Quarterly Groundwater Monitoring Report

Red Hill Bulk Fuel Storage Facility, Pearl Harbor, 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

June 2011

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

Environmental Technical Services
Contract Number N62742-08-D-1930, Contract Task Order HC14

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Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Hawai‘i
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Prepared under:

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List of Acronyms

<	less than
µg/L	micrograms per liter
COPC	chemical of potential concern
DL	detection limit or method detection limit (MDL)
DLNR	Department of Land and Natural Resources
DOH	State of Hawai‘i Department of Health
DON	Department of the Navy
DRO	diesel range organics
DTW (TOC)	depth to water from top of well casing
EAL	Environmental Action Level
EPA	U.S. Environmental Protection Agency
F-76	marine diesel fuel
FISC	Fleet and Industrial Supply Center
GRO	gasoline range organics
HAR	Hawai‘i Administrative Rules
IDW	investigation-derived waste
J	Estimated result. Indicates that the compound was identified but the concentration was above the DL and below the LOQ.
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
ND	not detected
NAVFAC	Naval Facilities Engineering Command
NP	measurement not provided
NT	measurement not taken
PAHs	polynuclear aromatic hydrocarbons
pH	hydrogen activity
PHWS	Pearl Harbor Water System
PPE	personal protective equipment
Q	data qualifier
QC	quality control
RHSF	Red Hill Bulk Fuel Storage Facility
RPD	relative percent difference
SSRBL	site-specific risk-based level
SWL	static water level
TEC	The Environmental Company, Inc.
TIC	tentatively identified compound
TPH	total petroleum hydrocarbons
U	Indicates the compound or analyte was analyzed for but not detected. The result is reported as ND.

U.S.	United States
USGS	United States Geological Survey
UST	underground storage tank
VOC	volatile organic compound

Executive Summary

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

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

This report presents the analytical results and compares them to the DOH Drinking Water EALs for samples collected on April 19, 20, and 28, 2011 at the five groundwater monitoring wells (RHMW2254-01, RHMW01, RHMW02, RHMW03, and RHMW05). Contaminant trends that have exceeded DOH Drinking Water EALs are also provided in this report.

April 2011 Groundwater Monitoring Results

Laboratory analytical results indicated that total petroleum hydrocarbons (TPH)-diesel range organics (DRO) and polynuclear aromatic hydrocarbons (PAHs), specifically 1-methylnaphthalene, were present in the groundwater beneath the RHSF at concentrations that exceeded the EALs. All other chemical of potential concern (COPC) concentrations (i.e., volatile organic compounds (VOCs) and dissolved lead) were below the EALs.

In monitoring wells RHMW2254-01, RHMW03, and RHMW05, all COPCs were not detected at or above the limits of detection (LODs) and limits of quantitation (LOQs).

In monitoring well RHMW01, TPH-DRO (300 micrograms per liter [µg/L]) was detected at a concentration which exceeded the EAL. All other COPCs in RHMW01 were not detected at or above the LODs and LOQs.

In monitoring well RHMW02, TPH-DRO (1,100 µg/L) and 1-methylnaphthalene (5.1 µg/L) were detected at concentrations which exceeded the EALs. TPH-gasoline range organics (GRO) (24 µg/L), 2-methylnaphthalene (0.43 µg/L), and naphthalene (3.5 µg/L) were detected at concentrations below the EALs. Acenaphthene (0.18 µg/L), acenaphthylene (0.071 µg/L), fluorene (0.086 µg/L), and xylenes (0.41 µg/L) were detected at estimated concentrations below the EALs. All other COPCs in RHMW02 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

From January 2008 to April 2010, TPH-DRO at RHMW01 fluctuated between the historical range established from September 2005 through September 2007 (Appendix A). In July 2010, TPH-DRO decreased to the lowest detected concentration observed at that time (228 μg/L). In October-November 2010 and during January 2011, TPH-DRO was not detected at or above the LODs and LOQs. In April 2011, TPH-DRO at RHMW01 was detected above the EALs.

At RHMW02, TPH-DRO concentrations were relatively stable prior to 2008, after which significant variations occurred. In October-November 2010 and during January 2011, TPH-DRO showed a decrease in concentrations. The latest observed TPH-DRO concentration at RHMW02 was detected below the historical range for this groundwater monitoring well.

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 to date (330 μg/L), which was above the EAL. TPH-DRO was not detected at or above the LOD and LOQ in January and April 2011.

At RHMW05, TPH-DRO concentrations increased from the first sampling event in May 2009 to January 2010. However, in April 2010, July 2010, October-November 2010, January and April 2011, TPH-DRO at RHMW05 was not detected above the LODs and LOQs.

TPH-GRO Contaminant Trends

TPH-GRO has remained below the 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 was detected at an estimated concentration of 17 μg/L, which was below the EAL. TPH-GRO concentrations increased slightly to a detected concentration of 24 μg/L during this April 2011 monitoring event.

PAHs Contaminant Trend in RHMW02

Since October 2008, the concentration of 2-methylnaphthalene has remained below the EAL. 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 during the January 2011 groundwater monitoring event. Naphthalene concentrations decreased to below the EAL again this April 2011 groundwater monitoring event. Similarly, 1-methylnaphthalene concentrations decreased below the EAL in October 2009, however concentrations have exhibited an increasing trend above the EAL during subsequent groundwater monitoring events, including this April 2011 groundwater monitoring event.

Conclusions

To date, the presence of light non-aqueous phase liquid (LNAPL) has been observed only once (i.e., in January 2008 in RHMW01 and RHMW02 with a thickness of less than 0.01 feet). This indicates 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 at or above the LODs and LOQs or are below 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 at least five consecutive 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. COPC concentrations of 1-methylnaphthalene detected in samples collected from RHMW02 however increased for three consecutive events, but then decreased during the most recent event. The fluctuations in concentration measured during this event and previous events indicates the current source of 1-methylnaphthalene is either residual contamination from a historical event or a very small chronic leak. The general overall long-term trend in 1-methylnaphthalene concentration is decreasing, making the scenario of a chronic leak the less likely of the two possible scenarios.

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 2 status of RHMW01 and RHMW02, submission of this quarterly report to DOH and continuation of a leak determination program as described in Section 3 of the RHSF Groundwater Protection Plan (TEC, 2008) to identify if tanks are leaking are recommended.

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Section 1 Introduction

This report presents the results of the 23rd groundwater monitoring event, conducted in April 2011 at the RHSF, Pearl Harbor, O‘ahu, Hawai‘i (Figure 1-1). The RHSF consists of 18 active and two inactive USTs operated by the Fleet and Industrial Supply Center (FISC), 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 HC14.

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

1.1 Project Objective

The groundwater monitoring was performed to evaluate the presence of COPCs in groundwater underlying the RHSF. The groundwater monitoring was conducted to ensure the DON remains in compliance with DOH UST release response requirements as described in Hawai‘i Administrative Rules (HAR) 11-281 Subchapter 7, Release Response Action. Analytical results are compared to the DOH Drinking Water EALs for 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 percent 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 percent of the potable water to the PHWS, which serves approximately 52,200 military consumers (The Environmental Company, Inc. (TEC), 2008).

1.2.2 Facility Information

The RHSF consists of 18 active and two inactive USTs operated by Navy FISC 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).

