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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Emergency Order to UNITED STATES NAVY For Emergency Change-In-Service and Defueling of 20 Underground Storage Tanks, Red Hill Bulk Fuel Storage Facility	DOCKET NO. 21-UST-EA-02 INTERVENOR HONOLULU BOARD OF WATER SUPPLY'S OBJECTIONS TO THE NAVY'S SUBMITTED TESTIMONY AND REQUEST FOR LEAVE TO SUPPLEMENT THE RECORD; CERTIFICATE OF SERVICE

INTERVENOR HONOLULU BOARD OF WATER SUPPLY'S OBJECTIONS TO THE NAVY'S SUBMITTED TESTIMONY AND REQUEST FOR LEAVE TO SUPPLEMENT THE RECORD

The United States Department of the Navy ("Navy") seeks to admit as hearsay evidence the Facility Environmental Report ("FER") of its expert witness Mr. Curtis Stanley from *In the Matter of the Application of the United States Navy For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility*, Docket No. 19-UST-EA-01 in this contested case proceeding. Mr. Stanley has not been offered as a witness in this contested case and therefore cannot be cross-examined to the extent his opinions might even apply to this proceeding, he has not affirmed that he believes the FER is still accurate in light of numerous recent fuel release events from the Red Hill Bulk Fuel Storage Facility ("Red Hill") and their catastrophic impact to Oahu's drinking water, and the parties can easily confirm that the Mr. Stanley's conclusions are vastly wrong.

At the meet-and-confer conference held among the parties on Thursday, December 16, 2021, all parties agreed to disclose their witnesses. Declaration of Ella Foley Gannon ("Gannon Decl."), ¶ 4. The Navy did not indicate that it intended to present Mr. Stanley as a witness, so the Honolulu Board of Water Supply ("BWS") did not designate Dr. Nicole DeNovio, a licensed hydrogeologist and geologist with substantial experience in groundwater flow, contaminant transport, fractured rock flow and transport, volatile and emerging contaminants, and numerical modeling, as its own witness to provide accurate testimony to rebut Mr. Stanley's false opinions. The other parties, including the Navy, also expressed concerns about the size of the record in this proceeding. In an effort to accommodate this request, the BWS did not offer as initial exhibits Dr. DeNovio's expert report and supporting materials. *Id.* Then, without explanation, the Navy attached the FER to the Declaration of Marnie Riddle. Declaration of Marnie E. Riddle Re: Red

Hill UST Permit Application Contested Case, ¶ 7, Exhibit N-6I. For reasons discussed below, Mr. Stanley's opinions and the FER are patently and demonstrably wrong. They should be afforded no evidentiary weight, and the BWS should be granted leave to supplement the record with the clear and convincing evidence that rebuts these false opinions.

I. <u>THE HEARINGS OFFICER CAN AND SHOULD ALLOW THE BWS TO SUPPLEMENT THE RECORD</u>

Pursuant to Hawaii Administrative Rules Section 11-1-24(b)(10), in any contested case, a hearings officer has broad discretion to "[a]dmit, receive, and exclude evidence." Where, as here, the Navy has offered the report of its expert witness in the guise of the administrative record from another proceeding, fundamental fairness dictates that the BWS should be afforded the opportunity to ensure a full and fair record. Mr. Stanley has also not verified or submitted a statement testifying that the FER remains accurate in light of recent events, nor could he credibly do so. The FER was fundamentally flawed when it was written and is almost comically inept now considering the multiple recent fuel releases from the Red Hill facility and resulting drinking water contamination central to this contested case proceeding.

A. <u>Mr. Stanley's Opinions and the Conclusions in the FER are Wrong, Have Note Been Affirmed, and Should Be Afforded No Evidentiary Value</u>

That the Navy would continue to rely upon Mr. Stanley's fatally defective opinions is disturbing. Central to Mr. Stanley's FER are assertions that available data demonstrates that "natural processes have inhibited movement of fuel product down to the groundwater, attenuated hydrocarbons in soil and groundwater in the immediate vicinity of the tanks, and kept the drinking water safe." Exhibit N-6I. These claims were wrong then, remain wrong today, and are directly contradicted by other testimony and exhibits submitted in this contested case proceeding. By way of example only, the key finding in the executive summary of the FER include:

- "No petroleum 'product' has ever been measured in any well during 913 tests conducted over 15 years, including before and after the 2014 Tank 5 Release." Exhibit N-6I at i. This conclusion is no longer true. The DOH took product and water samples from the Red Hill Shaft (*see* Exhibit D-36), and the sample results indicate that there was product floating on the water in the Red Hill Shaft. *See* Exhibit D-35 at 4. The Navy itself has also confirmed that its divers are engaged in "skimming operations" that captured approximately 31,000 gallons of a water and fuel mixture. Declaration of James G. Meyer, ¶ 8. Pumps are also being used by the Navy to directly remove the petroleum contamination floating on top of the Red Hill Well. *Id.*

- "No analyte has ever been detected at concentrations exceeding very conservative and highly protective regulatory screening levels in more than 790 analyses of 'chemicals of potential concern' identified by the regulators in 81 primary samples collected from the groundwater monitoring point at the Navy's drinking water supply well (Red Hill Shaft)." Exhibit N-6I at i. Samples taken from the Navy's Red Hill Shaft on December 5, 2021 show TPH-d levels as high as 140,000 µg/L in the Red Hill Shaft. *See* Exhibit B-409; Exhibit D-33. The amount of TPH-d present in certain samples from the Navy's Red Hill Shaft, RHMW2, and other monitoring wells exceed existing DOH environmental action limits (EALs) for gross contamination and drinking water toxicity which are 500 µg/L and 400 µg/L respectively. Testimony of Erwin M. Kawata ("Kawata Test."), ¶ 36; Exhibit B-16. Regulated chemicals have also been detected above EALs at Red Hill Shaft, with naphthalenes at 58.6 ppb (EAL is 17), 1-methylnaphthalene at 176 ppb (EAL is 27), and 2-methylnaphthalene at 93.9 ppb (EAL is 24). *See* Exhibit D-37.

- "No specific fuel constituents have ever been detected at concentrations exceeding the highly protective regulatory screening levels in over 6,800 analyses of over 650 samples collected from the 'perimeter wells' (i.e., the 16 groundwater monitoring wells other than the 3 wells in the immediate vicinity of the Facility's fuel storage tanks)." Exhibit N-6I at i.

- "The City and County of Honolulu Board of Water Supply recently acknowledged that its closest water supply well (approximately twice as far from the tanks as the Navy supply well) also remains safe." Exhibit N-6I at i. Although testing conducted to date indicates that the water served from the BWS' drinking water wells remains compliant with standards for safe drinking water, the BWS has been forced to shut off its Halawa Shaft drinking water well. Kawata Test. at ¶ 39. *Id.* In total, the BWS has been forced to shut off three of its well stations in the vicinity of the Red Hill facility, increase water quality testing at five well stations that are in close proximity to the Red Hill facility, and begin the process for approving the construction of another groundwater monitoring well in Halawa Valley in response to the releases. *Id.*

The FER's conclusions are clearly not accurate, and Mr. Stanley has not updated nor affirmed his testimony. If the Navy is allowed to introduce the FER as an exhibit, then the BWS deserves the right to introduce its own evidence that sets the record straight. *See* Decl. of Gannon, ¶¶ 5 through 14, Exhibits A through J. The BWS seeks to introduce these documents as well as the supporting materials reference therein.

In addition, the FER was submitted as an attachment to Marnie E. Riddle's Declaration. *See* Declaration of Marnie E. Riddle Re: Red Hill UST Permit Application Contested Case, ¶ 6. Ms. Riddle did not draft the FER and merely states that a "true and correct copy" of the report has been submitted as Exhibit N-6I. Ms. Riddle does not, and cannot, make the assertion that the FER's findings are still accurate. Mr. Stanley has not submitted a declaration affirming the validity of his conclusions in light of recent events, or updated his report to reflect the changed circumstances since the FER's submission in *In the Matter of the Application of the United States Navy For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility*, Docket No. 19-UST-EA-01. The FER was last updated in February 2021, before the May 6, 2021 fuel release from supply piping in the lower access tunnel tanks during the refilling of Tank 20, the previously undisclosed fuel releases from the Hotel Pier and Kilo Pier pipelines at the Red Hill facility, the pressure surge incident that occurred at a Red Hill pipeline on or about September 29, 2021, the notice of violation issued to the Navy on October 26, 2021, the detection of petroleum constituents in drinking water and monitoring wells in the vicinity of Red Hill in 2020 and 2021, the November 20 and 21, 2021 release of a supposed 14,000 gallons of a mix of water and fuel in the Red Hill lower access tunnel, and the <u>**contamination of the Navy's Red Hill Shaft drinking water well and water distribution system**</u>.. These events are critical to this contested case proceeding, and the FER does not account for them.

II. CONCLUSION AND REQUESTED RELIEF

The Navy's attempt to introduce Mr. Stanley's false opinions and the FER is misguided. The BWS objects to the FER because it is inaccurate and indefensible. To the extent the FER is admitted into evidence, it should not be given any evidentiary weight. The BWS can easily set the record straight, and requests the ability to supplement the record to do so.

DATED: Honolulu, Hawaii, December 19, 2021.

DANA M.O. VIOLA
Corporation Counsel

By *__/s/ Jeff A. Lau__*
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DEPARTMENT OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Emergency Order to UNITED STATES NAVY For Emergency Change-In-Service and Defueling of 20 Underground Storage Tanks, Red Hill Bulk Fuel Storage Facility	DOCKET NO. 21-UST-EA-02 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing documents were served upon the following, via email, to their last known email address on December 19, 2021:

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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Emergency Order to UNITED STATES NAVY For Emergency Change-In-Service and Defueling of 20 Underground Storage Tanks, Red Hill Bulk Fuel Storage Facility	DOCKET NO. 21-UST-EA-02 DECLARATION OF ELLA FOLEY GANNON; CERTIFICATE OF SERVICE

DECLARATION OF ELLA FOLEY GANNON

I, ELLA FOLEY GANNON, hereby declare as follows:

1. I am a Partner with the Law Firm Morgan, Lewis & Bockius LLP, and my office address is One Market, Spear Street Tower, 28th Floor, San Francisco, California 94105, office telephone (415) 442-1171.

2. I am counsel for the Intervenor Honolulu Board of Water Supply in the above-captioned matter.

3. I make this declaration in support of the Intervenor Honolulu Board of Water Supply's Objections to the Navy's Submitted Testimony and Request for Leave to Supplement the Record.

4. In a meet and confer on Thursday, December 16, 2021, the parties indicated that they would disclose all witnesses and the Navy did not indicate that it intended to present Mr. Curtis Stanley as a witness. The parties also expressed concerns about the size of the record in this proceeding.

5. Attached as Exhibit A is a true and correct copy of the Petitioner Honolulu Board of Water Supply's Motion to Strike the Testimony of Curst Stanley and/or For Negative Inference Addressing the Navy's Refusal to Comply with the December 30, 2020 Order to Produce Information submitted on March 16, 2021 in *In the Matter of the Application of United States Navy For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility*, Docket No. 19-UST-EA-01 ("Permit Contested Case").

6. Attached as Exhibit B is a true and correct copy of the Navy Brief in Opposition to the BWS' Motion to Strike and/or Negative Inference submitted on March 23, 2020 in the Permit Contested Case.

7. Attached as Exhibit C is a true and correct copy of the Navy Memorandum in Opposition to BWS Prehearing Motion for Negative Inference submitted on January 29, 2021 and then resubmitted with the Navy Brief in Opposition to the BWS' Motion to Strike and/or Negative Inference in the Permit Contested Case on March 23, 2020 in the Permit Contested Case.

8. Attached as Exhibit D is a true and correct copy of Petitioner Honolulu Board of Water Supply's Reply In Support of Motion to Strike the Testimony of Curtis Stanley and/or For Negative Inference Addressing the Navy's Refusal to Comply with the December 30, 2020 Order to Produce Information submitted on March 30, 2021 in the Permit Contested Case.

9. Attached as Exhibit E is a true and correct copy of the Navy's Sur-Reply in Opposition to the BWS Motion to Strike and/or Negative Inference submitted on April 6, 2021 in the Permit Contested Case.

10. Attached as Exhibit F is a true and correct copy of the Petitioner Honolulu Board of Water Supply's Sur-Reply in Support of Motion to Strike the Testimony of Curtis Stanley and/or for Negative Inference Addressing the Navy's Refusal to Comply with the December 30, 2020 Oder to Produce Information submitted on April 13, 2021 in the Permit Contested Case.

11. Attached as Exhibit G is a true and correct copy of the Order Denying Motion to Strike the Testimony of Curtis Stanley and/or for Negative Inference dated April 28, 2021 in the Permit Contested Case.

12. Attached as Exhibit H is a true and correct copy of the Second Updated Written Testimony of Nicole M. DeNovio submitted on March 12, 2021 in the Permit Contested Case.

13. Attached as Exhibit I is a true and correct copy of the Written Reply Testimony of Nicole M. DeNovio submitted on January 15, 2021 in the Permit Contested Case.

14. Attached as Exhibit J is a true and correct copy of the Updated Supplemental Written Testimony of Nicole M. DeNovio submitted on July 13, 2021 in the Permit Contested Case.

DATED: Los Angeles, California, December 19, 2021.

/s/ Ella Foley Gannon

ELLA FOLEY GANNON

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Emergency Order to UNITED STATES NAVY For Emergency Change-In-Service and Defueling of 20 Underground Storage Tanks, Red Hill Bulk Fuel Storage Facility	DOCKET NO. 21-UST-EA-02 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing documents were served upon the following, via email, to their last known email address on December 19, 2021:

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EXHIBIT A

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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 PETITIONER HONOLULU BOARD OF WATER SUPPLY'S MOTION TO STRIKE THE TESTIMONY OF CURTIS STANLEY AND/OR FOR NEGATIVE INFERENCE ADDRESSING THE NAVY'S REFUSAL TO COMPLY WITH THE DECEMBER 30, 2020 ORDER TO PRODUCE INFORMATION; DECLARATION OF ELLA FOLEY GANNON; EXHIBITS A THROUGH D; CERTIFICATE OF SERVICE

PETITIONER HONOLULU BOARD OF WATER SUPPLY'S MOTION TO STRIKE THE TESTIMONY OF CURTIS STANLEY AND/OR FOR NEGATIVE INFERENCE ADDRESSING THE NAVY'S REFUSAL TO COMPLY WITH THE DECEMBER 30, 2020 ORDER TO PRODUCE INFORMATION

The United States Department of the Navy ("Navy") has failed to comply with an order directing it to produce data and analyses relied upon by Navy witness Mr. Curtis Stanley in his written testimony, expert report, and oral testimony. Because this information was not provided as ordered, there was no meaningful opportunity for cross-examination; therefore, Mr. Stanley's testimony should be struck per Hawaii Administrative Rules § 11-1-38(h). In the alternative, if Mr. Stanley's testimony is not struck, a negative inference is warranted under Hawaii Administrative Rules § 11-1-24(b)(5) because the Navy cannot demonstrate good cause for its brazen disregard of the order.

The Navy's claim that Mr. Stanley has not relied upon the data and analyses it was ordered to produce is not credible. Mr. Stanley's testimony, both written and oral, and his Facility Environmental Report ("FER") repeatedly reference the unproduced data and modeling work and purport to characterize what they mean. Mr. Stanley admits that he is "one of the primary authors for *all* of the [Navy] reports" at issue in this proceeding (Testimony of Curtis Stanley ("Stanley Test."), at 5:17-6:6 (emphasis added)), and that he "attempts to concisely summarize a vast volume of data, analyses, and reports" such that the FER "is an attempt to summarize data and findings, as potentially relevant to this UST Operating Permit proceeding…" (FER at 5). Despite these statements, the Navy asserts that because Mr. Stanley did not "re-investigate[], re-examine[], or validate[]" the data and analyses as he authored his testimony or the FER, the information does not have to be produced in this matter. Declaration of Ella Foley Gannon ("Gannon Decl."), Ex. B. This is an inaccurate re-writing of the December

30, 2020 order, and misrepresents Mr. Stanley's own admitted reliance upon these categories of documents.

The Honolulu Board of Water Supply ("BWS") was thus deprived of its right to independently examine the information and determine whether the Navy's representations of the data and analyses were accurate in Mr. Stanley's written and oral testimony. Fundamentally, a determination of whether or not the Navy's Red Hill Bulk Fuel Storage Facility ("Red Hill") underground storage tank ("UST") permit application should be granted or denied is not possible without access to all of the information relied upon and underlying the reports and testimony submitted in this matter – which is precisely why the Navy was ordered to produce the information. Because the Navy failed to make these productions prior to the contested case hearing, and did so without good cause, Mr. Stanley's testimony should be struck from the record and/or it should be inferred that underlying information and data is unfavorable to the Navy's position in this matter.

The Navy's contention that Mr. Stanley did not re-examine or rely on underlying data sets and information does not help its case. Even if such an unsupported and absurd argument were to be accepted, then Mr. Stanley's testimony is merely a recitation of the Navy's position on various issues that remain unapproved or have been expressly rejected by the Hawaii Department of Health ("DOH") and the United States Environmental Protection Agency ("EPA") in connection with the Administrative Order on Consent ("AOC") process and thus offers no probative value.

In addition, if accepted as true, Mr. Stanley's lack of reliance on underlying data is deeply problematic for other reasons as well. Mr. Stanley is the only Navy witness to speak to the consequences of past and future releases from Red Hill. If he did not rely on underlying data and if he did not perform his own analysis, then the Navy did not put forth any witnesses or testimony that can speak to the true nature of the dire risks posed by the operations at Red Hill. The Navy, then, did not offer any evidence regarding one of the central issues in this case – the risk of future harm to human health and the environment resulting from fuel releases from the Red Hill USTs. Mr. Stanley also testifies to issues outside of his expertise. Such testimony should likewise be disregarded. Mr. Stanley's testimony, like the Navy's case, is fatally flawed; it must be struck or a negative inference must be drawn.

I. Factual Background

In his initial written testimony submitted on November 25, 2020, Mr. Stanley stated that he was "one of the primary authors for all of the reports submitted under the AOC." Stanley Test., at 5:17-6:6. This included the Navy's Conceptual Site Model Report, Groundwater Protection and Evaluation of Considerations for the Red Hill Bulk Fuel Storage Facility, Groundwater Flow Model Report, and Investigations and Remediation of Releases Report. *Id.* Because of Mr. Stanley's admitted reliance on underlying data and information to draft the FER, the BWS requested that the Navy produce all such data and information. Gannon Decl., Ex. B. On December 30, 2020, the Navy unsuccessfully argued that it should not be required to produce that data and information. Hearings Officer Louis L.C. Chang subsequently ordered the Navy to produce the following "categories of documents" relied upon by Mr. Stanley: (1) environmental data set, (2) 3D geological model, (3) strike and dip, lava flow, geology, and (4) ground water flow modeling files. The Navy was ordered to produce such documents by January 9, 2021. *Id.*

Rather than comply with the order, on January 8, 2021, the Navy stated that it would not be producing any of the categories of documents, and that the information relied upon by Mr. Stanley is available in reports that were prepared and issued by the Navy pursuant to the AOC.

Id. The Navy also claimed that "the raw data and model files underlying those reports were not re-investigated, re-examined, or validated in the course of preparing the FER, and Mr. Stanley's conclusions relied on the information as it was presented in the Navy's AOC reports." *Id.* In fact, Mr. Stanley signed a declaration on January 8, 2021 that stated it "was neither necessary nor practicable to independently re-analyze all such environmental data" and that the "FER did not independently re-analyze any data" related to "geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements." *Id.*, Ex. C at ¶¶ 5-6.

Despite these claims, on January 27, 2021, the Navy produced what it represented as "geologic model files depicting the area around the Red Hill facility." *Id.*, Ex. D. However, the Navy did *not* produce its 3D geologic model. Instead, it produced what amounts to 3D pictures of a geologic model, not the model in its native format, without access to underlying data and input parameters. What was produced was effectively useless. The Navy also reaffirmed its position that it would not be producing its groundwater flow model files and incorrectly argued that the BWS has the burden of proving a need for the underlying data and analyses.[1] That burden has already been met, and the issue correctly decided by Hearings Officer Chang's December 30, 2020 order requiring the Navy produce the requested data and analyses. There is no further burden on the BWS, and the Navy's continued effort to reargue a decided issue is meritless.

[1] Despite the Navy's repeated claims to the contrary, the BWS' request for information was not, nor was it intended to be, civil style discovery. The BWS' request, and the Hearings Officer's order, resulted from the need for and a right to examine the information giving rise to Mr. Stanley's opinions as presented in his own written testimony.

On January 29, 2021, the Navy submitted a preemptive memorandum in opposition to this motion. In an attached declaration, Mr. Stanley stated that the "FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy." Gannon Decl., Ex. C at ¶2. However, these statements are contradicted by Mr. Stanley's prior written and subsequent oral testimony. In his oral testimony, Mr. Stanley refers to the Navy's "interpretation of the data" (Hearing Transcript Vol. 3, 658:2), "looking at all of this data over the years…" (Vol. 3, 661:17-18), and how the Navy does not just look at "one data point, we look at data points all around" (Vol. 3, 677:5-6). Mr. Stanley also confirmed that he must know that the data is good in order to evaluate models and author environmental reports, and to make that assessment, he would have to, and did, look at the data. Vol. 3, 677:11-22.

The Navy is, thus, still in violation of the December 30, 2020 order on production and continues to refuse to fully produce information relied upon by Mr. Stanley in his report and testimony. Throughout his oral testimony during the contested case hearing, Mr. Stanley repeatedly stated that he relied on this underlying data despite the Navy's previous representations. *See* Vol. 3, 658:2-4 ("we've got soil vapor monitoring data we've looked at. We've looked at the data from all the borings"); 661:17-18 ("looking at all this data over the years"); 677:5-6 ("we look at data points all around"); 677:20-21 (confirming that he had to have looked at data to evaluate models); 679:3-5 (confirming that he is familiar with water level elevation data); 738:12-13 (confirming that an "analysis on the data" was necessary); Vol. 4, 770:9-11 ("We used the seismic, we used the well logs, and integrated all of that data and other data into the geological model."); 775:4-5 ("we have a pretty good understanding of where the past releases are at based on the data we've got"); 813:19-20 ("based on the data I've looked at"); 849:9-10 ("groundwater monitoring data in conjunction with the soil vapor monitoring data"). The production of this data and analyses is critical for evaluating the issues to be decided in this contested case, particularly where, as here, the DOH and EPA have repeatedly determined that the Navy has failed to present adequate justification for the conclusions presented in Navy reports.

II. Argument

Under Hawaii Administrative Rules § 11-1-38(h), a hearings officer may disregard or strike direct testimony if opposing parties do not have an opportunity for cross examination. Because underlying data and analyses were not produced to the BWS or other parties prior to the contested case hearing, the BWS was deprived of a full and fair opportunity to cross-examine Mr. Stanley, and his testimony should be struck. Specifically, the BWS could not properly cross-examine Mr. Stanley on the opinions he presented in his written testimony and the FER because soil vapor monitoring data, data from all the borings, water level elevation data, data from the soil vapor probes, transducer data, petrophysical data, data from RHMW16A and RHMW19, size and dimensions associated with deposits of lava flows, statistical methods used to generate general conclusions about strike and dip, data sets used to calibrate models, data used to estimate biodegradation rates, and data used to develop the holding model for the vadose zone were not produced. Nor could the BWS meaningfully cross-examine Mr. Stanley on his opinions based on the Navy's modeling work because none of the Navy's groundwater flow model files or geologic model files were produced.

In addition, under Hawaii Administrative Rules § 11-1-24(b)(5), a hearings officer "may draw inferences against the party if the evidence is not produced without good cause being shown." Here, the Navy was ordered to produce four specific categories of documents and sources relied upon by Mr. Stanley but refused to do so. The Navy cannot demonstrate good cause for its refusal to produce this information as ordered, so an adverse inference is warranted. Attached as **Exhibit A** to the Gannon Decl. is a table identifying specific references in Mr. Stanley's testimony and the FER that ought to be struck, warrant an adverse inference, and/or should otherwise be disregarded as outside the scope of the witness' expertise.

A. The Underlying Data Sets To The Facility Environmental Report Continue To Be Improperly Withheld

In addition to his admitted reliance on underlying data sets in his written testimony, Mr. Stanley also confirmed in his oral testimony that in order to assess models, he had to view and assess underlying data sets. Vol. 3, 739:15-18 ("Q. … And again, to be able to assess those models you've got to look at the underlying data, make sure everything was good, right? A. Yes."). Mr. Stanley also confirmed the importance of underlying data in his oral testimony. He stated that "the Navy undertook considerable effort to improve the data that was going into the models" in order to achieve the objectives of the AOC. Vol. 3, 702:17-19. Mr. Stanley admitted that the models only reflect the exact information and data that was used to create it; thus, if the data is inaccurate, the models are inaccurate as well. He even went as far as confirming that "garbage [data] in, garbage out" and that problems with interim models were due to the fact that there was "data that was questionable" and data that was "really iffy." Vol. 3, 707:19-20, 22-23; 678:21. Navy witness Commander Darrel Frame further supported this contention when he stated "what you input into the model will depend on what you get out…So I can make the models say whatever I want, but it depends on the input going into that model and those assumptions." Vol. 3, 574:7-11. Through its own witnesses, the Navy established that an assessment of underlying data, assumptions, parameters, and other information is critical to assessing model representations and the conclusions advanced in modeling reports, and that model outputs can be questionable or manipulated depending on the accuracy of the data and assumptions built into the models themselves. As such, underlying data and information should have been produced to all parties for independent verification and assessment and to allow for meaningful questioning of the Navy's witnesses regarding their assessment and conclusions based on this data and information.

i. The Navy Has Not Provided Sufficient Environmental Data Sets To Assess Their Accuracy And Use In Models

In his Updated FER, submitted on February 3, 2021, Mr. Stanley states that the Navy has conducted "[e]xtensive evaluation of the environmental monitoring data using a wide variety of methods and approaches" that has "fed into the development of a complex conceptual site model ('CSM') and a set of groundwater flow models." FER at 10. Mr. Stanley also emphasizes the importance of the Navy's environmental data collection for Red Hill, stating that it is the "largest environmental data set of any UST system" in Hawaii. FER at 18. In his oral testimony, in relation to environmental data sets relied on and evaluated, Mr. Stanley stated that he relied on "soil vapor monitoring data" (Vol. 3, 658:3), "data from all the borings" (Vol. 3, 658:4), "long-term monitoring study" in relation to groundwater monitoring (Vol. 3, 658:22-23), "water level elevation data" (Vol. 3, 679:8-9), "data from the soil vapor probes" (Vol. 3, 726:19-20), "transducer data" that was used in the final groundwater flow model report (Vol. 3, 678:23), "geologic data that we have as we are drilling the wells beneath the facility" (Vol. 3, 745:14-16), and "petrophysical data" (Vol. 3, 746:1). Mr. Stanley also confirmed that the Navy does not look at "just one data point, we look at data points all around to make sure that does this really make sense." (Vol. 3, 677:5-6).

The Navy, however, has not provided all of this underlying data so that the parties can assess the accuracy of data sets relied on by Mr. Stanley in developing his opinions in the FER. For example, there is a discrepancy in sample concentrations that differ between what is presented in the FER and what is presented in the groundwater monitoring quarterly reports. There are also boring logs missing from the references the Navy provided, specifically RHMW16 A and RHMW19. *See, generally,* BWS-355. In addition, some water levels are presented in the Navy's documents, but they are not consistent with the groundwater flow model report and need to be assessed for accuracy. Mr. Stanley's repeated references to these different data sets demonstrate that they were unquestionably critical in creating the models informing and opinions set forth in his testimony and the FER. However, because this information has been improperly withheld, the BWS has had no way to evaluate this data and analyses and thus had no meaningful opportunity to cross-examine Mr. Stanley on whether or not the opinions he asserted in this proceeding are scientifically defensible. Even on the face of the documents and reports that have been produced, it is evident that there is missing data and data discrepancies in the Navy's record.

ii. The Navy's Groundwater Flow Models Cannot Be Properly Evaluated Without The Model Files Themselves

In addition to the environmental data sets mentioned above, the groundwater flow models relied on by Mr. Stanley in his testimony also cannot be properly evaluated without underlying model files. In the FER, Mr. Stanley admits the importance of the groundwater flow models by stating that "[u]nderstanding the direction and rate of groundwater flow under a variety of reasonable supply well pumping scenarios is critical to assessing the risk that any hypothetical future fuel leak could pose to local drinking water." FER at 48. Mr. Stanley discussed the groundwater flow models at length in his oral testimony, stating that the Navy had "developed additional modeling plans and ways to obtain precise data, and a lot of that was integrated into the latest flow model that we've reported on." Vol. 3, 704:6-9. Mr. Stanley also confirmed that water level data is important to being able to form a groundwater model. *Id.* at 733:14-16. The Navy, however, has not provided the underlying data, assumptions, or parameters for the groundwater flow models. The BWS has only seen the CSM and the Groundwater Flow Model reports, and these reports only provide limited data sets and unvalidated Navy conclusions. In his oral testimony, Mr. Stanley repeatedly references the actual models, and not just the related reports. *See* Vol. 3, 708:2-3 ("We have multiple models we've developed…"); 735:4-5 ("We've integrated that into our model…"); 750:13-14 ("…integrate that geologic model into our holding capacity analysis."); Vol. 4, 806:14-15 ("…as we get more data, that conceptual site model continues to evolve…"); Vol. 4, 858:18 ("…what we used in our groundwater model…").

Even limited information that was produced, however, demonstrates the inconsistencies in the Navy's testimony. For example, a CSM requires corrected and uncorrected measured water levels to create it and to develop a groundwater model. The Navy agreed that all water levels should be corrected for barometric pressure and earth tides. *See* BWS-352. However, the Navy has not provided the corrected water levels used to develop its current set of multiple groundwater models nor has the Navy explained in any document how it corrected the water levels. Without the corrected data, the BWS is unable to fully evaluate the accuracy of the CSM and the groundwater model because it lacks the very information necessary to do so. In addition, the Navy has not provided the most recent set of corrected water levels from the 2017 through 2018 synoptic event used to develop and evaluate its recent groundwater models. This also means that the BWS is unable to scrutinize Mr. Stanley's opinions about the degree of capture afforded by Red Hill Shaft because it has not verified that the Navy's groundwater flow model is properly calibrated nor has it had the chance to assess the Navy's modeling assumptions.

iii. The Navy's Three-Dimensional Regional Geological Model Cannot Be Properly Evaluated Without Underlying Data

In the FER, Mr. Stanley states that the "Navy developed a geologic framework model and a three-dimensional regional geologic model of Red Hill and surrounding environs (including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor) to provide geologic support for its groundwater flow modeling effort." FER at 20. Mr. Stanley confirms that the "Navy used this and other data to prepare detailed geologic cross sections." *Id.* In his oral testimony, he stated that he "take[s] shape files, [which is] the configuration of the geology of these different layers and integrate[s] that into the model for the geology." Vol. 4, 771:7-9. He also stated that "we used all the borings that were available to us, which were a huge number, both on top of Red Hill and adjacent to Red Hill. We used the seismic, we used the well logs, and integrated all of that data and other data into the geologic model." *Id.* at 770:7-11.

The Navy developed the geologic model to define the extent and volumes of the geologic units within the Red Hill geologic framework model domain. However, the Navy and Mr. Stanley fail to present a map of the Red Hill geologic framework model domain that shows the distribution or density of all geologic control points used, including but not limited to surface geologic mapping, geologically logged boreholes, and artificial geologic subsurface control points. The Navy did produce what it represented as "geologic model files depicting the area around the Red Hill facility." Gannon Decl., Ex. D. However, the Navy did *not* produce its 3D geologic model. Instead, it produced what amounts to 3D pictures of a geologic model, not the model in its native format, without access to underlying data and input parameters. Producing pictures of a model is not producing the model itself. The Navy's production is unquestionably deficient and effectively useless because the BWS has no way to assess or even understand what assumptions were used to construct the geologic layers in the Navy's actual 3D geological model from the 3D pictures provided. The BWS also cannot ascertain if accurate model inputs were used because the underlying data was neither provided nor explained.

The lack of data also undermines the conclusions Mr. Stanley offered about the environmental conditions in the vadose zone (i.e., the unsaturated subsurface above the groundwater aquifer). In his report, Mr. Stanley acknowledges that he used the geologic model and evaluation of monitoring data to make the assertion that the "2014 Tank 5 Release (approximately 27,000 gallons of JP-8 fuel) was likely retained within the top one-third (approximately 30 feet) of the subsurface between the lower access tunnel (underneath the tanks) and the water table (i.e., the 'vadose zone') with no significant impact to groundwater…." FER at 42. Mr. Stanley also stated that "the 2014 release was used along with site-specific geologic data and data from scientific literature to estimate the vadose zone holding capacity for LNAPL [i.e., light non-aqueous phase liquid or free phase fuel]." *Id.* at 42. Mr. Stanley uses that estimate of the vadose zone holding capacity to claim that "the calculations showed that a hypothetical chronic release of 2,300 gallons per tank per year (6.3 gallons per tank per day) would be degraded within the vadose zone, resulting in, at most, a minimal impact to groundwater and likely preventing an exceedance of risk-based decision criteria in Red Hill Shaft." *Id.* This conclusion, however, is unverified and cannot be verified with what little data has been produced.

