Preliminary Work Plan Red Hill Fuel Storage Facility Pearl Harbor, Oahu, Hawaii Latitude: 21°22'15" N Longitude: 157°53'33" W

DOH Facility ID No. 9-102271 DOH Release ID No. 140010

March 2014

Prepared for:

Naval Supply Systems Command Fleet Logistics Center Pearl Harbor 1942 Gaffney Street, Suite 100 JBPHH, Hawaii 96860-4549

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Executive Summary

Naval Facilities Engineering Command, Hawaii (NAVFAC Hawaii) prepared this preliminary Work Plan in response to the State of Hawaii Department of Health (DOH) release response letters dated February 12, 2014 and February 26, 2014 for the Red Hill Fuel Storage Facility. The objective of this Work Plan is to address the three elements described in the initial February 12, 2014 letter and reiterated in the February 26, 2014 letter.

The Facility is located in the south-central portion of the Island of Oahu, Hawaii, in Halawa Heights. There are 18 active and 2 inactive, 12.5 million gallon, field-constructed underground storage tanks (USTs) located at the Red Hill Fuel Storage Facility. A confirmed release of Jet Propellant 8, also known as Jet Propulsion fuel, type 8 (JP-8) from Tank 5 was reported on January 24, 2014. Immediately following notification to the DOH, the Navy collected groundwater samples from monitoring wells to determine if the release had impacted groundwater beneath the Facility or the nearby water supply well. Results indicated no fresh fuel from Tank 5 in the groundwater or drinking water samples.

Summarized below is the Navy's response to the DOH request to provide a preliminary work plan that includes three elements:

- 1. *Models to estimate downward vertical migration of free product* The Navy is in the process of hiring a qualified contractor with the expertise to perform this work.
- 2. Methods or options for non-invasive scanning of basalt to determine area and volume of contaminant mass prior to any drilling investigation The Navy has queried the subject matter experts (SMEs) at Navy headquarters in Washington, D.C. to determine if there are other known locations where this technology has been used. The SMEs indicate that modeling to investigate vertical subsurface movement of pure petroleum liquid product has not been undertaken at other Navy sites with similar subsurface features due to the unusual nature of the subsurface.
- 3. *Methods and locations for borings to most efficiently characterize the extent of contamination* – The Navy is in the process of hiring a qualified contractor with the expertise to perform this work. Additionally, the Navy intends to evaluate various removal and remediation technologies that would be effective and feasible for future fullscale implementation.

The Navy has implemented a comprehensive drinking water and groundwater monitoring program to ensure the safety and viability of the drinking water aquifer beneath the facility. The monitoring program includes collecting groundwater samples quarterly from U.S. Navy well 2254-01 (RHMW2254-01) and three wells installed in the Facility lower access tunnel (RHMW01, RHMW02, RHMW05). The U.S. Navy well 2254-01 is located approximately 3,000 feet downgradient from the Red Hill Fuel Storage Facility and provides a percentage of the potable water to the Pearl Harbor Water System. The groundwater samples are analyzed for petroleum constituents and compared against DOH Drinking Water Environmental Action Levels (EALs) (DOH, 2005a).

Compliance sampling to date indicate that all Federal and State safe drinking water standards are attained.

The Navy is committed to providing safe drinking water to its users as well as ensuring the safety of the surrounding Pearl Harbor aquifer for all other users, while operating and maintaining the Red Hill Fuel Storage Facility. To accomplish this, the Navy will continue to provide weekly status reports to the DOH and will communicate all aspects of the investigation and remediation with the DOH.

1.0 Introduction

There are 18 active and 2 inactive, 12.5 million gallon, field-constructed underground storage tanks (USTs) located at the Red Hill Fuel Storage Facility (hereafter referred to as "the Facility"). The Facility is located at Joint Base Pearl Harbor-Hickam (JBPHH), Oahu, Hawaii. The Facility is operated by Naval Supply Systems Command (NAVSUP) Fleet Logistics Center Pearl Harbor (FLCPH).

As requested in DOH letter U0204RT of February 12, 2014, and DOH letter U0210RK of February 26, 2014, this preliminary Work Plan presents methods for achieving the requirements in Hawaii Administrative Rules (HAR) 11-281 Subchapter 7, Release Response Action. The release response actions are required in response to the confirmed release of Jet Propulsion fuel 8 (JP-8) from Tank 5. A copy of the DOH letter is presented as Appendix A.

The following are included in this preliminary Work Plan:

- 1. Models to estimate downward vertical migration of free product.
- 2. Methods or options for non-invasive scanning of basalt to determine area and volume of contaminant mass prior to any drilling investigation.
- 3. Methods and locations for borings to most efficiently characterize the extent of contamination.

1.1 Background

The following sections provide a description of the site and information on the Facility and USTs.

1.1.1 Site Description

The Facility is located in Halawa Heights on Oahu, Hawaii. Land adjacent to the north of the Facility is occupied by Halawa Correctional Facility and private businesses. Land to the south and west of the Facility includes the Coast Guard Reservation. Moanalua Valley is located east of the Facility (Dawson, 2006). Figure 1 shows the Facility location.

The U.S. Navy Public Works Department operates a potable water supply shaft and associated pumping station, which, in spite of its largely lateral configuration is officially designated as "well 2254-01". The station consists of a water infiltration shaft that is approximately 1,300 feet long connected to a water supply pumping station located approximately 3,000 feet downgradient (west) of the Facility. The pumping station provides a percentage of the potable water to the Pearl Harbor Water System, which serves approximately 52,200 military consumers (TEC, 2008).

1.1.2 Facility Information

The Facility consists of 18 active and 2 inactive USTs operated by NAVSUP FLCPH. Each UST has a capacity of 12.5 million gallons. The Facility is located approximately 100 feet above the basal aquifer (Dawson, 2006).

1.1.3 UST Information

The USTs were constructed in the early 1940s. The tanks were constructed of steel and are currently used to store Jet Propellant 5, also known as Jet Fuel (JP-5), Jet Propellant 8, also known as Jet Propulsion fuel, type 8 (JP-8), and Diesel Fuel Marine (DFM, or F-76). Previously, several tanks stored Navy Special Fuel Oil, Navy Distillate, aviation gasoline, and motor gasoline. Each tank measures approximately 250 feet in height and 100 feet in diameter. The upper domes of the tanks lie at depths varying between approximately 100 feet and 200 feet below the existing ground surface (TEC, 2006).

1.2 Groundwater Monitoring Wells

Five groundwater monitoring wells were installed at the Facility: RHMW01, RHMW02, RHMW03, RHMW04, and RHMW05. The locations of the monitoring wells are shown on Figure 2. Boring logs and well construction logs are presented as Appendix B.

RHMW01: From 1998 to 2001, the Navy conducted an investigation at the Facility to assess potential releases from the fuel storage Facility. In February 2001, the Navy installed a one-inch diameter sentinel well (MW-V1D) to monitor for contamination of the basal aquifer underlying the Facility. The well was installed and completed at approximately 100 feet below grade. At the time of well completion, depth to water in MW-V1D was measured at 86 feet below grade (Dawson, 2006). Monitoring well MW-V1D was later renamed RHMW01.

