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

March 2012

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

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

March 2012

Prepared for:

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

Prepared by:

Environet, Inc.
650 Iwilei Road, Suite 204
Honolulu, HI 96817-5318

Prepared under:

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

Table of Contents

Tables

Figures

Appendices

List of Acronyms

<	less than
%	percent
µg/L	micrograms per liter
B	The analyte was found in a method blank, as well as in the sample.
COPC	chemical of potential concern
DL	detection limit or method detection limit (MDL)
DLNR	Department of Land and Natural Resources
DOH	State of Hawaiʻi 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
F-76	marine diesel fuel
FLC	Fleet Logistics Center
GRO	gasoline range organics
HAR	Hawaiʻi 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)
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
NAVSUP	United States Naval Supply Systems Command
ND	not detected
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

Executive Summary

This report documents the results of the quarterly groundwater monitoring performed in January-February 2012 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 January 26, and, February 1 and 14, 2012 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.

January-February 2012 Groundwater Monitoring Results

Laboratory analytical results indicated that total petroleum hydrocarbons (TPH)-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 [μg/L]) was detected at a concentration equal to the DOH Drinking Water EAL, and exceeded the DOH Groundwater Gross Contamination EAL. Methylene chloride (0.59 μg/L) was detected at an estimated concentration 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 (1,700 μg/L) was detected at a concentration which exceeded the DOH Drinking Water and Gross Contamination groundwater EALs. Acenaphthene (0.29 μg/L), fluorene (0.21 μg/L), 1-methylnaphthalene (0.57 μg/L), and naphthalene (1.70 μg/L) were detected at concentrations below the DOH Drinking Water EALs. Acenaphthylene (0.089 μg/L), 2-methylnaphthalene (0.17 μg/L), ethylbenzene (0.30 μg/L), and lead (0.17 μg/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 (0.14 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).

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 five 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 eight 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 concentration increased slightly in April 2011 to a detected concentration of 24 µg/L, which was below the EAL. TPH-GRO was not detected above the LODs and LOQs in July 2011, October-November 2011, and January-February 2012 groundwater monitoring events.

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, October-November 2011, and January-February 2012 groundwater monitoring events. 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, October-November 2011, and January-February 2012 groundwater monitoring events.

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 eight 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 four 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.

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 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.

This page is intentionally left blank.

Section 1 Introduction

This report presents the results of the 26th groundwater monitoring event conducted in January-February 2012 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 January-February 2012 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 Hālawa Heights (Figure 1-1). Land adjacent to the north of the RHSF is occupied by the Hālawa 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).

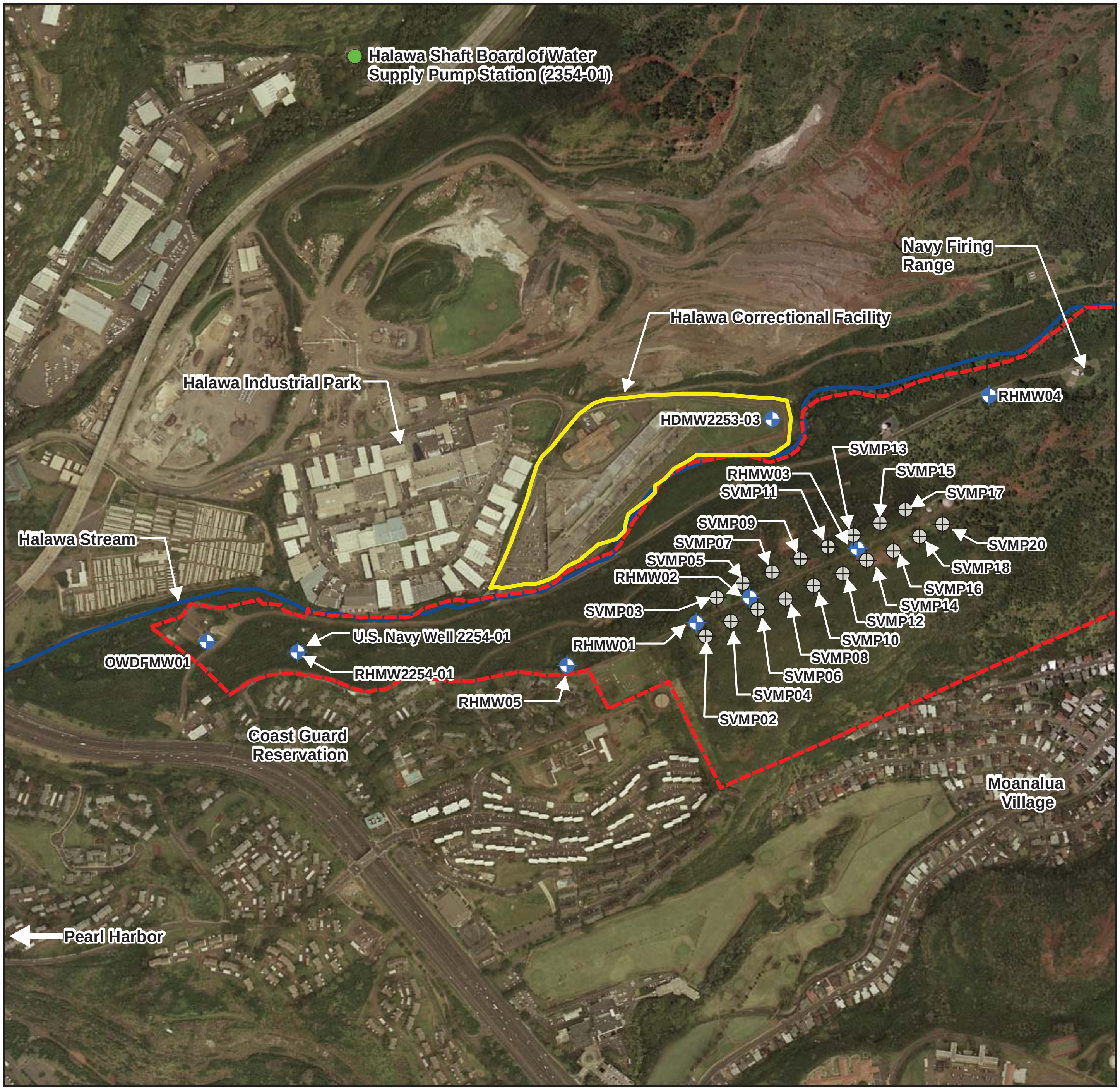
1.2.3 UST Information

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

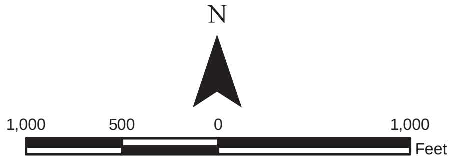


Figure 1-1
Groundwater Monitoring Well Location Map
Quarterly Groundwater Monitoring Report,
Red Hill Bulk Fuel Storage Facility,
JBPHH, O'ahu, Hawai'i

This page is intentionally left blank.

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);
24. Groundwater Monitoring Results, July 2011 (submitted September 2011); and
25. Groundwater Monitoring Results, October 2011 (submitted December 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 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, July, and October 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, July, and October 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 and October 2011;
- TPH-DRO and 1-methylnaphthalene were detected at concentrations which exceeded the EALs in samples collected from RHMW02 in January and April 2011. In July and October 2011, TPH-DRO was detected at concentrations which exceeded the EAL, and 1-methylnaphthalene was detected at concentrations which were below the EAL;
- naphthalene was detected at a concentration which exceeded the EAL in samples collected from RHMW02 in January 2011, however in April, July, and October 2011 naphthalene was detected at concentrations below the EAL;
- acenaphthene and 2-methylnaphthalene were detected at concentrations below the EALs at RHMW02 in January, July, and October 2011;
- TPH-GRO and 2-methylnaphthalene were detected at concentrations below the EALs at RHMW02 in April 2011, and 2-methylnaphthalene was detected at estimated concentrations below that EAL in July and October 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-methylnaphthale 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 January 26, and, February 1 and 14, 2012 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 four monitoring wells prior to purging and sample collection. A Solinst® 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® 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, directly into laboratory provided specially cleaned sample containers. Samples to be analyzed for dissolved lead were filtered in the field, and placed into polyethylene bottles already containing the appropriate preservative.

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® 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, and dissolved lead by EPA Method 6020.

