UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

STATE OF HAWAII
DEPARTMENT OF HEALTH
KA ʻOIHANA OLAKINO
P. O. BOX 3378
HONOLULU, HI 96801-3378

May 15, 2024

Rear Admiral Stephen Barnett
Commander, Navy Region Hawaiʻi
850 Ticonderoga St., Ste. 110
Joint Base Pearl Harbor Hickam, HI 96860-5101
(Sent via Electronic Mail)

Subject: Review of Draft Deep Soil Vapor Extraction Pilot Study Work Plan, Red Hill

Dear Rear Admiral Barnett:

Thank you for submitting the *Draft Deep Soil Vapor Extraction Pilot Study Work Plan, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam Oʻahu HI*, dated February 2023 (Work Plan). The Hawaiʻi Department of Health (DOH) and U.S. Environmental Protection Agency (EPA), collectively the Regulatory Agencies, have reviewed the Work Plan. The work plan proposes a pilot test to evaluate the effectiveness of deep soil vapor extraction (SVE).

SVE typically uses above-ground blowers or vacuum pumps to extract vapor from subsurface soil and rock not saturated with groundwater. This method is frequently used to remove volatile chemicals at contaminated sites and has the potential to remove contamination from the Red Hill Bulk Fuel Storage Facility (Facility). However, this technology's effectiveness at the Facility is uncertain. The DOH May 6, 2022 Emergency Order and EPA 2023 Administrative Consent Order require closure and remediation of releases from the underground storage tank system that includes the Facility. Therefore, we support the U.S. Department of the Navy's (Navy's) interest in completing pilot-scale tests to obtain real world, site-specific data that may lead to effective remediation.

The Work Plan indicates that the deep SVE construction is scheduled to begin after the evaluation of the shallow SVE field activities. The Regulatory Agencies accept this approach. We agree that evaluating additional information may help the Navy to design a deep SVE pilot

study that can better target the mass of contamination in the vadose zone and improve our understanding of subsurface conditions. Accordingly, we request an updated Work Plan that incorporates the Navy's findings from its shallow SVE pilot study as well as other relevant work, such as site assessment activities, ongoing soil vapor and groundwater monitoring, and information available from the University of Hawai'i's ongoing studies. We are providing the enclosed comments for incorporation into the revised Work Plan and may provide additional comments after reviewing the results from the shallow SVE pilot study.

If you have any questions regarding this letter, please contact Matthew Cohen, EPA Red Hill Project Coordinator, at Cohen.Matthew@epa.gov or (415) 972-3691; or Kelly Ann Lee, DOH Red Hill Project Coordinator, at KellyAnn.Lee@doh.hawaii.gov or (808) 586-4226.

Sincerely,

/s/

Matthew Cohen PG
Red Hill Project Coordinator
U.S. Environmental Protection Agency, Region 9

/s/

Kelly Ann Lee
Red Hill Project Coordinator
State of Hawai'i, Department of Health

Enclosure

cc w/encl. by email only:
RDML Marc Williams, Deputy Commander, Navy Closure Task Force – Red Hill
Sherri Eng, Executive Director, Navy Closure Task Force – Red Hill
Joshua Stout, ACO/AOC Portfolio Manager, Navy Closure Task Force – Red Hill
CAPT James Sullivan, Commanding Officer, NAVFAC Hawai'i
CDR Benjamin Dunn, Red Hill Environmental OIC, NAVFAC Hawai'i
LCDR Travis Myers, Aquifer Recovery Team Lead, NAVFAC Hawai'i

Enclosure
Regulatory Agency Comments on *Draft Deep Soil Vapor Extraction Pilot Study Work Plan, Red Hill Bulk Fuel Storage Facility* (Work Plan), Dated February 2023
May 15, 2024 Letter to Rear Admiral Stephen Barnett

General Comments:

1. Reference the applicable Quality Assurance Project Plan and Sampling and Analysis Plan. Include relevant details about sampling protocols and analytical methods.
2. Baseline sampling is first discussed in Section 7. Describe baseline sampling throughout the Work Plan. Include the collection of vapor samples to be analyzed via methods, TO-15 (including total petroleum hydrocarbon [TPH] fractions) and TO-17. Provide details on the locations, number, and frequency of analytical samples. Explain how the baseline results will be compared with the study results.
3. Describe how testing individual soil vapor extraction (SVE) wells will be sequenced to maximize use of the available soil vapor monitoring points (SVMPs) and calculation of radiuses of influence.

