

# Quarterly Groundwater Monitoring Report

Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam,  
O'ahu, Hawai'i

Latitude: 21°22'15"N

Longitude: 157°53'33"W

DOH Facility ID No. 9-102271

DOH Release ID No. 99051, 010011, 020028

December 2011

Department of the Navy  
Naval Facilities Engineering Command, Hawai'i  
400 Marshall Road  
JBPHH HI 96860-3139



Environmental Technical Services  
Contract Number N62742-08-D-1930, CTO HC21



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Prepared for:



Department of the Navy  
Naval Facilities Engineering Command, Hawai'i  
400 Marshall Road  
JBPHH HI 96860-3139

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## *List of Acronyms*

<	less than
%	percent
µg/L	micrograms per liter
COPC	chemical of potential concern
DL	detection limit or method detection limit (MDL)
DLNR	Department of Land and Natural Resources
DOH	State of Hawai'i Department of Health
DON	Department of the Navy
DRO	diesel range organics
DTW (TOC)	depth to water from top of well casing
EAL	Environmental Action Level
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
F-76	marine diesel fuel
FLC	Fleet Logistics Center
GRO	gasoline range organics
HAR	Hawai'i Administrative Rules
IDW	investigation-derived waste
J	Estimated result. Indicates that the compound was identified but the concentration was above the DL and below the LOQ.
JBPHH	Joint Base Pearl Harbor-Hickam
JP	Jet Propellant
LCS	laboratory control sample
LNAPL	light non-aqueous phase liquid
LOD	limit of detection
LOQ	limit of quantitation or reporting limit (RL)
MADEP	Massachusetts Department of Environmental Protection
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
ND	not detected
NAVFAC	Naval Facilities Engineering Command
NAVSUP	United States Naval Supply Systems Command
NP	measurement not provided
NT	measurement not taken
PAHs	polynuclear aromatic hydrocarbons
pH	hydrogen activity
PHWS	Pearl Harbor Water System
PPE	personal protective equipment
Q	data qualifier
QC	quality control
RHSF	Red Hill Bulk Fuel Storage Facility
RPD	relative percent difference
SSRBL	site-specific risk-based level
SWL	static water level

TEC	The Environmental Company, Inc.
TIC	tentatively identified compound
TPH	total petroleum hydrocarbons
U	Indicates the compound or analyte was analyzed for but not detected. The result is reported as ND.
U.S.	United States
USGS	United States Geological Survey
UST	underground storage tank
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon



## *Executive Summary*

This report documents the results of the quarterly groundwater monitoring performed in October-November 2011 at the Red Hill Bulk Fuel Storage Facility (RHSF). There are 18 active, and two inactive 12.5 million gallon capacity, field-constructed underground storage tanks (USTs) located at the RHSF. Previous environmental site investigations indicated a release had occurred and contaminated the groundwater underlying the RHSF.

The United States (U.S.) Navy implemented a groundwater monitoring program, which includes collecting groundwater samples quarterly from U.S. Navy Well 2254-01 (RHMW2254-01) and four groundwater monitoring wells (RHMW01, RHMW02, RHMW03, and RHMW05) installed within the RHSF lower access tunnel. The U.S. Navy Well 2254-01 is located approximately 3,000 feet downgradient from the RHSF and provides approximately 24 percent (%) of the potable water to the Pearl Harbor Water System (PHWS). The groundwater samples were analyzed for petroleum constituents and compared against State of Hawai'i Department of Health (DOH) Drinking Water Environmental Action Levels (EALs) for human toxicity (DOH, 2009).

This report presents the analytical results and compares them to the DOH Drinking Water EALs for samples collected on October 24, 25, and November 2, 2011 at the five groundwater monitoring wells (RHMW2254-01, RHMW01, RHMW02, RHMW03, and RHMW05). Contaminant trends that have exceeded DOH Drinking Water EALs are also provided in this report.

### October-November 2011 Groundwater Monitoring Results

Laboratory analytical results indicated that total petroleum hydrocarbons (TPHs)-diesel range organics (DRO) were present in the groundwater beneath the RHSF (monitoring wells RHMW01 and RHMW02) at or above the DOH Drinking Water EAL. All other chemical of potential concern (COPC) concentrations (i.e., TPH-Gasoline Range Organics (GRO), volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), and dissolved lead) were below the EALs.

In monitoring well RHMW2254-01, all COPCs were not detected at or above the limits of detection (LODs) and limits of quantitation (LOQs).

In monitoring well RHMW01, TPH-DRO (210 micrograms per liter [ $\mu\text{g/L}$ ]) was detected at a concentration equal to the DOH Drinking Water EAL and exceeded the DOH Gross Contamination groundwater EAL. Chloroform (0.13  $\mu\text{g/L}$ ) was detected at estimated concentrations below the DOH Drinking Water EAL. All other COPCs in monitoring well RHMW01 were not detected at or above the LODs and LOQs.

In monitoring well RHMW02, TPH-DRO (750  $\mu\text{g/L}$ ) was detected at a concentration which exceeded the DOH Drinking Water and Gross Contamination groundwater EALs. Naphthalene (0.80  $\mu\text{g/L}$ ) and 1-methylnaphthalene (0.53  $\mu\text{g/L}$ ) were detected at concentrations below the DOH Drinking Water EALs. Acenaphthene (0.17  $\mu\text{g/L}$ ), fluorene (0.082  $\mu\text{g/L}$ ), and 2-methylnaphthalene (0.15  $\mu\text{g/L}$ ) were detected at estimated concentrations below the DOH

Drinking Water EALs. All other COPCs in monitoring well RHMW02 were not detected at or above the LODs and LOQs.

In monitoring well RHMW03, dissolved lead (0.22 µg/L) was detected at an estimated concentration below the DOH Drinking Water EAL. All other COPCs in monitoring well RHMW03 were not detected at or above the LODs and LOQs.

In monitoring well RHMW05, all COPCs were not detected at or above the LODs and LOQs.

All laboratory detection limits (DLs), LODs, and LOQs were generally below the EALs. In the case where an EAL for a specific COPC is less than the LOQ, it is generally acceptable to consider the LOQ in place of the EAL (DOH, 2009).

Collective concentrations of aliphatic and aromatic hydrocarbons were analyzed this monitoring event utilizing Massachusetts Department of Environmental Protection (MADEP) extractable petroleum hydrocarbon (EPH) and volatile petroleum hydrocarbon (VPH) methods to more accurately determine if the TPH-DRO detected is petroleum based or non-petroleum based (DOH, 2010, Appendix A). The subsequent three consecutive quarterly monitoring events will not include MADEP EPH and VPH analyses.

MADEP EPH analytical results for TPH-DRO typically have the majority of the hydrocarbons in the C<sub>10</sub> to C<sub>20</sub> range. In monitoring well RHMW01, C<sub>11</sub>-C<sub>22</sub> aromatic hydrocarbons, C<sub>9</sub>-C<sub>10</sub> aromatic hydrocarbons, and C<sub>9</sub>-C<sub>12</sub> aliphatic hydrocarbons were detected at concentrations of 50.5 µg/L, 20.6 µg/L, and 69.9 µg/L, respectively. These analytical results are within carbon range C<sub>9</sub>-C<sub>18</sub> which indicates that the detected hydrocarbons are likely petroleum based. In monitoring well RHMW02, C<sub>11</sub>-C<sub>22</sub> aromatic hydrocarbons, C<sub>9</sub>-C<sub>10</sub> aromatic hydrocarbons, and C<sub>9</sub>-C<sub>12</sub> aliphatic hydrocarbons were detected at concentrations of 166 µg/L, 200 µg/L, and 671 µg/L, respectively. Aliphatic hydrocarbons (C<sub>9</sub>-C<sub>18</sub>) were detected at an estimated concentration of 28.0 µg/L. These analytical results are within carbon range C<sub>9</sub>-C<sub>22</sub> which indicates that the detected hydrocarbons are likely petroleum based.

In monitoring well RHMW03, C<sub>9</sub>-C<sub>18</sub> aliphatic hydrocarbons were detected at an estimated concentration of 26 µg/L. This analytical result indicates that the detected hydrocarbons are likely petroleum based.

In monitoring well RHMW05, all aliphatic and aromatic hydrocarbons were not detected at or above the LODs and LOQs.

#### TPH-DRO Contaminant Trends

TPH-DRO concentrations at RHMW01 have fluctuated at or above the DOH Drinking Water EAL except in October-November 2010 and January 2011 when TPH-DRO was not detected at or above the LODs and LOQs (Appendix B).

At RHMW02, TPH-DRO concentrations have been consistently well above the DOH Drinking Water EAL and exceeded the site-specific-risk-based level (SSRBL) twice: in December 2008 and April 2010 (Appendix B).

At RHMW03, TPH-DRO concentrations have fluctuated above and below the DOH Drinking Water EAL. From May 2009 through July 2010, TPH-DRO concentrations at RHMW03 were not detected above the LODs and LOQs. However, in October-November 2010, TPH-DRO was detected at the highest concentration (330 µg/L). TPH-DRO was not detected at or above the LODs and LOQs in the past four consecutive quarterly groundwater monitoring events.

At RHMW05, TPH-DRO concentrations increased from the first sampling event in May 2009 to January 2010 and were all above the DOH Drinking Water EAL. However, in the past seven consecutive quarterly groundwater monitoring events, TPH-DRO has not been detected above the DOH Drinking Water EAL or at or above the LODs and LOQs.

### TPH-GRO Contaminant Trends

TPH-GRO has remained below the DOH Drinking Water EAL or has not been detected in monitoring wells RHMW01, RHMW03, and RHMW05. TPH-GRO concentrations at RHMW02 have fluctuated above and below the EAL. In January 2011, TPH-GRO at RHMW02 was detected at an estimated concentration of 17 µg/L, which was below the EAL. TPH-GRO concentrations increased slightly in April 2011 to a detected concentration of 24 µg/L which is below the EAL. TPH-GRO was not detected above the LODs and LOQs in July 2011 and during this October-November 2011 event.

### PAHs Contaminant Trend at RHMW02

Since October 2008, the concentrations of 2-methylnaphthalene have remained below the EAL. Concentrations of 1-methylnaphthalene decreased below the EAL in October 2009; however concentrations have exhibited an increasing trend above the EAL during six subsequent quarterly groundwater monitoring events. Concentrations of 1-methylnaphthalene again decreased below the EAL in July 2011 and during the October-November 2011 groundwater monitoring event. Naphthalene concentrations decreased to below the EAL in May 2009 and July 2009, increased above the EAL in October 2009, and remained above the EAL in January 2011. Naphthalene concentrations decreased to below the EAL again in April 2011, July 2011, and during this October-November 2011 groundwater monitoring event.

### Conclusions

To date, the presence of light non-aqueous phase liquid (LNAPL) has been observed only once (i.e., in January 2008 in RHMW01 and RHMW02 with a thickness of less than 0.01 feet). This indicates that a significant release from one or more of the USTs at the RHSF has not occurred at this time.

COPC concentrations in samples collected from the U.S. Navy Well 2254-01 (RHMW2254-01) have not been increasing or detected at or above the EALs. This indicates that elevated COPC concentrations detected in samples collected from other monitoring wells within the RHSF are not migrating and impacting the Navy's potable water source.

COPC concentrations detected in samples collected from monitoring well RHMW05 have decreased to below the EALs for the past seven consecutive quarterly monitoring events. The data suggest that elevated COPC concentrations detected in samples collected from monitoring wells located adjacent to the USTs are not migrating in the downgradient direction. RHMW05 is

an intermediate monitoring point between the USTs and the U.S. Navy Well 2254-01. At this time, there is no indication that COPCs are migrating in a downgradient direction towards the Navy's potable water source.

COPC concentrations detected in samples collected from two monitoring wells adjacent to the USTs (i.e., RHMW01 and RHMW03) are not increasing between consecutive sampling events. Concentrations of 1-methylnaphthalene in RHMW02 increased for three consecutive events, but then decreased in the subsequent three groundwater monitoring events. The fluctuations in concentration measured during this event and previous events indicate the source of 1-methylnaphthalene is very likely residual contamination from a historical release at the RHSF. The general overall long-term trend in 1-methylnaphthalene concentration is decreasing and does not indicate a new release at the site.

The majority of the aliphatic and aromatic hydrocarbons detected were within the C<sub>10</sub>-C<sub>20</sub> range. This indicates that the detected TPH-DRO is likely petroleum based.

### Recommendations

Based on the results of this monitoring event, continuation of the quarterly groundwater monitoring program at the RHSF is recommended. In addition continuation of monthly free product measurements at RHMW01, RHMW02, RHMW03, and RHMW05; and monthly soil vapor monitoring are also recommended. In response to the Category 1 status of RHMW01 and RHMW03, and the Category 2 status of RHMW02, submission of this quarterly report to DOH and continuation of a leak determination program as described in Section 3 of the RHSF Groundwater Protection Plan (The Environmental Company Inc. (TEC), 2008) to identify if tanks are leaking are recommended.

## ***Section 1 Introduction***

This report presents the results of the 25<sup>th</sup> groundwater monitoring event conducted in October-November 2011 at the RHSF, Joint Base Pearl Harbor-Hickam (JBPHH), O'ahu, Hawai'i (Figure 1-1). The RHSF consists of 18 active and two inactive USTs operated by the United States Naval Supply Systems Command (NAVSUP) Fleet Logistics Center (FLC) Pearl Harbor. The groundwater sampling and analysis event is part of a groundwater monitoring program for the UST site in response to past UST releases, previous environmental investigations, and recommendations from the DOH. The groundwater monitoring was performed by Environet for the Department of the Navy (DON), Naval Facilities Engineering Command (NAVFAC), Hawai'i under Environmental Technical Services, Contract Number N62742-08-D-1930, Contract Task Order HC21.

The field activities performed for the October-November 2011 quarterly groundwater monitoring event were conducted in accordance with the procedures described in the *Work Plan, Long-Term Monitoring, Red Hill Bulk Fuel Storage Facility, Pearl Harbor, O'ahu, Hawai'i* (Environet, 2010).

### ***1.1 Project Objective***

The groundwater monitoring was performed to evaluate the presence of COPCs in groundwater underlying the RHSF. The groundwater monitoring was conducted to ensure the DON remains in compliance with DOH UST release response requirements as described in Hawai'i Administrative Rules (HAR) 11-281 Subchapter 7, Release Response Action. Analytical results are compared to the DOH Drinking Water EALs for human toxicity for samples collected from five groundwater monitoring wells (RHMW2254-01, RHMW01, RHMW02, RHMW03, and RHMW05).

### ***1.2 Background***

The U.S. Navy implemented a groundwater monitoring program, which includes collecting groundwater samples quarterly from U.S. Navy Well 2254-01 (RHMW2254-01) and four groundwater monitoring wells (RHMW01, RHMW02, RHMW03, and RHMW05) installed within the RHSF lower access tunnel. The U.S. Navy Well 2254-01 is located approximately 3,000 feet downgradient from the RHSF and provides approximately 24% of the potable water to the PHWS. The groundwater samples are analyzed for petroleum constituents and compared against DOH Drinking Water EALs (DOH, 2009).

#### ***1.2.1 Site Description***

The RHSF is located on the island of O'ahu, Hawai'i, approximately 2.5 miles northeast of Pearl Harbor in Hālawā Heights (Figure 1-1). Land adjacent to the north of the RHSF is occupied by the Hālawā Correctional Facility and private businesses. Land to the south and west of the facility includes the Coast Guard Reservation and other residential neighborhoods. Moanalua Valley is located east of the facility (Environet, 2010).