RHMW02, RHMW03, RHMW04: As part of a site investigation, TEC, Inc. installed three groundwater monitoring wells at the Facility between June and September 2005. Well RHMW02 was installed in the lower access tunnel near Tanks 5 and 6. Well RHMW03 was installed in the lower access tunnel near Tanks 13 and 14. Well RHMW04 was installed hydraulically upgradient of the USTs to provide geochemistry for water moving through the basal aquifer beneath the Facility. Wells RHMW02 and RHMW03 were completed to depths of approximately 125 feet below the tunnel floor, and well RHMW04 was completed to a depth of approximately 300 feet below ground surface outside the tunnel.

RHMW05: In April 2009, groundwater monitoring well RHMW05 was installed down-gradient from the Facility, within the lower access tunnel between RHMW01 and RHMW2254-01. The well was installed to identify contaminant migration before it reaches the infiltration gallery at RHMW2254-01.

2.0 Vertical Migration Models

At this time, it is unknown exactly where on Tank 5 the JP-8 release occurred and if or how much volume has migrated past the tank structure to the surrounding rock substrate. Since the monitoring wells located within the Facility were installed in the lower access tunnel, the boring logs for those monitoring wells provide geologic information for the subsurface located below the bottom of the USTs. To initiate the vertical modeling effort, the boring logs may be used to generalize the geology of the subsurface from the top of the ridge to the bottom of the USTs.

A survey of subject matter experts (SMEs) at Navy headquarters in Washington, D.C. indicate that modeling to investigate vertical subsurface movement of pure petroleum liquid product has

not been undertaken at other Navy sites with similar subsurface features due to the unusual nature of the subsurface: a combination of complex, alternating fractured and competent (i.e., "solid") basalt rock layers with occasional thin layers of ash and other less competent rock. However, the Navy has extended the search for appropriate transport models for this type of environment. The Navy has initiated the process to hire a contractor with demonstrated expertise and experience with non-Navy sites with similar subsurface conditions to identify any appropriate models to estimate downward vertical migration of free product.

3.0 Non-Invasive Scanning

A survey of Navy SMEs also indicate that there are no remote sensing (geophysical) applications for non-invasive scanning that can feasibly determine area and volume of contaminant mass in environments like the alternating competent/fractured basalt observed at the Facility. There is too much subsurface variability, complexity, and obstruction in the observed substrate for non-intrusive geophysical approaches such as seismic, ground penetrating radar (GPR), time-domain reflectometry (TDR), thermal, etc. to produce usable information.

In the absence of useful geophysical methods, the usual approach for differentiating/ delineating the extent of contaminant plumes for saturated and unsaturated is by way of intrusive methods. Research done to explore options for minimally intrusive methods for characterizing near surface contamination such as laser induced fluorescence (LIF) with a direct push rig is intended for consistent nonconsolidated (e.g., soil) substrate and is not suitable for the competent /fractured basalt substrate at the Facility.

Conversations within the Navy and with other agencies such as the United States Environmental Protection Agency (EPA) have indicated that the Facility is unique not only for the size of the features but also for the unusual nature and extreme complexity of the substrate. Therefore, the majority of conventional methods that would typically be appropriate for conventional-sized facilities with conventional conditions will either not be feasible or not yield usable information.

The only two methods available to determine approximate area and volume of contaminant mass are borings for intervals of less competent rock, and coring to penetrate more frequent competent and fractured rock intervals, combined with sampling, in-field screening, and laboratory analytical confirmation analyses. The limitations of these available methods are that they provide information to a limited extent and are also the most involved in terms of cost, level of effort, and logistics, particularly factoring in the relative immensity of the tank size and the substrate.

4.0 Methods and Locations for Borings

Because the feasible intrusive sampling characterization methods will yield information on a comparatively localized area, the Navy will try to direct the investigation to the most appropriate area that can be practicably identified. Planned inspection of the Tank 5 interior after draining and safety preparations have been completed pose the best possibility of identifying the most appropriate area to localize the location of the release. The tank inspection will commence after Tank 5 has been vented and deemed safe for entry.

While the tank is being vented, the Navy will hire a contractor to determine methods and locations for borings to most efficiently characterize the extent of contamination. Based on the tank inspection findings, the contractor will be expected to propose locations to determine if the fuel might be trapped in the interstitial space between the steel tank wall and the outer concrete wall, or if the fuel has migrated beneath the tank, and if so, to what depth.

The Navy intends to evaluate the performance of a pilot study to evaluate the effectiveness and feasibility of bioventing, soil vapor extraction, or other appropriate methods to reduce the volume of trapped product in-place, and if feasible, light non-aqueous phase liquid (LNAPL) removal from fractured basalt. Bioventing is being used at other Navy sites on Oahu with similar geology and is proven to be successful at reducing contaminant concentrations in both the vadose zone and groundwater.





5.0 References

Dawson Group, Inc. 2006. Fourth Quarter 2005 Groundwater Sampling Report, Red Hill Fuel Storage Facility, Hawaii. February.

Hawaii Administrative Rules, Title 11, Chapter 281, Subchapter 7.

State of Hawaii Department of Health. 2005a. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Volume 1: Summary Tier 1 Lookup Tables. Interim Final. May.

State of Hawaii Department of Health. 2005b. Use of May 2005 Environmental Action Levels ("EALs") at Leaking Underground Storage Tank Sites. Memo. 15 July.

The Environmental Company, Inc. 2006. *Red Hill Bulk Fuel Storage Facility, Final – Addendum Planning Documents, Pearl Harbor, Hawaii.* May.

The Environmental Company, Inc. 2008. *Red Hill Bulk Fuel Storage Facility, Final Groundwater Protection Plan, Pearl Harbor, Hawaii.* January.

Appendix A DOH Correspondence

- Letter of February 12, 2014
- Letter of February 26, 2014

NEIL ABERCROMBIE GOVERNOR OF HAWAII



STATE OF HAWAII DEPARTMENT OF HEALTH P. O. BOX 3378 HONOLULU, HI. 96801-3378

In reply, please refer to File:

February 12, 2014

U0204RT

DIRECTOR OF HEALTH

Mr. Aaron Poentis Program Director Environmental Department Navy Region Hawaii 850 Ticonderoga St. Suite 110 Pearl Harbor, Hawaii 96860

Dear Mr. Poentis:

SUBJECT: Red Hill Tank Complex Facility ID 9-102271/Release ID 140010

The U.S. Navy notified the Department of Health's Hazard Evaluation and Emergency Response (HEER) Office on Monday, January 13, 2014 to report a suspected underground storage tank release from Tank 5 of the Red Hill Tank Complex. The capacity of the tank is 12.7 million gallons. The DOH-HEER Office initiated an Incident Command structure and began gathering data from the Navy and coordinating the DOH response. Meetings were conducted by the DOH-HEER Office with participants from the Navy, DOH-Safe Drinking Water Branch, DOH-Solid and Hazardous Waste's Underground Storage Tank (UST) Section, and the Honolulu Board of Water Supply.

This letter will address the requirements of the DOH-UST Program and the regulations governing USTs under Hawaii Administrative Rules (HAR) Chapter 11-281 Underground Storage Tanks <u>http://gen.doh.hawaii.gov/sites/har/AdmRules1/11-281.pdf</u>

Monitoring of oil/water interface probes, soil vapor, and groundwater monitoring wells have been performed at increased frequency since the release was discovered. The DOH-HEER Office, Safe Drinking Water Branch, and UST Section have provided comments and approved the proposed short-term increased monitoring schedule that will continue monitoring of these parameters until July 2014, with increased monitoring frequency specified if increasing concentrations are found.