The three categories of information above – environmental data sets, geological model files, and groundwater flow model files – clearly need to be evaluated and assessed for accuracy in this matter. Without an independent of assessment of that data and analyses, Mr. Stanley's report cannot be relied on.

B. Mr. Stanley's Testimony Should Be Struck Because The BWS Was Not Given The Opportunity To Properly Cross-Examine Him

Under Hawaii Administrative Rules § 11-1-38(h), a hearings officer may disregard or strike direct testimony if opposing parties do not have an opportunity for cross-examination. As demonstrated above, Mr. Stanley relied upon certain data and analyses to form the opinions the Navy advanced in connection with this proceeding. This means that the BWS, and other parties, were entitled to cross-examine Mr. Stanley on the bases of his opinions at the contested case hearing. In addition to the BWS' right to cross-examine Mr. Stanley, the Navy was also directly ordered by Hearings Officer Chang to produce these documents. By refusing to do so, the Navy has deprived the BWS of the very information relied upon by Mr. Stanley and necessary to prepare a meaningful cross-examination. Without the data and analyses that underlie Mr. Stanley's report, assessments, and evaluations, the BWS could not independently assess the accuracy of the Mr. Stanley's report nor could they properly cross-examine Mr. Stanley at the contested case hearing. As such, Mr. Stanley's testimony should be struck from the record.

C. Because The Navy Refused To Produce The Data Without Good Cause, A Negative Inference Is Warranted

As stated above, the Navy refused to produce underlying data and information related to Mr. Stanley's report. In fact, the Navy attempted to flip the burden and argue that the BWS needed to demonstrate that it was entitled to data and information. Gannon Decl., Ex. B. The issue of whether the BWS was entitled to the data and information was already decided by Hearings Officer Chang through his December 30, 2020 order. *Id.* The Navy, not the BWS, must demonstrate why it did not produce the data and information because the Navy, not the

BWS, continues to knowingly violate an order requiring the production of the documents at issue. The Navy's misguided attempt to manufacture a basis by which it could withhold the data and analyses relied upon by Mr. Stanley by claiming that he did not "re-examine[]" the data and information defies logic. *Id.* It is clear from Mr. Stanley's testimony and the FER that he relied upon the environmental data and groundwater flow modeling to support or formulate his opinions. Mr. Stanley admitted that he relied upon the Navy reports. Vol. 3, 674:16-20 ("A. Yeah. I'm only saying what I've seen in those reports. Q. Okay, right. So that you're just kind of summarizing other people's words. A. Yes, ma'am."), 704:8-9 ("a lot of that was integrated into the latest flow model that we've reported on."), 714:6-10 ("We have written a Groundwater Protection and Evaluation Considerations Report, we have written the Final Groundwater Flow Modeling Report, and we have written the Investigation Remediation of Releases Report."); Vol. 4, 770:19-20 ("If you look at our reports, that model is described in one of the reports."). Mr. Stanley is the author of these Navy reports. The environmental data and modeling work have been represented by both the Navy and Mr. Stanley as the basis for the conclusions presented in these reports. Vol. 3, 676:15-16 (confirming that the information fed into the CSM is "really the basis for everything we do at the site."), 714:4-6 ("Well, the conceptual site model is not a deliverable, but it's the basis for a lot of the deliverables we've developed."). Mr. Stanley unquestionably relied on underlying data and information to support or formulate his opinions. Because of Mr. Stanley's obvious reliance on the data and information, and the Navy's blatant violation of an order, a negative inference is warranted as to Mr. Stanley's testimony.

D. If Mr. Stanley Did Not Rely On The Underlying Data, Then His Assessments Lack Probative Value And His Testimony Should Be Disregarded

If the Navy's assertion that raw data and model files underlying reports were not "re-investigated, re-examined, or validated in the course of preparing the FER," then Mr. Stanley's testimony is merely a recitation of Navy conclusions that remain unapproved or have been rejected by the regulators and should be afforded no evidentiary weight. Gannon Decl., Ex. B. Mr. Stanley's obvious reliance on underlying data and information is enough to strike his testimony. But if the Navy's argument and Mr. Stanley's declaration are to be believed, then Mr. Stanley did not perform an independent assessment or evaluation of critical data and information to form his opinions and conclusions in the FER. Rather, he merely reiterated and summarized findings from other Navy sources. Mr. Stanley even stated in his January 8, 2021 declaration that the "FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy." *Id.*, Ex. C. Mr. Stanley's testimony and report, then, should not be given any weight because he did not "critically analyze" any of the issues in this matter. Mr. Stanley's own statements directly undermine the credibility of his assessments; he stated that he "did not independently review or re-analyze the data underlying these models, nor did [he] run any of the model software files" in relation to the 3D geologic model in the course of prepping its groundwater flow model, proving that the models cannot hold weight in this matter. *Id.* at ¶7.

E. Mr. Stanley's Testimony Should Be Disregarded Because It Is Out Of Scope

Mr. Stanley made several assertions in his written and oral testimony that are admittedly outside of his limited hydrogeological expertise. These statements should be struck because Mr. Stanley does not have valid bases upon which to make such assessments. For example, in his declaration, Mr. Stanley states that "[w]hile no (petroleum-related or other) facility or activity is risk-free, operation of the Facility is currently protective of human health and the environment and is likely to remain so…" Stanley Test., at 11:12-14. However, Mr. Stanley is not an expert on risk assessment. Vol. 3, 673:10-11 ("I would not consider myself an expert in engineering risk assessment"). Mr. Stanley, then, has no basis to make this assertion.

In addition, Mr. Stanley stated that he has never studied corrosion and does not consider himself an expert on metals. Vol. 3, 672:5-19. Therefore, Mr. Stanley's assertion that the 2014 leak "was not a leak caused by corrosion of the tanks" and that it "did not result in any exposure to humans, plants, or animals" is unfounded. FER at 57, 61. He also has no formal education and only limited experience related to tank integrity and tank tightness testing. Vol. 3, 672:20-673:3. Mr. Stanley also admitted that, with regards to those areas, he was merely "saying what I've seen in those [related] reports." Vol. 3, 674:16-17. In addition, Mr. Stanley's assertion in the FER that "conducting an annual tank tightness test that can detect a 0.5 gallon per hour leak rate completely satisfies the Hawai'i UST regulations for leak detection" is similarly unfounded. FER at 47. Mr. Stanley does not have the expertise or training to opine on the tank tightness testing in this matter.

Mr. Stanley also states that "[c]onsidering all the Facility upgrades made and planned to be made, along with all of the data gathering and analyses, the Facility is protective of human health and the environment and should be permitted to continue to operate for the next 5 years under the watchful eye of the DOH and EPA while additional improvements, progress, and decisions continue to be made under the AOC." Stanley Test., at 12:3-7. This statement is also outside of Mr. Stanley's scope. He cannot make representations about what upgrades will be made at Red Hill nor can such speculative claims support an assertion that the facility is currently protective of human health and the environment. In fact, Navy witness John Floyd testified that certain improvements are still in progress; for example, double-walling the nozzle piping is a "proposed TUA implementation plan, tank upgrade alternative, but we're not there yet." Vol. 1, 155:25-156:1. Although the Navy claims to be updating the facilities at Red Hill, a UST permit can only be granted based on the information included in its permit application. Any assertions of improvements that are "planned to be made" are irrelevant.

F. Any Concerns About Protecting Critical Infrastructure Are Unfounded

The Navy has also stated that it will not produce the required data and analyses because it has to protect Department of Defense ("DoD") critical infrastructure information. Gannon Decl., Ex. B. Such claims are a distraction. First, neither the location of Red Hill Shaft nor the Navy's pumping information from that water source is a secret to any of the parties in this proceeding. Second, the vast majority of the information the Navy was ordered to produce can and should be produced as it does not implicate the locations of or pumping rates at Navy wells. To the extent some of the groundwater modeling files do contain such information, they can be provided without the Navy pumping data if needed. Third, a water utility like the BWS regularly does and is capable of managing sensitive water pumping data. As such, the Navy's argument that it needs to protect DoD critical infrastructure information is misplaced in this matter.

III. Conclusion

Mr. Stanley relied on the subject data and analyses in forming his testimony and FER. Despite this reliance, the Navy continues to refuse to produce the information as ordered. Although the Navy claims it has produced all the underlying data, certain environmental, geologic, and groundwater data sets remain missing. As for the analyses, the Navy only produced images of a 3D geological model, without the underlying data and analyses, and it did not produce its groundwater flow model files. Mr. Stanley admitted that he relied on this information, and as such, the BWS was deprived of its ability to properly cross-examine Mr. Stanley. In addition, Mr. Stanley's numerous contradictions about his reliance and non-reliance on this data and analyses serve to further undermine his testimony, as does his admitted lack of firsthand knowledge or meaningful expertise related to several opinions presented in his testimony. Because the Navy refused to produce the underlying data and analyses, Mr. Stanley's testimony should be struck from the record. If his testimony is not struck, then it should be afforded no evidentiary weight and, further, it can be inferred that underlying information is unfavorable to the Navy's position in this matter.

DATED: Honolulu, Hawaii, March 16, 2021.

PAUL S. AOKI
Acting Corporation Counsel

By *<u>/s/ Jeff A. Lau</u>*
JEFF A. LAU
Deputy Corporation Counsel
Attorney for Petitioner
Board of Water Supply,
City and County of Honolulu

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 DECLARATION OF ELLA FOLEY GANNON; EXHIBITS A THROUGH D

DECLARATION OF ELLA FOLEY GANNON

I, ELLA FOLEY GANNON, declare as follows:

1. I represent Petitioner Honolulu Board of Water Supply in the above-entitled action. I am an attorney licensed to practice law in California and I am admitted pro hac vice to practice in the state of Hawaii.

2. I make this declaration based upon personal knowledge and I am competent to testify as to all matters stated herein. I make this Declaration in support of Petitioner Honolulu Board of Water Supply's Motion to Strike the Testimony of Curtis Stanley and/or for Negative Inference Addressing the Navy's Refusal to Comply with the December 30, 2020 Order to Produce Information.

3. Attached as Exhibit A is table identifying specific references in the FER and Mr. Stanley's testimony that should be struck or should hold no probative value.

4. On December 30, 2020, Hearings Officer Chang emailed the parties ordering production of certain documents. A true and correct copy of this email, along with subsequent responses in the email chain, is attached as Exhibit B.

5. On January 8, 2021, the Navy submitted a declaration from Mr. Stanley regarding its refusal to produce certain data. This declaration was resubmitted as Exhibit B to the "Navy Memorandum in Opposition to BWS Prehearing Motion for Negative Inference," which was submitted on January 29, 2021. A true and correct copy of this document is attached as Exhibit C.

6. On January 27, 2021, the Navy emailed the parties and Hearings Officer Chang regarding geologic model files. A true and correct copy of this email is attached as Exhibit D.

DATED: San Francisco, California, March 16, 2021.

/s/ Ella Foley Gannon

ELLA FOLEY GANNON

Exhibit A

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	Basis for Striking / Drawing Adverse Inference
Mr. Stanley claims that the Red Hill Facility is protective of human health and the environment and will continue to be protective over time. Stanley Test., at 8:6-7: "As described in the FER, the environmental data and analyses show that the Facility is currently protective of human health and the environment." Stanley Test., at 10:19-11:2: "While the environmental data show that the Facility is currently protective, ongoing and future environmental investigations will further help ensure that the Facility remains protective of human health and the environment, during and past the duration of the 5-year operation permit currently under consideration…" Stanley Test., at 11:4: "Continued protectiveness is also ensured…" Stanley Test., at 11:12-14: "While no (petroleum-related or other) facility or activity is risk-free, operation of the Facility is currently protective of human health and the environment and is likely to remain so…" FER at i-ii: "For these reasons alone, and given that the extensive environmental monitoring network continues to be regularly sampled, tested, and analyzed, the extensive environmental data set confirms that the Facility is currently 'protective of human health and the environment,' satisfying the over-arching statutory criteria for issuance of the UST Operating Permit." FER at 1: "This *Facility Environmental Report* demonstrates how past, present, and anticipated future data, activities, analyses, operational improvements, and upgrades at the Red Hill Bulk Fuel Storage Facility (the 'Facility') show that operation of the Facility is and will continue to be 'protective of human health and the environment,' such that a UST Operating Permit for the Facility should issue in accordance with the	Mr. Stanley's opinions rely on underlying data sets, including data from "the extensive environmental monitoring network" (FER at i), "[a]ll the available environmental data" (*id.* at 10), and "raw and analyzed data" (*id.*). These opinions also rely on the Navy's 3D geologic model and groundwater models. *Id.* at 10 (relying on the "complex conceptual site model ("CSM") and a set of groundwater flow models" to establish that the Facility is protective of human health and the environment); *id.* at 48 (discussing the Navy's "multi-model approach" to "understand[] the direction and rate of groundwater flow"). Because this data and analyses were not produced, but clearly relied upon, there was no opportunity for meaningful cross-examination of Mr. Stanley and thus this testimony should be struck. HAR § 11-1-38(h). In addition, an adverse inference is warranted because the Navy has not demonstrated good cause for its refusal to comply with the December 30, 2020 order requiring production of this information. HAR § 11-1-24(b)(5). Even if the Navy's assertion that Mr. Stanley did not actually evaluate this data and analyses is accepted, the testimony should be disregarded because Mr. Stanley did not perform an independent assessment or evaluation of critical data and information to form these opinions or conclusions. Gannon Decl., Ex. C ("the FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy."). In addition, these opinions are based upon expertise, specifically risk assessment and regulatory compliance, which Mr. Stanley does not have and for which he is not qualified. Vol. 3, 673:10-11 ("I would not consider myself an expert in engineering risk assessment").

MR. STANLEY'S CONCLUSIONS THAT SHOULD BE STRUCK OR FOR WHICH AN ADVERSE INFERENCE IS WARRANTED	BASIS FOR STRIKING / DRAWING ADVERSE INFERENCE
State of Hawai'i Underground Storage Tank ('UST') statute and regulations." FER at 4: "While much of the work being conducted under the AOC is far beyond any specific requirement in the UST regulations, this work nevertheless provides further assurance of protectiveness." FER at 5: "All these analyses, improvements, repairs, and upgrades conducted under the AOC and GWPP ensure that operation of the Facility is currently protective of human health and the environment and will remain so." FER at 5: "This report attempts to concisely summarize a vast volume of data, analyses, and reports, which collectively show significant improvements that the Navy has already made and still plans to make to the Facility, and shows that operation of the Facility is and will remain protective of human health and the environment." FER at 10: "All the available environmental data, which are summarized in this section, indicate that operation of the Facility is currently protective of human health and the environment." FER at 10: "This work is summarized in a host of reports which provide raw and analyzed data and associated evaluations that establish that operation of the Facility is currently protective of human health and the environment, including the finding that natural processes, such as natural source-zone depletion and monitored attenuation, have prevented past releases from impacting the drinking water." FER at 14: "Comparison of the data from the long-term groundwater monitoring program to the EALs, as summarized in Appendix B, confirms that the drinking water does not pose even the potential for risk, and that operation of the Facility remains protective of human health and the environment."	

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	Basis for Striking / Drawing Adverse Inference
FER at 18: "Therefore, it is worth noting the variety of data sources and monitoring locations that have been and continue to be used to ensure that operation of the Facility remains protective of human health and the environment." FER at 46: "Taken together, the ongoing environmental monitoring and analyses and upgrades to Facility infrastructure and operations will help ensure that the Facility is operated and maintained in an environmentally protective manner and remain protective of the groundwater resource throughout and beyond the duration of the 5-year UST Operating Permit." FER at 46: "Thus, while the environmental data show that the Facility is currently protective, ongoing and future improvements will help ensure that the Facility becomes even more protective of human health and the environment, during and past the duration of the 5-year Operating Permit currently under consideration." FER at 51: "Taken together, these substantial data gathering and analyses will help the Navy and the Regulators ensure that the Facility remains protective during and beyond the 5-year Operating Permit duration." FER at 61: "Thus, while no petroleum facility or activity is risk-free, operation of the Facility is currently protective of human health and the environment and is likely to remain so, especially within the 5-year Permit period…" FER at 61: "Therefore, considering all the Facility upgrades made and planned to be made, along with all the data gathering and analyses, the Facility is protective of human health and the environment and should be permitted to continue to operate for the next 5 years…" Vol. 4, 812:10-14: "Q. So you believe the Red Hill tanks as they were constructed in the '40s were protective of the environment, correct? Yes	

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	Basis for Striking / Drawing Adverse Inference
or no? A. I believe they were at that time, and as time's gone on improvements have been made." Vol. 4, 812:22-813:2: "What my testimony says is currently protective of human health and the environment, so the conditions today are protective of human health, no impacts to drinking water supplies, no environmental impacts where you've got environmental resources impacted outside of immediately beneath the tanks."	
Mr. Stanley claims that the basaltic lava rock formation below the tanks has significant holding capacity. Stanley Test., at 8:14-17: "The basaltic lava formation between the tank bottoms and the basal groundwater aquifer have a holding capacity and zones of low permeability that impede the downward flow of water and petroleum constituents…" FER at 17-18: "The (basaltic) lava rock formation below the tank and above the groundwater has significant *holding capacity* (roughly analogous to a sponge), which is described in detail in the vadose zone retention capacity calculations in DON (2018b) (see Sidebar 9 and Sidebar 10). This holding capacity helps to impede released fuel from impacting groundwater by retaining the fuel in fractures and pore space of the rock, and this process is further enhanced by the presence of relatively low-permeability geological layers known to be present in Red Hill, which further impede the downward flow of hydrocarbons." FER at 42 – Sidebar 10: Holding Capacity Analyses [Section 2.1.2], including claims that "[u]pdated holding capacity calculations performed for hypothetical future release scenarios (Presented in the Red Hill *Investigation and Remediation of Releases Report*) (DON 2020b, at Appendix E) found that a sudden future release of approximately 120,000 gallons of LNAPL would have, at most, a minimal impact to groundwater and would not likely cause an exceedance of risk-based decision criteria in Red Hill Shaft."	Mr. Stanley's opinions rely on underlying data sets, including data from "available monitoring data" (FER at 42) and "site-specific geologic data and data from scientific literature" (*id.*). These opinions also rely on the Navy's 3D geologic model and groundwater models. *Id.* (confirming that the geologic model and evaluation of monitoring data was used to make claims about the holding capacity and vadose zone). Because this data and analyses were not produced, but clearly relied upon, there was no opportunity for meaningful cross-examination of Mr. Stanley and thus this testimony should be struck. HAR § 11-1-38(h). In addition, an adverse inference is warranted because the Navy has not demonstrated good cause for its refusal to comply with the December 30, 2020 order requiring production of this information. HAR § 11-1-24(b)(5). Even if the Navy's assertion that Mr. Stanley did not actually evaluate this data and analyses is accepted, the testimony should be disregarded because Mr. Stanley did not perform an independent assessment or evaluation of critical data and information to form these opinions or conclusions. Gannon Decl., Ex. C ("the FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy.").

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	Basis for Striking / Drawing Adverse Inference
FER at 52: "Importantly, even taking its (now updated) projections at face value, the QRVA does not predict any releases during the 5-year life of the Permit currently at issue (or during the 25-year maximum time frame for secondary containment) that would exceed the vadose zone holding capacity or (considering NSZD and MNA) otherwise impact human health or the environment…" Vol. 3, 658:9-15: "…if you look at some of our studies, especially the natural source zone depletion studies and the holding capacity studies, there's evidence that the hydrocarbon release from the 2014 release – the hydrocarbons from the 2014 release is constrained to approximately 30 feet below the tanks in the basalt." Vol. 3, 663:16-22: "…so what I'm saying is that the combination of the holding capacity of the basalt…is serving to basically stabilize the contaminate plume in ground water and actually cause it to recede over time." Vol. 3, 736:17-20: "And so by perch conditions we're talking a relatively impermeable layer above the water table that's holding water at a higher elevation above the basal aquifer." Vol. 3, 748:12-13: "…that basalt has a certain holding capacity that will basically absorb fuel…" Vol. 4, 823: 12-14: "Like I said, I think that would be highly, highly unlikely for that small of a release to exceed the holding capacity and make its way to groundwater."	In addition, these opinions are based upon expertise, specifically risk assessment and regulatory compliance, which Mr. Stanley does not have and for which he is not qualified. Vol. 3, 673:10-11 ("I would not consider myself an expert in engineering risk assessment").
Mr. Stanley claims that groundwater conditions in Halawa Valley create a hydrodynamic barrier to LNAPL flow. FER at 19, (b)(1): "Data from these multilevel wells suggest that: groundwater conditions in Halawa Valley create a hydrodynamic barrier to LNAPL flow toward BWS wells and may also impede the flow of dissolved constituents; upwelling of deeper groundwater is not	Mr. Stanley's opinions rely on underlying data sets, including "data from these multilevel wells." FER at 19. Because not all data and analyses from these wells were produced, but clearly were relied upon, there was no opportunity for meaningful cross-examination of Mr. Stanley and thus this testimony should be struck. HAR § 11-1-38(h). In addition, an adverse inference is warranted because the Navy has not demonstrated good cause for

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	Basis for Striking / Drawing Adverse Inference
important when investigating the Facility; and there are no indications of impacts to deeper aquifer zones."	its refusal to comply with the December 30, 2020 order requiring production of this information. HAR § 11-1-24(b)(5). Even if the Navy's assertion that Mr. Stanley did not actually evaluate this data and analyses is accepted, the testimony should be disregarded because Mr. Stanley did not perform an independent assessment or evaluation of critical data and information to form these opinions or conclusions. Gannon Decl., Ex. C ("the FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy.").
Mr. Stanley makes several representations about boring log data and monitoring well data. FER at 12: "Table B-3 further summarizes the results of long-term groundwater monitoring and shows that exceedances of regulatory screening levels have been primarily limited to a few analytes in monitoring well RHMW02 (located near Tank 5) and, to a lesser extent, RHMW01 (located near Tank 1)." FER at 19, (b)(1): "Of the groundwater monitoring wells, four are innovative multilevel wells with multiple discrete sampling zones extending deep into the aquifer that are thought to be the first of their kind in Hawai'i. Each multilevel well has multiple sampling ports installed at different levels in the borehole, enabling investigators to assess conditions at various depths and establish a vertical profile in a single areal space." FER at 20, (e): "The USGS has deployed water level instruments (known as transducers) in conventional wells and multilevel wells at the Facility and in the surrounding vicinity (Figure 6d). The Navy initiated the synoptic study to provide data for development of both the CSM and groundwater flow modeling. Data derived from the synoptic study have been used extensively for both purposes."	Mr. Stanley's opinions rely on underlying data sets, including data from "long-term groundwater monitoring" (FER at 12), and "data for development of both the CSM and groundwater flow modeling" (*id.* at 20). These opinions also rely on the Navy's 3D geologic model and groundwater models. *Id.* Because this data and analyses were not produced, but clearly relied upon, there was no opportunity for meaningful cross-examination of Mr. Stanley and thus this testimony should be struck. HAR § 11-1-38(h). In addition, an adverse inference is warranted because the Navy has not demonstrated good cause for its refusal to comply with the December 30, 2020 order requiring production of this information. HAR § 11-1-24(b)(5). Even if the Navy's assertion that Mr. Stanley did not actually evaluate this data and analyses is accepted, the testimony should be disregarded because Mr. Stanley did not perform an independent assessment or evaluation of critical data and information to form these opinions or conclusions. Gannon Decl., Ex. C ("the FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy.").

MR. STANLEY'S CONCLUSIONS THAT SHOULD BE STRUCK OR FOR WHICH AN ADVERSE INFERENCE IS WARRANTED	BASIS FOR STRIKING / DRAWING ADVERSE INFERENCE
FER at 44, Sidebar 12: Wells in the Current Red Hill Groundwater Monitoring Network: Mr. Stanley relied on boring logs for monitoring wells RHMW16A and RHMW19, which were reportedly installed in 2020 and not produced to the BWS.	
Mr. Stanley claims that any future release would flow towards Red Hill Shaft, and Red Hill Shaft can capture those releases. Stanley Test., at 10:12-18: "Moreover, the results of the groundwater modeling study indicate that, *in every one of the fourteen model configurations*, the Red Hill Shaft can capture groundwater from all areas of the tank farm. Therefore, if there were a future hypothetical release of sufficient quantity to reach groundwater, the Red Hill Shaft could be used to extract the impacted groundwater to eliminate or minimize impacts to offsite groundwater…" FER at 10: "These environmental monitoring systems, as well as the other Layers of Protection (*see* Sidebar 14) maintained by Facility operators, serve to prevent and detect potential releases, confirm that ongoing operations are being conducted in a safe manner, and would provide notice to minimize impacts to hypothetical future releases." FER at 20, (g): "The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawaiʻi ('UH') along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel (Figure 6f). In addition, the Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill."	Mr. Stanley's opinions rely on underlying data sets, including data from "the extensive environmental monitoring network" (FER at i), "[a]ll the available environmental data" (*id.* at 10), and "raw and analyzed data" (*id.*). These opinions also rely on the Navy's 3D geologic model and groundwater models. Stanley Test., at 10 ("the fourteen model configurations"); FER at 49 ("all models indicated…"); *id.* ("Certain models showed…"). Because this data and analyses were not produced, but clearly relied upon, there was no opportunity for meaningful cross-examination of Mr. Stanley and thus this testimony should be struck. HAR § 11-1-38(h). In addition, an adverse inference is warranted because the Navy has not demonstrated good cause for its refusal to comply with the December 30, 2020 order requiring production of this information. HAR § 11-1-24(b)(5). Even if the Navy's assertion that Mr. Stanley did not actually evaluate this data and analyses is accepted, the testimony should be disregarded because Mr. Stanley did not perform an independent assessment or evaluation of critical data and information to form these opinions or conclusions. Gannon Decl., Ex. C ("the FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy.").

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	**Basis for Striking / Drawing Adverse Inference**
FER at 44, Sidebar 12: Wells in the Current Red Hill Groundwater Monitoring Network: Water levels from RHMW16A and RHMW19 are used to evaluate flow directions. Water level data from multiple wells, including RHMW 11, RHMW13, RHMW14, and RHMW15, are used to evaluate groundwater flow direction in South Halawa Valley. FER at 49: "The interim modeling effort indicated that groundwater generally flows from the Facility southwest toward Red Hill Shaft, which pumps a significant amount of water." FER at 49: "Importantly, all models indicated that groundwater from beneath the tank farm is captured by Red Hill Shaft when it is pumping at its regulatory-permitted pumping limit, indicating that the Navy can capture and manage hypothetical future releases, should any reach the groundwater and extend beyond the tank farm (*see* Sidebar 16)." FER at 49: "Certain models showed that if Red Hill Shaft is not pumping, there are potential groundwater flow pathways to drinking water sources such as Hālawa Shaft. In those models, however, the groundwater travel time is relatively long, such that: There is time for natural attenuation to decrease or eliminate potential impacts drinking water…[and] there would be advance notice of the potential need to treat hypothetical dissolved constituents, if necessary. Such treatment systems could be similar to the granular activated carbon treatment systems currently used by BWS at other wells on O'ahu…" FER at 56 – Sidebar 16: Establishing a Groundwater Capture Zone [Section 3.1.5] Vol. 3, 720:20-24: "…so that if there was a release, any contaminants would be entrained in that flow and go to Red Hill Shaft and then not go anywhere else. So Red Hill Shaft would contain that contamination hydraulically."	

MR. STANLEY'S CONCLUSIONS THAT SHOULD BE STRUCK OR FOR WHICH AN ADVERSE INFERENCE IS WARRANTED	BASIS FOR STRIKING / DRAWING ADVERSE INFERENCE
Vol. 4, 864:2-4: "And so within that capture zone, groundwater flow within that capture zone is going to flow towards Red Hill Shaft." Vol. 4, 889:2-15: "So our models, the 13 models we developed, they all show that the capture zone extends under the tank farm at Red Hill. So what that means is if there was a release in that tank farm and it got into ground water, it would eventually flow to Red Hill Shaft. Q. And you're not seeing that? A. No, we – well, we're not seeing contaminants getting to Red Hill Shaft because they're biodegrading but that's more related to a potential future release if something happened in the future that got to groundwater. If Red Hill Shaft was pumping at its permitted rate, it would capture those materials before it went further in the aquifer, or before it impacted anything else."	
Mr. Stanley claims that the 2014 leak was not caused by corrosion. FER at 4: "Importantly, and often lost in public discourse, the 2014 Release was not due to corrosion of the tank; rather, prior to taking the tank out of service for maintenance (which is routinely conducted for all tanks to prevent failures due to corrosion), the tank was first confirmed to be intact via a tank tightness test." FER at 4: "Thus, the 2014 Tank 5 Release was essentially a perfect storm of errors during the repair project, *not* a failure stemming from corrosion of the tank." FER at 57: "The 2014 Tank 5 Release that precipitated the Red Hill AOC was a confluence of three facts and was not a leak caused by corrosion of the tanks." FER at 61: "…the 2014 Tank Release was not due to corrosion and did not result in any exposure to humans, plants, or animals…"	These opinions are based upon expertise, specifically risk assessment and corrosion, which Mr. Stanley does not have and for which he is not qualified. Vol. 3, 673:10-11 ("I would not consider myself an expert in engineering risk assessment"); Vol. 3, 672:5-19 (confirming that he has not studied corrosion and does not consider himself an expert on metals).
Mr. Stanley claims that the models, including the geologic, groundwater, and CSM models, are reliable, and uses the models to make several assertions in his testimony.	Mr. Stanley's opinions rely on underlying data sets, including "environmental monitoring data" (FER at 10), "other data" (*id.*), and "water level data" (*id.* at 21). These opinions also rely on the Navy's 3D geologic model and groundwater models. Stanley

MR. STANLEY'S CONCLUSIONS THAT SHOULD BE STRUCK OR FOR WHICH AN ADVERSE INFERENCE IS WARRANTED	BASIS FOR STRIKING / DRAWING ADVERSE INFERENCE
Stanley Test., at 10:12-18: "Moreover, the results of the groundwater modeling study indicate that, *in every one of the fourteen model configurations*, the Red Hill Shaft can capture groundwater from all areas of the tank farm. Therefore, if there were a future hypothetical release of sufficient quantity to reach groundwater, the Red Hill Shaft could be used to extract the impacted groundwater to eliminate or minimize impacts to offsite groundwater…" FER at Figure 2: Pictorial Conceptual Site Model. FER at 10: "Extensive evaluation of the environmental monitoring data using a wide variety of methods and approaches, including state of the art analyses, has fed into the development of a complex conceptual site model ('CSM') and a set of groundwater flow models describing a range of potential flow conditions as a result of various pumping scenarios." FER at 13, fn. 17: "Environmental risk assessment uses a risk-based exposure model to first identify the sources and migration pathways of contaminants, and then evaluate the exposure media (e.g., groundwater) and completeness of pathways for human and ecological receptors potentially exposed to these media (see Sidebar 4)." FER at 20, (g): "The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawai'i ('UH') along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel (Figure 6f). In addition, the Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill."	Test., at 10 ("the fourteen model configurations"); FER at 49 ("all models indicated…"); *id.* ("Certain models showed…"); Vol. 3, 676:15-16 (confirming that the information fed into the CSM is "really the basis for everything we do at the site."). Because this data and analyses were not produced, but clearly relied upon, there was no opportunity for meaningful cross-examination of Mr. Stanley and thus this testimony should be struck. HAR § 11-1-38(h). In addition, an adverse inference is warranted because the Navy has not demonstrated good cause for its refusal to comply with the December 30, 2020 order requiring production of this information. HAR § 11-1-24(b)(5). Even if the Navy's assertion that Mr. Stanley did not actually evaluate this data and analyses is accepted, the testimony should be disregarded because Mr. Stanley did not perform an independent assessment or evaluation of critical data and information to form these opinions or conclusions. Gannon Decl., Ex. C ("the FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy.").

