R. Whittier Summary of Comments on BWS Comments to Work Plan Scope of Work (SOW/WP) comments

Generally the HBWS comments mirror mine with the exception of drilling to find LNAPL. The risk to drinking water sources from the current and past releases is minimal and does not justify the cost of drilling near the tanks. The topography is difficult unless drilling inside the lower tunnel and there are already 4 wells there. A drill rig could be placed directly above the tanks, but that wouldn't make sense because you would be drilling through the access tunnels. Roadways and drill pads could always be excavated on the hillside but at great cost and to what benefit? Do agree that with proper precautions drilling could be done without mobilizing fuel, but again to what end?

Summary of Comments and Recommendations - Page: 2

Continued Reliance on Assumptions That Have Yet to be Tested - First Paragraph

Agree that numerous unsupported assumptions are made in the SOW/WP, including the mauka to makai regional groundwater flow. What is missing from the HBWS comment and the SOW/WP is any serious discussion that, in addition to the valley fill, the Aliamanu Tuff Rings of the Honolulu Volcanic Series may (actually very likely) affect the groundwater flow patterns.

Second Paragraph

I believe we will be acknowledging that the SOW/WP makes untested assumptions about the proven effectiveness of the valley in regards to preventing contamination migration to the Halawa Shaft.

Third Paragraph

HBWS correctly points out that the Rotzoll and El-Kadi model shows a mauka to Makai flow direction. Initially, the modelers did consider a groundwater flow direction other than mauka to makai. However, the Navy's SME strongly resisted any other flow direction. We felt there was insufficient data at the time to challenge the makua to makai flow conceptual model (CM). During the investigation, sufficient data were gathered to bring the makua to makai CM into question. However, it had to wait for the Tier III re-evaluation to gather any field evidence to support something other than the Mauka to Makai flow. Absent from the HBWS review of the 2007 groundwater model is one finding that supports a barrier between the Red Hill Bulk Fuel Storage Facility (Facility) and the Halawa Shaft. That is that the response of the HBWS Halawa Observation Wells to Red Hill Shaft pumping stresses was much less than the modeled. This implies that a barrier exists that was not incorporated correctly into the model. Also, not included in the HBWS review is that the major weakness of the model was using only one calibration point within the Red Hill Ridge for groundwater flow analysis. Had this been done, the mauka to makai flow CM would have been brought into question.

Page: 3

First Paragraph

HBWS contents that a monitoring well is needed to the northwest of the Facility. However, if there is a flow component around the South Halawa Valley Fill, RHMW04 is strategically located to monitor that route. The major reason for a well to the northwest would be to serve the original intent of RHMW04. That is to be a serve as a background well. There are alternatives to costly monitoring wells that should be considered. Need a cost/benefit analysis to evaluate whether a NW MW is a good idea.

Second Paragraph

The HBWS desires more vadose zone monitoring points. Before mandating the costly installation of vadose monitoring wells, a robust evaluation of the large amount vadose zone data already available should be done. This would include characterizing the strike and dip of the lava flows. The barrel logs could be very useful for this. The anecdotal comment that detailed data exist about the tank excavations needs to be pursued, evaluated, and preserved.

Third Paragraph

Agree, it appears that available data have not been studied, or have been ignored. Generally the SOW/WP seems weak on consolidating the available site specific data. Or at best, selectively including and excluding data. For example there is little or no mention in the SOW/OP of the monthly water levels. During TEC's tenure the water levels were measured with the downhole pumps removed, providing accurate groundwater elevation data from RHMW03 to RHMW05 on a monthly basis. This is valuable information for planning the groundwater study.

3. Lacks Characterization of Vadose Zone Sources and Migration; Page: 4

First Paragraph

Agree, having no evaluation of F&T in the vadose zone a very critical data gap. Using a good technical application of available data a reasonable LNAPL F&T CM of the vadose zone can be developed. If, after this analysis, the data gaps are significant enough to warrant further investigation, vadose zone monitoring points can be considered.

3. Lacks Characterization of Vadose Zone Sources and Migration; Page: 4

Second Paragraph

Disagree, to what end would we purse an intense and intrusive vadose zone survey? Interesting data and analysis, but the question is how far and in what direction laterally will the LNAPL from a large release would travel. We already have some good monitoring points around Tank 5, the SMVPs and the RHMW02. Anything happening in the vicinity of Tank 5 is interesting and could help better constrain fuel degradation in the vadose zone, but it will not do much to answer the critical questions about the large scale F&T of LNAPL.