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® oil/water interface probe and Horiba® 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.

This page is intentionally left blank.

Section 3 Groundwater Monitoring Results

This section provides a summary of analytical results for groundwater samples collected from the five monitoring wells on January 26, and, February 1 and 14, 2012. 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 January-February 2012 sampling event. The trend of free product measurements over time shows 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 detection 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). All other COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix E).

RHMW02

TPH-DRO was detected at a concentration of 1,700 µg/L which exceeded the DOH Drinking Water EAL (210 µg/L) and the DOH Groundwater Gross Contamination EAL (100 µg/L) (Table 3-2 and Appendix E). Acenaphthene (0.29 µg/L), fluorene (0.21 µg/L), 1-methylnaphthalene (0.57 µg/L), and naphthalene (1.70 µg/L) were detected at concentrations below the DOH Drinking Water EALs. Acenaphthylene (0.089 µg/L), 2-methylnaphthalene (0.17 µg/L), ethylbenzene (0.30 µg/L), and lead (0.17 µg/L) were detected at estimated concentrations below the DOH Drinking Water EALs. All other COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix E).

RHMW03

Dissolved lead (0.14 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).

RHMW05

In monitoring well RHMW05, all COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix E).

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 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 DOH Drinking Water EAL in April 2011 and July 2011, and at the EAL in October-November 2011 and January-February 2012 (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.

Table 3-1: Red Hill Oil/Water Interface Measurements, September 2007 through January-February 2012

	RHMW01			RHMW02			RHMW03			RHMW05		
	Elevation[1] = 102.27			Elevation[1] = 104.76			Elevation[1] = 121.06			Elevation[1] = 101.55		
Date	DTW (TOC)	SWL	LNAPL	DTW (TOC)	SWL	LNAPL	DTW (TOC)	SWL	LNAPL	DTW (TOC)	SWL	LNAPL
Sep-2007	NT[2]	NT[2]	NT[2]	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[3]	NT[3]	NT[3]	~	~	~
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[4]	NT[4]	NT[4]	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[5]	83.72	18.55	0.00	86.37	18.39	0.00	102.59	18.47	0.00	NT[6]	NT[6]	NT[6]
May-2009	83.50	18.77	0.00	86.15	18.61	0.00	102.41	18.65	0.00	NT[6]	NT[6]	NT[6]
Jul-2009[7]	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
Jan-2012	83.75	18.52	0.00	86.31	18.45	0.00	102.56	18.50	0.00	83.15	18.40	0.00

Notes:

[1] 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.*

[2] A measurement was not taken at RHMW01 in September 2007.

[3] A measurement was not taken at RHMW03 in January 2008 due to equipment malfunction.

[4] A measurement was not taken at RHMW01. The monitoring well was inaccessible due to extensive work being conducted at Tank 02.

[5] The April 2009 measurements were pushed back a week (to 5/6/09) due to RHMW05 installation.

[6] Measurements were not taken at RHMW05 until the installation of the dedicated oil/water interface probe was completed.

[7] 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

Table 3-2: Analytical Results for Quarterly Groundwater Monitoring, January-February 2012

Method	Chemical	DOH Drinking Water EALs for Human Toxicity[a]	DOH Groundwater Gross Contamination EALs[a]	RHMW2254-01 (ES062)					RHMW01 (ES069)					RHMW02 (ES061)					RHMW03 (ES060)					RHMW05 (ES063)				
				Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL
EPA 8015B (Petroleum)	TPH-DRO	210	100	ND	U	150[b]	80.8	40.4	210	++	150[b]	80.8	40.4	**1,700**	++	150[b]	80.8	40.4	ND	U	150[b]	80.8	40.4	ND	U	150[b]	80.8	40.4
EPA 8260 B (Petroleum)	TPH-GRO	100	100	ND	U	20.0	12.12	6.06	ND	U	20.0	12.12	6.06	ND	U	20.0	12.12	6.06	ND	U	20.0	12.12	6.06	ND	U	20.0	12.12	6.06
EPA 8270D SIM (PAHs)	Acenaphthene	370	20	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0.29		0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06
	Acenaphthylene	240	2,000	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0.089	J	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06
	Anthracene	1,800	22	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05
	Benzo(a)anthracene	0.092	4.7	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07
	Benzo(g,h,i)perylene	1,500	0.13	ND	U	0.2[b]	0.16	0.08	ND	U	0.2[b]	0.16	0.08	ND	U	0.2[b]	0.16	0.08	ND	U	0.2[b]	0.16	0.08	ND	U	0.2[b]	0.16	0.08
	Benzo(a)pyrene	0.2	0.81	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06
	Benzo(b)fluoranthene	0.092	0.75	ND	U	0.2[b]	0.12	0.06	ND	U	0.2[b]	0.12	0.06	ND	U	0.2[b]	0.12	0.06	ND	U	0.2[b]	0.12	0.06	ND	U	0.2[b]	0.12	0.06
	Benzo(k)fluoranthene	0.92	0.4	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07
	Chrysene	9.2	1	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05
	Dibenzo(a,h)anthracene	0.0092	0.52	ND	U	0.2[b]	0.10	0.05	ND	U	0.2[b]	0.10	0.05	ND	U	0.2[b]	0.10	0.05	ND	U	0.2[b]	0.10	0.05	ND	U	0.2[b]	0.10	0.05
	Fluoranthene	1,500	130	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08
	Fluorene	240	950	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0.21		0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06
	Indeno(1,2,3-cd)pyrene	0.092	0.095	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07
	1-Methylnaphthalene	4.7	10	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0.57		0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06
	2-Methylnaphthalene	24	10	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0.17	J	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06
	Naphthalene	17	21	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	1.70		0.2	0.10	0.05	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05
	Phenanthrene	240	410	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07
	Pyrene	180	68	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08
EPA 8260 B (VOCs)	1,1,1-Trichloroethane	200	970	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14
	1,1,2-Trichloroethane	5	50,000	ND	U	1.0	0.40	0.20	ND	U	1.0	0.40	0.20	ND	U	1.0	0.40	0.20	ND	U	1.0	0.40	0.20	ND	U	1.0	0.40	0.20
	1,1-Dichloroethane	2.4	50,000	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19
	1,1-Dichloroethylene (1,1-Dichloroethene)	7	1,500	ND	U	1.0	0.60	0.30	ND	U	1.0	0.60	0.30	ND	U	1.0	0.60	0.30	ND	U	1.0	0.60	0.30	ND	U	1.0	0.60	0.30
	1,2,3-Trichloropropane	0.6	50,000	ND	U	2.0[b]	0.78	0.39	ND	U	2.0[b]	0.78	0.39	ND	U	2.0[b]	0.78	0.39	ND	U	2.0[b]	0.78	0.39	ND	U	2.0[b]	0.78	0.39
	1,2,4-Trichlorobenzene	70	3,000	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21
	1,2-Dibromo-3-chloropropane	0.04	10	ND	U	2.0[b]	1.52	0.76	ND	U	2.0[b]	1.52	0.76	ND	U	2.0[b]	1.52	0.76	ND	U	2.0[b]	1.52	0.76	ND	U	2.0[b]	1.52	0.76
	1,2-Dibromoethane	0.0065	50,000	ND	U	1.0[b]	0.40	0.20	ND	U	1.0[b]	0.40	0.20	ND	U	1.0[b]	0.40	0.20	ND	U	1.0[b]	0.40	0.20	ND	U	1.0[b]	0.40	0.20
	1,2-Dichlorobenzene	600	10	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17
	1,2-Dichloroethane	0.15	7,000	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14
	1,2-Dichloropropane	5	10	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17
	1,3-Dichlorobenzene	180	50,000	ND	U	1.0	0.22	0.11	ND	U	1.0	0.22	0.11	ND	U	1.0	0.22	0.11	ND	U	1.0	0.22	0.11	ND	U	1.0	0.22	0.11
	1,3-Dichloropropene (total of cis/trans)	0.43	50,000	ND	U	1.0[b]	0.36	0.18	ND	U	1.0[b]	0.36	0.18	ND	U	1.0[b]	0.36	0.18	ND	U	1.0[b]	0.36	0.18	ND	U	1.0[b]	0.36	0.18
	1,4-Dichlorobenzene	75	5	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19
	Acetone	22,000	20,000	ND	U	10.0	1.90	0.95	ND	U	10.0	1.90	0.95	ND	U	10.0	1.90	0.95	ND	U	10.0	1.90	0.95	ND	U	10.0	1.90	0.95
	Benzene	5	170	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16
	Bromodichloromethane	0.22	50,000	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14
	Bromoform	100	510	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14
	Bromomethane	8.7	50,000	ND	U	2.0	0.48	0.24	ND	U	2.0	0.48	0.24	ND	U	2.0	0.48	0.24	ND	U	2.0	0.48	0.24	ND	U	2.0	0.48	0.24
	Carbon Tetrachloride	5	520	ND	U	1.0	0.20	0.10	ND	U	1.0	0.20	0.10	ND	U	1.0	0.20	0.10	ND	U	1.0	0.20	0.10	ND	U	1.0	0.20	0.10
	Chlorobenzene	100	50	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21
	Chloroethane	8,600	16	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21
	Chloroform	70	2,400	ND	U	1.0	0.14	0.07	ND	U	1.0	0.14	0.07	ND	U	1.0	0.14	0.07	ND	U	1.0	0.14	0.07	ND	U	1.0	0.14	0.07
	Chloromethane	1.8	50,000	ND	U	1.0	0.84	0.42	ND	U	1.0	0.84	0.42	ND	U	1.0	0.84	0.42	ND	U	1.0	0.84	0.42	ND	U	1.0	0.84	0.42
	cis-1,2-Dichloroethylene (cis-1,2-Dichloroethene)	70	50,000	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16
	Dibromochloromethane (Chlorodibromomethane)	0.16	50,000	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19
	Ethylbenzene	700	30	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	0.30	J	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23
	Hexachlorobutadiene	0.86	6	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19
	Methyl ethyl ketone (2-Butanone)	7,100	8,400	ND	U	10.0	1.20	0.60	ND	U	10.0	1.20	0.60	ND	U	10.0	1.20	0.60	ND	U	10.0	1.20	0.60	ND	U	10.0	1.20	0.60
	Methyl isobutyl ketone (4-Methyl-2-pentanone)	2,000	1,300	ND	U	10.0	3.80	1.90	ND	U	10.0	3.80	1.90	ND	U	10.0	3.80	1.90	ND	U	10.0	3.80	1.90	ND	U	10.0	3.80	1.90
	Methyl tert-butyl Ether	12	5	ND	U	1.0	0.52	0.26	ND	U	1.0	0.52	0.26	ND	U	1.0	0.52	0.26	ND	U	1.0	0.52	0.26	ND	U	1.0	0.52	0.26
	Methylene chloride	4.8	9,100	ND	U	5.0[b]	0.70	0.35	0.59	B J	5.0[b]	0.70	0.35	ND	U	5.0[b]	0.70	0.35	ND	U	5.0[b]	0.70	0.35	ND	U	5.0[b]	0.70	0.35
	Styrene	100	10	ND	U	1.0	0.50	0.25	ND	U	1.0	0.50	0.25	ND	U	1.0	0.50	0.25	ND	U	1.0	0.50	0.25	ND	U	1.0	0.50	0.25
	Tetrachloroethane, 1,1,1,2-	0.52	50,000	ND	U	1.0[b]	0.26	0.13	ND	U	1.0[b]	0.26	0.13	ND	U	1.0[b]	0.26	0.13	ND	U	1.0[b]	0.26	0.13	ND	U	1.0[b]	0.26	0.13
	Tetrachloroethane, 1,1,2,2-	0.067	500	ND	U	1.0[b]	0.20	0.10	ND	U	1.0[b]	0.20	0.10	ND	U	1.0[b]	0.20	0.10	ND	U	1.0[b]	0.20	0.10	ND	U	1.0[b]	0.20	0.10
	Tetrachloroethylene (Tetrachloroethene)	5	170	ND	U	1.0	0.48	0.24	ND	U	1.0	0.48	0.24	ND	U	1.0	0.48	0.24	ND	U	1.0	0.48	0.24	ND	U	1.0	0.48	0.24
	Toluene	1,000	40	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17
	trans-1,2-Dichloroethylene (trans-1,2-Dichloroethene)	100	260	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19
	Trichloroethylene (Trichloroethene)	5	310	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16
	Vinyl chloride	2	3,400	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23
	Xylenes	10,000	20	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19
EPA 6020	Lead	15	5,000	ND	U	0.5	0.22	0.11	ND	U	0.5	0.22	0.11	0.17	J	0.5	0.22	0.11	0.14	J	0.5	0.22	0.11	ND	U	0.5	0.22	0.11