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	Basis for Striking / Drawing Adverse Inference
FER at 21, (i): "A variety of environmental and geotechnical investigations have been conducted both at the Facility and within the general vicinity: URS (2012), Macdonald (1941), Dames & Moore (1991), and PGE (2015). The Navy used the geologic data from these logs to verify their more recent geologic mapping and to develop the CSM and the three-dimensional geologic model (Figure 6h). The water level data were used in conjunction with current groundwater levels to better characterize hydraulic conditions at the Facility." FER at 49: "Importantly, all models indicated that groundwater from beneath the tank farm is captured by Red Hill Shaft when it is pumping at its regulatory-permitted pumping limit, indicating that the Navy can capture and manage hypothetical future releases, should any reach the groundwater and extend beyond the tank farm (see Sidebar 16). Certain models showed that if Red Hill Shaft is not pumping, there are potential groundwater flow pathways to drinking water sources such as Hālawa Shaft. In those models, however, the groundwater travel time is relatively long…" FER at 56 – Sidebar 16: Establishing a Groundwater Capture Zone [Section 3.1.5]. Vol. 3, 676:15-16: Claiming that the CSM is "really the basis for everything we do at the site." Vol. 3, 704:6-9: "And again, since this time we had developed additional modeling plans and ways to obtain very precise data, and a lot of that was integrated into the latest flow model what we've reported on." Vol. 3, 708:2-5: "We have multiple models we've developed to represent different perspectives from different stakeholders so that we can try to bound what the flow conditions are."	

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	Basis for Striking / Drawing Adverse Inference
Vol. 3, 714:4-10: "Well, the conceptual site model is not a deliverable, but it's the basis for a lot of the deliverables we've developed. We have written a Groundwater Protection and Evaluation Considerations Report, we have written the Final Groundwater Flow Modeling Report, and we have written the Investigation Remediation of Releases Report." Vol. 3, 745:19-746:5: "We had additional work in the surrounding area where we put together sort of a geologic model of what's beneath the facility and the surrounding area, and so there's a range of properties for each of those rock types. So we put a – in our analysis we utilized a range of those properties, and in addition, we sent some of the cores off site to be analyzed for petrophysical data to help us understand potential retention capacities and things like that, and we utilized literature values for that as well, and that was all integrated into the analysis that we did for the holding capacity analysis." Vol. 3, 755:12-15: "So the combination of all these borings, all the seismic work, all the cores we have from our monitoring wells all were integrated into developing this geologic model." Vol. 4, 770:7-11: "So we used all the borings that were available to us, which were a huge number, both on top of Red Hill and adjacent to Red Hill. We used the seismic, we used the well logs, and integrated all of that data and other data into the geologic model." Vol. 4, 771:3-9: "So they'll take what they call shape files from the geologic model. So the model has different layers in it, and our model has nine layers in the land surface down to the fresh water/salt water interface. And we take shape files, the configuration of the geology of these different layers and integrate that into the model for the geology." Vol. 4, 801:25-802:1: "So in the final groundwater modeling report I believe we used 13 models…"	

MR. STANLEY'S CONCLUSIONS THAT SHOULD BE STRUCK OR FOR WHICH AN ADVERSE INFERENCE IS WARRANTED	BASIS FOR STRIKING / DRAWING ADVERSE INFERENCE
Vol. 4, 889:2-15: "So our models, the 13 models we developed, they all show that the capture zone extends under the tank farm at Red Hill. So what that means is if there was a release in that tank farm and it got into ground water, it would eventually flow to Red Hill Shaft. Q. And you're not seeing that? A. No, we – well, we're not seeing contaminants getting to Red Hill Shaft because they're biodegrading but that's more related to a potential future release if something happened in the future that got to groundwater. If Red Hill Shaft was pumping at its permitted rate, it would capture those materials before it went further in the aquifer, or before it impacted anything else."	
Mr. Stanley claims that the Facility is compliant with UST regulations. Stanley Test., at 11: "Continued protectiveness is also ensured by Facility upgrades and improvements, many of which far exceed the regulatory requirements at issue…" Stanley Test., at 11: "Even though the Facility complies with the UST regulations…" FER at ii: "Most of this work significantly exceeds regulatory mandates…" FER at 1: "This *Facility Environmental Report* demonstrates how past, present, and anticipated future data, activities, analyses, operational improvements, and upgrades at the Red Hill Bulk Fuel Storage Facility (the 'Facility') show that operation of the Facility is and will continue to be 'protective of human health and the environment,' such that a UST Operating Permit for the Facility should issue in accordance with the State of Hawai'i Underground Storage Tank ('UST') statute and regulations." FER at 4: "While much of the work being conducted under the AOC is far beyond any specific requirement in the UST regulations, this work nevertheless provides further assurance of protectiveness.	These opinions are based upon expertise, specifically regulatory compliance, which Mr. Stanley does not have and for which he is not qualified. Vol. 3, 690:21-22 (confirming that he is not an expert in certain areas and that he summarized conclusions from other Navy documents). In fact, the Navy put forth another witness – Ms. Danae Smith – as their witness with the most knowledge about regulatory compliance. This testimony should be struck for these reasons.

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	**Basis for Striking / Drawing Adverse Inference**
FER at 46: "Much of this additional work and the improvements planned for implementation and yet to be decided upon under the AOC exceeds Federal and State UST regulatory requirements, will be subject to oversight of and approval by the DOH and the EPA." FER at 46: "As shown in Sidebar 14, the proposed TUA and Release Detection Decision Document identifies the following additional layers of protection for release detection and safe operation of the Facility, which exceed the requirements of the UST regulations: 1. Conduct tank tightness testing (which is the only regulatory requirement for release detection) twice as frequently as required by the regulations." FER at 46: "Of these six completed or ongoing release detection methods, *annual* tank tightness testing is sufficient under the regulations for field-constructed tanks such as those at the Facility and is, therefore, the leak detection method indicated in the Permit application form." FER at 47: "The Navy's identification of and commitment to these measures exceeds the requirements of State and Federal UST permitting regulations." FER at 47: "It is important to stress in this Contested Case that, at a Facility such as this, conducting 'an annual tank tightness test that can detect a 0.5 gallon per hour leak rate' completely satisfies the Hawai'i UST regulations for leak detection." FER at 50: "Like the groundwater flow modeling, contaminant fate and transport modeling will provide additional information and protection beyond that required by Hawaii's UST regulations." FER at 51: "As described in this document and other testimony submitted concurrently, while current methods comply with the existing regulations, the Navy is developing its recommendations for additional	

Mr. Stanley's Conclusions That Should Be Struck or For Which an Adverse Inference Is Warranted	Basis for Striking / Drawing Adverse Inference
TUA and Release Detection methods that go beyond the regulatory requirements." FER at 52: "Risk assessment under the AOC is a process that is above and beyond any requirement in the UST regulations…" FER at 61: "Even though the Facility currently complies with the UST regulations, the Navy and Regulators have agreed to collect additional data, perform additional analyses, and make additional improvements over the years."	
Mr. Stanley claims that from a risk-based perspective, the Facility is protective of human health and the environment. FER at ii: "Facility components determined to present the most risk have been and will continue to be upgraded or replaced." FER at 4: "To date, neither EPA nor DOH have alleged that conditions at the Facility pose such risks, which is a further indication that the Facility is currently safe." FER at 52: "Risk assessment under the AOC is a process that is above and beyond any requirement in the UST regulations—such analyses are not required, and we are not aware of another UST facility in Hawai'i or elsewhere that has embarked upon such a detailed quantitative analysis of risk." FER at 54: "Reduced risk by decommissioning small nozzles from service."	These opinions are based upon expertise, specifically risk assessment and regulatory compliance, which Mr. Stanley does not have and for which he is not qualified. Vol. 3, 673:10-11 ("I would not consider myself an expert in engineering risk assessment"); Vol. 3, 690:21-22 (confirming that he is not an expert in certain areas and that he summarized conclusions from other Navy documents).
Mr. Stanley claims that the Navy's prevention and detection procedures are sufficient. FER at 11: "Operational procedures to prevent and detect releases are being improved upon and expanded."	These opinions are based upon expertise, specifically Red Hill's maintenance, detection, and operation procedures, which Mr. Stanley does not have and for which he is not qualified. Vol. 3, 690:21-22 (confirming that he is not an expert in certain areas and that he summarized conclusions from other Navy documents).

MR. STANLEY'S CONCLUSIONS THAT SHOULD BE STRUCK OR FOR WHICH AN ADVERSE INFERENCE IS WARRANTED	BASIS FOR STRIKING / DRAWING ADVERSE INFERENCE
FER at 53: "The Navy is closing collaborating with UH in a number of research projects designed to improve the Facility's maintenance and operational procedures and its release detection capabilities (*see* Sidebar 18), including: • Ultrasonic, infrared, and electromagnetic tank inspection • Continuous soil vapor monitoring • Tank inspect and repair protocols • Advanced microscopic methods for mapping tank corrosion • Concrete degradation, inspection, and retrofit • Permanent-magnet, wall-crawling mobile robot for remote inspection of backside corrosion of tank while fuel-submerged • Microbial degradation of fuel hydrocarbons in subsurface for early detection of releases" FER at 57 – Sidebar 17: Preventing a Recurrence of the 2014 Tank 5 Release [Section 3.2], as to the "Improvements Currently Being Implemented" and the "Improvements Planned for Implementation" sections.	

Exhibit B

Brown, David K.

From: Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Sent: Friday, January 8, 2021 2:27 PM
To: Lou Chang; 'David Kimo Frankel'; Brown, David K.; Foley Gannon, Ella; Fitzpatrick, David CIV USN (USA); ''Lau, Jeff A''; Law, Michael B CIV USN (USA); ''Luka, Jean''; marnier+NLO@gmail.com; Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA); Minott, Karrin H CIV USN OGC WASH DC (USA); ''Paige, James C''; ''Steven Jacobson''
Subject: RE: production of information relied upon by experts
Attachments: Stanley Declaration 1-8-21.pdf; DA Determination - DCRIT Hawaii Water Wells.pdf; 2018 Kawata Manfredi correspondence.pdf

[EXTERNAL EMAIL]
Dear Hearing Officer Chang and Advocates,

The attached Declaration of Curtis Stanley ("Declaration") is submitted in response to the Hearing Officer's order of December 30, 2020 that the Navy produce to BWS certain categories of "information or sources relied upon by the Navy expert witness." The Declaration addresses the Facility Environmental Report ("FER") statements quoted by BWS in its request, and indicates where the information relied upon to make these statements can be found in the references listed by the FER. The information relied upon is available in reports that were previously prepared and issued by the Navy pursuant to the Administrative Order on Consent ("AOC") and other publicly available documents. The raw data and model files underlying those reports were not re-investigated, re-examined, or validated in the course of preparing the FER, and Mr. Stanley's conclusions relied on the information as it was presented in the Navy's AOC reports. (Declaration at ¶2.)

It is the Navy's understanding that secondary and tertiary data that may underlie other reports, but that was not reviewed or relied upon to derive the conclusions in Mr. Stanley's testimony or the FER, need not be obtained and produced. As his Declaration makes clear, the information relied on by Mr. Stanley to prepare his conclusions for this contested case hearing can be found in documents that are already available to the parties. Therefore, no additional data is being produced at this time.

Regarding the groundwater flow model files specifically requested by BWS: Mr. Stanley's work for the FER did not require the use of these model files, but in any event, the model files incorporate information about the locations and pumping rates of Navy wells that has been deemed DoD critical infrastructure security information (DCRIT). The DCRIT determination dated June 19, 2018, is attached to this email. The 2018 email exchange between Red Hill Regional Program Director Mark Manfredi and BWS's Erwin Kawata, also attached, indicates BWS's awareness that the information must be protected from public disclosure, and that the Navy "cannot provide this information to one or any organization we do not have a signed NDA with."

Mr. Kawata states, in ¶22(b) of his testimony, that "[o]n January 14, 2014, the BWS began performing additional water quality testing at the five well stations that are in close proximity to the RHBFSF. This water quality testing is in addition to and goes above and beyond the BWS' regular water quality testing. Weekly testing occurred in January 2014, monthly testing occurred in February and March 2014, and quarterly testing has occurred from April 2014 to the present." In ¶22(c), Mr. Kawata states that "[o]n August 31, 2017, the BWS completed construction of a monitoring well at its Moanalua Reservoir No. 405 property designed to detect potential petroleum contamination from the RHBFSF." In ¶3, Mr. Kawata states that his "work over the past 38 years has been in the chemical, microbiological, biological, and radiological testing of the water served by the department". Finally, in ¶35, Mr. Kawata attests that his conclusions are "[b]ased on my work experience at BWS and knowledge about the RHBFSF," including "[i]ts close proximity (100 feet) to the groundwater table and the groundwater's vulnerability to contamination" and "contamination detected in the groundwater underneath the RHBFSF." The Navy therefore requests that BWS produce the results of all water quality testing performed "at the five well stations that are in close proximity to the RHBFSF" and at the "monitoring well … designed to detect potential petroleum contamination."

Best regards,

Marnie Riddle
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Naval Litigation Office
Office of the General Counsel
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From: Lou Chang <louchang@hula.net>
Sent: Wednesday, December 30, 2020 3:31 PM
To: 'David Kimo Frankel' <davidkimofrankel@hawaiiantel.net>; david.brown@morganlewis.com; ''Ella Gannon'' <ella.gannon@morganlewis.com>; Fitzpatrick, David CIV USN (USA) <david.fitzpatrick2@navy.mil>; ''Lau, Jeff A'' <jlau3@honolulu.gov>; Law, Michael B CIV USN (USA) <michael.b.law@navy.mil>; ''Luka, Jean'' <Jean.Luka@doh.hawaii.gov>; marnier+NLO@gmail.com; Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>; ''Paige, James C'' <james.c.paige@hawaii.gov>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>; ''Steven Jacobson'' <steven.jacobson@doh.hawaii.gov>
Subject: [Non-DoD Source] production of information relied upon by experts

Dear Advocates:

Confirming elements of our status conference discussion today:

1. With respect to documents and sources relied upon by the Navy and BWS expert witnesses,
    a. BWS has requested that the Navy produce or provide information to allow BWS to access information or sources relied upon the Navy expert witness. The categories of documents are (1) environmental data set, (2) 3D geologic model, (3) strike and dip, lava flow, geology and (4) ground water flow modeling files.
    b. The Navy will make a request for such documents and sources info to its expert today and will plan to produce such by Jan. 9, 2021.
    c. The Navy will make a request to BWS by Jan. 8, 2021 for documents and sources relied upon by the BWS expert witnesses.
    d. BWS will plan to produce such by Jan. 15, 2021.
2. We agreed to start our hearings at 8 AM each day.
3. Parties will have an opportunity to make an oral opening statement on the first day of hearings. Oral and written closing statements are also OK.

I hope that your planned meet and confer tomorrow will be useful and productive. Any agreements you can reach for stipulations or for the further streamlining of our planned hearings will be much appreciated. Thank you for your efforts and cooperation.

Hope you all have a festive and safe New Year holiday!

Aloha,
Lou

Hearing Officer

Mediation
Arbitration
Neutral Services
Lou Chang, ALC
Attorney At Law

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Mediation & Arbitration Panel Member:
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Exhibit C

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DEPARTMENT OF HEALTH

STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Red Hill Permit Application	Case No. 19-UST-EA-01 **DECLARATION OF CURTIS STANLEY** CERTIFICATE OF SERVICE

DECLARATION OF CURTIS STANLEY

1. I previously testified in this contested case hearing that I helped develop the Facility Environmental Report ("FER") that was prepared for this contested case and attached to my prior testimony. (Testimony of Curtis Stanley ("Stanley Testimony"), pp. 5-6.) I briefly described the important findings that were summarized in the FER. (Stanley Testimony, pp. 8-12.)

2. The FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy. Instead, it contextualizes these investigations, and highlights and explains the findings and conclusions that may be relevant and useful for this contested case hearing. (*See* FER, p. 1.) The FER does not fulfill any requirement of the Administrative Order on Consent ("AOC"). The information relied on to prepare the FER is contained in the site investigations and environmental reports that were conducted by the Navy pursuant to the AOC, listed in FER Section 4. The underlying datasets used by the Navy to prepare those reports were not re-analyzed in the FER.

3. I have been informed by counsel for the Navy that counsel for the Board of Water Supply ("BWS") made the following set of requests for documents, quoting the enclosed passages from the FER:

> Documents relied upon by Curtis Stanley to form his expert opinions as described in the Facility Environmental Report (FER), including:
>
> > "Red Hill is probably the most extensively studied UST system in the State of Hawai'i with the largest environmental data set of any UST system in the State. The Navy has collected a plethora of data that have greatly expanded understanding of the geology and hydrogeology at Red Hill, as well as conditions in the underlying groundwater aquifer, which has enabled the studies and conclusions briefly summarized above. The data serve as the foundation for the

> Navy's AOC environmental investigation findings and will continue to do so as more data are collected and investigations, evaluations, and decision making continue (see Section 3)." [FER, at 18]

Please produce the referenced and relied upon environmental data set, including all: geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements.

> "The Navy developed a geologic framework model and a three-dimensional regional geologic model of Red Hill and surrounding environs (including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor) to provide geologic support for its groundwater flow modeling effort. The three-dimensional geologic model encompassed the groundwater flow model domain and incorporated information from borehole logs, subsurface structural geology surveys, developed cross sections, and published literature. The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawai'i ("UH") along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel." [FER, at 20]

Please produce the referenced and relied upon Navy three-dimensional regional geologic model.

> "[T]he Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill." [FER, at 20]

Please produce the referenced and relied upon Navy measurements of strike and dip of lava flows and clinker units.

> "Understanding the direction and rate of groundwater flow under a variety of reasonable supply well pumping scenarios is critical to assessing the risk that any hypothetical future fuel leak could pose to local drinking water. Initially, the AOC SOW scoped the groundwater flow model effort as one of updating a model developed for a previous 2007 Facility environmental investigation (DON 2007). The Navy modeling team found that updating the 2007 model was insufficient and recommended additional work, including entirely rebuilding, providing more detail, and expanding the model. Working with the AOC Parties and other stakeholders, the Navy refined the modeling domain to extend approximately 51 square miles from Waimalu Valley in the northwest to Kalihi Valley in the southeast, and from near the Ko'olau crest in the northeast to Pearl Harbor and the Pacific Ocean in the southwest (see Location Map, Figure 1), far beyond where

> any impacts might reasonably be expected. Since there are a range of factors that require consideration, the Navy developed a multi-model approach to bound expected flow conditions (Ajami et al. 2006). Such an effort requires additional work on behalf of the Navy but results in a more reliable range of predictions under given scenarios." [FER, at 48]

Please produce the referenced and relied upon groundwater flow modeling files, including Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy's March 2020 Groundwater Flow Model Report.

4. Section 4 of the FER lists documents that "contain detailed underlying data for the information presented herein or are otherwise considered important enough [to] incorporate into the record in this contested case," and provides URLs where these documents can be accessed by members of the public (FER, p. 59). The FER passages quoted above reference and rely upon these documents. In the following paragraphs, I will identify the specific documents listed in Section 4 of the FER where the data I relied upon in forming my conclusions can be found, and where appropriate will identify additional documents that may contain data of interest to the parties.

5. Page 18 of the FER, quoted above in BWS's document request, states that the Navy has collected a large amount of environmental data, and that this data forms the basis for the Navy's studies of and conclusions about the environmental impacts of the Red Hill Facility and "the foundation for the Navy's AOC environmental investigation findings." (FER, p. 18.) It was neither necessary nor practicable to independently re-analyze all such environmental data, nor replicate all of the Navy's past environmental investigations, before preparing the FER for use in this contested case. The results of the Navy's studies and investigations are described in the references listed in Section 4 of the FER, including the Investigation and Remediation of

Releases Report,[1] Groundwater Flow Model Report,[2] Conceptual Site Model report,[3] and Groundwater Protection and Evaluation Considerations Report.[4] Current groundwater monitoring data is provided in quarterly monitoring reports, like the Second Quarter 2020 Groundwater Monitoring Report.[5]

6. In connection with the above passage on page 18 of the FER, BWS has specifically requested "geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements." The FER did not independently re-analyze any data in these categories underlying the Navy's site investigations. However, discussions, summaries, tables, and other presentations of data falling into these categories can be found in the following documents, referenced in Section 4 of the FER and/or publicly available.

Geophysical and drilling logs:

- Investigation and Remediation of Releases Report, Appendix B.2

[1] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0014424 to NAVYREF0016641, as well as Exhibit N-078. It was produced by BWS as Exhibit B-339. It is also publicly available at https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-investigation-and-remediation-of-releases-report-rev00-redacted-2020-03-25.pdf

[2] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0003407 to NAVYREF0004104. It was produced by BWS as Exhibit B-361. It is also publicly available at https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-groundwater-flow-model-report-redacted-2020-03-25-.pdf

[3] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0002443 to NAVYREF0003406. It was produced by BWS as Exhibit B-352. It is also publicly available at https://www.epa.gov/sites/production/files/2019-07/documents/red_hill_conceptual_site_model_20190630-redacted.pdf

[4] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0001983 to NAVYREF0002442. It was produced by BWS as Exhibit B-348. It is also publicly available at https://www.epa.gov/sites/production/files/2018-09/documents/red_hill_interim_groundwater_flow_model-rev00_2018- 07-27-redacted.pdf

[5] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0005200 to NAVYREF0014423. It was produced by BWS as Exhibit B-83. It can also be found at https://health.hawaii.gov/shwb/ust-red-hill-project-main/red-hill-technical-documents-2020/ and at https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-1.pdf, https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-2.pdf and https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-3.pdf

- Groundwater Flow Model Progress Reports, available at https://www.epa.gov/red-hill/groundwater-flow-patterns-red-hill-additional-documents and produced by BWS as Exhibits B-340, B-342, B-343, B-347, B-350, B-351, B-353, B-354, B-355

Water levels:

- Red Hill Quarterly Groundwater Monitoring Reports, available under "Red Hill Technical Documents" at https://health.hawaii.gov/shwb/ust-red-hill-project-main/
- Groundwater Flow Model Progress Reports

Chemistry and temperature measurements:

- Red Hill Quarterly Groundwater Monitoring Reports

Petrophysical measurements:

- Conceptual Site Model report, Appendix F

7. Page 20 of the FER, quoted above in BWS's document request, explains that the Navy developed a geologic framework model and a 3-D regional geologic model of Red Hill in the course of preparing its groundwater flow model. I did not independently review or re-analyze the data underlying these models, nor did I run any of the model software files, in the course of preparing the FER or my conclusions. In fact, the quoted passage simply summarizes some of the work previously performed by the Navy in its environmental studies of the site. The geologic framework model and 3D regional geologic model, as well as the Navy's use of them, are described in more detail in Appendices C ("Strike and Dip Data"), D ("Evaluation of Potential Pahoehoe Lava Flow Paths Through Tank Farm Area"), E ("Geologic Framework Model"), F ("Petrographic Analytical Report"), and G ("Infiltration Study Report") of the Conceptual Site Model listed in Section 4 of the FER, which is available to BWS (see footnote 3, above). More information about the geologic model is available in the Investigation and

Remediation of Releases Report, page A-18 (see footnote 1, above); the Existing Data Summary and Evaluation Report, pages 3-1 to 3-2 (BWS Exhibit B-331), and Seismic Profiling to Map Hydrostratigraphy in the Red Hill Area (BWS Exhibit B-346).

8. On page 20, the FER summarizes, but does not independently re-evaluate, past Navy investigations of the strike and dip of lava flows at Red Hill. The FER relies on information about strike and dip data that is available in Appendix C ("Strike and Dip Data") of the Conceptual Site Model (see footnote 3, above).

9. On page 48, the FER briefly describes work done by the Navy to model groundwater flows as required by the AOC. The FER does not independently evaluate, validate, or analyze this work itself, and all of the information in the passage quoted by BWS is available in the documents referenced in FER Sections 4 and 6. For example, the FER describes the Navy's expansion of the modeling domain to include the entire area from Waimalu Valley to Kalihi Valley and from near the Ko'olau crest to Pearl Harbor; this is also reported on page 1-2 of the Groundwater Flow Model Report (see footnote 2, above). Similarly, the Navy's use of a multimodel approach, briefly described in the quoted passage of the FER, is discussed in detail in the Groundwater Flow Model Report (see, e.g., pp. 1-1, 1-10 to 1-12, 2-1 to 2-5, 4-1, and Section 5) cited in FER Section 4.

10. BWS has requested "Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy's March 2020 Groundwater Flow Model Report." No groundwater flow model files were generated, validated, or independently re-analyzed in order to form the conclusions in the FER. The FER relies on the groundwater flow information as presented in the Groundwater Flow Model Report in order to form its conclusions.

Executed this 8th day of January, 2021, at Boerne, Texas.

/S/ Curtis Stanley

Curtis Stanley

DEPARTMENT OF HEALTH
STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Permit Application	)	CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I hereby certify that, on this date, a true and correct copy of the foregoing document was emailed to the following:

Hearings Officer

Lou.chang@hula.net

Board of Water Supply

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david.brown@morganlewis.com

Honolulu Corporate Counsel

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Department of Health

James.c.paige@hawaii.gov

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davidkimofrankel@gmail.com

Respectfully Submitted,

Dated: January 8, 2021

/S/ Marnie E. Riddle
Marnie E. Riddle
Agency Representative

Exhibit D

Brown, David K.

From: NoReplyTo@mail.mil
Sent: Wednesday, January 27, 2021 7:55 AM
To: Brown, David K.
Subject: [DoD SAFE] RIDDLE.MARNIE.E has dropped off a file for you

[EXTERNAL EMAIL]
This is an automated message sent to you by the DoD SAFE service.

RIDDLE.MARNIE.E <**marnie.riddle@navy.mil**> has dropped off a file for you.

IF YOU TRUST THE SENDER and are expecting to receive a file from them, you may choose to retrieve the drop-off by clicking the following link (or copying and pasting it into your web browser):

https://safe.apps.mil/pickup.php?claimID=vAYtp6jsKUH5f6Mu&recipCode=KYWxXj

You will be required to enter the claim passcode, which is:
ihRvhicUjHYkWMvP

You have 7 days to retrieve the drop-off; after that the link above will expire.

The sender has left you a note:

The enclosed are geologic model files depicting the area around the Red Hill facility. Groundwater flow model files are not included. The Navy's expert did not review or rely on the enclosed data in his work for this contested case, but we are transmitting them as a courtesy.

Full information about the drop-off:

Claim ID:	vAYtp6jsKUH5f6Mu
Recipient Code:	KYWxXj
Claim Passcode:	ihRvhicUjHYkWMvP
Date of Drop-off:	2021-01-27 15:54:28 UTC

— Sender —

Name:	RIDDLE.MARNIE.E
Organization:	USN
Email Address:	marnie.riddle@navy.mil

— File —

Name:	sendfiles_archive.zip
Size:	308.1 MB
SHA-256 Checksum:	4FD01808395F058E2FAC301D750950B4373C28EFB2407FA14174CAD19A2B6776
Content Type:	application/x-zip-compressed

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing document was served upon the following, via email, to their last known email address on March 16, 2021:

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Hearings Officer

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DATED: Honolulu, Hawaii, March 16, 2021.

PAUL S. AOKI
Acting Corporation Counsel

By */s/ Jeff A. Lau*
JEFF A. LAU
Deputy Corporation Counsel
Attorney for Petitioner
Board of Water Supply,
City and County of Honolulu

EXHIBIT B

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DEPARTMENT OF HEALTH

STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re: Red Hill Permit Application	Case No. 19-UST-EA-01 **NAVY BRIEF IN OPPOSITION TO BWS MOTION TO STRIKE AND/OR NEGATIVE INFERENCE** **DECLARATION OF MARNIE E. RIDDLE AND EXHIBITS A THROUGH C** CERTIFICATE OF SERVICE

MEMORANDUM IN OPPOSITION

BWS has failed to articulate any reasonable justification for striking any part of Mr. Stanley's testimony or for drawing a negative inference against the Navy. BWS had a full and fair opportunity to cross-examine Mr. Stanley on the foundation and basis for his opinions, and had access to all of the information he relied on prior to that cross-examination. BWS has never identified any information relied on by Mr. Stanley that is not contained in the voluminous publicly-available documents designated as exhibits in this proceeding, and there is no such information. There is no basis for any part of BWS's motion, and it should be denied in its entirety.

A. BWS had the opportunity to cross-examine Mr. Stanley, and had access to the information he relied on in formulating his opinions. BWS has stated no valid grounds for striking his testimony.

HAR § 11-1-38(h) states that "[t]he hearings officer may disregard or strike direct testimony if opposing parties do not have an opportunity for cross-examination." This is the only ground provided in the HAR for striking testimony in a contested case. Although BWS cross-examined Mr. Stanley for several hours without objection (*see* Hearing Transcript Vol. 3, 460:13 through Vol. 4, 890:25), it now asserts that this opportunity was not "meaningful" because, BWS claims, it lacked access to unspecified "data" and to computer files that Mr. Stanley did not rely on.[1]

As a threshold matter, the language of HAR § 11-1-38(h) is clear and unambiguous. The rule does not allow testimony to be struck where an opposing party had an opportunity for cross-examination, but in that party's opinion, the opportunity was not sufficiently "meaningful." BWS has cited no interpretation of the rule that would allow such a result, and the Navy has found none. Since the Navy would be severely prejudiced by the exclusion of testimony from a key expert witness, it is all the more important that the requirement set forth in HAR § 11-1-38(h) be applied as written. Nonetheless, in order to correct a number of misstatements made by

[1] See, e.g.: BWS Motion at 7 ("Nor could the BWS meaningfully cross-examine Mr. Stanley"); Motion at 9 ("underlying data and information should have been produced … to allow for meaningful questioning of the Navy's witnesses"); Motion at 10 ("[T]he BWS … had no meaningful opportunity to cross-examine Mr. Stanley").

BWS and to clarify ambiguities BWS has introduced, the Navy will address BWS's arguments in full.

When presented with citations to the record containing data it claims to lack,[2] BWS ignores these citations and simply repeats its insistence that "underlying data" was not produced.[3] But the Navy has withheld nothing on which Mr. Stanley relied. His expert report provided a full listing of the Navy reports incorporated by reference (FER Section 4, pp. 59-60 (Counsel Dec. Exh. A)), all of which are publicly available and designated exhibits in this proceeding, and all other references (FER Section 6, pp. 62-65 (Counsel Dec. Exh. A)), which are either publicly available or were produced to BWS at the same time as the report.

The reports listed in FER Section 4 are not mere summaries of conclusions. The Administrative Order on Consent (AOC), pursuant to which these reports were produced, required them to be submitted to the Regulatory Agencies accompanied by a certification that the information therein is "true, accurate, and *complete*." (Exh. N-001, p. 13, emphasis added.) The

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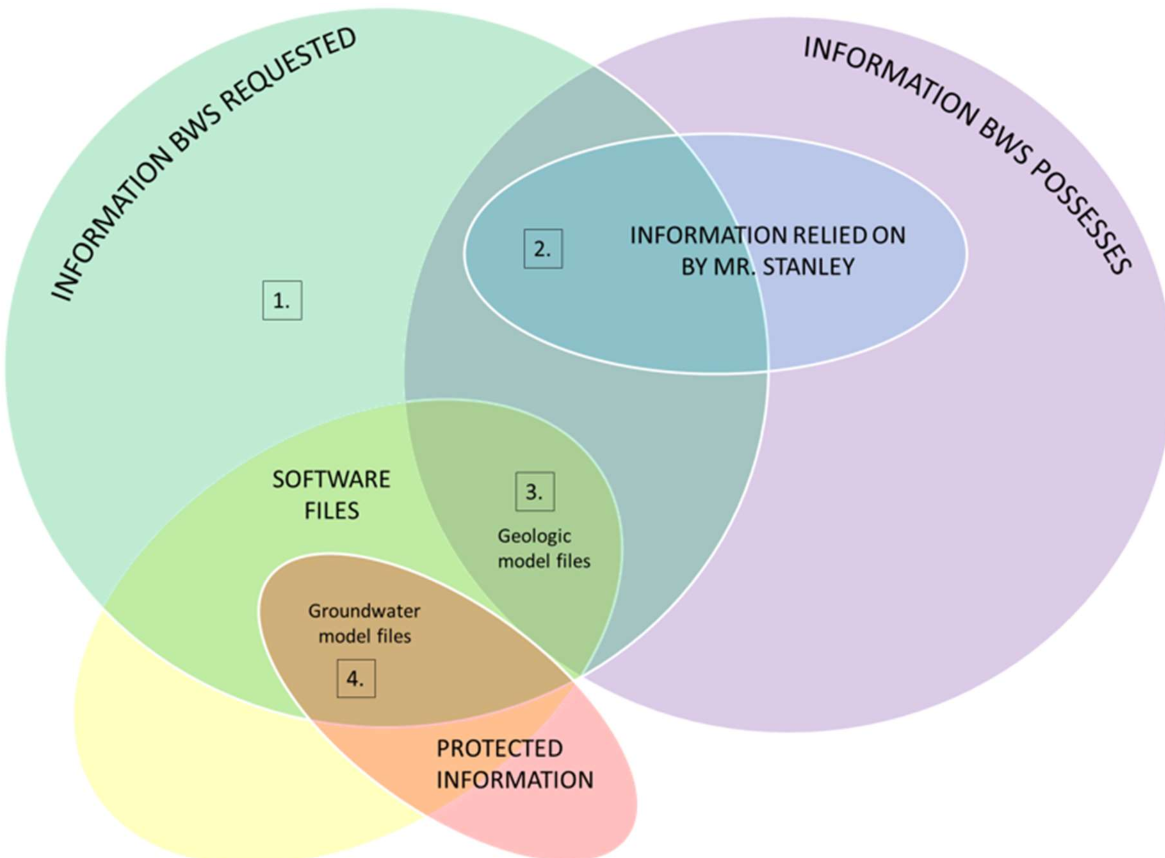
[2] For details of these citations, please see pages 5-9 of the Navy's Memorandum in Opposition to BWS Prehearing Motion for Negative Inference, filed January 29, 2021, and the accompanying Declaration of Counsel and Exhibits A through M cited in those pages. Due to their size, this Memorandum and its Exhibits are not attached hereto, but the Navy will forward a copy contemporaneously with service of this brief for the convenience of the hearings officer and parties. See also Mr. Stanley's January 8, 2021 Declaration, attached hereto as Exhibit B to the Declaration of Counsel.

