5 ft) Blows: 5,6,11 (N=17) Drive sample
					Homogeneous.		4		NA		1355		
									NA				
						12			NA		(42)		
									NA				
									NA		1400		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 59.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					ALLUVIUM SILT (ML); moist; reddish brown; very stiff with trace fine sand. *(continued)*	13	4		NA				SPT Sample 4 (61 ft - 62.5 ft) Blows: 7,8,12 (N=20) Drive sample
									NA		1409		
						14			NA		(42)		
									NA		1414		
						15			NA				SPT Sample 5 (66 ft - 67.5 ft) Blows: 6,5,11 (N=16) Drive Sample
-9.0	68.0								NA		1419		
					ALLUVIUM SILTY SAND to SANDY SILT (SM-ML), light yellowish brown to reddish brown (mottled), Coralline Derived?.	16		60	NA		(26)		At 68.8-73.8 ft: UCS=54 psi TUW=89.0 pcf
-11.0	70.0								NA				At 69.6-69.8 ft: PL Is(50)=4 psi At 69.6-69.7 ft: PL Is(50)=5 psi
			M		BEDROCK **BASALT**, gray, highly weathered, weak, fine grained.						1427		
						17			NA				SPT Sample 6 (71 ft - 71.75 ft) Blows: 14, 50 blows/3 inches Drive Sample
					Becomes moderately weathered, strong.						1510		At 71.8-72.1 ft: PL Is(50)=302 psi At 71.8-79.1 ft: PL Is(50)=236 psi
			M						0				At 72.8-73.2 ft: PL Is(50)=103 psi
			M						NA				
			M										
			M										
			M		Becomes highly weathered, weak.	18		52		20	(33)		
			M						0				
			M						NA				
											1518		
											1524		
									NA		(75)		

Boring Designation B-02

DRILLING LOG (Cont Sheet)

NOTES

SHEET 6 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 59.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS	
					BEDROCK **BASALT**, gray, highly weathered, weak, fine grained. *(continued)*		4		NA					77
									NA					78
						19		40	NA		(75)			79
									NA					
-21.0	80.0													80
					OLDER ALLUVIUM SILT (ML); moist; brown to reddish brown, hard.				NA		1528			81
									NA				Push 2.5 feet run	
						20			NA					82
									NA					83
									NA				Push Recovered 5 feet of soils	
						21			NA					84
									NA					85
									NA				Push	86
						22			NA					87
									NA					88
									NA					89
									NA					
-31.0	90.0													90

Boring terminated at 90-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-48 feet and
0.010-inch slotted screen 48-88 feet with end cap; annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 45-88 feet, bentonite pellets 40-45 feet, and neat cement grout tremied 2-40 feet; redimix concrete 0-2 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-03 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Edge of Road	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	2/22/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	122.0ft	Screen Material: Slot Size:	PVC/.020in
Depth to Water:	17.4ft	Screen Length: Screen Depth:	81.4ft-121.4ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	53ft-121.4ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Borehole consumed 6.5 bags

Well Abandonment Information	
Date of Abandonment: 11/26/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y / (N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y / (N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) / N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Borehole consumed 6.5 bags	
Driller's Signature: (b) (6)	Date: 12-4-13
Consultant's Sign:	Date: 12/5/13

~~For Red Hill AOC Party Use Only~~

Boring Designation B-03

DRILLING LOG

DIVISION

NOTES

SHEET 1 OF 8 SHEETS

1. PROJECT
Red Hill Tunnel Repair Project Pearl Harbor

9. COORDINATE SYSTEM HI State Plane Zone 3 | HORIZONTAL NAD83 | VERTICAL NAVD88

10. SIZE AND TYPE OF BIT
HQ3 Diamond Bit

2. HOLE NUMBER
B-03

LOCATION COORDINATES
(b) (3) (A) [redacted]

11. MANUFACTURER'S DESIGNATION OF DRILL
CME 55 Track Rig

3. DRILLING AGENCY
Taber Drilling Company

12. TOTAL SAMPLES 1 | DISTURBED 1 | UNDISTURBED 0

4. NAME OF DRILLER
(b) (6) [redacted]

13. TOTAL NUMBER CORE BOXES 8

5. DIRECTION OF BORING
☒ VERTICAL
☐ INCLINED
DEG FROM VERTICAL ---
BEARING

14. ELEVATION GROUND WATER
INITIAL 17.4 2/29/12 STATIC

15. DATE STARTED 2/20/12 | DATE COMPLETED 2/22/12

6. THICKNESS OF OVERBURDEN 0.0 ft

16. ELEVATION TOP OF BORING 138.0

7. DEPTH DRILLED INTO ROCK 100.4 ft

17. TOTAL CORE RECOVERY FOR BORING N/A

8. TOTAL DEPTH OF BORING 122.0 ft

18. LOGGED BY (b) (6) [redacted] | CHECKED BY

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
137.5	0.5				PAVEMENT 3-in thick Asphalt over 3-in thick Base.								2/20/12 6' solid stem augur to 3 feet 5 inches ID casing driven to 3.5 feet
					TUFF, brown, slightly to moderately weathered, strong, fine to coarse grained, massive, Ash to Lapilli Tuff (interbbeded), moderately hard.								
											1002		SPT Sample 1 (2 ft - 2.33 ft) Blows: 50 blows/4 inches Begin HQ3 coring using #2 bit Begin 2/20/2012
					1: 75, V, Vn, Ca, Fl, Ir, Sr		1						
									NA		(22)		
			2 M M M M M M M M			1		71	1	77			
									0		1014		
											1022		
			1 M M M M M						1				
									0				
					1: Bedding 0-5 degrees.								
			M M M M M			2		99	0	93	(33)		
			M 1 1						2				
			M M M M		Moderately to highly weathered from 11.5-ft to 11.9-ft.				0		1031		
			1								1035		
									1		(43)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 8 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 138.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M	Y Y A A A	**TUFF**, brown, slightly to moderately weathered, strong, fine to coarse grained, massive, Ash to Lapilli Tuff (interbbeded), moderately hard. *(continued)*		1		0				Averaging 10-15 gallons of water loss per run
			M	Y Y A A A					0				
				Y Y A A A									
			M	Y Y A A A		3		100	0	100			
				Y Y A A A							(43)		
			M	Y Y A A A	Gravel size clasts (Lapilli) from 12-ft to 15.2-ft.								
			M	Y Y A A A					0				
			M	Y Y A A A									
			M	Y Y A A A					0				
			M	Y Y A A A							1042		
			M	Y Y A A A							1045		
			M	Y Y A A A					0				
			M	Y Y A A A									
			M	Y Y A A A					0				
			M	Y Y A A A									
			M	Y Y A A A			2		0				
			M	Y Y A A A									
			M	Y Y A A A		4		80	0	80	(43)		
			M	Y Y A A A									
			M	Y Y A A A					0				
			M	Y Y A A A									
			M	Y Y A A A					0				
			M	Y Y A A A							1052		
			M	Y Y A A A							1054		
			M	Y Y A A A					0				
			M	Y Y A A A									
			M	Y Y A A A					0				
			M	Y Y A A A									
			M	Y Y A A A		5		100	0	100	(43)		
			M	Y Y A A A									
			M	Y Y A A A					0				
			M	Y Y A A A									
			M	Y Y A A A					0				
			M	Y Y A A A									
			M	Y Y A A A							1101		
			M	Y Y A A A							1104		
			M	Y Y A A A					0				
				Y Y A A A							(38)		
				Y Y A A A					0				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 8 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 138.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, brown, slightly to moderately weathered, strong, fine to coarse grained, massive, Ash to Lapilli Tuff (interbbeded), moderately hard. *(continued)*	6	2	100	0	100			
			M						0		(38)		
			M						1		1112		
			1		Becomes gray, slightly weathered, strong to very strong, hard.				0		1115		
			M				3		0				
						7		100	0	100	(50)		
									0				
									0				
			M		Large gravel size clasts and angular cobble size zenolith from 36.3-ft to 36.8-ft.						1121		
									0		1125		
									0				
						8		100	0	100	(38)		
									0				
									0				
			M								1133		
									0		1147		Change to #8 bit
									0		(38)		
93.0	45.0					9		100	0	100			

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 8 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 138.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					TUFF, gray, moderately hard, slightly weathered, strong, fine to coarse grained, massive, Ash to Lapilli Tuff (interbbeded) *(continued)*.		3		0				
			M										
									0		(38)		
			M								1155		
									0		1200		
									0				
			M										
					Moderately weathered from 49-ft to 49.4-ft.								
					Becomes predominately Lapilli size.	10		100	0	100	(60)		
			M										
			M						0				
									0		1205		
							4				1208		
									0				
									0				
									0				
						11		100	0	100	(75)		
			M										
			M						0				
									0				
			M								1212		
			M								1216		
									0				
			M										
									0				
											(50)		
						12		100	0	100			
									0				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 8 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 138.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, gray, moderately hard, slightly weathered, strong, fine to coarse grained, massive, Ash to Lapilli Tuff (interbbeded) *(continued)*. (continued)		4						
			M				5		0		(50)		
			M		Moderately weathered from 61.2-ft to 61.5-ft.						1222		
											1226		
									0				
									0				
			M										
			M						0				
			M										
			M		Highly weathered from 64-ft to 64.8-ft.								
			M			13		100	0	100	(50)		
			M										
			M						0				
			M										
			M						0				
			M										
			M						0				
											1232		
									0				
									0				
									0				
						14		100	0	100			
			M						0				
									0				
			M										
									0		1242		
											1249		
									0				
									0				
			M										
						15			0		(38)		
							6						
			M						0				
			M										
			M						0				
			M										
			M						0				
			M								1257		

61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76

DRILLING LOG (Cont Sheet)

NOTES

SHEET 6 OF 8 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 138.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					TUFF, gray, moderately hard, slightly weathered, strong, fine to coarse grained, massive, Ash to Lapilli Tuff (interbbeded) *(continued)*. (continued)		6		0		1301		
									0				
									0				
						16		100	0	100	(50)		
					Moderately weathered from 80-ft to 82-ft.				0				
									0		1307		
									0		1312		At 82.0-86.9 ft: UCS=2856 psi TUW=129.8 pcf
									0				
									0				
						17		100	0	100	(23)		
									0				
									0				
									0		1325		
									0				
									0				
					Becomes gray with an increase in grain/clast size (gravel).	18		100	0	100			
									0				At 89.5-89.7 ft: PL Is(50)=379 psi
									0		1333		
									0		1110		Begin 2/21/2012
									0				
									0		(25)		
							7		0				
45.0	93.0					19		98		98			

77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92

DRILLING LOG (Cont Sheet)

NOTES

SHEET 7 OF 8 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 138.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M M M M M M		**LAPILLI TUFF**, gray, slightly weathered, fine to coarse grained, massive, becomes interbeded, sand to Lapilli size clasts.		7		0				
											(25)		
					Silt lens (ML), moist, olive brown from 94.2-ft to 94.4-ft.				0				At 94.5-99.5 ft: UCS=1289 psi TUW=128.6 pcf 2 feet run
			M M M M M								1121		
											1127		
									0				
			M M			20		98		98	(30)		At 95.9-96.2 ft: PL Is(50)=261 psi At 95.9-96.0 ft: PL Is(50)=287 psi
			M						0				
											1131		
											1135		At 97.0-97.3 ft: PL Is(50)=217 psi At 97.0-97.1 ft: PL Is(50)=274 psi
									0				
									0				
					Lean Clay lens (CL), moist, brown from 99.2-ft to 99.3-ft. Lean Clay lens (CL), moist, brown from 99.6-ft to 99.7-ft.	21		84	2	60	(25)		
			M M M M						0				Lost circulation at 100.5 feet
36.9	101.1		M M		Silty Sand lens (SM), gray from 101-ft to 101.1-ft.								
					RESIDUAL SOIL SANDY LEAN CLAY (CL); moist; reddish brown; to clay (CL), hard.				NA		1147		
											1204		
									NA				
						22		80			(30)		Circulation resumed at 103 feet
									NA				At 103.5-104.0 ft: UCS=112 psi TUW=120.3 pcf At 104.0-104.4 ft: UCS=7660 psf TUW=121.3 pcf
									NA		1209		
											1219		
									NA				
						23		100			(75)		
									NA				
											1221		
							8				1226		
									NA				
											(30)		
						24		100					
									NA				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 8 OF 8 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 138.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					RESIDUAL SOIL SANDY LEAN CLAY (CL); moist; reddish brown; to clay (CL), hard. *(continued)*		8		NA		(30) 1231		
											1246		
									NA				
						25		60			(38)		
									NA				
											1250		
											1256		
									NA				
									NA				
									NA				
						26		0			(43)		
									NA				
									NA				
											1303		
											1306		
						27		0	NA		(20)		
											1309		
											1314		
									NA				
									NA				
						28		0			(60)		
									NA				
									NA				
16.0	122.0										1318		

Boring terminated at 122-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-81.4 feet and
0.020-inch slotted screen 81.4-121.4 feet with end cap; annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 65-121.4 feet, bentonite
pellets 53-65 feet, and neat cement grout tremied
2-53 feet; redimix concrete 0-2 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-04 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Edge of Road	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	2/24/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	130.0ft	Screen Material: Slot Size:	PVC/.020in
Depth to Water:	38.6ft	Screen Length: Screen Depth:	90ft-130ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	62ft-130ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Borehole consumed 7.5 bags.

Well Abandonment Information	
Date of Abandonment: 11/26/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Borehole consumed 7.5 bags	
Driller's Signature (b) (6)	Date: 12-4-13
Consultant's Sign (b) (6)	Date: 12/5/13

~~For Red Hill AOC Party Use Only~~

Boring Designation B-04

DRILLING LOG

DIVISION

NOTES

SHEET 1 OF 9 SHEETS

1. PROJECT
Red Hill Tunnel Repair Project Pearl Harbor

9. COORDINATE SYSTEM HI State Plane Zone 3 | HORIZONTAL NAD83 | VERTICAL NAVD88

10. SIZE AND TYPE OF BIT
HQ3 Diamond Bit

2. HOLE NUMBER
B-04

LOCATION COORDINATES
(b) (3) (A) [redacted]

11. MANUFACTURER'S DESIGNATION OF DRILL
CME 55 Track Rig

3. DRILLING AGENCY
Taber Drilling Company

12. TOTAL SAMPLES 1 | DISTURBED 1 | UNDISTURBED 0

4. NAME OF DRILLER
(b) (6)

13. TOTAL NUMBER CORE BOXES 9

5. DIRECTION OF BORING
☒ VERTICAL
☐ INCLINED

DEG FROM VERTICAL ---

BEARING

14. ELEVATION GROUND WATER
INITIAL 38.6 2/29/12 STATIC

15. DATE STARTED 2/23/12 | DATE COMPLETED 2/24/12

6. THICKNESS OF OVERBURDEN 0.0 ft

16. ELEVATION TOP OF BORING 162.0

7. DEPTH DRILLED INTO ROCK 115.5 ft

17. TOTAL CORE RECOVERY FOR BORING N/A

8. TOTAL DEPTH OF BORING 130.0 ft

18. LOGGED BY
(b) (6)

CHECKED BY

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
161.5	0.5				PAVEMENT 3-in thick Asphalt over 3-in thick Base.								2/23/12 6" solid stem augur to 3.8 feet 5" ID casing driven to 4 feet
					TUFF, slightly to moderately weathered, strong, fine to coarse grained, Ash to Lapilli Tuff (interbedded), light brown to light gray.								
													Very difficult using solid stem augur
			M				1		0		1409		SPT Sample 1 (3.6 ft - 3.25 ft) Blows: 50 blows/3 inches Begin coring with #2 bit Begin 2/23/2012
			M M			1		95	0	95	(18)		Good circulation
			M						0				
			M M								1419 1430		Switch to #10 bit
			M						0				
			M						0				
			M M M M M M			2		100	0	100	(50)		
			M						0				
			M M						0		1436 1439		
									0		(50)		

FOR OFFICIAL USE ONLY

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 9 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 162.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M M M M M		**TUFF**, slightly to moderately weathered, strong, fine to coarse grained, Ash to Lapilli Tuff (interbedded), light brown to light gray. *(continued)*		1		0				
						3		100	0	100	(50)		
			M						0				
									0		1445		
											1448		
			M				2		0				
			M			4		100	0	100	(75)		
									0				
			M		Moderately weathered from 21-ft to 22.3-ft.				0				
											1452		
											1455		
									0				
									0				
			M			5		100	0	100	(60)		
			M M						0				
									0		1500		
											1502		
									0				
									0		(50)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 9 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 162.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, slightly to moderately weathered, strong, fine to coarse grained, Ash to Lapilli Tuff (interbedded), light brown to light gray. *(continued)* Large gravel size clasts from 29-ft to 29.4-ft.	6	2	100	0	100			
			M						0		(50)		
			M						0				
			M						0		1508		
			M		15-25% pea size voids filled to partially filled with secondary minerals (Opalescent) from 31.6-ft to 32.2-ft.		3		0		1511		
									0				
									0				
						7		100	0	100	(50)		
									0				Driller reports water loss averaging about 5-10 gallons per run
									0				
			M								1517		
			M		25% large cobble to large gravel size clasts from 37.8-ft to 38.3-ft.				0		1519		
									0				
						8		100	0	100	(50)		
									0				
			M						0		1525		
									0		1528		
									0				
									0		(60)		
						9		100	0	100			

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 9 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A)

ELEVATION TOP OF BORING: 162.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, slightly to moderately weathered, strong, fine to coarse grained, Ash to Lapilli Tuff (interbedded), light brown to light gray. *(continued)*		3		0				
									0		(60)		
							4				1533		
									0		1536		
									0				
									0				
						10		100	0	100	(60)		
			M						0				
					15-30% very large cobble size clasts from 50.2-ft to 54-ft.				0				
			M						0		1541		
									0		1544		
									0				
									0				
						11		100	0	100	(50)		
									0				
									0				
									0		1550		
			M						0		846		Begin 2/24/2012
			M		Moderately weathered from 57.5-ft to 57.8-ft.								
			M		Becomes 10-20% large gravel to cobble size clasts.				0				
			M								(38)		
						12		100	0	100			
							5		0				
			M										

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 9 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A)

ELEVATION TOP OF BORING: 162.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, slightly to moderately weathered, strong, fine to coarse grained, Ash to Lapilli Tuff (interbedded), light brown to light gray. *(continued)*		5		0		(38)		
											854		
											857		Good circulation
									0				
			M		Highly to moderately weathered from 62.8-ft to 63.4-ft.								Partial water loss at 63 feet
			M						0				
			M										
			M										
			M										
			M						0				
			M										
			M		Highly to moderately weathered from 64.1-ft to 65-ft.	13		100	0	100	(43)		
			M										
			M						0				
			M										
			M						0				
			M										
			M						0				
											904		
			M						0		907		
			M										
			M						0				
			M										
			M						0				
			M										
			M						0				
			M			14		100	0	100	(38)		
			M										
			M						0				
			M										
			M						0				
			M										
			M						0				
			M								915		
			M						0		918		
					20% coarse sand to fine gravel size voids or vesicles from 72.6-ft to 73-ft.								
									0				
									0				
						15	6	100	0	100	(50)		
			M										
									0				
									0				
			M								924		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 6 OF 9 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 162.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					TUFF, slightly to moderately weathered, strong, fine to coarse grained, Ash to Lapilli Tuff (interbedded), light brown to light gray. *(continued)*		6		0		930		
									0				
									0				
						16		100	0	100	(50)		
			M						0				
									0				
			M						0		936		
									0		940		
									0				
									0				
			M			17		100	0	100	(43)		
									0				
			M						0				
			M						0		947		
			M			18		100	0	100	950 (10) 955		0.7 feet run
			M				7				1001		
			M						0				
			M						0				
						19		100		100	(32)		
			M						0				
									0				
			M						0		1009		
									0		1012		
									0		(43)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 7 OF 9 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 162.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, slightly to moderately weathered, strong, fine to coarse grained, Ash to Lapilli Tuff (interbedded), light brown to light gray. *(continued)*		7		0				
			M		Angular mechanical breaks are parallel to bedding.	20		100	0	100	(43)		
			M						0				
									0		1019		Loss of circulation at last 1 feet of run 20
			1		1: 40, V, N, Ca, Fl, Pl, Sr 2: 35, V, Vn-N, Ca, Fl, Pl, Sr 3: 88, V, Vn-N, Ca, Fl, Pl, Sr				1		1023		Full circulation resumes
			M						0				
			M			21		100		100	(37)		
			M						2				Driller reports slower rate of drilling
			2										
			3						0				
			M								1030		
			M				8		>10		1035		
			M		Highly weathered from 101.4-ft to 101.7-ft.				0				At 101.9-106.9 ft: UCS=1277 psi TUW=145.9 pcf Cuttings change color to brownish
			M			22		100	0	78	(23)		At 102.6-103.0 ft: PL Is(50)=470 psi
			M						>10				
			M		Highly weathered from 104.8-ft to 105.2-ft.				>10				At 104.9-109.9 ft: UCS=1015 psi TUW=124.4 pcf
			M								1048		
			M		Highly weathered from 105.9-ft to 106.6-ft.				>10		1120		
			M						0		(22)		
			M										At 107.9-112.9 ft: UCS=1901 psi TUW=128.7 pcf
			M			23		100	0	91			
			M										At 108.8-109.1 ft:

DRILLING LOG (Cont Sheet)

NOTES

SHEET 8 OF 9 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 162.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					TUFF, slightly to moderately weathered, strong, fine to coarse grained, Ash to Lapilli Tuff (interbedded), light brown to light gray. *(continued)*		8		0				PL Is(50)=260 psi
									0		(22)		
											1133		
					Possible void, clay infilling.						1147		
			M						0				
			M										
			M						0				At 112.3-112.5 ft: PL Is(50)=258 psi
			M										
			M										Circulation loss at 113 feet
						24		94	0	94	(38)		
			M										
									0				
			M		Moderately weathered from 114.7-ft to 115.4-ft.								
			M										
			M						0				
			M										
			M								1155		
			M				9				1209		LL=84, PI=38
45.6	116.4		M						NA				
					ALLUVIUM SANDY ELASTIC SILT (MH); moist; dark olive brown; 66% high plasticity fines; 34% sand; 0% gravel; SANDY CLAY (CL); moist; brown.	25		100					
									NA				
											(36)		
													SA: S=34% F=66%
									NA				
						26		100					
42.4	119.6								NA		1215		
					ALLUVIUM SANDY ELASTIC SILT (MH); moist; dark olive brown; SANDY CLAY to CLAYEY SAND (CL-SC); moist; brown; medium to coarse grained sand.								
									NA		1300		
									NA				
			M										
			M		Possible basaltic alluvial boulder, highly weathered (122 ft - 126 ft).				NA				
			M			27		66			(22)		
			M										
			M						NA				
			M										
			M										
			M						NA				
			M										
			M								1312		

Boring Designation B-04

DRILLING LOG (Cont Sheet)

NOTES

SHEET 9 OF 9 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) [redacted] (A) [redacted]

ELEVATION TOP OF BORING: 162.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					ALLUVIUM SANDY ELASTIC SILT (MH); moist; dark olive brown; SANDY CLAY to CLAYEY SAND (CL-SC); moist; brown; medium to coarse grained sand. *(continued)*		9		NA		1335		
					Becomes brown to light gray, with some gravel.				NA				
						28		64	NA		(30)		
					Becomes less gravel.				NA				
									NA				
32.0	130.0										1345		