The Initial Release Response Report is due within 90 days of reporting a confirmed UST release. The DOH received the Confirmation of UST Release form on January 24, 2014.

Mr. Aaron Poentis February 12, 2014 Page 2

Please also include the following information in your Initial Release Response Report:

- Date and time release was discovered.
- 2. Method of detection and measurements and calculations for determining fuel lost.
- 3. Time interval between discovery of release and commencement of tank draining.
- Time interval to drain tank to bottom and remove all residual product.
- 5. Modification of 2008 Groundwater Protection Plan and 2009 revisions to comply with the requirements of Environmental Hazard Evaluations as specified in the DOH-HEER Guidance.
- 6. Models to estimate groundwater flow and capture zones using recent local groundwater elevations for the Navy's drinking water pump station and Honolulu Board of Water Supply wells.

The facility is unique in both construction and storage capacity. As responsible parties of this UST system, the Navy is responsible for compliance with Subchapter 7, "Release Response Action." Certain requirements that are routine for a UST release at a retail gasoline facility may be difficult to achieve for this subterranean facility constructed within the basalt.

In addition to the Initial Release Response Report, the DOH requests a preliminary Work Plan report to discuss methods for achieving the requirements of HAR 11-281 Subchapter 7. Please complete the preliminary report within 30 days of your receipt of this letter and discuss with the DOH if you encounter any challenges or obstacles to this deadline. The following should be included in the preliminary Work Plan report:

- 1. Models to estimate downward vertical migration of free product.
- 2. Methods or options for non-invasive scanning of basalt to determine area and volume of contaminant mass prior to any drilling investigation.
- 3. Methods and locations for borings to most efficiently characterize the extent of contamination.

Following review, the DOH-UST Section would like to meet with the Navy and other interested parties to discuss selection of methods before the final work plan is prepared and work commences.

The DOH-UST Section uses the DOH-HEER guidance for Environmental Action Levels (EALs), Environmental Hazard Evaluations (EHEs) and Environmental Hazard Management Plans. All sites with contamination exceeding the DOH-HEER EALs are

Mr. Aaron Poentis February 12, 2014 Page 3

required to prepare an EHE. The data provided previously for the comprehensive risk assessment may be used and updated with data obtained since 2008.

The DOH-HEER EAL guidance: <u>http://eha-web.doh.hawaii.gov/eha-</u> cma/Leaders/HEER/environmental-hazard-evaluation-and-environmental-action-levels

The DOH-HEER Technical Guidance Manual (TGM) <u>http://www.hawaiidoh.org/</u>. For petroleum guidance and use of EALs, including for soil vapor sampling. The DOH-UST Section does not currently require multi-increment sampling for UST release sites but it is an option if responsible parties wish to perform MIS according to the DOH-HEER TGM.

The DOH UST homepage: http://health.hawaii.gov/shwb/underground-storage-tanks/.

If you have any questions regarding this letter, please contact Mr. Steven Chang, Program Manager, Solid & Hazardous Waste Branch at (808) 586-4226.

Sincerely,

STUART YAMADA, P.E., CHIEF Environmental Management Division

c: Gary Gill, Deputy Director for Environmental Health Steven Chang, Solid and Hazardous Waste Branch Keith Kawaoka, Hazard Evaluation and Emergency Response Office Joanna Seto, Safe Drinking Water Branch Roger Brewer, Hazard Evaluation and Emergency Response Office Ernest Lau, Honolulu Board of Water Supply Wade Hargrove III, Hawaii Department of the Attorney General Steven Linder, EPA Region 9 Bob Pallarino, EPA Region 9 Roy Hardy, Department of Land and Natural Resources NEIL ABERCROMBIE GOVERNOR OF HAWAII



STATE OF HAWAII DEPARTMENT OF HEALTH P. O. BOX 3378 HONOLULU, HI 96801-3378

In reply, please refer

February 26, 2014

U0205RK

Rear Admiral Richard L. Williams Commander Navy Region Hawaii 850 Ticonderoga Street Suite 110 JBPHH, HI 96860-5101

Captain Mark S. Wheeler Commanding Officer NAVSUP Fleet Logistics Center Pearl Harbor 1942 Gaffney Street Suite 100 JBPHH, HI 96860-4549

Dear Admiral Williams and Captain Wheeler:

SUBJECT: Red Hill Tank Complex Facility ID 9-102271 / Release ID 140010

The purpose of this letter is to describe the Department of Health's understanding of the status of the response to the January 13, 2014 report of a suspected release of JP-8 jet fuel from Tank 5 of the Red Hill Tank Complex and to request specific follow up actions by the Navy.

The Department of Health (DOH) received the Confirmation of Underground Storage Tank (UST) Release form on January 24, 2014 for the confirmed UST release at Tank 5.

The DOH UST letter dated February 12, 2014 requested that the Navy prepare a preliminary work plan to be submitted by March 14, 2014. The requirements of the preliminary work plan were stated as follows:

- 1. Models to estimate downward vertical migration of free product.
- 2. Methods or options for non-invasive scanning of basalt to determine area and volume of contaminant mass prior to any drilling investigation.
- 3. Methods and locations for borings to most efficiently characterize the extent of contamination.

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At the Unified Command meeting of January 15, 2014 at DOH, representatives of the Navy stated that venting of Tank 5 would take three to four weeks before workers could safely enter Tank 5 to begin investigating possible release point(s).

In communication with Unified Command, the Navy stated that draining of Tank 5 was completed on January 18, 2014. The DOH UST-Section learned on February 18, 2014 that ventilation of Tank 5 had not commenced.

Investigation of the release point(s) inside the tank is necessary to determine the location of the JP-8 released. Venting and inspection of Tank 5 are essential for identifying release points.

The DOH requests that the Navy undertake the following <u>release response action items</u>, which shall be initiated immediately and completed as soon as practicable or as otherwise stated below:

- 1. Provide a schedule for the ventilation of Tank 5 and an estimated date to commence the investigation of release point(s) within Tank 5.
- 2. The rate of vertical migration for the released JP-8 free product is unknown. Information from the previously collected basalt cores could be used for initial modeling of vertical migration. This information is necessary to protect drinking water resources from petroleum contamination.

Prepare models for petroleum JP-8 releases of 10,000, 20,000 and 30,000 gallons from points at 25% intervals from the bottom to the top of Tank 5. Progress in developing these models should be included in the preliminary work plan.

- 3. Removal of petroleum free product from the area outside the tank will reduce downward migration of the released JP-8 free product. Characterization of the free product plume and recovery of free product with increased monitoring are required to address this plume.
- 4. Additional studies and procedures are required to address the potential and impact of any future releases from the USTs within the Complex. This will require new financial and personnel resources to complete. Funding for the preliminary work plan and all necessary following work is critical.

Reserve and increase funding as needed for all phases of your release response including:

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- Developing the work plan. .
- Remediation and removal of contamination. .
- Modeling the extent and fate & transport of the JP-8 free product plume. •
- Planning for and installation of additional monitoring wells to the Northwest • and South to serve as sentinel wells for the Honolulu Board of Water Supply's Halawa pump station and Moanalua pump station.
- Measures that will reduce or eliminate future spills and protect nearby drinking water wells.
- 5. Provide written weekly progress reports by email to the DOH-UST Section by 11am each Tuesday, followed by hard copy to the DOH-UST office.