[3] See, e.g.: Motion at 3 (BWS claims to lack "access to all of the information relied upon and underlying the reports and testimony submitted in this matter"); Motion at 5 (BWS claims to lack "access to underlying data and input parameters" for the geologic model); Motion at 6 (BWS states Navy "refuse[s] to fully produce information relied upon by Mr. Stanley in his report"); Motion at 7 ("underlying data and analyses were not produced to the BWS"); Motion at 10 (BWS claims the Navy "has not provided all of this underlying data"); Motion at 11 (BWS claims the Navy "has not provided the underlying data, assumptions, or parameters for the groundwater flow models"); Motion at 13 ("the underlying data was neither provided nor explained"); Motion at 14 ("the Navy refused to produce underlying data and information related to Mr. Stanley's report"); Motion at 18 ("certain environmental, geologic, and groundwater data sets remain missing"); Motion at 19 ("the Navy refused to produce the underlying data and analyses"). Absolutely none of this is true.

AOC also required "[a]ll results of sampling, testing, modeling or other data generated … during implementation of this AOC" to be submitted to the Regulatory Agencies (Exh. N-001, p. 14) and "[a]ll data, information, and records created or maintained for purposes of implementation of this AOC, and all records relating to Facility operations and maintenance, or to site conditions" to be made available to the Regulators upon request unless privileged from disclosure. (Exh. N-001, p. 17). Once received, such data, information, and records "may be made available to the public by EPA or DOH without further notice to Navy and DLA." (Exh. N-001, p. 17). And indeed, EPA has made such information available to the public at its Red Hill website, where the reports listed in Section 4 of Mr. Stanley's expert report can be found (Counsel Dec., Exh. A; see "URL" column). With limited redactions, *the data and information underlying the Navy reports and models are included* in those documents, or are otherwise publicly available. If BWS still believed that "underlying data" was missing from these sources, it did not take the opportunity to clarify the matter with Mr. Stanley upon cross-examination.

The general rule in Hawaii is that "expert testimony should be liberally admitted at trial," *Ditto v. McCurdy,* 86 Hawaii 93, 108, 947 P.2d 961, 976 (App.), *rev'd on other grounds*, 86 Hawaii 84, 947 P.2d 952 (1997). "'[E]xtensive cross-examination of the expert so as to elicit his [or her] assumptions and test his [or her] data' is a more practical truth-seeking method than the exclusion of relevant opinion testimony." *Ditto*, 86 Hawaii at 109, 947 P.2d at 977; *see also Lai v. St. Peter*, 10 Haw. App. 298, 314–15, 869 P.2d 1352, 1361 (1994) ("broad cross-examination of an expert is permitted in recognition of the liberal bases allowed for an expert's testimony"). BWS had the opportunity to probe the boundaries of Mr. Stanley's reliance on underlying data during cross-examination and, if possible, gather evidence that would support its claim that relied-on information was withheld. But BWS elected not to pursue such a line of questioning. BWS cannot now claim that its *lack* of such evidence proves its point.

The visual aid below is provided to assist in understanding the categories of information discussed in BWS' motion. The information at issue and the relevant arguments are addressed in the following four subsections:



1. BWS requested several types of information. At the December 30, 2020 status conference, BWS identified four categories of information, described in the subsequent Order as "(1) environmental data set, (2) 3D geologic model, (3) strike and dip, lava flow, geology and (4) ground water flow modeling files." (BWS Motion, Gannon Decl., Exh. B.) In its motion, BWS mischaracterizes both the Navy's argument at that status conference and the effect of the order that followed. First, the Navy did not argue that it should not have to produce information Mr.

Stanley relied on, as BWS incorrectly states on p. 4 of its Motion. Instead, the Navy argued that it should not be required to produce data that was *not* actually relied on by Mr. Stanley in this proceeding, and successfully established that "secondary" and "tertiary" data – information he did not actually review or rely on, but which might have informed something he *did* review or rely on – was not encompassed by the order. And indeed, the order captured this outcome; it ordered that such information be produced to the extent "relied upon" by Mr. Stanley, and ordered the Navy to "make a request for such documents and sources [of] info to its expert," which the Navy did. (BWS Motion, Gannon Decl., Exh. B.) The order did *not* include a finding that any information was being withheld and must be produced. This outcome is in accord with Hawaii case law addressing materials underlying expert opinion; see *Tabieros v. Clark Equip. Co.,* 85 Haw. 336, 384, 944 P.2d 1279, 1327 (1997) (HRE 703 and 705 permit, but do not require, disclosure of underlying materials "provided, of course, that (1) the expert has *actually* relied on the material as a basis of the opinion" (emphasis added)); quoted in *Klink v. State (In re Estate of Klink),* 113 Haw. 332, 355, 152 P.3d 504, 527 and *Steigman v. Outrigger Enters.,* 126 Haw. 133, 159, 267 P.3d 1238, 1264.

With the exception of the specific files discussed below in (3) and (4), BWS has never identified any particular document, database, or other item that it believes would fall into this category and that it believes has been withheld. As discussed in (2), below, the documents and information Mr. Stanley actually relied upon have been available to BWS at least since they received Mr. Stanley's report, and in many cases longer.

2. BWS already has the information relied on by Mr. Stanley. Following the December 30 status conference and order, the Navy duly inquired as to the sources of information relied on by its expert and submitted Mr. Stanley's Declaration (Counsel Dec., Exh.

B). In that Declaration, Mr. Stanley "identif[ied] the specific documents listed in Section 4 of the FER where the data I relied upon in forming my conclusions can be found" (Counsel Dec., Exh. B; see also Counsel Dec., Exh. A, which includes Section 4 of the FER), documents BWS had already produced as its own exhibits in this proceeding.[4] The documents and information Mr. Stanley *did* rely on are voluminous and thorough, amounting to thousands of pages of analysis of data that is provided in the documents' appendices or publicly available online (see discussion *supra* at 3-4). BWS's refusal to either accept this representation, or attempt to disprove it through cross-examination, does not create grounds to strike Mr. Stanley's testimony.

BWS points out that Mr. Stanley used the word "data" at various times in his oral testimony, in an attempt to support its claim that the Navy "continues to refuse to fully produce information relied upon by Mr. Stanley." (Motion at 6-7, 8-9.) But since all data identified with specificity in these excerpts ("water level elevation data," "soil vapor monitoring data," "seismic" data, "well logs," "groundwater monitoring data," "data that was going into the models," "transducer data," and "petrophysical data") *can be found in documents BWS already possesses*,[5] the point is entirely unclear. If BWS required additional assistance in locating information Mr. Stanley relied on, it had the opportunity when it cross-examined him. BWS's refusal to ask Mr. Stanley about it does not prove that it was withheld.

Instead of exploring the issue with Mr. Stanley on cross-examination, BWS leapt to its own conclusions. Specifically, BWS believes it has identified two types of discrepancies

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[4] BWS has repeatedly, and wrongly, used incendiary language to accuse the Navy of "brazen disregard" for, and ongoing violation of, an order issued by this hearings officer (Motion at 2, 6). The Navy objects to this inaccurate characterization of its response to the order, and respectfully asserts that directing BWS to where the sought-after information can be found in documents BWS demonstrably possesses is not the same as "refusing to produce" the information.

[5] See Footnote 2, above, and discussion at pages 3-4.

between data sets and two missing boring logs that, it claims, prove the Navy (1) improperly withheld information relied on by Mr. Stanley and (2) deprived BWS of a meaningful opportunity to cross-examine him (Motion at 10). In fact, BWS's examples disprove both points. BWS could not have identified these putative discrepancies in data sets it had no access to, nor (allegedly) missing or redacted items in data sets that were withheld. And in fact, all of the documents mentioned in this passage were available to BWS before the hearing. It is difficult to evaluate the truth of BWS's inconsistency claims since no page numbers were provided and BWS did not elaborate on its conclusory assertions that discrepancies exist – and, more importantly, since it never cross-examined any witness about them – but clearly it is accessing *some* data to make these claims.

BWS cannot jump to the conclusion that underlying data is missing, fail to pursue the perceived discrepancy with a witness when it has the chance, and then claim it lacked a "meaningful" opportunity to cross-examine that witness. BWS had the opportunity to cross-examine Mr. Stanley on all three of these claims – the "discrepancy in sample concentrations" between the FER and the groundwater monitoring quarterly reports, the two purportedly missing boring logs, and the inconsistency in water levels between "the Navy's documents" and "the groundwater flow model report" – but chose not to do so. Thus, BWS could not and did not establish that Mr. Stanley relied on missing data, boring logs, or documents in preparing his opinions for this proceeding. The fact that BWS did not pursue its questions about the data with Mr. Stanley when it had the chance neither proves that information was withheld nor constitutes grounds to strike his testimony.

3. BWS misunderstands Mr. Stanley's testimony about models. Mr. Stanley had no need to, and did not, rely on the modeling software files BWS asked for (Counsel Dec., Exh. B at

5). The relevant data and information supporting the related models are contained in the Conceptual Site Model Report and Groundwater Flow Model Report (Exhibits B-352 and B-361; Counsel Dec., Exh. B at 5-6). Although Mr. Stanley did not rely on the 3D model files in preparing his opinions for this proceeding, the Navy provided them to BWS in advance of the hearing (BWS Motion, Gannon Decl ¶ 6 and Exh. D). BWS characterized these files in its brief as "effectively useless" (Motion at 5) – but without testimony from any witness regarding the nature and contents of these files (besides Mr. Stanley's declaration that he did not rely on or run them), it is impossible to evaluate BWS's characterization of them.[6] BWS's failure to cross-examine Mr. Stanley about these files does not create grounds to strike his testimony.

BWS also appears to conflate the software files with the modeling work documented in the relevant reports. BWS refers to "the actual models, and not just the related reports" and cites Mr. Stanley's use of the word "model" (Motion at 11), but the excerpts BWS cites simply do not refer to the software Mr. Stanley has already stated he did not run (Counsel Dec., Exh. B, p. 5). BWS complains, without citation to the record, that the Conceptual Site Model and Groundwater Flow Model reports (which amount to over 1,600 pages) "only provide limited data sets" and claims that the Navy "has not provided the underlying data, assumptions, or parameters for the groundwater flow models." (Motion at 11.) First, BWS has ignored all attempts to direct it toward the relevant portions of the record.[7] Second, the reports are intended to be "true,

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[6] The usefulness of the information to BWS is not relevant to any argument supporting its motion to strike. Even if there were some question as to whether BWS's cross-examination opportunity was adequate (and it was), the only possibly-relevant determination is whether Mr. Stanley actually relied on these particular files, which he did not (Counsel Dec., Exh. B), and BWS did not establish otherwise on cross-examining him.

[7] See footnote 2, above. E.g.: "The Groundwater Flow Model Report, which BWS itself produced as Exhibit B-361, thoroughly details the model's parameters, assumptions, inputs and outputs. Counsel Dec. Exh. M excerpts pages from the Groundwater Flow Model Report that outline the information contained therein and provide salient examples of the level of detail

accurate, and complete" AOC deliverables that make the underlying data available for use by the Regulatory Agencies (see discussion *supra* at pp. 3-4). Finally, to the extent BWS believes the data provided in the reports leaves out some crucial piece of information on which Mr. Stanley relied, it failed to establish such reliance by cross-examining him as to the basis for his opinions about the groundwater model and identifying that information. There are simply no grounds to strike Mr. Stanley's testimony regarding environmental modeling.

4. Mr. Stanley did not rely on the groundwater model file(s) and the Navy did not withhold them improperly. BWS claims that it cannot evaluate the Navy's groundwater flow model without the "model files." Motion at 10. The relevant question for purposes of its motion to strike, however, is whether the software model files were relied on by Mr. Stanley, not whether BWS needs them to conduct its own evaluation of the Navy's modeling work.[8] Since Mr. Stanley has already stated that he did not run the software files or rely on them in preparing his opinions (Counsel Dec., Exh. B, p. 5), and since BWS did not elicit any testimony to the contrary, BWS' lack of access to them is not grounds for a motion to strike.

Not only did Mr. Stanley not use the groundwater flow model computer file(s) in forming his opinion, they also contain defense critical infrastructure ("DCRIT") information. Even if such file(s) had been relied upon by Mr. Stanley, and thus fell within the ambit of the December 30 Order (which they did not), the inclusion of DCRIT information constitutes good cause not to produce them. As BWS is aware (and has been aware for some years prior to this proceeding),

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found in the report. For instance, the excerpted tables show pumping rates for wells in the model, parameter ranges for geologic materials in the model, model calibration statistics, and other defining aspects of the model. The excerpts also provide information about the Navy's multi-model approach." 1/29/21 Navy Memorandum at 8-9.

[8] In any case, the Groundwater Flow Model Report contains or describes the information underlying the model; see discussion at pages 3-4, *supra* and footnote 2.

the Navy is not willing to produce this information to BWS without a nondisclosure agreement in place, and BWS has refused to sign one.[9] BWS's arguments in Section F of its Motion, page 18, do not amount to a showing that the Navy is required to produce the file(s) without such protection. Even if, as BWS alleges, "a water utility like the BWS regularly does and is capable of managing sensitive water pumping data" and "neither the location of Red Hill Shaft nor the Navy's pumping information from that water source is a secret to any of the parties in this proceeding," the Navy is not thereby obliged to place the information in the record nor to give BWS the power to do so. BWS also claims, without basis, that "[t]o the extent some of the groundwater modeling files do contain such information, they can be provided without the Navy pumping data if needed." It is not apparent that this claim is true, nor that a file with such data redacted would still constitute information on which (BWS alleges) Mr. Stanley relied – if that is BWS's ultimate concern.

In short, BWS has never identified any non-privileged information it believes the Navy was ordered to produce and did not.[10] The "environmental data and modeling work" referred to by BWS *are included in the reports*, either as tables and figures in the text, attached as appendices, or through clear references to publicly available data. BWS failed to elicit any testimony from Mr. Stanley showing reliance on *any information that BWS does not have*, and it remains completely obscure what "data and information" BWS believes is missing from its own exhibits. Furthermore, the Navy would be severely prejudiced by the exclusion of testimony

[9] In the years preceding this hearing, the Navy offered to provide the groundwater flow model files on the condition that BWS sign an NDA to protect this information, which it did not do (see Counsel Dec. at ¶ 4 and Exh. C). As Exhibit C (a 2018 exchange of emails regarding the groundwater flow model and the NDA condition) shows, the groundwater model files were of interest to BWS, and BWS was aware of this condition, well before this contested case arose.
[10] To the extent that BWS identifies such information with specificity for the first time in its reply brief, the Navy respectfully requests the opportunity to file a sur-reply.

from a key expert witness, while BWS – since it had access to the relied-on information – suffers no cognizable prejudice to its own case from allowing Mr. Stanley's testimony to stand. There are no grounds for striking any part of Mr. Stanley's testimony.

B. Because no non-privileged evidence on which Mr. Stanley relied has been withheld, there is no basis for a negative inference.

There is no basis for a negative inference on any element of the Navy's case because there is no non-privileged evidence that has been withheld in contravention of any order. HAR § 11-1-24(b)(5) states that "[i]n any contested case, the hearings officer may: … (5) For good cause shown, upon motion or the hearings officer's own initiative, order a party to produce non-privileged evidence, and may draw inferences against the party if the evidence is not produced without good cause being shown." In Section C of its motion (pp. 14-15), BWS argues that a negative inference is warranted here "as to Mr. Stanley's testimony"[11] because, it claims, the Navy cannot demonstrate good cause for its (alleged) failure to comply with such an order. As discussed in footnotes 2 and 4, Section A.2, and in previous briefing and declarations, the Navy responded to the order by inquiring with its witness and providing his January 8, 2021 Declaration (Counsel Dec., Exh. B) showing BWS where the specific information requested could be found in documents BWS already had in its possession.

None of the testimony excerpted by BWS in this section of its Motion demonstrates the existence of withheld data. BWS states that "Mr. Stanley admitted that he relied upon the Navy reports," citing four excerpts of his testimony in support, but all of the referenced reports are

[11] It is not clear what specific negative inference BWS is requesting, nor which element of the Navy's case it would apply to. If BWS particularizes the negative inference it believes should be drawn against the Navy for the first time in its reply brief, the Navy respectfully requests the opportunity to file a sur-reply.

already exhibits in this proceeding and demonstrably were not withheld from BWS. This cannot be the basis for a negative inference. Then, BWS cites "environmental data and modeling work … the basis for the conclusions presented in these reports" and quotes two short excerpts of Mr. Stanley's testimony referencing the "conceptual site model," presumably the same model set forth in hundreds of pages of detail in BWS's Exhibit B-352 ("Conceptual Site Model"). A quick examination of Exhibit B-352 shows that it contains copious amounts of environmental data and details the modeling work performed.[12] Not only is this document already a BWS exhibit, Mr. Stanley expressly included it in a list of environmental documents in his expert report, tallying and enumerating the "plethora" of data and analyses collected by the Navy and providing publicly available web addresses where they could be found (FER at 59-60, Counsel Dec. Exh. A). BWS cannot justify a negative inference against the Navy by simply ignoring the record.

C. The remainder of BWS's arguments go to the weight, not the admissibility, of Mr. Stanley's testimony.

Sections D and E of BWS's motion, pp. 16-18, argue that portions of Mr. Stanley's testimony should be struck for reasons (lack of probative value, qualification, basis, or foundation) that are not encompassed by HAR § 11-1-38(h), which provides the sole available

[12] For example, Appendix C: Strike and dip data, azimuth field measurements; Appendix D: Random walk modeling of potential historical lava flow paths; Appendix E: Current stratigraphic model: geophysical investigation, new cross sections, tuff complex, marine sediments, and alternative saprolite evaluation/interpretation for South Hālawa Valley; Appendix F: Petrographic laboratory analytical report; Appendix G: Geotechnical results of infiltration testing; and Appendix H: Analysis of selected 2017–2018 synoptic monitoring data to extract information for numerical groundwater model calibration and estimate equivalent regional-scale aquifer hydraulic properties and anisotropy.

ground for striking testimony in this proceeding (lack of opportunity to cross-examine). Striking testimony on any of these grounds is not authorized by the HAR.

CONCLUSION

BWS had an opportunity to cross-examine Mr. Stanley, and in doing so, did not establish the existence of any previously-withheld basis for his opinions. Its claim that this opportunity was not "meaningful" is neither supported by the record nor a legally cognizable basis for striking Mr. Stanley's testimony. BWS has also failed to establish any ground for drawing a negative inference against the Navy on any element of its case. BWS's arguments regarding the weight of Mr. Stanley's testimony are not grounds for either striking testimony or drawing a negative inference, and should be disregarded. BWS's motion should be denied in its entirety.

Respectfully Submitted,

Dated: March 23, 2021

/S/ _Marnie Riddle___
David Fitzpatrick
Marnie E. Riddle

DEPARTMENT OF HEALTH
STATE OF HAWAII

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Contested Case Hearing Re Permit Application</td>
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<td>DECLARATION OF MARNIE E. RIDDLE IN SUPPORT OF NAVY'S OPPOSITION TO MOTION FOR NEGATIVE INFERENCE</td>
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DECLARATION

I, Marnie E. Riddle, declare:

1. I am a Navy Office of General Counsel attorney admitted *pro hac vice* in Hawaii.

2. Attached as Exhibit A is a true and correct copy of pages 59-60 and 62-65 excerpted from the Facility Environmental Report appended to the Testimony of Curtis C. Stanley dated November 25, 2020, in the above-captioned matter.

3. Attached as Exhibit B is a true and correct copy of the Declaration of Curtis C. Stanley in the above-captioned matter, dated January 8, 2021.

4. Attached as Exhibit C is a true and correct copy of email correspondence between Navy employee Mark Manfredi and BWS employee Erwin Kawata, dated July 19-20, 2018. This correspondence was forwarded to me in January 2021. I am informed and believe that the "well locations and pump rates" referred to at the top of the third page are integrated into the groundwater flow model that I am also informed and believe is the subject of the "ongoing modeling efforts" referred to in the next paragraph of the email.

I declare these facts are true to my knowledge and belief under penalty of perjury.

DATED: March 23, 2021 at Alexandria, VA.

/S/ Marnie Riddle_____
Marnie E. Riddle

Exhibit A

4. Documents Incorporated Into the Record

The Navy has collected a plethora of data and conducted a vast number of analyses for the Facility prior to and pursuant to the AOC, which are described in a host of documents related to the Facility. Several of the documents contain detailed underlying data for the information presented herein or are otherwise considered important enough they incorporate into the record in this contested case. Table 1 lists Red Hill environment-related documents that the Navy submits for incorporation into the record for this Contested Case Hearing; links to official government websites are provided where available.

Table 1: Environmental Documents to be Incorporated Into the Record

Document	URL
1. AOC SOW § 2: Tank Inspection, Repair, and Maintenance (TIRM):	
a. Navy's TIRM Report	https://www.epa.gov/sites/production/files/2016-10/documents/red-hill-aoc-section-2-2-tirm-report-2016-10-11.pdf
b. Navy's TIRM Decision Document	https://www.epa.gov/sites/production/files/2017-09/documents/red_hill_aoc_tirm_decision_document.pdf
c. Navy's Red Hill Facility Evaluation Report (concludes Facility is safe)	https://www.epa.gov/sites/production/files/2017-06/documents/red_hill_facility_compliance_evaluation_report_june_2017.pdf
d. AOC Regulatory Agencies' Approval of TIRM Decision Document	https://www.epa.gov/sites/production/files/2017-09/documents/epa_and_doh_approval_of_tirm_decision_document.pdf
2. AOC SOW § 3: Tank Upgrade Alternatives (TUA):	
a. Navy's Proposed TUA and Release Detection Decision Document [a]	https://www.epa.gov/sites/production/files/2019-09/documents/red_hill_aoc_tua_proposal_decision_document_20190919.pdf
b. AOC Regulatory Agencies' Notice of Deficiencies for the TUA and New Release Detection Alternatives Decision Document (Disapproval)	https://www.epa.gov/red-hill/tank-upgrade-alternatives-red-hill#file-575447
3. AOC SOW § 4: Release Detection/Tank Tightness Testing:	
a. Navy's Current Fuel Release Monitoring Systems Report	https://www.epa.gov/sites/production/files/2016-04/documents/current-fuel-release-monitoring-systems-report-with-appendices-2016-04-04.pdf
b. AOC Regulatory Agencies' Approval of Current Fuel Release Monitoring Systems Report	https://www.epa.gov/sites/production/files/2016-09/documents/approval_of_current_fuel_release_monitoring_systems_report_15_sep_2016.pdf
c. Navy's Proposed TUA and Release Detection Decision Document [a]	https://www.epa.gov/sites/production/files/2019-09/documents/red_hill_aoc_tua_proposal_decision_document_20190919.pdf
d. AOC Regulatory Agencies' Notice of Deficiencies for the TUA and New Release Detection Alternatives Decision Document (Disapproval)	https://www.epa.gov/red-hill/tank-upgrade-alternatives-red-hill#file-575447
3. AOC SOW § 5: Corrosion and Metal Fatigue Practices:	
a. Navy's Destructive Testing Results Report	https://www.epa.gov/sites/production/files/2019-07/documents/red-hill-destructive-testing-results-report-20190707.pdf
b. AOC Regulatory Agencies' Joint Response to Destructive Testing Results Report (Disapproval)	https://www.epa.gov/sites/production/files/2020-03/documents/joint-response-red-hill-corrosion_metal_fatigue_practices_destructive_testing_results-signed-2020-03-16.pdf
c. Navy's Response to AOC Regulatory Agencies' Disapproval	https://www.epa.gov/sites/production/files/2020-07/documents/red_hill_dtrr_aoc_sow_sec_5_2jun.pdf
d. Regulatory Agencies' Response (Conditional Approval of Completion of AOC SOW § 5.3.3)	https://www.epa.gov/sites/production/files/2020-07/documents/red_hill_joint_regulatory_agency_response_2020-07-07.pdf
5. AOC SOW § 6: Investigation and Remediation of Releases:	
a. Navy's Investigation and Remediation of Releases Report [a]	https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-investigation-and-remediation-of-releases-report-rev00-redacted-2020-03-25.pdf

Document	URL
6. AOC SOW § 7: Groundwater Protection and Evaluation:	
a. Navy's Groundwater Flow Model Report [a]	https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-groundwater-flow-model-report-redacted-2020-03-25-.pdf
b. Navy's Conceptual Site Model Report, Revision 01	https://www.epa.gov/sites/production/files/2019-07/documents/red_hill_conceptual_site_model_20190630-redacted.pdf
c. Navy's Groundwater Protection and Evaluation Considerations Report	https://www.epa.gov/sites/production/files/2018-09/documents/red_hill_interim_groundwater_flow_model-rev00_2018-07-27-redacted.pdf
7. AOC SOW § 8: Risk/Vulnerability Assessment:	
a. Navy's Quantitative Risk and Vulnerability Assessment ["QRVA"] Phase 1 (Internal Events without Fire and Flooding)	https://www.epa.gov/sites/production/files/2019-06/documents/red_hill_risk_assessment_report_redacted-2018-11-12.pdf
b. Navy's QRVA Transmittal Letter	https://www.epa.gov/sites/production/files/2019-06/documents/risk_assessment_letter_and_summary.pdf
c. Navy's Risk and Vulnerability Assessment Summary, dated May 29, 2019	https://www.epa.gov/sites/production/files/2019-06/documents/risk_assessment_letter_and_summary.pdf
8. Soil Vapor and Groundwater Monitoring Reports:	
a. Navy's Red Hill Groundwater Protection Plan	https://health.hawaii.gov/shwb/files/2018/06/2014-08-encl-1-interim-update-final-gw-protection-plan.pdf
b. Navy's Soil Vapor Monitoring Reports: • Inception to 2015: • 2015 to present:	 • https://health.hawaii.gov/shwb/files/2016/02/2015-09-08-soil-vapor-for-aug-2015.pdf • https://health.hawaii.gov/shwb/files/2020/06/2020-06-12-soil-vapor-measurments-for-May-2020.pdf
c. Navy's 2014 to April 2020 Oil/Water Interface Measurement Quarterly Reports	https://health.hawaii.gov/shwb/files/2020/05/2020-05-07-oil-water-interface-measurement-April.pdf
d. Navy's Second Quarter 2020 Groundwater Monitoring Report	https://health.hawaii.gov/shwb/ust-red-hill-project-main/red-hill-technical-documents-2020/

[a] AOC SOW deliverable currently under review by the AOC Regulatory Agencies.

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Exhibit B

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DEPARTMENT OF HEALTH

STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Red Hill Permit Application	Case No. 19-UST-EA-01 **DECLARATION OF CURTIS STANLEY** CERTIFICATE OF SERVICE

DECLARATION OF CURTIS STANLEY

1. I previously testified in this contested case hearing that I helped develop the Facility Environmental Report ("FER") that was prepared for this contested case and attached to my prior testimony. (Testimony of Curtis Stanley ("Stanley Testimony"), pp. 5-6.) I briefly described the important findings that were summarized in the FER. (Stanley Testimony, pp. 8-12.)

2. The FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy. Instead, it contextualizes these investigations, and highlights and explains the findings and conclusions that may be relevant and useful for this contested case hearing. (*See* FER, p. 1.) The FER does not fulfill any requirement of the Administrative Order on Consent ("AOC"). The information relied on to prepare the FER is contained in the site investigations and environmental reports that were conducted by the Navy pursuant to the AOC, listed in FER Section 4. The underlying datasets used by the Navy to prepare those reports were not re-analyzed in the FER.

3. I have been informed by counsel for the Navy that counsel for the Board of Water Supply ("BWS") made the following set of requests for documents, quoting the enclosed passages from the FER:

> Documents relied upon by Curtis Stanley to form his expert opinions as described in the Facility Environmental Report (FER), including:
>
> > "Red Hill is probably the most extensively studied UST system in the State of Hawai'i with the largest environmental data set of any UST system in the State. The Navy has collected a plethora of data that have greatly expanded understanding of the geology and hydrogeology at Red Hill, as well as conditions in the underlying groundwater aquifer, which has enabled the studies and conclusions briefly summarized above. The data serve as the foundation for the

> Navy's AOC environmental investigation findings and will continue to do so as more data are collected and investigations, evaluations, and decision making continue (see Section 3)." [FER, at 18]

Please produce the referenced and relied upon environmental data set, including all: geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements.

> "The Navy developed a geologic framework model and a three-dimensional regional geologic model of Red Hill and surrounding environs (including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor) to provide geologic support for its groundwater flow modeling effort. The three-dimensional geologic model encompassed the groundwater flow model domain and incorporated information from borehole logs, subsurface structural geology surveys, developed cross sections, and published literature. The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawaiʻi ("UH") along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel." [FER, at 20]

Please produce the referenced and relied upon Navy three-dimensional regional geologic model.

> "[T]he Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill." [FER, at 20]

Please produce the referenced and relied upon Navy measurements of strike and dip of lava flows and clinker units.

> "Understanding the direction and rate of groundwater flow under a variety of reasonable supply well pumping scenarios is critical to assessing the risk that any hypothetical future fuel leak could pose to local drinking water. Initially, the AOC SOW scoped the groundwater flow model effort as one of updating a model developed for a previous 2007 Facility environmental investigation (DON 2007). The Navy modeling team found that updating the 2007 model was insufficient and recommended additional work, including entirely rebuilding, providing more detail, and expanding the model. Working with the AOC Parties and other stakeholders, the Navy refined the modeling domain to extend approximately 51 square miles from Waimalu Valley in the northwest to Kalihi Valley in the southeast, and from near the Koʻolau crest in the northeast to Pearl Harbor and the Pacific Ocean in the southwest (see Location Map, Figure 1), far beyond where

> any impacts might reasonably be expected. Since there are a range of factors that require consideration, the Navy developed a multi-model approach to bound expected flow conditions (Ajami et al. 2006). Such an effort requires additional work on behalf of the Navy but results in a more reliable range of predictions under given scenarios." [FER, at 48]

Please produce the referenced and relied upon groundwater flow modeling files, including Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy's March 2020 Groundwater Flow Model Report.

4. Section 4 of the FER lists documents that "contain detailed underlying data for the information presented herein or are otherwise considered important enough [to] incorporate into the record in this contested case," and provides URLs where these documents can be accessed by members of the public (FER, p. 59). The FER passages quoted above reference and rely upon these documents. In the following paragraphs, I will identify the specific documents listed in Section 4 of the FER where the data I relied upon in forming my conclusions can be found, and where appropriate will identify additional documents that may contain data of interest to the parties.

5. Page 18 of the FER, quoted above in BWS's document request, states that the Navy has collected a large amount of environmental data, and that this data forms the basis for the Navy's studies of and conclusions about the environmental impacts of the Red Hill Facility and "the foundation for the Navy's AOC environmental investigation findings." (FER, p. 18.) It was neither necessary nor practicable to independently re-analyze all such environmental data, nor replicate all of the Navy's past environmental investigations, before preparing the FER for use in this contested case. The results of the Navy's studies and investigations are described in the references listed in Section 4 of the FER, including the Investigation and Remediation of

Releases Report,[1] Groundwater Flow Model Report,[2] Conceptual Site Model report,[3] and Groundwater Protection and Evaluation Considerations Report.[4] Current groundwater monitoring data is provided in quarterly monitoring reports, like the Second Quarter 2020 Groundwater Monitoring Report.[5]

6. In connection with the above passage on page 18 of the FER, BWS has specifically requested "geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements." The FER did not independently re-analyze any data in these categories underlying the Navy's site investigations. However, discussions, summaries, tables, and other presentations of data falling into these categories can be found in the following documents, referenced in Section 4 of the FER and/or publicly available.