125 126 127 128 129 130

Boring terminated at 130-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-90 feet and
0.020-inch slotted screen 90-130 feet with end cap; annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 80-130 feet, bentonite
pellets 62-80 feet, and neat cement grout tremied
2-62 feet; redimix concrete 0-2 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-05 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Grass Area	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	3/19/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	85.0ft	Screen Material: Slot Size:	PVC/.020in
Depth to Water:	81.0ft	Screen Length: Screen Depth:	42.5ft-82.5ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	14ft-17ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Boring Collapsed @ 17' Borehole consumed 2.0 bags

Well Abandonment Information	
Date of Abandonment: 11/22/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Boring Collapsed @ 17' Borehole consumed 2.0 bags	
Driller's Signatu (b) (6)	Date: 12-4-13
Consultant's Sig	Date: 12/5/13

~~For Red Hill AOC Party Use Only~~

Boring Designation B-05

DRILLING LOG	DIVISION	NOTES	SHEET 1 OF 6 SHEETS

1. PROJECT Red Hill Tunnel Repair Project Pearl Harbor		9. COORDINATE SYSTEM HI State Plane Zone 3	HORIZONTAL NAD83 / VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT HQ3 Diamond Bit	
2. HOLE NUMBER B-05	LOCATION COORDINATES (b) (3) (A) [redacted]	11. MANUFACTURER'S DESIGNATION OF DRILL CME 55 Track Rig	
3. DRILLING AGENCY Taber Drilling Company		12. TOTAL SAMPLES 0	DISTURBED 0 / UNDISTURBED 0
4. NAME OF DRILLER (b) (6)		13. TOTAL NUMBER CORE BOXES 4	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL ---	14. ELEVATION GROUND WATER INITIAL 81.0 4/23/12	STATIC
	BEARING	15. DATE STARTED 3/19/12	DATE COMPLETED 3/19/12
6. THICKNESS OF OVERBURDEN 47.2 ft		16. ELEVATION TOP OF BORING 153.0	
7. DEPTH DRILLED INTO ROCK 37.8 ft		17. TOTAL CORE RECOVERY FOR BORING N/A	
8. TOTAL DEPTH OF BORING 85.0 ft		18. LOGGED BY (b) (6)	CHECKED BY

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					FILL SANDY SILT (ML); moist; red.								5" ID casing driven to 9 feet
					With volcanic cobbles and gravels.								
							1		NA		917		Begin HQ3 coring with #10 bit No circulation Didn't retrieve sample, just a few volcanic cobbles Begin 3/19/2012
						1		10	NA		(60)		
									NA		920		
									NA		923 (100)		No circulation while advancing entire boring
140.0	13.0												

0 1 2 3 4 5 6 7 8 9 10 11 12 13

FOR OFFICIAL USE ONLY

Boring Designation B-05

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 153.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					SANDY SILT (ML); moist; red; with volcanic cobbles and gravels *(continued)*.		1		NA				
									NA				
						2		30	NA		(100)		
									NA				
									NA		926		
					Abundant cobbles.				NA		933		
									NA				
									NA				
						3		10	NA		(75)		
									NA				
									NA		937		
									NA		943		
									NA				
						4		8	NA		(43)		
									NA				
					Debris from an old concrete drain pipe.				NA				
126.0	27.0										950		
					LEAN CLAY (CL); moist; gray; with few gravels and cobbles.				NA		957		
											(30)		
									NA				

Boring Designation B-05

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 153.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					LEAN CLAY (CL); moist; gray; with few gravels and cobbles. *(continued)*	5	1	60	NA				
									NA		(30)		
121.7	31.3								NA				
					ALLUVIUM SANDY SILT (ML); moist; brown; with fine subrounded gravels.						1007		
									NA		1012		
									NA				
						6		60	NA		(60)		
									NA				
									NA				
116.0	37.0										1017		
					LEAN CLAY (CL); moist; dark red; low to medium plasticity fines; Homogeneous.				NA		1022		
									NA				
						7		70	NA		(23)		
									NA				
									NA				LL=36, PI=12
											1035		
									NA		1038		
						8		80	NA		(25)		
									NA		1044		
											1048		
											(75)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 153.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					LEAN CLAY (CL); moist; dark red; low to medium plasticity fines; Homogeneous. *(continued)*	9	2	0	NA		(75)		
									NA				
105.8	47.2										1050		
					BEDROCK **BASALT**, Red mottled with gray, completely weathered, extremely weak, rock fabric apparent but mostly weathered to clays and silts.	10		80	NA		1054 (25)		
									NA		1100		
						11		90	NA		1106 (19)		
									NA		1114		
						12		100	NA		1116 (30)		At 52.5-53.0 ft: TX-UU: Max. deviator stress=5250 psf, confining pressure=4320 psf
									NA		1121		
						13			NA		1125 (30)		
									NA		1130		
						14			NA		1134 (60)		
									NA		1137		
									NA		1402 (40)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 153.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BEDROCK **BASALT**, Red mottled with gray, completely weathered, extremely weak, rock fabric apparent but mostly weathered to clays and silts. *(continued)*	15	2	25	NA		(40)		
											1405		
							3				1408		
									NA				
						16		80			(38)		
									NA				
											1412		
									NA		1415		
						17		80			(50)		
									NA				
											1418		
											1423		
					Becomes completely to highly weathered.				NA				
									NA				
						18		70	NA		(43)		
									NA				
									NA				
											1430		
			1		Becomes light gray, slightly weathered, strong. 1: 5, B, W, Cl, Fl, Pl, Sr Clay filled bedding plane/joints with gray clay from 72.2-ft to 72.5-ft.						1434		
		W	M						1				At 72.5-72.7 ft: PL Is(50)=432 psi
			M						0				
			M			19		100	0	95	(23)		
			M						0				
		W	M						0				At 75.8-79.6 ft: UCS=2428 psi TUW=157.0 pcf At 76.3-76.7 ft: PL Is(50)=519 psi
			M						0				
76.0	77.0										1447		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 6 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 153.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray, slightly weathered, strong, *(continued)*.		4		NA		1450		
			M						NA				At 78.5-78.9 ft: PL Is(50)=433 psi
			M										
			M			20		84	NA		(38)		
					Becomes gray, completely to highly weathered, extremely weak to weak.								
									NA				
									NA				
											1458		
											1503		
									NA				
						21		20	NA		(30)		
									NA				
68.0	85.0										1509		

77 78 79 80 81 82 83 84 85

Boring terminated at 85-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-42.5 feet and
0.020-inch slotted screen 42.5-82.5 feet with end cap; hole collapsed to 17 feet when withdrawing the core barrel, remaining annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 16-17 feet, bentonite pellets 14-16 feet, and neat cement grout tremied 2-14 feet; redimix concrete 0-2 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-06 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Grass Area	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	3/21/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	165.5ft	Screen Material: Slot Size:	PVC/.020in
Depth to Water:	69.4ft	Screen Length: Screen Depth:	115ft-155ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	40ft-80ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Boring Collapsed @ 80' Borehole consumed 6.5 bags

Well Abandonment Information	
Date of Abandonment: 11/25/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Boring Collapsed @ 80' Borehole consumed 6.5 bags	
Driller's Signat [redacted]	Date: 12-4-13
Consultant's S [redacted]	Date: 12/5/13

~~For Red Hill AOC Party Use Only~~

Boring Designation B-06

DRILLING LOG	DIVISION	NOTES	SHEET 1 OF 11 SHEETS

1. PROJECT: Red Hill Tunnel Repair Project Pearl Harbor		9. COORDINATE SYSTEM: HI State Plane Zone 3	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: HQ3 Diamond Bit	
2. HOLE NUMBER: B-06	LOCATION COORDINATES: (b) (3) (A) [redacted]	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 55 Track Rig	
3. DRILLING AGENCY: Taber Drilling Company		12. TOTAL SAMPLES: 2	DISTURBED: 2 / UNDISTURBED: 0
4. NAME OF DRILLER: (b) (6)		13. TOTAL NUMBER CORE BOXES: 8	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING:	14. ELEVATION GROUND WATER: INITIAL 69.4 4/23/12	STATIC
		15. DATE STARTED: 3/20/12	DATE COMPLETED: 3/21/12
6. THICKNESS OF OVERBURDEN: 9.0 ft		16. ELEVATION TOP OF BORING: 219.0	
7. DEPTH DRILLED INTO ROCK: 147.5 ft		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 165.5 ft		18. LOGGED BY: (b) (6)	CHECKED BY:

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
218.8	0.3				PAVEMENT 3-in thick Asphalt.								3/20/12 6" solid stem augur to 9 feet 5" ID casing driven to 9 feet
					RESIDUAL SOIL LEAN CLAY (CL); moist; red; with few rounded fine gravels, stiff.								
													SPT Sample 1 (4 ft - 5.5 ft) Blows: 5,4,5 (N=9)
							1				1005		Begin HQ3 coring SPT Sample 2 (9 ft - 10.5 ft) Blows: 11,24,18 (N=52) Begin 3/20/2012
					BASALT boulder (floater), highly weathered, light gray, weak from 9.2-ft to 10.4-ft.	1		70	NA		(20)		Good circulation
									NA		1011		
									NA		1025		
											(60)		Good circulation
									NA				No reconery

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A)

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					RESIDUAL SOIL LEAN CLAY (CL); moist; red; with few rounded fine gravels, stiff. *(continued)*	2	1	0	NA				Good circulation through 63 feet
									NA		(60)		
									NA		1030		
									NA		1035		
									NA				
201.0	18.0												
			M		BEDROCK **BASALT**, light gray, moderately weathered, fine grained, weak to strong (many mechanical breaks).	3		60	0	30	(27)		
			M						0				
			M						NA		1046		
			M						0		1050		
			M						0				
			M		Highly weathered from 22.8-ft to 25.9-ft.	4		32	NA		(33)		
			M						NA				
			M						NA		1059		
			M						NA		1104		
			M						0		(25)		
			M										
			M			5		95	0	80			
			M										

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A)

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
189.5	29.5		M M M M M M		**BASALT**, light gray, slightly weathered, strong, fine grained.		1		0		(25)		
									0		1116		
									NA		1119		
					Becomes light gray to light blue gray with occasional vesicle-rich zones.				NA				
			M M M M M M M M M M			6		50	0	50			
									0				
									0				
							2		0				
			M M M M M M M M M M M M M M M M M M M M			7		100	0	100			
									0				
									0				
									0				
			M M M M M M M M M M			8		100	0	100			
									0				
									0				
174.0	45.0								0				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, light gray to light blue gray, slightly weathered, strong, fine grained, with occasional vesicle-rich zones *(continued)*.		2		0				
			M						0				
									0				
						9		100	0	80			
			M						NA				
			M		Highly weathered (ozidized red), weak to strong from 49.7-ft to 50.6-ft.								
			M						NA				
			M										
			M		Slighlty oxidized from 50.9-ft to 53-ft.		3		0				
									0				
			M										
			M										
			M			10		100	0	100			
			M						0				
			M										
			M						0				
			M										
			M						0				
			M						0				
			M			11		100	0	100			
									0				
			M						0				
									0		1213		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray to light blue gray, slightly weathered, strong, fine grained, with occasional vesicle-rich zones *(continued)*. (continued)		3		0		1222		
			M						NA				
156.0	63.0		M		**BASALT**, a'a clinker gravels, slightly oxidized.								Water loss at 63 feet
						12		60	NA	45	(33)		
									NA				
									NA		1231		
											1238		
									NA				
						13		8	NA	0			
									NA				
									NA				
							4						Driller ran water down the annulus to reduce friction
						14		5	NA	0			
											1238		
											1302		
									NA				
									NA				
						15		6	NA	0	(23)		
									NA				
									NA				
											1315		
											1335		
									NA		(60)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 6 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, a'a clinker gravels, slightly oxidized. *(continued)*		4		NA				
						16		22	NA	0			
									NA		(60)		
									NA				
											1340		
											1350		
									NA				
									NA				
136.0	83.0												
					BASALT, light gray, slightly weathered, strong, fine grained.	17		60	0	60	(75)		
									0				
			M										
			M										
			M						0				
			M								1354		
133.0	86.0												
					BASALT, light gray with zones of red, a'a clinker gravels.						1403		
									NA				
									NA				
						18		35	NA	0	(60)		
									NA				
									NA				
											1408		
											1410		
									NA				
											(17)		
									NA				

Boring Designation B-06

DRILLING LOG (Cont Sheet)

NOTES

SHEET 7 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, light gray with zones of red, a'a clinker gravels. *(continued)*	19	4	38	NA				
									NA		(17)		
123.4	95.6								NA				
					BASALT, light gray, slightly weathered, fine grained, strong to very strong.						1428		
			M						0		1431		
			M						0		(36)		
			M			20		100	0	100			
			M						0		1436		
									0		1439		
			M						0				
			M						0				
			M				5		0				
			M			21		100	0	100	(60)		
			M						0				
			M						0				
			M						0		1446		
									0		1448		
									0		(60)		
			M			22		100	0	100			

93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108

DRILLING LOG (Cont Sheet)

NOTES

SHEET 8 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray, slightly weathered, fine grained, strong to very strong. *(continued)*		5		0				
									0		(60)		
			M								1453		
									0		1456		
			M						0				
									0				
			M			23		86	0	86	(38)		
			M						NA				
104.0	115.0		M		**BASALT**, fine grained, a'a clinker gravels.								
									NA				
											1504		
							6				1507		
									NA				
102.0	117.0												
			M		**BASALT**, blue gray, slightly weathered, strong, fine grained, some stretched vesicles (a'a flow).				0				
			M										
			M										
			M			24		70	0	80	(50)		
			M						0				
													At 119.7-120.2 ft: PL Is(50)=561 psi
			M						0				
			M								1513		
98.0	121.0												
					BASALT, fine grained, a'a clinker gravels.				NA		1516		
									NA				
											(33)		
						25		10	NA	0			Some of the A'A gravels fell down the hole Driller pulled drill rod out
									NA				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 9 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, fine grained, a'a clinker gravels. *(continued)*		6		NA		(33)		
											1525		
					Gravels become red and cemented together with red clay.				NA		949		Begin 3/21/2012
									NA				
									NA				
						26		55	NA	0	(30)		
									NA				
									NA				
											959		
											1002		
									NA				
						27		5		0	(12)		
									NA				
											1012		
											1015		
									NA				
					Decrease in weathering.				NA				
						28		50		0	(30)		
									NA				
											1021		
											1041		
									NA				
									NA				
81.0	138.0												
		M			**BASALT**, light gray, slightly weathered, fine grained, strong to very strong, with few vesicles.	29		92	0	60	(33)		
		M					7		0				
									0				
											1050		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 10 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, light gray, slightly weathered, fine grained, strong to very strong, with few vesicles. *(continued)*		7		0		1054		
			M						0				
									0				
						30		100	0	100	(43)		
			M						0				At 144.0-144.3 ft: PL Is(50)=1761 psi
			M						0				
			M						0		1101		
			M								1244		
									0				
									0				
			M			31		100	0	100	(43)		
									0				At 149.4-154.4 ft: UCS=5797 psi TUW=168.5 pcf
			M						0				
			M								1251		
			M		Increase in vesicles.						1259		
									0				
							8		0				At 152.1-152.3 ft: PL Is(50)=990 psi
			M M						0				
						32		100	0	95	(25)		
									0				At 153.5-147.7 ft: UCS=8120 psi TUW=172.0 pcf
									0				
63.5	155.5		M		**BASALT**, red, highly weathered, fine grained, BASALT and a'a gravel, oxidized.				NA		1310		
											1415		
									NA		(19)		

Boring Designation B-06

DRILLING LOG (Cont Sheet)

NOTES

SHEET 11 OF 11 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 219.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
							8						
						33		50	NA	0			
									NA		(19)		
									NA				
58.8	160.2		M		**BASALT**, light gray, slightly to moderately weathered, strong, fine grained, some oxidation, with vesicles and occasional rip-up inclusions.				0		1430		
											1436		
			M						0				
			M						0				
			M			34		100	0	100	(26)		
			M						0				
			M						0				
			M										
53.5	165.5		M								1448		

157 158 159 160 161 162 163 164 165

Boring terminated at 165.5-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-115 feet and
0.020-inch slotted screen 115-155 feet with end cap; hole collapsed to 80 feet when withdrawing the core barrel, remaining annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 50-80 feet, bentonite pellets 40-50 feet, and neat cement grout tremied 2-40 feet; redimix concrete 0-2 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-07 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Clearing/Grass Area	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	3/20/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	455.0ft	Screen Material: Slot Size:	PVC/.020in
Depth to Water:	79.2ft	Screen Length: Screen Depth:	402ft-442ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	20ft-238ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Boring Collapsed @ 238' & 40'. Borehole consumed 8.5 bags

Well Abandonment Information	
Date of Abandonment: 11/25/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Boring Collapsed @ 238' & 40' Borehole consumed 8.5 bags	
Driller's Signature: (b) (6)	Date: 12-4-13
Consultant's Signa:	Date: 12/5/13

Boring Designation B-07

DRILLING LOG

DIVISION

NOTES

SHEET 1 OF 29 SHEETS

1. PROJECT
Red Hill Tunnel Repair Project Pearl Harbor

9. COORDINATE SYSTEM HI State Plane Zone 3 | HORIZONTAL NAD83 | VERTICAL NAVD88

10. SIZE AND TYPE OF BIT
HQ3 Diamond Bit

2. HOLE NUMBER
B-07

LOCATION COORDINATES
(b) (3) (A) [redacted]

11. MANUFACTURER'S DESIGNATION OF DRILL
CME 55 Track Rig

3. DRILLING AGENCY
Taber Drilling Company

12. TOTAL SAMPLES 0 | DISTURBED 0 | UNDISTURBED 0

4. NAME OF DRILLER
(b) (6)

13. TOTAL NUMBER CORE BOXES 30

5. DIRECTION OF BORING
☒ VERTICAL
☐ INCLINED

DEG FROM VERTICAL ---

BEARING

14. ELEVATION GROUND WATER
INITIAL 79.2 4/17/12 STATIC

15. DATE STARTED 3/20/12 | DATE COMPLETED 4/3/12

6. THICKNESS OF OVERBURDEN 28.0 ft

16. ELEVATION TOP OF BORING 534.0

7. DEPTH DRILLED INTO ROCK 455.0 ft

17. TOTAL CORE RECOVERY FOR BORING N/A

8. TOTAL DEPTH OF BORING 455.0 ft

18. LOGGED BY
(b) (6)

CHECKED BY

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					RESIDUAL SOIL **BASALT**, gray mottled with red, decomposed to completely weathered, extremely weak, fine grained.								3/30/12 6" solid stem augur to 4 feet 5" ID casing driven to 4 feet
							1		NA		1227		Begin HQ3 coring with #6 bit Begin 3/30/2012
						1		100	NA	0	(60)		
									NA		1230		
									NA		1240		
									NA				
						2		60	NA	0	(75)		
									NA				
									NA		1244		
									NA		1247 (43)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					RESIDUAL SOIL **BASALT**, gray mottled with red, decomposed to completely weathered, extremely weak, fine grained. *(continued)*		1		NA				
						3		60	NA	0			100% circulation recovery
											(43)		
									NA				
									NA		1254		
											1300		
									NA				
									NA				
			M			4		100	NA	0	(75)		
									NA				
									NA				
									NA		1304		
							2		NA		1342		
									NA				
						5		100	NA	0	(75)		
									NA				
									NA		1346		
									NA		1349		
506.0	28.0				BEDROCK **BASALT**, light gray, moderately weathered, strong, fine grained, slightly vesicular.				0		(33)		100% circulation water loss

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (6), (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		BEDROCK **BASALT**, light gray, moderately weathered, strong, fine grained, slightly vesicular. *(continued)*	6	2	85	0	0			
									0		(33)		
			M										
			M						0				
			M,M								1358		
			M										
			M										
502.0	32.0												
					BASALT, gray, highly weathered, weak, fine grained, slightly vesicular.				NA		1415		
									NA				
									NA				
						7		75	NA	0	(33)		
					Moderately weathered, moderately vesicular from 35-ft to 35.9-ft.				NA				
									NA				
497.4	36.6								NA				
					BASALT, brown, highly to completely weathered, very weak, fine grained, slightly to non-vesicular.						1424		
											1439		
									NA				
									NA				
						8		75	NA	0	(30)		Circulation returns
									NA				
493.0	41.0												
					TUFF, brown and red, highly weathered, very weak, Interbedded Ash to Lapilli Tuff with few cobble-sized clasts, much weathered to clay.		3		NA		1449		
											1452		
									NA				
									NA		(100)		
						9		100	NA	0			

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					TUFF, brown and red, highly weathered, very weak, Interbedded Ash to Lapilli Tuff with few cobble-sized clasts, much weathered to clay. *(continued)*		3		NA				
									NA		(100)		
											1455		
					Becomes mostly gray, extremely weathered.						1500		
									NA				
									NA				
						10		80	NA	0	(38)		
									NA				
483.2	50.8												
			M		**TUFF**, light gray, moderately weathered, weak, Interbedded Ash to Lapilli Tuff with few cobble-sized clasts, much weathered to clay.				0		1508		
			M								1522		
					Highly weathered, brown from 52-ft to 52.2-ft.				0				
			M										
			M						0				
			M										
			M,M		Highly weathered, from 54-ft to 54.2-ft.				0				
			M			11		100		0	(33)		
			M						0				
			M				4						
			M						0				
477.6	56.4												
					BASALT, light gray, slightly to moderately weathered, strong, fine grained, slightly vesicular.						1531		
			M								1535		
			M		Becomes moderately vesicular (stretched vesicles).				0				
			M			12		100		0	(30)		
			M						0				
											1539		
			M		Becomes slightly vesicular.						1544		
									0				
			M								(30)		
						13		100	0	0			

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray, slightly to moderately weathered, strong, fine grained, slightly vesicular. *(continued)*		4		0		(30)		
			M								1550		
			M								1553		
471.5	62.5		M						0				
			M	Y Y	**TUFF**, light gray, moderately weathered, moderately strong, Interbedded Ash to Lapilli Tuff with few cobble-sized clasts.								
			M	Y Y					0				
					Becomes strong.								
			M			14		100	0	0	(43)		
									0				
			M										
									NA				
					Becomes highly weathered, weak.						1600		
											1603		
									NA				
									NA				100% circulation water loss
						15		55	NA	0	(38)		
									NA				
									NA				
462.0	72.0						5				1611		
			M		**BASALT**, gray, slightly weathered, strong, fine grained, moderately vesicular.						1615		
			M						0				
			M										
			M						0				
			M		Oxidized red, moderately weathered from 74-ft to 74.3-ft.								
			M			16		100	0	100	(50)		
			M						0				
			M										
			M						0				
			M										
			M						0				
457.0	77.0				Becomes highly vesicular.						1621		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 6 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, gray, slightly weathered, strong, fine grained, highly vesicular *(continued)*.		5		NA		1625		
					Highly weathered from 77.5-ft to 78.2-ft.				0				
			M		Becomes moderately weathered, slightly vesicular.								
			M						0				
			M			17		100	0	75	(43)		
			M						0				
			M						0				
			M						0		1632		
			M		Becomes slightly weathered, moderately vesicular.						1635		
			M						0				
			M						0				
			M						0				
			M			18		100	0	100	(38)		
			M				6		0				
			M						0				
			M						0		1643		
			M						0		1650		
			M						0				
			M						0				
			M			19		100	0	100	(43)		
			M						0				
			M						0				
443.2	90.8												
			M		**TUFF**, gray and red, moderately weathered, moderately strong, Interbedded Ash to Lapilli Tuff with few cobble-sized clasts.				0		1657		
			M								1703		
									0		(38)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 7 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, gray and red, moderately weathered, moderately strong, Interbedded Ash to Lapilli Tuff with few cobble-sized clasts. *(continued)*		6		0				
			M			20		100	0	100	(38)		
			M						0				
			M						0				
			M,M		Becomes strong to weak.				0		1711		
436.5	97.5		M								1713		
					TUFF, light gray to white, highly weathered, very weak, Interbedded Ash to Lapilli Tuff.				NA				
						21		70	NA	5	(50)		
					Becomes moderately weathered, moderately strong.				NA		1716		
			M								1719		
433.5	100.5						7		0				
					BASALT, light gray, slightly weathered, strong, fine grained, moderately vesicular.	22		100		100	(25)		
									0		1725		
											840		Begin 3/31/2012
			M						0				
			M						0				
									0				
			M			23		100	0	100	(38)		
			M						0				
			M,M						0				
			M,M										
			M						0				
			M								848		
			M								853		
			M						NA				
					Highly weathered, weak from 107.6-ft to 108-ft.						(21)		
						24		85	NA	15			
425.0	109.0		M		Becomes red, highly to moderately weathered, moderately strong.								

