

# **Groundwater Flow Model Progress Report 04, Red Hill Bulk Fuel Storage Facility**

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

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

**April 5, 2018  
Revision 00**



**Comprehensive Long-Term Environmental Action Navy  
Contract Number N62742-12-D-1829, CTO 0053**

This page intentionally left blank

1 **Groundwater Flow Model Progress**  
2 **Report 04, Red Hill Bulk Fuel**  
3 **Storage Facility**

4 **JOINT BASE PEARL HARBOR-HICKAM, O'AHU, HAWAI'I**

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

9 **April 5, 2018**  
10 **Revision 00**

11 Prepared for:

12 **Defense Logistics Agency Energy**  
13 **8725 John J Kingman Rd Suite 4950**  
14 **Fort Belvoir, VA 22060-6222**

15 Prepared by:

16 **AECOM Technical Services, Inc.**  
17 **1001 Bishop Street, Suite 1600**  
18 **Honolulu, HI 96813-3698**

19 Prepared under:



21 **Comprehensive Long-Term Environmental Action Navy**  
22 **Contract Number N62742-12-D-1829, CTO 0053**

This page intentionally left blank

---

|    |   |   |
|----|---|---|
| 1  | <b>CONTENTS</b>   |   |
| 2  | Acronyms and Abbreviations  | v |
| 3  | 1. Introduction   | 1 |
| 4  | 2. Work Completed This Period   | 1 |
| 5  | 2.1 Current Status  | 1 |
| 6  | 2.1.1 Technical Progress  | 2 |
| 7  | 2.1.2 Technical Issues  | 8 |
| 8  | 2.2 Submittal of Modeling Deliverables                                  | 8 |
| 9  | 3. Anticipated Work for Next Reporting Period                           | 8 |
| 10 | 4. References   | 9 |
| 11 | <b>FIGURES</b>  |   |
| 12 | 1 Current Groundwater Monitoring Network and Seismic Transect Locations | 5 |

This page intentionally left blank

---

## ACRONYMS AND ABBREVIATIONS

|    |        |  |
|----|--------|--|
| 1  |        |  |
| 2  | AOC    | Administrative Order on Consent                            |
| 3  | bgs    | below ground surface                                       |
| 4  | BWS    | Board of Water Supply, City and County of Honolulu         |
| 5  | CF&T   | contaminant fate and transport                             |
| 6  | CWRM   | Commission on Water Resource Management, State of Hawai'i  |
| 7  |        | Department of Land and Natural Resources                   |
| 8  | DLNR   | Department of Land and Natural Resources, State of Hawai'i |
| 9  | DOH    | Department of Health, State of Hawai'i                     |
| 10 | EPA    | Environmental Protection Agency, United States             |
| 11 | ft     | foot/feet  |
| 12 | GWFMWG | Groundwater Flow Model Working Group                       |
| 13 | msl    | mean sea level   |
| 14 | SAP    | sampling and analysis plan                                 |
| 15 | SME    | Subject Matter Expert                                      |
| 16 | SOW    | scope of work  |
| 17 | TUA    | Tank Upgrade Alternatives                                  |
| 18 | TWG    | Technical Working Group                                    |
| 19 | UH     | University of Hawai'i                                      |
| 20 | USGS   | United States Geological Survey                            |
| 21 | UST    | underground storage tank                                   |
| 22 | WP     | work plan  |

This page intentionally left blank



## 1. Introduction

This *Groundwater Flow Model Progress Report 04* is the fourth in a series of modeling progress reports that describe the technical status of the groundwater flow modeling effort being conducted for the Investigation and Remediation of Petroleum Product Releases and Groundwater Protection and Evaluation project at the Red Hill Bulk Fuel Storage Facility (“Facility”), Joint Base Pearl Harbor-Hickam, O’ahu, Hawai‘i. The progress report is a component of the overall project reporting as specified in the project *Work Plan/Scope of Work* (WP/SOW) (DON 2017a). The WP/SOW presents the process, tasks, and deliverables that address the goals and requirements of Statement of Work Sections 6 and 7 of the *Administrative Order on Consent* (AOC) *In the Matter of Red Hill Bulk Fuel Storage Facility* (EPA Docket No: RCRA 7003-R9-2015-01; DOH Docket No: 15-UST-EA-01) (EPA Region 9 and DOH 2015). Submittal of groundwater flow model progress reports at a minimum of every 4 months is stipulated in AOC Statement of Work Section 7.1.2.

