DEPARTMENT OF THE NAVY
COMMANDER
NAVY REGION HAWAII
850 TICONDEROGA ST STE 110
JBPHH, HAWAII 96860-5101

5750
Ser N4/0478
03 APR 2019

CERTIFIED NO: 7016 0910 0001 0891 6898

Mr. Omer Shalev
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

CERTIFIED NO: 7016 0910 0001 0891 6904

Ms. Roxanne Kwan
State of Hawaii Department of Health
Solid and Hazardous Waste Branch
2827 Waimano Home Road, #100
Pearl City, HI 96782

Dear Mr. Shalev and Ms. Kwan:

SUBJECT: ADMINISTRATIVE ORDER ON CONSENT STATEMENT OF WORK SECTION 6 AND SECTION 7 GROUNDWATER FLOW MODEL PROGRESS REPORT 07 FOR REGULATORY AGENCY REVIEW, RED HILL BULK FUEL STORAGE FACILITY (RED HILL), JOINT BASE PEARL HARBOR-HICKAM, OAHU, HAWAII

The Groundwater Flow Model Progress Report 07 for Red Hill pursuant to the Administrative Order on Consent (AOC) Statement of Work (SOW) Section 6, Investigation and Remediation of Releases, and Section 7, Groundwater Protection and Evaluation is enclosed.

This progress report is the seventh of a series of groundwater flow modeling progress reports that describe the technical status of the groundwater flow modeling effort being conducted for the investigation and remediation of releases, and protection and evaluation of groundwater at Red Hill in accordance with the AOC and the January 4, 2017 AOC SOW Section 6 and Section 7 Work Plan/Scope of Work.

We respectfully request that you review the Groundwater Flow Model Progress Report 07 and forward any comments as soon as possible to maintain the expedited timeline.

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Ser N4/0478
03 APR 2019

If you have any questions, please contact Aaron Y. Poentis of our Regional Environmental Department at (808) 471-3858, or at aaron.poentis@navy.mil.

Sincerely,

M. R. DELAO
Captain, CEC, U.S. Navy
Regional Engineer
By direction of the
Commander

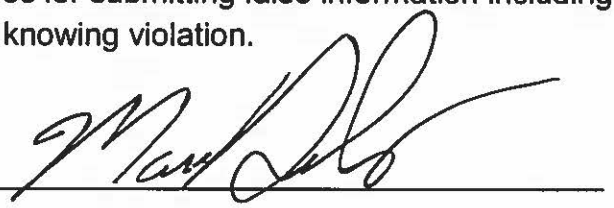
Enclosure: 1. Groundwater Flow Model Progress Report 07, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oahu, Hawaii, April 3, 2019

Red Hill Administrative Order on Consent,
Groundwater Flow Model Progress Report 07 Deliverable

Section 6.2 Investigation and Remediation of Releases Scope of Work
Section 7.1.2 Groundwater Flow Model Report Scope of Work
Section 7.2.2 Contaminant Fate and Transport Model Report Scope of Work
Section 7.3.2 Groundwater Monitoring Well Network Scope of Work

In accordance with the Red Hill Administrative Order on Consent, paragraph 9, DOCUMENT CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fines and imprisonment for knowing violation.

Signature: 

CAPT Marc R. Delao, CEC, USN
Regional Engineer, Navy Region Hawaii

Date: 3 Apr 19

Groundwater Model Progress Report 07, 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 3, 2019
Revision 00

Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-17-D-1800, CTO18F0126

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Groundwater Model Progress Report 07, 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 3, 2019
Revision 00

Prepared for:

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

Prepared by:

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

Prepared under:

Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-17-D-1800, CTO18F0126

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CONTENTS

FIGURE

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ACRONYMS AND ABBREVIATIONS

3-D	three-dimensional
AOC	Administrative Order on Consent
bgs	below ground surface
BWS	Board of Water Supply, City and County of Honolulu
CF&T	contaminant fate and transport
COPC	chemical of potential concern
CSM	conceptual site model
CWRM	Commission on Water Resource Management
DLA	Defense Logistics Agency
DLNR	Department of Land and Natural Resources, State of Hawai‘i
DOH	Department of Health, State of Hawai‘i
DON; Navy	Department of the Navy, United States
EPA	Environmental Protection Agency, United States
GIS	geographic information systems
GUI	graphical user interface
GWMWG	Groundwater Modeling Working Group
IRR	Investigation and Remediation of Releases
LNAPL	light non-aqueous-phase liquid
QC	quality control
SME	Subject Matter Expert
SOW	scope of work
TFN	transfer function-noise
TWG	Technical Working Group
U.S.	United States
UH	University of Hawai‘i
WP	work plan