The Navy Public Works Department operates a potable water infiltration tunnel approximately 1,550 feet hydraulically downgradient from the RHSF (Environet, 2010). The U.S. Navy Well 2254-01 is located approximately 3,000 feet downgradient (west) of the RHSF and provides approximately 24% of the potable water to the PHWS, which serves approximately 52,200 military consumers (TEC, 2008).

### ***1.2.2 Facility Information***

The RHSF consists of 18 active and two inactive USTs operated by NAVSUP FLC Pearl Harbor. Each UST has a capacity of 12.5 million gallons. The RHSF is located approximately 100 feet above the basal aquifer (Dawson Group, Inc., 2006).

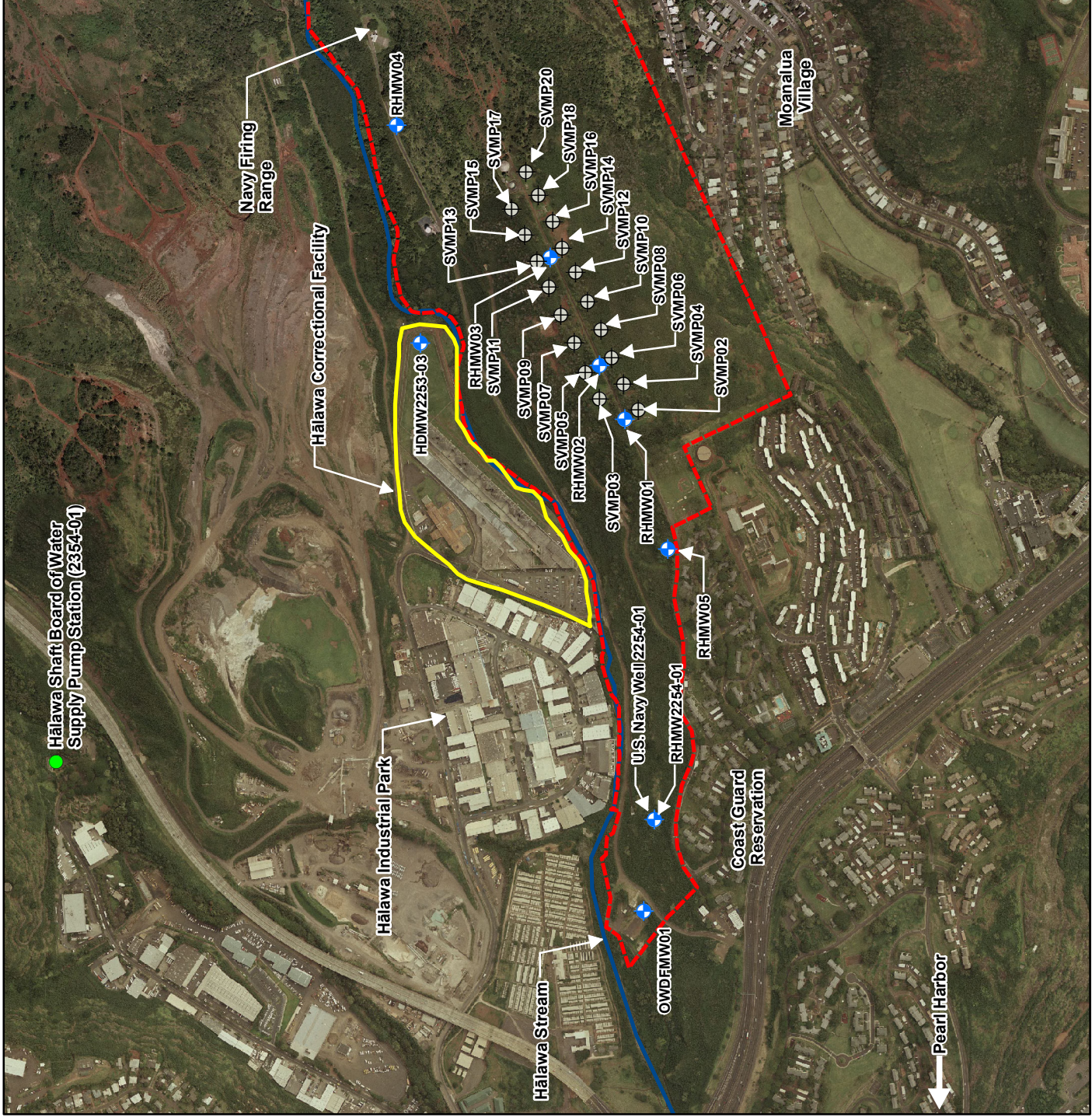
### ***1.2.3 UST Information***

The USTs were constructed in the early 1940s. The tanks were constructed of steel and currently contain Jet Propellant (JP)-5 fuel, JP-8, and marine diesel fuel (F-76). Previously, several tanks stored Navy Special Fuel Oil, Navy Distillate, aviation gasoline, and motor gasoline. Each tank measures approximately 245 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).

### ***1.2.4 Previous Reports***

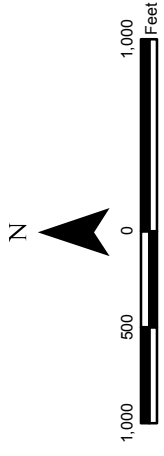
The following groundwater monitoring reports were previously submitted to the DOH:

1. Groundwater Sampling Report, First Quarter 2005 (submitted April 2005);
2. Groundwater Sampling Report, Second Quarter 2005 (submitted August 2005);
3. Groundwater Sampling Report, Third Quarter 2005 (submitted November 2005);
4. Groundwater Sampling Report, Fourth Quarter 2005 (submitted February 2006);
5. Groundwater Monitoring Results, July 2006 (submitted September 2006);
6. Groundwater Monitoring Results, December 2006 (submitted January 2007);
7. Groundwater Monitoring Results, March 2007 (submitted May 2007);
8. Groundwater Monitoring Results, June 2007 (submitted August 2007);
9. Groundwater Monitoring Results, September 2007 (submitted October 2007);
10. Groundwater Monitoring Results, January 2008 (submitted March 2008);
11. Groundwater Monitoring Results, April 2008 (submitted May 2008);
12. Groundwater Monitoring Results, July 2008 (submitted October 2008);
13. Groundwater Monitoring Results, October and December 2008 (submitted February 2009);
14. Groundwater Monitoring Results, February 2009 (submitted May 2009);



LEGEND	
	Soil Vapor Monitoring Points
	Groundwater Monitoring Wells
	Board of Water Supply Pump Station
	Halawa Correctional Facility
	Red Hill Naval Reservation
	Halawa Stream

SOURCE	
USGS, 2005	



**Figure 1-1**  
**Groundwater Monitoring Well**  
**Location Map**  
 Quarterly Groundwater  
 Monitoring Report,  
 Red Hill Bulk Fuel Storage Facility,  
 JBPHH, O'ahu, Hawaii'

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15. Groundwater Monitoring Results, May 2009 (submitted July 2009);
16. Groundwater Monitoring Results, July 2009 (submitted September 2009);
17. Groundwater Monitoring Results, October 2009 (submitted December 2009);
18. Groundwater Monitoring Results, January, February, and March 2010 (submitted April 2010);
19. Groundwater Monitoring Results, April 2010 (submitted May 2010);
20. Groundwater Monitoring Results, July 2010 (submitted August 2010);
21. Groundwater Monitoring Results, October 2010 (submitted December 2010);
22. Groundwater Monitoring Results, January 2011 (submitted March 2011);
23. Groundwater Monitoring Results, April 2011 (submitted June 2011); and
24. Groundwater Monitoring Results, July 2011 (submitted September 2011).

### ***1.2.5 Previous Environmental Investigations***

**1998 to 2001** - From 1998 to 2001, the Navy conducted an investigation at the RHSF to assess potential releases from the fuel USTs and piping systems. In February 2001, the Navy installed a one-inch diameter monitoring well RHMW01 (previously known as MW-V1D) to monitor for contamination of the basal aquifer underlying the RHSF. The well was installed and completed at approximately 100 feet below grade within the lower access tunnel. At the time of well completion, depth to water in RHMW01 was measured at 86 feet below grade (Dawson group, Inc., 2006).

In February 2001, groundwater samples collected from RHMW01 contained TPH concentrations ranging from 883 µg/L to 1,050 µg/L and total lead ranging from 10.4 µg/L to 15 µg/L. The total lead concentrations exceeded the DOH Tier 1 Action Level of 5.6 µg/L for dissolved lead (Dawson Group, Inc., 2006).

**2005 Groundwater Sampling** - The Navy began quarterly groundwater sampling at existing monitoring wells in 2005. Dawson Group, Inc. collected groundwater samples from RHMW01 and RHMW2254-01 in February 2005, June 2005, September 2005, and December 2005.

Samples collected in February 2005 and June 2005 were not filtered in the field prior to analysis for lead. Analytical results for samples collected from RHMW01 indicated concentrations of total lead were above the DOH Tier 1 Action Level of 5.6 µg/L. The results were not considered appropriate for risk assessment since the sample had not been filtered. In addition, lead was not a component of fuels from the tanks near RHMW01, but was a component in fuels stored in other tanks during the history of the RHSF. Lead may have been part of the RHSF construction material (TEC, 2007). Previous sampling efforts showed elevated lead concentrations when analyzed as unfiltered samples. Subsequent efforts where the lead samples were filtered had resolved this issue. Samples were filtered in September 2005 and December 2005, and dissolved lead concentrations were below the DOH Tier 1 Action Level. Concentrations of all other COPCs were below the DOH Tier 1 Action Levels.

**2005 Site Investigation** - As part of a site investigation, TEC installed three groundwater monitoring wells at the RHSF between June 2005 and September 2005. Monitoring well RHMW02 was installed in the lower access tunnel near Tank 05 and Tank 06. Monitoring well RHMW03 was installed in the lower access tunnel near Tank 13 and Tank 14. Monitoring well RHMW04 was installed north of the UST Tank 20 to evaluate groundwater within the basal aquifer upgradient from the RHSF. Monitoring 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. Groundwater samples were collected from the three newly installed wells and two existing wells (RHMW01 and RHMW2254-01) in September 2005 (TEC, 2010).

Naphthalene and trichloroethylene were detected in samples collected from RHMW02 at concentrations greater than the DOH Tier 1 Action Levels. Lead was detected in the sample collected from RHMW01 at a concentration greater than the DOH Tier 1 Action Level; however, the sample was not filtered in the field prior to analysis. Analytical results for filtered samples obtained by Dawson Group, Inc. during the same period indicated concentrations of dissolved lead were below the DOH Tier 1 Action Level (TEC, 2010).

**2006 Site Investigation** - Dedicated sampling pumps were installed in five monitoring wells (RHMW01, RHMW02, RHMW03, RHMW04, and RHMW2254-01). TEC collected groundwater samples from the monitoring wells in July 2006. The groundwater samples were analyzed for petroleum constituents. Naphthalene was detected in samples collected from RHMW02 at concentrations above the DOH Tier 1 Action Level (TEC, 2010).

In September 2006, with concurrence from the DOH, the Navy decided to use the newer DOH EALs for the Red Hill Site Investigation and Risk Assessment project. The EALs provide action levels for more chemicals, and are much more useful for conducting screening risk assessments. Since the DOH (DOH May 2005) Policy Letter stated that the two sets of action levels should not be mixed, the Tier 1 screening levels presented in HAR Section 11-281-78 would no longer be used to evaluate environmental impact at the RHSF (TEC, 2010).

**2006 Groundwater Sampling** - Groundwater samples were collected in December 2006. Analytical results indicated the following:

- no COPCs were detected in samples collected from RHMW2254-01 or RHMW03;
- TPH-DRO concentrations were detected in samples collected from RHMW01 at concentrations above the EAL; and
- TPH-GRO, TPH-DRO, and naphthalene were detected in samples collected from RHMW02 at concentrations above the EALs (TEC, 2010).

**2007 Groundwater Sampling** - Groundwater samples were collected in March, June, and September 2007. Analytical results indicated the following:

- no COPCs were detected above the EALs at RHMW2254-01;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW01 during all three monitoring events;

- TPH-GRO concentrations exceeded the EAL in samples collected from RHMW02 in March 2007;
- TPH-DRO and naphthalene concentrations exceeded the EALs in samples collected from RHMW02 during all three monitoring events;
- 1-methylnaphthalene and 2-methylnaphthalene concentrations exceeded the DOH Groundwater Gross Contamination EALs in samples collected from RHMW02 during all three monitoring events; and
- TPH-DRO concentrations exceeded the EAL in the sample collected from RHMW03 in June 2007.

**2008 Groundwater Sampling** - Groundwater samples were collected in January, April, July, and October 2008. Analytical results indicated the following:

- no COPCs were detected above the EALs at RHMW2254-01;
- trace detections of 1-methylnaphthalene and naphthalene prompted a resample event in December 2008 at RHMW2254-01, no chemicals were detected above the LODs;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW01 during all four monitoring events;
- TPH-GRO concentrations did not exceed the EAL in samples collected from RHMW02;
- TPH-DRO, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene concentrations exceeded the EALs in samples collected from RHMW02. Additionally, the site-specific risk-based level (SSRBL) of 4,500 µg/L for TPH-DRO was exceeded in the October 2008 monitoring event at RHMW02 (Appendix B); and
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW03 during all four monitoring events.

**2009 Groundwater Sampling and RHMW05 Installation** - Groundwater samples were collected in February, May, July, and October 2009. In April 2009, a new groundwater monitoring well, RHMW05, was installed by TEC. RHMW05 is located within the lower access tunnel between RHMW01 and RHMW2254-01 (located at the U.S. Navy Well 2254-01). It was installed to identify any contamination migrating past RHMW01 prior to it reaching the U.S. Navy Well 2254-01 (TEC, 2010). Analytical results indicated the following:

- no COPCs have been detected above the EALs at RHMW2254-01;
- TPH-GRO concentrations in samples collected from RHMW2254-01 were detected above the LOD and significantly below the LOQ and EAL in February and May 2009;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW01 during all four monitoring events;
- TPH-GRO concentrations did not exceed the EAL in samples collected from RHMW02;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW02 during all four monitoring events;

- naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene concentrations exceeded the EALs in samples collected from RHMW02 in February 2009, however only the 1-methylnaphthalene concentration exceeded the EAL in May 2009 and July 2009 and only the naphthalene concentration exceeded the EAL in October 2009;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW03 in February 2009, but not in May or July 2009; and
- TPH-DRO concentrations exceeded the EAL in the samples collected from RHMW05 during the May and July 2009 monitoring events.

**2010 Groundwater Sampling** - Groundwater samples were collected in January, April, July, and October-November 2010 (and TPH-DRO was re-sampled at RHMW02 in February 2010 and March 2010). Analytical results indicated the following:

- no COPCs have been detected above the EALs in samples collected from RHMW2254-01;
- lead was detected in samples collected from RHMW2254-01 at a concentration below the EAL in October-November 2010;
- naphthalene concentrations in the samples collected from RHMW2254-01 were detected below the LOQ and EAL in January and October-November 2010;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW01, except in October-November 2010 when they were not detected at or above the LOQ;
- lead was detected in samples collected from RHMW01 at a concentration below the EAL in October-November 2010;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW02 in January, February, March, April, July, and October-November 2010 however, significant increases in January and February 2010 were attributed to tentatively identified compounds (TICs) apparently not associated with petroleum from the RHSF (TEC, 2010);
- naphthalene and 1-methylnaphthalene concentrations exceeded the EALs in samples collected from RHMW02 in January, April, July, and October-November 2010;
- TPH-GRO concentrations exceeded the EAL in samples collected from RHMW02 in October-November 2010;
- TPH-DRO concentrations in samples collected from RHMW03 were not detected above the LOD in January, April, and July 2010. However, in October-November 2010 TPH-DRO was detected above the EAL; and
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW05 in January 2010; however, the significant increase was attributed to TICs apparently not associated with petroleum from the RHSF. TPH-DRO concentration was not detected at or above the LOD in October-November 2010.