Navy Region Hawaii (NRH) is the registered Owner of the USTs in the Red Hill Tank Complex. Naval Supply Systems Command (NAVSUP) Fleet Logistics Center Pearl Harbor (FLCPH) is the Operator of these USTs. NRH and NAVSUP may collaborate on a single report or submit separate reports but in either case, the Navy's submissions to the DOH must reflect and acknowledge the collaborative effort required to successfully complete the release response action items. The DOH will provide a written response as deemed necessary.

If you have any questions regarding this letter, please contact Mr. Steven Chang of the Solid and Hazardous Waste Branch at (808) 586-4226.

Sincerely,

GARY GILL Deputy Director for Environmental Health

C: Aaron Poentis, Navy Region Hawaii Stuart Yamada, Environmental Management Division Steven Chang, Solid and Hazardous Waste Branch Joanna Seto, Safe Drinking Water Branch Keith Kawaoka, Hazard Evaluation and Emergency Response Office Ernest Lau, Honolulu Board of Water Supply Wade Hargrove III, Hawaii Department of the Attorney General Steven Linder, EPA Region 9

Appendix B Boring Logs and Well Construction Logs

contract direct

PROJECT: Red Hill Bulk Storage Facility Boring/Monitoring Well No. CLIENT: PACNAVFACENGCOM Project No.									B-V1D		
LOCAT	ION:	V1	D - Ba	isal Aquifer			ELEVATION: 102.56				
DRILLE	ER:	Salis	sbury 8	Associates, Inc.			DATE DRILLED: 2/13/01	LOGGED BY: Lar	nce Williams		
ำRILL I	RIG:	SA	ITECH	I EH5, Portable C	ore [Drill	DEPTH TO WATER>	FIRST: 86.0	COMPL.: 86.1		
ORIN	G AN	IGLE	5 90		WEI	L DI	AMETER (inch): 1"				
Correc Elevati Borin Length	ted on/ g (ft)	Core Run Number	PID Reading (ppm)	Sample Number	Core Recovery %	Graphic Log	SOIL DESCRIPTIC	SOIL DESCRIPTION			
24.06	- 80	22	0		100		Medium vesicles; no odor; 10YR 2				
18.86 15.66		23	0.0	RH-BR-V1D-S02	106		Medium vesicles; no odor; 10YR 2	/2			
	- 90	24	0.0		96		Large vesicles; no odor; 10YR 2/1				
10.16 9.56	F	25	0.0		86		Small vesicles; no odor; 10YR 2/2 Clinker zone 93-100'				
6.56 4.96 4.96 2.56	- -	26 27	0.0 0.0	RH-BR-V1D-S03	56 50		Medium vesicles; clinker zone; no Medium vesicles; clinker zone; no Clinker zone	odor; 10YR 2/1 odor; 10YR 2/2			
	-						B-V1D terminated at 100.0'	<u> </u>			
	- - - 110										
	- 120										
	- - - 130										
	- 140										
	- 150										
Corre	ecter	elev	vations	are provided for	angle		nas.		Appendix 1		
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outpart of the local

This information pertains only to this boring and shout be interpreted as being indicitive of the site.



Location: RI	ISF		Stat	tion Name: RHMW02	2	Location Type: Monitoring Well					
Location Descrip	tion: lov	ver acc	ess t	unnel, N of Tank 6	Esta	blishin	g C	ompany: TEC Inc.			
Drilling Foreman	: Dean I	McLure	•		Drilli	ng Cor	mpa	any: Valley Well D	rilling		
Geologist: N. C	Griffin/S	. МасМ	illan	Ground Surface Ele	vation	(ft): 1	06	.57	Datum:	MS	iL
Drilling Sampling	Method:	Rocl	k Cori	ing			Bo	orehole Diameter (in)): 5		
Total Depth (ft):	103.5	Date D	rilling S	Started: 27 July 20	005			Date Drilling Endeo	d: 28 July	200	5
Remarks:											
Well Construction	Well Fill	USCS		Soil Description							Soil Sample
	Cement Grout	CON FILL IE CON		Concrete - gray. Sand base. Basalt boulders. Concrete - Rate = 5/10 Basalt - brownish black 100% recovery. no odd Basalt - brownish black - 1 cm, 69% recovery. n Basalt - brownish black 0.5 cm - 1 cm, 100% reco Basalt - brownish black 2 mm - 4 mm, 100% recovery. Basalt - brownish black 100% recovery. verticle Basalt - brownish black 100% recovery. verticle Basalt - brownish black 100% recovery. Basalt - brownish black 100% recovery.	0.5. (5YR or, PID (5YR oovery. (5YR (5YR (5YR (5YR (5YR (5YR (5YR)	2/ 1). R sample 2/ 1). R. 2/ 1). R. 2/ 1). R. 2/ 1). R. 2/ 1). R.	QD hea ate ate PIC ate sent QD cles	= 68.3%, 60% vesicles d space: 0 ppm. = 1/4, RQD = 69.4%, 4 e head space: 0 ppm. = 5/15, RQD = 100%, 0 sample head space: 0 = 5/5, RQD = 86.7%, 0 sample head space: 0 = 5/5, RQD = 80.8%, 6 - possible shearing from = 43.3%, 75% vesicles : 2mm, 100% recovery. 5/5, RQD = 46.7%, 60%	: 3mm - 7mm. 10% vesicles: 10% vesicles: 10% vesicles: 0 ppm. 30% vesicles: m drill. : 3mm - 5mm. % vesicles: 2n	5mm 5mm 5mm.	

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Location: RHSF	Station Name: RHMW02	Location Type: Monitorin	g Well							
Location Description: lower acc	ess tunnel, N of Tank 6	Establishing Company: TEC Inc								
Drilling Foreman: Dean McLure		Drilling Company: Valley Well I	Drilling							
Geologist: N. Griffin/S. MacMi	Ilan Ground Surface Ele	vation (ft): 106.57	Datum: MSL							
Drilling Sampling Method: Rock	Coring	Borehole Diameter (ir	n): 5							
Total Depth (ft): 103.5 Date Dr	illing Started: 27 July 20	Date Drilling Ende	ed: 28 July 2005							
Remarks:										
35 - Bentonite	Basalt - grayish black (N2), Rate = 5/ 5, RQD = 81.7%, 40% vesicles: 3mm - 5 100% recovery, no odor, PID sample head space: 0 ppm. Basalt - grayish black (N2), Rate = 5/ 5, RQD = 81.7%, 40% vesicles: 3mm - 5 100% recovery, no odor, PID sample head space: 0 ppm.									
40 -	Basalt - grayish black (N2), Rate = 8/5, RQD = 66.7%, 60% vesicles: 4mm - 10mm, 100% recovery, no odor.									
45	Basalt - grayish black to 66.7%, 70% vesicles: 1 Basalt - grayish black (recovery. no odor. Basalt - greyish black (90% recovery. Basalt - grayish black (90% recovery. Basalt - grayish black (10mm, 90% recovery.	 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 - greyish 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% vesicles: 5mm - 10mm, 90% recovery. 								
50 -	0% recovery. Basalt - moderate brow 5/10, RQD = 0%, 70-80	n to dusky yellowish brown (5YR 4/4 to)% vesicles: 2mm - 3mm, 20% recovery.	10YR 2/2), Rate = no odor, PID							
55-	Basalt - grayish black to V V V V V V V V V V V V V V V	: 0 ppm, soft drilling. :k to blackish red (N2 to 5R 2/2). Rate = 5/10, RQD = 0%, - 5mm, 25% recovery, PID sample head space: 0.4 ppm,								
60	Basalt - grayish black to blackish red (N2 to 5R 2/2), Rate = 5/10, RQD = 0%, 25% vesicles: 1 mm - 5mm, 25% recovery, PID sample head space: 0 ppm, clinker v v v v v v									
	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, blu	ie rock.	ere establistis strategi							