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1. Introduction

This *Groundwater Model Progress Report 07* is the seventh in a series of modeling progress reports that describe the technical status of the Groundwater 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 (WP)/scope of work (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 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 are 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 in the vicinity of the Facility and includes groundwater modeling. The collective work conducted under Section 7 of the AOC Statement of Work will be used to inform changes to the current Red Hill *Groundwater Protection Plan* (DON 2014).

Reporting Period 07 covered in this report represents progress for the seventh 4-month period (December 4, 2018 – April 3, 2019) following conditional approval of the project WP/SOW by the Regulatory Agencies, which was received by the United States (U.S.) Department of the Navy (DON; Navy) on December 5, 2016 (EPA Region 9 and DOH 2016). *Groundwater Flow Model Progress Reports 01, 02, 03, 04, 05,* and *06* were submitted previously (DON 2017b, 2017c, 2017d, 2018a, 2018c, 2018d).

2. Work Completed This Period

2.1 CURRENT STATUS

Groundwater Modeling Working Group (GWMWG). The GWMWG met once during this reporting period, on March 15, 2019. The GWMWG is composed of representatives from the Navy, Defense Logistics Agency (DLA), U.S. Geological Survey, U.S. 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. Each meeting includes a review of the modeling objectives and responses to previous meeting action items.

GWMWG Meeting #14, March 15, 2019: The following main topics were covered in the March GWMWG meeting:

- Modeling Objectives, Intent, and Issues & Action Items
- Regulatory Agencies' Conceptual Site Model (CSM) Technical Comments

- Current Schedule for October 2019 Groundwater Flow Model
- Conceptual Site Model Update: Hydrogeology Considerations
  - Geology
  - Synoptic Water Level Study
  - Transfer Function-Noise (TFN) Analysis
- Groundwater Flow Model Update: Grids, Layers, and Boundaries
- Groundwater Flow Model Calibration: TFN Analysis
- Sensitivity Analyses: Alternative Models
- Regulatory Agencies' Looking Forward/Future Considerations
- Status Updates: Navy's Current/Projected Field Activities
- Summary and Next Steps

AOC Parties and Subject Matter Experts (SMEs) Meetings. The AOC Parties Technical Working Group (TWG) met six times during this reporting period, on January 17, February 13, February 21, March 4, March 13, and March 14, 2019. The main topics covered at each meeting are described below:

- *TWG Meeting #11, January 17, 2019*
  - Status of AOC Parties' data requests and field work
  - Split sampling results
  - Synoptic study data review
  - TFN analysis
  - Modeling update approach and progress
- *TWG Meeting #12, February 13, 2019:*
  - LNAPL transport in vadose zone and evaluation approaches
- *TWG Meeting #13, February 21, 2019:*
  - Evaluation of chemicals of potential concern (COPCs)
  - Evaluation of geochemistry
  - Evaluation of non-COPCs
  - Evaluation of tentatively identified compounds
- *TWG Meeting #14, March 4, 2019:*
  - Navy's modeling objective and feedback on two-dimensional modeling approach
  - Navy's approach and formulation for potential simplified three-dimensional (3-D) modeling
  - Verification of simplified approach
  - Simulation of light non-aqueous-phase liquid (LNAPL) migration in the vadose zone and water table

  - Key parameters for LNAPL migration evaluations
  - Demonstration of simulation approach at Red Hill
  - Potential path forward
- *TWG Meeting #15 Day 1, March 13, 2019:*
  - Geology- and water-related issues in the CSM
  - Potential soil vapor and groundwater tracer considerations proposed by DOH's SME
- *TWG Meeting #15 Day 2, March 14, 2019:*
  - Groundwater modeling timeline considerations
  - Potential simplified 3-D LNAPL model
  - LNAPL CSM
  - Alignment discussions

Other meetings held during this reporting period included:

- *February 6 City Council Meeting (City and County of Honolulu; Committee on Public Infrastructure, Technology and Sustainability):*
  - Navy Red Hill update presentation including evaluation of groundwater chemistry data, groundwater modeling status, and summary of Regulators' Top Ten Concerns
  - BWS presentation on groundwater flow and the Interim Groundwater Flow Model Report (DON 2018b, Appendix A).
- *February 15 teleconference with Navy and EPA SME:*
  - EPA SME technical details of the "Random Walk" analysis
  - Presence of preferential pathways and the effect on groundwater flow and contaminant transport
  - Likelihood of a preferential pathway from Red Hill to Red Hill Shaft or from Red Hill to BWS Hālawa Shaft

2.1.1 Technical Progress

Groundwater Sampling. During this reporting period, the Navy performed groundwater sampling at RHMW2254-01, under both Red Hill Shaft pumps on and off conditions, and in January–February performed the First Quarter 2019 quarterly groundwater sampling.

Field Activities. The Navy conducted the following field work during this period (see Figure 1 for well and test boring locations):

- **RHMW14.** Drilling of RHMW14 at Hālawa Correctional Facility resumed on January 3, 2019:
  - Advanced to 45 feet below ground surface (bgs) with a core bucket auger.
  - Installed 20-inch steel surface casing and grouted to 45 feet bgs.
  - Advanced hollow-stem augers from 45 to 57 feet bgs, decision made to begin coring operations.

- Completed HQ coring from 57 to 89 feet bgs, decision made to install 10-inch steel conductor casing.
- Reamed borehole and installed 10-inch steel conductor casing to 88 feet bgs.
- Completed HQ coring from 89 to 134 feet bgs.
- Reamed borehole and installed 5-inch steel conductor casing to 135 feet bgs.
- Completed PQ coring from 135 to 495 feet bgs (total depth).
- Conducted well development.
- Performed video logging, geophysical and gyroscopic survey.
- Met with DOH SME for RHMW14 core review and preliminary well design on March 8, 2019.
- Met with DLNR/CWRM and DOH SME to review and finalize well design on March 18, 2019.

RHMW14 planned future activities:

- Perform additional gyroscopic survey.
- Perform additional well development.
- Install Westbay multi-level well.

• **RHMW15.** Resumed drilling of RHMW15 on February 11, 2019 by reaming the borehole and installing 5-inch steel conductor casing to 265 feet bgs.

• **RHTB01.** Commenced vegetation clearing and construction of a drill pad on February 4, 2019.