Specific Comments:

4. **Section 1, Page 1**
    a. Item 1 states Phase 1 sampling will occur "on two pilot study extraction wells with pre-determined locations[,]" while two additional deep SVE wells will be installed during Phase 2 "[a]ssuming that the outcome of the first test phase is favorable…" We are concerned that limiting the evaluation to two deep SVE wells during the initial phase of the study may limit the chances for a successful pilot test. We recommend adding one additional SVE extraction well to Phase 1 of the study based on expected fuel mass location(s).
    b. The second paragraph indicates that locations for the proposed SVE wells and nested, deep soil vapor monitoring points (DSVMPs) were identified based on site characterization activities completed between November 2021 and October 2022, and may be altered based on additional characterization and field observations. Given that additional work has occurred since the Work Plan was submitted, please clarify whether new locations were selected, provide the basis for the selection(s), and update the figures and Table 3 accordingly.
    c. Provide an additional figure that estimates the potential distribution of fuel mass based on these investigation results.
5. **Section 3.7, Pages 4 to 9**
    a. The first paragraph on page 4 notes that, "[i]nvestigation activities to determine the nature and extent of JP-5 impacts in the Adit 3 study area are ongoing." Page 9 discusses the extent of light non-aqueous-phase liquid (LNAPL). Describe additional investigation activities that have occurred since the Work Plan was submitted and update the discussions of the extent of LNAPL to reflect current knowledge.

   b. Figure 1 on page 5, add dashed blue, green, and orange lines to the figure legend (also applies to Section 6, Figure 3, Page 15). Clarify which is the Hume Line and describe in the Section 3 text whether there is any drainage from the orange or green lines into Red Hill Shaft (RHS).
   c. While the title of this section is Conceptual Site Model, the content appears to align more with a physical description. Revise the title accordingly.

6. **Table 2, Page 11**
   a. Add study question "What are baseline concentrations of xxx..." at the beginning of Step 2. Later, the mass removal study questions should include, "Compare concentrations over time with the baseline concentrations."
   b. Provide additional details of the analytical approach for achieving the study goal, "Determine design and optimal operating parameters for long-term SVE system."
      i. Use mass recovery rate instead of mass loading rate as the basis for evaluating system effectiveness and specify the mass recovery rate at which the U.S. Department of the Navy (Navy) will decide that the system has reached diminishing returns and whether to shut the system down.
7. **Section 6, Page 14** – Add a step to collect baseline samples to determine pre-operational concentrations of constituents in SVMPs.
8. **Section 6.1, Page 14** – The first sentence indicates that the deep SVE construction is scheduled to begin after the evaluation of the shallow SVE field activities. Please confirm whether this is still the proposed timeline.
9. **Section 6.4, Page 17** – The second-to-last section indicates that SVE-2 is located in a region with known perched water. Figure 2 seems to show that one of the DSVMPs is also constructed below the water table. The Hawai'i Department of Health (DOH) and U.S. Environmental Protection Agency (EPA), collectively the Regulatory Agencies, acknowledge that the purpose of this placement is to compare an SVE location with known LNAPL impacts to an SVE location where LNAPL was not identified, but we question the effectiveness of SVE in an area with perched water. Add text to this section describing how close the saturated soil is to the screened intervals of the SVE wells and whether the DSVMP is placed in saturated soil. Include a figure showing the saturated zone in relation to the SVE-2 intake.
10. **Section 6.4.1, Page 19**
    a. It is stated that the hole will be reamed to 4.9 inches outer diameter to a depth of two feet from the bottom of the grout plug. It then states that a 5-inch inner diameter casing will be installed in the reamed hole. Describe how this casing will be installed into the hole.

b. Given the history of contamination in and near Adit 3, sample any LNAPL that is encountered during drilling or that has accumulated on perched groundwater, and analyze it for:
    i. Saturated Hydrocarbons (EPA Method 8015M via GC/FID), including analysis for alkanes C9-C40, pristane, phytane, and other selected isoprenoids.
    ii. Alkylated polycyclic aromatic hydrocarbons (PAHs) (EPA Method 8270M via GC/MS-SIM), including analysis for parent and alkyl PAHs including naphthalenes.
    iii. Semi-volatile organic compounds (Method SW8270 via GC/MS), including analysis for 2-(2-methoxyethoxy)-ethanol and phenol.
    iv. Volatile organic compounds with methylbenzenes (Method SW8260 via GC/MS), including analysis for tri- and tetra-methylbenzenes.