**2011 Groundwater Sampling** - Groundwater samples were collected in January, April and July 2011. Analytical results indicated the following:

- no COPCs were detected at or above the LODs and LOQs in samples collected from RHMW2254-01 in January, April, and July 2011 except for dissolved lead detected at a concentration below the EAL in July 2011;
- no COPCs were detected at or above the LODs and LOQs in samples collected from RHMW01 in January 2011;
- TPH-DRO was detected at a concentration which exceeded the EAL in samples collected from RHMW01 in July 2011;
- TPH-DRO and 1-methylnaphthalene were detected at concentrations which exceeded the EALs in samples collected from RHMW02 in January and April 2011; and TPH-DRO was detected at a concentration which exceeded the EAL, and 1-methylnaphthalene was detected at concentration which were below the EAL in July 2011;
- naphthalene was detected at a concentration which exceeded the EAL in samples collected from RHMW02 in January 2011, however in April and July 2011 naphthalene was detected at a concentration below the EAL;
- acenaphthene and 2-methylnaphthalene were detected at concentrations below the EALs at RHMW02 in January and July 2011;
- TPH-GRO and 2-methylnaphthalene were detected at concentrations below the EALs at RHMW02 in April 2011, and 2-methylnaphthalene was detected at an estimated concentration below that EAL in July 2011;
- dissolved lead was detected at a concentration below the EAL at RHMW02 in July 2011;
- TPH-GRO, acenaphthylene, fluorene, and xylenes were detected at estimated concentrations below the EALs at RHMW02 in January 2011. Acenaphthene, acenaphthylene, fluorene, and xylenes were detected at estimated concentrations below the EALs in April 2011. Fluorene was detected at an estimated concentration below the EALs in July 2011. All other COPCs in RHMW02 were not detected at or above the LODs and LOQs in January and April 2011; and
- no COPCs were detected at or above the LODs and LOQs in samples collected from RHMW03 and RHMW05 in January and April 2011; however dissolved lead was detected at estimated concentrations below the EAL in samples collected from both RHMW03 and RHMW05 in July 2011. All other COPCs were not detected at or above the LODs and LOQs in samples collected from RHMW03 and RHMW05 in July 2011.

### ***1.2.6 Regulatory Updates***

During the summer and fall of 2008 DOH updated their EALs which resulted in significant changes to the action levels associated with methylnaphthalenes. The drinking water toxicity EAL for these compounds was 240 µg/L. This concentration presumed that methylnaphthalenes were non-carcinogenic. Evidence that they are human carcinogens has now been accepted by the U.S. Environmental Protection Agency (EPA). As a result, DOH adopted more rigorous EALs of 4.7 µg/L for 1-methylnaphthalene and 24 µg/L for 2-methylnaphthalene, corresponding to a residential tap water scenario, and a one in a million cancer risk (DOH, 2009). As a result of the EAL changing from 240 µg/L to 4.7 µg/L, concentrations of 1-methylnaphthalene collected from RMHW2254-01, RHMW02, RHMW03, and RHMW05 previously categorized as under the EAL are now over the EAL. Also, the drinking water EAL for naphthalene was increased from 6.2 µg/L to 17 µg/L (DOH, 2009). Finally, the DOH Drinking Water EAL for TPH-DRO was increased from 100 µg/L to 210 µg/L, although the DOH Groundwater Gross Contamination EAL for TPH-DRO remains 100 µg/L.

## ***Section 2 Groundwater Monitoring Activities***

Groundwater monitoring was conducted at the five monitoring wells (RHMW2254-01, RHMW01, RHMW02, RHMW03, and RHMW05) on October 24, 25, and November 2, 2011 using procedures described in the Work Plan (Environet, 2010). Field activities were documented in the field notebook (Appendix C).

### ***2.1 Oil/Water Interface Measurements***

The presence and thickness of LNAPL, otherwise known as “free product”, released from the USTs is monitored at the RHSF. Groundwater gauging measurements were collected at the five monitoring wells prior to purging and sample collection. A Solinst<sup>®</sup> oil/water interface probe was used to measure the depth to groundwater, as well as detect the presence and thickness of LNAPL to the nearest 0.01 foot, according to the procedures described in Procedure I-C-3, *Monitoring Well Sampling* (DON, 2007).

### ***2.2 Groundwater Sampling***

Groundwater samples were collected from the five monitoring wells according to the procedures described in Procedure I-C-3, *Monitoring Well Sampling* (DON, 2007).

#### ***2.2.1 Monitoring Well Purging***

Each monitoring well was purged using a dedicated bladder pump system. Groundwater was purged at a low flow rate (less than one liter per minute) using the dedicated bladder pump system until three or more successive water quality parameter measurements had stabilized within 10%. A Horiba<sup>®</sup> U-52 multi-parameter water quality meter was used to measure hydrogen activity (pH), temperature, specific conductivity, dissolved oxygen, turbidity, and oxidation reduction potential. At least four readings were recorded in Groundwater Sampling Log data sheets (Appendix D).

#### ***2.2.2 Groundwater Sample Collection***

Groundwater samples were collected using dedicated bladder pump systems. Groundwater samples were collected directly into laboratory provided specially cleaned sample containers already containing the appropriate preservatives (i.e., nitric acid for dissolved lead analysis, hydrochloric acid for aliphatic and aromatic hydrocarbon analyses). The dissolved lead samples were filtered in the field, and placed in polyethylene bottles containing preservatives.

#### ***2.2.3 Sample Management and Shipment***

Each sample container sent to the laboratory was assigned a project-specific chain-of-custody identification number and a descriptive identification number. The sample identifiers provided specific data unique to each sample and were entered into the field notebook. The samples were labeled according to the procedures described in Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody* (DON, 2007).

Following sample collection and labeling, the sample containers were bubble-wrapped and placed into individual ZipLoc<sup>®</sup> bags, then immediately into insulated coolers with ice for preservation. The samples were shipped via FedEx to the laboratory on the same day of collection or the following day. The samples were managed under standard chain-of-custody protocol and documentation from collection to delivery to the laboratory. Sample handling, storage, and transport were performed according to the requirements described in Procedure III-F, *Sample Handling, Storage, and Shipping* (DON, 2007).

### **2.3 Analytical Program**

Five primary groundwater samples, one duplicate groundwater sample, three trip blank samples for VOCs and TPH-GRO analysis, and one quality control (QC) groundwater sample (i.e., matrix spike (MS)/matrix spike duplicate (MSD)) were submitted to APPL, Inc. located in Clovis, California. Groundwater samples were analyzed for VOCs and TPH-GRO by EPA Method 8260B, TPH-DRO by EPA Method 8015B, PAHs by EPA Method 8270D SIM, dissolved lead by EPA Method 6020, and aliphatic and aromatic hydrocarbons by MADEP VPH and EPH methods. APPL, Inc. subcontracted the aliphatic and aromatic hydrocarbon analyses to Gulf Coast Analytical Laboratories.

Collective concentrations of aliphatic and aromatic hydrocarbons were analyzed this monitoring event utilizing MADEP EPH and VPH methods to more accurately determine if the TPH-DRO detected is petroleum based or non-petroleum based (DOH, 2010, Appendix A). The subsequent three consecutive quarterly monitoring events will not include MADEP EPH and VPH analyses. MADEP EPH analytical results for TPH-DRO typically have the majority of the hydrocarbons in the C<sub>10</sub> to C<sub>20</sub> range.

### **2.4 Field Quality Control Samples**

Field QC procedures were followed to ensure viability and integrity of sample analytical data. Field duplicates were collected according to the procedures described in Procedure III-B, *Field QC Samples (Water, Soil)* (DON, 2007) and the Work Plan (Environet, 2010). Field duplicate samples were collected at a minimum of 10% of primary samples and analyzed for the same contaminants. Field rinsate samples were not required since dedicated bladder pump systems were used.

### **2.5 Laboratory Quality Control Samples**

Laboratory QC samples were analyzed as part of the standard laboratory QC protocols as presented in the Work Plan (Environet, 2010). Laboratory QC for the monitoring event consisted of method blanks, laboratory control samples (LCS), surrogate spikes, and MS/MSD. Laboratory QC samples were prepared and analyzed according to the procedures described in Procedure III-A *Laboratory QC Samples (Water, Soil)* (DON, 2007). Laboratory QC MS/MSD samples are an aliquot (i.e., a subset) of the field sample that is spiked with accurate amounts of target analytes. They are not separate samples, but a special designation of an existing sample. Laboratory QC MS/MSD samples were analyzed for the same constituents as the standard samples. At a minimum, one MS/MSD sample pair was required per 20 samples, including field QC samples.



## ***2.6 Equipment Decontamination***

Decontamination of monitoring equipment was performed to ensure data quality, to prevent cross contamination, and to prevent the potential introduction of contaminants into previously un-impacted areas. Decontamination of monitoring equipment (i.e., Solinst<sup>®</sup> oil/water interface probe and Horiba<sup>®</sup> multi-parameter U-52 water quality meter) was conducted between monitoring locations according to the procedures described in Procedure I-F, *Equipment Decontamination* (DON, 2007). Decontamination water was disposed of in the RHSF's lower tunnel oil/water separator sump.

## ***2.7 Investigation-Derived Waste Management***

Investigation-derived waste (IDW) was managed in accordance with the procedures described in Procedure I-A-6, *IDW Management* (DON, 2007). The various potential waste streams included the following:

- personal protective equipment (PPE) including: nitrile gloves, etc.;
- liquids including: equipment rinse water and purged groundwater; and
- disposable sampling equipment and supplies, including: poly sheeting, etc.

Equipment rinse water and purge water was disposed of in the RHSF's lower tunnel oil/water separator sump.

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## ***Section 3 Groundwater Monitoring Results***

This section provides a summary of analytical results for groundwater samples collected from the five monitoring wells on October 24, 25, and November 2, 2011. Complete analytical laboratory reports are provided in Appendix E.

### ***3.1 Results of Oil/Water Interface Measurements***

Free product was not observed at RHMW01, RHMW02, RHMW03, and RHMW05 during the October-November 2011 sampling event. The trend of free product measurements over time show that in January 2008, LNAPL was measured in monitoring wells RHMW01 and RHMW02 at a thickness of less than 0.01 feet, but was not observed in any other monitoring wells. Since the thickness of less than 0.01 feet observed in January 2008, no free product has been observed in any of these RHSF monitoring wells (Table 3-1).

### ***3.2 Summary of Groundwater Analytical Results***

All DLs, LODs, and LOQs were generally below the EALs. In the case where an EAL for a specific COPC is less than the LOQ, it is generally acceptable to consider the LOQ in place of the EAL (DOH, 2009).

#### ***RHMW2254-01***

All COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix E).

#### ***RHMW01***

TPH-DRO was detected at a concentration of 210 µg/L which is equal to the DOH Drinking Water EAL (210 µg/L) and exceeds the DOH Groundwater Gross Contamination EAL (100 µg/L). Chloroform was detected at an estimated concentration of 0.13 µg/L, which was below the DOH Drinking Water EAL. All other COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix E).

Aromatic hydrocarbons (C<sub>11</sub>-C<sub>22</sub>), C<sub>9</sub>-C<sub>10</sub> aromatic hydrocarbons, and C<sub>9</sub>-C<sub>12</sub> aliphatic hydrocarbons were detected at concentrations of 50.5 µg/L, 20.6 µg/L, and 69.9 µg/L, respectively. MADEP EPH analytical results for TPH-DRO typically have the majority of the hydrocarbons in the C<sub>10</sub> to C<sub>20</sub> range. These analytical results are within carbon range C<sub>9</sub>-C<sub>22</sub> which indicates that the detected hydrocarbons are likely petroleum based.

#### ***RHMW02***

TPH-DRO was detected at a concentration of 750 µg/L which exceeded both the DOH Drinking Water EAL (210 µg/L) and the DOH Groundwater Gross Contamination EAL (100 µg/L) (Table 3-2 and Appendix E). Naphthalene (0.80 µg/L) and 1-methylnaphthalene (0.53 µg/L) were detected at concentrations which were below both the DOH Drinking Water EALs (17 µg/L for naphthalene and 4.7 µg/L for 1-methylnaphthalene) and the DOH Groundwater Gross Contamination EALs (21 µg/L for naphthalene and 10 µg/L for 1-methylnaphthalene).

Acenaphthene (0.17 µg/L), fluorene (0.082 µg/L) and 2-methylnaphthalene (0.15 µg/L) were detected at estimated concentrations which were below both the DOH Drinking Water EALs (370 µg/L for acenaphthene, 240 µg/L for fluorene and 24 µg/L for 2-methylnaphthalene) and the DOH Groundwater Gross Contamination EALs (20 µg/L for acenaphthene, 950 µg/L for fluorene, and 10 µg/L for 2-methylnaphthalene). All other COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix E).

Aromatic hydrocarbons (C<sub>11</sub>-C<sub>22</sub>), C<sub>9</sub>-C<sub>10</sub> aromatic hydrocarbons, and C<sub>9</sub>-C<sub>12</sub> aliphatic hydrocarbons were detected at concentrations of 166 µg/L, 200 µg/L, and 671 µg/L, respectively. Aliphatic hydrocarbons (C<sub>9</sub>-C<sub>18</sub>) were detected at an estimated concentration of 28.0 µg/L. These analytical results are within carbon range C<sub>9</sub>-C<sub>22</sub> which indicates that the detected hydrocarbons are likely petroleum based.

#### RHMW03

Dissolved lead (0.22 µg/L) was detected at an estimated concentration which was below both the DOH Drinking Water EAL (15 µg/L) and the DOH Groundwater Gross Contamination EAL (5,000 µg/L). All other COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix E).

Aliphatic hydrocarbons (C<sub>9</sub>-C<sub>18</sub>) were detected at an estimated concentration of 26 µg/L. This analytical result indicates that the detected hydrocarbons are likely petroleum based.

#### RHMW05

All COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix E). All aliphatic and aromatic hydrocarbons were also not detected at or above the LODs and LOQs.

### **3.3 Groundwater Contaminant Trend**

Groundwater samples have been collected and analyzed in monitoring wells RHMW01, RHMW02, and RHMW03 since September 2005, and in monitoring well RHMW05 since May 2009 (Appendix B). Monitoring well RHMW2254-01 was installed in February 2005. The following is a discussion of COPCs that exceeded DOH Drinking Water EALs during two or more recent consecutive sampling events of increasing or decreasing concentrations, thus establishing a trend:

#### RHMW2254-01

COPCs have never been detected at RHMW2254-01 at concentrations greater than the DOH Drinking Water EALs.