4. Lacks a Decision Process for Extending the Subsurface Monitoring Network; Page 4

First Paragraph

Yes, there does not seem to be much benefit in spending money to characterize the South Halawa Valley Fill, when it is the North Halawa Valley Fill that the Rotzoll and El-Kadi model indicated may be the barrier between the Facility and the Halawa Shaft. There is already HDMW-2253-03 in the South Halawa Valley Fill that provides sufficient stratigraphy data. The biggest benefits I can see from RHMW11 is to define the groundwater gradient between the Facility and the Halawa Shaft and as an off-site sentinel well.

4. Lacks a Decision Process for Extending the Subsurface Monitoring Network; Page 5

First Bullet

It seems ironic that now HBWS is using the term "upgradient". Again, we don't know what upgradient and downgradient is at this point in the game!

5. Ambiguous Risk Assessment; Page 5

I need to review this. I don't recall any proposed re-evaluation of the SSRBLs although I feel that is needed. Particularly the SVMP SSRBL since the current one was not exceeded immediately after the leak.

Detailed Comments and Recommendations; Page 5

Item 1, First Paragraph

The HBWS observation is valid that the OWDFMW1 is NOT downgradient from the Red Hill Shaft is valid. A gradient study done by EarthTech (2000) showed groundwater flow from the OWDB to the east and east-northeast.

Detailed Comments and Recommendations; Page 6

Item 1, First Full Paragraph

I believe the HBWS needs to seriously reconsider their position that the basal groundwater beneath the OWDB is not confined. Evidence points toward locally confined groundwater that is chemically distinct from the groundwater in other parts of the Facility. I will re-read EarthTech (2000), but what I take away from it right now is that the basal water beneath the OWDB is:

1) locally confined by an apparent massive lava layer, possibly a sill;

2) has high pH; and

3) is brackish.

All are very different from the water in the other RHMWs with the exception of RHMW06&07 being brackish (i.e. chloride >250 mg/L). It is important to note that, without further analysis, the TPH at OWDMW1 can't be attributed to any definite source so all must be considered possible including UST leaks.

Also, the SOW/WP's use of "major hydrogeologic barriers" seems to be very cavalier.

Detailed Comments and Recommendations; Page 7

Item 5

Agree that the TEC 2010 Tier III re-evaluation stated that the greatest calculated groundwater gradient was to the northwest and not the southwest (mauka to makai).

Item 7

Yes it doesn't make sense not to include the most recent data throughout the report!

Item 8

Agree that the Navy seems to dismiss any analytical results where the TPH chromatograph does not resemble fresh fuel. It should be the responsibility of the Navy to show with evidence that the TPH hits are not from the USTs if that is their belief. The SOW/WP statement (Section 2.3.2.2) while accurate for evaluating fresh fuel, is not really applicable since the sample chromatographs are weathered fuel. Once released to the environment fuel degrades and otherwise changes chemical composition. To support what is implied the Navy would have to research what the chromatograph for highly weathered fuel looks like.

Detailed Comments and Recommendations; Page: 8

Item 13

Agree that data on perched are available and should be included in the SOW/WP. Reviewing geologic logs of the RHMW04 and OWDB Wells, as well as the reports that provided the basis for Table 1 (SOW/WP Section 3) will provide insight to what known about perched water in the area.

Item 16

Agree, the terms “upgradient, down gradient, and cross gradient” are used in manners throughout the SOW/WP that can’t be supported by available data.

Detailed Comments and Recommendations; Page: 8

Item 18

Yes it appears significant artistic license was taken in the development of Figure 6, SOW/WP Section 3.

Detailed Comments and Recommendations; Page: 9

Third Paragraph

This seems rather nit-picky since there currently no boreholes to do detailed stratigraphy!!!!

Item 19

Based on Figure 7 (USTs and stream profile) it is true that lateral migration could impact the streams. Thus the importance of characterizing the vadose zone.

Item 21

Agree that the SOW/WP incorrectly contends that the hydraulic properties of the vadose zone are "unresolvable". There is much valuable interpretation of the vadose zone that can be done. The first would be determining the strike and dip of the lava beds. There are exposures in the valley walls and the barrel logs that make this feasible. The next step would be identifying any low permeability units (i.e. ash beds, sills, dense a'a layers). The sources of the data include the barrel logs, geologic boring logs, SVMP data, groundwater level data, etc.

Detailed Comments and Recommendations; Page: 10

Item 22

Yes as stated in the SOW/WP this is factually incorrect and misleading to state that no response to pumping has been detected across the Halawa Valley Fills. There were muted responses across the North Halawa Valley Fill in both the 2006 and 2015 aquifer tests.