DRILLING LOG (Cont Sheet)

NOTES

SHEET 8 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, red, highly to moderately weathered, moderately strong, fine grained, *(continued)*.		7		NA		(21) 900		
			M						NA		905		
			M			25		85		0	(38)		
			M						NA		909		
			M						0		912		
			M						>10				
			M		Highly weathered from 113.8-ft to 114.2-ft.								
			M						>10				
419.5	114.5		M		**BASALT**, light gray, moderately to slightly weathered, strong, fine grained, moderately vesicular.	26		100		55	(75)		
			M				8		0				
			M						0		916		
			M						0		919		
416.0	118.0		M		**BASALT**, red to gray, highly weathered, very weak, fine grained, clinker gravels.				NA				
			M			27		65	NA	10	(60)		
			M						NA				
			M						NA		924		
			M						NA		930		
410.7	123.3		M		**BASALT**, light gray to gray, moderately to slightly weathered, strong, fine grained, moderately vesicular.				NA		(38)		
			M			28		95	0	75			

DRILLING LOG (Cont Sheet)

NOTES

SHEET 9 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray to gray, moderately to slightly weathered, strong, fine grained, moderately vesicular. *(continued)*		8		0				
									0		(38)		
			M								938		
					Becomes scoriaceous.				0		942		
					Becomes moderately scoriaceous.				0				
			M										
						29		100	0	100	(33)		
									0				
					Becomes scoriaceous.		9						
			M						0		951		
402.0	132.0		M		**BASALT**, red to gray, highly weathered, very weak, fine grained, clinker.				NA		958		
						30		10	NA	0	(30)		
									NA		1003		
											1010		
						31		10	NA	0	(30)		
									NA				
											1015		
											1020		
						32		8	NA	0	(30)		
											1022		
											1028		
									NA				
						33		20		0	(21)		
									NA				
											1035		
									NA		1038		
											(45)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 10 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A)

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
392.7	141.3				**BASALT**, light gray, highly weathered, very weak, fine grained.	34	9	60	0	0	(45) 1040		
			M						0		1044		
			M						0				
			M						0				
			M		Becomes moderately vesicular.	35		100	0	100	(27)		
			M						0				
			M						0		1055		
			M						0		1100		
			M						0				
			M				10		0				
			M			36		100	0	100	(43)		
			M						0				
			M		Becomes oxidized.								
			M		Becomes moderately vesicular.				NA		1107		
382.2	151.8				**TUFF**, red and yellowish gray, highly weathered, very weak, Interbedded Ash to Lapilli Tuff.						1114		
									NA				
			M		Becomes moderately to highly weathered, weak.				NA				
						37		90	NA	20	(50)		
									NA				
									NA				Last foot of Run #37 advanced faster than rest of run
											1120		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 11 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
376.7	157.3				**BASALT**, gray to light gray, highly weathered, very weak, fine grained, clinker.		10		NA		1126		
						38		50		0	(15)		
									NA		1134		
374.8	159.2		M		**BASALT**, light gray to gray, moderately weathered, moderately strong, fine grained.						1141		
			M		Highly weathered 159.9-ft to 160.1-ft.				0				
			M		Becomes slightly weathered, very strong, slightly vesicular.	39		100	NA	90	(45)		
									0		1145		
											1150		
			M						0				
			M		Becomes moderately vesicular.				0				
			M										
						40	11	100	0	100	(38)		
			M						0				
			M										
			M						0		1158		
			M								1201		
									0				
			M						0				
					Becomes slightly vesicular.	41		80	0	65	(43)		
363.8	170.2		M		**BASALT**, Red, highly weathered, very weak, fine grained, clinker.				NA				
									NA		1208		
											1213		
									NA		(38)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 12 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, Red, highly weathered, very weak, fine grained, clinker. *(continued)*		11		NA				
					Becomes strong to very strong, cemented with a grout-like uniform, gray to white matrix. No reaction with HCl.	42			NA	0	(38)		
									NA				
									NA		1221		
									NA		1225		
					Absence of grout-like matrix, becomes very weak.	43	12		NA	0	(30)		
									NA		1229		
									NA		1358		
						44		100	NA	0	(36)		
					Becomes cemented with grout-like matrix, strong to very strong.				NA		1403		At 181.4-182.0 ft: UCS=2106 psi TUW=132.3 pcf
									NA		1414		
			M		Absence of grout-like matrix, becomes very weak.				NA				
		NR				45		80	NA	0	(60)		
									NA				
					Becomes cemented with grout-like matrix, strong to very strong.				NA		1419		
					Absence of grout-like matrix, becomes very weak.				NA		1424		
		NR									(50)		
									NA				

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DRILLING LOG (Cont Sheet)

NOTES

SHEET 13 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, Red, highly weathered, very weak, fine grained, clinker. *(continued)*	46	12	80	NA	0			
									NA		(50)		
343.2	190.8				**BASALT**, reddish Brown to light gray, highly to moderately weathered, weak, fine grained, slightly vesicular.				NA		1430		
			M		Becomes moderately weathered.				0				
					Becomes slightly weathered, strong to very strong.				0				
			M			47		100	0	98			
			M						0				
			M						0				
			M						0		1508		
			M				13		0		1512		
			M		Becomes moderately weathered, strong.				0				
			M						0				
			M		Becomes slightly weathered, strong.	48		100	0		(27)		
			M						0				
			M		Becomes light red, highly to moderately weathered, very weak.				NA		1523		
									NA		1528		
			M						NA		(33)		
			M		Becomes moderately weathered, moderately strong.	49		98	NA	45			
329.0	205.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 14 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light red, moderately weathered, moderately strong, fine grained, slightly vesicular *(continued)*.		13		0				
			M								(33)		
									0				
					Becomes highly weathered, very weak.						1537		
			M								1540		
					Becomes moderately weathered, moderately strong.				NA				
			M										
									0				
			M										
			M										
			M			50		95	0	70	(33)		
			M										
									0				
			M										
			M,M		Becomes highly weathered, very weak.				NA				
			M,M								1549		
							14				1556		
									NA				
									NA				
			M,M										
			M,M		Becomes moderately weathered, weak.	51		70	0	40	(50)		
			M,M										
			M						0				
			M										
			M						0				
											1602		
					Becomes light gray, highly weathered.						1608		
						52		95	NA	0	(14)		
			M		Becomes light gray, moderately weathered, strong, moderately vesicular.						1613		
			M						0		1620		
			M										
			M						0				
											(46)		
			M			53		100		100			
			M						0				
			M										
			M										
313.0	221.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 15 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray, moderately weathered, strong, fine grained, moderately vesicular *(continued)*.		14		0		(46)		
											1625		
			M						0		1630		
			M						0				
			M						0				
			M			54		98	0	94	(25)		
			M										
			M						0				
			M										
307.4	226.6		M,M						NA				
					BASALT, red, highly weathered, very weak, fine grained, clinker.						1642		
									NA		1644		
							15						
									NA				
						55		50	NA	0	(38)		
					Increasing scoriaceous basalt cobbles.								
									NA				
									NA				
											1652		
301.7	232.3		M								1701		
			M		**BASALT**, light gray, slightly weathered, strong, fine grained, moderately vesicular (stretched vesicles).				NA				
									0				
			M										
						56		100	0	97	(38)		
			M						0				
									0				
											1709		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 16 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M M		**BASALT**, light gray, slightly weathered, strong, fine grained, moderately vesicular (stretched vesicles). *(continued)*		15		0		1057		Begin 4/2/2012
									0				
			M						0				
			M			57		95	0	90	(50)		
									0				
292.6	241.4								NA		1103		
					BASALT, gray, highly weathered, very weak, fine grained, clinker, slightly cemented with grout-like matrix.						1107		
									NA				
291.0	243.0				**BASALT**, light gray to gray, slightly weathered, strong, fine grained, slightly vesicular.								
			M						0				
			M			58	16	100	0	70	(27)		
			M						0				
			M M M,M M M M		Becomes moderately strong to strong.				0		1118		
			M,M						NA		1126		
			M						0				
			M		Becomes strong to very strong, moderately vesicular (stretched vesicles).	59		95	0	95	(33)		
									0				
			M						0		1135		
									0		1140		
281.0	253.0		M						0		(30)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 17 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, light gray to gray, slightly weathered, strong, fine grained, moderately vesicular (stretched vesicles) *(continued)*.		16		0				
			M			60		100	0	99			
											(30)		
			M						0				
			M						0				
277.1	256.9										1150		
					BASALT, moderately weathered, very weak, fine grained, clinker, intermittantly cemented with grout-like matrix.						1211		
									NA				
									NA				
							17						
						61		100	NA	20	(38)		
273.5	260.5												
									NA				
					BASALT, gray to dark gray, moderately weathered, strong, fine grained, scoriaceous.								
			M						0		1219		
											1221		
			M						0				
									0				
			M,M		Becomes moderately strong to strong.								
			M			62		100	0	100	(38)		
			M										
									0				
			M,M										
									0				
			M								1229		
											1234		
			M						0				
											(30)		
			M						0				
265.0	269.0		M										

DRILLING LOG (Cont Sheet)

NOTES

SHEET 18 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, gray to dark gray, moderately weathered, moderately strong, fine grained, scoriaceous *(continued).*	63	17	100	0	100			
			M						0		(30)		
			M		Becomes slightly red (oxidized), moderately strong to weak.								
			M						0		1244		
			M								1254		
			M						0				
			M,M				18						
			M						0				
			M										
			M						0				
			M										
			M			64		100	0	100	(150)		
			M						0				
			M,M										
			M						0				
			M,M										
			M								1256		
			M,M								1306		
			M		Becomes strong.				0				
			M										
									0				
						65		100	0	100	(100)		
			M										
					Vesicle content decreasing, with increasing vesicle size.				0				
			M										
									0		1309		
			M								1315		
									0				
			M		Becomes scoriaceous.						(100)		
									0				
						66		100	0	100			
249.0	285.0												

269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284

DRILLING LOG (Cont Sheet)

NOTES

SHEET 19 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M,M		**BASALT**, red, moderately weathered, strong, fine grained, scoriaceous *(continued)*.		18		0				
			M		Becomes moderately strong.				0		(100)		
			M								1318		
			M				19				1336		
246.5	287.5								NA				
					BASALT, red, highly weathered, very weak, fine grained, clinker.				NA				
244.8	289.2												
			M		**BASALT**, gray, moderately weathered, strong, fine grained, highly vesicular with large vesicles.	67		100	0	100	(75)		
			M,M						0				
			M						0				
			M,M		Highly weathered from 292-ft to 292.6-ft.						1340		
											1346		
									NA				
									0				
			M		@294.2-ft, partially filled joint on bedding plane with grout-like cement.	68		100	0	85	(33)		
			M										
			M		Slightly oxidized and red from 295.2-ft to 295.7-ft.				0				
			M		Becomes scoriaceous.								
									0				
			M								1355		
			M								1404		
			M						0				
									0		(27)		
			M			69		100	0	100			
									0				
233.0	301.0		M										

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DRILLING LOG (Cont Sheet)

NOTES

SHEET 20 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, gray, moderately weathered, strong, fine grained, scoriaceous *(continued)*.		19		0		(27)		
			M								1415		
			M				20				1425		
			M						0				
									0				
									0				
						70		100	0	95	(100)		
			M		Becomes oxidized, moderately to highly weathered, moderately strong to weak.				0				
			M										
			M						0				
			M										
			M		Becomes moderately weathered, moderately strong to strong.						1428		
									0		1431		
									0				
			M		Becomes moderately strong, slightly oxidized.	71		100	0	100	(75)		
			M										
			M						0				
			M										
			M		Becomes strong to moderately strong.				0				
			M								1435		
			M								1438		
			M,M						0				
			M										
			M						0				
			M		With intermittant grout-like cementation from 313.3-ft to 314.1-ft.								
			M						0				
			M			72		100	0	100	(100)		
			M						0				
			M										
			M						0				
217.1	316.9										1441		

301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316

DRILLING LOG (Cont Sheet)

NOTES

SHEET 21 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, gray, moderately weathered, strong, fine grained, oxidized. *(continued)*		21		0		1447		
									0				
214.5	319.5				**BASALT**, gray, highly weathered, very weak, fine grained, clinker.	73		95	NA	45	(38)		
					With grout-like cementation from 320.4-ft to 321-ft.				NA				
									NA		1455		
									NA		1500		
									NA				
209.6	324.4				**BASALT**, gray, moderately weathered, moderately strong, fine grained, slightly vesicular.	74		80	NA	10	(33)		
									0				
207.8	326.2				**BASALT**, light gray, highly weathered, very weak, fine grained, clinker.				NA		1509		
									NA		1515		
									NA				
						75		75	NA	0	(43)		
									NA				
									NA		1522		
201.6	332.4		M M		**BASALT**, light gray, slightly weathered, strong, fine grained, slightly vesicular.		22		NA		1526 (25)		

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DRILLING LOG (Cont Sheet)

NOTES

SHEET 22 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray, slightly weathered, strong, fine grained, slightly vesicular. *(continued)*		22		0				
			M						0				
			M			76		98	0	98			
			M								(25)		
			M						0				
			M						0				
			M		Becomes moderately vesicular (stretched vesicles).						1538		
			M								1542		
			M						0				
			M						0				
			M			77		100	0	100	(23)		
			M						0				
			M						0				
			M						0		1555		
			M								1601		
			M						0				
			M						0				
			M			78		100	0	100	(20)		
			M						0				
			M						0				
			M						0		1616		
			M				23				1623		
			M						0				
			M						0		(33)		
185.0	349.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 23 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray, slightly weathered, strong, fine grained, moderately vesicular (stretched vesicles) *(continued)*.	79	23	100	0	100			
			M										
183.8	350.2		M										
					BASALT, red, highly to moderately weathered, moderately strong, fine grained, scoriaceous.				0		(33)		Drill advances at faster rate
			M										
			M						0				
			M,M								1632		
			M								1638		
			M						0				
			M		Becomes light gray to gray, moderately weathered, strong.								
			M,M						0				
			M			80		100	0	100	(43)		
			M						0				
			M						0				
			M								1645		
											1650		
			M						0				
			M		Becomes slightly oxidized.				0				
			M										
			M			81		100	0	80	(38)		
			M						0				
			M										
			M						0				
			M								1658		
			M				24				1706		
			M						0				
			M										
			M		@362.9-ft partially infilled opening with grout-like cement.				0		(25)		
			M										
			M			82		100	0	100			
169.0	365.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 24 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray to gray, moderately weathered, strong, fine grained, slightly oxidized *(continued)*.		24		0				
											(25)		
			M						0				
											1718		
			M								1735		
			M										
166.5	367.5								NA				
		cr			LEAN CLAY (CL); moist; gray; low plasticity fines.								Clay sample bagged
165.9	368.1												
			M,M		**BASALT**, gray to dark gray, moderately weathered, weak, fine grained, scoriaceous.				0				
			M										
			M			83		100		93	(16)		
			M						0				
			M										
					Becomes moderately strong to strong.				0				
			M,M								1748		
			M								1759		
			M										
			M			84		100	0	100	(18)		
			M								1804		
											1818		
			M						0				
					Slightly oxidized red from 372.7-ft to 373.7-ft.								
			M						0				
			M										
									0				
			M			85		100		100	(60)		
					Becomes slightly weathered, strong to very strong, highly vesicular with large vesicles.				0				
							25						
									0				
											1823		
											1833		
									0				
									0				
											(33)		
					Becomes scoriaceous.	86		100	0	100			
			M										
									0				
153.0	381.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 25 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, gray to dark gray, slightly weathered, strong, fine grained, scoriaceous *(continued)*.		25		0		(33)		
											1842		
			M						0		947		Begin 4/3/2012
					Olivine infilling in some vesicles common.								
									0				
									0				
						87		100	0	100	(27)		
			M						0				
					Absence of olivine infilling.				0				
			M,M		Becomes slightly oxidized red.						958		
											1006		
			M						0				
			M		Grout-like infilling from 387.8-ft to 388-ft.								
									0				
									0				
						88	26	100	0	100	(27)		
			M		Decreasing oxidation.								
									0				
			M										
			M						0				
			M,M		Becomes gray to dark gray, moderately strong to strong.						1017		
			M								1021		
			M						0				
			M,M										
			M										
			M						0				
			M										
			M						0				
			M		Decreasing oxidation.								
						89		100	0	100	(33)		
									0				
			M										
			M						0				
			M								1030		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 26 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M,M		**BASALT**, gray to dark gray, slightly weathered, strong, fine grained, scoriaceous *(continued)*. (continued)		26		0		1035		
			M,M										
			M						0				
									0				
						90		100	0	100	(30)		
			M						0				
									0				
			M										
			M						0				
			M,M								1045		
											1057		
			M						0				
			M		Grout-like infilling from 402.9-ft to 403.2-ft.				0				
			M										
			M										
			M										
			M			91	27	90	0	90	(60)		
			M										
			M						0				
			M,M										
					Grout-like infilling from 406.2-ft to 407.7-ft, possible filled void.				NA				At 406.3-406.8 ft: PL Is(50)=969 psi Diametral; PL Is(50)=895 psi Diametral; PL Is(50)=1700 psi Axial
											1102		
			M								1112		
			M						0				
			M										
									0				At 408.4-408.9 ft: PL Is(50)=529 psi Diametral; PL Is(50)=139 psi Diametral; PL Is(50)=637 psi Axial
						92		100	0	100	(43)		At 408.9-409.8 ft: UCS=7980 psi; TUW=145 pcf
			M		Becomes slightly oxidized red, moderately weathered, moderately strong.								
			M						0				
			M										
									0				
			M,M								1119		
											1127		
			M						0		(43)		
121.0	413.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 27 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, gray to red, moderately weathered, moderately strong, fine grained, scoriaceous *(continued)*.		27		0				
			M										
						93		100	0	100			
											(43)		
			M						0				
			M										
					Grout-like infilling of joints or bedding features at 416.4-ft and 418-ft.				0				
											1134		
											1141		
			M						0				
							28						
									0				
						94		100	0	100	(75)		
			M										
			M						0				
					Grout-like infilling of joints or bedding features from 421.3-ft to 422.6-ft.				0				
			M								1145		
			M								1156		At 422.2-423.2 ft: UCS=5770 psi TUW=129 pcf
									0				
			M										
			M						0				
			M			95		100	0	100	(75)		
					Becomes gray to dark gray.				0				
			M										
									0		1200		
			M								1216		
									0				
											(38)		
									0				
105.0	429.0		M										

413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428

DRILLING LOG (Cont Sheet)

NOTES

SHEET 28 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, gray to dark gray, moderately weathered, moderately strong, fine grained, scoriaceous *(continued)*.	96	28	100	0	100			
			M						0		(38)		
			M						0				At 430.9-431.3 ft: PL Is(50)=805 psi Diametral PL Is(50)=271 psi Diametral PL Is(50)=334 psi Axial
			M,M M								1224		
							29		0		1441		Slight fuel/gas odor
									0				
			M M		Highly to moderately weathered zone from 434-ft to 435-ft.	97		100	0	100	(33)		At 433.7-434.5 ft: UCS=4360 psi TUW=106 pcf
			M M										
			M		Grout-like infilling of joint or bedding feature at 435.6-ft.				0				
			M						0		1450		
			M		Oxidized red, highly to moderately weathered from 437-ft to 438.4-ft.				0		1508		
			M,M						0				
			M			98		100	0	100	(75)		
			M						0				
			M,M						0				
			M,M M		Grout-like material, possible infilled void from 441.3-ft to 441.8-ft.				0		1512		
			M		Becomes weak to moderately strong.						1522		Strong fuel/gas odor
			M M,M			99		65	0	50			
			M M		Void from 443.3-ft to 444.9-ft.				NA		(38)		
									NA				
89.0	445.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 29 OF 29 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 534.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, gray to red, moderately weathered, weak, fine grained, scoriaceous *(continued)*.		29		0				
			M,M								(38)		
			M		Grout-like infilling of joint or bedding feature at 446.3-ft.				0				
			M		Becomes strong.						1530		
											1607		At 447.0-447.4 ft: PL Is(50)=960 psi Diametral PL Is(50)=934 psi Diametral PL Is(50)=2943 psi Axial
			M						0				
			M				30		0				
			M,M		Highly weathered from 449.5-ft to 450-ft.	100		100	0	100	(75)		At 449.3-449.9 ft: PL Is(50)=396 psi Diametral PL Is(50)=186 psi Diametral
			M,M						0				
			M,M										
			M						0				
			M								1611		
											1617		
			M						0				
			M			101	30	100	0	100	(45)		
			M,M						0				
79.0 ▽	455.0		M,M		Becomes moderately strong to weak.						1621		

Boring terminated at 455-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-402 feet and 0.020-inch slotted screen 402-442 feet with end cap; hole collapsed to 238 and 40 feet when withdrawing the core barrel, remaining annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 198-238 feet, bentonite pellets 20-40 feet, and redimix concrete 0-20 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-08 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Paved Area Off Road	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	3/16/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	95.0ft	Screen Material: Slot Size:	PVC/.020in
Depth to Water:	-1.1ft	Screen Length: Screen Depth:	75ft-95ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	47.5ft-95ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Boring Borehole consumed 4.5 bags

Well Abandonment Information	
Date of Abandonment: 11/26/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Boring Borehole consumed 4.5 bags	
Driller's Signatur (b) (6)	Date: 12-4-13
Consultant's Sig	Date: 12/5/13

~~For Red Hill AOC Party Use Only~~

Boring Designation B-08

DRILLING LOG	DIVISION	NOTES	SHEET 1 OF 7 SHEETS

1. PROJECT: Red Hill Tunnel Repair Project Pearl Harbor		9. COORDINATE SYSTEM: HI State Plane Zone 3	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: HQ3 Diamond Bit	
2. HOLE NUMBER: B-08	LOCATION COORDINATES: (b) (3) (A) [redacted]	11. MANUFACTURER'S DESIGNATION OF DRILL: CME 55 Track Rig	
3. DRILLING AGENCY: Taber Drilling Company		12. TOTAL SAMPLES: 1	DISTURBED: 1 / UNDISTURBED: 0
4. NAME OF DRILLER: (b) (6)		13. TOTAL NUMBER CORE BOXES: 6	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING:	14. ELEVATION GROUND WATER: INITIAL -1.1 3/19/12	STATIC
		15. DATE STARTED: 3/15/12	DATE COMPLETED: 3/16/12
6. THICKNESS OF OVERBURDEN: ft		16. ELEVATION TOP OF BORING: 62.0	
7. DEPTH DRILLED INTO ROCK: 52.2 ft		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 95.0 ft		18. LOGGED BY: (b) (6)	CHECKED BY:

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					FILL SILTY, CLAYEY SAND with Gravel (SC-SM); moist; gray.								3/15/12 6" solid stem augure to 6.5 feet 5" ID casing driven to 6.5 feet
56.5	5.5				**TUFF**, gray, completely to highly weathered, extremely weak, Alimano to Makalapa Tuff.								
						1	1	0			1152 (10) 1155		Begin HQ3 coring using #2 bit SPT Sample 1 (6.5 ft - 6.83 ft) Blows: 50 blows/4 inches Begin 3/15/2012
54.8	7.2				**TUFF**, gray to light brown, moderately to slightly weathered, strong, Ash to Lapilli Tuff (with occasional cobble size clasts).				0		1203		Switch to #10 bit at 7 feet
									0				
			M						0				Good circulation though 41 feet
			M			2		98	0	98	(38)		
			M						0				
			M						0				
			M						0		1211 1214		
									0		(30)		

FOR OFFICIAL USE ONLY

DRILLING LOG (Cont Sheet)

NOTES			SHEET 2 OF 7 SHEETS
PROJECT: Red Hill Tunnel Repair Project Pearl Harbor	COORDINATE SYSTEM: HI State Plane Zone 3	HORIZONTAL: NAD83	VERTICAL: NAVD88
LOCATION COORDINATES: (b) (3) (A) [redacted]	ELEVATION TOP OF BORING: 62.0		

ELEV	DEPTH	Fracture Number	FIELD CLASSIFICATION OF MATERIALS (Description)	Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	REMARKS
	13	M	**TUFF**, gray to light brown, moderately to slightly weathered, strong, Ash to Lapilli Tuff (with occasional cobble size clasts). *(continued)*		1		0			
	14	M M		3		100	0	85		
	15	M M M					0		(30)	
	16	M M M M M M M M M	Highly weathered, very weak from 16.2-ft to 16.9-ft.				na		1224	
	17	M M M M M M M					0		1228	
	18						0			
	19	M M M		4		100	0	100	(30)	
	20	M M					0			
	21	M M					0		1238	
	22				2		0		1305	
	23	M M					0			
	24	M M M M M	Highly weathered from 24.4-ft to 24.5-ft.	5		100	0	99	(33)	
	25						0			
	26						0		1314	
	27	M M	Becomes strong to very strong.				0		1317 (33)	
33.2	28.8						0			

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 7 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 62.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					TUFF, gray to light brown, moderately to slightly weathered, strong to very strong.	6	2	100	0	100			
			M						0		(33)		
			M						0				
			M						0		1326		
									0		1329		
									0				
									0				
			M			7		100	0	100	(33)		
			M				3		0				
									0				
									0		1338		
									0		1342		
									0				
									0				
			M			8		100	0	100	(30)		
			M						0				
			M						0				
20.6	41.4		M										
			M		**TUFF**, brown, moderately weathered, weak to moderately strong, Ash to Lapilli Tuff.				0		1352		
			M								1356		
			M						0				
			M		Many breaks along highly weathered bedding from 43-ft to 44.3-ft.				>10		(43)		No circulation
			M			9		100	>10	20			

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 7 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 62.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**TUFF**, brown, moderately weathered, weak to moderately strong, Ash to Lapilli Tuff. *(continued)* Many breaks along highly weathered bedding from 44.8-ft to 46.2-ft.		3		>10				
			M								(43)		
			M						>10				
			M		Many breaks along highly weathered bedding from 46.6-ft to 47.4-ft.						1403		
			M								1406		
			M						>10				
			M						0				
			M										
			M			10		100	0	100	(30)		
			M				4		0				
			M		Becomes slighty weathered.								At 50.8-55.7 ft: UCS=1940 psi TUW=134.2 pcf
			M						0		1416		
			M								1422		
			M						0				
8.7	53.3												
					ALLUVIUM SILT (ML); moist; reddish brown.				NA				
						11		90	NA	100	(43)		
									NA				
									NA				
											1429		
											1456		
									NA				
									NA				
											(60)		
						12		100	NA				
									NA				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 7 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 62.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					ALLUVIUM SILT (ML); moist; reddish brown. *(continued)*		4		NA		(60)		
											1501		
									NA		1505		
									NA				
									NA				
						13		100	NA		(75)		
							5		NA				
									NA				
											1509		
									NA		1514		
						14		100	NA		(36)		
									NA				At 69.0-72.3 ft: TX-UU: Max. deviator stress=3862 psf, confining pressure=8640 psf
											1519		
									NA		830		At 70.0-73.9 ft: UCS=7787 psf TUW=113.5 pcf Begin 3/16/2012
						15		0			(20)		No recovery - Likely due to Packer testing
									NA				
											836		
											845		
									NA				
									NA				
						16		100	NA		(50)		
									NA				
									NA				
											851		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 6 OF 7 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Red Hill Tunnel Repair Project Pearl Harbor	HI State Plane Zone 3	NAD83	NAVD88

LOCATION COORDINATES (b) (3) (A) [redacted]

ELEVATION TOP OF BORING 62.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					ALLUVIUM SILT (ML); moist; reddish brown. *(continued)*		5				910		
-16.0	78.0				SANDY SILT (ML); moist; brown.				NA				
					Highly weathered to moderately weathered basaltic boulder from 79-ft to 79.8-ft.	17		60	NA		(60)		Driller repors hardening at 79 feet
									NA				
									NA		915		
					Becomes reddish brown to brown (mottled).		6				923		
									NA				
									NA		(105)		
						18		100	NA				
									NA		925		Push
									NA				
									NA		930		
									NA				
									NA				
						19		100	NA		(60)		
									NA				
-28.7	90.7				BEDROCK **BASALT**, light brown, highly to moderately weathered, very weak.				0		935		
			M										
			M		Becomes moderately weathered, weak.				0		937		At 92.0-92.2 ft: PL Is(50)=35 psi At 92.0-92.4 ft: PL Is(50)=39 psi
			M										
-31.0	93.0		M										

DRILLING LOG (Cont Sheet)

NOTES

SHEET 7 OF 7 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 62.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light brown, moderately weathered, strong.	20	6	100	0	100			
			M		Becomes gray.								
			M						0				
			M										
-33.0	95.0												

93 94 95

Boring terminated at 95-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-55 feet and
0.010-inch slotted screen 75-95 feet with end cap; annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 51.5-95 feet, bentonite pellets 47.5-51.5 feet, and neat cement grout tremied
2-47.5 feet; redimix concrete 0-2 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-09 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Grass Area in Median Strip	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	2/22/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	90.0ft	Screen Material: Slot Size:	PVC/.020in
Depth to Water:	-3.1ft	Screen Length: Screen Depth:	50ft-90ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	32.5ft-90ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Boring Borehole consumed 5.0 bags

Well Abandonment Information	
Date of Abandonment: 11/26/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Boring Borehole consumed 5.0 bags	
Driller's Signature: (b) (6)	Date: 12-4-13
Consultant's Signa (b) (6)	Date: 12/5/13

Boring Designation B-09

DRILLING LOG

DIVISION

NOTES

SHEET 1 OF 6 SHEETS

1. PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

9. COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

10. SIZE AND TYPE OF BIT: HQ3 Diamond Bit

2. HOLE NUMBER: B-09 | LOCATION COORDINATES: (b) (3) (A) [redacted]

11. MANUFACTURER'S DESIGNATION OF DRILL: CME 55 Track Rig

3. DRILLING AGENCY: Taber Drilling Company

12. TOTAL SAMPLES: 1 | DISTURBED: 1 | UNDISTURBED: 0

4. NAME OF DRILLER: (b) (6)

13. TOTAL NUMBER CORE BOXES: 7

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: --- | BEARING:

14. ELEVATION GROUND WATER: INITIAL -3.1 2/29/12 | STATIC

15. DATE STARTED: 2/22/12 | DATE COMPLETED: 2/22/12

6. THICKNESS OF OVERBURDEN: ft

16. ELEVATION TOP OF BORING: 65.0

7. DEPTH DRILLED INTO ROCK: 48.9 ft

17. TOTAL CORE RECOVERY FOR BORING: N/A

8. TOTAL DEPTH OF BORING: 90.0 ft

18. LOGGED BY: (b) (6) | CHECKED BY:

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
64.6	0.4				TOPSOIL SILTY, CLAYEY SAND (SC-SM); moist; brown; hard.				NA				2/22/12 5" ID casing driven to 3.5 feet
					TUFF, highly to completely weathered, fine to coarse grained, Ash to Lapilli Tuff, weak to very weak.								
63.6	1.4				**TUFF**, brown, slightly to moderately weathered, fine to coarse grained, massive, Ash to Lapilli Tuff (interbedded), with zones of highly weathered, moderately hard to soft, strong to moderately strong.				NA				
									NA				
					Becomes Ash to sand size clasts.		1		NA		1136		Begin coring with #2 bit SPT Sample 1 (3.5 ft - 3.67 ft) Blows: 50 blows/2 inches Begin 2/22/2012
			M			1		65	0	65	(17)		Good circulation Using drilling mud/additive ("Instavis-Plus")
			M						0		1145		
			M						0		1155		Switch to #8 bit
			M						0				
			M		Becomes medium to coarse sand to Lapilli size clasts.				0				
			M			2		100	0		(38)		
			M		Becomes Ash to sand size clasts.				0				
			M						0				
			M						0		1203		
			M						0		1211		Switch to #10 bit
			M		Highly weathered from 12-ft to 12.3-ft.				0		(40)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A)

ELEVATION TOP OF BORING: 65.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M M	Y Y A A	**TUFF**, brown, slightly to moderately weathered, fine to coarse grained, massive, Ash to Lapilli Tuff (interbedded), with zones of highly weathered, moderately hard to soft, strong to moderately strong. *(continued)*	3	1	76	0	30			
					Highly weathered from 14-ft to 14.5-ft.				>10		(40)		
					Highly weathered from 15-ft to 15.5-ft.				>10		1218		Run 3 shortened to a 4.7 feet run - Drilling wasn't advancing
			M M M M		Highly weathered from 17.5-ft to 18.4-ft.	4		100	>10	33	1222		
									>10		(40)		Good circulation
			M M M				2		0				
			M M						0		1230		Run 4 is a 5.3 feet run
			M M M M M		Highly weathered from 21.3-ft to 22.1-ft.				>10		1234		
									0				
			M M M M M M		Highly weathered from 24-ft to 25.2-ft.	5		88	0	25	(30)		
									>10				
									>10		1244		Good circulation - Very little loss
			M M		Highly weathered from 26.4-ft to 27.4-ft.				>10		1248		
			M M		Highly weathered from 27.7-ft to 28.3-ft.				>10		(43)		
						6		92	>10	20			

13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 65.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M	Y Y	**TUFF**, brown, slightly to moderately weathered, fine to coarse grained, massive, Ash to Lapilli Tuff (interbedded), with zones of highly weathered, moderately hard to soft, strong to moderately strong. *(continued)*		2		>10				
			M	Y Y							(43)		
					Highly weathered from 29.4-ft to 30.7-ft.				>10				
			M	Y Y							1255		
			M	Y Y							1259		
			M	Y Y	Becomes Lapilli (rounded gravel) size clasts.				0				
			M	Y Y					5				
			M	Y Y	Highly weathered from 32.5-ft to 32.7-ft.								
			M	Y Y		7		100	4	90	(39)		
			M	Y Y	Highly weathered from 33.8-ft to 40-ft.								Run 7 is a 4.6 feet run due to lack of advancement
				Y Y			3		1				
			M	Y Y					4		1306		
			M	Y Y							1311		
			M	Y Y					0				At 36.6-37.0 ft: PL Is(50)=345 psi
			M	Y Y	Becomes light gray, slightly weathered, strong.								
				Y Y					0				
				Y Y		8		100		90	(33)		
				Y Y					0				At 38.6-43.5 ft: UCS=1585 psi TUW=130.7 pcf Run 8 is a 5 feet run
				Y Y					>10				
				Y Y	Becomes dark brown, moderately weathered, moderately strong.								
				Y Y					>10		1320		
			M	Y Y							1327		
			M	Y Y					6				
			M	Y Y									
			M	Y Y					>10				
			M,M	Y Y	Highly weathered from 42-ft to 44.6-ft.						(36)		
			M,M	Y Y		9		100	>10	30			Run 9 is 5.4 feet run
20.4	44.6		M,M	Y Y					>10				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 65.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					ALLUVIUM SILTY SAND (SM); moist; reddish brown; 60% sand; 40% fines; 0% gravel; with trace fine gravel. *(continued)*		3		NA		(36) 1336		Drillers reports last 1 foot advanced faster
											1356		
									NA				
						10		100			(150)		
									NA				
									NA		1357		
							4						Driller turned water off and pushed the sampler 2 feet and recovered 5 feet of soil
						11		100	NA				
									NA				Drilled to 51 feet Pushed from 51 feet to 54.2 feet At 50.8-51.2 ft: TX-UU: Max. deviator stress=9379 psf, confining pressure=4320 psf
									NA				
						12		100	NA				
									NA				
									NA				Pushed 54.2 feet to 56 feet recovered 4.2 feet of material
						13		100	NA				
									NA				Pushed 56 feet to 59 feet recovered 5 feet of material
									NA				
						14		100	NA				
									NA				
							5						Pushed 1 foot recovered 1 foot of material SA: S=60% F=40%
						15		100	NA				
4.8	60.2												
					ELASTIC SILT (MH); moist; brown; high plasticity fines; SILTY SAND to SANDY SILT (SM-ML), moist, reddish brown, fine grained sand.	16		100	NA		846 (60)		Pushed LL=58, PI=21 Begin 2/23/2012

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 6 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 65.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					ELASTIC SILT (MH); moist; brown; high plasticity fines; SILTY SAND to SANDY SILT (SM-ML), moist, reddish brown, fine grained sand. *(continued)*		5		NA				Failed attempt to push sampler. Begin coring.
						17		100	NA		(60)		
									NA		849		
									NA		905		
									NA				
									NA				
						18		100	NA		(50)		
									NA				
									NA				
									NA		911		Rotated drill stem for a few seconds and then pushed. At 68.8-73.6 ft: UCS=3578 psf TUW=109.9 pcf
									NA				
									NA				
						19		100	NA				
									NA				
					Becomes grayish brown, with some meduim to coarse sand.				NA				
									NA				Pushed
-9.4	74.4				SILTY to CLAYEY SAND (SM-SC) with few gravels, moist, dark brownish gray, fine to coarse grained sand.				NA				
									NA				
						20	6	100	NA				
-11.7	76.7				SANDY SILT (ML); moist; reddish brown.								

DRILLING LOG (Cont Sheet)

NOTES	SHEET 6 OF 6 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Red Hill Tunnel Repair Project Pearl Harbor	HI State Plane Zone 3	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
(b) (3) (A) [redacted]	65.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
	77				SANDY SILT (ML); moist; reddish brown. *(continued)*		6		NA				
	78								NA				Pushed
	79								NA				
-15.5	80.5				SILTY SAND with CLAY (SM), moist, dark brown to reddish brown.				NA				
	81					21		100	NA				
	82								NA				
	83								NA				Pushed
	84					22		100	NA				Cored the last 1 foot
-19.7	84.7				Becomes very dense, gray to dark gray, medium to coarse grained sand, well cemented.								
	85	NR			BEDROCK **BASALT**, gray to bluish gray, slightly weathered, strong, fine grained.				NA		1051		
	86		M M M M M M M M M M M M M M M M M M M						0				
	87					23		90	0	90	(27)		
	88						7		0				
	89								0				
-25.0	90.0										1102		

Boring terminated at 90-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-50 feet and
0.020-inch slotted screen 50-90 feet with end cap; annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 42.5-90 feet, bentonite pellets 32.5-42.5 feet, and neat cement grout tremied
2-32.5 feet; redimix concrete 0-2 feet; a 6-inch flush-mounted Christy box was set at surface.

~~For Red Hill AOC Party Use Only~~

Abandonment of Monitoring Well Summary Report Form

B-10 (Monitoring Well ID)

Submit form within 30 days of well abandonment or within 90 days if included in a site closure, monitoring, or investigation report. In addition, submit copies of the original boring log and well construction diagram for the monitoring well, a site map showing the location of the abandoned monitoring well, and the disposal documentation for wastes generated during the abandonment process. Submit all documentation to: Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Attention: SDAR, 919 Ala Moana Blvd, Rm. 206, Honolulu Hawai'i 96814.

Location Information		Owner Information	
Facility Name:	Red Hill Tunnel Repair	Well Owner:	Navfac Hawaii
Facility Address:		Contact Person:	(b) (6)
	Pearl Harbor, Hawaii	Mailing Address:	FEAD, North Team, CM
Latitude:	(b) (3) (A)		JBPHH
Longitude:	(b) (3) (A)	Phone Number: Fax Number:	808-474-3220 X.286
TMK:		Land Owner:	Department of the Navy
Location Description:	Grass Area	Contact Person:	
		Mailing Address:	
Monitoring well location map attached: (Y) / N		Phone Number: Fax Number:	

Well Construction Information			
Date of Installation:	2/22/12	Casing Material: Casing Diameter:	PVC
Drilling Company:	Taber Drilling	Casing Length: Casing Depth:	Total Depth
Total Depth:	295.0ft	Screen Material: Slot Size:	PVC/.020in
Depth to Water:	None	Screen Length: Screen Depth:	255ft-295ft
Was well set in an aquifer that is current or potential drinking water source? Y / (N)		Annular Material: Depth:	Basaltic/Bentonite/Cement
Boring log / well construction diagram attached: (Y) / N		Annular Material: Depth:	134ft-153ft

General Abandonment Information			
Drilling Firm:	FCT, Inc	Consulting Firm:	URS Corp
Contact Person:	(b) (6)	Contact Person:	(b) (6)
Mailing Address:	P.O.Box 75346	Mailing Address:	841 Bishop St., Ste. 500
	Kapolei, HI 96707		Honolulu, HI96813
Phone Number: Fax Number:	808-620-4107	Phone Number: Fax Number:	(808) 593-1116

Neat Cement was injected by use of tremie pipe, filling cavity from base to surface.

Boring Borehole collapsed @153ft and consumed 13.5 bags

Well Abandonment Information	
Date of Abandonment: 11/26/2013	Sealing Material Depth: Neat Cement
Reason for Abandonment: Geotech. Rep. Finish	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Wat
Casing/Screen Removed: Y /(N)	Sealing Material: Neat Cement Depth: Total Depth
If Yes, was annular material removed? Y /(N)	Volume/Weight/Bags Mixing Ratio: 94#cement/6gal Water
If No, was casing cut off below surface? (Y) N	Method of Sealing Material Placement:
Comments: Neat Cement was injected by use of tremie pipe, filling cavity from base to surface. Boring Borehole collapsed @153ft and consumed 13.5 bags	
Driller's Signatur (b) (6)	Date: 12-4-13
Consultant's Sign	Date: 12/5/13

~~For Red Hill AOC Party Use Only~~

Boring Designation B-10

DRILLING LOG	DIVISION	NOTES	SHEET 1 OF 19 SHEETS

1. PROJECT: Red Hill Tunnel Repair Project Pearl Harbor
2. HOLE NUMBER: B-10
3. DRILLING AGENCY: Taber Drilling Company
4. NAME OF DRILLER: (b) (6)
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:
6. THICKNESS OF OVERBURDEN: 10.0 ft
7. DEPTH DRILLED INTO ROCK: 295.0 ft
8. TOTAL DEPTH OF BORING: 295.0 ft
9. COORDINATE SYSTEM: HI State Plane Zone 3; HORIZONTAL: NAD83; VERTICAL: NAVD88
10. SIZE AND TYPE OF BIT: HQ3 Diamond Bit
11. MANUFACTURER'S DESIGNATION OF DRILL: CME 55 Track Rig
12. TOTAL SAMPLES: 0; DISTURBED: 0; UNDISTURBED: 0
13. TOTAL NUMBER CORE BOXES: 18
14. ELEVATION GROUND WATER: INITIAL 4/23/12; STATIC
15. DATE STARTED: 3/22/12; DATE COMPLETED: 3/29/12
16. ELEVATION TOP OF BORING: 404.0
17. TOTAL CORE RECOVERY FOR BORING: N/A
18. LOGGED BY: (b) (6); CHECKED BY:

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
403.8	0.3				TOPSOIL								3/22/12 6" solid stem augur to 7 feet 5" ID casing driven to 7 feet
					RESIDUAL SOIL LEAN CLAY (CL); moist; red; fine, rounded gravel.								
							1		NA		1013		Begin 3/22/2012
									NA				100% circulation recovery
						1		100	NA	0	(33)		
394.0	10.0				BEDROCK **BASALT**, red, completely weathered, extremely weak, fine grained, rock fabric apparent, weathered to lean clay (CL).				NA				
									NA				
											1022		
									NA		1026 (75)		

FOR OFFICIAL USE ONLY

DRILLING LOG (Cont Sheet)

NOTES

SHEET 2 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BEDROCK **BASALT**, red, completely weathered, extremely weak, fine grained, rock fabric apparent, weathered to lean clay (CL). *(continued)*		1		NA				
						2		70	NA	0			
					Becomes less weathered.				NA		(75)		
									NA				
											1030		
					Becomes red mottled with gray and brown.						1038		
									NA				
									NA				
						3		100	NA	0	(43)		
383.5	20.5								NA				
					BASALT, red mottled with brownish gray, highly weathered, extremely weak, fine grained.				NA				
											1045		
							2				1049		
									NA				
									NA				
						4		100	NA	0	(50)		
									NA				
									NA				
											1055		
											1105		
									NA				
											(60)		
									NA				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 3 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, red mottled with brownish gray, highly weathered, extremely weak, fine grained. *(continued)*	5	2	92	NA	0			
									NA		(60)		
									NA				
											1110		
						6		100	NA	0	1114		
									NA				
									NA		(75)		
									NA				
									NA				
											1118		
						7	3	90	NA	0	1121		
									NA				
									NA		(50)		
									NA				
									NA				
											1127		
						8		100	NA	0	1129		
									NA				
									NA		(43)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 4 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (6) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, red mottled with brownish gray, highly weathered, extremely weak, fine grained. *(continued)*		3		NA				
											(43)		
									NA				
											1136		
											1140		
									NA				
									NA				
						9		100	NA	0	(43)		
									NA				
									NA				
											1147		
							4				1155		
									NA				
									NA				
						10		100	NA	0	(43)		
									NA				
									NA				
											1202		
					Becomes less weathered, very weak.						1207		
									NA				
									NA				
						11		90		0	(60)		
									NA				
									NA				
343.0	61.0										1211		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 5 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) [redacted] (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, red mottled with brownish gray, highly to moderately weathered, very weak, fine grained, *(continued)*.		4		NA		1215		Drill stops advancing, 4-foot run
341.6	62.4				**BASALT**, light gray, moderately to slightly weathered, strong, fine grained, with few vesicles.				NA				
			M			12		100	0	50	(22)		
			M						0				
			M						0				
			M						0		1227		
			M						0		1319		Pull rods, bit worn down change to #8 bit
			M			13		100	0	100	(22)		
			M						0		1323		
			M		Becomes slightly weathered.		5		0		1327		
			M						0				
			M						0				
			M			14		100	0	100	(60)		
			M						0				
			M						0				
			M						0		1332		
			M						0		1336		
			M,M						0				
			M						0				
			M,M			15		100	0	100	(60)		100% circulation loss, fast drilling
			M,M						0				
			M						0				
			M,M						0				
327.0	77.0										1341		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 6 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b)(3)-(A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, light gray, slightly weathered, strong, fine grained, with few vesicles *(continued)*.		5		0		1348		
			M						0				
			M			16		100	0	100	(25)		
			M						0				
			M						0				
			M								1400		
			M				6				1412		
			M						0				
			M						0				
			M			17		60	0	55	(43)		
319.0	85.0				**BASALT**, light gray to red, highly weathered, weak, fine grained.				NA				
									NA		1419		
316.4	87.6								NA		1423		
					BASALT, red to light yellow, moderately weathered, strong, fine grained, vesicle-rich (PUMICE).				NA				
			M			18		90	0	60	(43)		
			M						0				
			M						0		1430		
									0		1433		
											(43)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 7 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A)