#### RHMW01

Concentrations of TPH-DRO have been greater than the DOH Drinking Water EAL between September 2005 and July 2010, and again in April 2011 and July 2011 but less than 25% of the SSRBL of 4,500 µg/L. TPH-DRO concentrations decreased from October 2008 through July 2009; increased in October 2009 (299F µg/L), January 2010 (312F µg/L), and April 2010 (377

**Table 3-1: Red Hill Oil/Water Interface Measurements, September 2007 through October-November 2011**

Date	RHMW01			RHMW02			RHMW03			RHMW05		
	Elevation = 102.27 ft. <sup>1</sup>			Elevation = 104.76 ft. <sup>1</sup>			Elevation = 121.06 ft. <sup>1</sup>			Elevation = 101.55 ft. <sup>1</sup>		
	DTW (TOC)	SWL	LNAPL	DTW (TOC)	SWL	LNAPL	DTW (TOC)	SWL	LNAPL	DTW (TOC)	SWL	LNAPL
Sep-2007	NT <sup>2</sup>	NT <sup>2</sup>	NT <sup>2</sup>	86.80	17.96	NP	103.44	17.62	NP	~	~	~
Jan-2008	84.67	17.60	<0.01	86.23	18.53	<0.01	NT <sup>3</sup>	NT <sup>3</sup>	NT <sup>3</sup>	~	~	~
Jul-2008	83.37	18.90	0.00	86.10	18.66	0.00	102.45	18.61	0.00	~	~	~
Oct-2008	83.80	18.47	0.00	86.45	18.31	0.00	102.49	18.57	0.00	~	~	~
Nov-2008	83.91	18.36	0.00	86.56	18.20	0.00	102.80	18.26	0.00	~	~	~
Jan-2009	83.13	19.14	0.00	85.79	18.97	0.00	102.04	19.02	0.00	~	~	~
Feb-2009	NT <sup>4</sup>	NT <sup>4</sup>	NT <sup>4</sup>	86.35	18.41	0.00	102.56	18.50	0.00	~	~	~
Mar-2009	83.82	18.45	0.00	86.44	18.32	0.00	102.64	18.42	0.00	~	~	~
May-2009 <sup>5</sup>	83.72	18.55	0.00	86.37	18.39	0.00	102.59	18.47	0.00	NT <sup>6</sup>	NT <sup>6</sup>	NT <sup>6</sup>
May-2009	83.50	18.77	0.00	86.15	18.61	0.00	102.41	18.65	0.00	NT <sup>6</sup>	NT <sup>6</sup>	NT <sup>6</sup>
Jul-2009 <sup>7</sup>	83.75	18.52	0.00	86.42	18.34	0.00	102.67	18.39	0.00	83.09	18.46	0.00
Aug-2009	84.04	18.23	0.00	86.71	18.05	0.00	102.84	18.22	0.00	83.51	18.04	0.00
Sep-2009	84.21	18.06	0.00	86.84	17.92	0.00	103.07	17.99	0.00	83.61	17.94	0.00
Oct-2009	84.24	18.03	0.00	86.87	17.89	0.00	103.07	17.99	0.00	83.62	17.93	0.00
Nov-2009	83.91	18.36	0.00	86.56	18.20	0.00	102.81	18.25	0.00	83.25	18.30	0.00
Dec-2009	84.12	18.15	0.00	86.75	18.01	0.00	103.00	18.06	0.00	83.53	18.02	0.00
Jan-2010	84.36	17.91	0.00	87.00	17.76	0.00	103.22	17.84	0.00	83.75	17.80	0.00
Feb-2010	84.24	18.03	0.00	86.89	17.87	0.00	103.14	17.92	0.00	83.60	17.95	0.00
Mar-2010	84.53	17.74	0.00	87.15	17.61	0.00	103.38	17.68	0.00	83.96	17.59	0.00
Apr-2010	84.75	17.52	0.00	87.37	17.39	0.00	103.60	17.46	0.00	84.17	17.38	0.00
May-2010	84.80	17.47	0.00	87.43	17.33	0.00	103.66	17.40	0.00	84.23	17.32	0.00
Jun-2010	84.87	17.40	0.00	87.51	17.25	0.00	103.74	17.32	0.00	84.30	17.25	0.00
Jul-2010	85.03	17.24	0.00	87.66	17.10	0.00	103.89	17.17	0.00	84.48	17.07	0.00
Sep-2010	85.30	16.97	0.00	87.92	16.84	0.00	104.13	16.93	0.00	84.71	16.84	0.00
Oct-2010	85.29	16.98	0.00	87.91	16.85	0.00	104.13	16.93	0.00	84.75	16.80	0.00
Nov-2010	85.20	17.07	0.00	87.84	16.92	0.00	104.30	16.76	0.00	84.60	16.95	0.00
Dec-2010	84.87	17.40	0.00	87.55	17.21	0.00	103.98	17.08	0.00	84.22	17.33	0.00
Jan-2011	85.32	16.95	0.00	86.91	17.85	0.00	103.41	17.65	0.00	83.65	17.90	0.00
Feb-2011	83.82	18.45	0.00	86.48	18.28	0.00	103.02	18.04	0.00	83.20	18.35	0.00
Mar-2011	83.77	18.50	0.00	86.39	18.37	0.00	102.87	18.19	0.00	83.20	18.35	0.00
Apr-2011	83.54	18.73	0.00	86.18	18.58	0.00	102.39	18.67	0.00	82.90	18.65	0.00
May-2011	83.39	18.88	0.00	86.39	18.37	0.00	102.69	18.37	0.00	82.72	18.83	0.00
Jun-2011	83.41	18.86	0.00	86.11	18.65	0.00	102.33	18.73	0.00	82.81	18.74	0.00
Jul-2011	83.57	18.70	0.00	86.22	18.54	0.00	102.44	18.62	0.00	82.99	18.56	0.00
Aug-2011	83.81	18.46	0.00	86.42	18.34	0.00	102.66	18.40	0.00	83.21	18.34	0.00
Sep-2011	83.81	18.46	0.00	86.44	18.32	0.00	102.69	18.37	0.00	83.21	18.34	0.00
Oct-2011	83.71	18.56	0.00	86.38	18.38	0.00	102.90	18.16	0.00	83.15	18.40	0.00

Notes:  
<sup>1</sup> Elevations were updated based on the *Groundwater Flow Direction/Gradient and Tier 3 Risk Assessment Re-evaluation Letter Report, Red Hill Bulk Fuel Storage Facility, Pearl Harbor, HI, Contract #N47408-04-D-8514, Task Order 54, dated April 15, 2010.*  
<sup>2</sup> A measurement was not taken at RHMW01 in September 2007.  
<sup>3</sup> A measurement was not taken at RHMW03 in January 2008 due to equipment malfunction.  
<sup>4</sup> A measurement was not taken at RHMW01. The monitoring well was inaccessible due to extensive work being conducted at Tank 02.  
<sup>5</sup> The April 2009 measurements were pushed back a week (to 5/6/09) due to RHMW05 installation.  
<sup>6</sup> Measurements were not taken at RHMW05 until the installation of the dedicated oil/water interface probe was completed.  
<sup>7</sup> The June 2009 measurements were skipped due to the installation of dedicated oil/water interface probes.

Units are in feet (ft.).  
 Measurements recorded prior to September 2010 were collected by TEC. Measurements recorded in September 2010 and after were collected by Environet.  
 DTW (TOC) - depth to water from top of well casing  
 LNAPL - light non-aqueous phase liquid attributed to the Red Hill Bulk Fuel Storage Facility  
 NP - measurement not provided  
 NT - measurement not taken  
 SWL - static water level  
 ~ - period prior to the installation of RHMW05  
 < - less than

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µg/L); decreased in July 2010 (228F µg/L); and were not detected above the LODs and LOQs in October-November 2010 and January 2011. TPH-DRO concentrations increased to above the EAL in April 2011 and remained above the EAL in July 2011 and at the EAL in October-November 2011 (210 µg/L) (Appendix B).

### RHMW02

The averages of primary and duplicate samples were used for determining contaminant trends. From September 2005 through February 2009, TPH-DRO concentrations exceeded the DOH Drinking Water EAL of 210 µg/L and were greater than 50% of the SSRBL (estimated solubility limit of 4,500 µg/L). The concentration of TPH-DRO was relatively stable until July 2008 and October 2008 when the concentrations increased, with the October 2008 average also exceeding the SSRBL of 4,500 µg/L.

TPH-DRO concentrations decreased from October 2008 through July 2009. In May 2009 and July 2009, TPH-DRO remained above the DOH Drinking Water EAL, but was below 50% of the SSRBL of 4,500 µg/L. In October 2009, TPH-DRO began an increasing trend greater than 50% of the SSRBL which continued through February 2010 when it exceeded the SSRBL due to TICs apparently not associated with petroleum from the RHSF (TEC, 2010). In March 2010 (2,490 µg/L) and April 2010 (2,215 µg/L), TPH-DRO exhibited a decreasing trend and the TICs detected in the two previous monitoring events were not observed. During July 2010, TPH-DRO concentrations at RHMW02 increased to an average concentration of 3,085 µg/L, above 50% of the SSRBL of 4,500 µg/L. During October-November 2010, TPH-DRO concentrations decreased to 1,700 µg/L, and in January 2011 concentrations decreased further to 1,040 µg/L, below 50% of the SSRBL. TPH-DRO exhibited a concentration detected at 1,100 µg/L in April 2011; however concentrations increased to 1,450 µg/L in July 2011. TPH-DRO concentration decreased to 750 µg/L in October-November 2011.

Since September 2005, TPH-GRO concentrations have remained below the EAL, except in July 2006 (145 µg/L), December 2006 (124 µg/L), March 2007 (135 µg/L), and October-November 2010 (155 µg/L).

From September 2005 through October 2008, naphthalene concentrations remained above the EAL and were relatively stable. In February 2009, naphthalene concentrations began decreasing and reached the lowest average concentration in May 2009 (2 µg/L) which was below the EAL. From July 2009 through July 2010, concentrations increased above the EAL. Then in October-November 2010 and January 2011, naphthalene concentrations decreased slightly to concentrations which were still above the EAL. In April 2011 naphthalene concentrations decreased to below the EAL. Concentrations of naphthalene remained below the EAL in July 2011 and October-November 2011.

Similar to the naphthalene concentration trend, 1-methylnaphthalene concentrations remained relatively stable from September 2005 through October 2008. In February 2009, 1-methylnaphthalene began decreasing and reached the lowest average concentration in October 2009 (3.2 µg/L) which was below the EALs. In January 2010, 1-methylnaphthalene concentrations increased above the EALs; then decreased in April 2010; and have exhibited an increasing trend from July 2010 through January 2011 (Appendix B). The average concentration

(5.1 µg/L) for 1-methylnaphthalene in April 2011 decreased to slightly above the DOH Drinking Water EAL of 4.7 µg/L. The average concentration for 1-methylnaphthalene decreased to below the DOH EALs in July 2011 and October-November 2011.

Since October 2008, the concentrations of 2-methylnaphthalene have remained below the EALs.

### RHMW03

Historically, concentrations of TPH-DRO have fluctuated around the DOH Drinking Water EAL, but have been significantly lower than corresponding values observed at RHMW01 and RHMW02. TPH-DRO concentrations have decreased since October 2008 dropping below the LODs in May 2009 through July 2010.

However, during the October-November 2010 groundwater monitoring event, TPH-DRO was detected at the highest concentration to date (330 µg/L) which was above the EAL. In January 2011, April 2011, July 2011, and this October-November 2011 groundwater monitoring event, TPH-DRO concentrations decreased to below the LODs.

### RHMW05

There was an increasing trend for TPH-DRO since it was first sampled in May 2009 through January 2010. Starting with the July 2009 monitoring event, TPH-DRO concentrations were greater than the DOH Drinking Water EAL (210 µg/L) with the highest concentration of 2,060 µg/L being observed in January 2010. It is important to note that the January 2010 concentration contained TICs apparently not associated with petroleum from the RHSF (TEC, 2010). However, during this October-November 2011 and the previous six groundwater monitoring events TPH-DRO concentrations exhibited a decrease and were not detected at or above the LOD or LOQ.

## **3.4 Groundwater Status**

Facility-specific contaminants of concern are defined as petroleum-related chemicals that have been observed in the groundwater samples above the DOH Drinking Water EALs. In accordance with the Red Hill Bulk Fuel Storage Facility, Final Groundwater Protection Plan (TEC, 2008), Table 3-3 defines these RHSF-specific compounds and their associated SSRBLs and updated EALs (DOH, 2009).

In addition, the Groundwater Protection Plan defines four Results Categories of groundwater status for the RHSF, based on concentrations of COPCs detected in samples collected from RHMW2254-01, RHMW01, RHMW02, RHMW03, and RHMW05, and requires specific responses when these categories are observed during quarterly groundwater sampling (Table 3-4). The current Results Categories for the monitoring wells were determined using the October-November 2011 analytical data (Table 3-5). Monitoring well RHMW01 is in Category 1 and RHMW02 is in Category 2.

**Table 3-3: Action Levels for Contaminants of Concern**

Chemical	DOH Drinking Water EAL (µg/L)	SSRBL (µg/L)
<b>Petroleum Mixtures</b>		
TPH-DRO	210	4,500
TPH-GRO	100	4,500
<b>Semi-Volatile Compounds</b>		
1-Methylnaphthalene	4.7	N/A
2-Methylnaphthalene	24	N/A
Naphthalene	17	N/A

Notes:  
 N/A – not applicable  
 SSRBLs are applicable at RHMW01, RHMW02, RHMW03, and RHMW05  
 EALs are applicable at RHMW2254-01

**Table 3-4: Results Categories and Response Actions to Changes in Groundwater Status**

Results Category	RHMW02, RHMW03, or RHMW05*	RHMW01	RHMW2254-01
Results Category 1: Result above detection limit but below drinking water EAL and trend for all compounds stable or decreasing	A	A	A, D, M, E
Results Category 2: Trend for any compound increasing or drinking water EAL exceeded	A, B	A, B	A, B, C, D, E, F, G, K, L, O
Results Category 3: Result Between 1/10X SSRBL and SSRBL for benzene, or between 1/2X SSRBL and SSRBL for TPH	A, B, G, H, I, J	A, B, E, G, H, I, J	A, B, C, D, E, F, G, I, J, K, L, O
Results Category 4: Result Exceeding any SSRBL or petroleum product observed	A, C, D, E, F, I, J, K, M, N	A, C, D, E, F, I, J, K, M, N, O	A, C, D, E, F, G, I, J, K, L, O

Notes:  
 \*RHMW05 was installed in April 2009 and has subsequently been added to this table.  
 Specific Responses:  
 A. Send quarterly reports to DOH.  
 B. Begin program to determine the source of leak.  
 C. Notify DOH verbally within one day and follow with written notification in 30 days.  
 D. Notify NAVSUP Chain of Command within one day.  
 E. Send Type 1 Report (see box below) to DOH.  
 F. Send Type 2 Report (see box below) to DOH.  
 G. Increase monitoring frequency to once per month (if concentrations increasing).  
 H. Notify DOH verbally within seven days and follow with written notification in 30 days.  
 I. Remove sampling pumps, measure product in pertinent wells with interface probe, re-install pumps if product is not detected.  
 J. Immediately evaluate tanks for leaks.  
 K. Collect samples from nearby Hälawa Deep Monitoring Well (2253-03) and OWDFMW01. For permission to sample 2253-03, call Department of Land and Natural Resources (DLNR) Commission on Water Resource Management 808-587-0214, DLNRCWR@Hawaii.gov.  
 L. Provide alternative water source at RHMW2254-01.  
 M. Prepare for alternative water source at RHMW2254-01.  
 N. Re-measure for product every month with reports to DOH.  
 O. Install additional monitoring well downgradient.