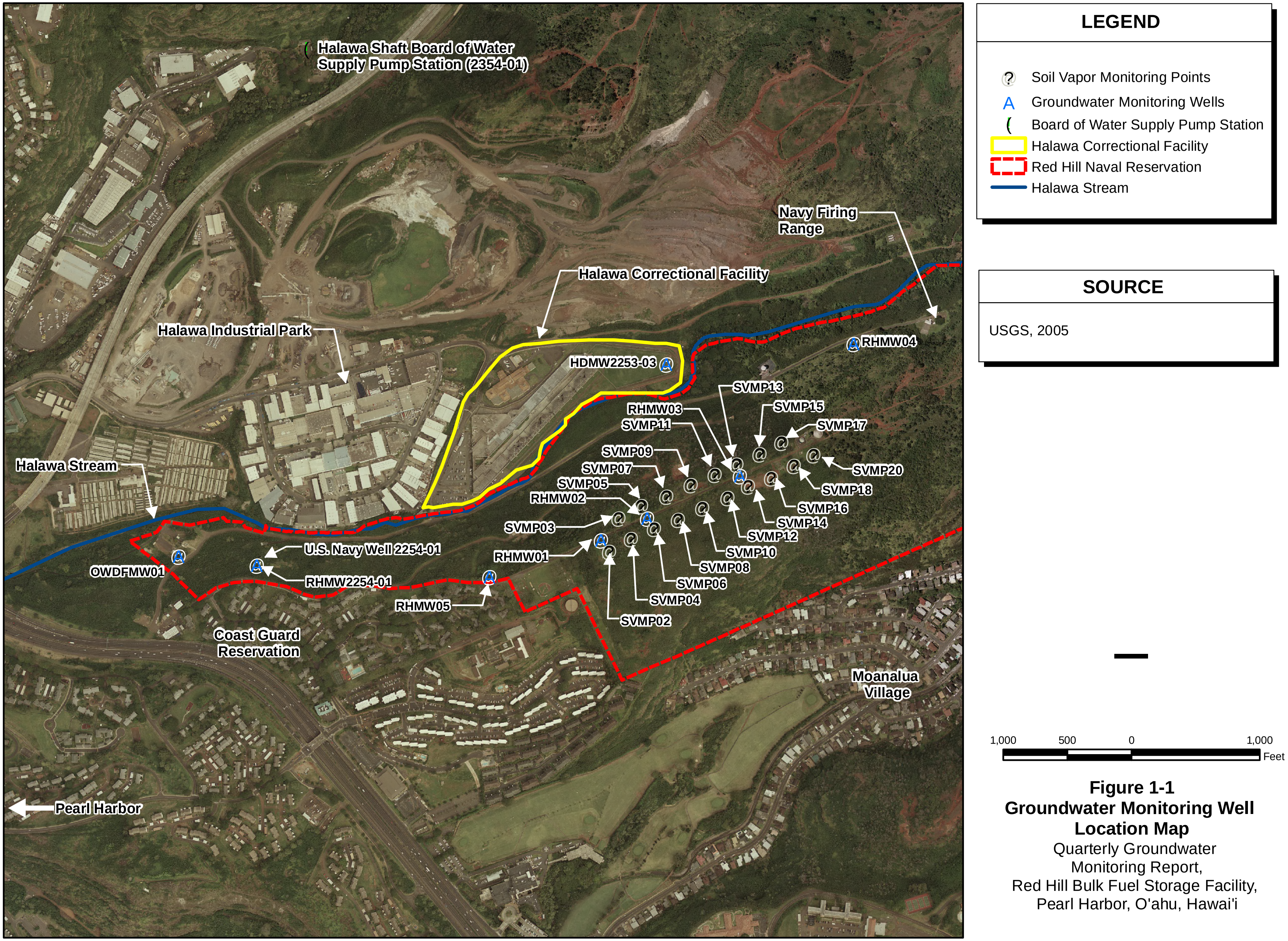
1.2.3 UST Information

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);



SOURCE

USGS, 2005

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

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15. Groundwater Monitoring Results, May 2009 (submitted July 2009);
16. Groundwater Monitoring Results, July 2009 (submitted September 2009);
17. Groundwater Monitoring Results, October 2009 (submitted December 2009);
18. Groundwater Monitoring Results, January, February, and March 2010 (submitted April 2010);
19. Groundwater Monitoring Results, April 2010 (submitted May 2010);
20. Groundwater Monitoring Results, July 2010 (submitted August 2010);
21. Groundwater Monitoring Results, October 2010 (submitted December 2010); and
22. Groundwater Monitoring Results, January 2011 (submitted March 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 storage 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 (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 the 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;
- 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 DOH Groundwater Gross Contamination EAL 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.

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 at RHMW2254-01, no chemicals were detected above the LODs;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW01 during all four monitoring events;
- TPH-GRO concentrations did not exceed the EAL in samples collected from RHMW02;
- TPH-DRO, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene concentrations exceeded the EALs in samples collected from RHMW02. Additionally, the site-specific risk-based level (SSRBL) of 4,500 µg/L for TPH-DRO was exceeded in the October monitoring event at RHMW02 (Appendix A); 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, but not in May or July; 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 chemicals have been detected above the EALs in samples collected from RHMW2254-01;
- naphthalene concentrations in the samples collected from RHMW2254-01 were detected below the LOQ and EAL in January and October-November;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW01, until October-November when they were not detected at or above the LOQ;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW02 in January, February, March, April, July, and October-November however, significant increases in January and February 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;
- TPH-DRO concentrations exceeded the EAL in samples collected from RHMW05 in January, however, the significant increase was attributed to TICs apparently not associated with petroleum from the RHSF. TPH-DRO concentrations were not detected at or above the LOD in October-November;
- TPH-DRO concentrations in samples collected from RHMW03 were not detected above the LOD in January, April, and July. However, in October-November TPH-DRO was detected above the EAL;
- TPH-GRO concentrations exceeded the EAL in samples collected from RHMW02 in October-November; and
- Lead was detected in samples collected from RHMW2254-01 and RHMW01 at concentrations which were below the EALs in October-November 2010.

2011 Groundwater Sampling – Groundwater samples were collected in January 2011. Analytical results indicated the following:

- no chemicals were detected at or above the LODs and LOQs in samples collected from RHMW2254-01, RHMW01, RHMW03, and RHMW05;
- TPH-DRO, 1-methylnaphthalene, and naphthalene were detected at concentrations which exceeded the EALs in samples collected from RHMW02;
- acenaphthene and 2-methylnaphthalene were detected at concentrations below the EALs at RHMW02; and
- TPH-GRO, acenaphthylene, fluorine, and xylenes were detected at estimated concentrations below the EALs. All other COPCs in RHMW02 were not detected at or above the LODs and LOQs.

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.

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Section 2 Groundwater Monitoring Activities

Groundwater monitoring was conducted at the five monitoring wells (RHMW2254-01, RHMW01, RHMW02, RHMW03, and RHMW05) on April 19, 20 and 28, 2011 using procedures described in the Work Plan (Environet, 2010). Field activities were documented in the field notebook (Appendix B).

2.1 Oil/Water Interface Measurements

The presence and thickness of LNAPL, otherwise known as “free product”, released from the USTs is monitored at the RHSF. Groundwater gauging measurements were collected at the five monitoring wells prior to purging and sample collection. A Solinst® 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 percent. A Horiba® U-22 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 to six readings were recorded on Groundwater Sampling Log data sheets (Appendix C).

2.2.2 Groundwater Sample Collection

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

2.2.3 Sample Management and Shipment

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

Following sample collection and labeling, the sample containers were bubble-wrapped and placed into individual ZipLoc® 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, 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. The results of the laboratory analyses are presented and discussed in Section 3.

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 percent 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 anayltes. 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® U-22 water quality meter) was conducted between monitoring locations according to the procedures described in Procedure I-F, *Equipment Decontamination* (DON, 2007). Decontamination water was disposed of in the RHSF's lower tunnel oil/water separator sump.

2.7 Investigation-Derived Waste Management

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

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

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

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Section 3 Groundwater Monitoring Results

This section provides a summary of analytical results for groundwater samples collected from the five monitoring wells on April 19, 20, and 28, 2011. Complete analytical laboratory reports are provided in Appendix D.

3.1 Results of Oil/Water Interface Measurements

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

3.2 Summary of Groundwater Analytical Results

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

RHMW2254-01

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

RHMW01

TPH-DRO was detected at 300 μg/L which exceeded both the DOH Drinking Water EAL (210 μg/L) and 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 D).

RHMW02

TPH-DRO was detected at 1,100 μg/L which exceeded both the DOH Drinking Water EAL (210 μg/L) and the DOH Groundwater Gross Contamination EAL (100 μg/L). 1-methylnaphthalene was detected at 5.1 μg/L which exceeded the DOH Drinking Water EAL (4.7 μg/L) but not the DOH Groundwater Gross Contamination EAL (10 μg/L) (Table 3-2 and Appendix D).