11. **Section 6.4.1.2, Page 19** – Add text stating that the recordings of the down-hole images will be provided to the Regulatory Agencies in a format that can easily be viewed on a standard PC.
12. **Table 4, Page 21**
    a. Clarify whether the "AOC POC Call" is the weekly Closure Technical Working Group meeting.
    b. Update the Regulatory Agency point of contact information:
        i. EPA – Lynn Brockway and Matthew Cohen
        ii. DOH – Remove Fenix Grange and replace with Kelly Ann Lee and Gracelda Simmons
13. **Section 6.5.1, Page 22** – Add text to Scenario 3, Bullet 2 documenting that the Navy will also notify EPA.
14. **Section 6.8.1, Page 30**
    a. Paragraph 1 indicates the helium tracer test will only be performed on one of the SVE wells. Consider doing a helium tracer on all SVE wells and DSVMPs to characterize the interconnectivity of geologic units laterally and vertically.
    b. Extend the soil vapor tracer testing to include point-to-point continuity testing and recovery evaluations, along with mass balances. Provide an explanation of the gas volumes and logistics of the proposed injection into RHS and how that feature will be sealed to prevent gas loss.
15. **Section 7.0, Page 30** – While it appears that transient biorespirometry testing will be conducted, it's unclear how the data will be used to determine the potential utility of aeration. Conduct transient biorespirometry testing to determine the rates of oxygen

utilization and carbon dioxide production by soil microbes and determine the associated rates of hydrocarbon degradation using stoichiometric relationships.

16. **Section 7.1 and Table 6, Pages 30 and 31** – Include sample collection and laboratory analysis in the initial baseline testing.
17. **Section 8.0, Page 33**
    a. Describe the partitioning characteristics of the vadose zone contamination and compare it to bench testing conducted for the shallow SVE pilot study. Estimate the phase distribution of the fuel mass in the formation to predict reductions in contaminant mass and changes in TPH composition resulting from SVE.
    b. Based on the data, assess the applicability of SVE for achieving specific remedial objectives. If the technology is deemed viable, quantify the likely outcomes and in-situ endpoints of SVE. These may include the estimated percentage of mass recovered relative to the total fuel mass in-place, time to achieve endpoints, character of the residual mass, necessary operational facets (number of wells, flow rates, treatment, etc.), and other factors related to the net benefit of applying this remedial technology in the Adit 3 area. Comment on whether the results of these evaluations can be applied to other areas of the Red Hill Bulk Fuel Storage Facility.
    c. The data should also be assessed to identify any vertical aspects of vapor flow and leakage. This can be accomplished by using data collection and evaluation methods outlined in Falta, 1996; Benson et al, 1993; and Beckett & Huntley, 1994. The associated air flow parameters should be derived from the transient vacuum propagation at each location. Vapor pressure transducers can greatly assist in the quality of these field measurements.
18. **Section 9, Page 35 –** The third paragraph indicates that the proposed additional SVE well and DSVMP locations will be communicated to the Regulatory Agencies prior to installation. Add that, "DOH and EPA shall have the opportunity to comment on the additional SVE well and DSVMP locations prior to installation."
19. **Section 11, Page 36** – In addition to the technical memorandum that will be submitted four weeks after the conclusion of the study, include interim reporting (e.g., a letter report after Phase 1 is completed, verbal updates during weekly meetings, field change requests, etc.).
20. **Appendix A –** This SVE Operations and Maintenance (O&M) Manual was written for Onizuka Village in 2016. Many components that were used in Onizuka Village and the site-specific parameters do not apply to the current SVE operation and maintenance at Red Hill. Please provide an updated SVE Manual for Red Hill in 2024. Use the data from the shallow SVE system to set site-specific parameters and then update the O&M manual

after the deep SVE system has been in operation. Consider providing the Regulatory Agencies with the table of contents prior to resubmitting the plan so we can ensure all the required, site-specific, components are included.

21. **Appendix D**
    a. Table D.2-1 – Include TPH–gasoline range for soil gas and Per- and Polyfluorinated Substances for groundwater. Add LNAPL sampling, should it be encountered.
    b. Table D.2-2 – Update with current Environmental Action Levels and Regional Screening Levels.

References:

- Benson, D.A., Huntley, David and Johnson, Paul, 1993. *Modeling Vapor Extraction and General Transport in the Presence of NAPL Mixtures and Non-Ideal Conditions*. Journal of Groundwater, Vol 31, Issue 3.
- Falta, Ronald, 1996; *A Program for Analyzing Transient and Steady-State Soil Gas Pump Tests*. Journal of Groundwater, Vol 34, Issue 4.
- G. D. Beckett, David Huntley, 1994. *Characterization of Flow Parameters Controlling Soil Vapor Extraction*. Journal of Groundwater, Vol 32, Issue 2.