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, red to light yellow, moderately weathered, strong, fine grained, vesicle-rich (PUMICE). *(continued)*		6						
			M						0				
			M			19		100	0	100			
											(43)		
			M						0				
			M						0				
											1440		
			M						0		1443		
			M										
			M				7						
			M						0				
			M			20		100	0	100	(50)		
			M						0				
			M						0				
			M								1449		
			M						0		1453		
			M						0				
			M			21		100	0	100	(50)		
			M						0				
			M						0				
			M								1459		
			M						0		1504		
			M								(100)		
			M						0				

DRILLING LOG (Cont Sheet)

NOTES

SHEET 8 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, red to light yellow, moderately weathered, strong, fine grained, vesicle-rich (PUMICE). *(continued)*		7						
			M			22		100	0	100			
			M										
			M						0		(100)		
			M										
			M						0				
			M								1507		
			M								1511		
			M						0				
			M										
			M						0				
			M				8						
			M										
			M			23		100	0	95	(50)		
			M										
			M						0				
			M										
287.8	116.2												
					BASALT, light brown, highly to moderately weathered, weak, fine grained.				NA		1517		
											1520		
									NA				
									NA				
						24		30	NA	10	(38)		
									NA				
283.0	121.0												
			M		**BASALT**, gray, moderately to slightly weathered, very weak, fine grained, vesicle-rich (PUMICE).								
			M						NA				
			M								1528		
											1535		Samples are smaller diameter than normal HQ due to bit over-cutting core
									NA				
									NA		(75)		
			M			25		50	0	50			

109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124

DRILLING LOG (Cont Sheet)

NOTES

SHEET 9 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M M M M M M		**BASALT**, gray, moderately to slightly weathered, very weak, fine grained, vesicle-rich (PUMICE). *(continued)*		8		0		(75)		
									0		1539		
		NR									1544		Rotation speed of drill decreased
									NA				
									NA				
		NR				26		50	NA	5	(60)		
			M M M M M M						0				
									0		1549		
											1554		
									NA				
									NA				
		NR				27		40	NA	40	(50)		
			M,M M M M M M						NA				4" ID casing set to 135-ft bgs Still no circulation return
267.6	136.4		M						0		1600		
			M M		**BASALT**, gray, moderately weathered, weak, fine grained, a'a.						1614		
			M						0				
			M			28		100		20	(16)		
			M,M		Highly weathered from 138-ft to 138.3-ft.				0				
			M				9				1621		
					Becomes moderately weathered, strong, with some stretched vesicles.						1626		
			M						0				
											(37)		
						29		100	0	100			
263.0	141.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 10 OF 19 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Red Hill Tunnel Repair Project Pearl Harbor	HI State Plane Zone 3	NAD83	NAVD88

LOCATION COORDINATES (b) (6), (b) (7)(A) [redacted]

ELEVATION TOP OF BORING 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, gray, moderately weathered, strong, fine grained, with some stretched vesicles *(continued)*.		9		0		(37)		
			M								1631		
			M						0		1635		
			M						0				
260.5	143.5		M						0				
					BASALT, light gray to red, highly to moderately weathered, fine grained, gravelly (a'a gravels).	30		70	0	30	(43)		
		NR							NA				
									NA		1642		
		NR									1647		
									NA				
									NA				
						31		90		0	(30)		
									NA				
									NA				
253.2	150.8										1655		
					BASALT, gray, moderately weathered, strong, fine grained, few vesicles.				0		944		Begin 3/23/2012
			M,M			32		100		100	(15)		
			M						0		950		
			M								1002		
			M				10						
			M						0				
			M										
			M						0				
						33		100		100	(34)		
			M						0				
			M										
			M						0				
			M										
			M						0		1010		

141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156

DRILLING LOG (Cont Sheet)

NOTES

SHEET 11 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, gray, moderately weathered, strong, fine grained, few vesicles. *(continued)*		10		0		1014		
			M										
			M						0				
			M										
			M						0				
			M			34		100	0	100	(38)		
			M										
			M						0				
			M										
			M						0				
			M								1022		
			M								1028		
			M						0				
			M										
			M						0				
			M,M										
			M,M						0				
			M			35		70		60	(38)		
			M										
238.5	165.5								NA				
					BASALT, red to gray, highly weathered, very weak, fine grained, gravelly (a'a gravels).								
									NA		1036		
											821		Begin 3/28/2012
									NA				Change bit to HQ3 #6
									NA				
						36		40	NA	0	(43)		
									NA				
232.8	171.2												
					BASALT, gray, moderately weathered, strong, fine grained, with some stretched (a'a) vesicles.				0		828		
			M								849		
									0		(60)		

157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172

DRILLING LOG (Cont Sheet)

NOTES

SHEET 12 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, gray, moderately weathered, strong, fine grained, with some stretched (a'a) vesicles. *(continued)*		10		0				
			M										
						37		100	0	90			
			M								(60)		
									0				
			M,M										
			M						0				
227.0	177.0										854		
					BASALT, gray to red, highly weathered, fine grained, oxidized; a'a gravels.		11				905		
									NA				
						38		15		0	(18)		
									NA		910		
											912		
									NA				
						39		10		0	(30)		
									NA				
											917		
											920		
222.4	181.6					40		80	NA	0	(12)		
											925		
					BASALT, gray, moderately weathered, strong, fine grained, with few vesicles. A'a gravels from 182-ft to 182.6-ft.						930		
									NA				
			M		Becomes oxidized red, highly to moderately weathered, weak.				NA				
			M			41		100		20	(24)		
			M						NA				
			M										
									NA				
											940		
											948		
						42		100	NA	0	(30)		
					Becomes highly weathered.						950		
							12				956		
									NA				
											(75)		
									NA				
215.0	189.0												

DRILLING LOG (Cont Sheet)

NOTES

SHEET 13 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, red, highly weathered, weak, fine grained, with few vesicles *(continued)*.	43	12	45	NA	0			
					Becomes highly to completely weathered.								
			M										
			M						NA		(75)		
			M										
									NA		1000		
											1005		
			M						NA				
					Becomes moderately to highly weathered, weak to strong.								
			M,M										
			M						0				
			M										
					Becomes moderately weathered, strong.								
			M			44		100	0	50	(38)		
									0				
			M										
			M,M						0				
			M								1013		
											1038		
			M						0				
			M,M						0				
			M			45		100	0	100	(33)		
					Weak to strong from 200-ft to 201.4-ft.								
									0				
			M						0				
											1047		
			M								1108		
			M						0				
			M										
						46	13	90	0	70	(24)		
			M										
					A'a gravels, red, highly weathered, weak from 204.1-ft to 204.7-ft.						1114		
									NA		1117		
199.0	205.0		M								(31)		

DRILLING LOG (Cont Sheet)

NOTES

SHEET 14 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, red, moderately weathered, strong, fine grained, increasing vesicles to approx. 30%.	47	13	80	0	70			
									0		(31)		
			M						0		1122		
			M								1129		
					Becomes a'a gravels.	48		60	NA	10	(25)		
									NA				
									NA		1136		
						49		50	NA	0	1140		
									NA		(24)		
											1145		
						50		100	NA	10	1200		
									NA		(20)		
											1208		
189.2	214.8		M						NA		1215		
			M,M		**BASALT**, gray, moderately to highly weathered, weak, fine grained.								
			M						NA				
			M		Becomes moderately weathered, strong.	51		100		60	(30)		
			M						0		1220		
			M								1224		
			M						0				
			M						0		(30)		
			M										
			M			52	14	100	0	100			
			M						0				
183.0	221.0												

205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220

DRILLING LOG (Cont Sheet)

NOTES

SHEET 15 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M		**BASALT**, gray, moderately weathered, strong, fine grained, *(continued)*.		14		0		(30)		
			M								1234		
			M								1239		
			M						0				
			M,M										
			M,M						0				
			M										
			M						0				
			M			53		100		98	(33)		
			M						0				
			M										
			M						0				
			M										
			M						0		1248		
			M								1251		
			M						0				
			M										
			M						0				
			M		Becomes a'a gravels.								
			M			54		85	NA	40	(30)		
			M										
			M						NA				
			M										
			M						NA				
			M								1301		
171.2	232.8		M						NA		1329		
			M		**BASALT**, light red, moderately weathered, moderately strong, fine grained, a'a gravels.								
			M						0				
			M				15						
			M			55		85	0	70	(20)		
			M										
			M						0				
			M										
			M						NA				
167.3	236.7										1344		

DRILLING LOG (Cont Sheet) | NOTES | SHEET 16 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor | COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted] | ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, gray, highly to moderately weathered, weak, fine grained, a'a gravels. *(continued)*		15		NA		1347		
									NA				
									NA				
						56		20	NA	0	(27)		
									NA				
									NA		1358		
									NA		1400		
						57		50	NA	0	(19)		
									NA		1408		
									NA		1416		
						58		10	NA	0	(14)		
									NA		1427		
156.2	247.8								NA		1431		At 247.3-252.3 ft: UCS=3908 psi TUW=164.6 pcf
			M		**BASALT**, gray, moderately weathered, moderately strong, fine grained, a'a.				0				
			M			59		100	0	65	(33)		
					Highly weathered from 250.2-ft to 250.8-ft.				NA				
									0		1440		
			M M M						0		1446 (16)		At 252.0-252.2 ft: PL Is(50)=904 psi At 252.0-252.5 ft: PL Is(50)=1507 psi

237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252

DRILLING LOG (Cont Sheet)

NOTES

SHEET 17 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) (3) (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
			M,M		**BASALT**, gray, moderately weathered, moderately strong, fine grained, a'a. *(continued)*		15		0				
			M										
			M			60		85	0	70			
			M,M								(16)		
			M,M										
			M						0				
147.6	256.4		M				16						
					BASALT, gray, highly weathered, weak, fine grained, a'a gravels.				0		1505		
											1512		
									NA				
									NA				
						61		45	NA	0	(18)		
									NA				
									NA				
											1529		
											1529		
									NA				
									NA				
						62		40	NA	0	(43)		
									NA				
									NA				
											1536		
											1546		
									NA				
136.1	267.9										(25)		
			M		**BASALT**, gray, moderately to slightly weathered, strong, fine grained.				0				At 268.3-273.3 ft: UCS=4738 psi TUW=159.2 pcf

DRILLING LOG (Cont Sheet)

NOTES

SHEET 18 OF 19 SHEETS

PROJECT: Red Hill Tunnel Repair Project Pearl Harbor

COORDINATE SYSTEM: HI State Plane Zone 3 | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: (b) [redacted] (A) [redacted]

ELEVATION TOP OF BORING: 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, gray, moderately to slightly weathered, strong, fine grained. *(continued)*	63	16	100	0	80			At 268.9-269.2 ft: PL Is(50)=1074 psi
			M						0		(25)		
			M						0		1558		
			M						0		1602		
			M						0				
			M,M						0				
			M,M		Very weak from 275.1-ft to 275.3-ft.	64	17	100	0	90	(30)		
			M						0		1612		
			M						0		1108		Begin 3/29/2012
			M						0				
			M						0				
			M,M			65		100	0	80	(33)		
			M		Becomes highly weathered, moderately strong.				0				
122.9	281.1				**BASALT**, red, highly weathered, very weak, fine grained, a'a gravels.				NA		1117		
									NA		1122		
									NA		(25)		
119.8	284.2				**BASALT**, gray to red, highly weathered, weak, fine grained.	66		80	NA	0			

269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284

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DRILLING LOG (Cont Sheet)

NOTES

SHEET 19 OF 19 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Red Hill Tunnel Repair Project Pearl Harbor	HI State Plane Zone 3	NAD83	NAVD88

LOCATION COORDINATES (b) (3) (A) [redacted]

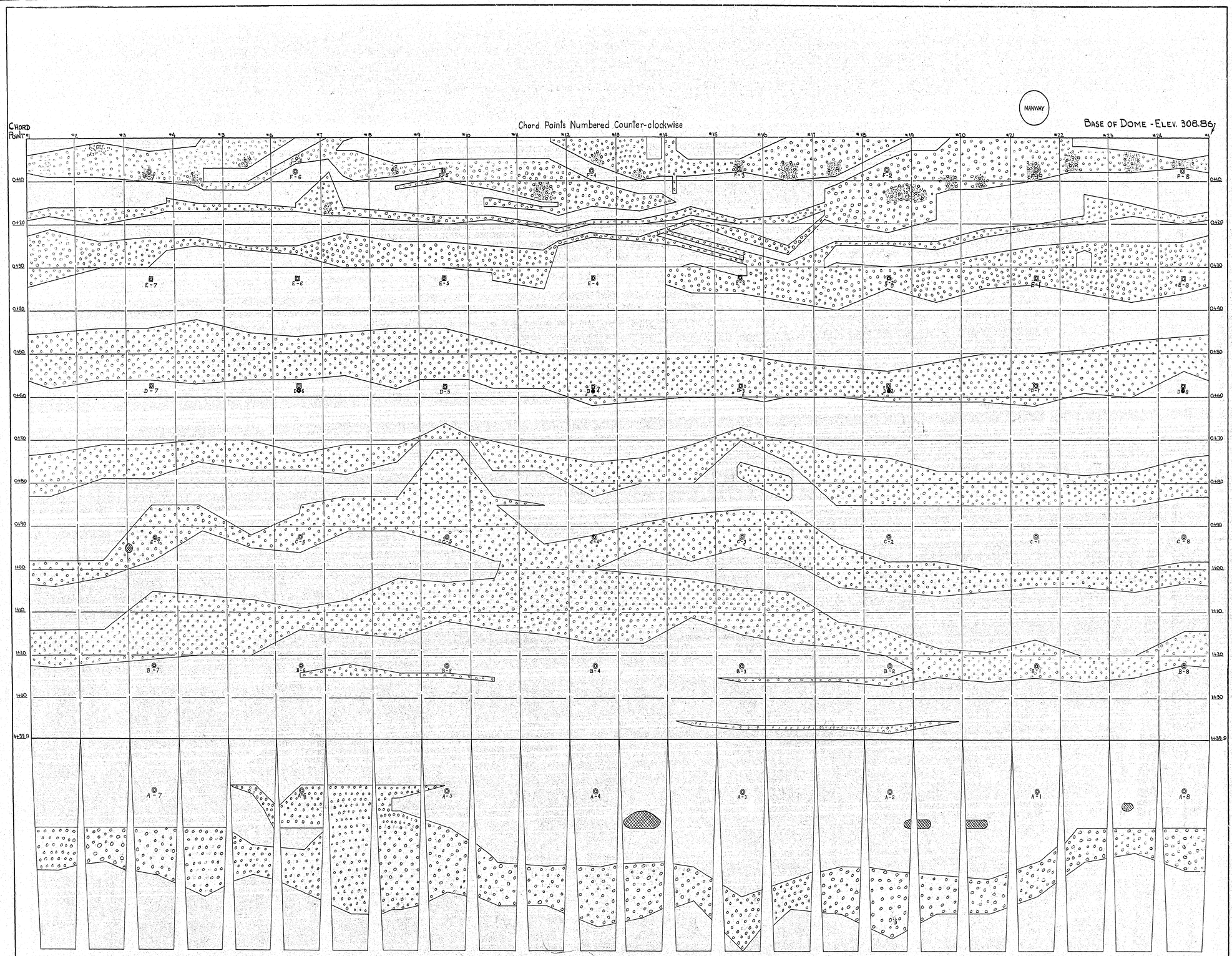
ELEVATION TOP OF BORING 404.0

ELEV	DEPTH	Fracture Drawing	Fracture Number	Legend	FIELD CLASSIFICATION OF MATERIALS (Description)	Rock Core: Run No.	Box No.	Rec %	Frac. per foot	RQD %	Drill Time (Rate ft/hr)	W_x	REMARKS
					BASALT, gray to red, highly weathered, weak, fine grained. *(continued)*		17		NA				
											(25)		
									NA				
117.2	286.8		M		**BASALT**, gray, slightly weathered, strong, fine grained, slightly vesicular (massive a'a).						1134		
			M						0		1144		At 287.0-292.0 ft: UCS=6559 psi TUW=165.5 pcf
									0				
						67		100	0	100	(50)		
			M				18		0				
			M						0				
			M								1150		
			M								1210		At 292.0-292.4 ft: PL Is(50)=1197 psi
									0				
			M,M			68		100	0	100	(30)		
			M										
			M						0				
109.0	295.0		M								1216		

Boring terminated at 295-ft bgs. A standpipe piezometer was installed consisting of Sch 40 1.5-inch-ID PVC casing, blank 0-255 feet and
0.020-inch slotted screen 255-295 feet with end cap; hole collapsed to 153 feet when withdrawing the core barrel, remaining annulus was backfilled with Hawaiian basaltic "termite barrier" size sand 137-153 feet, bentonite pellets 134-137 feet, and redimix concrete 0-134 feet; a 6-inch flush-mounted Christy box was set at surface.

Attachment 4:
Tank Barrel Logs (1941–43)
(DON 1943)

~~For Red Hill AOC Party Use Only~~



LEGEND:

- Rock
- Clinker
- Clinker & Grout
- Lava Tube
- ◎ Grout Header
- ⊠ Grout Outlet
- • Strain Gauge

Log of Tank Barrel No. 1

Scale: 1" = 10'

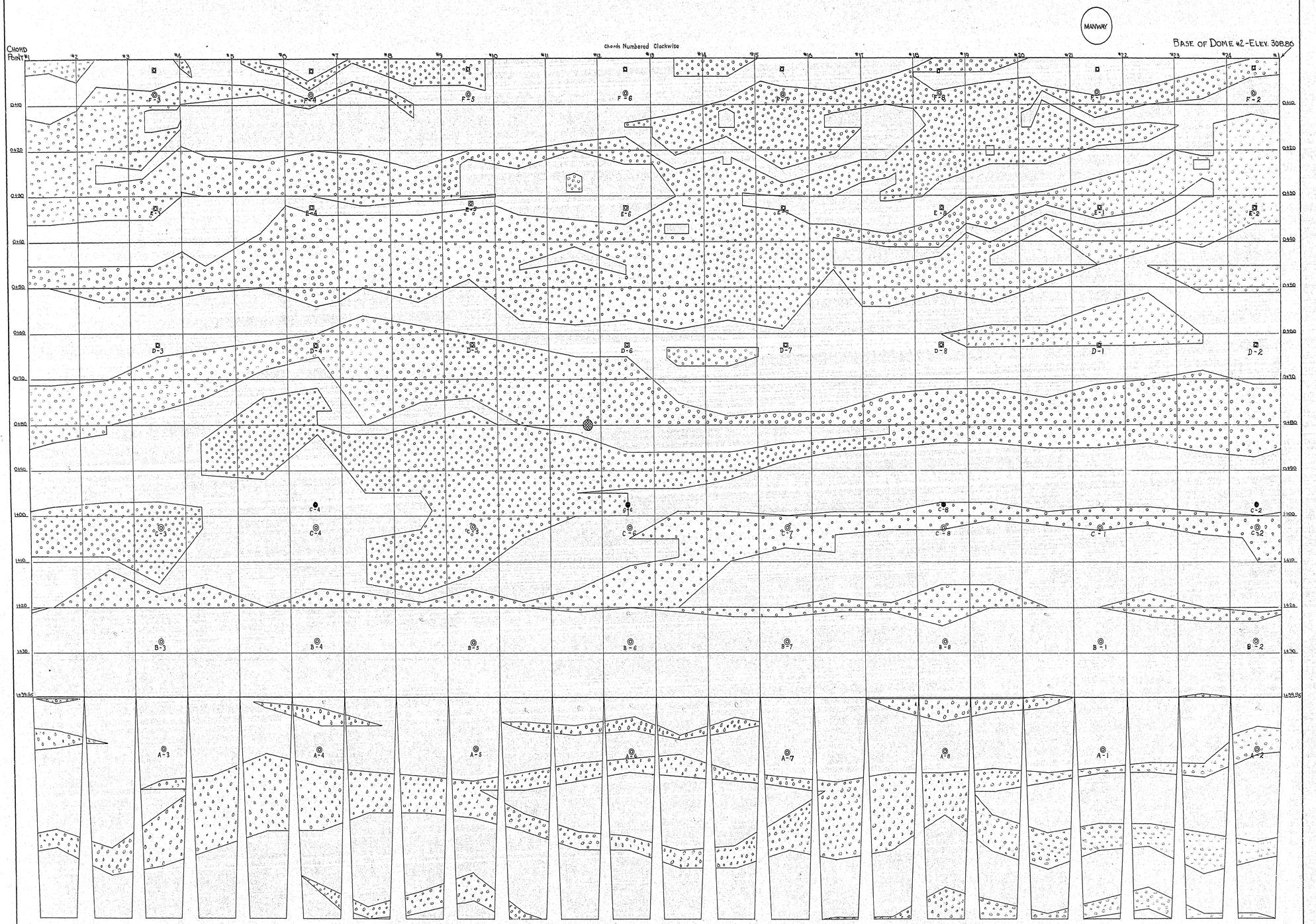
BY & D No. 29396 2
NTD No. DAN 24-439

Drawn by M.L. Date 12/1/41	Scale 1" = 10'
Checked by ____ Date ____	
Engineer ____	
Chief Engineer ____	
Recommended	Log of Formations in Tank Excavation
Member of Operating Committee	
Approved AS BUILT Date ____	Contractors Pacific Naval Air Bases Contract NOy 4173
Officer in Charge NOy 4173	
By ____	O. E. Drwg. No. 9UF-SK187

293562

23

65



LEGEND –

- Rock
- Clinker
- Clinker & Grout
- Lava Tube
- ◎ Grout Header
- ▣ Grout Outlet
- ● Strain Gauge