The objective of the AOC is to take steps to ensure that the drinking water resources in the vicinity of the Facility is protected and to ensure that the Facility is operated and maintained in an environmentally protective manner. Work to support Section 6 of the AOC Statement of Work is being conducted in response to the January 2014 release from Tank 5, and to evaluate potential remediation methods for the January 2014 Tank 5 release, as well as any potential future releases. Work to support Section 7 of the AOC Statement of Work is being conducted to monitor and characterize the flow of groundwater around the Facility and includes groundwater modeling. The collective work conducted under Section 7 will be used to inform changes to the current *Groundwater Protection Plan* (DON 2014).

Reporting Period 04 covered in this report represents progress for the fourth 4-month period (December 4, 2017 – April 5, 2018) following conditional approval of the project WP/SOW by the Regulatory Agencies, which was received by the Navy on December 5, 2016 (EPA Region 9 and DOH 2016). *Groundwater Flow Model Progress Reports 01, 02, and 03* were submitted on April 5, August 4, and December 3, 2017, respectively.

## 2. Work Completed This Period

### 2.1 CURRENT STATUS

The Groundwater Flow Model Working Group (GWFMWG) met four times during this reporting period, on December 20, 2017, January 11, 2018, February 12, 2018, and March 16, 2018. The GWFMWG is composed of representatives from the Navy, United States Geological Survey (USGS), United States Environmental Protection Agency (EPA), State of Hawai‘i Department of Health (DOH), State of Hawai‘i Department of Land and Natural Resources (DLNR) Commission on Water Resource Management (CWRM), City and County of Honolulu Board of Water Supply (BWS), and the University of Hawai‘i (UH). The working group was formed to coordinate the Navy’s development of accurate and reliable groundwater flow and contaminant fate and transport (CF&T) models, and solicit technical feedback from stakeholders during the model development process. Agenda items covered in the four GWFMWG meetings held during the current reporting period include:

- December 20:
  - Water Level Data Assimilation
  - Calibration Targets, Weights and Error Bounds
  - Parameter Values and Ranges

- 1           – Recharge and Pumping Stresses
- 2           – Conceptual Groundwater Budget Estimates
- 3           – Model Construction
- 4           – Synoptic Monitoring Update
- 5       • January 11:
  - 6           – Field Data Collection Update
  - 7           – Groundwater Potentiometric Map
  - 8           – Interim Modeling
  - 9           – LNAPL Modeling
  - 10          – Synoptic Monitoring Update
- 11       • February 12:
  - 12          – Field Data Collection Update
  - 13          – Interim Modeling
  - 14          – Synoptic Monitoring Update
- 15       • March 16:
  - 16          – Interim Modeling / Sensitivity Analyses
  - 17          – Final Groundwater Flow Model – due December 5, 2018
  - 18          – Contaminant Fate & Transport Considerations
  - 19          – Synoptic Monitoring Update

## 20   **2.1.1    Technical Progress**

### 21   2.1.1.1    GROUNDWATER FLOW MODEL

22   During this reporting period, the Navy developed a calibrated interim groundwater flow model based  
23   on MODFLOW USG (for Unstructured Grid) to support the forthcoming TUA decision. The model  
24   was calibrated to average groundwater elevations for the years 2006, 2015, and 2017. Transient  
25   calibration was performed using synoptic monitoring data from 2006 and 2015.