TPH-GRO (24 μg/L), 2-methylnaphthalene (0.43 μg/L), and naphthalene (3.5 μg/L) were detected at concentrations which were below both the DOH Drinking Water EALs (100 μg/L for TPH-GRO, 24 μg/L for 2-methylnaphthalene, and 17 μg/L for naphthalene) and the DOH Groundwater Gross Contamination EALs (100 μg/L for TPH-GRO, 10 μg/L for 2-methylnaphthalene, and 21 μg/L for naphthalene) (Table 3-2 and Appendix D).

Acenaphthene (0.18 μg/L), acenaphthylene (0.071 μg/L), fluorene (0.086 μg/L), and xylenes (0.41 μg/L), were detected at estimated concentrations which were below both the DOH Drinking Water EALs (370 μg/L for acenaphthene, 240 μg/L for acenaphthylene, 240 μg/L for fluorine, and 10,000 µg/L for xylenes) and the DOH Groundwater Gross Contamination EALs (20 µg/L for acenaphthene, 2,000 µg/L for acenaphthylene, 950 µg/L for fluorine, and 20 µg/L for xylenes). All other COPCs were not detected at or above the LODs and LOQs (Table 3-2 and Appendix D).

RHMW03

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

RHMW05

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

3.3 Groundwater Contaminant Trend

Groundwater samples have been collected and analyzed in monitoring wells RHMW01, RHMW02, RHMW03 since September 2005, and in monitoring well RHMW05 since May 2009 (Appendix A). 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. In April 2011, all COPCs were not detected at or above the LODs and LOQs.

RHMW01

Concentrations of TPH-DRO have been greater than the DOH Drinking Water EAL between September 2005 and July 2010, and in April 2011 but less than 25 percent 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 was not detected above the LODs and LOQs in October-November 2010 and January 2011. TPH-DRO concentration increased to above the EAL in April 2011 (Appendix A).

RHMW02

The averages of primary and duplicate samples were used for determining contaminant trends. From September 2005 through February 2009, TPH-DRO exceeded the DOH Drinking Water EAL of 210 µg/L and was greater than 50 percent 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.

However, 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 percent of the SSRBL of 4,500 µg/L. In October 2009, TPH-DRO began an increasing trend greater than 50 percent 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 averaged concentration of 3,085 µg/L, above 50 percent 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 percent of the SSRBL. TPH-DRO exhibited a stable concentration detected at 1,100 µg/L in April 2011.

Since September 2005, TPH-GRO concentrations have remained below the EAL, except in July 2006, December 2006, March 2007, and October-November 2010.

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.

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 EAL. In January 2010, 1-methylnaphthalene concentrations increased above the EAL; then decreased in April 2010; and has exhibited an increasing trend from July 2010 through January 2011 (Appendix A). 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.

Since October 2008, the concentration of 2-methylnaphthalene has remained below the EAL.

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 and during this April 2011 groundwater monitoring event, TPH-DRO concentrations decreased to below the LODs.

RHMW05

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

3.4 Groundwater Status

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

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

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

Date	RHMW01			RHMW02			RHMW03			RHMW05		
	Elevation = 102.27 ft.[1]			Elevation = 104.76 ft.[1]			Elevation = 121.06 ft.[1]			Elevation = 101.55 ft.[1]		
	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

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

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Table 3-2: Analytical Results for Quarterly Groundwater Monitoring, April 2011

Method	Chemical	DOH Drinking Water EALs for Human Toxicity[a]	DOH Groundwater Gross Contamination EALs[a]	RHMW2254-01 (ES019)					RHMW01 (ES033)					RHMW02 (ES020)					RHMW03 (ES025)					RHMW05 (ES024)				
				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	**300**	++	150	80.8	40.4	**1,100**	++	150[b]	80.8	40.4	ND	U	150	80.8	40.4	ND	U	150	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	24	++	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	0.18	J	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	0.071	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	0.14	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
	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	0.086	J	0.2	0.12	0.06	ND	U	0.2	0.12	0.06	ND	U	0.2	0.12	0.06
	Ideno(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	**5.1**		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	0.43		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	3.5		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	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	0.36	0.18	ND	U	1.0	0.36	0.18	ND	U	1.0	0.36	0.18	ND	U	1.0	0.36	0.18	ND	U	1.0	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	0.62	0.31	ND	U	1.0	0.62	0.31	ND	U	1.0	0.62	0.31	ND	U	1.0	0.62	0.31	ND	U	1.0	0.62	0.31
	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	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	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	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
	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	0.38	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
	Methylene chloride	4.8	9,100	ND	U	5.0	0.70	0.35	ND	U	5.0	0.70	0.35	ND	U	5.0	0.70	0.35	ND	U	5.0	0.70	0.35	ND	U	5.0	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	0.26	0.13	ND	U	1.0	0.26	0.13	ND	U	1.0	0.26	0.13	ND	U	1.0	0.26	0.13	ND	U	1.0	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	0.30	0.15	ND	U	1.0	0.30	0.15	ND	U	1.0	0.30	0.15	ND	U	1.0	0.30	0.15	ND	U	1.0	0.30	0.15
	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	0.41	J	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	ND	U	0.5	0.22	0.11	ND	U	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).

++ 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
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
Bold - Result exceeds one or both DOH EALs.

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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 FISC 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

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Table 3-5: Summary of Result Categories and Response Actions, April 2011

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	No	No	No	No
Results Category 2: Trend for any compound increasing or drinking water EAL exceeded	No	Yes	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 April monitoring event	None	None	Category 2	None	None
New Category: Category assignment based on results of theApril monitoring event	None	Category 2	Category 2	None	None
Response Actions: Requirements of new category	None	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 2. Initiation of a leak determination program to identify if tanks are leaking	None	None

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Section 4 Data Quality Assessment

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

4.1 Data Validation

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

4.1.1 Quality Control Program

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

4.1.2 Data Assessment

Precision

Precision is defined as the agreement between a set of replicate measurements without assumption and knowledge of the true value. Precision is evaluated by relative 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 percent 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 field duplicates (sample ES020 and sample ES021) collected from RHMW02, met the RPD precision criteria of 50% for all analytes (Table 4-1). The RPDs for MS/MSD were also within the laboratory established criteria (Appendix D). Therefore the data precision is considered good.

Accuracy

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

All of the LCS, MS/MSD and surrogate spike recoveries for analyzed constituents were within acceptable percent recovery limits except for a MSD recovery of TPH-Diesel. In this case, the percent recovery was 40.5% and was below the lower limit of the acceptable criteria (61%). However, it is not expected to significantly impact the data accuracy because it is the only anomaly observed in the QC tests. Therefore the data accuracy for this monitoring event is considered acceptable.

Representativeness

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

Representativeness is also evaluated through the compliance of the sample holding time and the analysis of blank samples including method blank and trip blank samples. The sample holding time complied with the EPA criteria. None of the COPCs were detected in the laboratory method blanks. For this sampling event five trip blank samples were collected and none of the VOCs and TPH-Gasoline were detected in the trip blanks (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 percent, 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. Therefore, the data assessment concludes that all data generated during this event are suitable for the intended use.