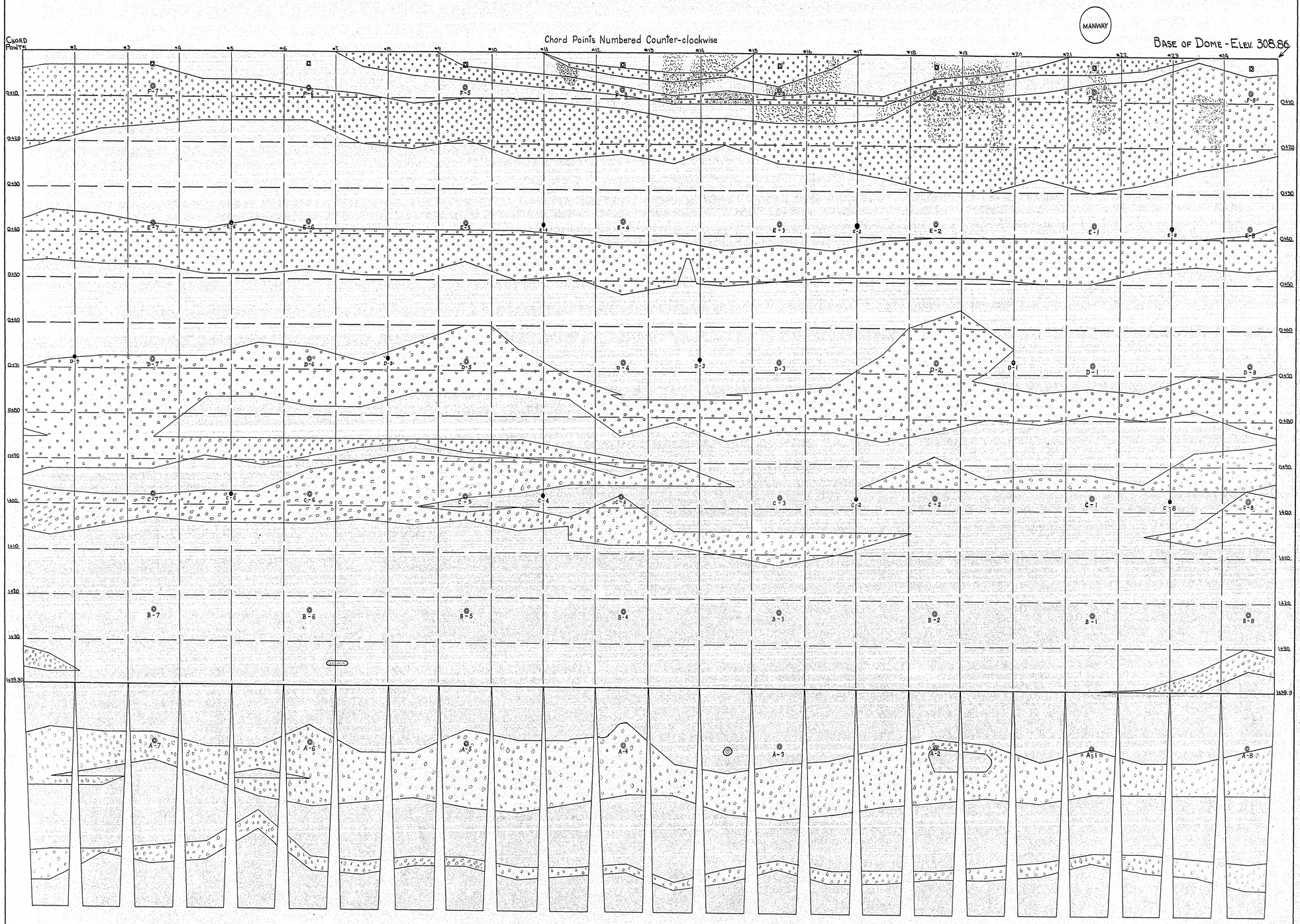
LOG OF TANK BARREL NO. 2

SCALE: 1" = 10'

BY & D No 293963
14th ND No OAN24-440

DRAWN BY M.L. DATE 11/29/41	SCALE 1" = 10'
CHECKED BY ____ DATE ____	
ENGINEER ____	
CHIEF ENGINEER ____	LOG OF FORMATIONS IN TANK EXCAVATION
RECOMMENDED ____	
MEMBER OF OPERATING COMMITTEE ____	CONTRACTORS PACIFIC NAVAL AIR BASES CONTRACT NOy 4173
APPROVED AS BUILT DATE ____	
OFFICER IN CHARGE NO. 4173	O & B DRWG NO. 9UF-SK188

293963



LEGEND

- Rock
- Clinker
- Grout
- Lava Tube
- ◎ Grout Header
- ⊠ Grout Outlet
- ● Strain Gauge

Log of Tank Barrel No. 3

Scale: 1" = 10'

BYED No 293964
14th ND No. OAN24.441

DRAWN BY M.L. DATE 1/10/42	SCALE 1" = 10'
CHECKED BY ____ DATE ____	
ENGINEER ____	
CHIEF ENGINEER ____	
RECOMMENDED ____	LOG OF FORMATIONS IN TANK EXCAVATION
MEMBER OF OPERATING COMMITTEE ____	
APPROVED AS BUILT DATE ____ OFFICER IN CHARGE NOy 4173	CONTRACTORS PACIFIC NAVAL AIR BASES CONTRACT NOy 4173
BY ____	O. B. DRWG. NO. 9UF-SK189

293964

23

CHORD (Numbered Clockwise)

POINT #1 #2 #3 #4 #5 #6 #7 #8 #9 #10 #11 #12 #13 #14 #15 #16 #17 #18 #19 #20 #21 #22 #23 #24 #1

MANWAY

BASE OF DOME #4 - ELEV. 308.86

Q+10 Q+20 Q+30 Q+40 Q+50 Q+60 Q+70 Q+80 Q+90 1400 1410 1420 1430 1439.9

F-3 F-4 F-5 F-6 F-7 F-8 F-1 F-2

E-2 E-3 E-4 E-5 E-6 E-7 E-8 E-1 E-2

D-2 D-3 D-4 D-5 D-6 D-7 D-8 D-1 D-2

C-3 C-3 C-4 C-5 C-6 C-7 C-8 C-1 C-2

B-3 B-4 B-5 B-6 B-7 B-8 B-1 B-2

A-3 A-4 A-5 A-6 A-7 A-8 A-1 A-2

LEGEND -

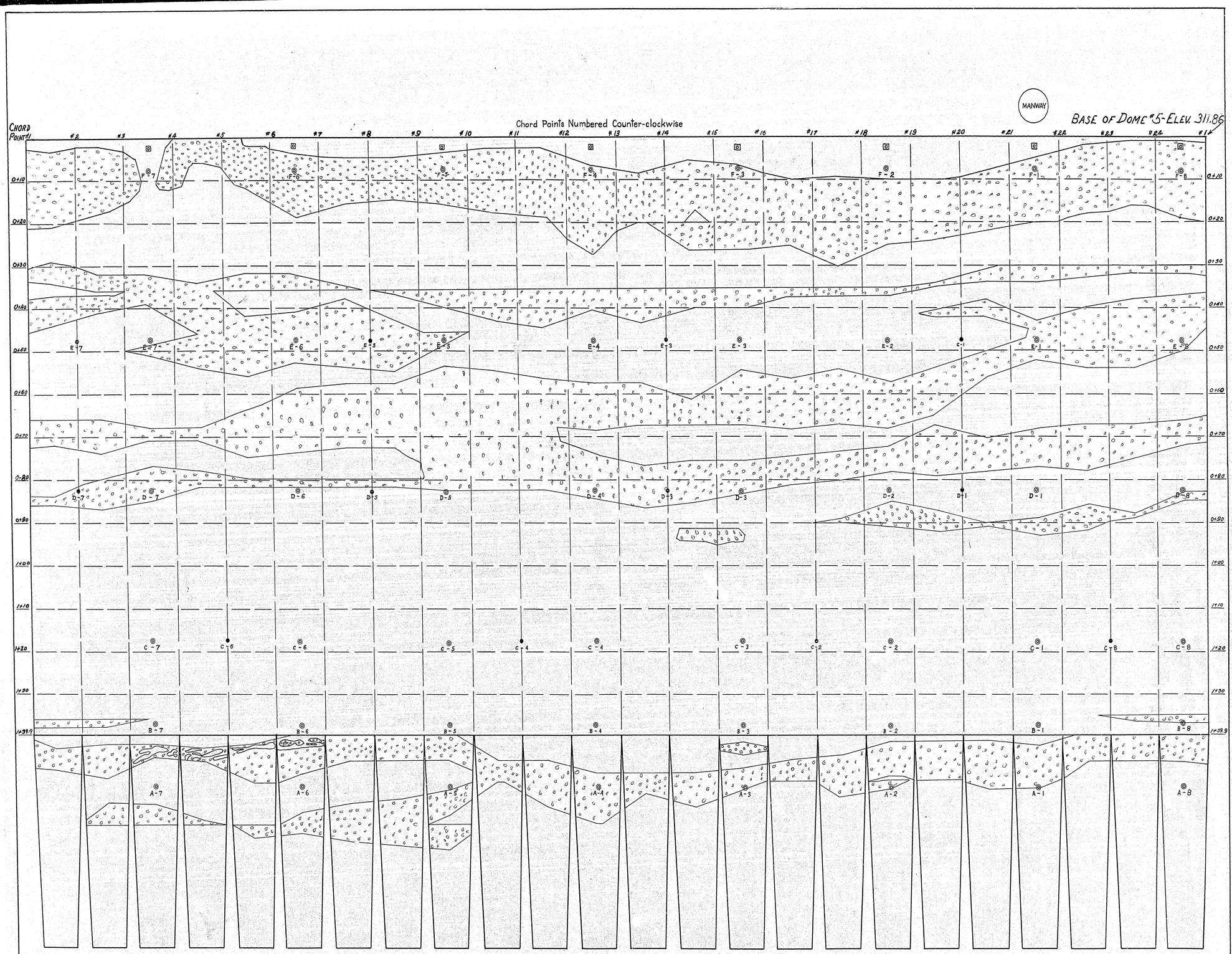
- Rock
- Clinker
- Grout
- Lava Tube
- ◎ Grout Header
- ⊠ Grout Outlet
- • Strain Gauge

LOG OF TANK BARREL No. 4

SCALE: 1" = 10'

BY & D No. 293965
14th ND No. OAN-24-442

D...N BY M.L. DATE 12/26/61	SCALE 1" = 10'
CHECKED BY ... DATE ...	
...NEER ...	
... ENGINEER ...	
...COMMENDED ...	LOG OF FORMATIONS IN TANK EXCAVATION
... OF OPERATING COMMITTEE ...	
DATE ...	CONTRACTORS PACIFIC NAVAL AIR BASES CONTRACT NOY 4173
...PROVED AS BUILT OFFICER IN CHARGE NOY 4173	O. B. DRWG. NO. 9UF-SK190
...	



LEGEND

- Rock
- Clinker
- Grout
- ◎ Grout Header
- ⊡ Grout Outlet
- • Strain Gauge

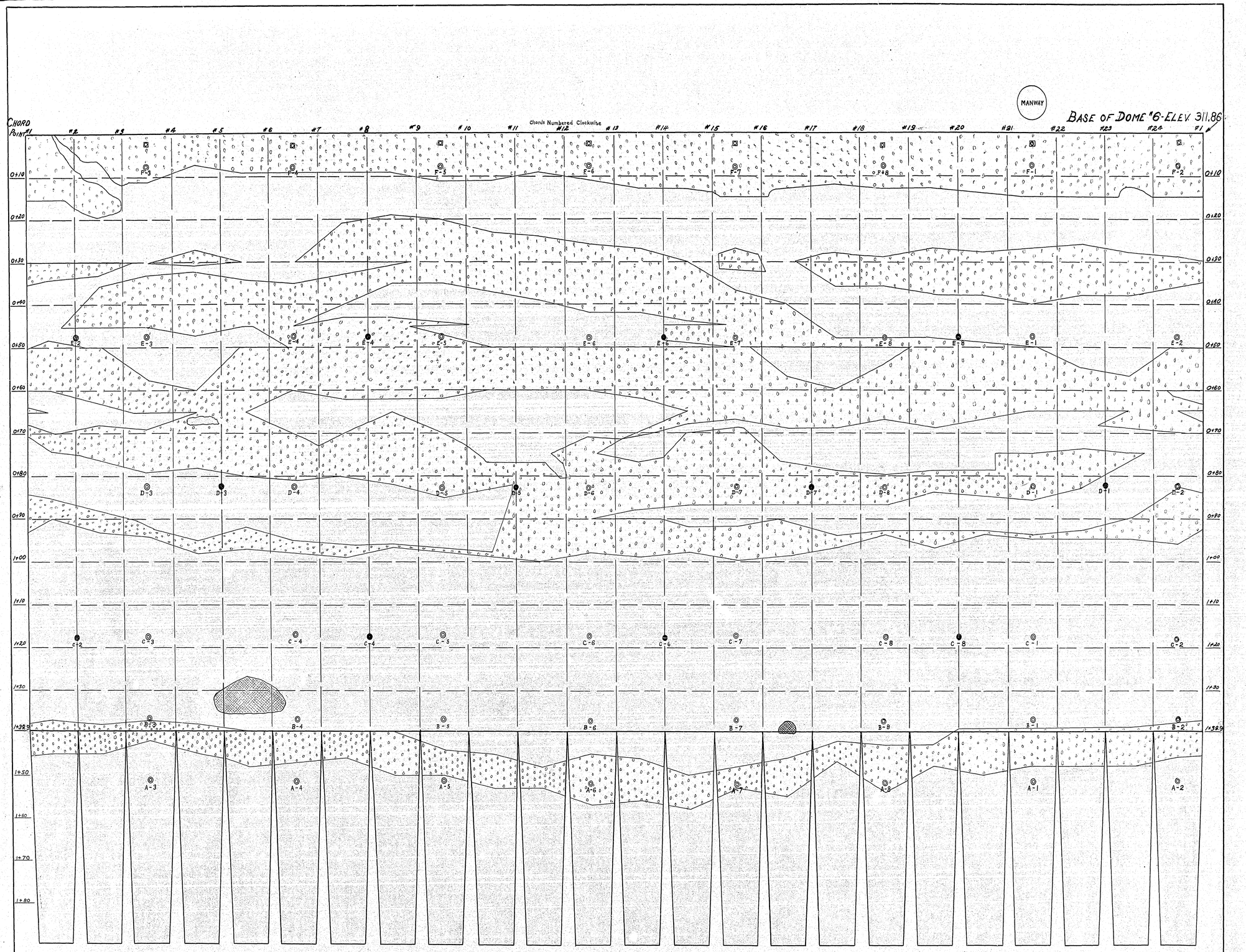
LOG OF TANK BARREL No. 5

SCALE: 1"=10'

BY&D No. 293966
14th ND No. OAN2A-443

DRAWN BY C.C. DATE 3/24/42	1" = 10'
TRACED BY ____ DATE ____	
CHECKED ENGINEER ____	
RECOMMENDED ____ CHIEF OF OPERATING COMMITTEE	LOG OF FORMATIONS IN TANK EXCAVATION
APPROVED AS BUILT DATE ____ ENGINEER IN CHARGE NOY 4173	CONTRACTOR PACIFIC NAVAL AIR BASES CONTRACT NOY 4173
	U. S. DEPT. NO. 9UF-SK 191

293966



LEGEND:

- ROCK
- CLINKER
- GROUT
- LAVA TUBE
- ◎ GROUT HEADER
- ⊠ GROUT OUTLET
- ● STRAIN GAUGE

LOG OF TANK BARREL No. 6

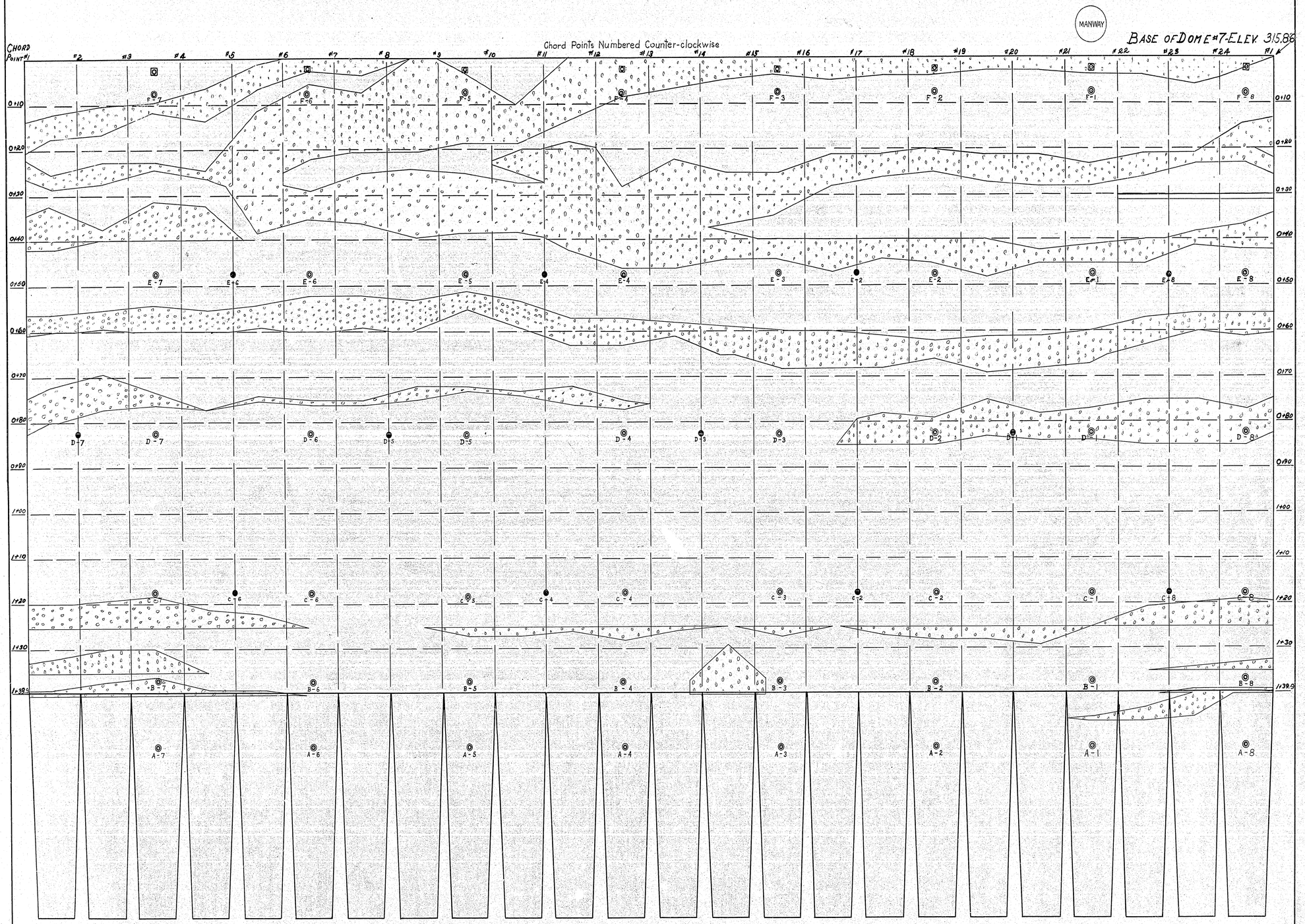
SCALE: 1" = 10'

BY&D No. 293967
14th ND No. OAN24-444

DRAWN BY G.C. DATE 3-26-42	SCALE: 1" = 10'
CHECKED BY ____ DATE ____	
ENGINEER ____	
CHIEF ENGINEER ____	LOG OF FORMATIONS IN TANK EXCAVATION
RECOMMENDED ____	
MEMBER OF OPERATING COMMITTEE	CONTRACTORS PACIFIC NAVAL AIR BASES CONTRACT NOY 4173
APPROVED AS BUILT DATE ____ OFFICER IN CHARGE NOY 4173	C. D. DRWG. NO. 9UF-SK-192
BY ____	

293967

23



LEGEND

- ROCK
- CLINKER
- GROUT
- ◎ GROUT HEADER
- ◘ GROUT OUTLET
- • STRAIN GAUGE

LOG OF TANK BARREL NO. 7

SCALE: 1" = 10'

BY&D No. 293968

14th ND No. OAN24-445

DRAWN BY G.C. DATE 3-26-42
CHECKED BY ____ DATE ____
ENGINEER ____
CHIEF ENGINEER ____
RECOMMENDED ____
CHIEF OF OPERATING COMMITTEE
DATE ____
APPROVED AS BUILT
OFFICER IN CHARGE NAV AIDS

SCALE 1" = 10'

LOG OF FORMATIONS IN TANK EXCAVATION

CONTRACTORS
PACIFIC NAVAL AIR BASES
CONTRACT NOY 4173

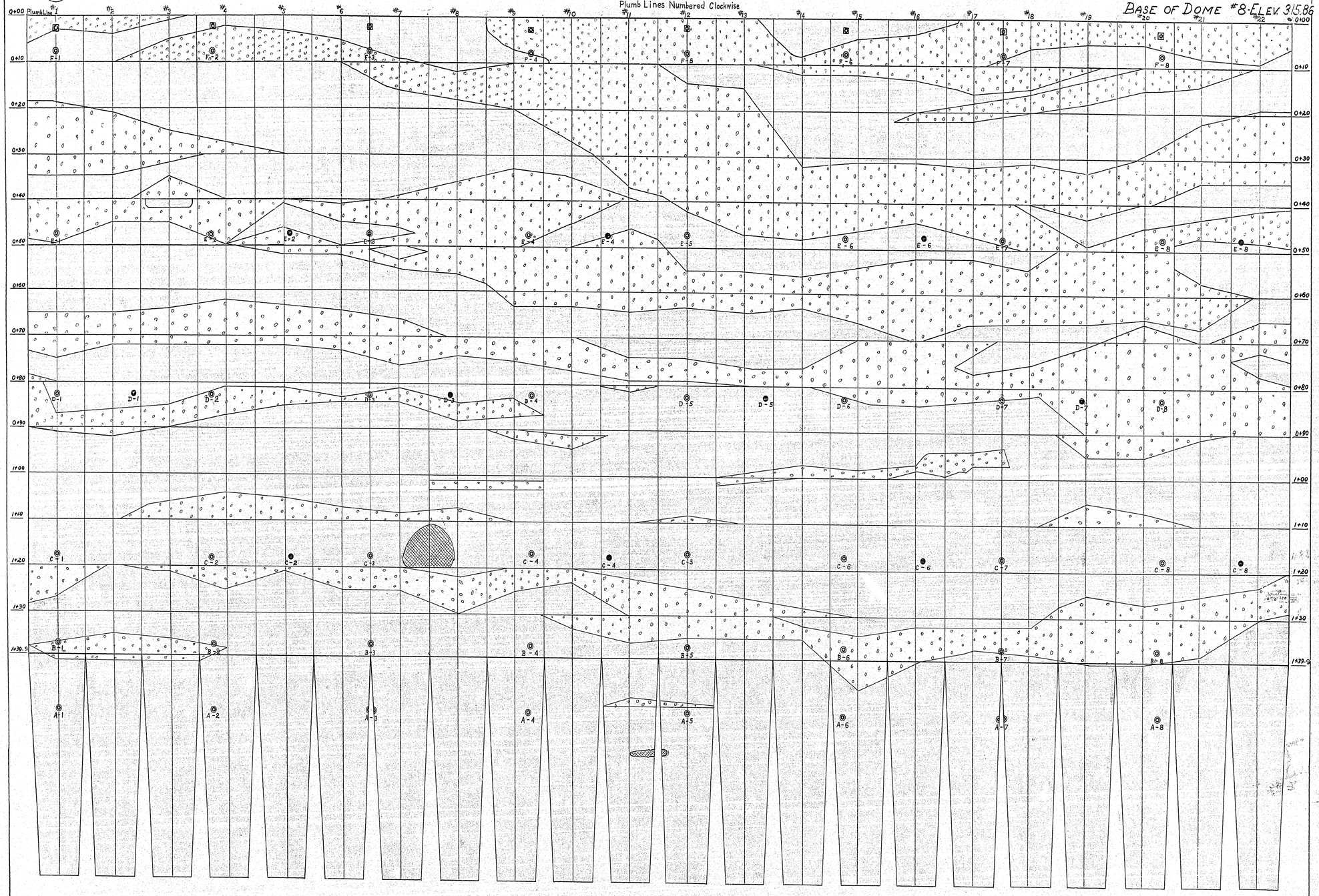
DRAWING NO. 9UF-SK193

293968

MAY WAY

Plumb Lines Numbered Clockwise

BASE OF DOME #8-ELEV. 315.86



LEGEND -

- ROCK
- CLINKER
- LAVA TUBE
- GROUT
- GROUT HEADER
- GROUT OUTLET
- STRAIN GAUGE

LOG OF TANK BARREL NO. 8

Revision	Date	By/ed

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NO. 4173

Drawn By G.T.C. 9-5-42 — Recommended
Checked By
Engr. In Charge — Member Operating Comm.