Item 23

Agree that the statement in the SOW/WP about low vertical permeability is inaccurate and shows a lack of understanding. Physical and modeling data dispute the SOW/WP contention. A review of the SVMP, monthly water level readings, and rain fall infer fairly rapid vertical infiltration rates. If the SOW/WP contention were true, the hydrologic situation at the Facility would be more similar to the NE Big Island or upland West Maui rather than the leeward flanks of the Koolaus. On the topic of misleading or just lack of understanding, the SOW/WP frequently cites the presence of intrusives (dikes and sills) without presenting any real evidence. The Facility is outside of any mapped dike zone. Also, the USGS uses a vertical to horizontal hydraulic conductivity ratio of 1:200. Since the flank lavas in the area are very permeable, 2,000 to 4,000 ft/d; the bulk vertical hydraulic conductivity would be from 10 to 20 ft/d. Vertical hydraulic conductivities in this range are certainly high enough to allow jet fuel to migrate to the water table.

Detailed Comments and Recommendations; Page: 11

Item 24

I am uncertain why HBWS takes issue with the term "compartmentalization". A four ft water level difference between RHMW07 and the other RH monitoring wells strongly infers some sort of compartmentalization. On the subject of the trace contamination at RHMW07 it could be from infiltrating water. While the USGS pumping test inferred some connectivity to the bigger part of the basal aquifer the high water table elevation makes it difficult to get contamination from beneath Tank 5 to RHMW07.

Item 25

Yes the SOW/WP does take artistic license in their use of "barriers". Each use of the term should be supported by technical/scientific evidence.

Item 27

Yes, improper relating dissolved oxygen in the groundwater to a contaminated area in the vadose zone is another case of improperly "connecting the dots".

Page: 12

Item 28

Yes a vadose zone evaluation should be done. However, this evaluation requires a clear understanding of multi-phase fluid flow dynamics and of the hawaii geologic setting. Neither have been displayed by the SOW/WP.

Item 29

The criteria for LNAPL "measureable quantities" has changed over time. Up to and including some time in 2008, measureable was defined as any steady tone response from the oil/water interface probe on the initial contact with the fluid surface. It was later decided that erroneous positive responses were resulting. A measurable LNAPL measurement was redefined as a repeatable positive detection from the oil water interface probe. The limit of detection is generally assumed to be 0.01 ft since that is resolution on the wireline tape. The specification given by Solinist, a major instrument manufacturer, is 1/200th of a foot.

Item 34

Disagree, it seems premature to be designing an entire monitoring well network without a a full evaluation of the data that will be acquired as part of the SOW/WP. Possibly applicable after the current MWs are installed to evaluate whether or not new wells are needed.

Page: 13

Item 35

Agree, the proposed one-week "synoptic" water level monitoring does not seem well thought out. There is insufficient data in the SOW/WP to determine whether or not the proposed one-week monitoring period serves any real purpose. If it is just for a "snapshot" then it meets the criteria. However, a snapshot will not really answer critical questions and will only be valid for that snapshot period.

Item 37

Agree, the modeling section of the SOW/WP needs significant changes. Generally, the modeling section seems to under-estimate the modeling challenge. There are sufficient data currently available to show, that Moanalua/Red Hill/Halawa area is going to be very difficult to model. The use of the term "Refine" in Appendix H implies no real comprehension of what is required to do an adequate job of the modeling. Boiled down the essentials, the SOW/WP approach is to deepen the valley fill until the modeled response on the Halawa side of the modeled domain matches what was measured in 2006. This will direct more groundwater flow in mauka to makai direction increasing the simulated hydraulic gradient in that direction. This will move the model results away from the long-term status-quo conditions, where there is no measurable groundwater gradient from RHMW03 to RHMW01. This presents the modeler with a huge corundum!

Item 38

Disagree, the catastrophic leak assessment should be done in Task 8. But should be referenced in Task 6 and 7.

Page: 15

Item 44

See previous global comment on modeling.

Item 50

Disagree with HBWS's assessment of only parts of the aquifer being suitable for natural attenuation. All parts of the basal aquifer are amenable to natural attenuation until all of the NAPs are depleted. The Red Hill area seems particularly amenable to natural attenuation due to a high SO4 concentration. The zones that are not favorable to natural attenuation are likely not favorable to transport so the contamination would not go there.

Page: 16

Item 55

Agree, that the SOW/WP glosses over establishing degradation coefficients with even the slightest detail of how this will be done. There is nothing in the SOW/WP that would lend itself to a site specific evaluation of degradation coefficients. At the least "reasonable" should be changed to "most conservative" in Appendix H, Section 5.5.1.