Geophysical and drilling logs:

- Investigation and Remediation of Releases Report, Appendix B.2

---

[1] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0014424 to NAVYREF0016641, as well as Exhibit N-078. It was produced by BWS as Exhibit B-339. It is also publicly available at https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-investigation-and-remediation-of-releases-report-rev00-redacted-2020-03-25.pdf

[2] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0003407 to NAVYREF0004104. It was produced by BWS as Exhibit B-361. It is also publicly available at https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-groundwater-flow-model-report-redacted-2020-03-25-.pdf

[3] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0002443 to NAVYREF0003406. It was produced by BWS as Exhibit B-352. It is also publicly available at https://www.epa.gov/sites/production/files/2019-07/documents/red_hill_conceptual_site_model_20190630-redacted.pdf

[4] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0001983 to NAVYREF0002442. It was produced by BWS as Exhibit B-348. It is also publicly available at https://www.epa.gov/sites/production/files/2018-09/documents/red_hill_interim_groundwater_flow_model-rev00_2018- 07-27-redacted.pdf

[5] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0005200 to NAVYREF0014423. It was produced by BWS as Exhibit B-83. It can also be found at https://health.hawaii.gov/shwb/ust-red-hill-project-main/red-hill-technical-documents-2020/ and at https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-1.pdf, https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-2.pdf and https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-3.pdf

- Groundwater Flow Model Progress Reports, available at https://www.epa.gov/red-hill/groundwater-flow-patterns-red-hill-additional-documents and produced by BWS as Exhibits B-340, B-342, B-343, B-347, B-350, B-351, B-353, B-354, B-355

Water levels:

- Red Hill Quarterly Groundwater Monitoring Reports, available under "Red Hill Technical Documents" at https://health.hawaii.gov/shwb/ust-red-hill-project-main/
- Groundwater Flow Model Progress Reports

Chemistry and temperature measurements:

- Red Hill Quarterly Groundwater Monitoring Reports

Petrophysical measurements:

- Conceptual Site Model report, Appendix F

7. Page 20 of the FER, quoted above in BWS's document request, explains that the Navy developed a geologic framework model and a 3-D regional geologic model of Red Hill in the course of preparing its groundwater flow model. I did not independently review or re-analyze the data underlying these models, nor did I run any of the model software files, in the course of preparing the FER or my conclusions. In fact, the quoted passage simply summarizes some of the work previously performed by the Navy in its environmental studies of the site. The geologic framework model and 3D regional geologic model, as well as the Navy's use of them, are described in more detail in Appendices C ("Strike and Dip Data"), D ("Evaluation of Potential Pahoehoe Lava Flow Paths Through Tank Farm Area"), E ("Geologic Framework Model"), F ("Petrographic Analytical Report"), and G ("Infiltration Study Report") of the Conceptual Site Model listed in Section 4 of the FER, which is available to BWS (see footnote 3, above). More information about the geologic model is available in the Investigation and

Remediation of Releases Report, page A-18 (see footnote 1, above); the Existing Data Summary and Evaluation Report, pages 3-1 to 3-2 (BWS Exhibit B-331), and Seismic Profiling to Map Hydrostratigraphy in the Red Hill Area (BWS Exhibit B-346).

8. On page 20, the FER summarizes, but does not independently re-evaluate, past Navy investigations of the strike and dip of lava flows at Red Hill. The FER relies on information about strike and dip data that is available in Appendix C ("Strike and Dip Data") of the Conceptual Site Model (see footnote 3, above).

9. On page 48, the FER briefly describes work done by the Navy to model groundwater flows as required by the AOC. The FER does not independently evaluate, validate, or analyze this work itself, and all of the information in the passage quoted by BWS is available in the documents referenced in FER Sections 4 and 6. For example, the FER describes the Navy's expansion of the modeling domain to include the entire area from Waimalu Valley to Kalihi Valley and from near the Ko'olau crest to Pearl Harbor; this is also reported on page 1-2 of the Groundwater Flow Model Report (see footnote 2, above). Similarly, the Navy's use of a multimodel approach, briefly described in the quoted passage of the FER, is discussed in detail in the Groundwater Flow Model Report (see, e.g., pp. 1-1, 1-10 to 1-12, 2-1 to 2-5, 4-1, and Section 5) cited in FER Section 4.

10. BWS has requested "Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy's March 2020 Groundwater Flow Model Report." No groundwater flow model files were generated, validated, or independently re-analyzed in order to form the conclusions in the FER. The FER relies on the groundwater flow information as presented in the Groundwater Flow Model Report in order to form its conclusions.

Executed this 8th day of January, 2021, at Boerne, Texas.

/S/ Curtis Stanley

Curtis Stanley

DEPARTMENT OF HEALTH
STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Permit Application	)	CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I hereby certify that, on this date, a true and correct copy of the foregoing document was emailed to the following:

Hearings Officer

Lou.chang@hula.net

Board of Water Supply

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Honolulu Corporate Counsel

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Department of Health

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Sierra Club

davidkimofrankel@gmail.com

Respectfully Submitted,

Dated: January 8, 2021

/S/ Marnie E. Riddle____________
Marnie E. Riddle
Agency Representative

Exhibit C

From:	Riddle, Marnie E CIV USN OGC WASH DC (USA)
To:	Riddle, Marnie E CIV USN OGC WASH DC (USA)
Subject:	FW: Data sharing
Date:	Friday, January 8, 2021 12:53:59 PM

From: Erwin Kawata <EKAWATA@hbws.org>
Sent: Friday, July 20, 2018 11:23 AM
To: Manfredi, Mark S CIV CNRH, N4A <mark.manfredi@navy.mil>
Cc: Ernest Lau <elau@hbws.org>; Lisa Kim <LKIM@hbws.org>; 'Steven Linder (linder.steven@epa.gov)' <linder.steven@epa.gov>; 'Shalev, Omer' <Shalev.Omer@epa.gov>; 'Ichinotsubo, Lene K (lene.ichinotsubo@doh.hawaii.gov)' <lene.ichinotsubo@doh.hawaii.gov>; 'Kwan, Roxanne S' <roxanne.kwan@doh.hawaii.gov>
Subject: [Non-DoD Source] FW: Data sharing

Mark,

Thank you for sharing a copy of the Office of the Secretary of Defense's confirmation concerning information regarding the location and pumping rates of Navy water production wells. As you know BWS is equally concerned with similar information for our wells and can understand the Navy's position. At the same time, please know that BWS regards the Navy as an official government agency and we have no objections providing you, without conditions, BWS well information to an agency we believe knows how to safeguard such information.

In this regard, the BWS believes it has responded to all of the Navy's data requests to date and we have met your needs per our ongoing data sharing discussions. Below is a summary of my understanding of BWS' data sharing efforts to date.

BWS submitted its pumping data for Halawa Shaft, Moanalua Wells, and Kalihi Shaft collected during the synoptic water level study and water level data from Halawa T45 and Manaiki T24 to USGS. The BWS understood that all interested parties agreed that USGS would collect this data from the agencies participating in the study. BWS has no objections to USGS making our data available to the Navy as a groundwater modeling working group participant, provided that the Navy treat this information as confidential and abide by any and all safeguards afforded to such information by existing federal and state laws.

Regarding the Navy's June 6, 2017 letter to Mayor Caldwell, BWS responded on June 27, 2017 (copy enclosed). Our letter states that on June 22, 2017, the EPA, Navy, DOH and BWS met to discuss information exchange, including the Navy's June 6, 2017 letter. During the meeting, we discussed the need for a formal process for data and information exchange to address past BWS experiences and concerns with this subject. At that time, EPA instructed the meeting participants to defer action on exchanging information, including the Navy's June 6, 2017 letter, until a formal data sharing process was established.

As the discussions between EPA, DOH, Navy and BWS continued, BWS sent another letter to EPA dated July 31, 2017 proposing each party designate an individual or individuals to clarify scope of any then-existing information requests and to discuss appropriate timeframes for response. At that time, BWS understood this approach was the go-forward plan for exchanging information. On August 3, 2017, I received your email that provided me with your list of what the Navy considered to be the top 3 data sets (see attached email) that it needed. The BWS has since responded to all of the data requests on your August 3, 2017 email and understood this satisfied the requests set forth in the Navy's June 6, 2017 letter.

On July 19, 2018, I received your email below which again included the Navy's June 6, 2017 letter and a spreadsheet purporting to show certain requested information items as complete and incomplete. BWS does not believe these documents portray the current state of data sharing. First, the spreadsheet is also dated from June 2017 and does not appear to be accurate in light of data BWS has provided since that time.

Second, the spreadsheet and request overlooks the fact that some of the requested information is publically available or has been provided to other sources equally accessible to the Navy. For example, in addition to the data provided to USGS, and as explained in the past, the Navy should consult the BWS 30-year master plan and watershed management plans for information about our water resource and development plans. These documents are available on the BWS' website at www.boardofwatersupply.com

Third, the context in which the email and spreadsheet were sent appears to suggest that BWS has not been forthright in providing information. Please know that BWS firmly disagrees with any such implication. As set forth above, BWS has responded to the Navy's requests fully and, in fact, we remain open to the designated individuals meeting to discuss and clarify the scope of any requests for information as well as appropriate timeframes for a response.

If you have any questions, feel free to call me at 748-5080. Thanks.

Erwin

-----Original Message-----
From: Manfredi, Mark S CIV CNRH, N4A <mark.manfredi@navy.mil>
Sent: Thursday, July 19, 2018 9:18 AM
To: Erwin Kawata <EKAWATA@hbws.org>
Cc: Ichinotsubo, Lene K <lene.ichinotsubo@doh.hawaii.gov>; 'roxanne.kwan@doh.hawaii.gov' <roxanne.kwan@doh.hawaii.gov>; Shalev, Omer <Shalev.Omer@epa.gov>; Linder, Steven (Linder.Steven@epa.gov) <Linder.Steven@epa.gov>; TU, LYNDSEY (Tu.Lyndsey@epa.gov) <Tu.Lyndsey@epa.gov>; Waki, Cory K CIV NAVFAC HI, EV1 <cory.waki@navy.mil>
Subject: Data sharing

Erwin,
I wanted to share with you confirmation we received from the Office of the Secretary of Defense concerning information regarding the location and pumping rates of navy water production wells. The document (attached) states "This information qualifies as DoD critical infrastructure security

information (DCRIT), as defined by 10 U.S.C.§ 130e, because the disclosure of well locations and pump rates would reveal the primary water source for bases and commands on and adjacent to Joint Base Pearl Harbor-Hickam which are critical to national security." As such, we are required to protect such information from public disclosure. (I recognize BWS is equally concerned with similar information on their wells.). Further, we are also required to ensure certain measures are in place to prevent such disclosure; which is why we require NDAs and cannot provide this information to one or any organization we do not have a signed NDA with.

I understand BWS's position regarding NDA's, and don't intend to revisit that discussion. However, I also recognize the significance of this information as well as other non-navy data has on the accuracy/reliability of ongoing modeling efforts. To that end, would BWS consider an NDA or other such MOU/MOA, that only addresses specific data sets, rather than a blanket document? For example, the paper would state something to the effect that "BWS agrees to not share the geographic location and pumping rate data for Navy's Red Hill Shaft". Of course, we would sign something similar for any BWS related information. Absent something like that, we would unfortunately not be able to provide BWS with that specific information. Let me know your thoughts.

To that end, I would also like to ask again for the following data. This information in particular is critical to our modeling efforts:
1. Pumping data for Halawa Shaft, Moanalua Wells, and Kalihi Shaft during the synoptic water level study (approximately July 1, 2018 through March 31, 2018 or what they provided to USGS) 2. Synoptic water level data from wells Halawa T45 (3-2255-033) and Manaiki T24 (3-2153-009) that were monitored by BWS 3. Any data that they can provide from the new well (BWS2253-J1 [State Well No. 3-2253-006]) installed by BWS near RHMW09 in addition to what was provided by DLNR as described in the attached table

Thanks

v/r
Mark

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DEPARTMENT OF HEALTH
STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Permit Application	**CERTIFICATE OF SERVICE**

CERTIFICATE OF SERVICE

I hereby certify that, on this date, a true and correct copy of the foregoing documents were emailed to the following:

Hearings Officer

Lou.chang@hula.net

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Department of Health

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Sierra Club

davidkimofrankel@gmail.com

Respectfully Submitted,

Dated: March 23, 2021

/S/ Marnie Riddle_
Marnie E. Riddle
Agency Representative

EXHIBIT C

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DEPARTMENT OF HEALTH

STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re: Red Hill Permit Application	Case No. 19-UST-EA-01 **NAVY MEMORANDUM IN OPPOSITION TO BWS PREHEARING MOTION FOR NEGATIVE INFERENCE** **DECLARATION OF MARNIE E. RIDDLE AND EXHIBITS A THROUGH M** CERTIFICATE OF SERVICE

MEMORANDUM IN OPPOSITION

In email correspondence with the Navy (attached as Exhibit A to the accompanying Declaration of Marnie E. Riddle (Counsel Dec.)), BWS identified four passages from the Facility Environmental Report (FER) prepared by the Navy's expert, Curt Stanley, and requested the production of four categories of data (Exh. A, pp. 2-3). In this correspondence and in discussions of the issue at status conferences, BWS has repeatedly made two incorrect assertions about the categories of data they identified: (1) that Mr. Stanley relied on it in forming his conclusions, and

(2) that the Navy has wrongly withheld it. BWS has stated that they intend to move for a negative inference against the Navy based on these inaccurate statements.

A negative inference is unwarranted for several reasons. First, BWS already has virtually all of the information they are asking for. The January 8, 2021 Declaration of Curtis Stanley (Counsel Dec. Exh. B) directed BWS to the specific portions of the reports prepared for the Administrative Order on Consent (AOC) and other publicly-available documents that contain the information they requested – almost all of which have been submitted by BWS as exhibits in this contested case. The FER itself identified the documents it listed in Section 4 as those that "contain detailed underlying data for the information presented herein" (Counsel Dec. Exh. F, p. 59). With the exception of software model files, these underlying data are appended to the AOC reports or the work is described in enough detail to allow DOH and EPA, as regulators, to fully evaluate it. Exhibits G through M of the accompanying Counsel Declaration, which consist of pages from BWS's own exhibits, demonstrate that BWS already has this information. The only data BWS has asked for that they do not already have are two sets of modeling files (1) on which Mr. Stanley did not rely in preparing the FER and (2) that were not in a format readily amenable to publication and dissemination on the EPA's Red Hill docket.

Second, BWS has not shown good cause for the Navy to produce the modeling files or any other additional information not contained in the FER references. As his January 8 Declaration (attached as Counsel Dec. Exh. B) makes clear, Mr. Stanley had no need to rely on, and did not rely on, any information that was not already in the documents cited in Section 4 of the FER – which, as discussed above, were comprehensive. BWS's broad-stroke efforts to ascribe knowledge of and reliance on *all* environmental data the Navy has ever collected at Red Hill to Mr. Stanley[1] are misapplied.

The model files BWS has requested do not undergird Mr. Stanley's opinions. Although the Rules of Evidence do not govern this contested case hearing, the approach embodied by Rule 703 of the Federal Rules of Evidence, which allows the disclosure of otherwise-inadmissible "basis evidence" on which an expert relied, "is based on the idea that the disclosure of basis evidence can help the factfinder understand the expert's thought process and determine what weight to give to the expert's opinion." *Williams v. Illinois,* 132 S. Ct. 2221, 2240, 567 U.S. 50, 78 (2012). As previously stated, all of the evidence that underlies Mr. Stanley's thought process in arriving at the conclusions set forth in the FER is contained in the references cited in Section 4 of the FER. Mr. Stanley did not work directly with these models and his opinions do not rely on them (see Counsel Dec. ¶ 15); therefore, they cannot help the factfinder understand his thought process. BWS may confirm this by cross-examining Mr. Stanley.

Even though Mr. Stanley did not rely on them in the FER, the Navy has nonetheless provided BWS with one of the modeling files they requested, the underlying geologic model files, in an effort to resolve this dispute (see Counsel Dec. at ¶ 16). The Navy has previously

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[1] At a status conference where this issue was discussed, BWS characterized Mr. Stanley as "the principal author" of the Navy's portfolio of AOC documents. Although Mr. Stanley has contributed substantially to the Navy's AOC compliance efforts, characterizing him as "the principal author" is inaccurate. As he has testified in this case, Mr. Stanley is a principal at GSI. AECOM was contracted by the Navy to collect environmental data and conduct environmental analyses at Red Hill, and AECOM subcontracted GSI in 2017 to assist in this work. Stanley Testimony (excerpted as Counsel Dec. Exh. C), p. 1. Subsequently, Mr. Stanley was appointed as GSI's project manager to "oversee the technical efforts of GSI experts" and has been "one of," though not the only, primary authors for AOC reports "since I was brought onto the project." *Id.* Mr. Stanley then testified that he "helped develop" several of the key reports, which he lists. *Id.*, pp. 5-6. He also named several other experts with whom he has collaborated in these efforts and described their specialized areas of expertise. *Id.*, pp. 6-7.

offered to provide the groundwater flow model files, which contain Department of Defense Critical Infrastructure Information (DCRIT), on the condition that BWS sign an NDA to protect this information, which it has declined to do (see Counsel Dec. at ¶ 5 and Exhs. D and E).[2] As Exhibit D (a 2018 exchange of emails regarding the groundwater flow model and the NDA condition) shows, the groundwater model files were of interest to BWS, and BWS was aware of this offer and condition, well before this contested case arose. BWS's decision should not give rise to a negative inference against the Navy.

The following subsections address each of BWS's requests in more detail.

1. Environmental data set

BWS's first request quotes the following portion of the FER (excerpted as Counsel Dec. Exh. F), page 18:

> "Red Hill is probably the most extensively studied UST system in the State of Hawai'i with the largest environmental data set of any UST system in the State. The Navy has collected a plethora of data that have greatly expanded understanding of the geology and hydrogeology at Red Hill, as well as conditions in the underlying groundwater aquifer, which has enabled the studies and conclusions briefly summarized above. The data serve as the foundation for the Navy's AOC environmental investigation findings and will continue to do so as more data are collected and investigations, evaluations, and decision making continue (see Section 3)."

BWS then requests "the referenced and relied upon environmental data set, including all: geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements." (Counsel Dec. Exh. A, at 2).

The excerpted passage describes historical work done at the Red Hill site as part of the Navy's efforts to comply with the AOC. It does not show that Mr. Stanley "relied upon" any or

[2] HAR § 11-1-31(b) and (c) authorize the hearings officer to grant a request for confidential treatment or closure of the hearing. If production of the groundwater flow model software files is deemed necessary in relation to this contested case hearing, the Navy will evaluate its ability to produce them subject to the confidential treatment specified.

all geophysical and drilling logs, water level, chemistry, and temperature measurements, or petrophysical measurements in forming his opinions. Nor, for that matter, does it mention drilling logs, water levels, chemistry, temperature, or petrophysical measurements at all. BWS has not shown a link between any expert opinion of Mr. Stanley and any of the specific data they have requested.

Moreover, the AOC reports cited in the FER – and produced as exhibits by BWS – already contain the information BWS asked for. Counsel Dec. Exh. G excerpts several pages of Appendix B.2 of the Investigation and Remediation of Releases Report, which BWS itself produced in this contested case as Exhibit B-339. Exhibit G includes representative examples of the types of information found in Appendix B.2: (1) Well Development Logs contain, among other things, water level, pH (acidity), temperature, EC (electrical conductivity), and turbidity information; (2) Geologic Borehole Logs contain information logged during the drilling of monitoring wells and other borings at the site; (3) Geophysical Record pages include geophysical and petrophysical information obtained during well drilling. Counsel Dec. Exhibit H excerpts a few of the 1,000-plus pages of original drilling logs, appended in their entirety to the IRR Report.

Counsel Dec. Exh. I contains excerpts of the Conceptual Site Model Appendix F (Petrographic Analytical Report), which BWS produced for this case as Exhibit B-352. That appendix contains additional petrophysical information about the porosity, density, and permeability of the rock at Red Hill. Finally, Counsel Dec. Exh. J attaches pages from the Quarterly Groundwater Monitoring Reports, a recent example of which was produced by BWS as Exhibit B-83. These Quarterly Reports contain additional chemistry data, including test results at each monitoring well for groundwater contaminants of potential concern.

2. Geologic model

BWS's second request quotes from page 20 of the FER (Counsel Dec. Exh. F):

> "The Navy developed a geologic framework model and a three-dimensional regional geologic model of Red Hill and surrounding environs (including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor) to provide geologic support for its groundwater flow modeling effort. The three-dimensional geologic model encompassed the groundwater flow model domain and incorporated information from borehole logs, subsurface structural geology surveys, developed cross sections, and published literature. The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawaiʻi ("UH") along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel."

BWS then requests "the referenced and relied upon Navy three-dimensional regional geologic model." (Counsel Dec. Exh. A, at 3).

The excerpted passage describes environmental work done by the Navy in accordance with the AOC. It does not show that Mr. Stanley "relied upon" the geologic models in forming his opinions. It does, however, explain how the models were used by the Navy (not Mr. Stanley specifically) "to provide geologic support for its groundwater flow modeling effort" and "to prepare detailed geologic cross sections" along with other data. These geologic models are described in context in the Conceptual Site Model on page 5-13 (in Module D, Vadose Zone), attached as Counsel Dec. Exh. K. For both models, "[d]etails are presented in Appendix E." Counsel Dec. Exh. K also includes the details of the models as they were presented in Appendix E and the "detailed geologic cross sections" that the models were used to prepare.

Given that Mr. Stanley did not prepare the geologic models during his work on the Navy's AOC deliverables, and did not rely on them in forming the opinions set forth in the FER, and given that the details of the models and the geologic cross sections they were used to generate are set forth in Appendix E to the Conceptual Site Model, it is difficult to see how BWS could be prejudiced by a lack of access to the underlying model files themselves in cross-examining Mr. Stanley on the basis for his opinions. Nevertheless, to eliminate any potential prejudice, the Navy has provide BWS with the geologic model files (Counsel Dec. ¶ 16).

3. Strike and dip data

BWS's third request also quotes page 20 of the FER (Counsel Dec. Exh. F):

> "[T]he Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill."

BWS then requests "the referenced and relied upon Navy measurements of strike and dip of lava flows and clinker units." (Counsel Dec. Exh. A at 3).

The excerpted passage describes environmental measurements that have been historically performed at the Red Hill site in the course of the Navy's AOC work. It does not show that Mr. Stanley "relied upon" these measurements in forming his opinions, nor that he was involved in taking these measurements or using them to form any other conclusions about the Red Hill site. These measurements do not fall into the category of "basis evidence" that would help a factfinder understand Mr. Stanley's thought process.

BWS also already has the strike and dip measurements. Appendix C (Strike and Dip Data) of the Conceptual Site Model, which BWS produced in this contested case as Exh. B-352, is attached as Counsel Dec. Exhibit L. Exhibit L also includes pages from Module D (Vadose Zone) of the Conceptual Site Model, which summarizes, explains the significance of, and describes the weighting factors applied to, the strike and dip measurements in Appendix C.

4. Groundwater flow modeling files

BWS's final request quotes page 48 of the FER (Counsel Dec. Exh. F):

> "Understanding the direction and rate of groundwater flow under a variety of reasonable supply well pumping scenarios is critical to assessing the risk that any hypothetical future fuel leak could pose to local drinking water. Initially, the AOC SOW scoped the groundwater flow model effort as one of updating a model developed for a previous 2007 Facility environmental investigation (DON 2007). The Navy modeling team found that updating the 2007 model was insufficient and recommended additional work, including entirely rebuilding, providing more detail, and expanding the model. Working with the AOC Parties and other stakeholders, the Navy refined the modeling domain to extend approximately 51 square miles from Waimalu Valley in the northwest to Kalihi Valley in the southeast, and from near the Ko'olau crest in the northeast to Pearl Harbor and the Pacific Ocean in the southwest (see Location Map, Figure 1), far beyond where any impacts might reasonably be expected. Since there are a range of factors that require consideration, the Navy developed a multi-model approach to bound expected flow conditions (Ajami et al. 2006). Such an effort requires additional work on behalf of the Navy but results in a more reliable range of predictions under given scenarios."

BWS then requests "the referenced and relied upon groundwater flow modeling files, including Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy's March 2020 Groundwater Flow Model Report." (Counsel Dec. Exh. A, at 3).

The excerpted passage describes work undertaken by Navy experts, in concert with "the AOC Parties and other stakeholders," to refine and update the pre-existing model. It does not show that Mr. Stanley "relied upon" the groundwater flow modeling files – as opposed to the Groundwater Flow Model Report – to form his opinions or conclusions in this contested case. In fact, Mr. Stanley did not even open the groundwater flow modeling files in the course of his work for this contested case, nor was he the original creator of the groundwater flow model (Counsel Dec. ¶ 15).

As discussed above, the Navy has offered to provide BWS the groundwater modeling files if it signed an NDA, but BWS has declined to do so (see Counsel Dec. ¶ 5). But as with the preceding examples, it is difficult to guess what additional information BWS might require that is not thoroughly explicated in the report. The Groundwater Flow Model Report, which BWS itself produced as Exhibit B-361, thoroughly details the model's parameters, assumptions, inputs and outputs. Counsel Dec. Exh. M excerpts pages from the Groundwater Flow Model Report that outline the information contained therein and provide salient examples of the level of detail found in the report. For instance, the excerpted tables show pumping rates for wells in the model, parameter ranges for geologic materials in the model, model calibration statistics, and other defining aspects of the model. The excerpts also provide information about the Navy's multi-model approach.

CONCLUSION

As the foregoing indicates, BWS cannot establish any justification for a negative inference against the Navy. The accompanying Declaration and Exhibits demonstrate that all of the information Mr. Stanley relied on is available to BWS, as is all of the additional information they have requested. The Navy is prepared to brief specific evidentiary issues that arise during this contested case hearing, but respectfully requests that good cause be shown before such issues are set for briefing in advance of the parties' anticipated post-hearing memoranda.

Respectfully Submitted,

Dated: January 29, 2021

/S/ _David Fitzpatrick_ ________________
David Fitzpatrick
Marnie E. Riddle

DEPARTMENT OF HEALTH
STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Permit Application	))))))))))	**DECLARATION OF MARNIE E. RIDDLE IN SUPPORT OF NAVY'S OPPOSITION TO MOTION FOR NEGATIVE INFERENCE**

DECLARATION

I, Marnie E. Riddle, declare:

1. I am a Navy Office of General Counsel attorney admitted *pro hac vice* in Hawaii.
2. Attached as Exhibit A is a true and correct copy of an email sent to counsel for the Navy from BWS counsel David K. Brown, dated December 10, 2020, pertaining to matters that have arisen in the course of the above-captioned matter.
3. Attached as Exhibit B is a true and correct copy of the Declaration of Curtis C. Stanley in the above-captioned matter, dated January 8, 2021.
4. Attached as Exhibit C is a true and correct copy of pages 1 and 5-7 excerpted from the Testimony of Curtis C. Stanley in the above-captioned matter, dated November 25, 2020.
5. Attached as Exhibit D is a true and correct copy of email correspondence between Navy employee Mark Manfredi and BWS employee Erwin Kawata, dated July 19-20, 2018. This correspondence was forwarded to me in January 2021. I am informed and believe that the "well locations and pump rates" referred to at the top of the third page are integrated into the groundwater flow model that I am also informed and believe is the subject of the "ongoing modeling efforts" referred to in the next paragraph of the email.

6. Attached as Exhibit E is a true and correct copy of the Determination of the Director of Administration for the Department of Defense that "information regarding the locations and water production rates for United States Navy's water production wells on the Island of Oahu, Hawaii. … qualifies as DoD critical infrastructure security information (DCRIT), as defined by 10 U.S.C.§ 130e," dated June 19, 2018.
7. Attached as Exhibit F is a true and correct copy of pages 18, 20, 48, and 59 excerpted from the Facility Environmental Report appended to the Testimony of Curtis C. Stanley dated November 25, 2020, in the above-captioned matter.
8. Attached as Exhibit G is a true and correct copy of PDF pages 1314, 1322, 1328-1332, and 1334-1344 of Exhibit B-339, the Investigation and Remediation of Releases Report, Red Hill Bulk Fuel Storage Facility, dated March 25, 2020. These pages are located in Appendix B.2 of the Report, which contains over 400 pages of information that is broadly similar to that excerpted.
9. Attached as Exhibit H is a true and correct copy of PDF pages 141 and 954-959 of Exhibit B-339, the Investigation and Remediation of Releases Report, Red Hill Bulk Fuel Storage Facility, dated March 25, 2020. These pages are located in Appendix B.1 of the Report, which contains over 1,000 pages of photocopied well drilling logs.
10. Attached as Exhibit I is a true and correct copy of PDF pages 779 and 789-793 of Exhibit B-352, the Conceptual Site Model, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, dated June 30, 2019. These pages are located in Appendix F (Petrographic Analytical Report) of the Conceptual Site Model.

11. Attached as Exhibit J is a true and correct copy of PDF pages 53, 55, 141, and 143-177 of Exhibit B-83b, the Second Quarter 2020 – Quarterly Groundwater Monitoring Report, Red Hill Bulk Fuel Storage Facility, dated July 2020. These pages depict Figures 4A and 4B, and Appendix A.2 (Groundwater COPC Graphs) of the Quarterly Groundwater Monitoring Report.
12. Attached as Exhibit K is a true and correct copy of PDF pages 111, 749, 751-765, and 767-777 of Exhibit B-352, the Conceptual Site Model, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, dated June 30, 2019. These pages are located in Module D (Vadose Zone) and in Appendix E (Geologic Framework Model) of the Conceptual Site Model.
13. Attached as Exhibit L is a true and correct copy of PDF pages 101-103, 737, and 739-744 of Exhibit B-352, the Conceptual Site Model, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, dated June 30, 2019. These pages are located in Module D (Vadose Zone) and in Appendix C (Strike and Dip Data) of the Conceptual Site Model.
14. Attached as Exhibit M is a true and correct copy of PDF pages 9-17, 42-43, 63, 67, and 73-74 of Exhibit B-361, the Groundwater Flow Model Report, Red Hill Bulk Fuel Storage Facility, dated March 25, 2020.
15. I am informed and believe that Mr. Stanley did not create the geologic model files or groundwater flow model files that counsel for BWS refers to in Exhibit A. I am further informed and believe that Mr. Stanley does not possess the specialized software required to open such model files.

16. On January 27, 2021, I sent a zipped file containing geologic model files to counsel for BWS and Sierra Club, and to BWS's expert witness Nicole DeNovio, using the DoD SAFE secure file transfer site.

I declare these facts are true to my knowledge and belief under penalty of perjury.

DATED: January 29, 2021 at Alexandria, VA

/S/ Marnie E. Riddle________
Marnie E. Riddle

Exhibit A

Riddle, Marnie E CIV USN OGC WASH DC (USA)

From:	Brown, David K. <david.brown@morganlewis.com>
Sent:	Thursday, December 10, 2020 4:25 PM
To:	Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA); Riddle, Marnie E CIV USN OGC WASH DC (USA); Minott, Karrin H CIV USN OGC WASH DC (USA)
Cc:	Foley Gannon, Ella; 'jlau3@honolulu.gov' (jlau3@honolulu.gov)
Subject:	RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

Jon:

I write to continue to meet and confer regarding the documents missing from the Navy productions to date in response to the BWS' motion pending before Hearings Officer Chang in the contested case concerning the Navy's Red Hill UST permit application. As we have discussed on several occasions, the Navy still has not produced certain documents essential to preparation for and resolution of the issues central to this contested case. There is no dispute these documents do or should exist, and we have done everything in our power to identify them with particularity – even going so far as to refer to many by file name or as referenced in the Navy's own documents. Nevertheless, certain of these critical records remain missing from the Navy's document productions and have not been accounted for in any of the provided *Vaughn* indices. Specifically, we identify the following documents or categories of documents that have yet to be produced.

Request 2: *Documentation of releases from the Red Hill USTs*

- On October 20, 2020, we provided a list of leak history records referenced in previously-produced documents that were not included in any Navy production. In a response dated November 6, 2020, the Navy responded that it had located these documents and would be producing them. The following documents remain outstanding:

- **Whitacre 2014a.pdf** [RDHLCC0000657]
- **Whitacre 2014b.pdf** [RDHLCC0000657]
- **Whitacre 2014c.pdf** [RDHLCC0000657]
- **Whitacre 2014d.pdf** [RDHLCC0000657]
- **Whitacre 2014e.pdf** [RDHLCC0000657]
- **Whitacre 2014f.pdf** [RDHLCC0000657]
- **Whitacre 2014g.pdf** [RDHLCC0000657]
- **Whitacre 2014h.pdf** [RDHLCC0000657]

- Photos and/or videos documenting releases from Red Hill USTs (*see, e.g.*, Exhibit BWS-007).

Request 3: *Reports of all work done inspecting and/or certifying the condition of each of the Red Hill USTs*

- Inspection documentation, reports, and/or certifications for Tank 5, including the extensive evaluation, repairs, and testing conducted after the January 2014 fuel release and before Tank 5 was returned to service as reported in March 2020.