**Report Types**

DOH Type 1 Report

- Re-evaluate Tier 3 Risk Assessment/groundwater model results
- Proposal to DOH on course of action

DOH Type 2 Report

- Proposal for groundwater treatment

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**Table 3-5: Summary of Result Categories and Response Actions, October-November 2011**

<b>Results Category</b>	<b>RHMW2254-01</b>	<b>RHMW01</b>	<b>RHMW02</b>	<b>RHMW03</b>	<b>RHMW05</b>
<u>Results Category 1:</u> Result above detection limit but below drinking water EAL and trend for all compounds stable or decreasing	No	Yes	No	Yes	No
<u>Results Category 2:</u> Trend for any compound increasing or drinking water EAL exceeded	No	No	Yes	No	No
<u>Results Category 3:</u> Result between 1/10X SSRBL and SSRBL for benzene, or between 1/2X SSRBL and SSRBL for TPH	No	No	No	No	No
<u>Results Category 4:</u> Result exceeding any SSRBL or petroleum product observed	No	No	No	No	No
<u>Previous Category:</u> Category prior to October-November monitoring event	None	Category 2	Category 2	None	None
<u>New Category:</u> Category assignment based on results of the October-November monitoring event	None	Category 1	Category 2	Category 1	None
<u>Response Actions:</u> Requirements of new category	None	1. Quarterly reports to be sent to DOH	1. Quarterly reports to be sent to DOH 2. Initiation of a leak determination program to identify if tanks are leaking	1. Quarterly reports to be sent to DOH	None

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## ***Section 4 Data Quality Assessment***

Data quality assessment consists of a review of the overall groundwater sample collection and analyses process in order to determine whether the analytical data generated meets the quality objectives for the project. The field QC program consisted of standardized sample collection and management procedures and the collection of field duplicate samples and trip blank samples. The laboratory quality assurance program consisted of the use of standard analytical methods and the preparation and analyses of MS/MSD samples, surrogate spikes, method blanks, and LCS.

### ***4.1 Data Validation***

The usability of the data collected during this investigation depends upon its quality. A number of factors relate to the quality of data, including: sample collection methods, sample analysis methods, and adherence to established procedures for sample collection, preservation, management, shipment, and analysis. Data quality is judged in terms of its precision, accuracy, representativeness, completeness, and comparability.

#### ***4.1.1 Quality Control Program***

LOQs are established by the laboratory based on the method DLs or instrument DLs, historical data, and EPA limits established for the methods. The LOQs for samples may require adjustment due to matrix interference or if high levels of target analytes necessitate dilution before analysis. Matrix interference and sample dilutions have the effect of increasing the LOQs. None of the reporting limits were adjusted for this monitoring event.

#### ***4.1.2 Data Assessment***

##### ***Precision***

Precision is defined as the agreement between a set of replicate measurements without assumption and knowledge of the true value. Precision is evaluated by relative percent difference (RPD) of field duplicates and laboratory MS/MSD results. Field duplicate and MS/MSD samples were collected at a rate of approximately 10% of project samples. Field duplicates are sent to the laboratory with dummy sample numbers and analyzed as primary samples.

For this monitoring event, the RPDs of primary and field duplicate (sample ES046 and sample ES047) collected from RHMW02, met the RPD precision criteria of 50% for all analytes (Table 4-1). The RPDs for MS/MSD were also within the laboratory established criteria (Appendix E). Therefore the data precision is considered good.

##### ***Accuracy***

Accuracy is defined as the degree of agreement of a measurement to an accepted reference or true value. Accuracy is measured as the percent recovery of an analyte in a reference standard or spiked sample. Accuracy limits for laboratory control spike, MS, and MSD samples are established by the individual laboratory. The acceptance criteria for accuracy are dependent on the analytical method, and are based on historical laboratory data.

All of the LCS, MS/MSD and surrogate spike recoveries for analyzed constituents were within acceptable percent recovery limits except for a MSD recovery of TPH-DRO. In this case, the recovery was below the lower limit of the acceptable criteria (61%). However, it is not expected to significantly impact the data accuracy because it is the only anomaly observed in the QC tests. Therefore the data accuracy for this monitoring event is considered acceptable.

### ***Representativeness***

Representativeness is the degree that data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness was achieved by conducting sampling in compliance with the sample collection procedures described in the Work Plan specifically written for this project (Environet, 2010).

Representativeness is also evaluated through the compliance of the sample holding time and the analysis of blank samples including method blank and trip blank samples. The sample holding time complied with the EPA criteria. None of the COPCs were detected in the laboratory method blanks. For this sampling event, three trip blanks were collected and there were no detections of VOCs or TPH-GRO in them (Table 4-1). Therefore, the groundwater sample data are considered representative of the groundwater quality on site.

### ***Completeness***

Completeness is defined as the overall percentage of valid analytical results (including estimated values) compared to the total number of analytical results reported by the laboratory. The completeness goal for this project is 90 % which was successfully met. Successful completion of data acquisition can only be accomplished if both the field and laboratory portions of the project are performed according to the procedures described in the Work Plan (Environet, 2010).

### ***Comparability***

Comparability expresses the confidence with which one data set can be compared to another. Comparability can be related to accuracy and precision because these quantities are measures of data reliability. Data with acceptable precision and accuracy are considered comparable if collection techniques, analytical procedures, methods and reporting are equivalent. For this monitoring event the samples were collected using approaches consistent with those in the previous events, and the same analytical methods/procedures were used to measure the concentration of COPCs. Therefore the results are considered comparable within this data set and with the data collected from previous sampling events.

### ***4.1.3 Data Assessment Conclusions***

The precision, accuracy, representativeness, completeness, and comparability criteria were met. The hold time was met for all samples. Therefore, the data assessment concludes that all data generated during this event are suitable for the intended use.





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# ***Section 5 Summary, Conclusions, and Recommendations***

## ***5.1 Summary***

There is no indication of an immediate threat of disruption to drinking water resources at the U.S. Navy Well 2254-01 as a result of the October-November 2011 data. Based on the October-November 2011 groundwater monitoring event, RHMW2254-01 does not fall into any Results Category of the Groundwater Protection Plan.

### ***5.1.1 Results of Oil/Water Interface Measurements***

Free product was not observed at RHMW01, RHMW02, RHMW03, and RHMW05 during the October-November monitoring event. The trend of free product measurements over time shows that in January 2008, fuel was measured in monitoring wells RHMW01 and RHMW02 at a thickness of less than 0.01 feet, but was not observed in any other monitoring wells. Since the thickness of less than 0.01 feet observed in January 2008, no free product has been observed in any of these RHSF monitoring wells (Table 3-1).

### ***5.1.2 Summary of Groundwater Analytical Results***

Laboratory analytical results from the October-November 2011 groundwater monitoring event indicated that TPH-DRO was present in the groundwater beneath the RHSF at concentrations equal or above the DOH Drinking Water EAL. All other COPC concentrations (i.e., TPH-GRO, VOCs, PAHs, and dissolved lead) were below the EALs. All LODs and LOQs were generally below the EALs. In the case where an EAL for a specific COPC is less than the LOQ, it is generally acceptable to consider the LOQs in place of the EAL (DOH, 2009).

In monitoring well RHMW01, TPH-DRO (210 µg/L) was detected at a concentration equal to the DOH Drinking Water EAL. Chloroform (0.13 µg/L) was detected at an estimated concentration below the DOH Drinking Water EAL. All other COPCs in RHMW01 were not detected at or above the LODs and LOQs.

In monitoring well RHMW02, TPH-DRO (750 µg/L) was detected at a concentration which exceeded the DOH Drinking Water EAL. Naphthalene (0.80 µg/L) and 1-methylnaphthalene (0.53 µg/L) were detected at concentrations below the DOH Drinking Water EALs. Acenaphthene (0.17 µg/L), fluorene (0.082 µg/L) and 2-methylnaphthalene (0.15 µg/L) were detected at estimated concentrations below the DOH Drinking Water EALs. All other COPCs in RHMW02 were not detected at or above the LODs and LOQs.

In monitoring wells RHMW03 dissolved lead (0.22 µg/L) was detected at an estimated concentration below the DOH Drinking Water EAL. All other COPCs were not detected at or above the LODs and LOQs.

In monitoring wells RHMW2254-01 and RHMW05, no COPCs were detected at or above the LODs and LOQs.

MADEP EPH analytical results for TPH-DRO typically have the majority of the hydrocarbons in the C<sub>10</sub> to C<sub>20</sub> range. In monitoring well RHMW01, C<sub>11</sub>-C<sub>22</sub> aromatic hydrocarbons, C<sub>9</sub>-C<sub>10</sub> aromatic hydrocarbons, and C<sub>9</sub>-C<sub>12</sub> aliphatic hydrocarbons were detected at concentrations of 50.5 µg/L, 20.6 µg/L, and 69.9 µg/L, respectively. These analytical results are within carbon range C<sub>9</sub>-C<sub>18</sub> which indicates that the detected hydrocarbons are likely petroleum based. In monitoring well RHMW02, C<sub>11</sub>-C<sub>22</sub> aromatic hydrocarbons, C<sub>9</sub>-C<sub>10</sub> aromatic hydrocarbons, and C<sub>9</sub>-C<sub>12</sub> aliphatic hydrocarbons were detected at concentrations of 166 µg/L, 200 µg/L, and 671 µg/L, respectively. Aliphatic hydrocarbons (C<sub>9</sub>-C<sub>18</sub>) were detected at an estimated concentration of 28.0 µg/L. These analytical results are within carbon range C<sub>9</sub>-C<sub>22</sub> which indicates that the detected hydrocarbons are likely petroleum based.

In monitoring well RHMW03, C<sub>9</sub>-C<sub>18</sub> aliphatic hydrocarbons were detected at an estimated concentration of 26 µg/L. This analytical result indicates that the detected hydrocarbons are likely petroleum based.

In monitoring well RHMW05, all aliphatic and aromatic hydrocarbons were not detected at or above the LODs and LOQs.

## **5.2 Conclusions**

To date, the presence of LNAPL has been observed only once (i.e., in January 2008 in RHMW01 and RHMW02 at a thickness of less than 0.01 feet). This indicates a significant release from one or more of the USTs at the RHSF has not occurred at this time.

COPC concentrations in samples collected from the U.S. Navy Well 2254-01 have not been detected above the EALs. This indicates that elevated COPC concentrations detected in samples collected from monitoring wells within the RHSF are not migrating and impacting the Navy's potable water source.

COPC concentrations detected in samples collected from monitoring well RHMW05 have decreased to below the EALs for the past seven consecutive quarterly monitoring events. The data suggest that elevated COPC concentrations detected in samples collected from monitoring wells located adjacent to the USTs are not migrating in the downgradient direction. RHMW05 is an intermediate monitoring point between the USTs and the U.S. Navy Well 2254-01. At this time, there is no indication that COPCs are migrating in a downgradient direction towards the Navy's potable water source.

COPC concentrations detected in samples collected from two monitoring wells adjacent to the USTs (i.e., RHMW01 and RHMW03) are not steadily increasing between sampling events. Concentrations of 1-methylnaphthalene detected in samples collected from RHMW02 increased for three consecutive events; however they have decreased in the subsequent monitoring events. The fluctuation in concentrations measured during this event and previous events indicates the current source of 1-methylnaphthalene is potentially residual hydrocarbon contamination from a historical release. The general overall long-term trend in 1-methylnaphthalene concentration is decreasing and does not indicate a new release.

Because the majority of the aliphatic and aromatic hydrocarbons detected were within the C<sub>10</sub>-C<sub>20</sub> range, the detected TPH-DRO in monitoring wells RHMW01 and RHMW02 is likely to be petroleum based.

### ***5.3 Recommendations***

Based on the results of this monitoring event, continuation of the quarterly groundwater monitoring program at the RHSF is recommended. In addition, continuation of monthly free product measurements at RHMW01, RHMW02, RHMW03, and RHMW05; and monthly soil vapor monitoring are also recommended. In response to the Category 1 status of RHMW01 and RHMW03, and the Category 2 status of RHMW02, submission of this quarterly report to DOH and continuation of a leak determination program as described in Section 3 of the RHSF Groundwater Protection Plan (TEC, 2008) to identify if tanks are leaking are recommended.

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## *Section 6 References*

- Dawson Group, Inc., 2006. *Fourth Quarter 2005 Groundwater Sampling Report, Red Hill Fuel Storage Facility, Hawaii*. February.
- DOH, 2009. *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater*. Updated March 2009.
- DON, 2007. *Project Procedures Manual, U.S. Navy Environmental Restoration Program, NAVFAC Pacific*. February.
- Environet, 2010. *Work Plan, Long-Term Monitoring, Red Hill Bulk Fuel Storage Facility, Pearl Harbor, O'ahu, Hawai'i*. September.
- Hawai'i Administrative Rules, Title 11, Chapter 281, Subchapter 7.
- TEC, 2006. *Red Hill Bulk Fuel Storage Facility, Final – Addendum Planning Documents, Pearl Harbor, Hawaii*. May.
- \_\_\_\_\_, 2007. *Red Hill Bulk Fuel Storage Facility, Final Technical Report, Pearl Harbor, Hawaii*. August.
- \_\_\_\_\_, 2008. *Red Hill Bulk Fuel Storage Facility, Final Groundwater Protection Plan, Pearl Harbor, Hawaii*. January 2008 revised in December 2009.
- \_\_\_\_\_, 2010. *Quarterly Groundwater Monitoring Report, Red Hill Fuel Storage Facility, Pearl Harbor, Oahu, Hawaii*. August.
- U.S. Geological Survey (USGS), 2005. Aerial Image. <http://hawaii.wr.usgs.gov/index.html>.

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*Appendix A*  
*DOH Correspondence*





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

In reply, please refer to:  
File:

December 8, 2010

U1217RT

Ms. Raelynn Della Sala  
Navy Region Hawaii  
850 Ticonderoga Street, Suite 110  
Pearl Harbor, Hawaii 96860-5101

Dear Ms. Della Sala:

SUBJECT: Red Hill Tank Complex  
Facility ID 9-102271 / Release IDs 990051, 010011, 020028

The Department of Health (DOH) has reviewed the following reports:

1. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated May 2008 and prepared by TEC, Inc.
2. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated February 2009 and prepared by TEC, Inc.
3. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated April 2009 and prepared by TEC, Inc.
4. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated July 2009 and prepared by TEC, Inc.
5. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated September 2009 and prepared by TEC, Inc.
6. *Quarterly Groundwater Monitoring Report – Outside (Non-Tunnel) Wells*, dated September 2009 and prepared by TEC, Inc.
7. *API 653 Inspection and Repair Records for Red Hill Tank 15*, dated December 7, 2009 and prepared by Dunkin & Bush, Inc.
8. *Quarterly Groundwater Monitoring Report – Outside (Non-Tunnel) Wells*, dated December 2009 and prepared by TEC, Inc.

9. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated December 2009 and prepared by TEC, Inc.
10. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated April 2010 and prepared by TEC, Inc.
11. *Quarterly Groundwater Monitoring Report – Outside (Non-Tunnel) Wells*, dated April 2010 and prepared by TEC, Inc.
12. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated May 2010 and prepared by TEC, Inc.
13. *Quarterly Groundwater Monitoring Report – Outside (Non-Tunnel) Wells*, dated May 2010 and prepared by TEC, Inc.
14. *Type 1 Letter Report – Re-evaluation of the Tier 3 Risk Assessment/Groundwater Model & Proposed Course of Action Red Hill Bulk Fuels Storage Facility*, dated May 4, 2010 and prepared Tec, Inc.
15. *Quarterly Groundwater Monitoring Report Red Hill Fuel Storage Facility*, dated August 2010 and prepared by TEC, Inc.
16. *Quarterly Groundwater Monitoring Report – Outside (Non-Tunnel) Wells*, dated August 2010 and prepared by TEC, Inc.
17. *Work Plan, Long-Term Monitoring*, dated September 2010 and prepared by Naval Facilities Engineering Command.

