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James A. K. Miyamoto, P.E.
Deputy Operations Officer
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
Joint Base Pearl Harbor Hickam, HI 96860

**Re: Approval in part of Red Hill AOC SOW Deliverable under Sections 6 & 7 - Monitoring Well Installation Work Plan**

Dear Mr. Miyamoto:

The U.S. Environmental Protection Agency ("EPA") and Hawaii Department of Health ("DOH"), collectively the "Regulatory Agencies", have reviewed the *Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility* ("MWIWP") submitted by the U.S. Navy ("Navy") and Defense Logistics Agency ("DLA") on April 26, 2016. The Regulatory Agencies are approving the MWIWP in part, pursuant to AOC Sections 7(b)(a) and 7(b)(b) and under the conditions as detailed below. The attachment to this letter provides details on those portions of the MWIWP that are disapproved. The Navy is required to resubmit the MWIWP with revisions within 30 days of their receipt of this letter as per AOC Section 7(b).

Our purpose in approving this deliverable in part, rather than disapproving it under AOC Section 7(b)(d), is to allow the Navy to move forward in preparing for the new monitoring well installations. The Regulatory Agencies approve the locations of monitoring wells designated as RHMW08, RHMW09 and RHMW10. The Navy informed us during a June 9, 2016 teleconference that they have reconsidered their initial proposed location of RHMW11. Our comments on the Navy's new proposed location, as well as our other comments on the MWIWP are included in the attachment (Attachment 1) to this letter. As discussed in our meeting on May 10, 2016 in Honolulu, we are aware that moving forward on the installation of these new wells is of the upmost importance. Therefore we wanted to approve a portion of the MWIWP and trust that this partial approval allows you to begin site preparation work as soon as possible.

The comments from the Regulatory Agencies on the MWIWP are presented in the enclosed attachment to this letter. In addition, we have attached a copy of the MWIWP comment letter received from the Honolulu Board of Water Supply (May 27, 2016) (Attachment 2). Many of the Honolulu Board of Water Supply comments are consistent with the Regulatory Agencies comments.
If necessary, we are available to discuss our comments in more detail. Please contact us if you have any questions. Bob Pallarino can be reached at (415) 947-4128 or at [ HYPERLINK "mailto:pallarino.bob@epa.gov" ] and Steven Chang can be reached at (808) 586-4226 or at [ HYPERLINK "mailto:steven.chang@doh.hawaii.gov" ].

Sincerely,

Bob Pallarino
EPA Red Hill Project Coordinator

Steven Chang, P.E.
DOH Red Hill Project Coordinator

Enclosures

cc: Mr. Stephen Turnbull, U.S. Navy

**Attachment 1**
**Regulatory Agency Comments on April 29 2016 Monitoring Well Installation Plan, Red Hill Bulk Fuel Storage Facility**

**Section 1.2.1.3 – Geology and Soils, Page 1-5**
Lines 34 - 37:

- This paragraph describes the lava beds in the area of Red Hill as "near horizontal". The Regulatory Agencies believe an acknowledgement of the potential for these beds to dip is important. This paragraph should end with a sentence stating that characterizing the strike and dip of the lava flows is important for understanding any product migration in the vadose zone outside of the concrete cocoon of the tanks and will be conducted as part of the overall hydrologic investigation required under Sections 6 & 7 of the AOC SOW.

**Page 1-6**
Lines 1 to 11:

- The geology and soils section should include a brief discussion of late stage volcanics, e.g. Salt Lake, Caprock formation, and deep stream valley fill sediments and saprolite that could act as barriers to groundwater flow.

**Section 1.2.1.4 – Groundwater, Page 1-6**

- This section should include a paragraph to explain that perched groundwater is likely present at many locations in the study area, including the basalt and valley fill units in the Red Hill vicinity. The explanation should include what is known about perched water occurrences at Red Hill. Perched water is common in the Halawa Valley near the area where RHMW11 is proposed. During the drilling of RHMW04 a perched water zone was encountered that extended from 85 down to about 130 feet below ground surface. A review of the boring logs for RHMW06 and RHMW07 by the Regulatory Agencies found no mention of perched water, which may have been encountered while drilling these two wells.

Lines 13-17:

- There is some uncertainty as to whether the majority of the groundwater flow is towards the harbor. The investigation that is beginning with the installation of these monitoring wells will help us understand if there are conditions present in the subsurface that would cause the groundwater to flow in directions other than towards the harbor. The last sentence in the first paragraph (line 17) should make mention of this uncertainty.
- The description of groundwater in this section fails to mention high-level dike confined groundwater.