Notes:

All units are in micrograms per liter (µg/L).

[a] DOH EALs (DOH, 2009): Table D-1b. Groundwater Action Levels (Groundwater is a current or potential drinking water resource; surface water body is not located within 150 meters of release site).

[b] In the case where an EAL for a specific chemical is less than the LOQ for a commercial laboratory, it is generally acceptable to consider the LOQ in place of the action level (DOH, Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater 2008, updated March 2009).

B - The analyte was found in a method blank, as well as in the sample.

++ The analyst has noted that the chromatogram of this sample is mainly a match to hydrocarbons within the range of diesel fuel.

DL - detection limit or method detection limit (MDL)

DRO - diesel range organics

GRO - gasoline range organics

J - Estimated result. Indicates that the compound was identified but the concentration was above the DL and below the LOQ.

LOD - limit of detection

LOQ - limit of quantitation or reporting limit (RL)

ND - not detected

PAHs - polynuclear aromatic hydrocarbons

Q - data qualifier

TPH - total petroleum hydrocarbons

U - Indicates the compound or analyte was analyzed for but not detected. The result is reported as ND.

VOC - volatile organic compound

- Chemical does not have DOH EALs

Bold - Result exceeds DOH Drinking Water EALs.

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, but increased to 1,700 µg/L in January-February 2012.

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, October-November 2011, and January-February 2012.

Similar to the naphthalene concentration trend, 1-methylnaphthalene concentrations remained relatively stable from September 2005 through October 2008. In February 2009, 1-methylnapthalene 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, October-November 2011, and January-February 2012.

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, October-November 2011, and January-February 2012 groundwater monitoring events, TPH-DRO concentrations decreased to below the LODs. Lead has been detected at estimated concentrations in the October-November 2010, July 2011, October-November 2011, and January-February 2012 groundwater monitoring events.

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 the January-February 2012 and the previous seven groundwater monitoring events TPH-DRO concentrations exhibited a decrease and were not detected at or above the LODs or LOQs.

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 January-February 2012 analytical data (Table 3-5). Monitoring wells RHMW01 and RHMW03 are 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)
Petroleum Mixtures		
TPH-DRO	210	4,500
TPH-GRO	100	4,500
Semi-Volatile Compounds		
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 Hālawa 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

This page is intentionally left blank.

Table 3-5: Summary of Result Categories and Response Actions, January-February 2012

Results Category	RHMW2254-01	RHMW01	RHMW02	RHMW03	RHMW05
Results Category 1: Result above detection limit but below drinking water EAL and trend for all compounds stable or decreasing	No	Yes	No	Yes	No
Results Category 2: Trend for any compound increasing or drinking water EAL exceeded	No	No	Yes	No	No
Results Category 3: Result between 1/10X SSRBL and SSRBL for benzene, or between 1/2X SSRBL and SSRBL for TPH	No	No	No	No	No
Results Category 4: Result exceeding any SSRBL or petroleum product observed	No	No	No	No	No
Previous Category: Category prior to January-February monitoring event	None	Category 1	Category 2	Category 1	None
New Category: Category assignment based on results of the January-February monitoring event	None	Category 1	Category 2	Category 1	None
Response Actions: 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

This page is intentionally left blank.

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 percentage 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 ES058 and sample ES059), met the RPD precision criteria of 50% for all analytes except lead (Table 4-1). The RPDs for MS/MSD were also within the laboratory established criteria (Appendix E). Therefore the data precision is considered acceptable.

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. 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 except methylene chloride. For this sampling event, three trip blanks were collected and there were no detections of VOCs or TPH-GRO in them except methylene chloride that was detected in the trip blanks at estimated concentrations (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.