Please note the reports have been placed with the public record.

Since 2009, groundwater samples from monitoring wells within and outside the Red Hill Tank Complex have revealed low levels of Total Petroleum Hydrocarbons – Gasoline Range Organics (TPH-GRO), Total Petroleum Hydrocarbons – Diesel Range Organics (TPH-DRO), naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. The DOH Hazard Evaluation and Emergency Response (HEER) Office Environmental Action Levels (EALs) are being used at this site, as well as Site Specific Risk Based Levels (SSRBLs) for TPH-DRO.

In addition to TPH-GRO and TPH-DRO, the groundwater samples are analyzed for 18 poly-aromatic hydrocarbon (PAH) compounds, and approximately 40 volatile organic compounds (VOCs), and dissolved Lead. The five specific contaminants mentioned in the previous paragraph were the only compounds detected in these wells during 2009-2010. All others were non-detectable at minimum detection limits below HEER action levels. Due to the nature of the aquifer beneath the site as a current source of drinking water, as well as the

Ms. Raelynn Della Sala  
December 8, 2010  
Page 3

Navy's Drinking Water Pump Station nearby, the most stringent drinking water action levels are employed, the majority in the parts per billion range.

TPH-DRO, naphthalene, and 1-methylnaphthalene continue to be found in monitoring wells RHMW01, RHMW02, and RHMW02D. The July 2010 monitoring event revealed TPH-DRO from 228 to 3,110 parts per billion (ppb) vs. the HEER EAL of 210 ppb and SSRBL of 4,500 ppb. 1-methylnaphthalene was found at 7.05 to 7.43 ppb vs. the HEER EAL of 4.7 ppb. Naphthalene was found at 59 to 61 ppb by Method 8270C and 102 to 107 ppb by Method 8260B vs. the HEER EAL of 17 ppb. Water collected at the Navy's Drinking Water Pump Station was non-detectable for all contaminants above minimum detection limits.

In the wells outside the complex, naphthalene was detected for the first time in monitoring well HDMW2253-03 North of the Red Hill Complex in July 2010 at a concentration of 0.0596 ppb vs. the HEER EAL of 17 ppb. TPH-DRO was detected in this well in January 2010 at 322 ppb vs. the HEER EAL of 210 ppb and SSRBL of 4,500 ppb. TPH-DRO was found at 1,490 ppb vs. the HEER EAL of 210 ppb and SSRBL of 4,500 ppb in monitoring well OWDFMW2 that lies west of the Navy Drinking Water Pump Station.

The DOH concurs that monthly free product checks and soil vapor monitoring should continue as well as quarterly groundwater monitoring of the wells within the complex. It was stated that funding for sampling the wells outside the complex had been completed. The DOH concurs that consideration should be given for periodic sampling of these wells.

Regarding the Type 1 Letter Report, the DOH does not object to additional monitoring wells in the North-West direction. The DOH also concurs with utilizing the MADEP EPH VPH analyses with the current 8260B and 8270C analyses to more accurately determine if the TPH-DRO found is fuel based or from non-petroleum sources.

If you have any questions regarding this letter, please contact Mr. Richard Takaba of our Underground Storage Tank Section at (808) 586-4226.

Sincerely,

  
STEVEN Y.K. CHANG, P.E., CHIEF  
Solid and Hazardous Waste Branch

c: Roger Brewer, DOH-HEER Office  
✓Darren Uchima, Navy Region Hawaii  
Glenn Yoshinaga, NAVFAC Pacific, Pearl Harbor  
Jeff Hart, TEC, Inc., Honolulu



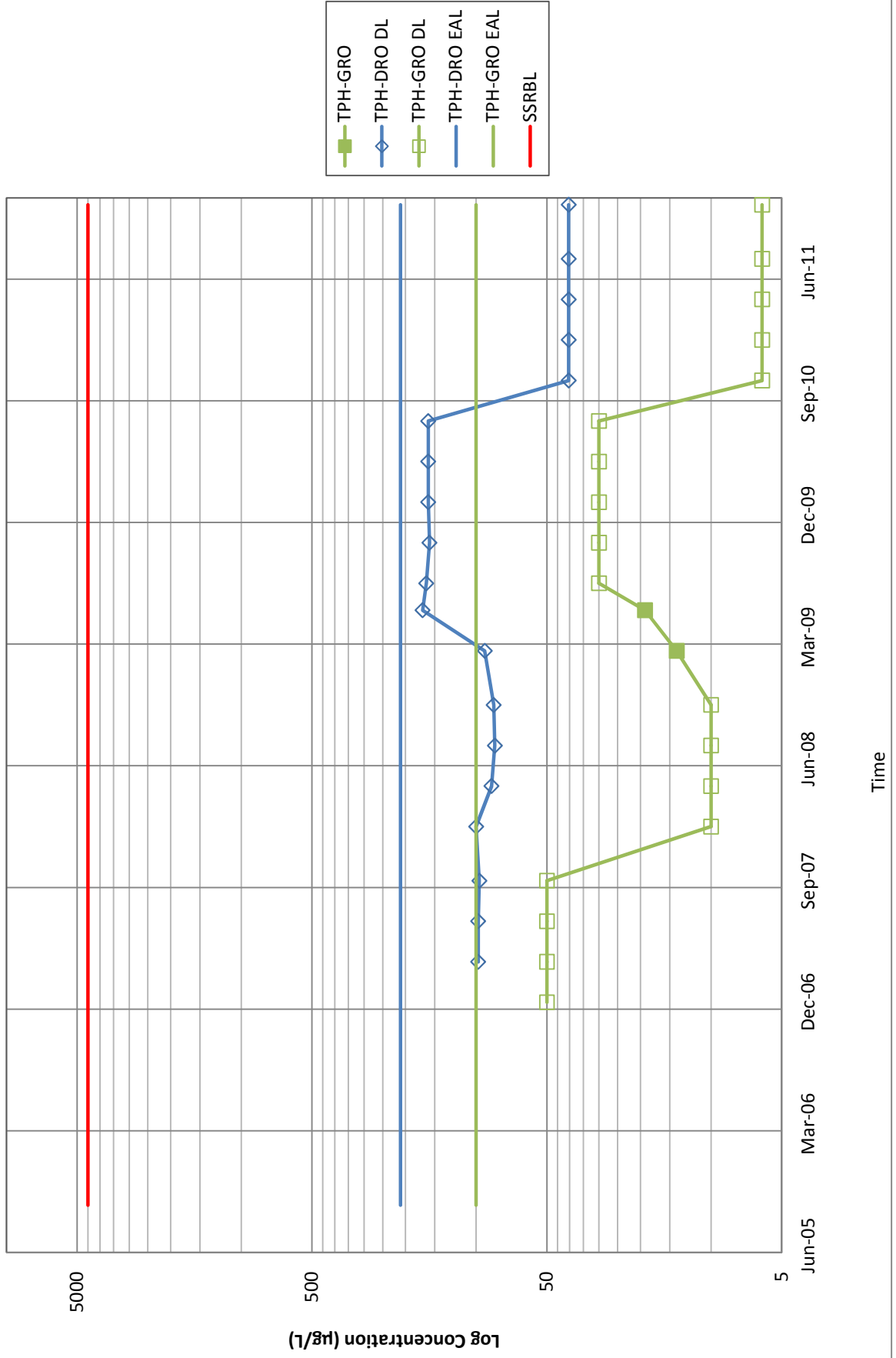
***Appendix B***

***Quarterly Groundwater Monitoring Results for  
TPH and PAHs, September 2005 through  
October-November 2011***

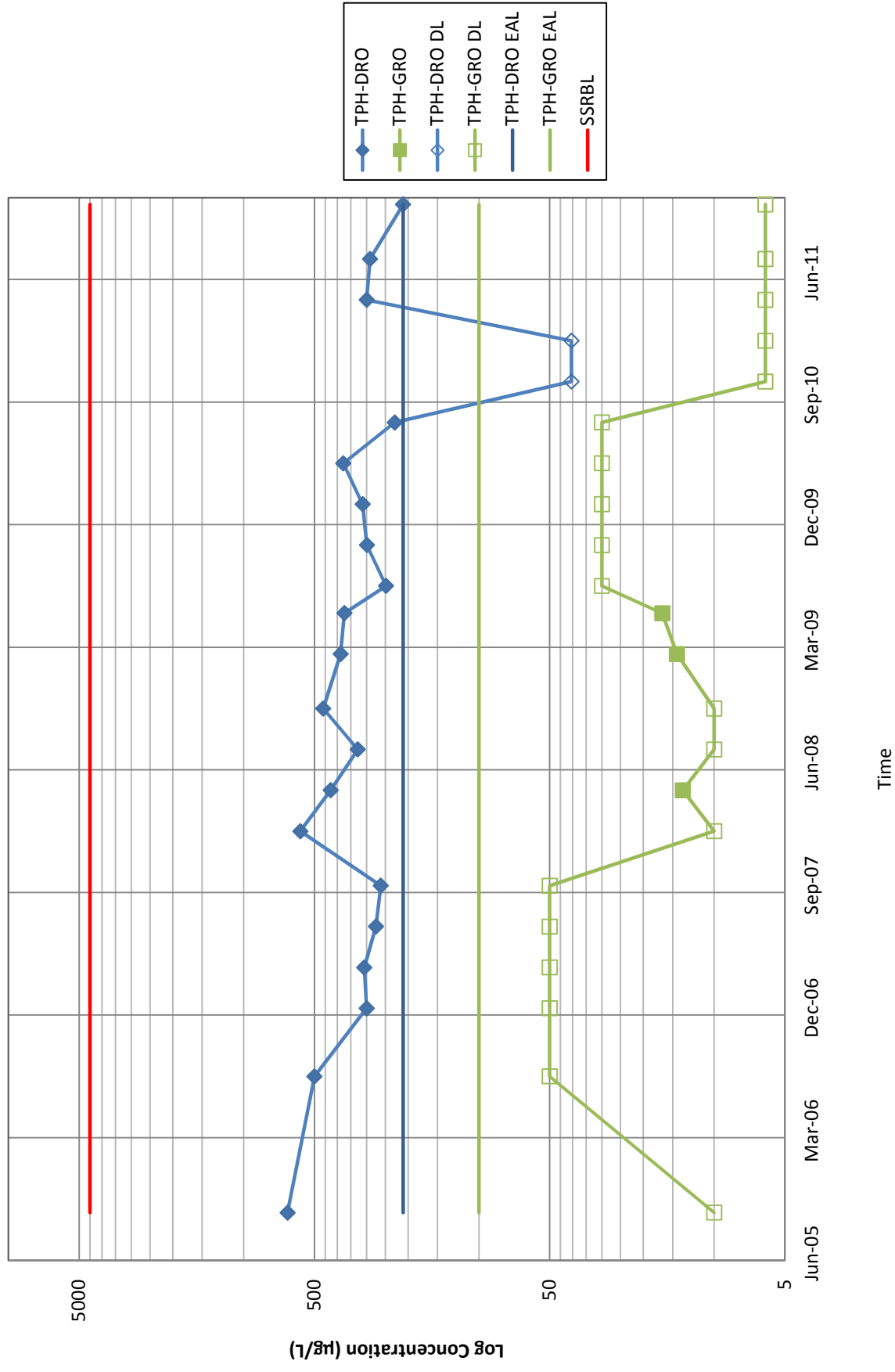




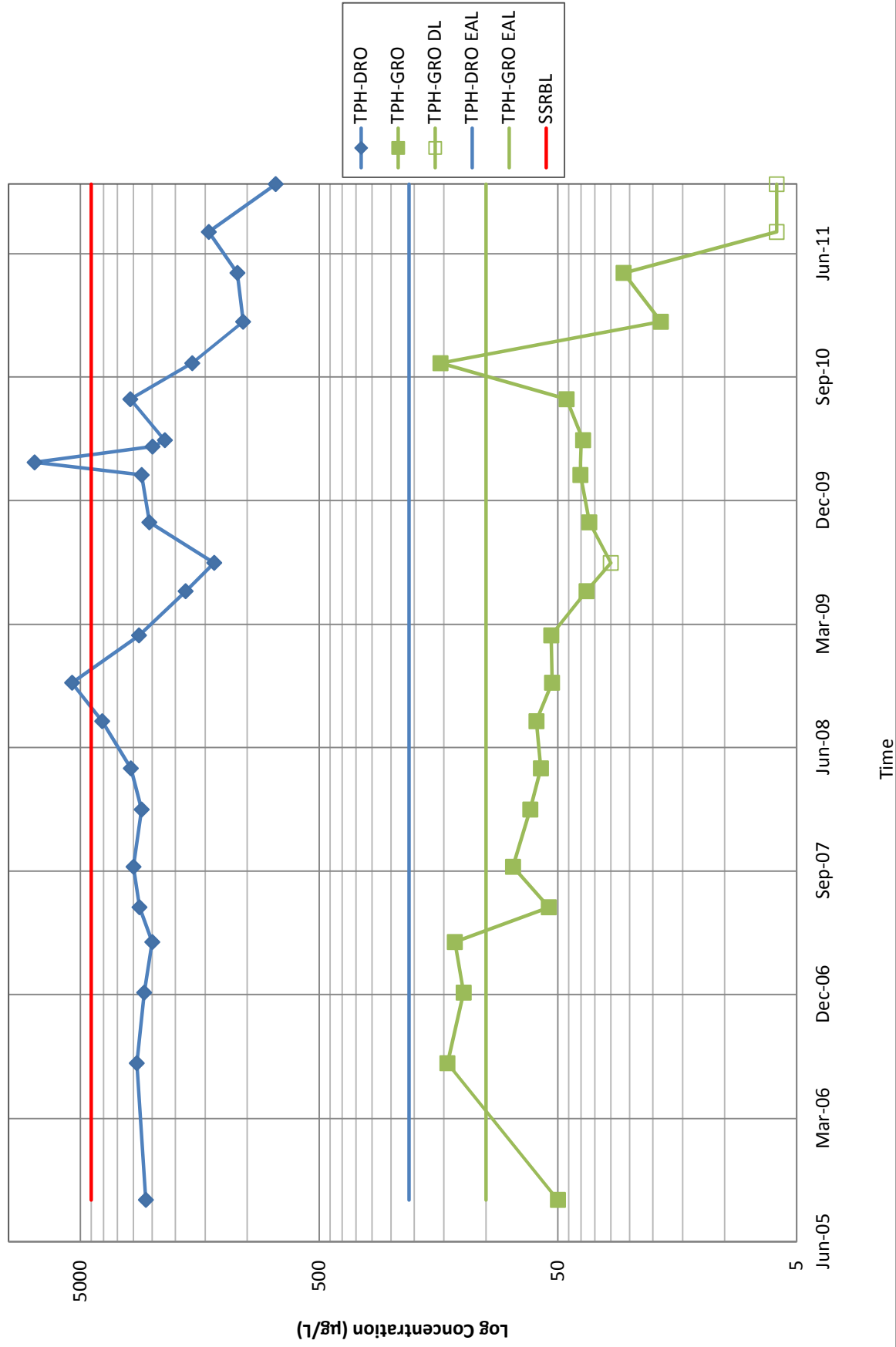
**Figure A-1: TPH at RHMW2254-01  
Quarterly Monitoring Results**