26   It is important to understand the uncertainty in various model input parameters that may influence  
27   model predictions. Consequently, an evaluation of more than 20 sensitivity analyses (under both  
28   steady-state and transient conditions) was conducted and included the following:

- 29       • Recharge multipliers
- 30       • Northeast boundary inflows
- 31       • Presence of clinker at water table under Red Hill ridge
- 32       • Northwest and Southeast General-Head Boundary stages
- 33       • Saprolite hydraulic properties same as basalt
- 34       • Lower vertical hydraulic conductivity of basalt with higher hydraulic conductivity for  
35        saprolite

- 1       • Horizontal and vertical hydraulic conductivity of basalt
- 2       • Transient sensitivities
- 3           – Specific yield
- 4           – Specific storage
- 5           – Horizontal anisotropy
- 6           – Presence of clinker at water table under Red Hill ridge
- 7           – High horizontal hydraulic conductivity of basalt

8 Additional sensitivity analyses continue to be conducted to answer specific questions developed in  
9 ongoing interactions with the AOC Parties and SMEs.

10 The calibrated interim model is being actively used for particle tracking analysis of several pumping  
11 scenarios. These analyses include:

- 12       • Red Hill Shaft on at average pumping rates:
  - 13           – With Hālawā Shaft pumping at maximum pumping rate and the BWS Moanalua Wells
  - 14           off
  - 15           – With the BWS Moanalua Wells pumping at maximum rate and Hālawā Shaft off
- 16       • Red Hill Shaft off:
  - 17           – With Hālawā Shaft pumping at maximum pumping rate and the BWS Moanalua Wells
  - 18           off
  - 19           – With the BWS Moanalua Wells pumping at maximum rate and Hālawā Shaft off

20 Impacts on particle tracks and zones of contribution when model parameters are changed have been  
21 evaluated as part of sensitivity analyses. The use of particle tracking to understand groundwater flow  
22 directions is important for understanding potential risk to drinking water supply wells and will help  
23 inform the forthcoming TUA decision. Generalized zones of contribution (with slight variability  
24 depending on the sensitivity analysis) have been established for the three zones of most interest (i.e.,  
25 Hālawā Shaft, Red Hill Shaft, and the Moanalua Wells). The interim model continues to be  
26 evaluated and refined for the Technical Memorandum in support of the forthcoming TUA decision,  
27 scheduled for submittal in July 2018.