Lines 25 – 31:

- This paragraph should clarify that while the Caprock aquifer does not extend to the areas in the vicinity of the tanks, it is present in the study area and can influence the flow of groundwater. The Caprock has the potential to divert groundwater flow and it's likely that other subsurface barriers that may confine flow exist within the study area and possibly site area.

**Section 1.2.2 – Site History, Page 1-7**
Line 37:

- The second paragraph of this section (lines 36-37) refers to the Navy supply well as being downgradient from the USTs. Since the actual downgradient direction in the vicinity of Red Hill has not been adequately defined this sentence should acknowledge the uncertainty, pointing out



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the importance of this and other investigations to characterize groundwater flow patterns beneath the foot print of the facility. It would be more accurate to state "the assumed down gradient direction" or similar since at this point since we don't know the regional gradient beneath the Facility.

- The stated distances from USTs to the RHS vary from <2000 to >4000 ft. The distance from the east end of the Red Hill Shaft infiltration gallery to UST-1 is about 1,500 ft, while the distance from west end of the infiltration gallery to UST-20 is about 4,500 ft. Some consistency needs to be used when describing this important parameter. The Regulatory Agencies believe the shortest distance to the infiltration gallery is a critical parameter when characterizing risk.

**Page 1-8**
Lines 1 – 7:

- The construction sequence of tanks is not described accurately. Upper domes were constructed first, cavity for tank barrel and bottom blasted and excavated and then barrel and bottom of tank were constructed.

**Section 2.2 – Step 2, Identify Study Objectives, Page 2-1**
Lines 19-21:

- This section states that one of the principal objectives of the MWIWP is to investigate the site stratigraphy and matrix physical properties. This implies that the MWIWP is the primary plan for developing the conceptual site model for the Red Hill project. The Regulatory Agencies do not agree with this implied objective. The sentence should be revised to state: "The principal objectives of the work proposed in this WP are to install monitoring wells at four locations (shown on Figure 2), ***collect data from the boring of the wells that can be used to better understand the site stratigraphy and matrix physical properties***, and obtain additional groundwater hydrologic data.

Lines 24 -28:

- Section 2.2 of the MWIWP states that the secondary objective of the MWIWP is to evaluate the nature of petroleum product and constituent chemicals in the soil, if present in the vadose and saturated zones underlying and downgradient of the tanks. It further states that the scope of the sampling and analysis program in the MWIWP is limited to the collection of subsurface **soil**, which will only be conducted if soil is encountered at depths below the bottom of the tanks or if contaminated soil is encountered. The Regulatory Agencies require the Navy and DLA to broaden the scope of their sampling and analysis to include any unconsolidated material that is coarse grained sand or smaller grain size, e.g. clay, sands, and clinker zone sand. Any contaminated material of this type will be sampled and analyzed if it is encountered while drilling regardless of its location.

**Section 2.5 – Step 5, Develop the Analytical Approach, Page 2-2**
Lines 10 – 11:

- See previous comment to sample all coarse grained sands or smaller sediments with evidence of contamination.

- This section should include a bullet specifically stating that the full length of all cores will be screened with a photoionization detector (PID) regardless of location, i.e. not just below the bottom of the tanks.

Lines 12-13:

- The Navy needs to define the term "significant contamination".
- The intention of this statement is not clear. What actions will the Navy propose to take in the event that significant contamination is detected (once "significant" is defined)?

**Location Map, Page 2-3**

- The blue arrow on the figure entitled "Location Map" is consistent with that shown in USGS publications. However, these publications are based on conceptual models developed decades ago and without the new water level data that has been, and will be acquired by Red Hill investigations. Furthermore, fuel related constituents have been detected in RHMW04 which suggests that at times there likely is groundwater flow from beneath the Red Hill USTs to the northwest. The arrow should be removed or otherwise modified to reflect the uncertainty.