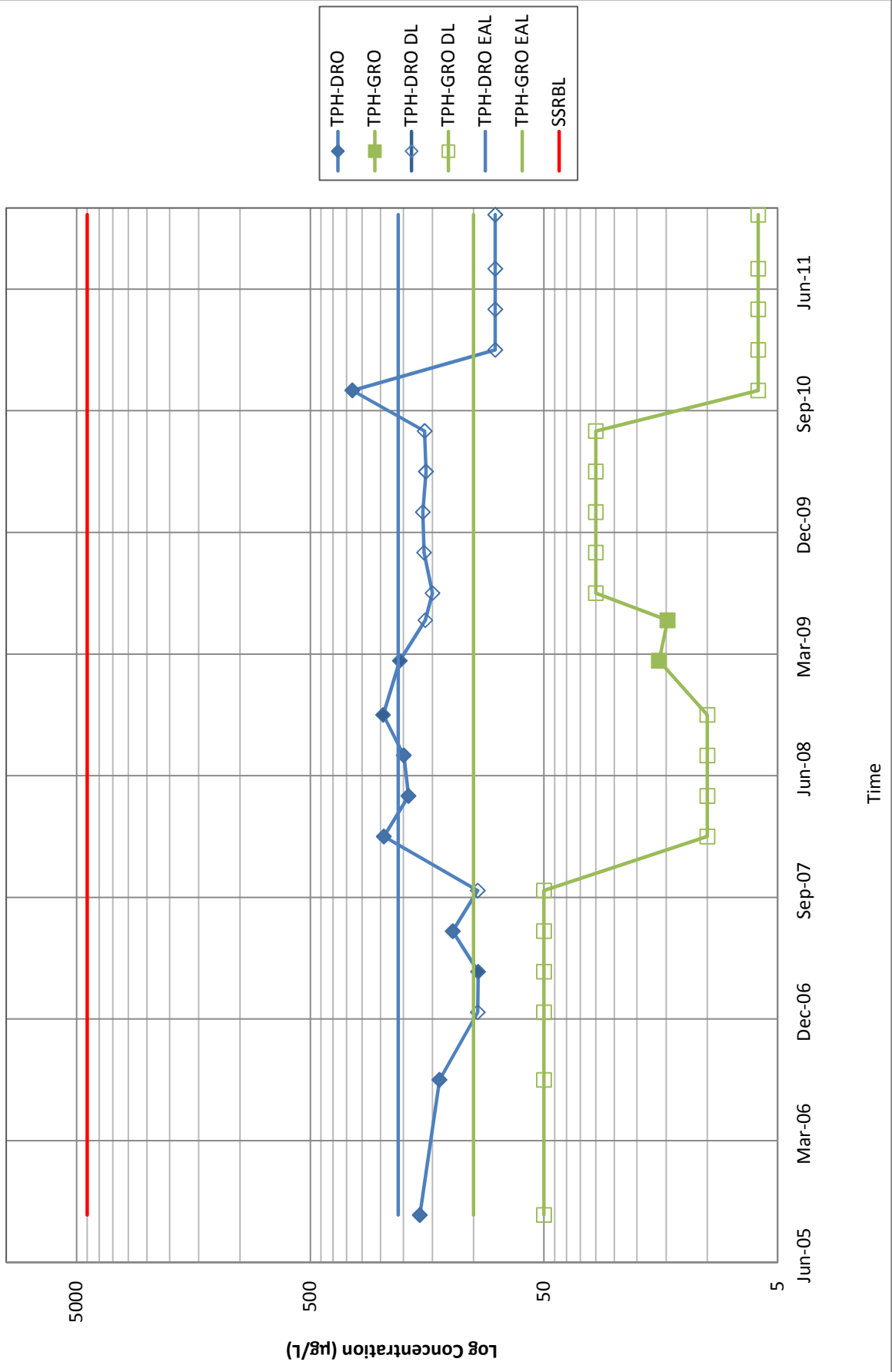
**Figure A-2: TPH at RHMW01  
Quarterly Monitoring Results**



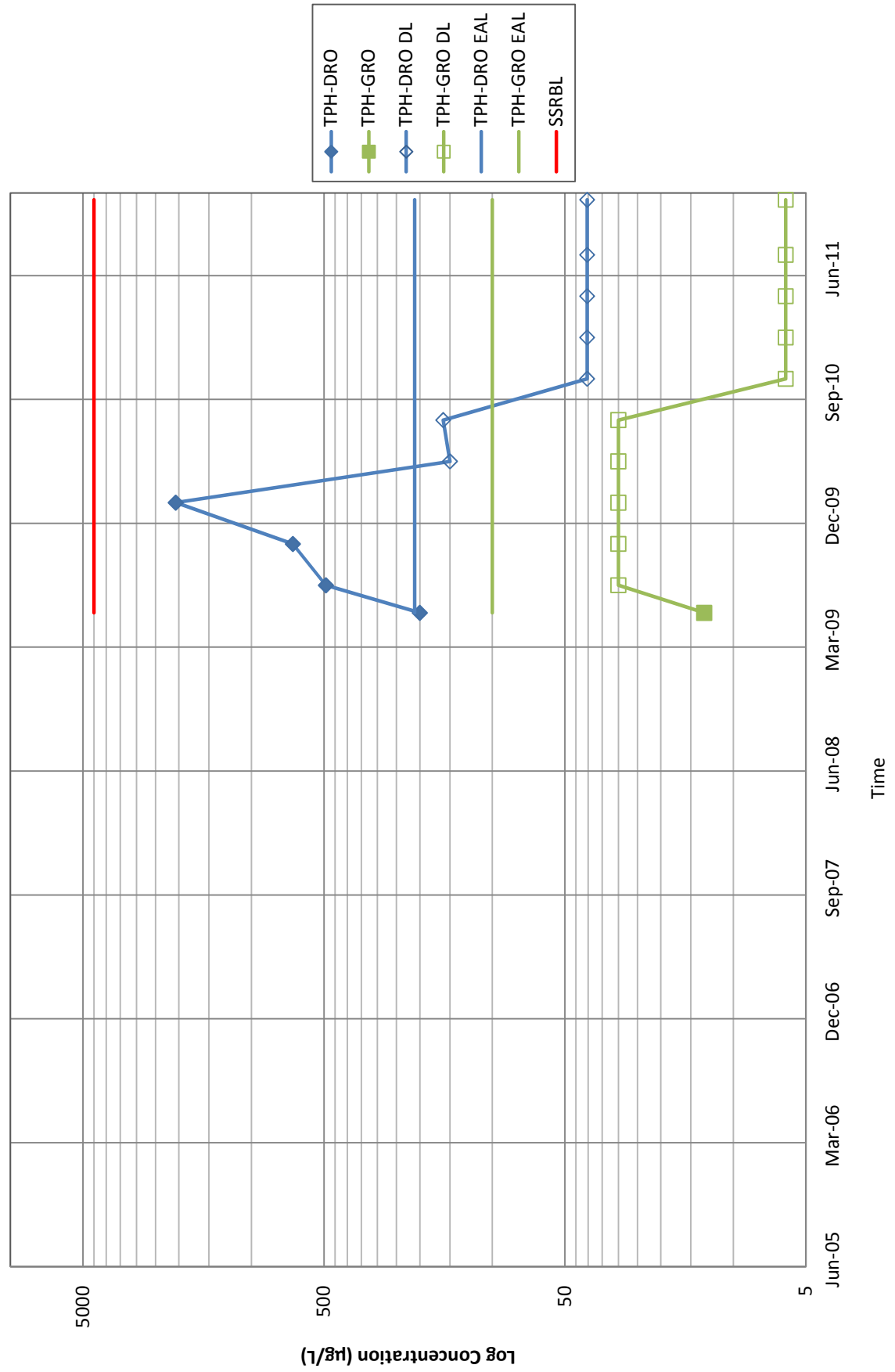
**Figure A-3: TPH at RHMW02  
Quarterly Monitoring Results**



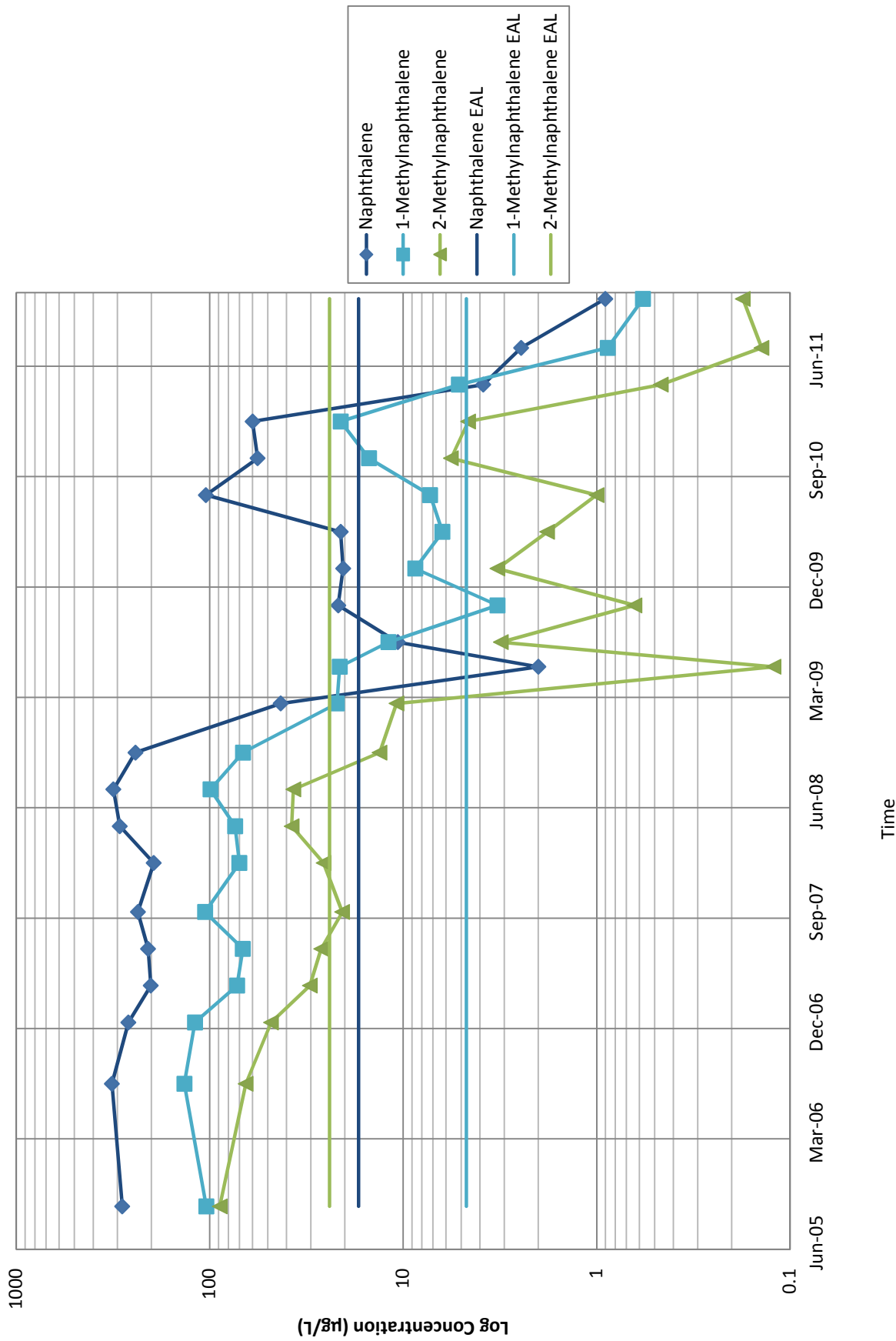
**Figure A-4: TPH at RHMW03  
Quarterly Monitoring Results**



**Figure A-5: TPH at RHMW05  
Quarterly Monitoring Results**



**Figure A-6: PAHs at RHMW02  
Quarterly Monitoring Results**



***Appendix C***  
***Field Notebook, October-November 2011***





10-24-11 1022-024

Activity - 6W Sampling  
Personnel: SF, CA

PPE: Level D

0640 Met at Dole office.

0700 Left Dole office for Storage.

0730 Stopped by gas station for ice.

0800 arrive at front Red Hill

gate

0808 Start unloading truck into tunnel.

0830 SConducted H+SM at tailgate.

0837 Train Arrived to pick us up and drop off at RHMW02.

0900 Calibrate PID PID reading 0.1 ppm

0930 Calibrated Horiba

0935 started purging

0955 Sampled MW02 collected Dup + MSMSD.

1150 Took Lunch. While waiting to Adit 5 train operator notified us that the elevator is broken + Adit 3 is the only way in + out.

1240 Continue sampling at MW02

1350 Called for train pickup.

Arrive at RHMW03

1415 Started purging after initial H<sub>2</sub>O level + PID readings1435 collected sample after taking H<sub>2</sub>O level

1515 train pickup from RHMW03

1600 Arrive at Ocean legends to refill scuba tanks.

1630 Arrive at office

study system  
for

10/25/11

Activity GW Sampling  
Personnel CA, SF  
PPE Level D  
0700 Met out of office  
0720 Left office stop at Storage  
0730 Pick up ice  
0800 Arrive at Front Gate. Vehicle  
license plates were not on  
guard list.  
0830 Arrive at Adit 3 meet  
Levi and load train  
0850 Arrive at pump station  
0900 Calibrate PID  
0911 Health + Safety Meeting  
conducted by SF.  
0915 Calibrate Horiba  
0924 Started purging pump station  
0950 Sampled ESO50  
1045 PID at RHMWS is 0-0 test initial  
depth at 63-15 ft.  
1130 Sampled RHMWS  
1210 Arrived at MWOL. Checked pump  
pump is working. Having problems  
purging.

10/25/11

1022-024

1328 Called train for Lunch.  
1400 Called for train to pick up from  
Lunch  
1420 packed up  
1500 Left tunnels.  
1540 Arrived in office. Going to  
check tubing and pump  
malfunctions in office.

Wendy  
and Jeff

- 1108 : Start purging @ SV10  
 1104: Completed measurements @ SV10  
 1115: Start purging @ SV11  
 1126 Completed measurements @ SV11  
 1128 start purging @ SV12  
 1138 Completed measurements @ SV12  
 1152 Start purging @ SV13  
 1208 Completed measurements @ SV13  
 1203 Start purging @ SV14  
 1216 Completed measurements @ SV14  
 1217 Start purging @ SV15  
 1228 Completed measurements @ SV15  
 1230 Start purging @ SV16  
 1240 Completed measurements @ SV16  
 1247 Start purging @ SV18  
 1255 Completed measurements @ SV18  
 1256 Start Purging @ SV20  
 1309 Completed measurements @ SV20  
 1315 Left tunnel  
 1410 Arrived @ Dole Office

Measuring  
 End of Entry

11/2/11

- Task: Groundwater monitoring +  
 Sampling @ RHMW01  
 Personnel: SK + VD  
 PPE:  
 720 Left Dole Office to Storage  
 740 Turned on Honiba  
 742 Left Storage, pick-up ice  
 815 Arrived @ Adit 3 RHSIF  
 820 Calibrated Honiba  
 0908 talk to Teddy, wait to fix  
 train.  
 0944 train arrive  
 0956 arrive @ RHMW01  
 1014 PIP = 0.0 ppm  
 1016 DTW = 83.71 ft  
 1029 begin purging @ RHMW01  
 1105 collect ES057 @ 1105  
 1159 DTW = 83.68 ft  
 1221 Train pickup  
 1230 Leave Red Hill  
 1335 FedEx to ship samples  
 + equipment  
 1355 Return scuba tanks  
 1405 Storage to return equipment  
 + materials.