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T.H.
FUEL DEPOT . SOUTH HALAWA . OAHU, T.H.
UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION
AS BUILT

Approved _____ 194

Public Works Officer

Y. & D. Drawing No.
293969

Project Manager

14th N. D. Drawing No.
OAN 24-446

(Plumb Lines Numbered Counter-clockwise)

Manway

Plumb Line #1 #2 #3 #4 #5 #6 #7 #8 #9 #10 #11 #12 #13 #14 #15 #16 #17 #18 #19 #20 #21 #22

BASE OF DOME #9 - ELEV. 319.85

0+00 0+10 0+20 0+30 0+40 0+50 0+60 0+70 0+80 0+90 1+00 1+10 1+20 1+30 1+39.9

F-1 F-8 F-7 F-6 F-5 F-4 F-3 F-2

E-1 E-8 E-8 E-7 E-6 E-6 E-5 E-4 E-4 E-3 E-2 E-2

D-1 D-8 D-7 D-7 D-6 D-5 D-5 D-4 D-3 D-3 D-2 D-1

C-1 C-8 C-8 C-7 C-6 C-6 C-5 C-4 C-4 C-3 C-2 C-2

B-1 B-8 B-7 B-6 B-5 B-4 B-3 B-2

A-1 A-8 A-7 A-7 A-5 A-4 A-3 A-2

LEGEND -

- ROCK
- CLINKER
- LAVA TUBE
- GROUT
- GROUT HEADER
- GROUT OUTLET
- STRAIN GAUGE

LOG OF TANK BARREL NO. 9

Revision	Date	Brief	Made by	Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NO. 4173

Drawn By G.T.C. 9-14-42 Recommended
Checked By
Engr. in Charge
Member Operating Comm.

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T.H.
FUEL DEPOT . SOUTH HALAWA . OAHU, T.H.
UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION
AS BUILT

Approved 194
Public Works Officer

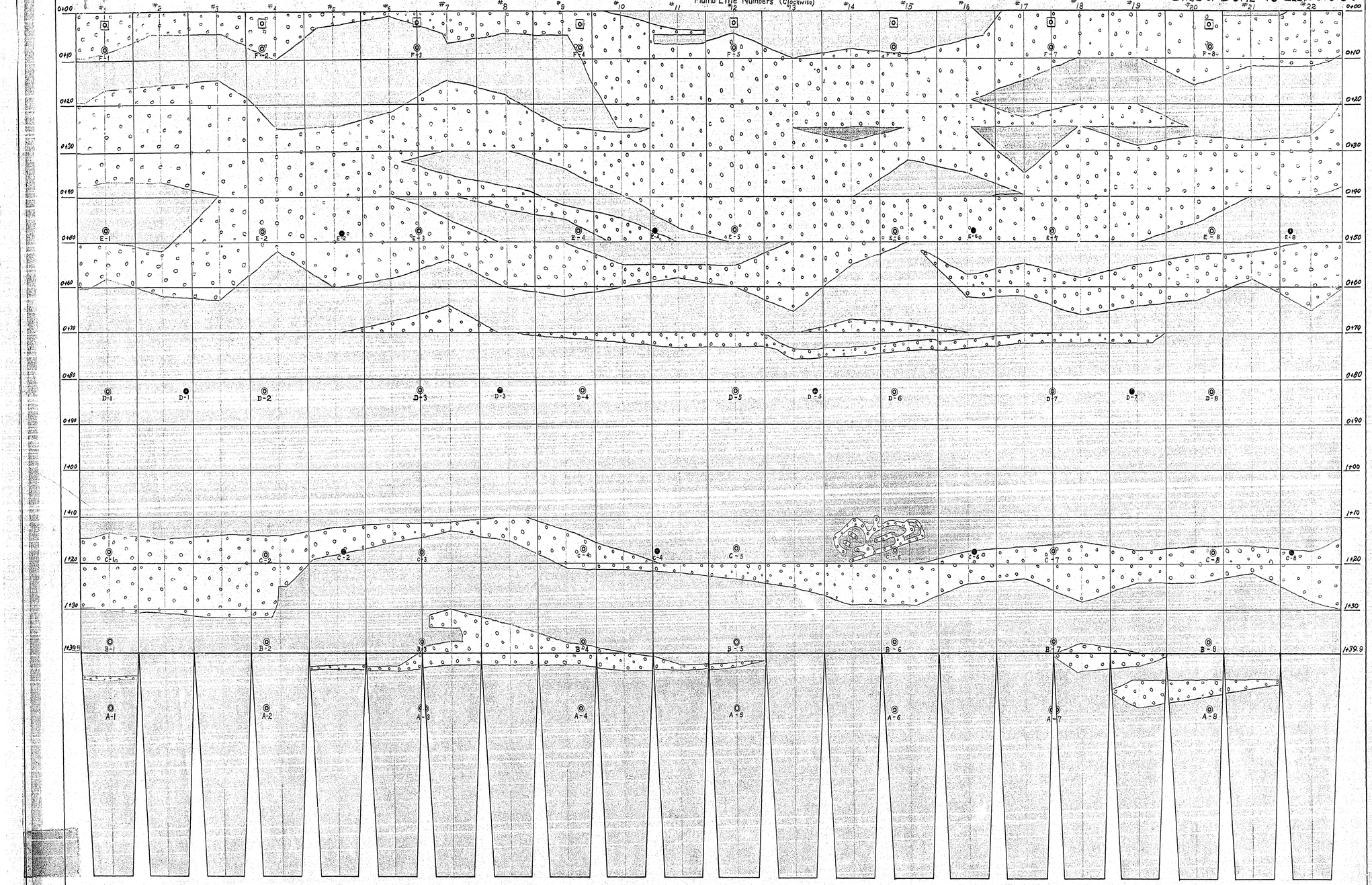
Y.&D. Drawing No. 293970

Project Manager
14th N. D. Drawing No. OA N-24-447

293970

Plumb Line Numbers (Clockwise)

BASE OF DOME #10 - ELEV. 319.86



LEGEND -

- ROCK
- CLINKER
- LAVA TUBE
- GROUT
- GROUT HEADER
- GROUT OUTLET
- STRAIN GAUGE

LOG OF TANK BARREL NO. 10

Revision	Date	Brief	Made By	Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NO. 4173

Drawn By F.D.S. 2-23-43 Recommended
Checked By
Engr. In Charge Member Operating Comm.

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T.H.
FUEL DEPOT . SOUTH HALAWA . OAHU, T.H.
UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION
AS BUILT

Approved 194

Public Works Officer

Y. & D. Drawing No. 293971

Project Manager

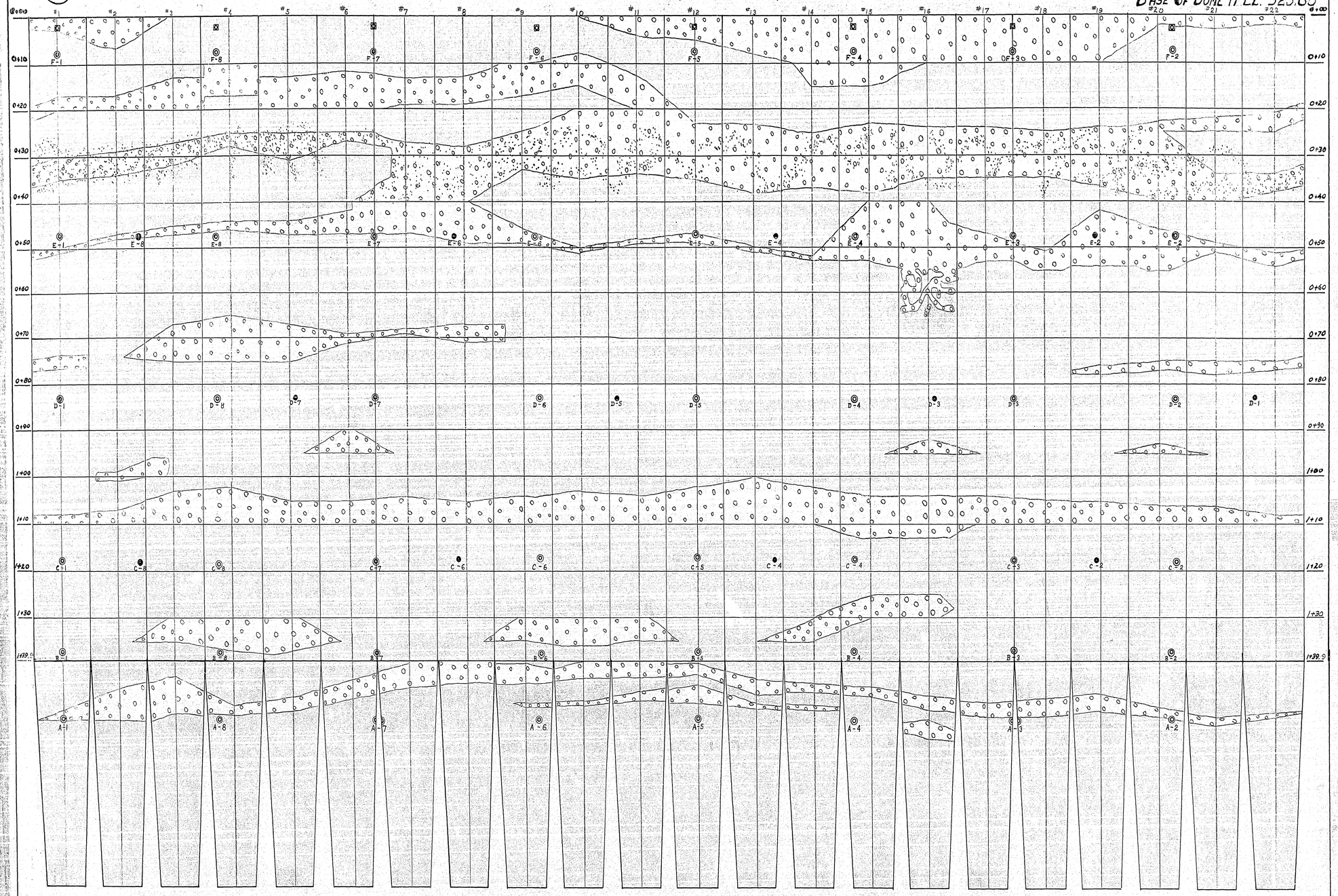
16th N. D. Drawing No. OAN-24-448

9UF-Sk. 196

293971

Plumb Lines (Numbered Counter-clockwise)

BASE OF DOME #11 - EL. 323.86



LEGEND -

- ROCK
- CLINKER
- LAVA TUBE
- GROUT
- GROUT HEADER
- GROUT OUTLET
- STRAIN GAUGE

LOG OF TANK BARREL No. 11

Revision	Date	Brief	By	Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NOy 4175

Drawn By G.T.C. 10-2-42 Recommended
Checked By
Engr. In Charge Member Operating Comm.

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T.H.
FUEL DEPOT . SOUTH HALAWA . OAHU, T.H.
UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION
AS BUILT

Approved 194

Public Works Officer

Y. & D. Drawing No. 293972

Project Manager

14th N. D. Drawing No. OA-N24-449

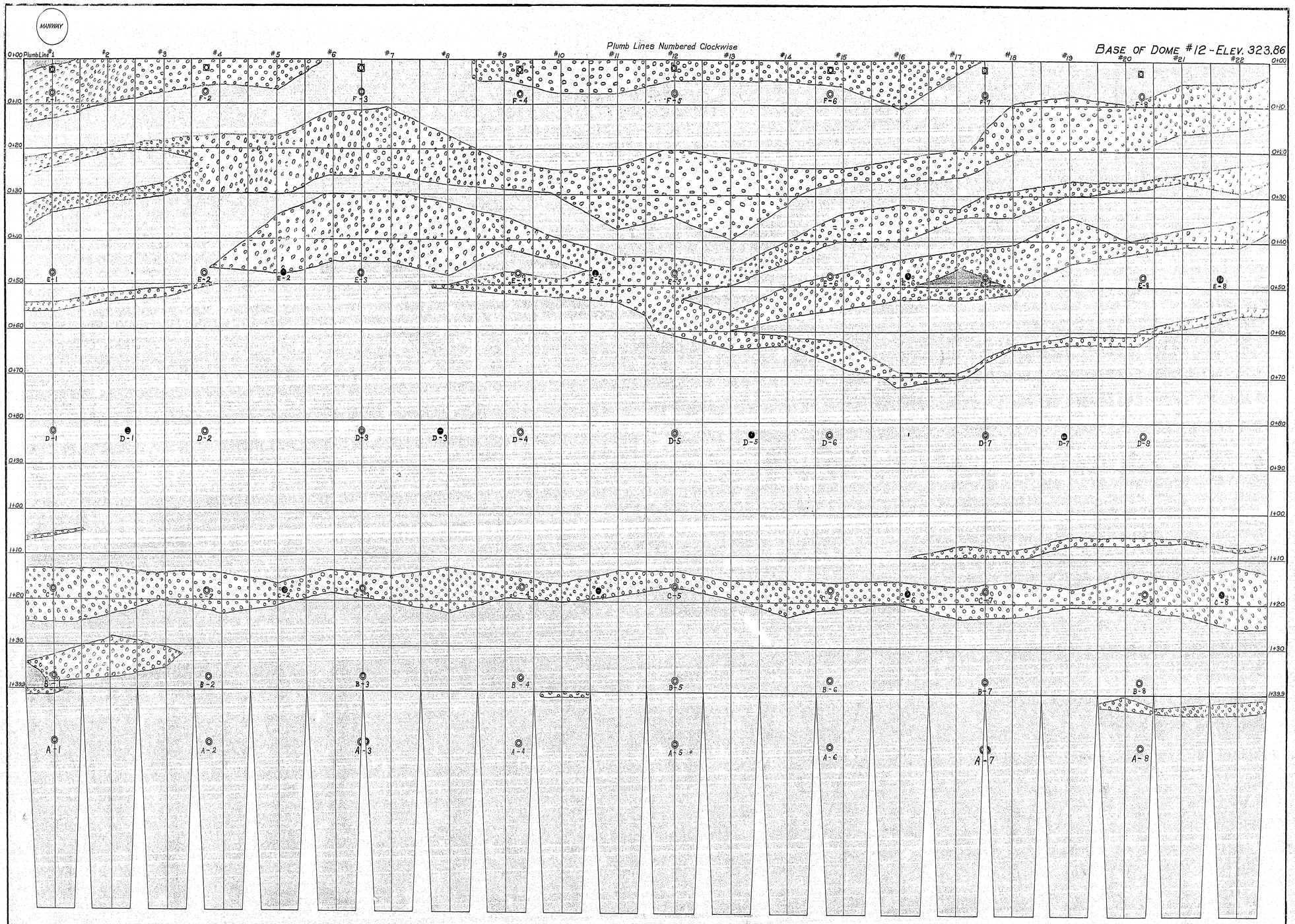
293572

9UF-Sk 197

MANWAY

Plumb Lines Numbered Clockwise

BASE OF DOME #12 - ELEV. 323.86



LEGEND :-

- Rock
- Clinker
- Lava Tube
- Grout
- Grout Header
- Grout Outlet
- Strain Gauge

LOG OF TANK BARREL NO. 12.

SCALE: 1" = 10'

Revision	Date	Brief	Made by / Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES

CONTRACT NOy 4173

Drawn By

Checked By M.Z. Belena 3-15-43

Engr. In Charge

Recommended

Member Operating Comm

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T.H.

FUEL DEPOT . SOUTH HALAWA , OAHU, T.H.

UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION

AS BUILT

Approved _____ 194

Public Works Officer

Y. & D. Drawing No. 293973

Project Manager

14th N. D. Drawing No. OA-N24-450

293973

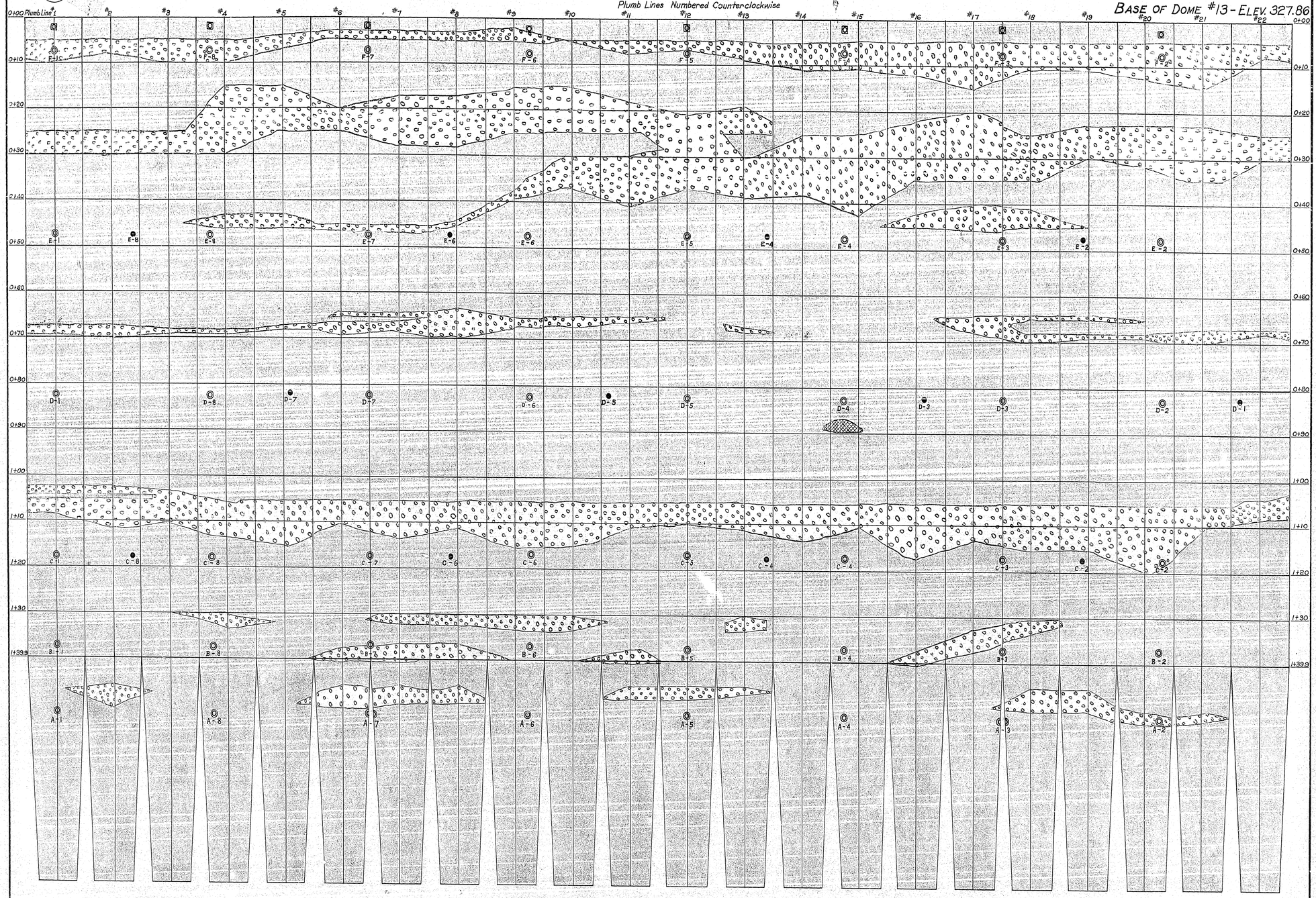
23

9UF-SR198

MAINWAY

Plumb Lines Numbered Counterclockwise

BASE OF DOME #13 - ELEV. 327.86



LEGEND:-

- Rock
- Clinker
- Lava Tube
- Grout
- Grout Header
- Grout Outlet
- Strain Gauge

LOG OF TANK BARREL NO. 13

SCALE: 1" = 10'

Revision	Date	Brief	Made by	Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES

CONTRACT NOy 4173

Drawn By [illegible] Recommended

Traced

Checked By M. Z. Baleno 3-15-43

Engr. In Charge _____ Member Operating Comm

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T. H.

FUEL DEPOT . SOUTH HALAWA . OAHU, T. H.

UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION

AS BUILT

Approved _____ 194

Public Works Officer

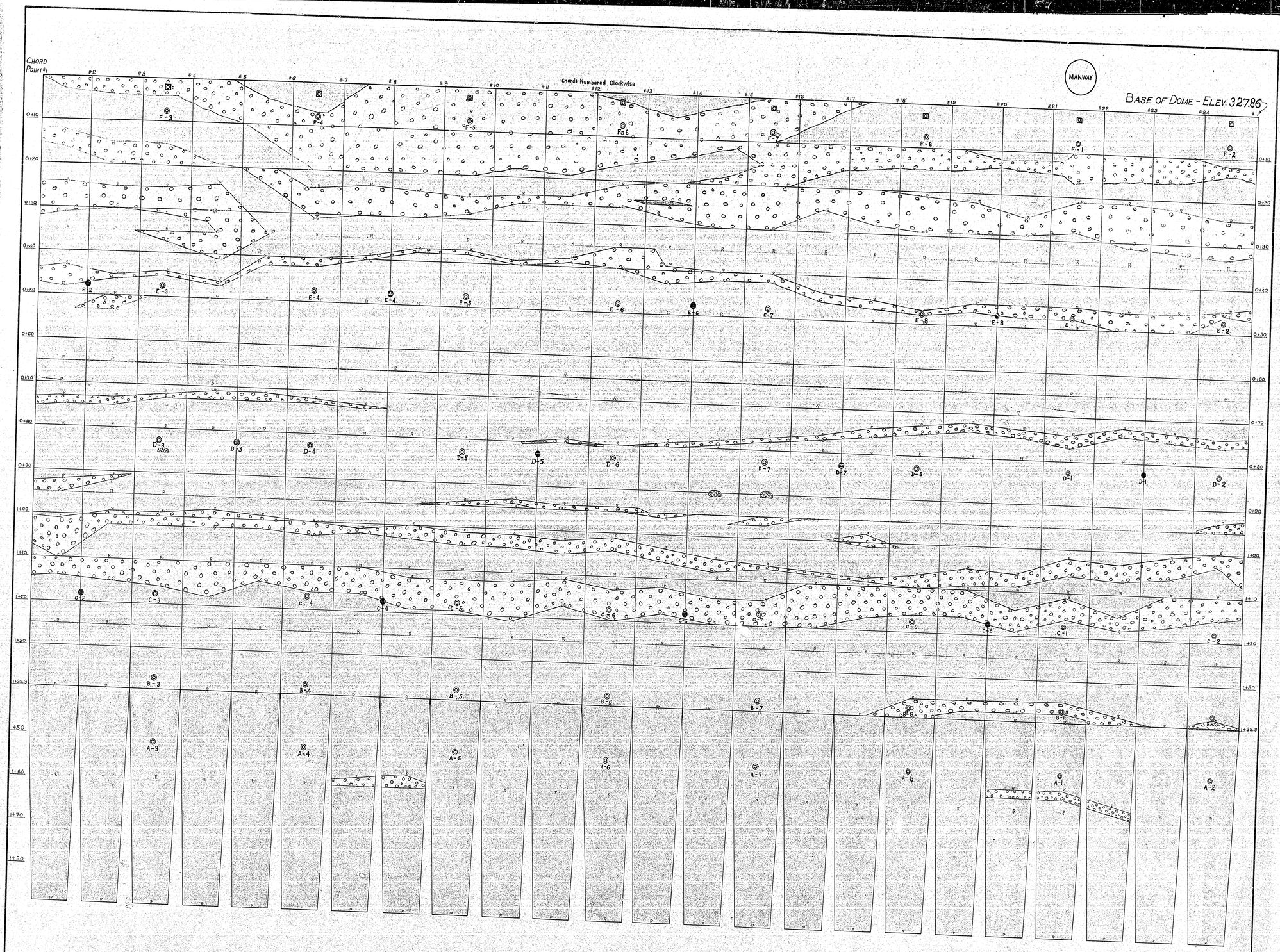
Y. & D. Drawing No.
293 974

Project Manager

Bureau Drawing No.
OA-N24-451

293974

2



LEGEND

ROCK	GROUT HEADER
CLINKER	GROUT OUTLET
GROUT	STRAIN GAUGE
LAVA TUBE	

LOG OF TANK BARREL No. 14

SCALE: 1" = 10'

CONTRACTORS, PACIFIC NAVAL AIR BASES

CONTRACT NO. 1

Drawn by F. D. S. 2-27-43

FOURTEENTH NAVAL DISTRICT - PEARL HARBOR, T. H.