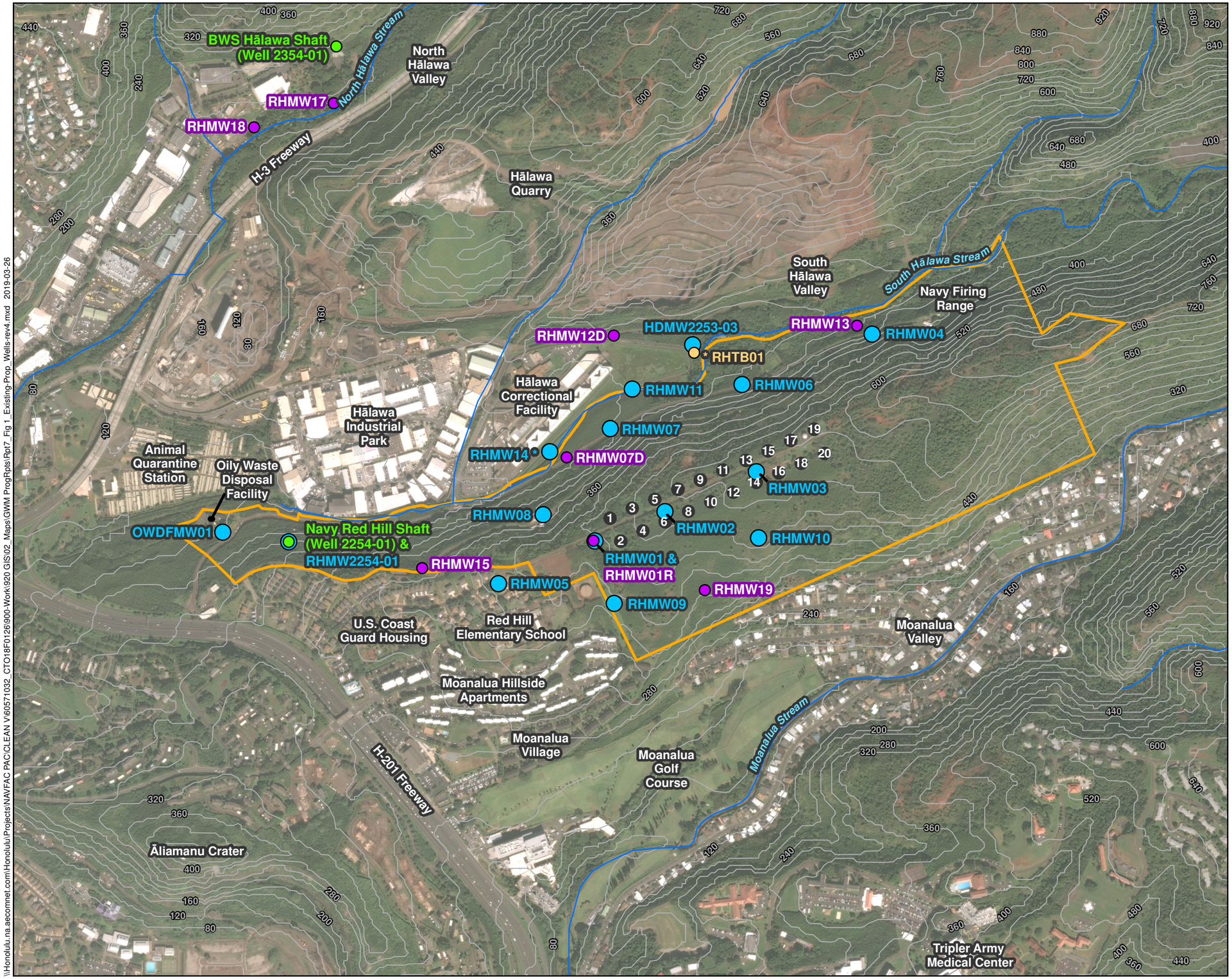
- Performed utility survey.
- Constructed drill pad.
- Hand cleared to 5 feet bgs.
- Advanced hollow-stem augers from 5 to 15 feet bgs, decision made to begin coring operations.
- Completed HQ coring from 15 to 100 feet bgs, decision made to install 10-inch steel conductor casing.
- Reamed borehole and installed 10-inch steel conductor casing to 100 feet bgs.
- Advanced PQ coring to a total depth of 281 feet bgs.

RHTB01 planned future activities:

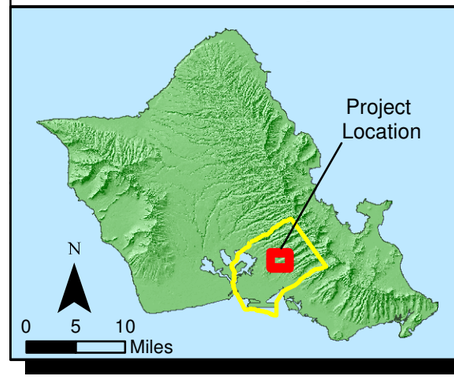
- Complete video and geophysical logging gyroscopic surveying.
- Install vibrating wire transducers.

• **RHMW12.** Commenced vegetation clearing and construction of a drill pad on February 7, 2019:

- Performed utility survey.
- Constructed drill pad.



Location Map



Legend

- Existing Monitoring Location
- Test Boring
- Proposed Monitoring Well
- Water Supply Well
- Stream
- 400 Topographic Contour (feet mean sea level)
- Red Hill Facility Boundary
- 1 Red Hill Fuel Storage Tank
- Groundwater Model Area

Notes

1. Map projection: NAD 1983 UTM Zone 4N
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Coordinates: NAD 1983 UTM Zone 4N

* Currently under construction

N

0 500 1,000 2,000 Feet

Figure 1
Existing and Proposed Groundwater Monitoring and Test Boring Locations
Groundwater Flow Model Progress Report 07
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

\\Honolulu.na.aecomnet.com\Honolulu\Projects\NAVFAC PAC\CLEAN V\60571032_CTO18F0126\900-Work\920 GIS\02_Maps\GWM Progrpts\Rpt7_Fig 1_Existing-Prop_Wells-rev4.mxd 2019-03-26