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Location: RHSF	Sta	tion Name: RHMW02	2 Locat	tion Type: Monitoring	g Well			
Location Description: lower a	cess t	tunnel, N of Tank 6	Establishin	g Company: TEC Inc	•			
Drilling Foreman: Dean McLu	e	_	Drilling Cor	mpany: Valley Well D	rilling			
Geologist: N. Griffin/S. Mac	Millan	Ground Surface Ele	vation (ft): 1	06.57	Datum: MS	SL		
Drilling Sampling Method: Ro	ck Cor	ring		Borehole Diameter (in): 5			
Total Depth (ft): 103.5 Date	Drilling	Started: 27 July 20	005	Date Drilling Ende	d: 28 July 200	5		
Remarks:								
70 - Sand IE 80 - Sand IE 85 - Sand IE 90 - Sand IE 100 - Sand IE		Basalt - moderate brow Basalt - medium gray (N 3mm, 100% recovery, o Basalt - dark gray (N4), 75% recovery, blue roc Basalt - Has possible n Basalt - moderate brow possible weak zone. Basalt - moderate brow RQD = 96.7%, Basalt - Rate = 15/5, F subround pieces, grade Basalt - grayish black (colored center. Basalt - dark gray (N3), 100% recovery, no odd Basalt - dark gray (N3), 100% recovery, no odd Basalt - dark gray (N2), 100% recovery, no odd Basalt - dark gray (N3), 100% recovery, no odd	n (5YR 3/4). F N5). Rate = 5/ core barrel and Rate = 15/3. k. atural horizont n (5YR 3/4). F n to grayish br QD = 96.7%. es to vesicular N2). Rate = 15/ Rate = 15/5. or, PID sample n (5YR 3/4). F every, no odor. Rate = 15/5. or, PID sample n (5YR 3/4). F no odor. PID Rate = 15/5. or, PID sample n (5YR 3/4). F no odor. PID Rate = 15/5. or, PID sample n (5YR 3/4). F no to light brow mm - 3mm, 10 ayish black (N 8% recovery. ayish black (N 8% recovery. ayish black (N	Rate = 5/10. RQD = 63.3% 10. RQD = 63.3%, 10-20% 1 rods stuck. RQD = 16.7%, <10% vesic rad fractures, approx. 0.5 - 1 Rate = 15/3, RQD = 16.7% rown (5YR 3/4 to 5YR 3/2 80% vesicles. 1st 3 clinker basalt. 5/5, RQD = 96.7%, 2 clinker basatt. 5/5, RQD = 96.7%, 2 clinker basatt. RQD = 63.3%, 80% vesicle head space: 2 ppm. Rate = 15/5, RQD = 63.3% PID sample head space: . RQD = 63.3%, 80% vesicles head space: 2 ppm. RAD = 65%, 90% vesicles head space: 0 ppm. Rate = 15/5, RQD = 65%, 5 sample head space: 0 ppm. RQD = 65%, 85% vesicles head space: 0 ppm. RATE = 15/5, RQD = 65%, 5 sample head space: 0 ppm. 10. (5YR 3/4 to 5YR 8/6), F 0% recovery, no odor, PID 3 to N2), Rate = 15/5, RQ no odor, PID sample head 3 to N2), Rate = 15/5, RQ no od	6. weathered. .vesicles: 1mm - cles: 4mm - 1mm. " thick. 6. weathered,), Rate = 15/5, 0.5 diameter er at 83'2, cream es: 1mm - 5mm, 6. 90% vesicles: 2 ppm. es: 1mm - 5mm, 6. 1mm - 5mm, 6. 1mm - 5mm, 85% vesicles: 1mm, 85% vesicles: 1mm, 85% vesicles: 1mm, 1mm - 5mm, 85% vesicles: 1mm, 1mm - 5mm, 85% vesicles: 1mm, 1mm - 5mm, 1mm	RHMW02S01		
	~~~ ~~~~ ~~~~	Basalt - grayish brown + - 50% vesicles: 2 mm -	to dark gray (5 5mm, 11.25%	SYR 3/2 to N3), Rate = 20/ recovery, highly weathered	5. RQD = 63%, 30 d - fractured.			

Locatio	n: l	Red Hill E	BFSF	Station ID:			Station Name:			RHMW02		Date:	7/2	27/2005
Sys_Samp_Code:		Elevation:			TD:		10	103.5'		Timo	Start:			
Driller:		Dean		CO.:	VW	D	Date Finished:		1:	7/28/200	5	Time	Finish:	
	Drilling Protocol													
Hole Dia	ameter:	5		Drilling Met	hod:	Coring		Inclinatio	n:	90°		Azimut	h:	n/a
Casing														
Material: PVC Sch 80		80	Diamotor	ID:	1.939		From: O'							
				Diameter	OD:	2.375		то: 84'				]		
						S	Scre	en						
Materia	d: I	PVC Sch 80		Diamotor	ID: 1.939			From: 84'				Slot #:		0.02
				Diameter	OD:	2.375		То:		99'				
	Annular Fill													
Sand	Mon	terey #3	Туре	Bontonito	Chips:	12	2	Bags	Grout:	0	Bags			
Sanu.		4	Bags	Demonite	Pellets:	2		Bkts	Cement:	10	Bags	T		

		Estimated Constructio	n		Actu	al Construction	า	
Surfa Type:	a <b>ce Casing</b> - Traffic Cover	Ground Surface				Groun Top of grout:	nd Surface 8"	_
Diameter:	12"	_						
Length:	12"	_						
						Top of Chips:	37.0'	
						Top of Pellets:	62.2'	
						Top of Sand:	78.8'	
						Top of Screen:	84.0'	
					$\nabla$	Water Level	87 1'	
				$\sim$	$\vdash$	Water Level.	07.1	Notes:
								Borehole caved in to 99'
Cem	ent							
Grou	ıt							
B. C B. P	hips ellets		-		]	Well TD:	99.0	
Sand	t					Bore Hole TD:	103.5'	



Location: RI	IFSF		Stat	ion Name	RHMW03	6	Locat	tion T	ype:	Moni	itorinę	g We			
Location Descrip	otion: <b>Iow</b>	er acce	ess tu	nnel, N	of Tank 14	Esta	ablishin	g Co	mpan	y: TE	C Inc.				
Drilling Foreman	: Tim R	obertso	n			Drill	ing Cor	mpan	y: Va	alley V	Vell D	rillin	g		
Geologist: N. C	Griffin/S	. MacMi	illan	Ground	Surface Ele	vatior	(ft): <b>1</b>	22.1	1			Dat	um:	MS	L
Drilling Sampling	Method:	Rock	( Cori	ing				Bor	ehole	Diame	eter (in)	: 5			
Total Depth (ft):	118	Date Dr	rilling S	Started:	2 Septem	ber 2	2005		Date I	Drilling	Endeo	d: 7	Septe	embe	er 2005
Remarks:															
Well Construction	Well Fill	uscs					Soil I	Descr	iption						Soil Sample