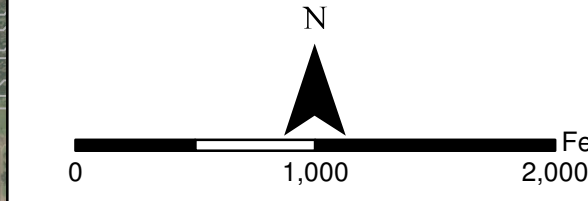
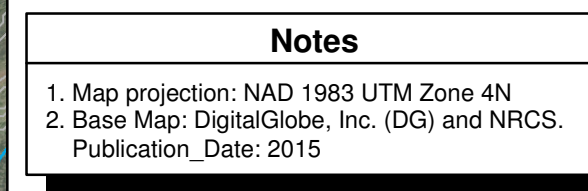
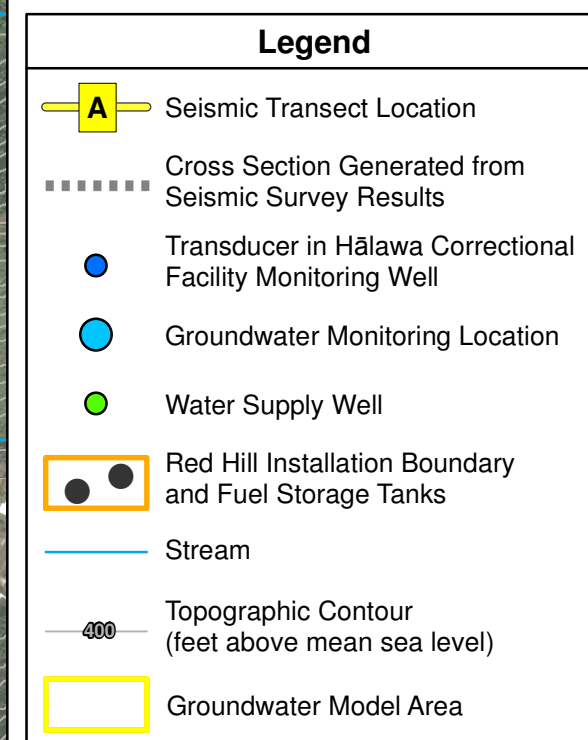
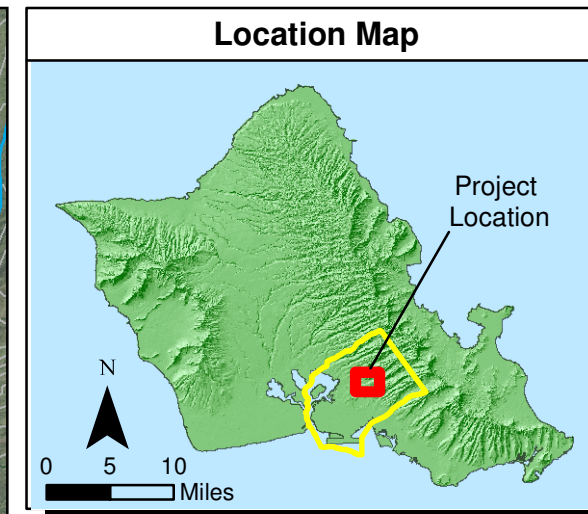
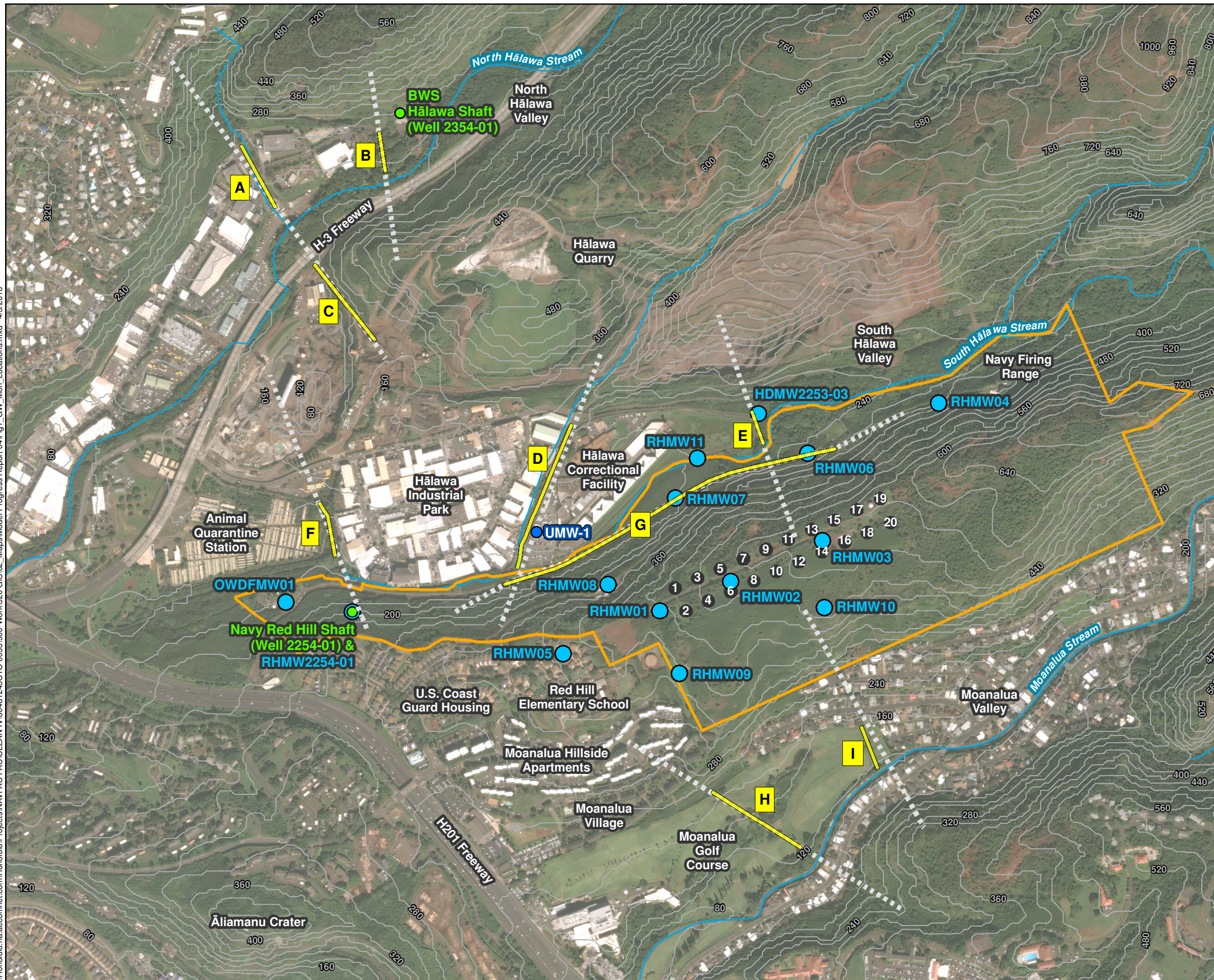
28 Interim model runs of various pumping scenarios performed to date have predicted groundwater  
29 from beneath the Facility will likely not migrate toward BWS Hālawā Shaft or Moanalua Wells;  
30 conversely, the interim model runs have predicted groundwater will likely flow to the southwest.