Table 4-1: Field QC Results, April 2011

Method	Chemical	DOH Drinking Water EALs for Human Toxicity^{a}	DOH Groundwater Gross Contamination EALs^{a}	RHMW02 Primary (ES020)					RHMW02 Duplicate (ES021)					RPD Duplicate (%)	Trip Blank (4/19/2011) ES022, ES023					Trip Blank (4/20/2011) ES026, ES027					Trip Blank (4/28/2011) ES034				
				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	**1,100**	++	150^{b}	80.8	40.4	**1,100**	++	150	80.8	40.4	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EPA 8260 B (Petroleum)	TPH-GRO	100	100	24	++	20.0	12.12	6.06	29	++	20.0	12.12	6.06	18.87	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	0.18	J	0.2	0.12	0.06	0.17	J	0.2	0.12	0.06	5.71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Acenaphthylene	240	2,000	0.071	J	0.2	0.12	0.06	0.07	J	0.2	0.12	0.06	1.42	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	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	0.14	0.07	ND	U	0.2	0.14	0.07	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	0.086	J	0.2	0.12	0.06	0.085	J	0.2	0.12	0.06	1.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Ideno(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	**5.1**		0.2	0.12	0.06	**5.2**		0.2	0.12	0.06	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2-Methylnaphthalene	24	10	0.43		0.2	0.12	0.06	0.53		0.2	0.12	0.06	20.83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Naphthalene	17	21	3.5		0.2	0.10	0.05	4.2		0.2	0.10	0.05	18.18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	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	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	0.36	0.18	ND	U	1.0	0.36	0.18	0	ND	U	1.0	0.36	0.18	ND	U	1.0	0.36	0.18	ND	U	1.0	0	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	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
	Bromodichloromethane	0.22	50,000	ND	U	1.0^{b}	0.28	0.14	ND	U	1.0	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	0.62	0.31	ND	U	1.0	0.62	0.31	0	ND	U	1.0	0.62	0.31	ND	U	1.0	0.62	0.31	ND	U	1.0	0.62	0.31
	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	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
	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	0.38	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
	Methylene chloride	4.8	9,100	ND	U	5.0	0.70	0.35	ND	U	5.0	0.70	0.35	0	ND	U	5.0	0.70	0.35	ND	U	5.0	0.70	0.35	ND	U	5.0	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	0.26	0.13	ND	U	1.0	0.26	0.13	0	ND	U	1.0	0.26	0.13	ND	U	1.0	0.26	0.13	ND	U	1.0	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	0.30	0.15	ND	U	1.0	0.30	0.15	0	ND	U	1.0	0.30	0.15	ND	U	1.0	0.30	0.15	ND	U	1.0	0.30	0.15
	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	0.41	J	1.0	0.38	0.19	0.41	J	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	ND	U	0.5	0.22	0.11	ND	U	0.5	0.22	0.11	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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).

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

Bold - Result exceeds one or both DOH EALs

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Section 5 Summary, Conclusions, and Recommendations

5.1 Summary

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

5.1.1 Results of Oil/Water Interface Measurements

Free product was not observed at RHMW01, RHMW02, RHMW03, and RHMW05 during the April 2011 sampling 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 other monitoring wells. Since the trace amounts observed in January 2008, no free product has been observed in any of these RHSF monitoring wells (Table 3-1).

5.1.2 Summary of Groundwater Analytical Results

Laboratory analytical results from the April 2011 groundwater monitoring event indicated that TPH-DRO, and PAHs, specifically 1-methylnaphthalene, were present in the groundwater beneath the RHSF at concentrations that exceeded the EALs. All other COPC concentrations were below the EALs. 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 LOQs in place of the EAL (DOH, 2009).

At monitoring wells RHMW2254-01, RHMW03, and RHMW05, all COPCs were not detected at or above the LODs and LOQs.

At monitoring well RHMW01, TPH-DRO (300 μg/L) was detected at a concentration which exceeded the EALs. All other COPCs in RHMW01 were not detected at or above the LODs and LOQs.

At monitoring well RHMW02, TPH-DRO (1,100 μg/L), and 1-methylnaphthalene (5.1 μg/L), were detected at concentrations which exceeded the EALs. TPH-GRO (24 μg/L) 2-methylnaphthalene (0.43 μg/L) and napthalene (3.5 μg/L) were detected at concentrations which were below the EALs. Acenapthene (0.18 μg/L), acenaphthylene (0.071μg/L), fluorene (0.086 μg/L, and xylenes (0.41 μg/L) were detected at estimated concentrations which were below the EALs. All other COPCs in RHMW02 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 LODs and are below 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 at least four consecutive 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 this event. The fluctuations in concentration measured during this event and previous events indicates the current source of 1-methylnaphthalene is potentially residual contamination from a historical event. The general overall long-term trend in 1-methylnaphthalene concentration is decreasing.

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 2 status of RHMW01 and 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.

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Appendix A

Quarterly Groundwater Monitoring Results for TPH and PAHs, September 2005 through April 2011