  The BWS acknowledges receipt of "Tank 5 Final API 653 Inspection Report REV 1 (sent) SIGNED.pdf". However, it appears that the Navy did not produce:

- "**WGS Warranty Repair & NDE Inspection Certification Report dated September 15, 2016**" [RDHLCC0028613, at 28634]; or
- Any return to service documentation in 2013 or 2019/2020 certifying that repairs were made prior to returning Tank 5 to service.

  Further, the BWS finds it surprising that in the aftermath of the fuel release of at least 27,000 gallons from Tank 5 reported in January 2014, the Navy would not have devoted considerable resources to immediately investigate and inspect this tank in an attempt to stop the release of fuel into the environment and to address the serious tank integrity problem. Since the Navy has produced no other documentation of any inspections performed on Tank 5 in the 2014 to 2020 time period, the only conclusion that can be reached is that the Navy has no documentation that such work was ever performed.

- Inspection documentation, reports, and/or certifications for Tank 14, including the extensive evaluation, repairs, and testing conducted before and after collection of steel liner samples in June 2018 and, specifically, **the data spreadsheet referenced in Section 1.2 of the report titled Red Hill Bulk Fuel Storage Facility Destructive Testing Results Report, AOC/SOW 5.3.3 prepared by Naval Facilities Engineering Command (Jan. 7, 2019)**.

  We know the Navy shared this document with the EPA and DOH in connection with the selection of steel liner samples collected from Tank 14.

- Inspection documentation, reports, and/or certifications, including API 653 or modified API 653 inspections reports for Tanks 1, 3, 4, 9, 11, 12, 18, and/or 19.

  Since the Navy has produced no inspection reports for these tanks, the only conclusion that can be reached is that the Navy has no documentation that such work was ever performed.

- Tank 19 repair documentation provided in the Navy's last supplemental production states:

  "From the 4 or 5 coupons cut from Red Hill tanks other than Tank 19 supplied by Tom Kitchen, it appears that the backside of the steel liners are suffering from two types of corrosion. The first type is a generalized corrosion attack that has resulted in broad areas of metal loss. These areas had corrosion pits of 1/2 to 1 1/2 inches in diameter. The second type of corrosion evident on the coupons is a very localized pitting with holes as small as 1/8 of an inch in diameter that had fully penetrated the 1/4 inch thick steel." [RDHLCC0027623, at 27625]

  Please provide all documentation related to these coupon samples, including the tanks and locations from which the coupons were extracted, data collected from these coupons, testing and analyses performed on these coupons, and/or reports generated in connection with the coupon removal, testing, or analysis.

- A copy of the contract or contracts by or between GTT North America and the Department of Defense or its Defense Innovation Unit to conduct a feasibility study to develop technologies for potential implementation at Red Hill, including related proposals and scopes of work, feasibility study descriptions, reports or analyses generated in connection with this work, if any, and documents relating to whether or not the Navy has committed to implementing such upgrades at Red Hill.

  In addition, we hereby request that the Navy provide the following information that has been referenced in Navy witness testimony and relied upon by Navy witnesses to form the basis of their opinions.

- AOC SOW Section 5.4 draft work plan sent to EPA and DOH on November 16, 2020 as described in the testimonies of Donald Panthen and Robert Jamond, and any request for or response to this work plan (or any drafts thereof) from EPA or DOH.
- Documents relied upon by Curtis Stanley to form his expert opinions as described in the Facility Environmental Report (FER), including:

- "Red Hill is probably the most extensively studied UST system in the State of Hawaiʻi with the largest environmental data set of any UST system in the State. The Navy has collected a plethora of data that have greatly expanded understanding of the geology and hydrogeology at Red Hill, as well as conditions in the underlying groundwater aquifer, which has enabled the studies and conclusions briefly summarized above. The data serve as the foundation for the Navy's AOC environmental investigation findings and will continue to do so as more data are collected and investigations, evaluations, and decision making continue (see Section 3)." [FER, at 18]

  Please produce the referenced and relied upon environmental data set, including all: geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements.

- "The Navy developed a geologic framework model and a three-dimensional regional geologic model of Red Hill and surrounding environs (including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor) to provide geologic support for its groundwater flow modeling effort. The three-dimensional geologic model encompassed the groundwater flow model domain and incorporated information from borehole logs, subsurface structural geology surveys, developed cross sections, and published literature. The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawai‘i (“UH”) along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel.” [FER, at 20]

Please produce the referenced and relied upon Navy three-dimensional regional geologic model.

- “[T]he Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill.” [FER, at 20]

  Please produce the referenced and relied upon Navy measurements of strike and dip of lava flows and clinker units.

- “Understanding the direction and rate of groundwater flow under a variety of reasonable supply well pumping scenarios is critical to assessing the risk that any hypothetical future fuel leak could pose to local drinking water. Initially, the AOC SOW scoped the groundwater flow model effort as one of updating a model developed for a previous 2007 Facility environmental investigation (DON 2007). The Navy modeling team found that updating the 2007 model was insufficient and recommended additional work, including entirely rebuilding, providing more detail, and expanding the model. Working with the AOC Parties and other stakeholders, the Navy refined the modeling domain to extend approximately 51 square miles from Waimalu Valley in the northwest to Kalihi Valley in the southeast, and from near the Ko‘olau crest in the northeast to Pearl Harbor and the Pacific Ocean in the southwest (see Location Map, Figure 1), far beyond where any impacts might reasonably be expected. Since there are a range of factors that require consideration, the Navy developed a multi-model approach to bound expected flow conditions (Ajami et al. 2006). Such an effort requires additional work on behalf of the Navy but results in a more reliable range of predictions under given scenarios.” [FER, at 48]

  Please produce the referenced and relied upon groundwater flow modeling files, including Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy’s March 2020 Groundwater Flow Model Report.

The BWS appreciates the parties’ ongoing efforts to meet and confer to address the exchange of information crucial to the resolution of this contested case. Given the issues associated with the Navy’s prior document productions, our review of Navy documents remains ongoing and the BWS reserves its right to amend, modify, or supplement these requests in the future.

Please do not hesitate to contact us if you have any questions or would like to discuss this matter forward. We intend to update the Hearings Officer as to the status of these meet and confer efforts next week.

Best,

David K. Brown
Morgan, Lewis & Bockius LLP
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Direct: +1.213.680.6816 | Main: +1.213.612.2500 | Fax: +1.213.612.2501
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-----Original Message-----
From: Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>
Sent: Monday, November 30, 2020 5:41 PM
To: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Brown, David K. <david.brown@morganlewis.com>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]

Ella,

We are available Thursday for a brief call before 1pm Pacific.

Exhibit B

Jonathan C. McKay
Marnie E. Riddle
Karrin H. Minott
Dave Fitzpatrick 6803
DEPARTMENT OF THE NAVY
OFFICE OF GENERAL COUNSEL
850 Ticonderoga Street, Suite 110
JBPHH, HI 96860
Telephone: (808) 473-1794
Facsimile: (808) 473-1791

DEPARTMENT OF HEALTH

STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Red Hill Permit Application	Case No. 19-UST-EA-01 **DECLARATION OF CURTIS STANLEY** CERTIFICATE OF SERVICE

DECLARATION OF CURTIS STANLEY

1. I previously testified in this contested case hearing that I helped develop the Facility Environmental Report ("FER") that was prepared for this contested case and attached to my prior testimony. (Testimony of Curtis Stanley ("Stanley Testimony"), pp. 5-6.) I briefly described the important findings that were summarized in the FER. (Stanley Testimony, pp. 8-12.)

2. The FER is not intended to independently replicate, validate, or critically analyze the extensive environmental investigations and studies that have already been performed by the Navy. Instead, it contextualizes these investigations, and highlights and explains the findings and conclusions that may be relevant and useful for this contested case hearing. (*See* FER, p. 1.) The FER does not fulfill any requirement of the Administrative Order on Consent ("AOC"). The information relied on to prepare the FER is contained in the site investigations and environmental reports that were conducted by the Navy pursuant to the AOC, listed in FER Section 4. The underlying datasets used by the Navy to prepare those reports were not re-analyzed in the FER.

3. I have been informed by counsel for the Navy that counsel for the Board of Water Supply ("BWS") made the following set of requests for documents, quoting the enclosed passages from the FER:

> Documents relied upon by Curtis Stanley to form his expert opinions as described in the Facility Environmental Report (FER), including:
>
> > "Red Hill is probably the most extensively studied UST system in the State of Hawai'i with the largest environmental data set of any UST system in the State. The Navy has collected a plethora of data that have greatly expanded understanding of the geology and hydrogeology at Red Hill, as well as conditions in the underlying groundwater aquifer, which has enabled the studies and conclusions briefly summarized above. The data serve as the foundation for the

> Navy's AOC environmental investigation findings and will continue to do so as more data are collected and investigations, evaluations, and decision making continue (see Section 3)." [FER, at 18]

Please produce the referenced and relied upon environmental data set, including all: geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements.

> "The Navy developed a geologic framework model and a three-dimensional regional geologic model of Red Hill and surrounding environs (including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor) to provide geologic support for its groundwater flow modeling effort. The three-dimensional geologic model encompassed the groundwater flow model domain and incorporated information from borehole logs, subsurface structural geology surveys, developed cross sections, and published literature. The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawaiʻi ("UH") along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel." [FER, at 20]

Please produce the referenced and relied upon Navy three-dimensional regional geologic model.

> "[T]he Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill." [FER, at 20]

Please produce the referenced and relied upon Navy measurements of strike and dip of lava flows and clinker units.

> "Understanding the direction and rate of groundwater flow under a variety of reasonable supply well pumping scenarios is critical to assessing the risk that any hypothetical future fuel leak could pose to local drinking water. Initially, the AOC SOW scoped the groundwater flow model effort as one of updating a model developed for a previous 2007 Facility environmental investigation (DON 2007). The Navy modeling team found that updating the 2007 model was insufficient and recommended additional work, including entirely rebuilding, providing more detail, and expanding the model. Working with the AOC Parties and other stakeholders, the Navy refined the modeling domain to extend approximately 51 square miles from Waimalu Valley in the northwest to Kalihi Valley in the southeast, and from near the Koʻolau crest in the northeast to Pearl Harbor and the Pacific Ocean in the southwest (see Location Map, Figure 1), far beyond where

> any impacts might reasonably be expected. Since there are a range of factors that require consideration, the Navy developed a multi-model approach to bound expected flow conditions (Ajami et al. 2006). Such an effort requires additional work on behalf of the Navy but results in a more reliable range of predictions under given scenarios." [FER, at 48]

Please produce the referenced and relied upon groundwater flow modeling files, including Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy's March 2020 Groundwater Flow Model Report.

4. Section 4 of the FER lists documents that "contain detailed underlying data for the information presented herein or are otherwise considered important enough [to] incorporate into the record in this contested case," and provides URLs where these documents can be accessed by members of the public (FER, p. 59). The FER passages quoted above reference and rely upon these documents. In the following paragraphs, I will identify the specific documents listed in Section 4 of the FER where the data I relied upon in forming my conclusions can be found, and where appropriate will identify additional documents that may contain data of interest to the parties.

5. Page 18 of the FER, quoted above in BWS's document request, states that the Navy has collected a large amount of environmental data, and that this data forms the basis for the Navy's studies of and conclusions about the environmental impacts of the Red Hill Facility and "the foundation for the Navy's AOC environmental investigation findings." (FER, p. 18.) It was neither necessary nor practicable to independently re-analyze all such environmental data, nor replicate all of the Navy's past environmental investigations, before preparing the FER for use in this contested case. The results of the Navy's studies and investigations are described in the references listed in Section 4 of the FER, including the Investigation and Remediation of

Releases Report,[1] Groundwater Flow Model Report,[2] Conceptual Site Model report,[3] and Groundwater Protection and Evaluation Considerations Report.[4] Current groundwater monitoring data is provided in quarterly monitoring reports, like the Second Quarter 2020 Groundwater Monitoring Report.[5]

6. In connection with the above passage on page 18 of the FER, BWS has specifically requested "geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements." The FER did not independently re-analyze any data in these categories underlying the Navy's site investigations. However, discussions, summaries, tables, and other presentations of data falling into these categories can be found in the following documents, referenced in Section 4 of the FER and/or publicly available.

Geophysical and drilling logs:

- Investigation and Remediation of Releases Report, Appendix B.2

[1] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0014424 to NAVYREF0016641, as well as Exhibit N-078. It was produced by BWS as Exhibit B-339. It is also publicly available at https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-investigation-and-remediation-of-releases-report-rev00-redacted-2020-03-25.pdf

[2] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0003407 to NAVYREF0004104. It was produced by BWS as Exhibit B-361. It is also publicly available at https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-groundwater-flow-model-report-redacted-2020-03-25-.pdf

[3] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0002443 to NAVYREF0003406. It was produced by BWS as Exhibit B-352. It is also publicly available at https://www.epa.gov/sites/production/files/2019-07/documents/red_hill_conceptual_site_model_20190630-redacted.pdf

[4] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0001983 to NAVYREF0002442. It was produced by BWS as Exhibit B-348. It is also publicly available at https://www.epa.gov/sites/production/files/2018-09/documents/red_hill_interim_groundwater_flow_model-rev00_2018- 07-27-redacted.pdf

[5] This document was produced to BWS by the Navy along with the FER, and can be found at Bates range NAVYREF0005200 to NAVYREF0014423. It was produced by BWS as Exhibit B-83. It can also be found at https://health.hawaii.gov/shwb/ust-red-hill-project-main/red-hill-technical-documents-2020/ and at https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-1.pdf, https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-2.pdf and https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-3.pdf

- Groundwater Flow Model Progress Reports, available at https://www.epa.gov/red-hill/groundwater-flow-patterns-red-hill-additional-documents and produced by BWS as Exhibits B-340, B-342, B-343, B-347, B-350, B-351, B-353, B-354, B-355

Water levels:

- Red Hill Quarterly Groundwater Monitoring Reports, available under "Red Hill Technical Documents" at https://health.hawaii.gov/shwb/ust-red-hill-project-main/
- Groundwater Flow Model Progress Reports

Chemistry and temperature measurements:

- Red Hill Quarterly Groundwater Monitoring Reports

Petrophysical measurements:

- Conceptual Site Model report, Appendix F

7. Page 20 of the FER, quoted above in BWS's document request, explains that the Navy developed a geologic framework model and a 3-D regional geologic model of Red Hill in the course of preparing its groundwater flow model. I did not independently review or re-analyze the data underlying these models, nor did I run any of the model software files, in the course of preparing the FER or my conclusions. In fact, the quoted passage simply summarizes some of the work previously performed by the Navy in its environmental studies of the site. The geologic framework model and 3D regional geologic model, as well as the Navy's use of them, are described in more detail in Appendices C ("Strike and Dip Data"), D ("Evaluation of Potential Pahoehoe Lava Flow Paths Through Tank Farm Area"), E ("Geologic Framework Model"), F ("Petrographic Analytical Report"), and G ("Infiltration Study Report") of the Conceptual Site Model listed in Section 4 of the FER, which is available to BWS (see footnote 3, above). More information about the geologic model is available in the Investigation and

Remediation of Releases Report, page A-18 (see footnote 1, above); the Existing Data Summary and Evaluation Report, pages 3-1 to 3-2 (BWS Exhibit B-331), and Seismic Profiling to Map Hydrostratigraphy in the Red Hill Area (BWS Exhibit B-346).

8. On page 20, the FER summarizes, but does not independently re-evaluate, past Navy investigations of the strike and dip of lava flows at Red Hill. The FER relies on information about strike and dip data that is available in Appendix C ("Strike and Dip Data") of the Conceptual Site Model (see footnote 3, above).

9. On page 48, the FER briefly describes work done by the Navy to model groundwater flows as required by the AOC. The FER does not independently evaluate, validate, or analyze this work itself, and all of the information in the passage quoted by BWS is available in the documents referenced in FER Sections 4 and 6. For example, the FER describes the Navy's expansion of the modeling domain to include the entire area from Waimalu Valley to Kalihi Valley and from near the Ko'olau crest to Pearl Harbor; this is also reported on page 1-2 of the Groundwater Flow Model Report (see footnote 2, above). Similarly, the Navy's use of a multimodel approach, briefly described in the quoted passage of the FER, is discussed in detail in the Groundwater Flow Model Report (see, e.g., pp. 1-1, 1-10 to 1-12, 2-1 to 2-5, 4-1, and Section 5) cited in FER Section 4.

10. BWS has requested "Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy's March 2020 Groundwater Flow Model Report." No groundwater flow model files were generated, validated, or independently re-analyzed in order to form the conclusions in the FER. The FER relies on the groundwater flow information as presented in the Groundwater Flow Model Report in order to form its conclusions.

Executed this 8th day of January, 2021, at Boerne, Texas.

/S/ Curtis Stanley

Curtis Stanley

DEPARTMENT OF HEALTH
STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Permit Application	)))))))))))	 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I hereby certify that, on this date, a true and correct copy of the foregoing document was emailed to the following:
Hearings Officer

Lou.chang@hula.net

Board of Water Supply

ella.gannon@morganlewis.com
david.brown@morganlewis.com

Honolulu Corporate Counsel

jlau3@honolulu.gov

Department of Health

James.c.paige@hawaii.gov

Sierra Club

davidkimofrankel@gmail.com

Respectfully Submitted,

Dated: January 8, 2021

/S/ Marnie E. Riddle___________
Marnie E. Riddle
Agency Representative

Exhibit C

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, EMPLOYER, AND BUSINESS ADDRESS.

A. My name is Curtis Stanley. I am the president of Curt Stanley Consulting Group, LLC and am under contract as a Principal to GSI Environmental Inc ("GSI"). GSI is a subcontractor to AECOM Technical Services Inc ("AECOM"), which has been contracted by the Navy to collect environmental data and conduct environmental analyses at the Red Hill Bulk Storage Facility (the "Facility").

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS MATTER?

A. I am testifying on behalf of the U.S. Navy.

Q. WHAT IS YOUR POSITION AT GSI AND HOW LONG HAVE YOU BEEN SO EMPLOYED?

A. I am a Principal with GSI and have 43 years of environmental experience in investigations and remediation. I have been employed in this position with GSI since September 2016. Prior to joining GSI, I was the Global Discipline Leader for Soil and Groundwater as part of my 37-year tenure at Shell, where I became Shell's first hydrogeologist in 1982.

Q. WHAT DOES YOUR POSITION AT GSI ENTAIL?

A. As a Principal at GSI, I serve in a variety of roles including as a project manager and hydrogeological technical lead.

environment, such that an operating permit for the Facility should be issued in accordance with the State of Hawai'i Underground Storage Tank ("UST") statute and regulations.

II. REVIEW AND ANALYSIS

Q. WHAT HAS BEEN YOUR GENERAL ROLE ON THIS PROJECT.

A. During the summer of 2017, AECOM hired GSI as a subcontractor to help provide deep technical expertise related to various environmental activities at the Facility in support of the US Navy. Due to my background, I was appointed as GSI's project manager responsible for the technical work conducted by GSI to help satisfy the Administrative Order on Consent ("AOC") Section 6 – Investigation and Remediation of Releases and Section 7 – Groundwater Protection and Evaluation.

Q. WHAT DID YOU DIRECTLY OVERSEE AND WHAT DID YOU ADVISE ON?

A. I provide advice to AECOM and the Navy for field efforts such as monitoring well design and installation, groundwater sampling and analysis, and development of specific field investigations and related analyses such as natural source zone depletion ("NSZD"), monitored natural attenuation ("MNA"), etc. In addition, I oversee the technical efforts of GSI experts related to various efforts such as the NSZD investigation, data evaluation, groundwater modeling, and report writing. I have been one of the primary authors for all of the reports submitted under the AOC since I was brought onto the project. Key reports that I helped develop include the following:

(1) Conceptual Site Model Report.

(2) Groundwater Protection and Evaluation of Considerations for the Red Hill Bulk Fuel Storage Facility.

(3) Groundwater Flow Model Report.

(4) Investigations and Remediation of Releases Report.

(5) Facility Environmental Report ("FER"), which will be filed in this contested case in support of this testimony.

In addition, I participate in various meetings and technical collaboration efforts with stakeholders including the Groundwater Modeling Working Group Meetings, Technical Working Group Meetings, and public meetings.

Finally, I was a coauthor of a peer-reviewed scientific paper on natural source zone depletion evidenced at Red Hill which was recently published in the Journal of Contaminant Hydrology (McHugh et al. 2020), and which is included as Appendix D to the FER.

Q. ARE THERE OTHER KEY EXPERTS THAT YOU HAVE RELIED ON IN PREPARING THE FACILITY REPORTS AND THIS TESTIMONY?

A. Yes. While GSI has a group of approximately 20 scientists and engineers that have supported the Red Hill effort, I have particularly relied on:

(1) Dr. Sorab Panday for groundwater modeling. Dr. Panday is a member of the National Academy of Engineering and is a world-renown groundwater modeler.

(2) Dr, Ileana Rhodes for her expertise in fuel chemistry and analysis of groundwater and drinking water samples (especially for her expertise in analysis of Total Petroleum Hydrocarbons). Dr. Rhodes is a world-renown petroleum chemist and has led various industry and agency training efforts, including for the DOH.

(3) Dr. Tom McHugh for his expertise related to attenuation of hydrocarbons in the subsurface. Dr. McHugh is a widely recognized and published expert.

I have also relied upon several senior staff at AECOM, including but not limited to two of its former Red Hill project managers, who remain involved with the project:

(4) Jeff Johnson, a hydrogeologist with over 30 years of experience conducting environmental investigations, most of which was in the State of Hawaii.

(5) Frank Cioffi, a Hawaii-licensed Civil (environmental) Professional Engineer with over 25 years conducting environmental investigations at underground storage tank and other sites, most of which was in the State of Hawaii.

Exhibit D

From: Riddle, Marnie E CIV USN OGC WASH DC (USA)
To: Riddle, Marnie E CIV USN OGC WASH DC (USA)
Subject: FW: Data sharing
Date: Friday, January 8, 2021 12:53:59 PM

From: Erwin Kawata <EKAWATA@hbws.org>
Sent: Friday, July 20, 2018 11:23 AM
To: Manfredi, Mark S CIV CNRH, N4A <mark.manfredi@navy.mil>
Cc: Ernest Lau <elau@hbws.org>; Lisa Kim <LKIM@hbws.org>; 'Steven Linder (linder.steven@epa.gov)' <linder.steven@epa.gov>; 'Shalev, Omer' <Shalev.Omer@epa.gov>; 'Ichinotsubo, Lene K (lene.ichinotsubo@doh.hawaii.gov)' <lene.ichinotsubo@doh.hawaii.gov>; 'Kwan, Roxanne S' <roxanne.kwan@doh.hawaii.gov>
Subject: [Non-DoD Source] FW: Data sharing

Mark,

Thank you for sharing a copy of the Office of the Secretary of Defense's confirmation concerning information regarding the location and pumping rates of Navy water production wells. As you know BWS is equally concerned with similar information for our wells and can understand the Navy's position. At the same time, please know that BWS regards the Navy as an official government agency and we have no objections providing you, without conditions, BWS well information to an agency we believe knows how to safeguard such information.

In this regard, the BWS believes it has responded to all of the Navy's data requests to date and we have met your needs per our ongoing data sharing discussions. Below is a summary of my understanding of BWS' data sharing efforts to date.

BWS submitted its pumping data for Halawa Shaft, Moanalua Wells, and Kalihi Shaft collected during the synoptic water level study and water level data from Halawa T45 and Manaiki T24 to USGS. The BWS understood that all interested parties agreed that USGS would collect this data from the agencies participating in the study. BWS has no objections to USGS making our data available to the Navy as a groundwater modeling working group participant, provided that the Navy treat this information as confidential and abide by any and all safeguards afforded to such information by existing federal and state laws.

Regarding the Navy's June 6, 2017 letter to Mayor Caldwell, BWS responded on June 27, 2017 (copy enclosed). Our letter states that on June 22, 2017, the EPA, Navy, DOH and BWS met to discuss information exchange, including the Navy's June 6, 2017 letter. During the meeting, we discussed the need for a formal process for data and information exchange to address past BWS experiences and concerns with this subject. At that time, EPA instructed the meeting participants to defer action on exchanging information, including the Navy's June 6, 2017 letter, until a formal data sharing process was established.

As the discussions between EPA, DOH, Navy and BWS continued, BWS sent another letter to EPA dated July 31, 2017 proposing each party designate an individual or individuals to clarify scope of any then-existing information requests and to discuss appropriate timeframes for response. At that time, BWS understood this approach was the go-forward plan for exchanging information. On August 3, 2017, I received your email that provided me with your list of what the Navy considered to be the top 3 data sets (see attached email) that it needed. The BWS has since responded to all of the data requests on your August 3, 2017 email and understood this satisfied the requests set forth in the Navy's June 6, 2017 letter.

On July 19, 2018, I received your email below which again included the Navy's June 6, 2017 letter and a spreadsheet purporting to show certain requested information items as complete and incomplete. BWS does not believe these documents portray the current state of data sharing. First, the spreadsheet is also dated from June 2017 and does not appear to be accurate in light of data BWS has provided since that time.

Second, the spreadsheet and request overlooks the fact that some of the requested information is publically available or has been provided to other sources equally accessible to the Navy. For example, in addition to the data provided to USGS, and as explained in the past, the Navy should consult the BWS 30-year master plan and watershed management plans for information about our water resource and development plans. These documents are available on the BWS' website at www.boardofwatersupply.com

Third, the context in which the email and spreadsheet were sent appears to suggest that BWS has not been forthright in providing information. Please know that BWS firmly disagrees with any such implication. As set forth above, BWS has responded to the Navy's requests fully and, in fact, we remain open to the designated individuals meeting to discuss and clarify the scope of any requests for information as well as appropriate timeframes for a response.

If you have any questions, feel free to call me at 748-5080. Thanks.

Erwin

-----Original Message-----
From: Manfredi, Mark S CIV CNRH, N4A <mark.manfredi@navy.mil>
Sent: Thursday, July 19, 2018 9:18 AM
To: Erwin Kawata <EKAWATA@hbws.org>
Cc: Ichinotsubo, Lene K <lene.ichinotsubo@doh.hawaii.gov>; 'roxanne.kwan@doh.hawaii.gov' <roxanne.kwan@doh.hawaii.gov>; Shalev, Omer <Shalev.Omer@epa.gov>; Linder, Steven (Linder.Steven@epa.gov) <Linder.Steven@epa.gov>; TU, LYNDSEY (Tu.Lyndsey@epa.gov) <Tu.Lyndsey@epa.gov>; Waki, Cory K CIV NAVFAC HI, EV1 <cory.waki@navy.mil>
Subject: Data sharing

Erwin,
I wanted to share with you confirmation we received from the Office of the Secretary of Defense concerning information regarding the location and pumping rates of navy water production wells. The document (attached) states "This information qualifies as DoD critical infrastructure security

information (DCRIT), as defined by 10 U.S.C.§ 130e, because the disclosure of well locations and pump rates would reveal the primary water source for bases and commands on and adjacent to Joint Base Pearl Harbor-Hickam which are critical to national security." As such, we are required to protect such information from public disclosure. (I recognize BWS is equally concerned with similar information on their wells.). Further, we are also required to ensure certain measures are in place to prevent such disclosure; which is why we require NDAs and cannot provide this information to one or any organization we do not have a signed NDA with.

I understand BWS's position regarding NDA's, and don't intend to revisit that discussion. However, I also recognize the significance of this information as well as other non-navy data has on the accuracy/reliability of ongoing modeling efforts. To that end, would BWS consider an NDA or other such MOU/MOA, that only addresses specific data sets, rather than a blanket document? For example, the paper would state something to the effect that "BWS agrees to not share the geographic location and pumping rate data for Navy's Red Hill Shaft". Of course, we would sign something similar for any BWS related information. Absent something like that, we would unfortunately not be able to provide BWS with that specific information. Let me know your thoughts.

To that end, I would also like to ask again for the following data. This information in particular is critical to our modeling efforts:
1. Pumping data for Halawa Shaft, Moanalua Wells, and Kalihi Shaft during the synoptic water level study (approximately July 1, 2018 through March 31, 2018 or what they provided to USGS) 2. Synoptic water level data from wells Halawa T45 (3-2255-033) and Manaiki T24 (3-2153-009) that were monitored by BWS 3. Any data that they can provide from the new well (BWS2253-J1 [State Well No. 3-2253-006]) installed by BWS near RHMW09 in addition to what was provided by DLNR as described in the attached table

Thanks

v/r
Mark

M. S. Manfredi
Red Hill Regional Program Director/Project Coordinator
850 Ticonderoga St, Suite 110
JBPHH, HI 96860
W: 808-473-4148
C: 808-200-6736
F: 808-473-4155

Exhibit E

DETERMINATION OF THE DIRECTOR OF ADMINISTRATION

Under the authority delegated to me by the Secretary of Defense, I have determined that the following information is exempt from disclosure under Exemption 3 of the Freedom of Information Act (5 U.S.C. § 552(b)(3)) because it meets the requirements for exemption under 10 U.S.C. § 130e:

> Locations and production rates of U.S. Navy-owned water production wells on the Island of Oahu, Hawaii.

Date: 6·19·18

Michael L. Rhodes
Director of Administration

STATEMENT OF THE BASIS FOR THE DETERMINATION BY THE DIRECTOR OF ADMINISTRATION

In accordance with 10 U.S.C. § 130e, I reviewed information regarding the locations and water production rates for United States Navy's water production wells on the Island of Oahu, Hawaii. I determined this information qualifies as DoD critical infrastructure security information (DCRIT), as defined by 10 U.S.C.§ 130e, because the disclosure of well locations and pump rates would reveal the primary water source for bases and commands on and adjacent to Joint Base Pearl Harbor-Hickam which are critical to national security. As defined by 10 U.S.C. § 130e, DCRIT includes:

> "…sensitive but unclassified information that, if disclosed, would reveal vulnerabilities in Department of Defense critical infrastructure that, if exploited, would likely result in the significant disruption, destruction, or damage of or to Department of Defense operations, property, or facilities, including information regarding the securing and safeguarding of explosives, hazardous chemicals, or pipelines, related to critical infrastructure or protected systems owned or operated by or on behalf of the Department of Defense, including vulnerability assessments prepared by or on behalf of the Department of Defense, explosives safety information (including storage and handling), and other site-specific information on or relating to installation security."

The disclosure of Navy well pump rates and their locations would reveal the primary water source for Department of Defense (DoD) installations on and adjacent to Joint Base Pearl Harbor-Hickam. Exploitation of this information, individually or in the aggregate, would likely endanger public health and safety and result in significant disruption, destruction, or damage of or to DoD operations, personnel, property, or facilities.

I considered the public interest in the disclosure of well locations and production rates against the risk of harm that might result if this information was exploited by an adversary. The U.S. Navy already discloses information on water quality from these wells to the State of Hawaii Department of Health and the United States Environmental Protection Agency for further distribution to the public. The harm that would likely result from disclosure of the well locations and pump rates is very serious and extremely significant. Therefore, the public interest consideration does not outweigh the national security risk posed by disclosure.

Exhibit F

relatively low-permeability geological layers known to be present in Red Hill, which further impede the downward flow of hydrocarbons.

- **Plume Stability.** The dissolved-constituent impacts are confined to groundwater near the tanks and do not appear to be increasing over the life of the groundwater monitoring program. In terms commonly used in the environmental field, this means that the impacts are "stable," "attenuated," and not migrating toward any human or ecological receptors (*see* Sidebar 8).

2.3 Red Hill's Substantial Environmental Data Collection

Red Hill is probably the most extensively studied UST system in the State of Hawai'i with the largest environmental data set of any UST system in the State. The Navy has collected a plethora of data that have greatly expanded understanding of the geology and hydrogeology at Red Hill, as well as conditions in the underlying groundwater aquifer, which has enabled the studies and conclusions briefly summarized above. The data serve as the foundation for the Navy's AOC environmental investigation findings and will continue to do so as more data are collected and investigations, evaluations, and decision making continue (*see* Section 3). Therefore, it is worth noting the variety of data sources and monitoring locations that have been and continue to be used to ensure that operation of the Facility remains protective of human health and the environment.

Figure 5 overlays all the features and testing locations described below to show the breadth and extent of data considered for the Navy's various environmental studies. This sizable dataset has allowed the Navy to:

- Refine the understanding of the local and regional geology and geohydrology.
- Conduct hydraulic analyses related to groundwater flow.
- Comprehensively evaluate groundwater chemistry.
- Analyze and quantify naturally occurring conditions and processes (NSZD and natural attenuation).
- Develop potential remedial alternatives for hypothetical future fuel releases.

Figure 6a through Figure 6l present different types of data and monitoring locations that have been employed (and which collectively compose Figure 5), which are briefly summarized below.

(a) **Drinking Water Supply Wells.** The three closest drinking water supply wells to the Facility are Red Hill Shaft, Hālawa Shaft, and the Moanalua Wells (Figure 6a).