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Groundwater Modeling. The Navy conducted the following groundwater modeling activities this reporting period:

- Held weekly groundwater modeling team progress meetings to establish short-term milestones and resolve technical issues as they arose.
- Revised 3-D geologic block model to incorporate most-current SME team interpretation of saprolite and Honolulu Series Volcanics:
  - Incorporated revisions into the groundwater model grid.
  - Performed quality control (QC) and correction of interpolation errors for topographic and geologic surfaces.
  - Identified and corrected data-processing errors that caused mismatches between the geologic interpretation software (EVS), GIS (ArcGIS), and the groundwater modeling graphic user interface (GUI) (GMS); the improved QC process now results in identical geologic representations in all three software packages.
  - Conducted manual adjustment of model grid to eliminate stranded model cells.
- Developed alternative geologic block model that represents the DOH saprolite interpretation and incorporated revisions into groundwater model (alternative) grid.
- Developed calibration targets derived from the TFN analysis. This provides drastically reduced model run times when calibrating to one "pure" aquifer response to pumping at each pumping center, as compared to simulating dozens of on/off cycles with confounding effects from weather and non-coordinated interfering pumping at other locations.
- Developed a process and tools to calibrate directly to drawdowns and head differences between wells, in addition to absolute elevation heads. This enables focusing the calibration effort directly on aquifer responses to pumping and gradient magnitudes, with less effort spent on elevation-survey quality and precision issues. Developing this process and tools was necessary because the groundwater modeling GUI does not support use of drawdown as a calibration target.
- By April, the first stage of calibration will be in progress for both the Navy and DOH saprolite interpretations, which is calibration to a 2017 steady-state set of calibration targets.

Other. Core Laboratories provided the petrophysical core testing final report in December 2018 (with revisions dated January 23, 2019). Evaluation of its results and those of the infiltration study (report provided by Geolabs, Inc. in November 2018) will be presented in the forthcoming CSM report Revision 01.

2.1.2 Technical Issues

No other technical issues were identified during this reporting period.

2.2 Submittal of Modeling Deliverables

Relevant deliverables submitted during this reporting period include:

- *Final Fourth Quarter 2018 - Quarterly Groundwater Monitoring Report* (DON 2019)
- *Draft First Quarter 2019 - Quarterly Groundwater Monitoring Report*

3. Anticipated Work for Next Reporting Period

Anticipated work for upcoming Reporting Period 08 (April 4–August 3, 2019) includes:

- Download and evaluate data from RHTB01 piezometers.
- Potentially perform additional thermal profiling of select Red Hill monitoring wells.
- Conduct Second Quarter 2019 quarterly groundwater monitoring.
- Revise CSM report.
- Continue groundwater flow modeling
- Present groundwater flow modeling results to the Regulatory Agencies (July).
- Prepare October 2019 Groundwater Flow Model Report.
- Prepare October 2019 Investigation and Remediation of Releases (IRR) Report.
- Potentially perform Random Walk modeling of preferential pathways.
- Potentially perform simplified 3-D LNAPL modeling.
- Update LNAPL holding model.

Anticipated deliverables due during upcoming Reporting Period 08 (April 4–August 3, 2019) include:

- *Final First Quarter 2019 - Quarterly Groundwater Monitoring Report*
- *Draft and Final Second Quarter 2019 - Quarterly Groundwater Monitoring Report*
- *CSM Revision 01*

4. References

Department of the Navy (DON). 2014. *Interim Update, Red Hill Bulk Fuel Storage Facility Final Groundwater Protection Plan, Pearl Harbor, Hawaii. (January 2008)*. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. August.

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Environmental Protection Agency, United States, Region 9; and Department of Health, State of Hawaii (EPA Region 9 and DOH). 2015. *Administrative Order on Consent 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*. September.

———. 2016. "Conditional Approval of Red Hill AOC SOW Deliverable under Sections 6 & 7 - Work Plan/Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, November 5, 2016 Revision 01." Letter from Bob Pallarino, EPA Red Hill Project Coordinator, and Steven Chang, DOH Red Hill Project Coordinator, to: Captain Richard D. Hayes, Navy Region Hawaii. December 2, 2016.

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