Figure A-4: TPH at RHMW03
Quarterly Monitoring Results

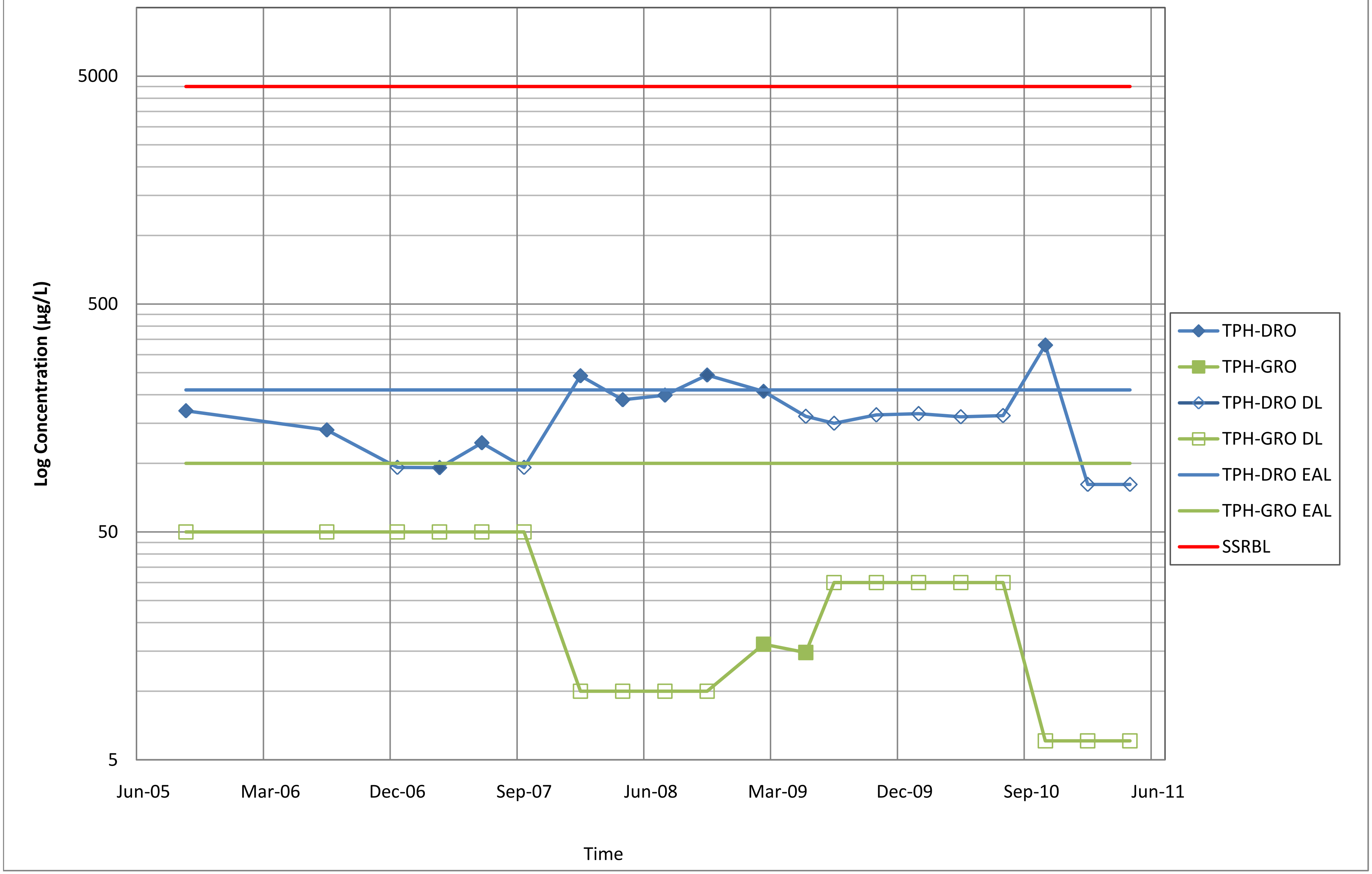


Figure A-3: TPH at RHMW02
Quarterly Monitoring Results

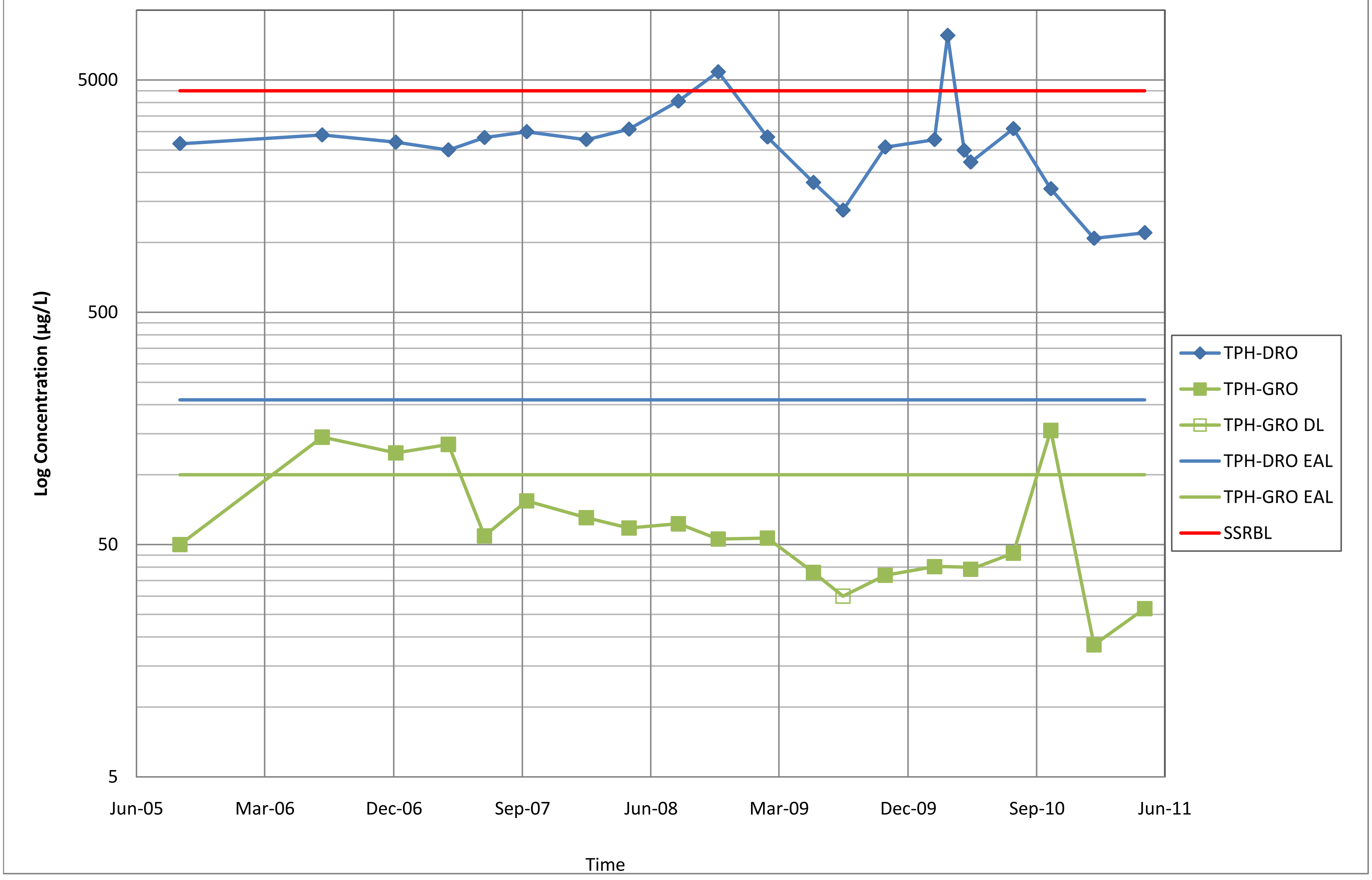


Figure A-2: TPH at RHMW01
Quarterly Monitoring Results