**Section 2.6.2 – Managing Decision Error, Page 2-5**

Lines 7-8:

- Leveling the drilling well twice a day during drilling may not be sufficient to ensure that a well is plumb. The Regulatory Agencies' concern with this proposal is that if the well is not vertical within a known amount than water level information obtained from these wells will be suspect. With groundwater gradients of approximately 1 ft/mi. it is important that a true vertical depth survey be performed since one of the primary products of Task 5 of the Navy's proposed Scope of Work for the Investigation and Remediation of Releases is characterizing the groundwater flow gradient. The extent that a well casing deviates from true vertical will affect the accuracy of water level measurements. While it is not critical that well casing be exactly plumb, any deviation from true vertical must be known so corrections to the wire line measurements can be made. The Regulatory Agencies require that a quantitative true vertical depth analysis be done using a gyroscopic alignment instrument either during well construction or after the wells are installed so appropriate corrections can be made to wireline measured depth to water. The MWIWP needs to be revised to include a more robust method to ensure that the vertical depth of the wells are known. The Navy should consult guidance developed by the National Groundwater Association ([ HYPERLINK "http://www.ngwa.org" ]) for more information on determining whether their wells are plumb.

**Section 3-1 – Monitoring Well Locations, Page 3-1**

Lines 34- 35:

- The Navy states that "The proposed well locations (Figure 2) were chosen based on their potential to provide more information about the site's geology and groundwater, and to fill in identified data gaps". Please provide a brief description that specifies the data gaps each well location is intended to address. The description can be included in this paragraph or in the paragraphs describing each well location on pages 3-1 and 3-2.

**Attachment 1**
**Regulatory Agency Comments on April 29 2016 Monitoring Well Installation Plan, Red Hill Bulk Fuel Storage Facility**

**Section 3-1 – Monitoring Well Locations, Page 3-2**
Lines 24-37:

- The Navy informed the Regulatory Agencies on a teleconference on June 9, 2016 that they have reconsidered the proposed location of RHMW11 and are seeking to install this well further south of the initial location. Before approving this new location, the Regulatory Agencies believe that further discussion is necessary in order for the Navy to adequately demonstrate the advantages and disadvantages of this relocation. As presented on the June 9, 2016 teleconference, the Navy's rationale for relocating the monitoring well location is that the new location will give better information about the geometry of the South Halawa Valley fill. This is insufficient justification for relocating the well.

  Locating this well farther south for the purpose of gathering more data in order to characterize the composition and extent of the South Halawa Valley fill is presented as effort to obtain data to help refine the groundwater models. However, the Rotzoll and El-Kadi model that AECOM and the Navy use as the starting point for their conceptual model of groundwater flow indicates that the North Halawa Valley Fill has a much greater effect on groundwater flow than the South Halawa Valley Fill. The Regulatory Agencies therefore question the benefit of better characterizing the South Halawa Valley Fill. The Regulatory Agencies also believe an important consideration for this well location is the optimum well geometry to evaluate the groundwater gradient. The original location was much better suited for evaluating the groundwater gradient from the Moanalua Aquifer to the Waimalu Aquifer. The inter-aquifer flow is a key component of the risk assessment since. If significant inter-aquifer flow does occur, contamination from the facility could be transported to the vicinity of the Halawa Shaft.

  The Navy needs to address these concerns in the revised MWIWP before the Regulatory Agencies can consider approval of the alternative location of RHMW11.

**Figure 3, Geological Cross Section (Transverse), Page 3-3**

- What is the basis for the extent of the Valley Fill and Saprolite areas as illustrated in Figure 3? The Navy needs to provide supporting documentation or references to support the characterization of the valley fill or clearly indicate that the extent of the valley fill depicted on the figure is speculative and not supported by geologic evidence.
- The description of RHMW11 on page 3-2 states that in order to fully investigate the extent of valley fill or saprolite this well boring may be extended if bedrock is not encountered. Figure 3 should provide an indicator to show the additional depth of RHMW11 in the event that bedrock is not encountered at the target depth.
- Since the facility is the focus of the investigation and RHMW02 is located more or less in the center of the facility, the Regulatory Agencies recommend that the X-axis be centered at RHMW02, which would make it easier to determine lateral distances from the facility.
- The figure incorrectly shows the Halawa Shaft terminating within the valley fill. The Halawa Shaft is actually a horizontal infiltration gallery in the basalt northwest of the valley fill. The Halawa Shaft is bored into the wall of North Halawa Valley so the depiction of a vertical well located in the center of the valley is inaccurate.

- Remove the word "sporadic" from Note 1 of Figure 3. Note 1 should be revised to, "Existing well logs show a complex subsurface comprised of alternating pahoehoe and a'a lava flow with clinker zones, fractures, and voids."