31 Other activities conducted during this reporting period relevant to groundwater flow modeling  
32 include the following:

- 33       • **Well Elevation Survey.** The *Well Elevation Survey Report* was published in January 2018  
34 (DON 2018b). The survey was conducted in Summer–Fall 2017 using Second Order, Class I  
35 techniques and included all existing sampling locations in the Red Hill groundwater  
36 monitoring network.
- 37       • **Conceptual Site Model Report.** Prepared in-progress draft report for internal review. The  
38 report includes the following modules:

- 1       – Physical Setting
- 2       – Facility Construction and Operations
- 3       – LNAPL Release and Source-Zone Migration Model
- 4       – Vadose Zone Model
- 5       – Saturated Zone Model
- 6       – Fate and Transport of LNAPL and Dissolved COPCs in Groundwater
- 7       – Exposure Model
- 8       • **Seismic Survey.** A seismic survey consisting of nine transects at North and South Hālawā  
9       Valleys, Moanalua Valley, and Red Hill was completed in December 2017 (see Figure 1).  
10       The survey assessed the depth of valley fill deposits, clay-rich decomposed volcanic units  
11       (i.e., saprolite), and relatively unweathered volcanic bedrock layers using seismic refraction  
12       and reflection technologies. Interpretation of the composite images generated for the  
13       transects and various borehole logs found saprolite to extend from above the local  
14       groundwater table to depths as great as -250 ft mean sea level (msl) in North Hālawā  
15       Valley, -304 ft msl in South Hālawā Valley, and -164 ft msl in Moanalua Valley. Results of  
16       the survey including 2D cross sections and 3D cross-section models were presented to the  
17       Regulatory Agencies and Subject Matter Experts (SMEs) on February 13 and March 2,  
18       2018. A *Seismic Profiling* report was published on March 30, 2018 (DON 2018d). Survey  
19       findings will be incorporated into the December 2018 groundwater flow model.
- 20       • **RHMW11 Installation.** RHMW11 was completed in South Hālawā Valley as a multi-level  
21       Westbay well in November 2017 (see Figure 1). During coring, valley fill deposits were  
22       encountered to a depth of 68.5 ft below ground surface (bgs), and saprolite was encountered  
23       below that, extending down to 279 ft bgs, or approximately 87 ft below the regional basal  
24       groundwater table (as recorded at the time of drilling; the boring log is presented in DON  
25       2018c, Attachment D). Recent monitoring shows that the saprolite is continuously saturated  
26       from approximately 104 ft bgs to the basal groundwater table.  
27       The well includes eight discrete sampling zones with can be equipped with transducers: five  
28       in the basal aquifer to a depth of 300 ft below the regional groundwater table, and three  
29       above that in the saprolite. Since well completion, hydraulic head measurements in the upper  
30       three sampling zones have continued to show high groundwater table elevations,  
31       significantly higher than those at RHMW07. Packer integrity was tested in December 2017  
32       and verified to be good (DON 2018c). Evaluations to determine the cause of the elevated  
33       water levels in the saprolite are ongoing.  
34       Groundwater in the five deeper zones of RHMW11 was first sampled in March 2018 and  
35       will be sampled again in April 2018 as part of the Red Hill quarterly monitoring events.  
36       Samples are being analyzed in accordance with the project *Sampling and Analysis Plan*  
37       (DON 2017b) and *SAP Addendum 01* (DON 2017c). Results from the March monitoring  
38       event samples are currently pending laboratory analysis and data validation.  
39       Data obtained during the RHMW11 installation including water level measurements were  
40       presented to the EPA and Hawai'i DOH on March 15, 2018. Additional data including the  
41       results of the pneumatic packer testing were presented to the DLNR CWRM on March 22,  
42       2018.