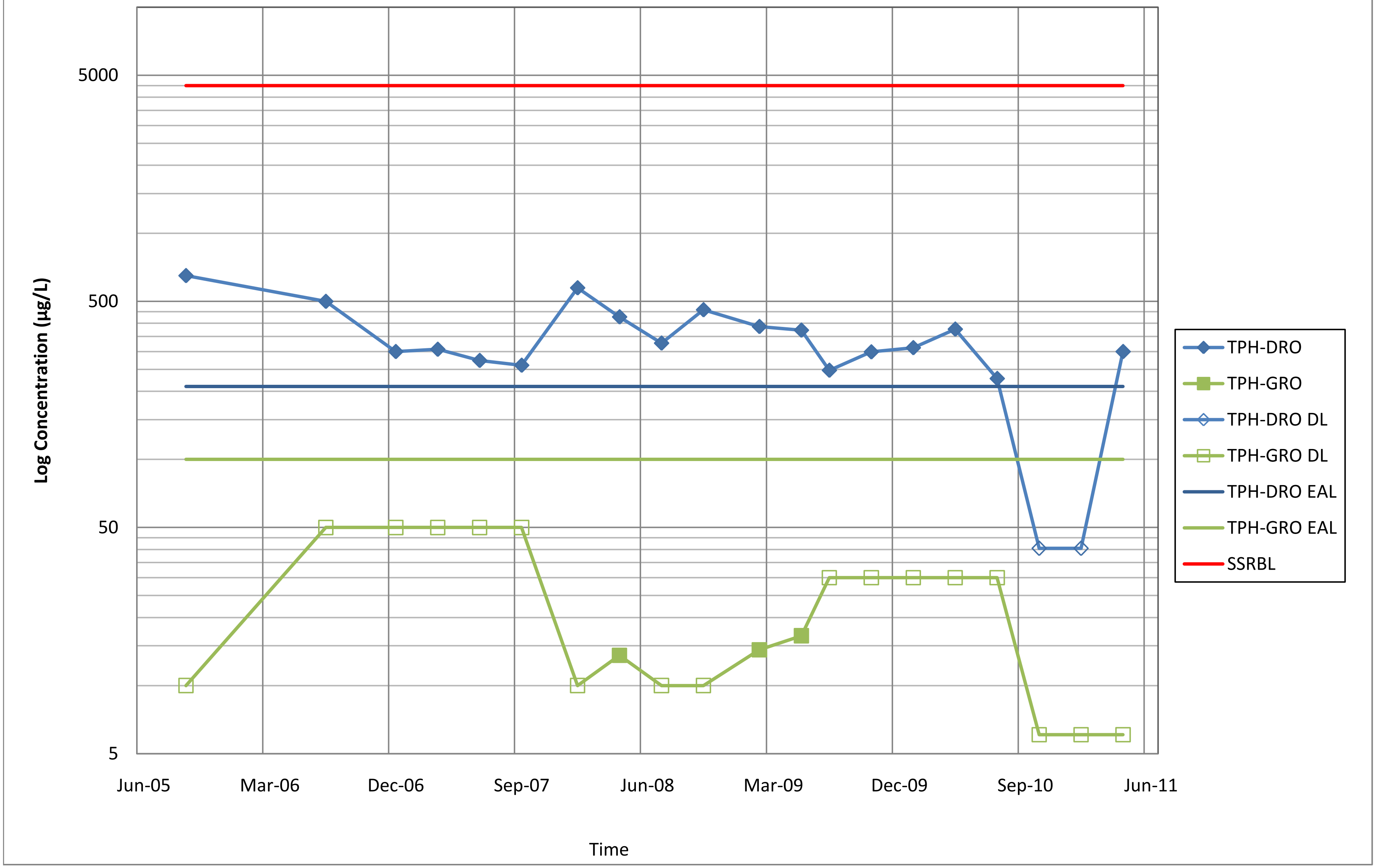


Figure A-1: TPH at RHMW2254-01
Quarterly Monitoring Results

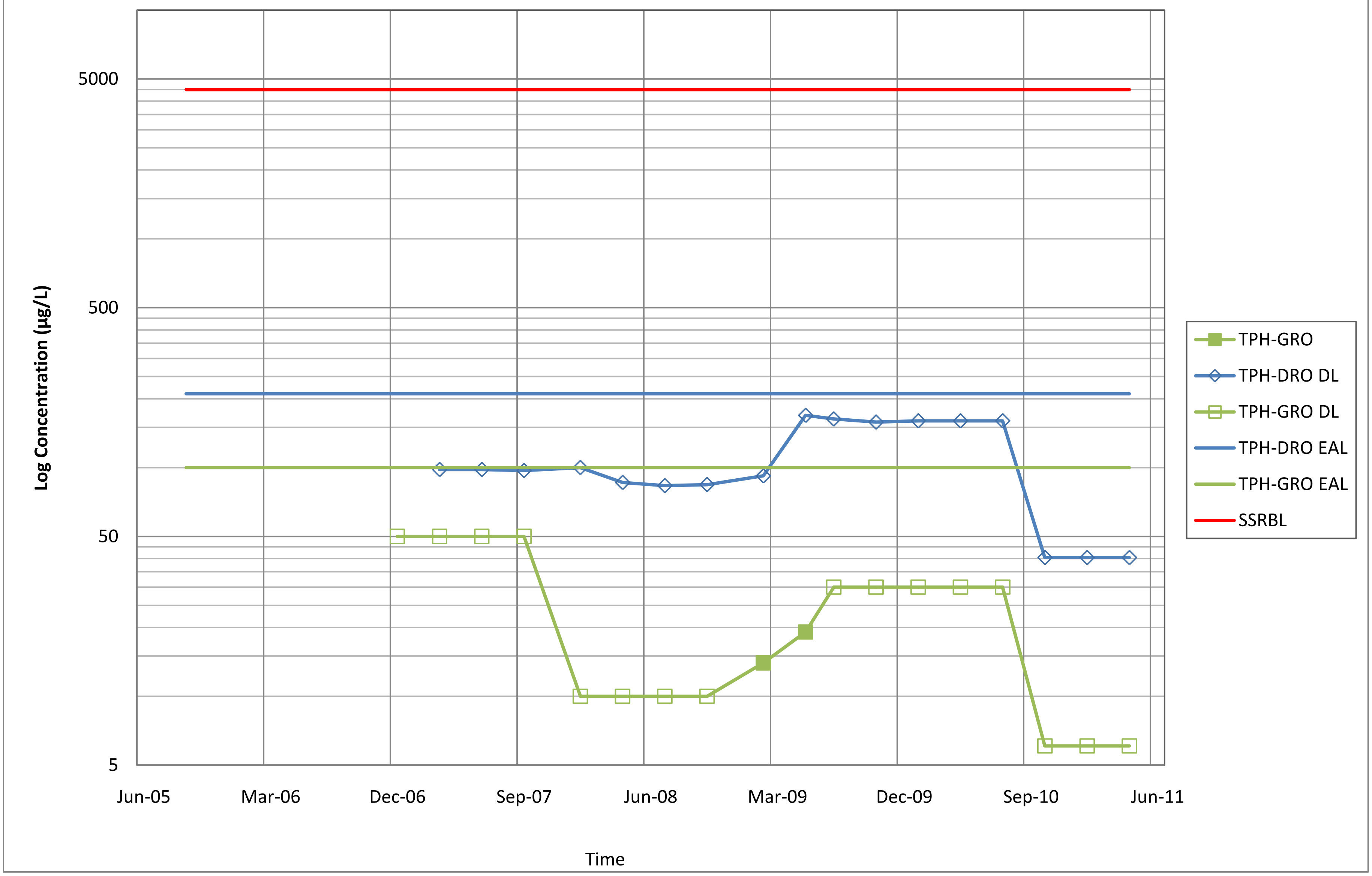


Figure A-5: TPH at RHMW05
Quarterly Monitoring Results

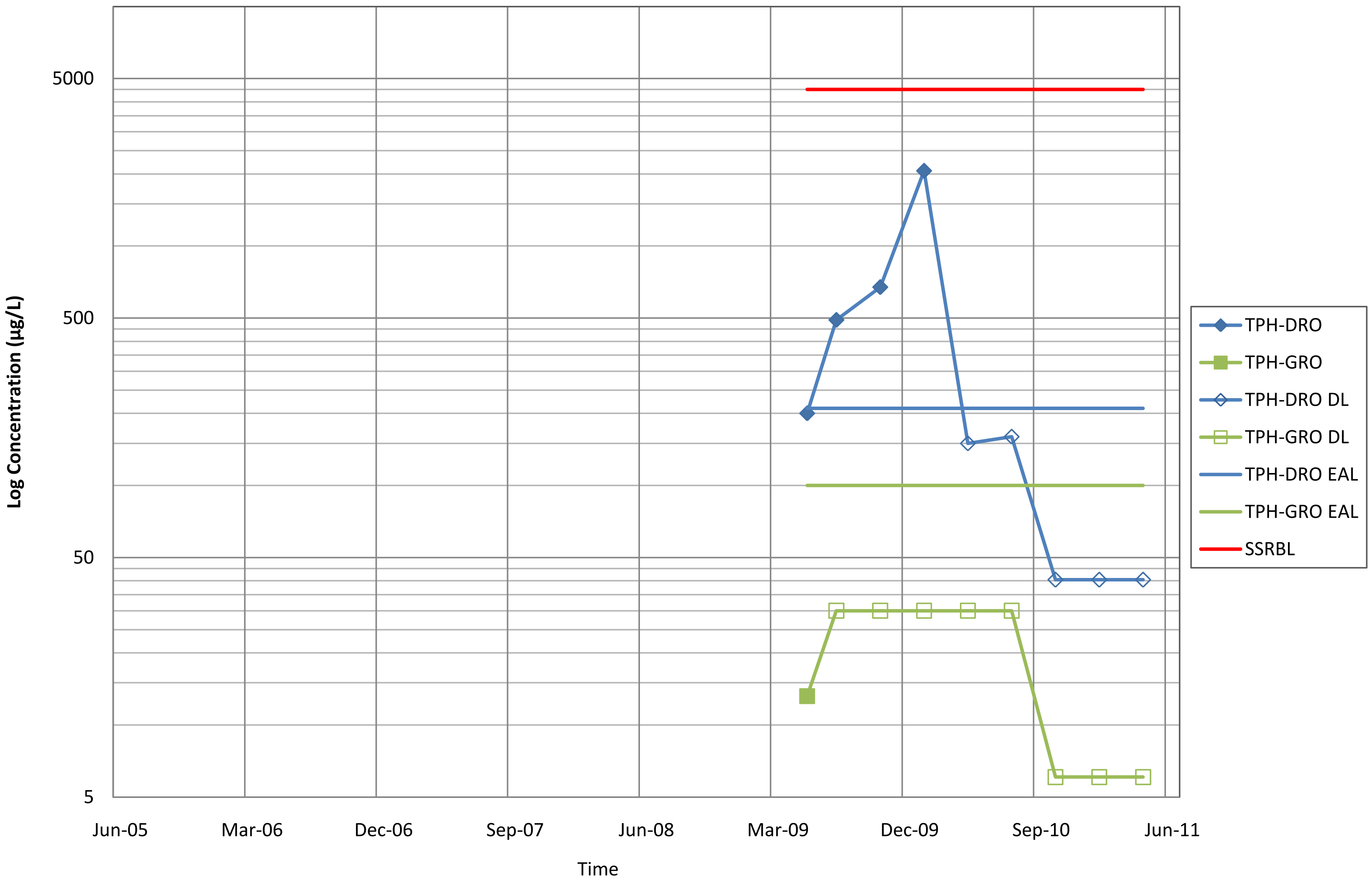
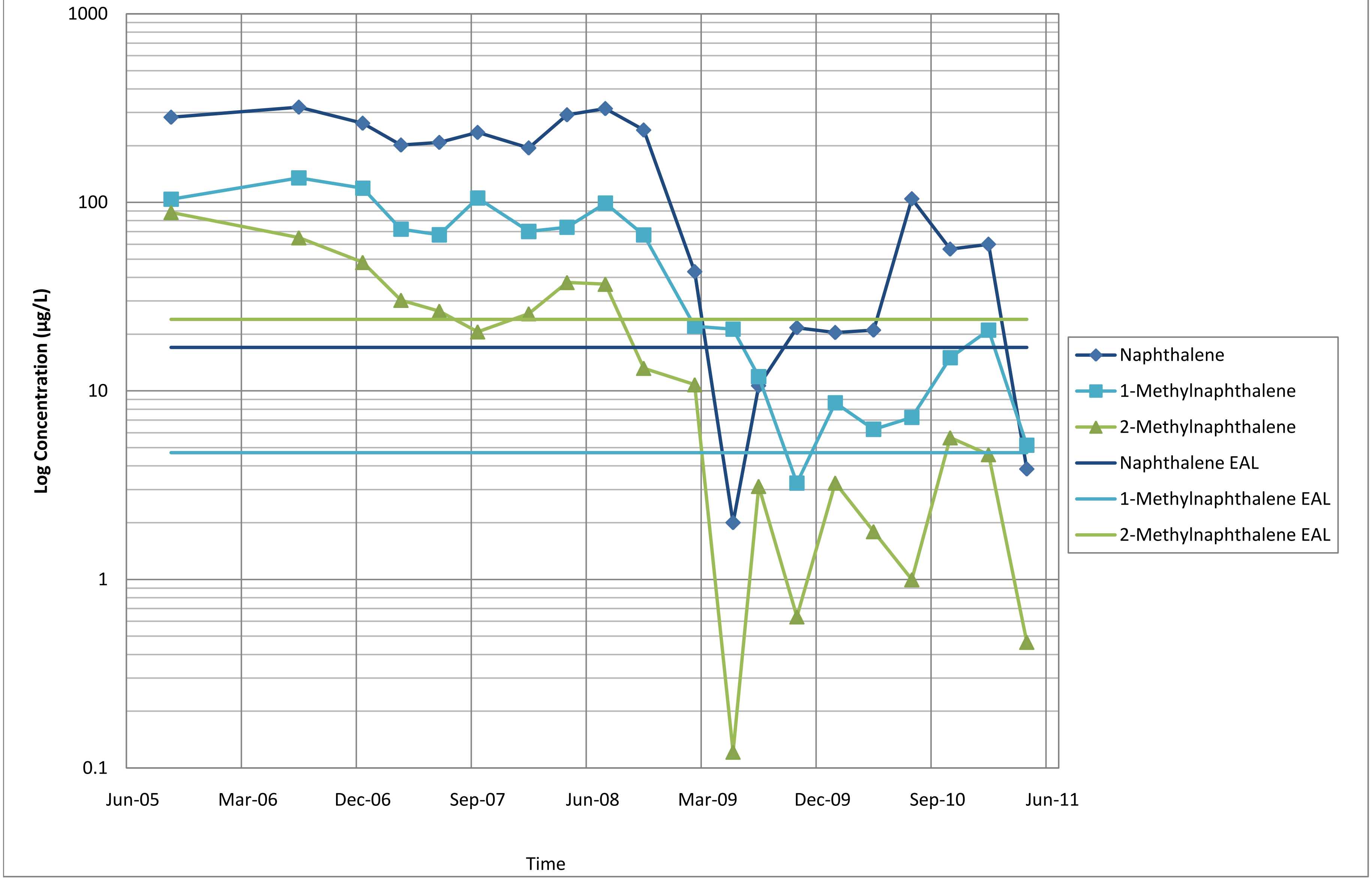