1420 Fill gas @ Aloha Dillingham  
1500 Arrived @ Dale Office

Mark  
End of Evening

11/22/11

TASK: sump monitoring  
Personnel; MS, CA

8:40 - arrive at adict 5

conduct H<sub>2</sub>S meeting ✓

calibrate Ppb RnE; Cal. Successful ✓

~~A~~

8:55 - enter adict 5.

9:04 - sample purge SV 20

9:12 - Finish sample SV 20

9:14 - Purge SV 18

9:24 - Finish sample @ SV 18

9:28 - Purge SV 16

9:41 - Finish sample @ SV 16

9:43 - Purge SV 15

9:51 - Finish sample @ SV 15

9:55 - purge SV 14

10:04 - finish sample @ SV 14

10:07 - Purge SV 13

10:16 - finish sample SV 13

10:21 - Purge SV 12

10:30 - finish sample @ SV 12

10:35 - Purge SV 11

10:38 - finish sample @ SV 11

10:42 - Purge SV 10

10:49 - finish sample @ SV 10

***Appendix D***  
***Groundwater Sampling Logs,***  
***October-November 2011***



GROUNDWATER SAMPLING LOG

WELL ID: RHMW2254-01 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-024
INITIAL WATER LEVEL: not applicable (N/A) DATE: 10/25/2011 TIME: 0930
TOTAL DEPTH OF WELL: unknown PERSONNEL INVOLVED: CA, SF
LENGTH OF SATURATED ZONE: N/A WEATHER CONDITIONS: N/A
VOLUME OF WATER TO BE REMOVED: N/A METHOD OF REMOVAL: Low flow dedicated bladder pump
WATER LEVEL AFTER PURGING: N/A PUMPING RATE: 0.5 L/min

WELL PURGE DATA:

Table with 9 columns: TIME, VOLUME REMOVED, pH, COND (mS/cm), TURBIDITY (NTU), DO (mg/l), TEMP (°C), SALINITY (ppt), REDOX (ORP) (mV). Rows include data for times 0932 through 0940.

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump
SAMPLE ID: ES050
SAMPLE COLLECTION TIME: 0950
SAMPLED BY: CA, SF

APPEARANCE OF SAMPLE:
COLOR: Clear
TURBIDITY: Clear
SEDIMENT: None
OTHER: None

COMMENTS AND OBSERVATIONS:

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES: TPH-GRO (EPA 8260B) & VOCs (EPA 8260B) with no preservative, TPH-DRO (EPA8015B) & PAHs (EPA 8270D SIM) with no preservative, dissolved lead (EPA 6020) with nitric acid preservative, and MADEP VPH and EPH with HCl preservative

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED: (4) - 40 mL VOAs, (3) - 1 L amber bottle, (1) - 500 mL polyethylene bottle (2) - 1 L Amber bottles, (3) - 40 mL VOAs

DECONTAMINATION PROCEDURES: Alconox, triple rinse with distilled water
SAMPLES DELIVERED TO: APPL, Inc. via FedEx TRANSPORTERS: JT
SAMPLE DELIVERY DATE: 10/26/2011 SAMPLE DELIVERY TIME: 1400

CAPACITY OF CASING (GALLONS/LINEAR FOOT)
2"-0.16; 4"-0.65; 6"-1.47; 8"-2.61; 10"-4.08; 12"-5.87

**GROUNDWATER SAMPLING LOG**

WELL ID: RHMW01 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-024  
INITIAL WATER LEVEL: 83.71 feet bTOC DATE: 11/2/2011 TIME: 1029  
TOTAL DEPTH OF WELL: 100.00 feet bTOC PERSONNEL INVOLVED: VD, SK  
LENGTH OF SATURATED ZONE: 16.3 feet WEATHER CONDITIONS: N/A  
VOLUME OF WATER TO BE REMOVED: N/A METHOD OF REMOVAL: Low flow bladder pump  
WATER LEVEL AFTER PURGING: 83.68 feet bTOC PUMPING RATE: 0.16 L/min

**WELL PURGE DATA:**

TIME	VOLUME REMOVED	pH	COND (mS/cm)	TURBIDITY (NTU)	DO (mg/l)	TEMP (°C)	SALINITY (%)	REDOX (ORP) (mV)
<u>1039</u>	<u>1L</u>	<u>7.10</u>	<u>0.383</u>	<u>0.1</u>	<u>2.81</u>	<u>23.61</u>	<u>0.2</u>	<u>-117</u>
<u>1043</u>	<u>2L</u>	<u>7.17</u>	<u>0.383</u>	<u>0.3</u>	<u>2.50</u>	<u>23.43</u>	<u>0.2</u>	<u>-125</u>
<u>1048</u>	<u>3L</u>	<u>7.15</u>	<u>0.382</u>	<u>0.2</u>	<u>1.95</u>	<u>23.41</u>	<u>0.2</u>	<u>-124</u>
<u>1053</u>	<u>4L</u>	<u>7.18</u>	<u>0.379</u>	<u>0.4</u>	<u>1.56</u>	<u>23.39</u>	<u>0.2</u>	<u>-124</u>
<u>1100</u>	<u>5L</u>	<u>7.15</u>	<u>0.376</u>	<u>0.3</u>	<u>1.30</u>	<u>23.37</u>	<u>0.2</u>	<u>-120</u>

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump APPEARANCE OF SAMPLE:  
COLOR Clear  
SAMPLE ID: ES057 TURBIDITY Clear  
SAMPLE COLLECTION TIME: 1105 SEDIMENT None  
SAMPLED BY: VD, SK OTHER  

COMMENTS AND OBSERVATIONS: PID = 0.0 ppm

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES: TPH-GRO (EPA 8260B) & VOCs (EPA 8260B) with no preservative, TPH-DRO (EPA8015B) & PAHs (EPA 8270D SIM) with no preservative, dissolved lead (EPA 6020) with nitric acid preservative, and MADEP VPH and EPH with Hcl preservative

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED: (4) - 40 mL VOAs, (3) - 1 L amber bottle, (1) - 500 mL polyethylene bottle

DECONTAMINATION PROCEDURES: Alconox, triple rinse with distilled water  
SAMPLES DELIVERED TO: APPL, Inc. via FedEx TRANSPORTERS: SK  
SAMPLE DELIVERY DATE: 11/2/2011 SAMPLE DELIVERY TIME:  

CAPACITY OF CASING (GALLONS/LINEAR FOOT)  
2"-0.16; 4"-0.65; 6"-1.47; 8"-2.61; 10"-4.08; 12"-5.87



### GROUNDWATER SAMPLING LOG

WELL ID: RHMW02      LOCATION: Red Hill Bulk Fuel Storage Facility      PROJECT NO: 1022-024  
 INITIAL WATER LEVEL: 86.38 feet bTOC      DATE: 10/24/2011      TIME: 0933  
 TOTAL DEPTH OF WELL: unknown      PERSONNEL INVOLVED: SF, CA  
 LENGTH OF SATURATED ZONE: N/A      WEATHER CONDITIONS: N/A  
 VOLUME OF WATER TO BE REMOVED: N/A      METHOD OF REMOVAL: Low flow dedicated bladder pump  
 WATER LEVEL AFTER PURGING: 86.38 feet bTOC      PUMPING RATE: 0.5 L/min

**WELL PURGE DATA:**

TIME	VOLUME REMOVED	pH	COND (mS/cm)	TURBIDITY (NTU)	DO (mg/l)	TEMP (°C)	SALINITY (%)	REDOX (ORP) (mV)
0942	2L	6.54	0.691	0.0	8.52	23.91	0.3	-109
0944	4L	6.54	0.696	0.0	7.83	23.81	0.3	-116
0947	6L	6.56	0.702	0.0	7.25	23.77	0.3	-116
0950	8L	6.56	0.706	0.0	6.50	23.73	0.3	-117
0953	10L	6.57	0.704	0.0	6.10	23.72	0.3	-115
0955	12L	6.57	0.702	0.0	5.84	23.71	0.3	-115

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump      APPEARANCE OF SAMPLE:  
 COLOR Light Brown  
 SAMPLE ID: ES046, ESO 47      TURBIDITY \_\_\_\_\_  
 SAMPLE COLLECTION TIME: 0955, 0830      SEDIMENT \_\_\_\_\_  
 SAMPLED BY: CA, SF      OTHER Petroleum Smell

COMMENTS AND OBSERVATIONS: PID = 0.1 ppm  
 \_\_\_\_\_  
 \_\_\_\_\_

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES: TPH-GRO (EPA 8260B) & VOCs (EPA 8260B) with no preservative, TPH-DRO (EPA8015B) & PAHs (EPA 8270D SIM) with no preservative, dissolved lead (EPA 6020) with nitric acid preservative, and MADEP VPH and EPH with Hcl preservative

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED: Primary and duplicate: (4) - 40 mL VOAs, (3) - 1 L amber bottle, (1) - 500 mL polyethylene bottle MS/MSD: (7) - 40 mL VOAs, (6) - 1 L amber bottle, (2) - 500 mL polyethylene bottle

DECONTAMINATION PROCEDURES: Alconox, triple rinse with distilled water  
 SAMPLES DELIVERED TO: APPL, Inc. via FedEx      TRANSPORTERS: JT  
 SAMPLE DELIVERY DATE: 10/25/2011      SAMPLE DELIVERY TIME: \_\_\_\_\_

CAPACITY OF CASING (GALLONS/LINEAR FOOT)  
 2"-0.16; 4"-0.65; 6"-1.47; 8"-2.61; 10"-4.08; 12"-5.87

### GROUNDWATER SAMPLING LOG

WELL ID:   RHMW03   LOCATION:   Red Hill Bulk Fuel Storage Facility   PROJECT NO:   1022-024    
INITIAL WATER LEVEL:   102.9 feet   DATE:   10/24/2011   TIME:   1415    
TOTAL DEPTH OF WELL:   unknown   PERSONNEL INVOLVED:   SF, CA    
LENGTH OF SATURATED ZONE:   N/A   WEATHER CONDITIONS:   N/A    
VOLUME OF WATER TO BE REMOVED:   N/A   METHOD OF REMOVAL:   Low flow dedicated bladder pump    
WATER LEVEL AFTER PURGING:   103.1 feet   PUMPING RATE:   0.4 L/min  

**WELL PURGE DATA:**

TIME	VOLUME REMOVED	pH	COND (mS/cm)	TURBIDITY (NTU)	DO (mg/l)	TEMP (°C)	SALINITY (%)	REDOX (ORP) (mV)
<u>  1419  </u>	<u>  2 L  </u>	<u>  6.89  </u>	<u>  0.793  </u>	<u>  41  </u>	<u>  2.83  </u>	<u>  26.83  </u>	<u>  0.4  </u>	<u>  82  </u>
<u>  1425  </u>	<u>  4 L  </u>	<u>  6.81  </u>	<u>  0.812  </u>	<u>  5.6  </u>	<u>  2.69  </u>	<u>  27.19  </u>	<u>  0.4  </u>	<u>  84  </u>
<u>  1429  </u>	<u>  5 L  </u>	<u>  6.82  </u>	<u>  0.811  </u>	<u>  6.9  </u>	<u>  2.72  </u>	<u>  27.10  </u>	<u>  0.4  </u>	<u>  51  </u>
<u>  1431  </u>	<u>  6 L  </u>	<u>  6.85  </u>	<u>  0.806  </u>	<u>  3.1  </u>	<u>  2.25  </u>	<u>  26.80  </u>	<u>  0.4  </u>	<u>  38  </u>
<u>  1433  </u>	<u>  7 L  </u>	<u>  6.86  </u>	<u>  0.802  </u>	<u>  0.0  </u>	<u>  2.20  </u>	<u>  26.69  </u>	<u>  0.4  </u>	<u>  39  </u>

SAMPLE RETRIEVAL METHOD:   Low flow dedicated bladder pump   APPEARANCE OF SAMPLE:  
COLOR   Clear    
SAMPLE ID:   ES049   TURBIDITY             
SAMPLE COLLECTION TIME:   1435   SEDIMENT             
SAMPLED BY:   SF, CA   OTHER           

COMMENTS AND OBSERVATIONS:   PID = 0.1 ppm    
\_\_\_\_\_  
\_\_\_\_\_

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES:   TPH-GRO (EPA 8260B) & VOCs (EPA 8260B) with no preservative,    
  TPH-DRO (EPA8015B) & PAHs (EPA 8270D SIM) with no preservative, and dissolved lead (EPA 6020) with nitric acid preservative, and MADEP VPH and EPH with Hcl preservative  

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED:   (4) - 40 mL VOAs, (3) - 1 L amber bottle, (1) - 500 mL polyethylene bottle    
\_\_\_\_\_

DECONTAMINATION PROCEDURES:   Alconox, triple rinse with distilled water    
SAMPLES DELIVERED TO:   APPL, Inc. via FedEx   TRANSPORTERS:   JT    
SAMPLE DELIVERY DATE:   10/25/2011   SAMPLE DELIVERY TIME:           

CAPACITY OF CASING (GALLONS/LINEAR FOOT)  
2"-0.16; 4"-0.65; 6"-1.47; 8"-2.61; 10"-4.08; 12"-5.87

GROUNDWATER SAMPLING LOG

WELL ID: RHMW05 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-024
INITIAL WATER LEVEL: 83.15 feet DATE: 10/25/2011 TIME: 1045
TOTAL DEPTH OF WELL: unknown PERSONNEL INVOLVED: CA, SF
LENGTH OF SATURATED ZONE: N/A WEATHER CONDITIONS: N/A
VOLUME OF WATER TO BE REMOVED: N/A METHOD OF REMOVAL: Low flow dedicated bladder pump
WATER LEVEL AFTER PURGING: 83.13 feet PUMPING RATE: 0.3 L/min

WELL PURGE DATA:

Table with 9 columns: TIME, VOLUME REMOVED, pH, COND (mS/cm), TURBIDITY (NTU), DO (mg/l), TEMP (°C), SALINITY (%), REDOX (ORP) (mV). Rows include data for times 1110 through 1126.

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump APPEARANCE OF SAMPLE:
COLOR Clear
SAMPLE ID: ES051 TURBIDITY
SAMPLE COLLECTION TIME: 1130 SEDIMENT
SAMPLED BY: CA, SF OTHER

COMMENTS AND OBSERVATIONS: PID = 0.0 ppm

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES: TPH-GRO (EPA 8260B) & VOCs (EPA 8260B) with no preservative, TPH-DRO (EPA8015B) & PAHs (EPA 8270D SIM) with no preservative, and dissolved lead (EPA 6020) with nitric acid preservative, and MADEP VPH and EPH with Hcl preservative

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED: (4) - 40 mL VOAs, (3) - 1 L amber bottle, (1) - 500 mL polyethylene bottle

DECONTAMINATION PROCEDURES: Alconox, triple rinse with distilled water
SAMPLES DELIVERED TO: APPL, Inc. via FedEx TRANSPORTERS: JT
SAMPLE DELIVERY DATE: 10/26/2011 SAMPLE DELIVERY TIME:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)
2"-0.16; 4"-0.65; 6"-1.47; 8"-2.61; 10"-4.08; 12"-5.87



***Appendix E***  
***Laboratory Analytical Results,***  
***October-November 2011 (on CD-ROM)***