\\Honolulu.na.aecomnet.com\Honolulu\Projects\NAVFAC PAC\CLEAN I\60481245CTO 00531900-Work\920 GIS\02\_Maps\Model Progress Report 04\Fig1\_GW\_Mon\_Locations.mxd 4/3/2018



**Figure 1**  
**Current Groundwater Monitoring Network and Seismic Transect Locations**  
**Groundwater Model Progress Report 04**  
**Red Hill Bulk Fuel Storage Facility**  
**JBPHH, O'ahu, Hawai'i**

This page intentionally left blank

- 1 • **Gyroscopic Corrections.** Groundwater elevation corrections were developed based on  
2 gyroscopic surveys of Red Hill monitoring wells. These will be provided in a forthcoming  
3 technical memorandum and are being used to adjust groundwater elevations based on well  
4 plumbness and alignment.
- 5 • **USGS Synoptic Water Level Study.** The synoptic water level study involving regional  
6 monitoring and supply wells ended in late February 2018. USGS installed transducers in Red  
7 Hill monitoring wells in July 2017 prior to and November 2017 following the Fourth Quarter  
8 2017 groundwater monitoring event; the First Quarter 2018 monitoring event was postponed  
9 from January until March 2018 to allow for continuous logging of water elevations. The  
10 transducers were swapped out with water pumps in March for the First Quarter (March) and  
11 Second Quarter (April) 2018 monitoring events.

12 The USGS released provisional water level data (under the condition that neither the USGS  
13 nor the United States Government may be held liable for any damages resulting from its use)  
14 on March 27, 2018. Final data from the synoptic monitoring will be submitted following  
15 receipt of the gyroscopic data from the Navy. Final data will be incorporated in the  
16 December 2018 groundwater flow model.

17 *Water Level Monitoring at Hālawā Correctional Facility.* On February 2, 2018, USGS  
18 installed a transducer in inactive shallow monitoring well UMW-1 in the Hālawā  
19 Correctional Facility parking lot (see Figure 1); this well was installed during an  
20 underground storage tank (UST) investigation in the late 1980s/early 1990s (Unitek 1988;  
21 Dames & Moore 1991). UMW-1 is located within what was initially conceptualized as a  
22 perched groundwater system (based on the UST investigation's boring logs), but what may  
23 actually be a continuously saturated section starting in the shallow subsurface and extending  
24 downward to the regional basalt aquifer. Plans to install transducers in two other nearby  
25 inactive monitoring wells in the Correctional Facility parking lot were discontinued after  
26 field inspection revealed their vaults to be flooded from recent rains to ensure contamination  
27 from street runoff would not be introduced into the wells.

- 28 • **AOC Parties Technical Working Group (TWG).** A TWG was formed in February to  
29 create dialogue that allows the AOC Parties to relay highest-level concerns on the Red Hill  
30 project so that the best data moving forward can be obtained. Formation of the group was  
31 described in two March 9, 2018 Navy letters providing responses to Regulatory Agency  
32 comments on four derivative deliverables and groundwater flow and CF&T modeling  
33 concerns. To date, meetings have been held on February 8, March 2, March 15, and  
34 March 20.