Figure A-6: PAHs at RHMW02 Quarterly Monitoring Results



Appendix B
Field Notebook, April 2011

RHSF LTM 1022-015

1403 purge SUMP3S
1405 sample SUMP3S
1406 purge SUMP3M
1408 sample SUMP3M
1409 purge SUMP4D
1411 sample SUMP4D
1418 purge SUMP2S
1420 samples SUMP2S
1421 purge SUMP2M
1423 sample SUMP2~~M~~
1424 purge SUMP2D
1426 sample SUMP2D
1429. Mobile to RHMW05 - no produ
1524 ~~1524~~ RHMW05 ~~PID=15~~ PID=521
1450 arrive @ RHMW-01 PID=46ppb
DTW = 83.54 ft no produc?
1504 RHMW02 PID= 545 ppb
DTW = 86.18 ft - no produc.
1515 RHMW03 PID= 196 ppb
1520 DTW = 102.39 ft - no produ.
1523 Sign out @ lower tunnel
1536 Leave site
1622 Back @ Dole office

End of Day

RHSF 1022-015 21

4/19/11
Task: Groundwater Monitoring
Personnel: SF, MS, CA
PPE: Level D
0700: Met at office to load truck
0815: Arrive at Adit 5. Health & Safety Mt.
0830: Arrive at Pump Station
0845: Calibrate Horiba + PID
0900: Start purging RHMW2254
1000: Sample collection. Sample ES019
1040: Took lunch after cleaning up
1100: Exit adit 3 for lunch
1145: Back at Pump Station waiting for train
1200 Drop off at RHMW02 PID reading 0.0 ppm
Depth 86.35
1225: Started purging. Tank started w/ 3100 psi
1250: Sample collection. Sample ES020
1310: Sample ES021
1330: Sample ES022 is trip blank
ES023 is trip blank
1415: Left tunnels to pack truck.

RHSF 1022-015

~~4/19/11~~ 4/20/11

0700 Met at office

Task : Ground water Sampling

Personnel: CA+SF

PPE : Level D

811 : Arrive at Adit 3 unloaded and wait for train, conducted Safety Mt.

8:58 Calibrate Horiba + PID

PID reading 0.1 ppm

9:05 83.11 ft

9:10 Started purging MW05

9:30 Sample Collected from MW05

10:00 Done with clean up waiting for train.

11:00 Arrived at MW01 PID = 0.9 ppm

Attempted purging but no water tried all different settings on controller tried switching tires when pump was out of water No pressure coming out of H_2O. Pump fell down well.

1300 Took lunch

1330 PID at MW03 0.7 ppm

1415 Sampled RHMW03. Encountered no problems

4/20/11

1500: Exited tunnels

bought ice to pack samples

1700: Dropped Samples off to Fed Ex to Ship to lab.

1800. Return to office to inventory for outside wells.

SF

End of Entry

4/21/2011

Task: Groundwater sampling outside wells
Personnel: MS, SF
PPE : Level D
0800 : Met at office + packed truck
0830 : Went to Citymill + Storage
0945 : Checked in at gate.
10:00 : Health + Safety Meeting.
10:40 : Collected sample from HBMW22S3-03
12:30 : Collected sample from OWDF well
Collected Dup + MS/MSD from OWDF.
1400 : Tried to retrieve MW01 pump.
1600 : Return to office after Storage and scuba shop.

End of Entry

4/22/2011

Task: Ship samples. retrieve pump
Personnel: SF, VD
PPE: Level D
0900 : Purchased equipment to retrieve pump from well.
1100 : Dropped samples off at Fed Ex
1300 : Arrived at tunnels to retrieve pump.
1530 : Unsuccessful using hooks, line and magnets.
1600 : Returned to office

End of Entry SF

4-28-11

Task: GW sampling @ RHMW01
Personnel: S. Koide, S. Fineran
PPE: Level D

1010 Arrive @ Adit 3
1014 SF conduct Safety meeting
1018 SF call train
11:00 Calibrated PID + Horiba
11:15 PID reading 0.3
DTW = 83.86 ft
1147 Begin Purging @ RHMW01, not getting H2O
1153 Stop purging, pull out pump and test, water in tube, put pump back in well
1156 Resume purging
1206 Still not recovering water, slowly adjusting pressure.
1231 water reached surface (purging)
1249 Stopped purging.
DTW = 83.85 ft
1300 Collect sample @ RHMW01
ES033
Trip blank (11 am)

1400 Ideal purge levels were 100 psi
I 10 sec E 10 sec
1427 Leave site
1450 Arrive @ Fedex, deliver samples, storage
1605 Back @ Dole office

End of Entry

Appendix C
Groundwater Sampling Logs, April 2011

GROUNDWATER SAMPLING LOG

WELL ID: RHMW2254-01 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-015

INITIAL WATER LEVEL: not applicable (N/A) DATE: 4/19/2011 TIME: 0915

TOTAL DEPTH OF WELL: unknown PERSONNEL INVOLVED: S.Fineran, C. Asselbaye, M. Solmssen