Table 4-1: Field QC Results, January-February 2012

Method	Chemical	DOH Drinking Water EALs for Human Toxicity[a]	DOH Groundwater Gross Contamination EALs[a]	OWDFMW01 ES058					OWDFMW01 dup ES059					RPD Duplicate (%)	Trip Blank (01/26)					Trip Blank (02/01)					Trip Blank (02/14)				
				Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL		Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL	Result	Q	LOQ	LOD	DL
EPA 8015B (Petroleum)	TPH-DRO	210	100	ND	U	150[b]	80.8	40.4	ND	U	150[b]	80.8	40.4	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EPA 8260 B (Petroleum)	TPH-GRO	100	100	ND	U	20.0	12.12	6.06	ND	U	20.0	12.12	6.06	0	ND	U	20.0	12.12	6.06	ND	U	20.0	12.12	6.06	ND	U	20.0	12.12	6.06
EPA 8270D SIM (PAHs)	Acenaphthene	370	20	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Acenaphthylene	240	2,000	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Anthracene	1,800	22	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Benzo(a)anthracene	0.092	4.7	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Benzo(g,h,i)perylene	1,500	0.13	ND	U	0.2[b]	0.16	0.08	ND	U	0.2[b]	0.16	0.08	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Benzo(a)pyrene	0.2	0.81	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Benzo(b)fluoranthene	0.092	0.75	ND	U	0.2[b]	0.12	0.06	ND	U	0.2[b]	0.12	0.06	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Benzo(k)fluoranthene	0.92	0.4	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chrysene	9.2	1	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Dibenzo(a,h)anthracene	0.0092	0.52	ND	U	0.2[b]	0.10	0.05	ND	U	0.2[b]	0.10	0.05	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Fluoranthene	1,500	130	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Fluorene	240	950	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Indeno (1,2,3-cd)pyrene	0.092	0.095	ND	U	0.2[b]	0.14	0.07	ND	U	0.2[b]	0.14	0.07	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	1-Methylnaphthalene	4.7	10	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2-Methylnaphthalene	24	10	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Naphthalene	17	21	ND	U	0.2	0.10	0.05	ND	U	0.2	0.10	0.05	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Phenanthrene	240	410	ND	U	0.2	0.14	0.07	ND	U	0.2	0.14	0.07	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Pyrene	180	68	ND	U	0.2	0.16	0.08	ND	U	0.2	0.16	0.08	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EPA 8260 B (VOCs)	1,1,1-Trichloroethane	200	970	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	0	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14
	1,1,2-Trichloroethane	5	50,000	ND	U	1.0	0.40	0.20	ND	U	1.0	0.40	0.20	0	ND	U	1.0	0.40	0.20	ND	U	1.0	0.40	0.20	ND	U	1.0	0.40	0.20
	1,1-Dichloroethane	2.4	50,000	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	0	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19
	1,1-Dichloroethylene (1,1-Dichloroethene)	7	1,500	ND	U	1.0	0.60	0.30	ND	U	1.0	0.60	0.30	0	ND	U	1.0	0.60	0.30	ND	U	1.0	0.60	0.30	ND	U	1.0	0.60	0.30
	1,2,3-Trichloropropane	0.6	50,000	ND	U	2.0[b]	0.78	0.39	ND	U	2.0[b]	0.78	0.39	0	ND	U	2.0[b]	0.78	0.39	ND	U	2.0[b]	0.78	0.39	ND	U	2.0[b]	0.78	0.39
	1,2,4-Trichlorobenzene	70	3,000	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	0	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21
	1,2-Dibromo-3-chloropropane	0.04	10	ND	U	2.0[b]	1.52	0.76	ND	U	2.0[b]	1.52	0.76	0	ND	U	2.0[b]	1.52	0.76	ND	U	2.0[b]	1.52	0.76	ND	U	2.0[b]	1.52	0.76
	1,2-Dibromoethane	0.0065	50,000	ND	U	1.0[b]	0.40	0.20	ND	U	1.0[b]	0.40	0.20	0	ND	U	1.0[b]	0.40	0.20	ND	U	1.0[b]	0.40	0.20	ND	U	1.0[b]	0.40	0.20
	1,2-Dichlorobenzene	600	10	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	0	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17
	1,2-Dichloroethane	0.15	7,000	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	0	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14
	1,2-Dichloropropane	5	10	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	0	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17
	1,3-Dichlorobenzene	180	50,000	ND	U	1.0	0.22	0.11	ND	U	1.0	0.22	0.11	0	ND	U	1.0	0.22	0.11	ND	U	1.0	0.22	0.11	ND	U	1.0	0.22	0.11
	1,3-Dichloropropene (total of cis/trans)	0.43	50,000	ND	U	1.0[b]	0.36	0.18	ND	U	1.0[b]	0.36	0.18	0	ND	U	1.0[b]	0.36	0.18	ND	U	1.0[b]	0.36	0.18	ND	U	1.0[b]	0.36	0.18
	1,4-Dichlorobenzene	75	5	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	0	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19
	Acetone	22,000	20,000	ND	U	10.0	1.90	0.95	ND	U	10.0	1.90	0.95	0	ND	U	10.0	1.90	0.95	ND	U	10.0	1.90	0.95	ND	U	10.0	1.90	0.95
	Benzene	5	170	0.70	J	1.0	0.32	0.16	0.58	J	1.0	0.32	0.16	18.8	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16
	Bromodichloromethane	0.22	50,000	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	0	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14	ND	U	1.0[b]	0.28	0.14
	Bromoform	100	510	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	0	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14	ND	U	1.0	0.28	0.14
	Bromomethane	8.7	50,000	ND	U	2.0	0.48	0.24	ND	U	2.0	0.48	0.24	0	ND	U	2.0	0.48	0.24	ND	U	2.0	0.48	0.24	ND	U	2.0	0.48	0.24
	Carbon Tetrachloride	5	520	ND	U	1.0	0.20	0.10	ND	U	1.0	0.20	0.10	0	ND	U	1.0	0.20	0.10	ND	U	1.0	0.20	0.10	ND	U	1.0	0.20	0.10
	Chlorobenzene	100	50	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	0	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21
	Chloroethane	8,600	16	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	0	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21	ND	U	1.0	0.42	0.21
	Chloroform	70	2,400	ND	U	1.0	0.14	0.07	ND	U	1.0	0.14	0.07	0	ND	U	1.0	0.14	0.07	ND	U	1.0	0.14	0.07	ND	U	1.0	0.14	0.07
	Chloromethane	1.8	50,000	ND	U	1.0	0.84	0.42	ND	U	1.0	0.84	0.42	0	ND	U	1.0	0.84	0.42	ND	U	1.0	0.84	0.42	ND	U	1.0	0.84	0.42
	cis-1,2-Dichloroethylene (cis-1,2-Dichloroethene)	70	50,000	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	0	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16
	Dibromochloromethane (Chlorodibromomethane)	0.16	50,000	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	0	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19
	Ethylbenzene	700	30	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	0	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23
	Hexachlorobutadiene	0.86	6	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	0	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19	ND	U	1.0[b]	0.38	0.19
	Methyl ethyl ketone (2-Butanone)	7,100	8,400	ND	U	10.0	1.20	0.60	ND	U	10.0	1.20	0.60	0	ND	U	10.0	1.20	0.60	ND	U	10.0	1.20	0.60	ND	U	10.0	1.20	0.60
	Methyl isobutyl ketone (4-Methyl-2-pentanone)	2,000	1,300	ND	U	10.0	3.80	1.90	ND	U	10.0	3.80	1.90	0	ND	U	10.0	3.80	1.90	ND	U	10.0	3.80	1.90	ND	U	10.0	3.80	1.90
	Methyl tert-butyl Ether	12	5	ND	U	1.0	0.52	0.26	ND	U	1.0	0.52	0.26	0	ND	U	1.0	0.52	0.26	ND	U	1.0	0.52	0.26	ND	U	1.0	0.52	0.26
	Methylene chloride	4.8	9,100	ND	U	5.0[b]	0.70	0.35	ND	U	5.0[b]	0.70	0.35	0	0.57	J	5.0[b]	0.70	0.35	0.37	J	5.0[b]	0.70	0.35	0.58	BJ	5.0[b]	0.70	0.35
	Styrene	100	10	ND	U	1.0	0.50	0.25	ND	U	1.0	0.50	0.25	0	ND	U	1.0	0.50	0.25	ND	U	1.0	0.50	0.25	ND	U	1.0	0.50	0.25
	Tetrachloroethane, 1,1,1,2-	0.52	50,000	ND	U	1.0[b]	0.26	0.13	ND	U	1.0[b]	0.26	0.13	0	ND	U	1.0[b]	0.26	0.13	ND	U	1.0[b]	0.26	0.13	ND	U	1.0[b]	0.26	0.13
	Tetrachloroethane, 1,1,2,2-	0.067	500	ND	U	1.0[b]	0.20	0.10	ND	U	1.0[b]	0.20	0.10	0	ND	U	1.0[b]	0.20	0.10	ND	U	1.0[b]	0.20	0.10	ND	U	1.0[b]	0.20	0.10
	Tetrachloroethylene (Tetrachloroethene)	5	170	ND	U	1.0	0.48	0.24	ND	U	1.0	0.48	0.24	0	ND	U	1.0	0.48	0.24	ND	U	1.0	0.48	0.24	ND	U	1.0	0.48	0.24
	Toluene	1,000	40	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	0	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17	ND	U	1.0	0.34	0.17
	trans-1,2-Dichloroethylene (trans-1,2-Dichloroethene)	100	260	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	0	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19
	Trichloroethylene (Trichloroethene)	5	310	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	0	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16	ND	U	1.0	0.32	0.16
	Vinyl chloride	2	3,400	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	0	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23	ND	U	1.0	0.46	0.23
	Xylenes	10,000	20	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	0	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19	ND	U	1.0	0.38	0.19
EPA 6020	Lead	15	5,000	0.20	J	0.5	0.22	0.11	0.11	J	0.5	0.22	0.11	58.1	--	--	--	--	--	--		--	--	--	--	--	--	--	--