- 35 • **Additional activities:**
  - 36 – Held preliminary coordination discussions with Queen Emma Estate regarding  
37 installation of monitoring wells RHMW12 and RHMW13 and drilling of a deep test hole  
38 adjacent to or in close vicinity of HDMW2253-03.
  - 39 – Surveyed elevation of Navy Hālawā Shaft (#2255-32); however, the survey could not be  
40 completed with standard digital surveying equipment due to space and access  
41 restrictions, and additional surveying will be required to meet precision requirements of  
42 the Second Order Class I survey.
  - 43 – Distributed the Red Hill Database to the AOC Parties and a redacted version to external  
44 parties/SMEs.
  - 45 – Re-assessed LNAPL and mass flux estimates.

- 1           – Exhibited posters and a 3D modeling video of Red Hill geology at the March 14 Public  
2           Information Workshop.
- 3           – Provided cores of Red Hill monitoring wells for inspection by AOC Parties and SMEs  
4           during the week of the Public Information Workshop (March 12–16, 2018).

### 5   **2.1.2    Technical Issues**

6   The nature and cause(s) of the elevated groundwater levels at RHMW07, HDMW2253-03, and  
7   RHMW11 (three shallow zones) continue to be explored.

8   During this reporting period, the Regulatory Agencies expanded their team of technical specialists  
9   and in a February 23, 2018 letter to the Navy identified five overarching concerns with the ongoing  
10   groundwater flow and CF&T modeling (e.g., prematurely drawn conclusions, non-conservative  
11   approaches, lack of strategy for evaluating uncertainty). The Navy provided written responses to the  
12   overarching concerns on March 9, 2018 and agreed to address detailed comments attached to the  
13   letter in future meetings of the newly established TWG or smaller-group technical meetings.

## 14   **2.2    SUBMITTAL OF MODELING DELIVERABLES**

15   Relevant deliverables submitted during this reporting period include:

- 16           • *Risk-Based Decision Criteria Development Plan*, December 11 (DON 2017d)
- 17           • *Sentinel Well Network Development Plan*, December 11 (DON 2017e)
- 18           • *Well Elevation Survey Report*, January 5 (DON 2018b)
- 19           • *Final Fourth Quarter 2017 - Quarterly Groundwater Monitoring Report*, January (DON  
20           2018a)
- 21           • *Technical Memorandum, Testing and Verification of Packer Integrity at RHMW11*,  
22           February 9 (DON 2018c)
- 23           • Red Hill Database Deliverable, distributed to AOC Parties and SMEs, February 16
- 24           • *Seismic Profiling to Map Hydrostratigraphy in the Red Hill Region, Oahu, Hawaii*  
25           (Department of Geosciences, Boise State University), March 30

26   Deliverables due for submittal during upcoming Reporting Period 05 (April 6 – August 4, 2018)  
27   include:

- 28           • *Conceptual Site Model*
- 29           • *Technical Memorandum, Sections 6 and 7 Support Document for Tank Upgrade Alternatives*  
30           *Decision and Interim Groundwater Flow Model Report*
- 31           • *Final First Quarter 2018 - Quarterly Groundwater Monitoring Report*
- 32           • *Final Second Quarter 2018 - Quarterly Groundwater Monitoring Report*

## 33   **3.    Anticipated Work for Next Reporting Period**

34   Anticipated work for Reporting Period 05 (April 6 – August 4, 2018) includes:

- 35           • GWFMWG meetings approximately monthly
- 36           • Additional particle tracking, if needed



- 1 • Refinement of the interim flow model with new data to in developing the flow model for the  
2 December 2018 Groundwater Flow Model Report
- 3 • Review and evaluation of synoptic water level study
- 4 • Groundwater sampling of the Red Hill groundwater monitoring network wells in April and  
5 July 2018
- 6 • Begin drilling and installation of one or more monitoring wells and/or a test hole