FUEL DEPOT, SETTLE HALAWA, OAHU, T. H.

UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION

AS BUILT

Approved _____ 194

Public Works Officer

U.S.N.D. Drawing No. 293975

Bureau Number OA-NZ4-452

293975

23X

CHORD POINT #1 (Numbered Counter-clockwise)

#2 #3 #4 #5 #6 #7 #8 #9 #10 #11 #12 #13 #14 #15 #16 #17 #18 #19 #20 #21 #22 #23 #24 #1

MANWAY

BASE OF DOME - ELEV. 331.86

0+10 0+20 0+30 0+40 0+50 0+60 0+70 0+80 0+90 1+00 1+10 1+20 1+30 1+39.9

F-7 F-6 F-5 F-4 F-3 F-2 F-1 F-8

E-7 E-6 E-5 E-4 E-3 E-2 E-1 E-8

D-7 D-6 D-5 D-4 D-3 D-2 D-1 D-8

C-7 C-6 C-5 C-4 C-3 C-2 C-1 C-8

B-7 B-6 B-5 B-4 B-3 B-2 B-1 B-8

A-7 A-6 A-5 A-4 A-3 A-2 A-1 A-8

LEGEND

- ROCK
- CLINKER
- GROUT
- LAVA TUBE
- ◎ GROUT HEADER
- ⊠ GROUT OUTLET
- ● STRAIN GAUGE

LOG OF TANK BARREL No. 15

SCALE: 1"=10'

Revision	Date	Brief	Made By	Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NOy 4173

Drawn By F.D.S. 3-13-43
Checked By
Engr. in Charge

Recommended
Member Operating Comm.

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T.H.
FUEL DEPOT . SOUTH HALAWA . OAHU, T.H.

UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION

AS BUILT

Approved _____ 194

Public Works Officer

Y. & D. Drawing No. 293976

Project Manager

14th N. D. Drawing No. OA-N24-453

9UF-SK 201

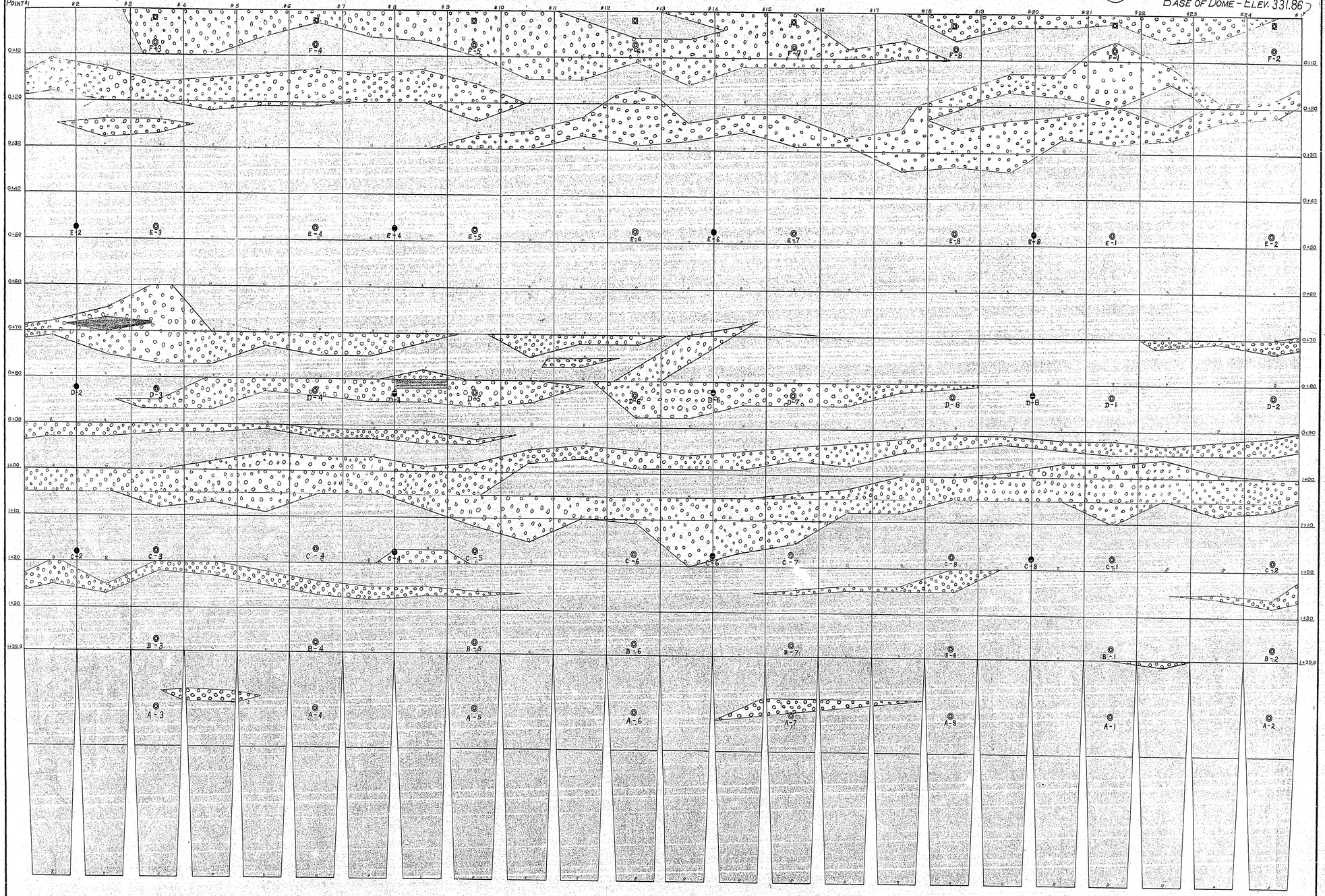
293976

23

CHORD (Numbered Clockwise)
POINT #1

MANWAY

BASE OF DOME - ELEV. 331.86



LEGEND

- Rock
- Clinker
- Grout
- Lava Tube
- ◎ Grout Header
- ⊠ Grout Outlet
- ● Strain Gauge

LOG OF TANK BARREL NO. 16

SCALE: 1" = 10'

Revision	Date	Item	Apr'd By Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NO. 4375

Drawn By F.D.S. 4-4-43 Recommended
Checked By
Engr. In Charge Manager Division Comm.

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T.H.
FUEL DEPOT . SUTT HALAWA . OAHU, T.H.
UNDERGROUND FUEL STORAGE
LOG OF FORMATIONS IN TANK EXCAVATION
AS BUILT

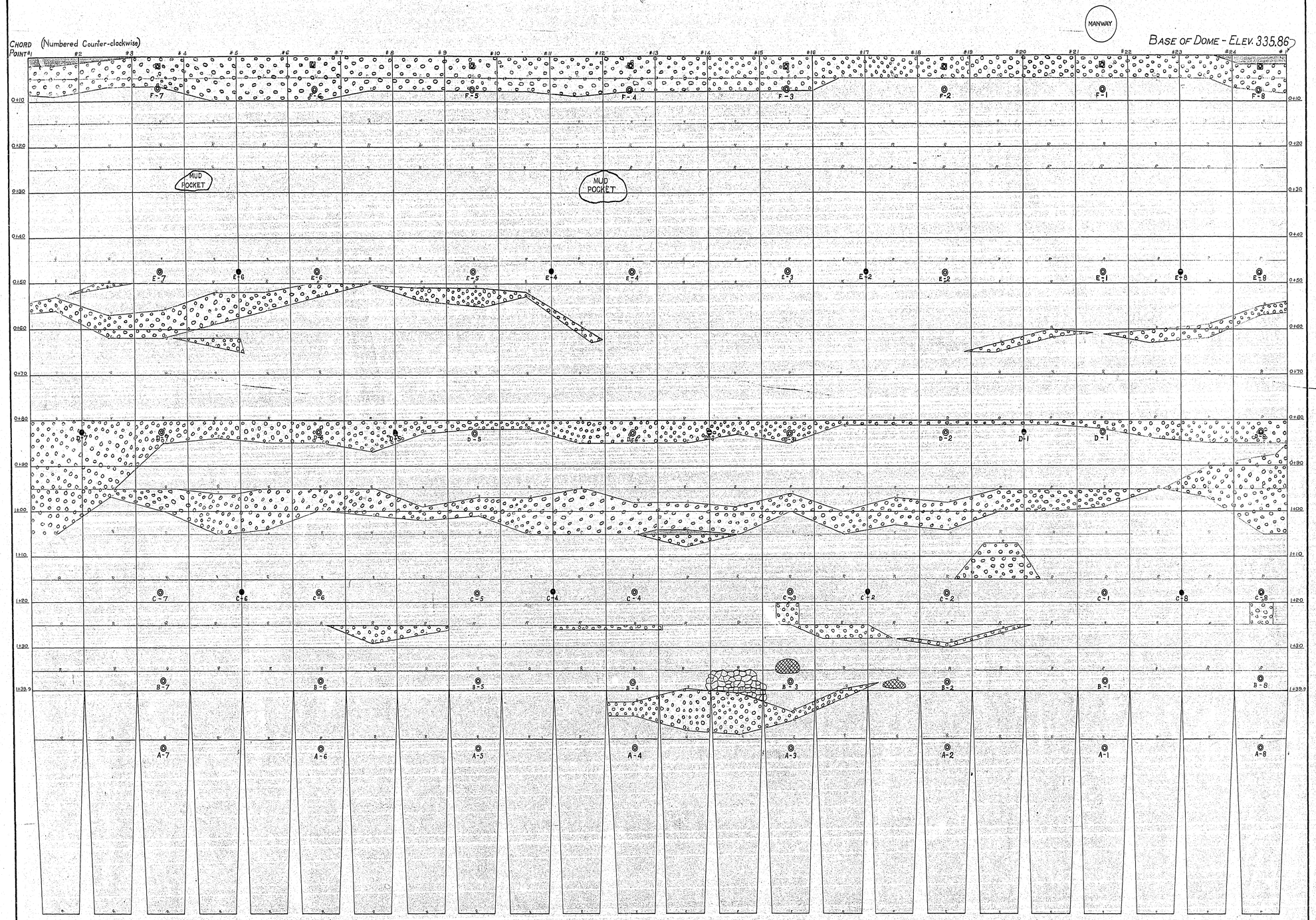
Approved 194
Public Works Officer

Y & D. Drawing No. 293 977

Project Manager
14th N. D. Drawing No. OAN29-454

293977

23x



LEGEND

ROCK	GROUT HEADER
CLINKER	GROUT OUTLET
GROUT	STRAIN GAUGE
LAVA TUBE	

LOG OF TANK BARREL No. 17

SCALE: 1"=10'

Revision	Date	Filed	Ready for Approval

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NO. 4173

Drawn By F.D.S. 4-5-43 Recommended
Checked By
Engr. in Charge Member Operations Comm.

FOURTEENTH NAVAL DISTRICT . PEARL HARBOR, T.H.
FUEL DEPOT . SOUTH HALAWA . OAHU, T.H.

UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION

AS BUILT

Approved _____ 193

Public Works Officer

Y. & D. Drawing No.
293978

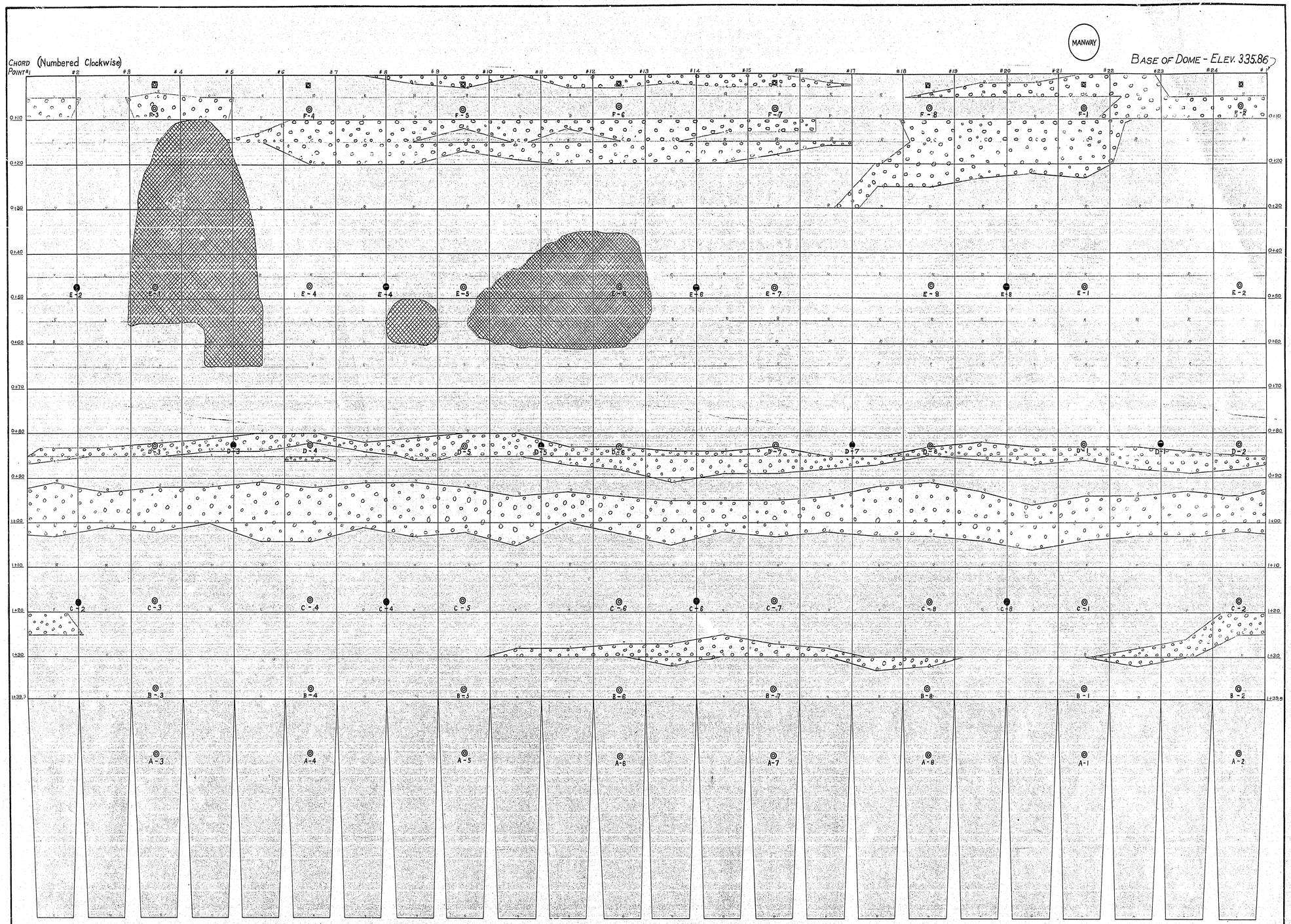
Project Manager

Navy Y. & D. Drawing No.
OA-N29-455

9UF-SK 201-B

293978

23x



LEGEND

- Rock
- Clinker
- Grout
- Lava Tube
- ◎ Grout Header
- ⊠ Grout Outlet
- ● Strain Gauge

LOG OF TANK BARREL NO. 18

SCALE: 1"=10'

Revision	Date	Init.	Y&D Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NO. 4173

Drawn By E.D.S. 5-23-43. Blueprinted
Checked By
Engr. In Charge
Member Quonset Comm.

FOURTEENTH NAVAL DISTRICT - PEARL HARBOR, T.H.
FUEL DEPOT, SOUTH HALAWA, OAHU, T.H.
UNDERGROUND FUEL STORAGE
LOG OF FORMATIONS IN TANK EXCAVATION
AS BUILT

Approved 1943
Public Works Officer

Y&D Drawing No.	Project Manager	14th N. D. Drawing No.
293979		0A-N29-456

9UF-SK201C

293579

23 X

MANWAY

CHORD (Numbered Counter-clockwise)

BASE OF DOME - ELEV. 339.86

POINT #1 #2 #3 #4 #5 #6 #7 #8 #9 #10 #11 #12 #13 #14 #15 #16 #17 #18 #19 #20 #21 #22 #23 #24 #1

0+10 0+20 0+30 0+40 0+50 0+60 0+70 0+80 0+90 1+00 1+10 1+20 1+30 1+39.9

F-7 F-6 F-5 F-4 F-3 F-2 F-1 F-8

E-7 E-6 E-6 E-5 E-4 E-4 E-3 E-2 E-2 E-1 E-8 E-8

D-7 D-6 D-5 D-5 D-4 D-3 D-3 D-2 D-1 D-1 D-8

C-7 C-6 C-6 C-5 C-4 C-4 C-3 C-2 C-2 C-1 C-8 C-8

B-7 B-6 B-5 B-4 B-3 B-2 B-1 B-8

A-7 A-6 A-5 A-4 A-3 A-2 A-1 A-8

LEGEND

ROCK	◎ GROUT HEADER
CLINKER	⊠ GROUT OUTLET
GROUT	● STRAIN GAUGE
LAVA TUBE	===== APPARENT OUTLINE OF LAVA TUBE
LOOSE ROCK	

LOG OF TANK BARREL No. 19

SCALE: 1"=10'

Revision	Date	Date

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NO. 4175

Drawn By [illegible] 5-24-43 Recommended

Checked By

Engr. In Charge Member Operating Comm.

FOURTEENTH NAVAL DISTRICT - PEARL HARBOR, T.H.

FUEL DEPOT - SOUTH HALAWA - OAHU, T.H.

UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION

AS BUILT

Approved 194

Public Works Officer

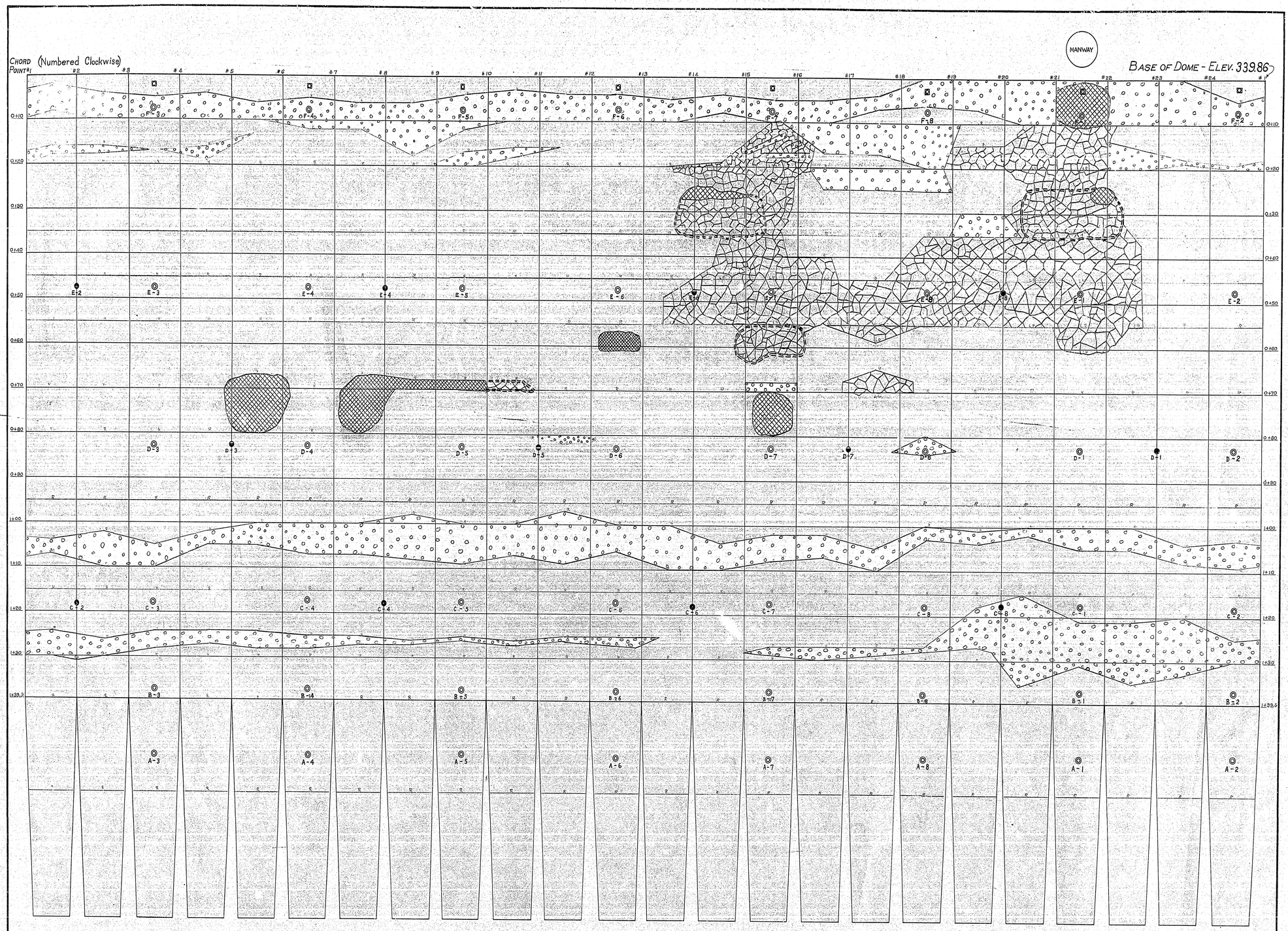
Y. & D. Drawing No. 293980

Project Manager

14th N. D. Drawing No. OA-N24-457

293980

9UF-SK201-D



LEGEND:

- ROCK
- LOOSE ROCK
- CLINKER
- GROUT HEADER
- GROUT
- GROUT OUTLET
- LAVA TUBE
- STRAIN GAUGE
- APPARENT OUTLINE OF LAVA TUBE

LOG OF TANK BARREL No. 20

SCALE: 1"=10'

Revision	Date	Entry	Job No. Approved

CONTRACTORS, PACIFIC NAVAL AIR BASES
CONTRACT NO. 4173

Drawn By 283 5-23-43 Recommended
Checked By
Engr. In Charge
Member Quartermaster Corps

FOURTEENTH NAVAL DISTRICT , PEARL HARBOR, T. H.
FUEL DEPOT , SOUTH HALAWA , OAHU, T. H.

UNDERGROUND FUEL STORAGE

LOG OF FORMATIONS IN TANK EXCAVATION

AS BUILT

Approved _____ 194

Public Works Officer

Y. & D. Drawing No. 293981

Project Manager

14th N. D. Drawing No. OA-N24-458

9UF-SK 201 E

23X