Notes:

All units are in micrograms per liter (µg/L).

RHMW02D is a duplicate sample of RHMW02.

[a] DOH EALs (DOH, 2009): Table D-1b. Groundwater Action Levels (Groundwater is a current or potential drinking water resource; surface water body is not located within 150 meters of release site).

[b] In the case where an EAL for a specific chemical is less than the LOQ for a commercial laboratory, it is generally acceptable to consider the LOQ in place of the action level (DOH, Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater 2008, updated March 2009).

B - The analyte was found in a method blank, as well as in the sample.

DL - detection limit or method detection limit (MDL)

DRO - diesel range organics

GRO - gasoline range organics

J - Estimated result. Indicates that the compound was identified but the concentration was above the DL and below the LOQ.

LOD - limit of detection

LOQ - limit of quantitation or reporting limit (RL)

ND - not detected

PAHs - polynuclear aromatic hydrocarbons

Q - data qualifier

RPD - relative percent difference

TPH - total petroleum hydrocarbons

U - Indicates the compound or analyte was analyzed for but not detected. The result is reported as ND.

VOC - volatile organic compound

-- not analyzed

- Chemical does not have DOH EALs

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 January-February 2012 data. Based on the January-February 2012 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 January-February 2012 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 detection 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 January-February 2012 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 and exceeded the DOH Groundwater Gross Contamination EAL. Methylene chloride (0.59 µg/L) was detected at an estimated concentration 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 (1,700 µg/L) was detected at a concentration which exceeded the DOH Drinking Water and Groundwater Gross Contamination EALs. Acenaphthene (0.29 µg/L), fluorene (0.21 µg/L), 1-methylnaphthalene (0.57 µg/L), and naphthalene (1.70 µg/L) were detected at concentrations below the DOH Drinking Water EALs. Acenaphthylene (0.089 µg/L), 2-methylnaphthalene (0.17 µg/L), ethylbenzene (0.30 µg/L), and lead (0.17 µg/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 (0.14 µg/L) was detected at an estimated concentration below the DOH Drinking Water EAL. All other COPCs in monitoring well RHMW02 were not detected at or above the LODs and LOQs.

In monitoring wells RHMW2254-01 and RHMW05, all COPCs 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 eight 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.

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.

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.

This page is intentionally left blank.