	Cement Grout			Concrete Basalt - d 80% vesi Basalt - g 2mm, 100 Basalt - n 10mm, 10 Basalt - d 10mm, 10 Basalt - d 10mm, 10 Basalt - d 10mm, 10 Basalt - n Basalt - lii mm - 3mr Basalt - d 5mm, 66° Basalt - s Basalt - s Basalt - s Basalt - s Basalt - n Basalt - n Basalt - n	ark gray to gra cles: 1 nm - 2r rayish black (I )% recovery, F noderate brow m. 100% reco ark gray (N3), 00% recovery, ark gray (N3), 00% recovery, noderate brow nm, 100% recovery ght brown (5Y n, 66% recover ark gray (N3), % recovery. Pl oft gray, Rate oft gray, Rate oft gray, Rate ad to soft gray ed, Rate = 5/ 1 ed to soft gray	ayish b nm, 10 V2). R PID sa n (5YF PID s Rate PID s n (5YF overy.   Rate D sam = 1/3 = 1/3 = 1/3 = 1/3 . Rate	rown (N 0% recc ate = 3/ mple he 3 3/4), F PID sam = 3/10, ample h 3 3/4), F PID sar = 3/10, ample h 3 3/4), F PID sar = 4.5/1; ple hea = 4.5/1; ple hea = 5/18	I3 to 3 pvery, 10. R ad sp Rate = nple h RQD ead s Rate = mple h = 4.5/ 2. RQ d spa = 42% = 42% . RQD = 42% . RQD . RQDD . RQD . RQD . RQD . RQD . RQD . RQD . RQD . RQD . RQDD . RQDDD . RQDDD . RQDDDD . RQDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD	DYR 3/ PID si QD = ace: 0 = 3/10, ead sp ace: = 90% pace: = 3/10, lead sp 12, RC d spac D = 11 ce: 0 p highly 100% highly 0 = 48%	(2). Rat ample h 73%, 7( ppm. , RQD = pace: 0 0 ppm. , 30 - 8 0 ppm. , RQD = pace: 0 0 ppm. , RQD = pace: 0 QD = 11 %, 80 - pace: 0 QD = 11 %, 80 - pace: 0 QD = 11 %, 80 - pace: 0 , vessic %, vessic r, soft -	e = 1/3 lead sp 0 - 90% = 73% 7 ppm. 0% ves = 90% 7 ppm. % 75 - m. 90% ve ular. 10 ery. ular. 10 ery. ular. so icular. 1 fracture	0, RC ace: 0 vesicl 70 - 90 icles: icles: 70 - 90 95% ¹ 95% ¹ 95% ¹ 95% ¹ 95% ¹ 0% re ft - fra 00% r dt - fra	2D = 33° ) ppm. les: 1 mm )% vesic 1 mm - 1 mm - 1 mm - 0% vesicles s: 1 mm covery. ctured, ecovery 0% reco one.	%, n - cles: cles: : 1 -	



Location: RHFSF	Station Name: RHMW03	RHMW03 Location Type: Monitoring Well							
Location Description: lower acce	ss tunnel, N of Tank 14	Establishing Company: TEC Inc							
Drilling Foreman: Tim Robertso	'n	Drilling Company: Valley Well D	rilling						
Geologist: N. Griffin/S. MacM	illan Ground Surface Ele	vation (ft): 122.11	Datum: <b>MSL</b>						
Drilling Sampling Method: Rocl	« Coring	Borehole Diameter (in	): <b>5</b>						
Total Depth (ft): <b>118</b> Date D	rilling Started: 2 Septem	ber 2005 Date Drilling Ender	d: 7 September 2005						
Remarks:									
	Basalt - gray to red, Ra Basalt - gray to red, Ra Basalt - gray to red, Ra Basalt - gray to red, Ra	te = 5/10, RQD = 50%, poor recovery, c te = 5/10, RQD = 50%, vessicular, 75% te = 5/10, RQD = 50%, vessicular, 75%	e = 5/ 10, RQD = 50%, poor recovery, clinker zone. e = 5/ 10, RQD = 50%, vessicular, 75% recovery. e = 5/ 10, RQD = 50%, vessicular, 75% recovery.						
40 40 40 40 40 40 40 40 40 40 40 40 40 4	Basalt - Rate = 5/11, Clinker. Basalt - gray to red, Rate = 5/11, RQD = 60%, very vessicular, 80% recovery.								
45 10110 101	Basalt - gray to red, Ra Basalt - red to gray, Ra Basalt - red to gray, Ra	Basalt - gray to red, Rate = 5/10, RQD = 70%, 83% recovery. Basalt - red to gray, Rate = 5/10, RQD = 70%, poor recovery, clinker. Basalt - red to gray, Rate = 5/10, RQD = 70%, soft, 83% recovery.							
	Basalt - gray, RQD = 5	0%, glassy, 50% recovery, PID sample he linker.	ead space: 0 ppm.						
55 HILL HALL	Basalt - hard fragmente	Basalt - hard fragmented material, very poor recovery, slow drilling, started in clinker.							
60 - Bentonite	Basalt - gray, nard. Basalt - hard drilling, ru Basalt - medium dark g - 8 mm, 50% recovery. Basalt - grayish black ( 100% recovery. no odd blue stone, rubble at la	bble zone. ray (N4), Rate = 3/ 63, RQD = 0%, 30 - 5 PID sample head space: 0 ppm. N2), Rate = 1.5/ 30, RQD = 0%, 5% vesion or, PID sample head space: 0 ppm, mech st 2 on top.	0% vesicles: 3 mm :les: 2 mm - 3 mm. anically fractured						
65 -	Basalt - grayish black ( mm, 60% recovery, no fractured blue stone.	Basalt - grayish black (N2), Rate = 3/30, RQD = 18%, 5 - 10% vesicles: 2 mm - 3 mm, 60% recovery, no odor, PID sample head space: 0 ppm, mechanically fractured blue stone.							



Location: RHFSF	Station Name: RHMW03 Location	n Type: Monitoring Well						
Location Description: lower acc	ess tunnel, N of Tank 14 Establishing	Company: TEC Inc.						
Drilling Foreman: Tim Roberts	Drilling Com	pany: Valley Well Drilling						
Geologist: N. Griffin/S. Mach	illan Ground Surface Elevation (ft): 12	2.11 Datum: MSL						
Drilling Sampling Method: Roc	c Coring	Borehole Diameter (in): 5						
Total Depth (ft): <b>118</b> Date I	rilling Started: 2 September 2005	Date Drilling Ended: 7 September 2005						
Remarks:	Northean New York							
	Basalt - grayish black (N2). Rate = 5/30 mm. 60% recovery. no odor. PID sample fractured blue stone. Basalt - grayish black (N2). Rate = 5/20 5mm. 80% recovery. no odor. PID sample fractured blue stone. Basalt - grayish black (N2). Rate = 5/20 recovery. no odor. PID sample head sp stone. Basalt - dusky yellowish brown (10YR 3 vesicles: 1 mm. 60% recovery. no odor. Basalt - light brown (5YR 5/6). Rate = 5 recovery. no odor.	0, RQD = 10%, 5 - 10% vesicles: 2 mm - 3 e head space: 0 ppm, mechanically 6, RQD = 0%, 5 - 10% vesicles: 1 mm - ble head space: 0 ppm, mechanically 6, RQD = 0%, 1% vesicles: 2 mm, 80% bace: 0 ppm, mechanically fractured blue 8/2), Rate = 5/25, RQD = 0%, 30% 5/25, RQD = 0%, 30% vesicles: 1 mm, 60%						