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: 0.25 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/m)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^oC)	SALINITY (%)	REDOX (ORP) (mV)
0926	2L	5.89	45.9	5.7	8.45	24.7	0.0	211
0930	3L	6.05	47.0	16.9	8.55	24.2	0.0	210
0932	3.5L	6.13	47.3	4.6	8.41	24.0	0.0	210
0934	4L	6.25	48.1	3.4	8.39	24.0	0.0	212

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump

APPEARANCE OF SAMPLE:
COLOR None
TURBIDITY None
SEDIMENT None
OTHER

SAMPLE ID: ES019 (RH-RHMW2254-01-GW23)
SAMPLE COLLECTION TIME: 1000
SAMPLED BY: S.Fineran, C. Asselbaye, M. Solmssen

COMMENTS AND OBSERVATIONS: PID = 0.0 ppm

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

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED: (4) - 40 mL VOAs, (4) - 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: S. Fineran
SAMPLE DELIVERY DATE: 4/20/2011 SAMPLE DELIVERY TIME: 1700

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

GROUNDWATER SAMPLING LOG

WELL ID: RHMW01 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-015

INITIAL WATER LEVEL: 83.86 feet bTOC (below top of casing) DATE: 4/28/2011 TIME: 1230

TOTAL DEPTH OF WELL: unknown PERSONNEL INVOLVED: S. Fineran, S. Koide

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: 83.85 feet bTOC PUMPING RATE: 0 .25 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/m)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^oC)	SALINITY (%)	REDOX (ORP) (mV)
1236	0.5L	6.18	35.5	10.2	3.61	24.3	0.0	-70
1238	1L	6.21	38.9	3.0	2.00	24.3	0.0	-96
1240	2L	6.37	40.8	1.3	1.15	24.1	0.0	-118
1243	2.5L	6.41	41.0	0.0	0.70	23.9	0.0	-126
1245	3L	6.42	40.9	0.0	0.53	23.8	0.0	-129
1248	3.5L	6.44	40.8	0.0	0.35	23.7	0.0	-131

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump

APPEARANCE OF SAMPLE:
COLOR Clear
TURBIDITY None
SEDIMENT None
OTHER

SAMPLE ID: ES033 (RH-RHMW01-GW23)
SAMPLE COLLECTION TIME: 1300
SAMPLED BY: S. Fineran, C. Asselbaye

COMMENTS AND OBSERVATIONS: PID reading = 0.3 ppm

LABORATORY ANALYSIS PARAMETERS AND PRESERVATIVES: TPH-GRO (EPA 8260B) & VOCs (EPA 8260B), TPH-DRO (EPA8015B) & PAHs (EPA 8270D SIM) with no preservative, and dissolved lead (EPA 6020) with no preservative (to be filtered in the laboratory)

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED: (4) - 40 mL VOAs, (4) - 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: S. Fineran, S. Koide
SAMPLE DELIVERY DATE: 4/28/2011 SAMPLE DELIVERY TIME: 1500

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

GROUNDWATER SAMPLING LOG

WELL ID: RHMW02
LOCATION: Red Hill Bulk Fuel Storage Facility
PROJECT NO: 1022-015

INITIAL WATER LEVEL: feet bTOC
DATE: 4/19/2011
TIME: 1226

TOTAL DEPTH OF WELL: unknown
PERSONNEL INVOLVED: C. Asselbaye, S. Fineran

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

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

WATER LEVEL AFTER PURGING: 86.30 feet bTOC
PUMPING RATE: 0.5 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/m)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^{o}C)	SALINITY (%)	REDOX (ORP) (mV)
1233	2L	5.98	61.5	15.4	2.33	25.0	0.0	-23
1235	3L	6.05	65.7	16.6	1.91	24.8	0.0	-16
1237	4L	6.05	68.5	17.0	1.81	24.8	0.0	-11
1239	5L	6.04	68.3	9.0	1.96	24.7	0.0	-20

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump

APPEARANCE OF SAMPLE:
COLOR None
TURBIDITY None
SEDIMENT None
OTHER

SAMPLE ID: ES020, ESO21 (RH-RHMW02-GW23)
SAMPLE COLLECTION TIME: 1300
SAMPLED BY: S. Koide, S. Fineran

COMMENTS AND OBSERVATIONS: 0.0 ppm
Collected MS/MSD sample
Collected duplicate sample = ES021 (RH-RHMW02-GW23Dup)

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

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

DECONTAMINATION PROCEDURES: Alconox, triple rinse with distilled water
SAMPLES DELIVERED TO: APPL, Inc. via FedEx
TRANSPORTERS: S. Fineran
SAMPLE DELIVERY DATE: 4/20/2011
SAMPLE DELIVERY TIME: 1700

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

GROUNDWATER SAMPLING LOG

WELL ID: RHMW03
LOCATION: Red Hill Bulk Fuel Storage Facility
PROJECT NO: 1022-015

INITIAL WATER LEVEL: 102.92 feet bTOC
DATE: 4/20/2011
TIME: 1454

TOTAL DEPTH OF WELL: unknown
PERSONNEL INVOLVED: C. Asselbaye, S. Fineran

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: 102.93 feet bTOC
PUMPING RATE: 0.5 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/m)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^{o}C)	SALINITY (%)	REDOX (ORP) (mV)
1358	2 L	6.33	68.8	51.0	2.37	27.9	0.0	274
1401	3 L	6.36	76.8	72.1	1.42	27.8	0.0	256
1403	4 L	6.36	83.8	45.0	1.34	27.2	0.0	239
1405	5 L	6.36	86.1	34.0	1.31	27.1	0.0	196
1407	6 L	6.36	86.3	22.9	1.31	27.0	0.0	157

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump

APPEARANCE OF SAMPLE:
COLOR None
TURBIDITY None
SEDIMENT None
OTHER

SAMPLE ID: ES025 (RH-RHMW03-GW23)
SAMPLE COLLECTION TIME: 1415
SAMPLED BY: S. Fineran, and C. Asselbaye

COMMENTS AND OBSERVATIONS:

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

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED: (4) - 40 mL VOAs, (4) - 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: S. Fineran
SAMPLE DELIVERY DATE: 4/20/2011
SAMPLE DELIVERY TIME: 1720

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

GROUNDWATER SAMPLING LOG

WELL ID: RHMW05 LOCATION: Red Hill Bulk Fuel Storage Facility PROJECT NO: 1022-015

INITIAL WATER LEVEL: 83.11 feet bTOC DATE: 4/20/2011 TIME: 0914

TOTAL DEPTH OF WELL: unknown PERSONNEL INVOLVED: S. Fineran, C. Asselbaye

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: 83.10 feet bTOC PUMPING RATE: 0.6 L/min

WELL PURGE DATA:

TIME	VOLUME REMOVED	pH	COND (mS/m)	TURBIDITY (NTU)	DO (mg/l)	TEMP (^oC)	SALINITY (%)	REDOX (ORP) (mV)
0915	2L	5.89	39.1	194.0	8.35	22.5	0.0	209
0917	3L	6.09	44.2	113.0	7.80	22.1	0.0	212
0919	4L	6.19	45.7	89.0	7.54	22.2	0.0	216
0920	5L	6.26	47.4	50.0	7.40	22.1	0.0	216

SAMPLE RETRIEVAL METHOD: Low flow dedicated bladder pump

APPEARANCE OF SAMPLE:
COLOR None
TURBIDITY slightly turbid
SEDIMENT None
OTHER

SAMPLE ID: ES024 (RH-RHMW05-GW23)
SAMPLE COLLECTION TIME: 930
SAMPLED BY: S. Fineran, C. Asselbaye

COMMENTS AND OBSERVATIONS: PID = 0.1 ppm

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

NUMBER AND TYPES OF SAMPLE CONTAINERS FILLED: (4) - 40 mL VOAs, (4) - 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: S. Fineran
SAMPLE DELIVERY DATE: 4/20/2011 SAMPLE DELIVERY TIME: 1700

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 D
Laboratory Analytical Results, April 2011 (on CD-ROM)