Appendix A
DOH Correspondence

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

DIRECTOR OF HEALTH

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

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 January-February 2012

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

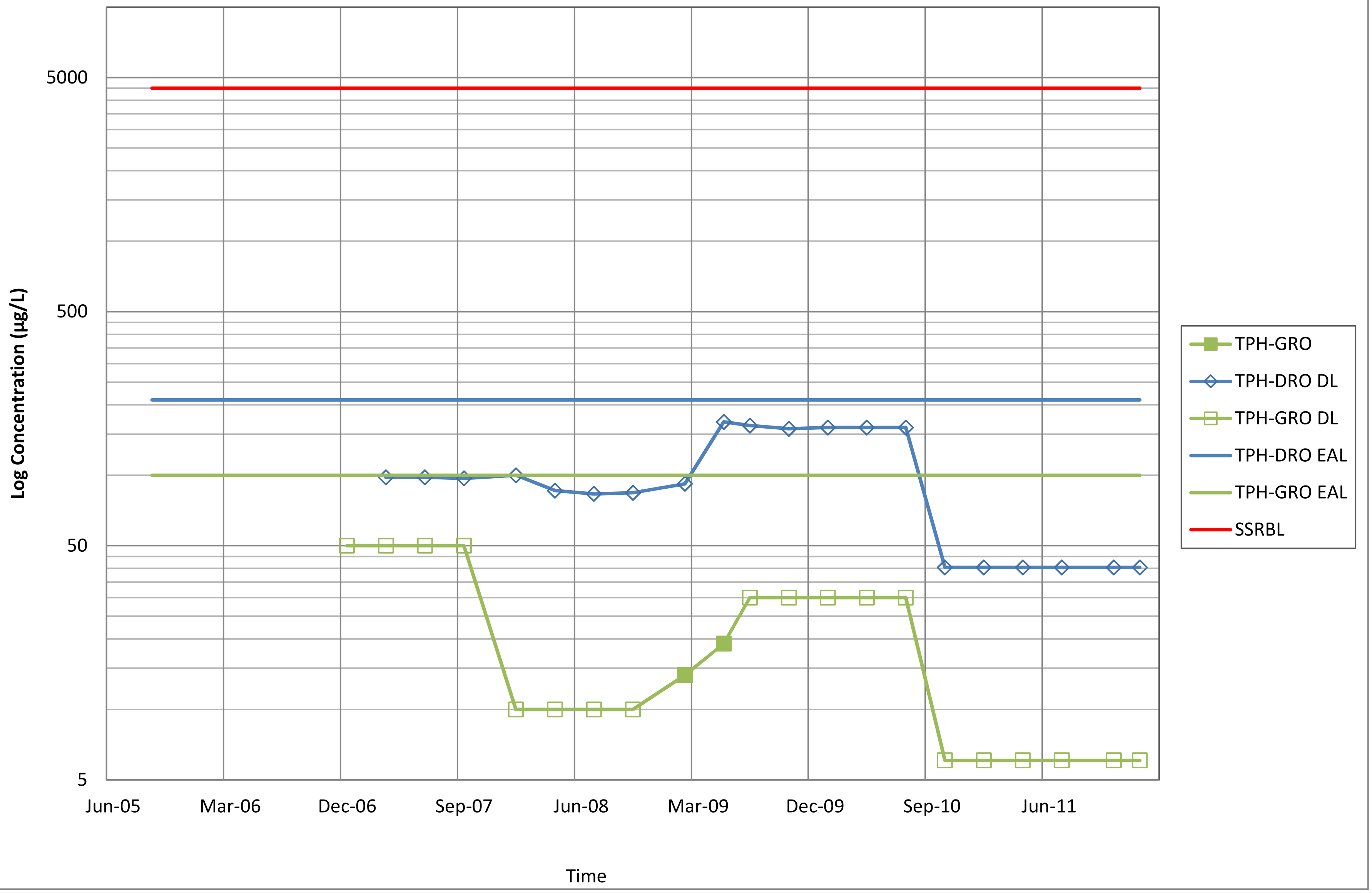


Figure A-2: TPH at RHMW01
Quarterly Monitoring Results

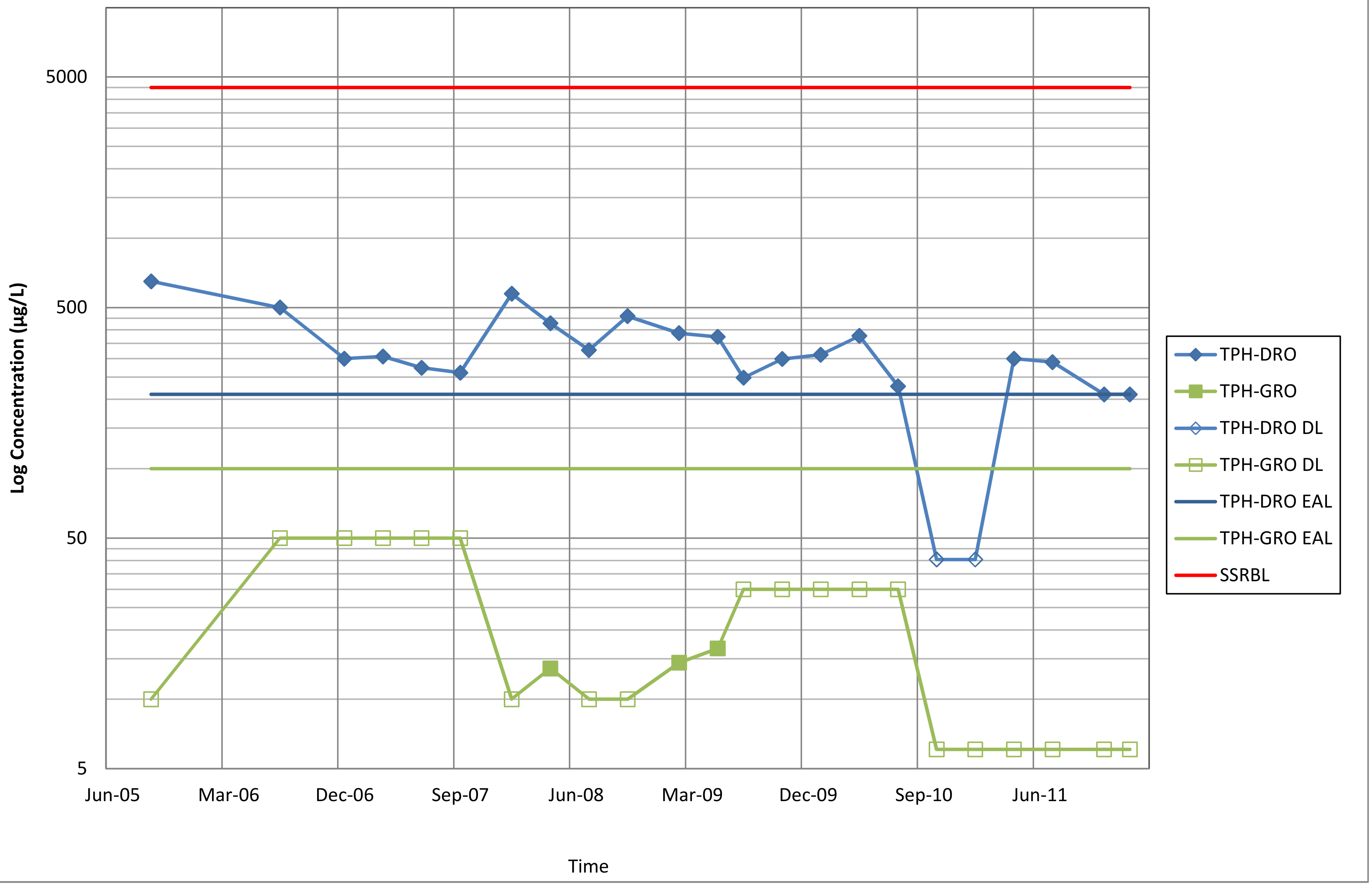


Figure A-3: TPH at RHMW02
Quarterly Monitoring Results

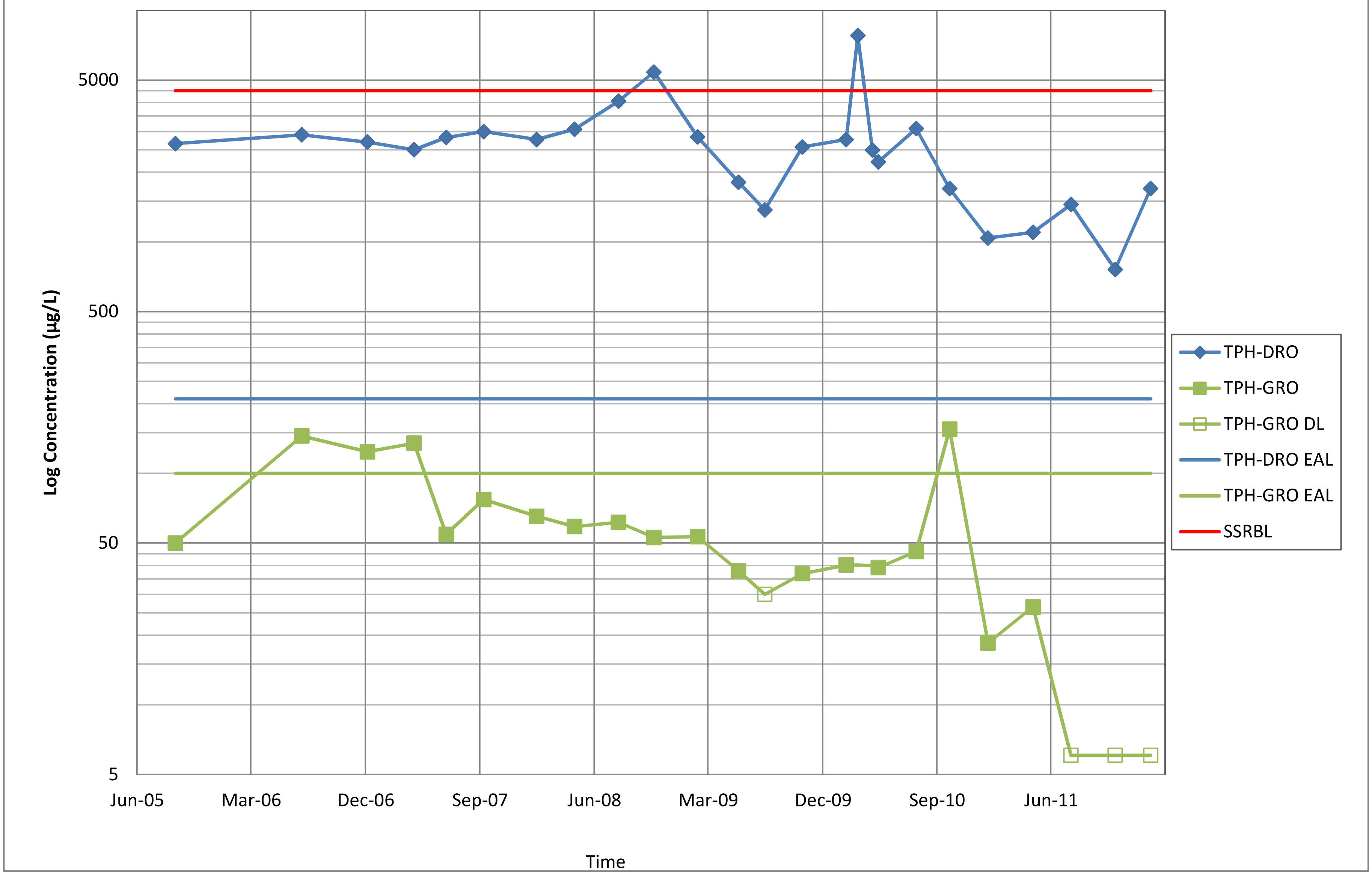


Figure A-4: TPH at RHMW03
Quarterly Monitoring Results

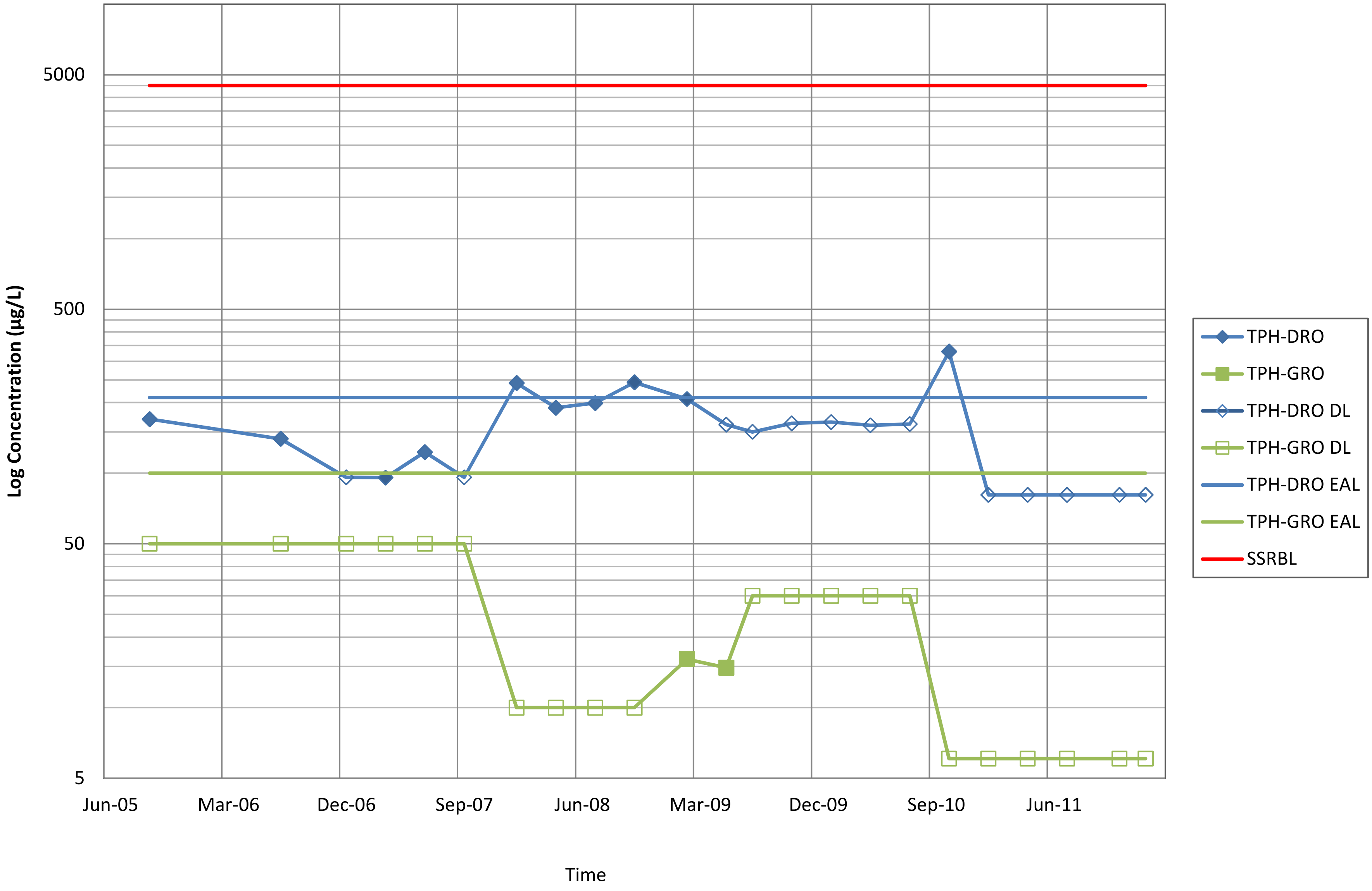
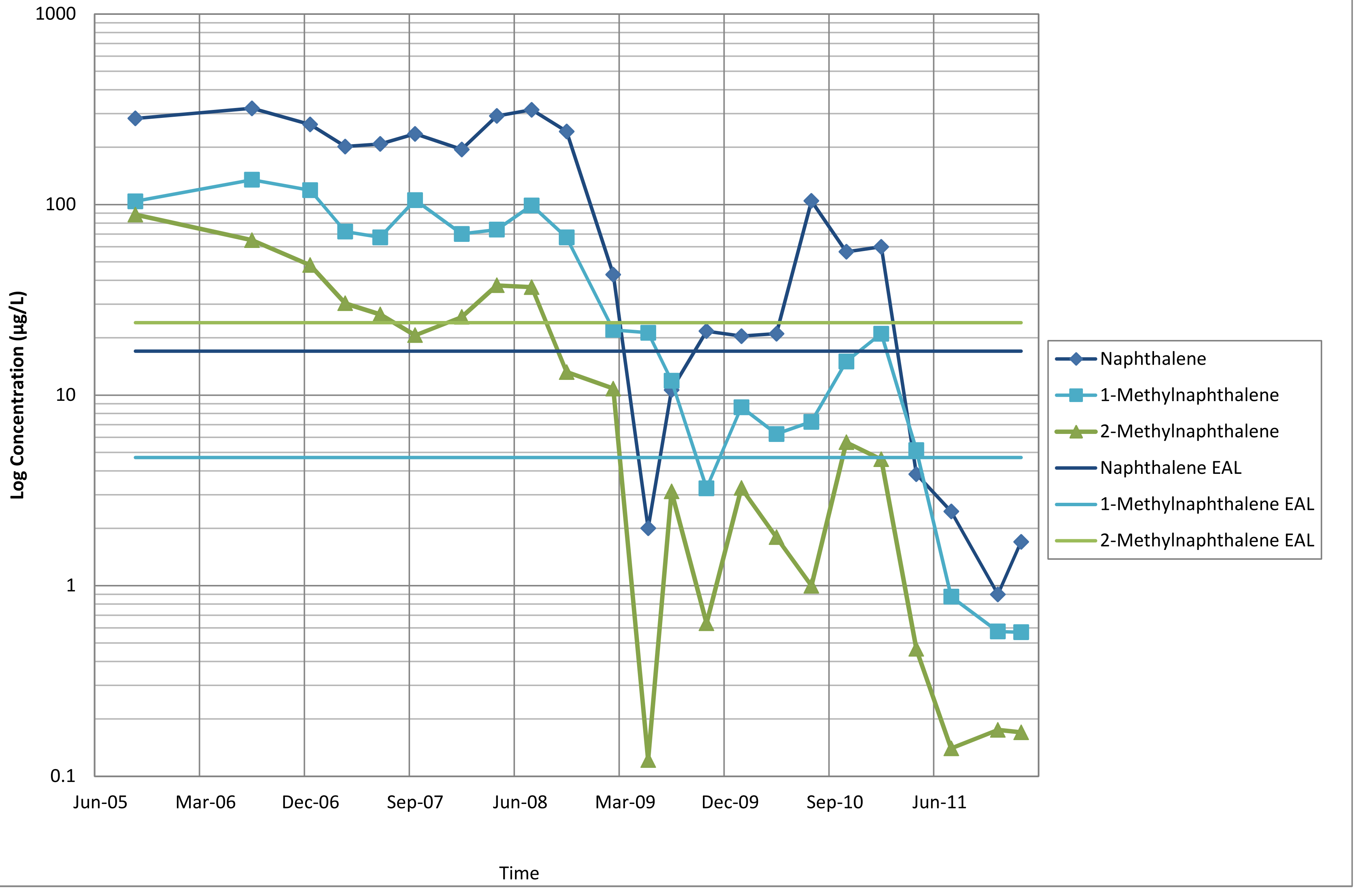


Figure A-5: TPH at RHMW05
Quarterly Monitoring Results

Figure A-6: PAHs at RHMW02
Quarterly Monitoring Results



Appendix C
Field Notebook, January-February 2012

1/26/12

Activity: ground water Sampling
Personell: MS, CA, JT
8:15 - leave office
8:45 - Conduct health & Safety meeting
9:00 - train arrives
9:20 - arrive at MW-3. Set up
930 - purge MW-3
10:00 - sample MW-3
(ES060 MS/MSD)
11:10 - arrive at MW-02
11:20 - purge MW-02
12:15 - Sample MW-02 (ES061)
12:40 - leave site
13:20 - drop off samples at FEDEX,
14:00 - return to office

2/1/12

Activity: Groundwater sampling
Personell: MS, CA, JT
7:30 - leave office
7:40 - arrive @ storage
8:20 - arrive at Adit 3
8:30 - Conduct health and safety meeting
8:40 - train not present, bring supplies to Pump room.
9:00 - Calibrate equipment
9:15 - Begin purging pump house MW.
930 - Sample pump hse MW (ES062)
10:00 - arrive at MW-5
10:18 - begin purging MW-5
1045 - Sample MW-5 (ES063)
11:20 - train arrives
11:35 - arrive at MW-1. Try to istall new pump. Pump will not fit in casing.
12:20 - leave site
13:00 - arrive at Fedex - ship samples
13:30 - arrive at office