85 - Pellets	Inecovery, no odor.         Basalt - grayish black (N2), Rate = 5/25, RQD = 0%, 3 - 5% vesicles: 1 mm - 2 mm, 60% recovery, no odor.         Basalt - medium dark gray (N4), Rate = 5/25, RQD = 33%, 60% vesicles: 1 mm, 67% recovery, no odor.         Basalt - grayish black (N2), Rate = 5/19, RQD = 45%, 75% vesicles: 1 mm, 87% recovery.         Basalt - grayish black (N2), Rate = 5/19, RQD = 45%, 75% vesicles: 1 mm, 87% recovery.         Basalt - grayish black (N2), Rate = 5/19, RQD = 45%, 75% vesicles: 1 mm, 87% recovery.							
95 - <b>8 1 1 1 1 1 1 1 1 1 1</b>	Basalt - brownish gray (5YR 4/1), Rate 87% recovery, highly fractured softer ba Basalt - dark gray w/ some light brown = 8.3%, 50 - 60% vesicles: 1 mm - 10 m head space: 0 ppm. Basalt - dark gray (N3), Rate = 5/20, R mm, 35% recovery, poor recovery, pose approx. 6.	= 5/ 19, RQD = 45%, 80% vesicles: 1 mm, asalt. clay (N3 w/ 5YR 5/ 6), Rate = 5/ 40, RQD m, 68% recovery, no odor, PID sample QD = 15%, 40 - 60% vesicles: 1 mm - 10 sible void - noted quick drop while drilling						



Location: RHFSF	Stat	tion Name: RHMW03	Loca	ation	Type: Monitoring	j Well			
Location Description: lower a	cess tu	innel, N of Tank 14	Establishi	ng C	Company: TEC Inc.				
Drilling Foreman: Tim Rober	tson	_	Drilling Co	mpa	any: Valley Well D	rilling			
Geologist: N. Griffin/S. MacMillan Ground Surface Elevation (ft): 122.11 Datum:									
Drilling Sampling Method: Rock Coring Borehole Diameter (in): 5									
Total Depth (ft): <b>118</b> Date	Drilling	Started: 2 Septem	ber 2005		Date Drilling Endec	: 7 September 2005			
Remarks:									
		Basalt - dark gray (N3), 85% recovery, no odor, Basalt - dark gray (N3), med. grained sand piec Basalt - dark gray (N3), recovery, poor recover	Rate = 5/20 PID sample Rate = 5/20 es. Rate = 5/13	, RG	ND = 28%, 40 - 50% vesi d space: 0 ppm. recovery, one small piec ND = 0%, 40% vesicles:	cles: 1 mm - 8 mm. ce of basalt, some 1 mm - 5 mm, 10%			

Location: Red Hill BFSF		Station ID:			Station Name:			RHMW03		Date: 9/2/200		005		
Sys_Samp_Code:			Elevation:			TD:		11	118.0'		Timo	Start:		
Driller:		Tim	า	CO.:	VW	/WD		Date Finished:		9/7/2005		TIME	Finish:	
Drilling Protocol														
Hole Dia	Hole Diameter:		5"		Drilling Method:		Coring		n:	90°		Azimuth:		/a
	Casing													
Materia	Material:		ch 80	Diamotor	ID:	1.939"		From: 0'						
				Diameter	OD:	2.375"		То:		102.3'				
						S	Scre	en						
Materia	d:	PVC So	ch 80	Diamotor	ID:	1.939"		From:		102.3'		Slot #:	0.0	2
				Diameter	OD:	2.375"		То:		117.3'				
	Annular Fill													
Sand	Mor	nterey #	З Туре	Bontonito	Chips:	8		Bags	Grout:	0.5	Bags			
Saliu.		2	Bags	Demonite	Pellets:	1.5	5	Bkts	Cement:	9	Bags	I		





Location: R	HFSF		Stat	tion Name: RHMW04	۱	Location Type: Monitoring Well				
Location Descrip	otion: wes	t. access	s rd., S	of Navy Firing Range	Esta	blishing	Company: TEC Inc			
Drilling Foremar	: Tomas	s Ferna	ndez		Drilli	ng Corr	npany: Valley Well D	rilling		
Geologist: N.	Griffin/S	. MacM	lillan	Ground Surface Ele	vation	(ft): <b>3</b> *	13.03	Datum: <b>M</b>	SL	
Drilling Sampling	g Method:	Roc	k Cor	ing			Borehole Diameter (in	): <b>8</b>		
Total Depth (ft):	320.5	Date D	rilling	Started: 22 July 20	005		Date Drilling Ende	d: 26 July 20	05	
Remarks:										
Well Construction Well Fill USCS					Soil Sample					
	Cement Grout	GW IE NSNR		Well-graded gravel with moist, 80% gravel, 15% Basalt bedrock. Basalt - moderate brow Basalt - dark gray (blue Basalt - dark gray (N3), Basalt - dark gray (N3), Rate = 5/18, no recove Basalt - dark gray (N3), encountered - to appro Basalt - dark gray (N3), encountered - to appro Basalt - dark gray (N3), Basalt - dark gray (N3), Basalt - dark gray (N3), Basalt - dark gray (N3), Basalt - dark gray (N3),	n sand fines, rock) i Rate = Rate = Rate = Rate = Rate = ery. n to da Rate = ery. n to da Rate = covn to ray to c	- dark re 5% fines (N3). Ra = 5/10, 7 = 5/7, m = 5/10, v = 5	ddish brown (5YR 2.5/2), , road base. ate = 5/5, 50 - 80% vesic te = 5/10, massive, 5% sr 70 - 90% vesicles:small. assive. 70 - 90% vesicles. 70 - 90% vesicles. resicles. resicles. (5YR 3/4 to N3), Rate = 5 resicles with min. deposits massive. ay (10YR 3/4 to N3), Rate (N4 to N3), Rate = 5/15 ay (10YR 3/4 to N3), Rate	medium stiff, les. nall crystals.	RHMW04S02	
140 HAR	-		V V V V V V V V V V V V V V V	Basalt - dark reddish br Basalt - dark gray (N3),	own (1 Rate =	0YR 3/4 = 5/12. v	l), Rate = 5/10, vesicles.		-	
물 물	1		V.V.V	÷ , , ,					r	



Location: RH	IFSF	Station Name: RHN	IW04 Loca	tion Type: Monitorin	g Well						
Location Descrip	tion: west. access	s rd., S of Navy Firing Ra	nge Establishi	ng Company: TEC Inc							
Drilling Foreman	Tomas Ferna	andez	Drilling Co	mpany: Valley Well I	Drilling						
Geologist: N. C	Griffin/S. MacM	lillan Ground Surfac	e Elevation (ft):	313.03	Datum: <b>MSL</b>						
Drilling Sampling	Method: Rocl	k Coring		Borehole Diameter (ir	n): <b>8</b>						
Total Depth (ft):	320.5 Date D	orilling Started: 22 Ju	uly 2005	Date Drilling Ende	ed: 26 July 2005						
Remarks:											
		Basalt - dark gra	y (N3). Rate = 5/ 5.	vesicles.							
	IE	Basalt - dark gra	y (N3). Rate = 5/15	vesicles.							
	Bentonite NSNR	Basalt - dark gra	y (N3), Rate = 5/ 30	vesicles.							
		Rate = 5/14. No	recovery.								
200 -	IE	Basalt - dark gra	y (N3), Rate = 5/10	, vesicles.							