(1) Red Hill Shaft (Hawai'i Well Identification [ID] 2254-01) is a potable water pumping station operated by Naval Facilities Engineering Systems Command, Hawaii's Utilities and Energy Division. The pumping station is located within the Facility's lower tunnel system approximately one-half mile *makai* (seaward) of the Facility tanks. The station pumps groundwater from a water development tunnel (also called an infiltration gallery) that extends from the pumping station to within 1,530 feet of the nearest Facility fuel storage tank. The pumping station supplies the Joint Base Pearl Harbor-Hickam water distribution system, which serves approximately 65,200 military workers, members, and their families.

(2) Hālawa Shaft (2354-01) is a municipal water supply well with an associated water development tunnel operated by BWS located approximately 4,400 feet northwest of the tank farm. The pumping station is located in an underground pump room approximately 150 feet below ground. Groundwater is pumped from a water development tunnel to provide municipal drinking water for O'ahu.

Navy's 2017 subsurface structural geology survey transect conducted along that location for its AOC environmental investigation (*see* Item (f)), and (2) improving the understanding of the presence and extent of valley fill and saprolite in South Hālawa Valley, and whether those geologic formations extend below the approximate elevation of the regional basal aquifer. The borehole was not converted to a monitoring well due to its proximity to the Hālawa Deep well. This borehole was also fitted with instruments that provide additional data regarding hydraulic conditions within the valley fill, saprolite, and underlying unweathered basalt volcanics.

(d) **Oily Waste Disposal Facility Monitoring Wells.** The Oily Waste Disposal Facility, located approximately 0.6 mile west and topographically downgradient of the Red Hill Facility, was constructed in the 1940s as a collection point for oily wastewater generated by the cleaning of Red Hill's fuel storage tanks. A series of two reclamation and disposal pits were constructed in the same approximate location and used intermittently from 1943 until 1986, when operations ceased. Several monitoring wells were installed at the site as part of environmental investigations in the 1990s and early 2000s (Figure 6c). The Navy incorporated the geologic and water level data from the boring logs into the CSM. One monitoring well from the earlier environmental investigations (now referred to as OWDFMW01) was added to the Red Hill groundwater monitoring network in 2016.

(e) **Groundwater Level Data Evaluation.** Since 2017, the USGS, on behalf of the Navy, has been executing a detailed groundwater level monitoring program (synoptic study). The USGS has deployed water level instruments (known as transducers) in conventional wells and multilevel wells at the Facility and in the surrounding vicinity (Figure 6d). The Navy initiated the synoptic study to provide data for development of both the CSM and groundwater flow modeling. Data derived from the synoptic study have been used extensively for both purposes.

(f) **Subsurface Structural Geology Surveys.** The Navy conducted subsurface structural geology surveys throughout the Red Hill area in December 2017 to better define subsurface conditions and hydrogeologic boundaries beneath Red Hill, North Hālawa Valley, South Hālawa Valley, and Moanalua Valley (DON 2018a). Results of nine acquired subsurface structural geologic profiles (Figure 6e) showed that valley fill sediments are constrained to the upper ~60 feet below land surface in all three valleys, and the saprolite base (a highly impermeable barrier to groundwater flow) extends to hundreds of feet below sea level in portions of North and South Hālawa Valleys (typical basal groundwater elevations in the Red Hill/Hālawa Valley area are approximately 18–20 feet above sea level).

(g) **Geologic Field Mapping.** The Navy developed a geologic framework model and a three-dimensional regional geologic model of Red Hill and surrounding environs (including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor) to provide geologic support for its groundwater flow modeling effort. The three-dimensional geologic model encompassed the groundwater flow model domain and incorporated information from borehole logs, subsurface structural geology surveys, developed cross sections, and published literature. The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawaiʻi ("UH") along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel (Figure 6f). In addition, the Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill.

The pilot study data will also be used to identify action levels for a full-scale continuous monitoring system, should one be developed. This will help to identify new fuel releases while minimizing false positive results. If this approach is deemed appropriate, data can be reviewed and action levels can be refined on a tank-by-tank basis to further improve release-detection capabilities.

3.1.4 Expanded Groundwater Monitoring Network and Continued Long-Term Monitoring

The Navy continues to expand its Red Hill groundwater monitoring network. From 5 wells that were being used before the 2014 Tank 5 Release to 19 wells in operation today, the current plans are to increase that number to 27 wells by 2023 (*see* Sidebar 15).[38] Due to the significant depth to groundwater, the complicated drilling in this heterogenous basaltic environment, and the limited number of on-island contractors (only one) with the equipment capable of performing this complicated drilling, each well takes significant time and care to install and comes at considerable expense. As new basal groundwater monitoring wells come online, they are added to the quarterly groundwater monitoring events, with results reported to DOH and made available to the public on at least a quarterly basis.

Not only will the additional data help document the safety of the drinking water supply, the geologic and hydrogeologic data collected during well drilling and installation will also greatly expand the understanding of subsurface conditions across Hālawa Valley. The Navy will incorporate the additional data to perform future modeling efforts, establish a formal groundwater monitoring network under the AOC SOW, and update the GWPP (*see* Sections 3.1.5–3.1.7).

3.1.5 Groundwater Flow Modeling

Understanding the direction and rate of groundwater flow under a variety of reasonable supply well pumping scenarios is critical to assessing the risk that any hypothetical future fuel leak could pose to local drinking water. Initially, the AOC SOW scoped the groundwater flow model effort as one of updating a model developed for a previous 2007 Facility environmental investigation (DON 2007). The Navy modeling team found that updating the 2007 model was insufficient and recommended additional work, including entirely rebuilding, providing more detail, and expanding the model. Working with the AOC Parties and other stakeholders, the Navy refined the modeling domain to extend approximately 51 square miles from Waimalu Valley in the northwest to Kalihi Valley in the southeast, and from near the Ko'olau crest in the northeast to Pearl Harbor and the Pacific Ocean in the southwest (*see* Location Map, Figure 1), far beyond where any impacts might reasonably be expected. Since there are a range of factors that require consideration, the Navy developed a multi-model approach to bound expected flow conditions (Ajami et al. 2006). Such an effort requires additional work on behalf of the Navy but results in a more reliable range of predictions under given scenarios.[39]

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[38] As is the case with soil vapor monitoring, it bears noting that "groundwater monitoring," although not required for this Facility, is generally an acceptable release detection method under the Hawaii UST regulations. HAR §11-280.1-43(6). While the Navy acknowledges that the depth to water is greater at the Facility than set forth in the regulations, HAR §11-280.1-43(6)(B), the other requirements are generally met. Perhaps most importantly, a compliant groundwater monitoring system must include "methods used can detect the presence of at least one-eighth of an inch of free product on top of the groundwater in the monitoring wells." HAR §11-280.1-43(6)(F). No such free product has ever been measured in any of the (currently 19) groundwater monitoring wells during the entire course of the long-term groundwater monitoring program.

[39] In the past, investigators often tried to complete a single predictive model for a given site. However, there is always a certain level of variation in environmental conditions at any site, especially one as geologically and hydrologically complicated as Red Hill, such that one single model cannot be counted upon to be completely accurate or precise. Therefore, many modern experts recommend the use of a multi-model approach, wherein a set of models are used to analyze different potential aquifer conditions, resulting in models that encompass or "bound" the reasonably likely outcomes (Scavia, DePinto, and Bertani 2016).

4. Documents Incorporated Into the Record

The Navy has collected a plethora of data and conducted a vast number of analyses for the Facility prior to and pursuant to the AOC, which are described in a host of documents related to the Facility. Several of the documents contain detailed underlying data for the information presented herein or are otherwise considered important enough they incorporate into the record in this contested case. Table 1 lists Red Hill environment-related documents that the Navy submits for incorporation into the record for this Contested Case Hearing; links to official government websites are provided where available.

Table 1: Environmental Documents to be Incorporated Into the Record

Document	URL
1. AOC SOW § 2: Tank Inspection, Repair, and Maintenance (TIRM):	
a. Navy's TIRM Report	https://www.epa.gov/sites/production/files/2016-10/documents/red-hill-aoc-section-2-2-tirm-report-2016-10-11.pdf
b. Navy's TIRM Decision Document	https://www.epa.gov/sites/production/files/2017-09/documents/red_hill_aoc_tirm_decision_document.pdf
c. Navy's Red Hill Facility Evaluation Report (concludes Facility is safe)	https://www.epa.gov/sites/production/files/2017-06/documents/red_hill_facility_compliance_evaluation_report_june_2017.pdf
d. AOC Regulatory Agencies' Approval of TIRM Decision Document	https://www.epa.gov/sites/production/files/2017-09/documents/epa_and_doh_approval_of_tirm_decision_document.pdf
2. AOC SOW § 3: Tank Upgrade Alternatives (TUA):	
a. Navy's Proposed TUA and Release Detection Decision Document [a]	https://www.epa.gov/sites/production/files/2019-09/documents/red_hill_aoc_tua_proposal_decision_document_20190919.pdf
b. AOC Regulatory Agencies' Notice of Deficiencies for the TUA and New Release Detection Alternatives Decision Document (Disapproval)	https://www.epa.gov/red-hill/tank-upgrade-alternatives-red-hill#file-575447
3. AOC SOW § 4: Release Detection/Tank Tightness Testing:	
a. Navy's Current Fuel Release Monitoring Systems Report	https://www.epa.gov/sites/production/files/2016-04/documents/current-fuel-release-monitoring-systems-report-with-appendices-2016-04-04.pdf
b. AOC Regulatory Agencies' Approval of Current Fuel Release Monitoring Systems Report	https://www.epa.gov/sites/production/files/2016-09/documents/approval_of_current_fuel_release_monitoring_systems_report_15_sep_2016.pdf
c. Navy's Proposed TUA and Release Detection Decision Document [a]	https://www.epa.gov/sites/production/files/2019-09/documents/red_hill_aoc_tua_proposal_decision_document_20190919.pdf
d. AOC Regulatory Agencies' Notice of Deficiencies for the TUA and New Release Detection Alternatives Decision Document (Disapproval)	https://www.epa.gov/red-hill/tank-upgrade-alternatives-red-hill#file-575447
3. AOC SOW § 5: Corrosion and Metal Fatigue Practices:	
a. Navy's Destructive Testing Results Report	https://www.epa.gov/sites/production/files/2019-07/documents/red-hill-destructive-testing-results-report-20190707.pdf
b. AOC Regulatory Agencies' Joint Response to Destructive Testing Results Report (Disapproval)	https://www.epa.gov/sites/production/files/2020-03/documents/joint-response-red-hill-corrosion_metal_fatigue_practices_destructive_testing_results-signed-2020-03-16.pdf
c. Navy's Response to AOC Regulatory Agencies' Disapproval	https://www.epa.gov/sites/production/files/2020-07/documents/red_hill_dtrr_aoc_sow_sec_5_2jun.pdf
d. Regulatory Agencies' Response (Conditional Approval of Completion of AOC SOW § 5.3.3)	https://www.epa.gov/sites/production/files/2020-07/documents/red_hill_joint_regulatory_agency_response_2020-07-07.pdf
5. AOC SOW § 6: Investigation and Remediation of Releases:	
a. Navy's Investigation and Remediation of Releases Report [a]	https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-investigation-and-remediation-of-releases-report-rev00-redacted-2020-03-25.pdf

Exhibit G

Appendix B.2
Boring Logs

Well Development Log

Location: Red Hill BFSF	Station ID:	Station Name: RHMW02	Diameter: 2"	Date: 9/8/2005
Sys_Samp_Code:		Elevation:	Material: PVC	Time Start: 1400
Sampler: Shawn/Tim		Dry: yes / no	Balier Dia./L (in): 1.5 X 90	Time Finish: 1530
CO.: TEC/VWD		TD: [redacted]	Development Method: SS Bailer	

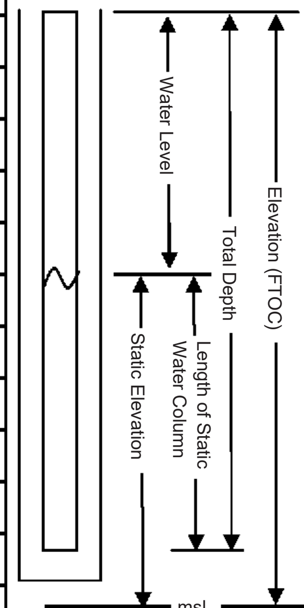
Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	Temp C°	Color	EC	Turbidity/ Sand (ppt)	Comments
9/8/05	1434	87.3'	3.50	7.48	25.0	Slightly Cloudy	0.83	0.41	
9/8/05	1445	87.3'	6.50	7.30	24.5	Slightly Cloudy	0.82	0.41	
9/8/05	1456	87.3'	10.25	7.26	24.3	Slightly Cloudy	0.84	0.42	
9/8/05	1502	87.3'	13.50	7.21	24.2	Slightly Cloudy	0.81	0.40	
9/8/05	1505	87.3'	14.25	7.24	24.2	Slightly Cloudy	0.81	0.41	
9/8/05	1507	87.3'	15.00	7.22	24.3	Slightly Cloudy	0.81	0.41	

Casing Volume Information

A	Hole Diam.	=	5.00
B	Well OD	=	2.375
C	Well ID	=	1.939
D	H2O Level	=	87.31
E	TD	=	[redacted]
F	Est. Filter Porosity	=	0.40

Vc=3.14(C/2)^2(E-D)

Vf=3.14[(A/2)^2-(B/2)^2](E-D)(F)



Casing ID	VOL Gal/Ft
1.00	0.04
1.50	0.09
2.00	0.16
2.50	0.26
3.00	0.37
3.50	0.50
4.00	0.65
4.50	0.83
6.00	1.50
7.00	2.00
8.00	2.60

Notes:

Well	Vc=	1.78	gal
	Vf=	3.67	gal
	Vt=	5.45	gal
	3Vt=	16.35	gal
Bailer	V=	0.68	gal

■ FOIA §(b)(3), Critical Infrastructure

Well Development Log

Location: Red Hill BFSF	**Station ID:**	**Station Name:** RHMW03	**Diameter:** 2"	**Date:** 9/7/2005	
Sys_Samp_Code:		**Elevation:**	**Material:** PVC	**Time**	**Start:**
Sampler: Shawn/Mike D.		**Dry:** yes / no	**Balier Dia./L (in):** 1.5 X 30		**Finish:**
CO.: TEC/VWD		**TD:** [redacted]	**Development Method:** PVC Bailer		

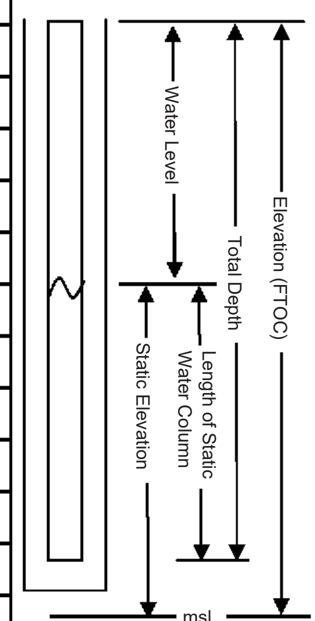
Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	Temp C°	Color	EC	Turbidity/ Sand (ppt)	Comments
9/7/05	1421	104.2	0.23	5.40	26.7	Dk Grayish	1.42	0.71	
9/7/05	1428	104.2	0.69	6.21	26.5	Dk Grayish	1.44	0.72	
9/7/05	1433	104.2	1.61	6.24	26.4	Dk Grayish	1.37	0.69	
9/7/05	1437	104.2	2.30	6.27	26.3	Dk Grayish	1.36	0.68	
9/7/05	1444	104.2	2.99	6.36	26.2	Dk Grayish	1.20	0.60	
9/7/05	1451	104.2	4.14	6.33	26.1	Dk Grayish	1.20	0.60	
9/7/05	1455	104.2	4.83	6.30	26.1	Dk Grayish	1.15	0.57	
9/7/05	1500	104.2	5.52	6.32	26.2	Dk Grayish	1.01	0.55	
9/7/05	1510	104.2	6.67	5.39	26.2	Dk Grayish	1.03	0.52	
9/7/05	1518	104.2	7.59	5.37	26.2	Dk Grayish	1.02	0.51	
9/7/05	1526	104.2	8.51	5.39	26.2	Dk Grayish	1.02	0.50	
9/7/05	1527	104.2	8.74	5.57	26.3	Dk Grayish	1.01	0.50	

Casing Volume Information

A	Hole Diam.	=	5.00
B	Well OD	=	2.375
C	Well ID	=	1.939
D	H2O Level	=	104.20
E	TD	=	[redacted]
F	Est. Filter Porosity	=	0.40

Vc=3.14(C/2)^2(E-D)

Vf=3.14[(A/2)^2-(B/2)^2](E-D)(F)



Casing ID	VOL Gal/Ft
1.00	0.04
1.50	0.09
2.00	0.16
2.50	0.26
3.00	0.37
3.50	0.50
4.00	0.65
4.50	0.83
6.00	1.50
7.00	2.00
8.00	2.60

Notes:

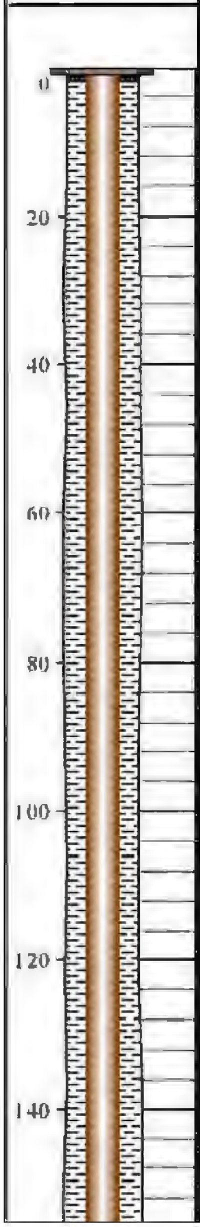
Well	**Vc=**	2.00	gal
	Vf=	4.11	gal
	Vt=	6.11	gal
	3Vt=	18.32	gal
Bailer	**V=**	0.23	gal

■ FOIA §(b)(3), Critical Infrastructure

For Red Hill AOC Party Use Only

GEOLOGIC BOREHOLE LOG

Location: **RHFSF**	Station Name: **RHMW04**	Location Type: **Monitoring Well**
Location Description: **west. access rd., S of Navy Firing Range**	Establishing Company: **TEC Inc.**	
Drilling Foreman: **Tomas Fernandez**	Drilling Company: **Valley Well Drilling**	
Geologist: **N. Griffin/S. MacMillan**	Ground Surface Elevation (ft): **313.03**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**	Borehole Diameter (in): **8**	
Total Depth (ft): **320.5**	Date Drilling Started: **22 July 2005**	Date Drilling Ended: **26 July 2005**
Remarks:		

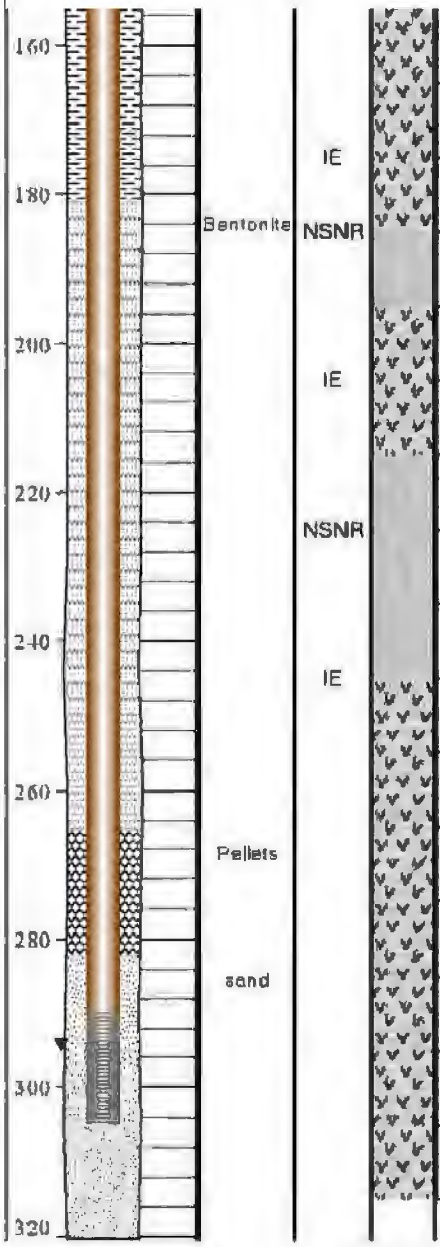


Well Construction	Well Fill	USCS	Soil Description	Soil Sample
	Cement Grout	GW	Well-graded gravel with sand - dark reddish brown (5YR 2.5/2), medium stiff, moist, 80% gravel, 15% fines, 5% fines, road base.	RHMW04S02
			Basalt bedrock.	
			Basalt - moderate brown (5YR 3/4). Rate = 5/5, 50 - 80% vesicles.	
			Basalt - dark gray (blue rock) (N3). Rate = 5/10, massive, 5% small crystals.	
		IE	Basalt - dark gray (N3). Rate = 5/10, 70 - 90% vesicles:small.	
			Basalt - dark gray (N3). Rate = 5/7, massive.	
			Basalt - dark gray (N3). Rate = 5/10, 70 - 90% vesicles.	
			Basalt - dark gray (N3). Rate = 5/10, vesicles.	
			Basalt - dark gray (N3). Rate = 5/10, vesicles.	
			Basalt - dark gray (N3). Rate = 5/12, vesicles.	
		NSNR	Rate = 5/18, no recovery.	
			Basalt - moderate brown to dark gray (5YR 3/4 to N3). Rate = 5/12, vesicles.	
			Basalt - dark gray (N3). Rate = 5/16, vesicles with min. deposits. Perched water encountered - to approx. 130 feet.	
			Basalt - dark gray (N3). Rate = 5/15, massive.	
			Basalt - dark reddish brown to dark gray (10YR 3/4 to N3). Rate = 5/20, vesicles.	
			Basalt - medium dark gray to dark gray (N4 to N3). Rate = 5/15, vesicles.	
		IE	Basalt - dark reddish brown to dark gray (10YR 3/4 to N3). Rate = 5/15, massive and vesicles.	
			Basalt - dark reddish brown (10YR 3/4). Rate = 5/10, vesicles.	
			Basalt - dark gray (N3). Rate = 5/12, vesicles.	

GEOLOGIC BOREHOLE LOG

Location: **RHFSF**	Station Name: **RHMW04**	Location Type: **Monitoring Well**
Location Description: **west. access rd., S of Navy Firing Range**	Establishing Company: **TEC Inc.**	
Drilling Foreman: **Tomas Fernandez**	Drilling Company: **Valley Well Drilling**	
Geologist: **N. Griffin/S. MacMillan**	Ground Surface Elevation (ft): **313.03**	Datum: **MSL**
Drilling Sampling Method: **Rock Coring**	Borehole Diameter (in): **8**	
Total Depth (ft): **320.5**	Date Drilling Started: **22 July 2005**	Date Drilling Ended: **26 July 2005**

Remarks:



Basalt - dark gray (N3). Rate = 5/5, vesicles.
Basalt - dark gray (N3). Rate = 5/15, vesicles
Basalt - dark gray (N3). Rate = 5/30, vesicles.
Rate = 5/14, No recovery.
Basalt - dark gray (N3). Rate = 5/10, vesicles.
Basalt - dark gray (N3). Rate = 5/13, vesicles.
Rate = 5/10, No recovery
Rate = 5/15, No recovery.
Rate = 5/12, No recovery
Basalt - dark gray (N3). Rate = 5/12, vesicles
Basalt - medium dark gray (N4). Rate = 5/10, vesicles.
Basalt - medium dark gray (N4). Rate = 5/10, vesicles.
Basalt - medium dark gray (N4). Rate = 5/10, vesicles.
Basalt - dark gray (N3). Rate = 5/10, vesicles.
Basalt - dark gray (N3). Rate = 5/10, vesicles.
Basalt - dark gray to blackish red (N3 to 5R 2/2). Rate = 5/8, vesicles, water at 311'

~~For Red Hill AOC Party Use Only~~

Well Construction Log

Location:	Red Hill BFSF	Station ID:		Station Name:	RHMW04	Date:	7/22/2005
Sys_Samp_Code:		Elevation:		TD:	320.5'	Time Start:	
Driller:	Tomas	CO.:	VWD	Date Finished:	7/26/2005	Time Finish:	

Drilling Protocol

Hole Diameter:	8"	Drilling Method:	Air Rotary	Inclination:	90°	Azimuth:	n/a

Casing

Material:	PCV Sch 80	Diameter	ID:	3.826"	From:	0'
			OD:	4.5"	To:	290'

Screen

Material:	PCV Sch 80	Diameter	ID:	3.826"	From:	290'	Slot #:	0.02
			OD:	4.5"	To:	305'		

Annular Fill

Sand:	Monterey #3	Type	Bentonite	Chips:	16	Bags	Grout:	2	Bags
	6	Bags		Pellets:	6	Bkts	Cement:	40	Bags

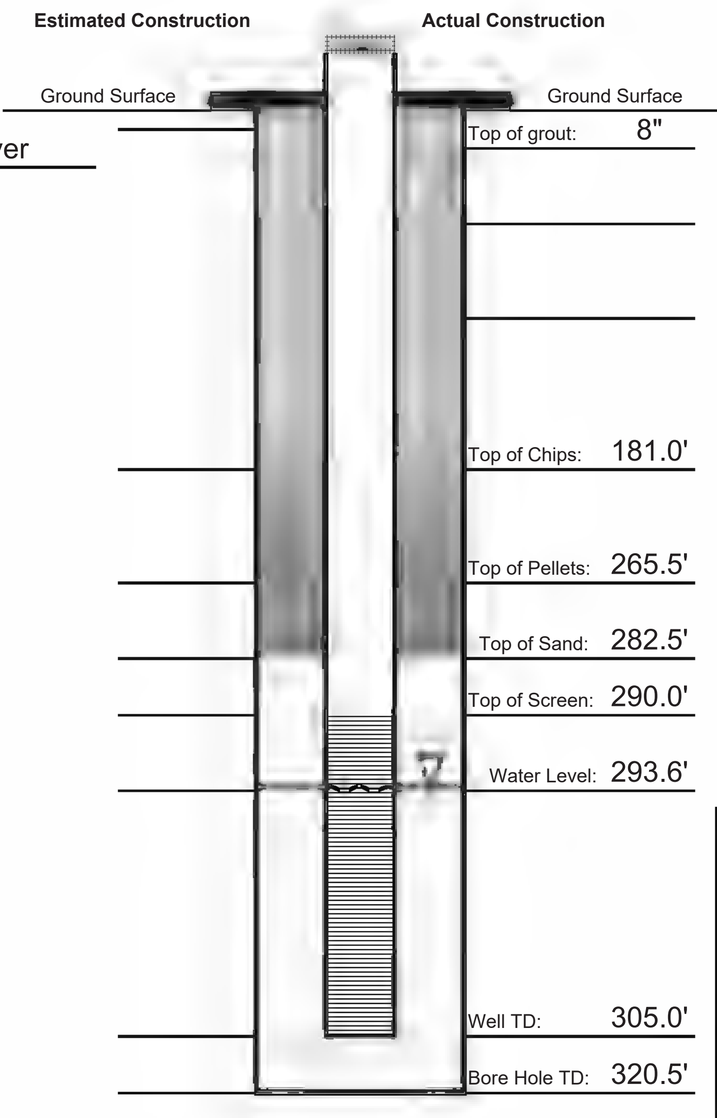
Surface Casing

Type: Traffic Cover

Diameter: 12"

Length: 12"

Pad: 3X3



Cement

Grout

B. Chips

B. Pellets

Sand

Notes:

~~For Red Hill AOC Party Use Only~~

Well Development Log

Location: Red Hill BFSF	**Station ID:**	**Station Name:** RHMW04	**Diameter:** 4"
Sys_Samp_Code:		**Elevation:**	**Material:** PVC
Sampler: Tomas		**Dry:** yes / no	**Balier Dia./L (in):** 4 X 48
CO.: VWD		**TD:** 305'	**Development Method:** SS Bailer

Date: 7/26/2005	
Time	**Start:** 1415
	Finish: 1515

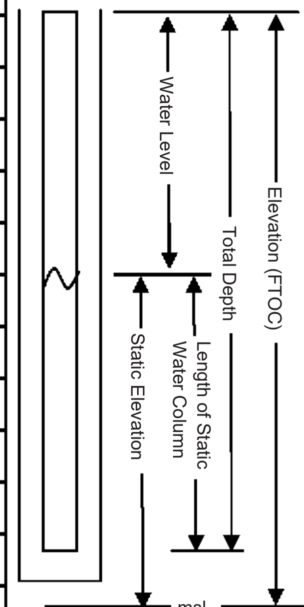
Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	Temp C°	Color	EC	Turbidity/ Sand (NTU)	Comments
7/26/05	1418	294.1	5.00	7.68	22.3	-----	0.58	450	
7/26/05	1425	294.1	10.00	7.38	22.9	-----	0.53	999+	
7/26/05	1431	294.1	15.00	7.26	22.7	-----	0.56	999+	
7/26/05	1436	294.1	20.00	7.30	22.8	-----	0.54	999+	
7/26/05	1443	294.1	25.00	7.17	22.4	-----	0.53	999+	
7/26/05	1451	294.1	30.00	7.20	22.6	-----	0.53	650	
7/26/05	1456	294.1	35.00	7.27	22.48	-----	0.52	600	
7/26/05	1503	294.1	40.00	7.21	22.33	-----	0.52	400	
7/26/05	1508	294.1	45.00	7.21	22.12	-----	0.53	450	

Casing Volume Information

A	Hole Diam.	=	8.00
B	Well OD	=	4.500
C	Well ID	=	3.826
D	H2O Level	=	294.10
E	TD	=	305.00
F	Est. Filter Porosity	=	0.40

Vc=3.14(C/2)^2(E-D)

Vf=3.14[(A/2)^2-(B/2)^2](E-D)(F)



Casing ID	VOL Gal/Ft
1.00	0.04
1.50	0.09
2.00	0.16
2.50	0.26
3.00	0.37
3.50	0.50
4.00	0.65
4.50	0.83
6.00	1.50
7.00	2.00
8.00	2.60

Notes:

Well	**Vc=**	6.47	gal
	Vf=	7.73	gal
	Vt=	14.20	gal
	3Vt=	42.59	gal
Bailer	**V=**	2.59	gal

GEOLOGIC LOG

DATE STARTED: 28-Aug-14	LOGGER: [illegible]	PAGE 1 OF 10	
DATE COMPLETED: 17-Sept-14	WEATHER: 90 degrees Fahrenheit	WELL NO.: RHMW06	

COMPANY NAME: PARSONS	DRILLING SUBCONTRACTOR: Valley Well Drilling	SURFACE ELEV.: 255.81 ft amsl
OFFICE LOCATION: South Jordan, Utah	DRILL RIG TYPE: Mobile B-59 and B-90	SOUNDING TUBE ELEV.: 259.01 ft
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01	DRILLING METHOD: Auger, HQ core, Air Rotary	NORTHING: [redacted]
LOCATION: Red Hill BFSF, HI JOB NUMBER: 749435	BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	EASTING: [redacted]

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)
0	(0.0, 10.0) Clay		CLAY			
5						
10	(10.0, 11.5) Clay: dark brown, CL, little silt, plastic, small rounded pebbles, poor recovery, Note: basalt cobbles and boulders within clay are present from ground surface to the saprolite contact		CLAY	0.0	12/19/19	
	(11.5, 15.0) Clay		CLAY			
15	(15.0, 16.5) Clay: dark yellowish brown, CH, stiff, plastic, small angular rock fragments, poor recovery				21/25/100 for 4"	
	(16.5, 20.0) Clay					
20	(20.0, 21.5) Clay: dark yellowish brown to gray, friable, dry		CLAY	0.0		
	(21.5, 23.0) Clay		CLAY	0.0		
	(23.0, 24.5) Clay: gray basalt in tip, cobble (?), only tip recovery		SAPR	0.0		
25	(24.5, 35.0) Saprolite: start coring, in and out of weathered basalt and saprolite, mottled yellowish to dark yellowish brown saprolite, thin bands of gray vesicular basalt, solid rock contact at about 35 feet bgs, NOTE: THE GSA ROCK COLOR CHART (1991) WAS USED FOR THE FOLLOWIING WET COLOR DESCRIPTIONS		VLBA	0.0		
30						

WELL CONSTRUCTION INFORMATION

SURFACE COMPLETION: 3.5' x 3.5' x 2' concrete pad w/ 8" above-ground steel casing

WELL CASING:
- Material: SCH. 80 PVC
- Diameter: 4"
- Interval: +3.2-230 bgs

WELL SCREEN:
- Material: SCH. 80 PVC
- Screen Opening: 0.020
- Diameter: 4"
- Interval: 230-260 bgs