Mark

2/14/12

Activity: groundwater sampling
Personell: MS, JT
815 - arrive at ADIT 3. Conduct health and safety meeting. Calibrate equipment
8:30 - Train arrives, load equipment.
9:00 - arrive at MW-1. Unload.
9:15 - Take PID reading at MW-1 PID = 0.0 ppm. Begin fastening pump to tubing
10:00 - begin purging MW-1
10:20 - Sample MW-1 (ES069).
1050 - Exit Adit 3.
1120 - ~~Return~~ arrive at FEDEX. Ship samples.
12:00 - return to office

Mark

Appendix D
Groundwater Sampling Logs, January-February 2012

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: 2/1/2012
TIME: 0915

TOTAL DEPTH OF WELL: unknown
PERSONNEL INVOLVED: MS, CA, JT

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: 0.7 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/cm)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^oC)	SALINITY (ppt)	REDOX (ORP) (mV)
0920	2.0 L	6.76	0.554	0.0	8.99	21.64	-	186
0923	3.0 L	6.88	0.554	0.0	8.92	21.60	-	183
0924	4.0 L	7.05	0.554	0.0	8.86	21.53	-	179
0926	5.0 L	7.16	0.553	0.0	8.83	21.50	-	176
0927	6.0 L	7.24	0.553	0.0	8.74	21.51	-	173
0929	7.0 L	7.24	0.553	0.0	8.74	21.52	-	172

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump

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

SAMPLE ID: ESO62
SAMPLE COLLECTION TIME: 0935
SAMPLED BY: MS, CA, JT

COMMENTS AND OBSERVATIONS:

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES: TPH-GRO (EPA 8260B) & VOCs (EPA 8260B) with no preservative
TPH-DRO (EPA8015B) & PAHs (EPA 8270C SIM) with no preservative, and dissolved lead (EPA 6020) with nitric acid 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: MS, CA, JT
SAMPLE DELIVERY DATE: 2/1/2012
SAMPLE DELIVERY TIME: 1300

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: RHMW-01
LOCATION: Red Hill Bulk Fuel Storage Facility
PROJECT NO: 1022-024

INITIAL WATER LEVEL: 83.75 feet bTOC
DATE: 2/14/2012
TIME: 1020

TOTAL DEPTH OF WELL: 100.00 feet bTOC
PERSONNEL INVOLVED: MS, JT

LENGTH OF SATURATED ZONE: 16.3 feet
WEATHER CONDITIONS: -

VOLUME OF WATER TO BE REMOVED: N/A
METHOD OF REMOVAL: Low flow pump

WATER LEVEL AFTER PURGING: -
PUMPING RATE: 0.15 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/cm)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^oC)	SALINITY (ppt)	REDOX (ORP) (mV)
1005	2.0 L	4.85	0.070	5.2	6.51	23.07	-	103
1010	3.0 L	6.82	0.335	5.6	2.65	23.71	-	-57
1014	3.5 L	6.93	0.337	4.3	1.96	23.68	-	-63
1018	4.0 L	7.01	0.339	3.7	1.43	23.65	-	-69

SAMPLE RETRIEVAL METHOD: Low flow pump

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

SAMPLE ID: ESO69
SAMPLE COLLECTION TIME: 1020
SAMPLED BY: MS, JT

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 8270C SIM) with no preservative, and dissolved lead (EPA 6020) without nitric acid 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: MS, JT
SAMPLE DELIVERY DATE: 2/14/2012
SAMPLE DELIVERY TIME: 1120

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: RHMW-02 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-024

INITIAL WATER LEVEL: 86.31 feet bTOC DATE: 1/26/2012 TIME: 1215

TOTAL DEPTH OF WELL: unknown PERSONNEL INVOLVED: MS, JT

LENGTH OF SATURATED ZONE: N/A WEATHER CONDITIONS: -

VOLUME OF WATER TO BE REMOVED: N/A METHOD OF REMOVAL: Low flow dedicated bladder pump

WATER LEVEL AFTER PURGING: 86.30 feet bTOC PUMPING RATE: 0.67 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/cm)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^{o}C)	SALINITY (ppt)	REDOX (ORP) (mV)
1028	2 L	6.67	0.576	3.3	0.61	23.93	0.0	-
1132	3 L	6.65	0.608	0.1	1.17	23.80	0.0	-
1136	6 L	6.51	0.610	1.0	1.13	23.81	0.0	-
1138	8 L	6.51	0.609	1.0	1.11	23.82	0.0	-

SAMPLE RETRIEVAL METHOD: Low flow pump

SAMPLE ID: ESO61

SAMPLE COLLECTION TIME: 1215

SAMPLED BY: MS, JT

APPEARANCE OF SAMPLE:

COLOR Light Brown

TURBIDITY -

SEDIMENT -

OTHER Petroleum Smell

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 8270C SIM) with no preservative, and dissolved lead (EPA 6020) with nitric acid 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: MS, JT

SAMPLE DELIVERY DATE: 1/26/2012 SAMPLE DELIVERY TIME: 1320

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: RHMW-03 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-024

INITIAL WATER LEVEL: 102.56 feet bTOC DATE: 1/26/2012 TIME: 1215

TOTAL DEPTH OF WELL: unknown PERSONNEL INVOLVED: MS, JT

LENGTH OF SATURATED ZONE: N/A WEATHER CONDITIONS: -

VOLUME OF WATER TO BE REMOVED: N/A METHOD OF REMOVAL: Low flow dedicated bladder pump

WATER LEVEL AFTER PURGING: 102.57 feet bTOC PUMPING RATE: 0.6 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/cm)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^{o}C)	SALINITY (ppt)	REDOX (ORP) (mV)
0944	2 L	6.98	0.725	24.5	3.24	26.85	-	174
0947	4 L	6.91	0.727	22.8	2.49	26.53	-	167
0951	6 L	6.92	0.726	13.3	1.96	26.41	-	146

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump

APPEARANCE OF SAMPLE:

COLOR Clear

TURBIDITY -

SEDIMENT -

OTHER -

SAMPLE ID: ESO60

SAMPLE COLLECTION TIME: 1000

SAMPLED BY: MS, JT

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 8270C SIM) with no preservative, and dissolved lead (EPA 6020) with nitric acid 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: MS, JT

SAMPLE DELIVERY DATE: 1/26/2012 SAMPLE DELIVERY TIME: 1320

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: RHMW-05 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-024

INITIAL WATER LEVEL: 83.15 feet (bTOC) DATE: 2/1/2012 TIME: 1015

TOTAL DEPTH OF WELL: unknown PERSONNEL INVOLVED: MS, CA, JT

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: 83.06 feet (bTOC) PUMPING RATE: 0.7 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/cm)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^oC)	SALINITY (ppt)	REDOX (ORP) (mV)
1019	2.0 L	7.63	0.308	108.0	8.30	21.75	-	147
1021	3.0 L	7.54	0.308	51.8	6.96	21.60	-	149
1024	4.0 L	7.46	0.308	36.1	6.63	21.57	-	153
1026	5.0 L	7.46	0.308	11.9	6.81	21.56	-	154
1028	6.0 L	7.45	0.309	8.9	6.56	21.57	-	155
1029	7.0 L	7.45	0.309	6.6	6.71	21.56	-	155
1030	8.0 L	7.44	0.315	5.9	6.31	21.55	-	156
1031	9.0 L	7.44	0.321	3.2	6.61	21.56	-	157

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump

APPEARANCE OF SAMPLE:

COLOR: Clear

TURBIDITY: None

SEDIMENT: None

OTHER: -

SAMPLE ID: ESO63

SAMPLE COLLECTION TIME: 1045

SAMPLED BY: MS, CA, JT

COMMENTS AND OBSERVATIONS: PID = 1.1 PPM

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES: TPH-GRO (EPA 8260B) & VOCs (EPA 8260B) with no preservative
TPH-DRO (EPA8015B) & PAHs (EPA 8270C SIM) with no preservative, and dissolved lead (EPA 6020) with nitric acid 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: MS, CA, JT

SAMPLE DELIVERY DATE: 2/1/2012 SAMPLE DELIVERY TIME: 1300

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, January-February 2012 (on CD-ROM)