		Basalt - dark gra	y (N3). Rate = 5/13	, vesicles.							
220 -	NSNR	Rate = 5/10, No	recovery.								
		Rate = 5/15. No	recovery.								
240 -	IE	Rate = 5/12, No	recovery.								
		Basalt - dark gra	y (N3), Rate = 5/ 12	vesicles.							
260 -		Basalt - medium	dark gray (N4). Rate	e = 5/10, vesicles.							
	Pellets	Basalt - medium	dark gray (N4). Rate	e = 5/10, vesicles.							
280 -	sand	Basalt - medium	dark gray (N4), Rate	e = 5/10, vesicles.							
		Basalt - dark gra	y (N3). Rate = 5/ 10	vesicles.							
300 -		Basalt - dark gra	y (N3), Rate = 5/10	vesicles.							
		Basalt - dark gra 311'.	y to blackish red (N	3 to 5R 2/2), Rate = 5/8, v	vesicles, water at						
320											

Location: Red Hill BFSF		Station ID:			Station Name:			RHMW04		Date: 7/22/200		22/2005		
Sys_Samp_Code:			Elevation:			TD:		320	320.5'		Timo	Start:		
Driller:		Tomas		CO.:	VW	D	Date Finished:		l: .	7/26/2005		Time	Finish:	
Drilling Protocol														
Hole Diameter:		8"		Drilling Method:		Air Rotary		Inclinatio	n:	<b>90</b> °		Azimuth:		n/a
	Casing													
Materia	I: PC	V Sch	80	Diamator	ID:	3.826"		From:	om: 0'					
				Diameter	OD:	4.5"	To:			290'				
						S	Scre	en						
Materia	I: PC	V Sch	80	Diamotor	ID:	3.826"		From:		290'		Slot #:		0.02
				Diameter	OD:	4.5"		То:		305'				
	Annular Fill													
Sandi	Monte	rey #3	Туре	Pontonito	Chips:	16	5	Bags	Grout:	2	Bags			
Sand:	6	3	Bags	Demonite	Pellets:	6		Bkts	Cement:	40	Bags			



	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								
	fier:	RHMW05 Drilling Technique: Air Rotary					tary Coring				
	Start Date:	lici.	April 10, 2009			Bit Type/Size:	Diamond Co	and Core // 8-inches diam			
	Start Date.		April 10, 200	9		Bit Type/Size.	Diamond Core /4.8-inches diam				
	End Date:	_	April 24, 2009	9		Filter Pack:	1 mm,	1 mm,			
	Completion	n Type:	Flush Mounted			silica sand					
	Riser Mater	rial:	2-inch, Scheo	dule 80 PVC, flus	sh threaded	Annular Seal:	Bentonite C	Bentonite Chips/Pellets			
Screen Material:			2-inch, Scheo	dule 80 PVC, 0.0	2 slot size	Groun	dwater Eleva	tion			
	Screened I	nterval:	78 ft to 93 ft b	78 ft to 93 ft below ground surface Range between 7/14/2009							
Coord	inates (m):		Northing	Northing Easting Elevation							
NAD 83. HI State P	lane. Zone 3	. FIPS 5103	22,461	o of ca	isina						
,	, ,	,	,	,					0		
NAD 83, HI State P         RHMW5 Well Constr         0         2         4         6         8         10         PVC         0	ruction (m)		Concrete. Vesicular Ba Vesicular Ba dor. High Vesicular Ba dor. Smai Vesicular Ba dor. Smai Vesicular Ba dor. Smai Vesicular Ba Vesicular Ba Vesicular Ba Vesicular Ba Vesicular Ba Vesicular Ba Vesicular Ba Vesicular Ba	asalt, medium grey asalt, medium grey asalt, reddish brown, rk reddish brown, rk red-brown asalt, medium grey o dor. asalt, dark grey, asalt, dark grey, asalt, dark grey, asalt, dark grey, asalt, dark grey, asalt, dark grey, ll rubble zone at 2 asalt, dark grey, rk red brown, asalt, dark grey, ll rubble zone at 2 asalt, dark grey, rk red brown, asalt, dark reddish asalt, dark reddish brown, asalt, dark reddish asalt, dark reddish asalt, medium grey	Lithology y, large ves wn, vesicul vesicular - y, large ves fine vesicles the vesicles the vesicles abundant vesicles abundant fin abundant fin 9 ft. abundant ve abundant ve abundant vesicul brown, ab y, abundant ve	icles and vugs - <10%, apha ar - 50% - ~1 mm, aphanitic, no icles and vugs - <10% - 2 to 4 ; aphanitic, no odor. sicles, aphanitic, no odor. ; evesicles - 1-2 mm, aphani e vesicles - 40% - 1-2 mm, a sicles - 50%, aphanitic, no odor. undant vesicles - 50%, aphanitic, no 20 50%, aphanitic, no odor.	Initic, no odor. no odor. odor. color i mm, is more i, aphanitic, phanitic, no dor. Color inphanitic, no dor. Color anitic, no odor.	0 ⁻	RQD (m)		
			Vesicular Ba Vesicular Ba Water stainin Vesicular Ba Clinkers, red No recovery Clinkers, dar Vesicular Ba staining in fr Clinkers, red	asalt, dark grey, asalt, dark grey, ng in fractures. asalt, dark grey, abundant vesi no odor. k reddish brown, asalt, dark grey, actures. actures. actures.	large vesicle large vesicle abundant ve icles, aphan abundant v vesicles - 15 icles, aphan	Is - 30-50%, aphanitic, no oc is - 10% - 2-5 mm, aphanitic, sicles - 40% - 1-2 mm, apha itic, no odor. Vesicles - 30%, aphanitic, no oc itic, no odor.	or. no odor. nitic, no odor. odor. dor. Water		$\leq$		
22 24 26 28			Clinkers, dar Some clinker Vesicular Ba odor. Wate Vesicular Ba odor.	lavas mixed with asalt, medium grey er at about 83.7 fe r fragments up to asalt, dark reddish asalt, dark grey,	y, less vesi eet bgs - few moderate a 0.2 ft. 1 brown, ve moderate an	cles than previous - 1-4 mm, er fractures - some vesicles a mount of vesicles, aphanitic sicles - 30% - up to 8 mm, a nount of vesicles - 2-5 mm, a	aphanitic, no stretched. , no odor. phanitic, no phanitic, no	-			
30			Vesicular Basalt, dark reddish brown, fine vesicles - 30% - 1 mm, aphanitic, no odor. Vesicular Basalt, medium grey, large vesicles - 3-8 mm, aphanitic, no odor. Iron staining in fractures.								

TEC Representative : Robert Whittier, P.G.

Driller: Tomas Fernandez; Valley Well Drilling, Inc.