#### 7 **4. References**

- 8 Dames & Moore. 1991. *Site Characterization, Halawa Medium Security Facility, Halawa Valley,*  
9 *Oahu, Hawaii.* D&M Job Number 0314-147-037. October 25.
- 10 Department of the Navy (DON). 2014. *Interim Update, Red Hill Bulk Fuel Storage Facility Final*  
11 *Groundwater Protection Plan, Pearl Harbor, Hawaii. (January 2008).* Pearl Harbor, HI: Naval  
12 Facilities Engineering Command, Pacific. August.
- 13 ———. 2017a. *Work Plan / Scope of Work, Investigation and Remediation of Releases and*  
14 *Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl*  
15 *Harbor-Hickam, O'ahu, Hawai'i; January 4, 2017, Revision 02.* Prepared by AECOM Technical  
16 Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA,  
17 under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
- 18 ———. 2017b. *Sampling and Analysis Plan, Investigation and Remediation of Releases and*  
19 *Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl*  
20 *Harbor-Hickam, O'ahu, Hawai'i; April 20, 2017, Revision 01.* Prepared by AECOM Technical  
21 Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA,  
22 under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
- 23 ———. 2017c. *Sampling and Analysis Plan Addendum 01, Investigation and Remediation of*  
24 *Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility,*  
25 *Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i; September 1, 2017, Revision 00.* Prepared by  
26 AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency  
27 Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
- 28 ———. 2017d. *Risk-Based Decision Criteria Development Plan, Investigation and Remediation of*  
29 *Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility,*  
30 *Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i; December 11, 2017, Revision 00.* Prepared  
31 by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency  
32 Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
- 33 ———. 2017e. *Sentinel Well Network Development Plan, Investigation and Remediation of*  
34 *Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility,*  
35 *Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i; December 11, 2017, Revision 00.* Prepared  
36 by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency  
37 Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
- 38 ———. 2018a. *Final Fourth Quarter 2017 - Quarterly Groundwater Monitoring Report, Red Hill*  
39 *Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i.* Prepared by

- 1 AECOM Technical Services, Inc. JBPHH HI: Naval Facilities Engineering Command, Hawaii.  
2 January.
- 3 ———. 2018b. *Well Elevation Survey Report, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl*  
4 *Harbor-Hickam, O'ahu, Hawai'i; January 5, 2018, Revision 00.* Prepared by AECOM Technical  
5 Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA,  
6 under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
- 7 ———. 2018c. *Technical Memorandum, Testing and Verification of Packer Integrity at RHMW11,*  
8 *Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i;*  
9 *February 9, 2018.* Naval Facilities Engineering Command, Hawaii, JBPHH HI.
- 10 ———. 2018d. *Seismic Profiling to Map Hydrostratigraphy in the Red Hill Area, Red Hill Bulk*  
11 *Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i; March 30, 2018,*  
12 *Revision 00.* Prepared by Lee Liberty and James St. Claire, Boise State University, Boise, ID,  
13 For AECOM Technical Services, Inc., Honolulu, HI. A Boise State University Report. Technical  
14 Report BSU CGISS 18-01. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA,  
15 under Naval Facilities Engineering Command, Hawaii, JBPHH HI.
- 16 Environmental Protection Agency, United States, Region 9; and Department of Health, State of  
17 Hawaii (EPA Region 9 and DOH). 2015. *Administrative Order on Consent In the Matter of Red*  
18 *Hill Bulk Fuel Storage Facility, EPA Docket No: RCRA 7003-R9-2015-01; DOH Docket No: 15-*  
19 *UST-EA-01.* September.
- 20 ———. 2016. "Conditional Approval of Red Hill AOC SOW Deliverable under Sections 6 & 7 -  
21 Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater  
22 Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, November 5, 2016 Revision 01."  
23 Letter from Bob Pallarino, EPA Red Hill Project Coordinator, and Steven Chang, DOH Red Hill  
24 Project Coordinator, to: Captain Richard D. Hayes, Navy Region Hawaii. December 2, 2016.
- 25 Unitek. 1988. *Halawa Medium Security Facility Borings by P.R. Drilling/Kenton Beal for Wells*  
26 *8067-001 to -005.* Reproduced in App. G of Dames & Moore 1991: Site Characterization,  
27 Halawa Medium Security Facility, Halawa Valley, Oahu, Hawaii (D&M Job Number 0314-147-  
28 037).