**Figure 4, Longitudinal Cross Section. Page 3-5**

- Delete the word "Geological" from the title of this figure since no geologic features are depicted in this figure.

**Section 3.2.3 – Rock Coring, Page 3-8**

Lines 21-22:

- Checks for perched groundwater should occur more frequently than at the beginning and end of each workday. Perched groundwater is present at many locations in the study area, including the basalt and valley fill units in the Red Hill vicinity. If only checked at the beginning and end of the day it would be easy to drill through a perched zone without knowing it. When potential perching formations are observed in the rock cores (e.g. highly weathered basalt, soil, very massive lava, etc.), the borehole should be checked for standing water.

**Figure 5, Cross section of Borehole and Monitoring Well, Page 3-9**

- Figure 5 indicates that bentonite chips will be used to seal the annular space between the well casing and the borehole. In a teleconference with the Navy and its contractors on June 9, 2016, the Navy indicated that it could use a bentonite slurry to seal the annular space rather than bentonite chips that require hydration. According to guidance developed by the National Ground Water Association, bentonite grout, which may include or be another term for bentonite slurry, is recommended for sealing the annulus of a well in the unsaturated zone. The MWIWP needs to provide more detail on the composition of the slurry and the method of installing it in the annular space of the wells.

**Section 3.3 – Subsurface Soil Sampling, Page 3-11**

Lines 2-9

- The term "soil" should be replaced with "unconsolidated material". See the Regulatory Agencies' comment on the MWIWP Section 2.2 above.

**Section 3.4 – Monitoring Well Installation, Page 3-11**

Lines 26-29:

- This section should include an explanation and rationale for the Navy's choice of a 30 foot screen length. Appendix I-C-1 of the MWIWP includes a discussion of appropriate screen lengths (page 16 of 44 of the section entitled "Monitoring Well Installation and Abandonment") stating that screen length should be limited to 5 to 10 feet, however longer intervals may be justified in certain circumstances.

**Attachment 1**
**Regulatory Agency Comments on April 29 2016 Monitoring Well Installation Plan, Red Hill Bulk Fuel Storage Facility**

**Table 3-3, Existing and Anticipated Borehole and Well Dimensions**

- Regarding Monitoring Wells RHMW2254-01 and HDMW 2253-03, since neither of these wells are screened the Navy should determine and provide the depth of the bottom of the well casing for the wells rather than stating "Not Applicable" for the screen interval.

**Section 3.5 – Surveying, Page 3-12**

Lines 5 – 12:

- The groundwater flow gradient is a regional problem involving the possibility of groundwater flow from the Honolulu Aquifer to the Pearl Harbor Aquifer. Measuring the groundwater flow gradient requires measuring water levels in wells from the Moanalua Ridge to well west of North Halawa Valley. The TOC elevation of all wells used in the gradient calculations and in the calibration of the groundwater flow model need to be accurately surveyed to a common vertical datum. The Regulatory Agencies strongly recommend the Navy consult with the National Oceanic and Atmospheric Administration's National Geodetic Survey (NOAA NGS) before beginning this work. The Regulatory Agencies can provide the Navy or their contractor a point of contact at NOAA NGS.

**Section 4.3.9 – Subsurface Soil Sampling, Page 4-7**

Lines 34-35:

- This section states that samples will be collected and handled in accordance with Navy procedures as presented in attachments located in the appendix to the MWIWP. These procedures provide a number of options and are generic procedures. The Regulatory Agencies require the Navy to include specific details on soil/sediment collection procedures that will be used at the Red Hill study area, including specifications on the type of sample containers that will be used. These details should also be included in Table 5-1. Lines 35-37:
- Revise the sentence beginning on line 35 to read "*The subsurface soil samples will be inspected* ***for evidence of contamination (visual, olfactory, elevated PID readings) in order*** *to evaluate the potential migration of LNAPL and associated constituents.*"

**Table 5-2, Geotechnical Sample Details for Monitoring Well Installation WP, RHSF, Page 5-3**

- Table 5-2 indicates that laboratory analyses of a material listed as a solid matrix contained in cores will be performed. Please provide a description of what type of material that the tests specified in this table will be performed on. Providing references to Department of Navy protocols does not provide a sufficient level of detail.

**Table 5-3, Potable Water Sample Details for Monitoring Well Installation WP, RHSF, Page 5-4**

- The purpose of including Table 5-3 is unclear to the Regulatory Agencies. Please provide additional details on the contents of Table 5-3, including sample collection procedures.



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