CONDUCTOR CASING:
- Material: PVC
- Diameter: 10"
- Interval: 0-40 bgs

DEPTH INTERVAL:
- Concrete: 0-3
- Cement Grout: 3-40 bgs
- Bentonite Chips: 40-215 bgs
- Bentonite Seal: 215-223 bgs
- Sand Pack: 223-269 bgs
- Hole Cuttings: 269-270 bgs

NOTE:
All intervals are measured from ground surface.

amsl - Above Mean Sea Level	DP - Direct Push	CN - Concrete	SD - Sand
bgs - Below Ground Surface	HSA - Hollow Stem Auger	COBL - Cobble or Boulder	SDSL - Sand and Silt
ft - feet	SSA - Solid Stem Auger	CORL - Coral	SDGR - Sand and Gravel
mm - millimeter(s)	TD - Total Depth	FILL - Fill or other Man-Made Deposits	SEDU - Sedimentary (Undifferentiated)
N/A - Not Applicable	HS - Head Space	GVL - Gravel	SLCL - Silt and Clay
NS - Not Sampled	ERPIMS CODE DESCRIPTIONS:	GVLP - Gravel, predominantly pebble-sized	SLGV - Silt and Gravel
PID - Photoionization Detector	ASPT - Asphalt	GVSL - Gravel and Silt	SLSD - Silt and Sand
ppmv - Parts per Million, Volume per Volume	CLAY - Clay	NDPS - No Description Provided, Problems in Sampling	VLBA - Basalt, Lava
SAA - Same as Above	CLGV - Clay and Gravel	NSNR - No Sample or No Recovery Obtained	VLTF - Volcanic Tuff
Horizontal Survey System: NAD 83 Epoch 2010.0	CLSD - Clay and Sand	PTHM - Peat, Humus, and other Organic Material	
Elevations: Local Mean Sea Level (feet)	CLSL - Clay and Silt	SAPR - Saprolite	

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG

For Red Hill AOC Party Use Only

DATE STARTED: 28-Aug-14	LOGGER: T.W. Jensen	PAGE 2 OF 10	
DATE COMPLETED: 17-Sept-14	WEATHER: 90 degrees Fahrenheit	WELL NO.: RHMW06	
COMPANY NAME: PARSONS	DRILLING SUBCONTRACTOR: Valley Well Drilling	SURFACE ELEV.: 255.81 ft amsl	
OFFICE LOCATION: South Jordan, Utah	DRILL RIG TYPE: Mobile B-59 and B-90	SOUNDING TUBE ELEV.: 259.01 ft	
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01	DRILLING METHOD: Auger, HQ core, Air Rotary	NORTHING: [redacted]	
LOCATION: Red Hill BFSF, HI	JOB NUMBER: 749435	BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	EASTING: [redacted]

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
30							
35	(35.0, 40.0) Basalt: olive gray, 5Y 4/1, pumice-like vesicular with small semi-round voids, vertical fracture at 37 ft with iron stained and weathered surfaces, 3 ft. recovery				75%		
40	(40.0, 45.0) Basalt : SAA, vesicular with 30% small and round voids, competent, infilled voids near bottom at 44 ft.				90%		
45	(45.0, 50.0) Basalt: SAA, vesicular with up to 35% voids, variable size and shape voids-some larger than 5 mm., moderate strength w/ mechanical fractures		VLBA	0.0	80%		
50	(50.0, 55.0) Basalt: olive gray to greenish gray, dense, 10% voids, oblique fractures w/ weathered surfaces, drilling water return		VLBA	0.0	50%		
55	(55.0, 60.0) Basalt: greenish gray and dense from 55-57, up to 1 in. vugs w/ some secondary infilling, transitions back to olive gray vesicular basalt		VLBA	0.0	NA		
60							

amsl - Above Mean Sea Level
bgs - Below Ground Surface
ft - feet
mm - millimeter(s)
N/A - Not Applicable
NS - Not Sampled
PID - Photoionization Detector
ppmv - Parts per Million, Volume per Volume
SAA - Same as Above
Horizontal Survey System: NAD 83 Epoch 2010.0
Elevations: Local Mean Sea Level (feet)

DP - Direct Push
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
TD - Total Depth
HS - Head Space
ERPIMS CODE DESCRIPTIONS:
ASPT - Asphalt
CLAY - Clay
CLGV - Clay and Gravel
CLSD - Clay and Sand
CLSL - Clay and Silt

CN - Concrete
COBL - Cobble or Boulder
CORL - Coral
FILL - Fill or other Man-Made Deposits
GVL - Gravel
GVLP - Gravel, predominantly pebble-sized
GVSL - Gravel and Silt
NDPS - No Description Provided, Problems in Sampling
NSNR - No Sample or No Recovery Obtained
PTHM - Peat, Humus, and other Organic Material
SAPR - Saprolite

SD - Sand
SDSL - Sand and Silt
SDGR - Sand and Gravel
SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
SLSD - Silt and Sand
VLBA - Basalt, Lava
VLTF - Volcanic Tuff

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG	DATE STARTED: 28-Aug-14 DATE COMPLETED: 17-Sept-14	LOGGER: T.W. Jensen WEATHER: 90 degrees Fahrenheit	PAGE 3 OF 10 WELL NO.: RHMW06
COMPANY NAME: PARSONS OFFICE LOCATION: South Jordan, Utah		DRILLING SUBCONTRACTOR: Valley Well Drilling DRILL RIG TYPE: Mobile B-59 and B-90	SURFACE ELEV.: 255.81 ft amsl SOUNDING TUBE ELEV.: 259.01 ft
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01 LOCATION: Red Hill BFSF, HI JOB NUMBER: 749435		DRILLING METHOD: Auger, HQ core, Air Rotary BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	NORTHING: [redacted] EASTING: [redacted]

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
60	(60.0, 65.0) Basalt: olive gray, vesicular w/ 30% small round voids, iron-stained voids and natural fractures from 63-65 ft.		VLBA	0.0	75%		
65	(65.0, 70.0) Basalt: SAA, large angled fracture at 67.5 ft., voids infilled with white mineral, grades to non-vesicular and more dense at 69 ft.		VLBA	0.0	80%		
70	(70.0, 75.0) Basalt: lost core, trip out, recover 2 ft. of gray vesicular basalt		VLBA	0.0	NA		
75	(75.0, 80.0) Basalt: brownish black 5YR 2/1, vesicular, grades to brownish gray 5YR 4/1 with larger voids at 76 ft., some secondary infilling of voids from 76-77 ft, some fractures		VLBA	0.0	75%		
80	(80.0, 85.0) Basalt: grayish black (N2), dense, vugs with pristine "needle-like" zeolite cyrstals, light coating of white to bluish gray amporphous silica within voids indicative of the movement of water, large fracture at 82 ft. with secondary rust colored mineralization		VLBA	0.0	80%		
85	(85.0, 90.0) Basalt: dark gray (N3), hard, dense, competent, 10% open voids, as large as 5 mm., some infilling of voids with amorphous quartz or zeolite, 10% slightly weathered olivine phenocrysts, Note: first occurrence of phenocrysts, rock above is aphanitic w/ very few phenocryts		VLBA	0.0	80%		
90							

amsl - Above Mean Sea Level	DP - Direct Push	CN - Concrete	SD - Sand
bgs - Below Ground Surface	HSA - Hollow Stem Auger	COBL - Cobble or Boulder	SDSL - Sand and Silt
ft - feet	SSA - Solid Stem Auger	CORL - Coral	SDGR - Sand and Gravel
mm - millimeter(s)	TD - Total Depth	FILL - Fill or other Man-Made Deposits	SEDU - Sedimentary (Undifferentiated)
N/A - Not Applicable	HS - Head Space	GVL - Gravel	SLCL - Silt and Clay
NS - Not Sampled	ERPIMS CODE DESCRIPTIONS:	GVLP - Gravel, predominantly pebble-sized	SLGV - Silt and Gravel
PID - Photoionization Detector	ASPT - Asphalt	GVSL - Gravel and Silt	SLSD - Silt and Sand
ppmv - Parts per Million, Volume per Volume	CLAY - Clay	NDPS - No Description Provided, Problems in Sampling	VLBA - Basalt, Lava
SAA - Same as Above	CLGV - Clay and Gravel	NSNR - No Sample or No Recovery Obtained	VLTF - Volcanic Tuff
Horizontal Survey System: NAD 83 Epoch 2010.0	CLSD - Clay and Sand	PTHM - Peat, Humus, and other Organic Material	
Elevations: Local Mean Sea Level (feet)	CLSL - Clay and Silt	SAPR - Saprolite	

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG

For Red Hill AOC Party Use Only

DATE STARTED: 28-Aug-14	LOGGER: T.W. Jensen		WELL NO.: RHMW06
DATE COMPLETED: 17-Sept-14	WEATHER: 90 degrees Fahrenheit		
COMPANY NAME: PARSONS	DRILLING SUBCONTRACTOR: Valley Well Drilling		SURFACE ELEV.: 255.81 ft amsl
OFFICE LOCATION: South Jordan, Utah	DRILL RIG TYPE:	Mobile B-59 and B-90	SOUNDING TUBE ELEV.: 259.01 ft
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01	DRILLING METHOD:	Auger, HQ core, Air Rotary	NORTHING: [redacted]
LOCATION: Red Hill BFSF, HI JOB NUMBER: 749435	BOREHOLE DIAMETER:	6 & 12"Auger, 4" Core, 8" Air	EASTING: [redacted]

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
90	(90.0, 93.0) Basalt: partial run, SAA, transitions to as much as 35% voids, zones where voids are infilled with reddish orange clay-like soft silica, large infilled fracture at 90-91 ft.		VLBA	0.0	80%		
	(93.0, 98.0) Basalt: SAA, 25 % voids, range from 1 mm. to 8 mm., zones w/ infilling of voids, few fractures		VLBA		90%		
95				0.0			
	(98.0, 100.0) Basalt: SAA, few healed or infilled fracture zones		VLBA		60%		
100	(100.0, 105.0) Basalt: SAA, grades dense, competent, and unweathered at 104 ft., cyrstalline texture, few olivine phenocrysts, lost circulation, switched over to all water and no air		VLBA	0.0	75%		
105	(105.0, 110.0) Basalt: SAA, grades from dense and hard to low density and weak pumice-like vesicular w/ 50% small and round voids at 109 ft.		VLBA	0.0	85%		
110	(110.0, 115.0) Basalt: SAA, dark gray vesicular, zones with reddish orange soft silica along fractures and in voids, 6 in. clay zone at 114 ft., possibly a weathered zone between flows		VLBA	0.0	50%		
115	(115.0, 120.0) Basalt: SAA, dark gray, variable void percentage througout, mechanical breaks, reddish orange soft silica where weathered		VLBA	0.0	60%		
120							

amsl - Above Mean Sea Level	DP - Direct Push	CN - Concrete	SD - Sand
bgs - Below Ground Surface	HSA - Hollow Stem Auger	COBL - Cobble or Boulder	SDSL - Sand and Silt
ft - feet	SSA - Solid Stem Auger	CORL - Coral	SDGR - Sand and Gravel
mm - millimeter(s)	TD - Total Depth	FILL - Fill or other Man-Made Deposits	SEDU - Sedimentary (Undifferentiated)
N/A - Not Applicable	HS - Head Space	GVL - Gravel	SLCL - Silt and Clay
NS - Not Sampled	ERPIMS CODE DESCRIPTIONS:	GVLP - Gravel, predominantly pebble-sized	SLGV - Silt and Gravel
PID - Photoionization Detector	ASPT - Asphalt	GVSL - Gravel and Silt	SLSD - Silt and Sand
ppmv - Parts per Million, Volume per Volume	CLAY - Clay	NDPS - No Description Provided, Problems in Sampling	VLBA - Basalt, Lava
SAA - Same as Above	CLGV - Clay and Gravel	NSNR - No Sample or No Recovery Obtained	VLTF - Volcanic Tuff
Horizontal Survey System: NAD 83 Epoch 2010.0	CLSD - Clay and Sand	PTHM - Peat, Humus, and other Organic Material	
Elevations: Local Mean Sea Level (feet)	CLSL - Clay and Silt	SAPR - Saprolite	

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG

DATE STARTED: 28-Aug-14	LOGGER: M. Jensen		
DATE COMPLETED: 17-Sept-14	WEATHER: 90 degrees Fahrenheit	WELL NO.: RHMW06	
COMPANY NAME: PARSONS	DRILLING SUBCONTRACTOR: Valley Well Drilling	SURFACE ELEV.: 255.81 ft amsl	
OFFICE LOCATION: South Jordan, Utah	DRILL RIG TYPE: Mobile B-59 and B-90	SOUNDING TUBE ELEV.: 259.01 ft	
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01	DRILLING METHOD: Auger, HQ core, Air Rotary	NORTHING: [redacted]	
LOCATION: Red Hill BFSF, HI; JOB NUMBER: 749435	BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	EASTING: [redacted]	

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
120	(120.0, 125.0) Basalt: SAA, washout from 123-124 ft., 60% recovery		VLBA	0.0	50%		
125	(125.0, 130.0) Basalt: dark gray (N3), stronger rock, 25% voids, large irregular voids up to 10 mm., fresh high-angle fracture at 128.5 ft., minor infilling of voids at 129 ft. w/ reddish orange soft silica, mechanical breaks		VLBA	0.0	85%		
130	(130.0, 135.0) Basalt: dark gray (N3), overall brown from oxidation, looks like broken up rubble zone at top of flow, lava inclusions, secondary infilling in weak zones		VLBA	0.0	40%		
135	(135.0, 140.0) Basalt: dark gray (N3), harder and dense, vesicular basalt, 20% voids, two high-angle fractures at 139 ft., coated fracture surfaces and some infilling of voids		VLBA	0.0	85%		
140	(140.0, 145.0) Basalt: SAA, aphanitic-crystalline texture, dense, irregular voids, a few fresh fractures w/light iron-oxide staining		VLBA	0.0	80%		
145	(145.0, 150.0) Basalt: dark gray, compentent, moderate strength, mechanical breaks, not much infilling of voids		VLBA	0.0	90%		
150							

amsl - Above Mean Sea Level	DP - Direct Push	CN - Concrete	SD - Sand
bgs - Below Ground Surface	HSA - Hollow Stem Auger	COBL - Cobble or Boulder	SDSL - Sand and Silt
ft - feet	SSA - Solid Stem Auger	CORL - Coral	SDGR - Sand and Gravel
mm - millimeter(s)	TD - Total Depth	FILL - Fill or other Man-Made Deposits	SEDU - Sedimentary (Undifferentiated)
N/A - Not Applicable	HS - Head Space	GVL - Gravel	SLCL - Silt and Clay
NS - Not Sampled	ERPIMS CODE DESCRIPTIONS:	GVLP - Gravel, predominantly pebble-sized	SLGV - Silt and Gravel
PID - Photoionization Detector	ASPT - Asphalt	GVSL - Gravel and Silt	SLSD - Silt and Sand
ppmv - Parts per Million, Volume per Volume	CLAY - Clay	NDPS - No Description Provided, Problems in Sampling	VLBA - Basalt, Lava
SAA - Same as Above	CLGV - Clay and Gravel	NSNR - No Sample or No Recovery Obtained	VLTF - Volcanic Tuff
Horizontal Survey System: NAD 83 Epoch 2010.0	CLSD - Clay and Sand	PTHM - Peat, Humus, and other Organic Material	
Elevations: Local Mean Sea Level (feet)	CLSL - Clay and Silt	SAPR - Saprolite	

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG	DATE STARTED: 28-Aug-14 DATE COMPLETED: 17-Sept-14	LOGGER: [illegible] WEATHER: 90 degrees Fahrenheit	 WELL NO.: RHMW06
COMPANY NAME: PARSONS OFFICE LOCATION: South Jordan, Utah		DRILLING SUBCONTRACTOR: Valley Well Drilling DRILL RIG TYPE: Mobile B-59 and B-90	SURFACE ELEV.: 255.81 ft amsl SOUNDING TUBE ELEV.: 259.01 ft
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01 LOCATION: Red Hill BFSF, HI	JOB NUMBER: 749435	DRILLING METHOD: Auger, HQ core, Air Rotary BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	NORTHING: [redacted] EASTING: [redacted]

For Red Hill AOC Party Use Only

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
150	(150.0, 155.0) Basalt: dark gray, crystalline, dense, some olivine, 5% voids, mechanical breaks		VLBA	0.0	80%		
155	(155.0, 160.0) Clinker: switched bits and went to air, poor recovery, bad core resulting from air coring, rounded, red rock possibly clinker		VLBA	0.0	NA		
160	(160.0, 163.0) Clinker: grayish red 10R 4/2 clinker, lost water circulation, diesel odor in ambient air from apparent venting of tanks		VLBA	BG=1.5	NA		
	(163.0, 168.0) Basalt: dark gray, hard, dense, crystalline texture, some quartz, 10% voids, trace secondary black mineral coating, fresh fractures w/ little secondary mineralization on surfaces, PID interference from background fumes in ambient air		VLB	BG=27	90%		
165							
	(168.0, 170.0) Basalt: SAA, finish run, silica-coated vertical fracture, some mechanical breaks		VLBA	0.0			
170	(170.0, 175.0) Basalt: SAA, dark gray, two healed fractures from 170-171, grades to rubbly broken zone, weathered rock and mud from 172-175, poor recovery		VLBA	0.0	NA		
175	(175.0, 180.0) Basalt: dark gray and less compentent pumice-like vesicular w/ about 30% small round voids, few thin broken zones, several healed fractures		VLBA	0.0	50%		
180							

amsl - Above Mean Sea Level
bgs - Below Ground Surface
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mm - millimeter(s)
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NS - Not Sampled
PID - Photoionization Detector
ppmv - Parts per Million, Volume per Volume
SAA - Same as Above
Horizontal Survey System: NAD 83 Epoch 2010.0
Elevations: Local Mean Sea Level (feet)

DP - Direct Push
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
TD - Total Depth
HS - Head Space
ERPIMS CODE DESCRIPTIONS:
ASPT - Asphalt
CLAY - Clay
CLGV - Clay and Gravel
CLSD - Clay and Sand
CLSL - Clay and Silt

CN - Concrete
COBL - Cobble or Boulder
CORL - Coral
FILL - Fill or other Man-Made Deposits
GVL - Gravel
GVLP - Gravel, predominantly pebble-sized
GVSL - Gravel and Silt
NDPS - No Description Provided, Problems in Sampling
NSNR - No Sample or No Recovery Obtained
PTHM - Peat, Humus, and other Organic Material
SAPR - Saprolite

SD - Sand
SDSL - Sand and Silt
SDGR - Sand and Gravel
SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
SLSD - Silt and Sand
VLBA - Basalt, Lava
VLTF - Volcanic Tuff

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG

DATE STARTED: 28-Aug-14	LOGGER: T. Jensen		
DATE COMPLETED: 17-Sept-14	WEATHER: 90 degrees Fahrenheit	WELL NO.: RHMW06	

COMPANY NAME: PARSONS	DRILLING SUBCONTRACTOR: Valley Well Drilling	SURFACE ELEV.: 255.81 ft amsl
OFFICE LOCATION: South Jordan, Utah	DRILL RIG TYPE: Mobile B-59 and B-90	SOUNDING TUBE ELEV.: 259.01 ft
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01	DRILLING METHOD: Auger, HQ core, Air Rotary	NORTHING: [redacted]
LOCATION: Red Hill BFSF, HI JOB NUMBER: 749435	BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	EASTING: [redacted]

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
180	(180.0, 185.0) Basalt: dark gray vesicular, variable void percentage, broken zone from 181-183 ft., fractures and voids infilled with reddish orange soft silica		VLBA	0.0	50%		
185	(185.0, 190.0) Basalt: SAA, grades to brownish gray then back to dark gray, less voids from 190-192 ft, fractured w/ gouged slickenside surfaces at 193 ft., infilling of voids with soft silica		VLBA	0.0	70%		
190	(190.0, 195.0) Basalt: dark gray (N3), vesicular, variable void size, shape, and percentage, more compentent, fractures at 194 ft., coated fracture surface with reddish orange silica and black oxides and infilling of voids below fractures, mechanical breaks,		VLBA	0.0	70%		
195	(195.0, 200.0) Basalt: dark gray, vesicular, larger connected voids, dense, light olive brown coating in voids indicative of the movement of water, some olivine, few horizontal fractures		VLBA	0.0	50%		
200	(200.0, 205.0) Basalt: dark gray (N3), cyrstalline texture, compentent and consistent core, subtle flow layering w/ stretched voids, horizontal fractures from 200-201 feet, secondary black oxides		VLBA	0.0	90%		
205	(205.0, 210.0) Basalt: dark gray, weathered w/ secondary infilling, broken zones		VLBA	0.0	50%		
210							

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bgs - Below Ground Surface
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PID - Photoionization Detector
ppmv - Parts per Million, Volume per Volume
SAA - Same as Above
Horizontal Survey System: NAD 83 Epoch 2010.0
Elevations: Local Mean Sea Level (feet)

DP - Direct Push
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
TD - Total Depth
HS - Head Space
ERPIMS CODE DESCRIPTIONS:
ASPT - Asphalt
CLAY - Clay
CLGV - Clay and Gravel
CLSD - Clay and Sand
CLSL - Clay and Silt

CN - Concrete
COBL - Cobble or Boulder
CORL - Coral
FILL - Fill or other Man-Made Deposits
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GVLP - Gravel, predominantly pebble-sized
GVSL - Gravel and Silt
NDPS - No Description Provided, Problems in Sampling
NSNR - No Sample or No Recovery Obtained
PTHM - Peat, Humus, and other Organic Material
SAPR - Saprolite

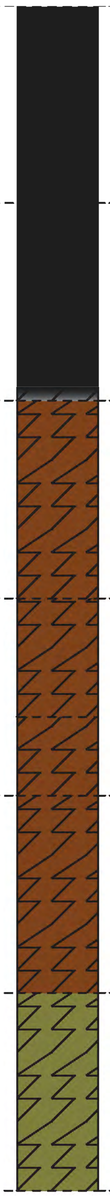
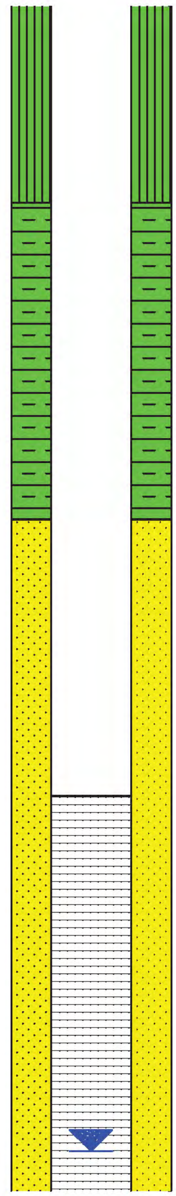
SD - Sand
SDSL - Sand and Silt
SDGR - Sand and Gravel
SEDU - Sedimentary (Undifferentiated)
SLCL - Silt and Clay
SLGV - Silt and Gravel
SLSD - Silt and Sand
VLBA - Basalt, Lava
VLTF - Volcanic Tuff

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG

DATE STARTED: 28-Aug-14 DATE COMPLETED: 17-Sept-14	LOGGER: TW Jensen WEATHER: 90 degrees Fahrenheit	 WELL NO.: RHMW06
COMPANY NAME: PARSONS OFFICE LOCATION: South Jordan, Utah	DRILLING SUBCONTRACTOR: Valley Well Drilling DRILL RIG TYPE: Mobile B-59 and B-90	SURFACE ELEV.: 255.81 ft amsl SOUNDING TUBE ELEV.: 259.01 ft
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01 LOCATION: Red Hill BFSF, HI JOB NUMBER: 749435	DRILLING METHOD: Auger, HQ core, Air Rotary BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	NORTHING: [redacted] EASTING: [redacted]

For Red Hill AOC Party Use Only

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
210	(210.0, 215.0) Basalt: brownish gray 5YR 4/1, 30% voids, less dense, broken w/ soft silica infillling, dark reddish brown non-vesicular bands, grades to dark gray at 214 ft.		VLBA	0.0			
215	(215.0, 220.0) Basalt: brownish gray 5YR 4/1, w/ dark yellowish brown bands, less competent, moderate strength, broken zone from 218-219 w/ secondary infilling, olive gray w/ 10% voids from 219-220 ft.		VLBA	0.0			
220	(220.0, 225.0) Basalt: grayish red 10R 4/2, low density and weak, weathered matrix,		VLBA	0.0	75%		
225	(225.0, 230.0) Basalt: SAA, alternating with dark gray vesicular, olive gray basalt w/ 30% voids at 229 ft., irregular voids up to 1 in., light silica coating in voids indicative of the movement of water		VLBA	0.0			
230	(230.0, 235.0) Basalt: SAA, but more competent, up to 30% irregular voids, increase in void percentage near bottom of run, black oxide secondary mineralization in some voids and surfaces		VLBA	0.0	90%		
235	(235.0, 240.0) Basalt: dark brown to dark yellowish brown to olive to greenish black, possible alteration to serpentine or chlorite in places, friable in places, non-competent, weathered to clay		VLBA	0.0	25%		
240							

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bgs - Below Ground Surface	HSA - Hollow Stem Auger	COBL - Cobble or Boulder	SDSL - Sand and Silt
ft - feet	SSA - Solid Stem Auger	CORL - Coral	SDGR - Sand and Gravel
mm - millimeter(s)	TD - Total Depth	FILL - Fill or other Man-Made Deposits	SEDU - Sedimentary (Undifferentiated)
N/A - Not Applicable	HS - Head Space	GVL - Gravel	SLCL - Silt and Clay
NS - Not Sampled	ERPIMS CODE DESCRIPTIONS:	GVLP - Gravel, predominantly pebble-sized	SLGV - Silt and Gravel
PID - Photoionization Detector	ASPT - Asphalt	GVSL - Gravel and Silt	SLSD - Silt and Sand
ppmv - Parts per Million, Volume per Volume	CLAY - Clay	NDPS - No Description Provided, Problems in Sampling	VLBA - Basalt, Lava
SAA - Same as Above	CLGV - Clay and Gravel	NSNR - No Sample or No Recovery Obtained	VLTF - Volcanic Tuff
Horizontal Survey System: NAD 83 Epoch 2010.0	CLSD - Clay and Sand	PTHM - Peat, Humus, and other Organic Material	
Elevations: Local Mean Sea Level (feet)	CLSL - Clay and Silt	SAPR - Saprolite	

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG

DATE STARTED: 28-Aug-14	LOGGER: TW Jensen	PAGE 9 OF 10	
DATE COMPLETED: 17-Sept-14	WEATHER: 90 degrees Fahrenheit	WELL NO.: RHMW06	

COMPANY NAME: PARSONS	DRILLING SUBCONTRACTOR: Valley Well Drilling	SURFACE ELEV.: 255.81 ft amsl
OFFICE LOCATION: South Jordan, Utah	DRILL RIG TYPE: Mobile B-59 and B-90	SOUNDING TUBE ELEV.: 259.01 ft
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01	DRILLING METHOD: Auger, HQ core, Air Rotary	NORTHING: [redacted]
LOCATION: Red Hill BFSF, HI JOB NUMBER: 749435	BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	EASTING: [redacted]

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
240	(240.0, 245.0) Basalt: brownish gray, moderate density and strength, low void percentage, grades to olive gray vesicular basalt that is low density and weak, zones of infilling with clay-like pinkish gray soft silica		VLBA	0.0	60%		
245	(245.0, 250.0) Basalt: olive gray, 3-foot partial run, blocked off, variable void percentage, moderate density and strength, large and irregular open voids that are lightly coated with secondary amporphous silica indicative of water saturated conditions, finish 2-foot run, SAA, <10% voids, voids infilled with white mineral		VLBA	0.0	75%		
250	(250.0, 255.0) Basalt: SAA, from 250-253, more infilling of voids, grades to olive black 5YR 2/1 basalt, shows slickenlines along fracture plane and possible serpentine or talc-like secondary alteration on fracture surfaces		VLBA	0.0	70%		
255	(255.0, 260.0) Basalt: SAA, olive black, light density and weak, pumice-like vesicular, 30% small and round voids, some infilled, grades to olive gray and more dense basalt w/ larger voids, slickenlines on fracture surfaces		VLBA	0.0	50%		
260	(260.0, 265.0) Basalt: SAA from 260-262 ft., grades back to olive black light density vesicular basalt, 3 in. band of white silica at 263 ft., weak rock and strongly oxidized at 264 ft., lost water pressure during coring at 263 feet		VLBA	0.0	50%		Well TD = 260 ft bgs
265	(265.0, 270.0) Basalt: SAA, poor recovery, weak and broken rock		VLBA	0.0	NA		
270							

amsl - Above Mean Sea Level	DP - Direct Push	CN - Concrete	SD - Sand
bgs - Below Ground Surface	HSA - Hollow Stem Auger	COBL - Cobble or Boulder	SDSL - Sand and Silt
ft - feet	SSA - Solid Stem Auger	CORL - Coral	SDGR - Sand and Gravel
mm - millimeter(s)	TD - Total Depth	FILL - Fill or other Man-Made Deposits	SEDU - Sedimentary (Undifferentiated)
N/A - Not Applicable	HS - Head Space	GVL - Gravel	SLCL - Silt and Clay
NS - Not Sampled	ERPIMS CODE DESCRIPTIONS:	GVLP - Gravel, predominantly pebble-sized	SLGV - Silt and Gravel
PID - Photoionization Detector	ASPT - Asphalt	GVSL - Gravel and Silt	SLSD - Silt and Sand
ppmv - Parts per Million, Volume per Volume	CLAY - Clay	NDPS - No Description Provided, Problems in Sampling	VLBA - Basalt, Lava
SAA - Same as Above	CLGV - Clay and Gravel	NSNR - No Sample or No Recovery Obtained	VLTF - Volcanic Tuff
Horizontal Survey System: NAD 83 Epoch 2010.0	CLSD - Clay and Sand	PTHM - Peat, Humus, and other Organic Material	
Elevations: Local Mean Sea Level (feet)	CLSL - Clay and Silt	SAPR - Saprolite	

■ FOIA § (b)(9), Well Information

GEOLOGIC LOG	DATE STARTED: 28-Aug-14 DATE COMPLETED: 17-Sept-14	LOGGER: TW Jensen WEATHER: 90 degrees Fahrenheit	 WELL NO.: RHMW06
COMPANY NAME: PARSONS OFFICE LOCATION: South Jordan, Utah		DRILLING SUBCONTRACTOR: Valley Well Drilling DRILL RIG TYPE: Mobile B-59 and B-90	SURFACE ELEV.: 255.81 ft amsl SOUNDING TUBE ELEV.: 259.01 ft
PROJECT: Monitoring Well Installation N62583-11-D-0515, TO KB01 LOCATION: Red Hill BFSF, HI JOB NUMBER: 749435		DRILLING METHOD: Auger, HQ core, Air Rotary BOREHOLE DIAMETER: 6 & 12"Auger, 4" Core, 8" Air	NORTHING: [redacted] EASTING: [redacted]

DEPTH (ft bgs)	DESCRIPTION OF MATERIALS	GRAPHIC LOG	ERPIMS LITHO-LOGIC CODE	PID HS, ppmv (DEPTH, ft bgs)	BLOW COUNT/ RQD	WELL CONSTRUCTION (ft bgs)	WELL CONSTRUCTION INFORMATION
270	(270.0, 275.0) Basalt: olive gray, large open voids coated with silica and black oxides from 270-272 ft., grades to more dense and fractured, back to brownish gray at the bottom		VLBA	0.0	75%		
275	(275.0, 280.0) Basalt: SAA, grades back to olive gray, zone w/ large coated open voids, some infilling w/ white mineral in smaller voids, few vertical fractures w/ slickenlines on fresh fracture surfaces		VLBA	0.0	75%		
280							

amsl - Above Mean Sea Level	DP - Direct Push	CN - Concrete	SD - Sand
bgs - Below Ground Surface	HSA - Hollow Stem Auger	COBL - Cobble or Boulder	SDSL - Sand and Silt
ft - feet	SSA - Solid Stem Auger	CORL - Coral	SDGR - Sand and Gravel
mm - millimeter(s)	TD - Total Depth	FILL - Fill or other Man-Made Deposits	SEDU - Sedimentary (Undifferentiated)
N/A - Not Applicable	HS - Head Space	GVL - Gravel	SLCL - Silt and Clay
NS - Not Sampled	ERPIMS CODE DESCRIPTIONS:	GVLP - Gravel, predominantly pebble-sized	SLGV - Silt and Gravel
PID - Photoionization Detector	ASPT - Asphalt	GVSL - Gravel and Silt	SLSD - Silt and Sand
ppmv - Parts per Million, Volume per Volume	CLAY - Clay	NDPS - No Description Provided, Problems in Sampling	VLBA - Basalt, Lava
SAA - Same as Above	CLGV - Clay and Gravel	NSNR - No Sample or No Recovery Obtained	VLTF - Volcanic Tuff
Horizontal Survey System: NAD 83 Epoch 2010.0	CLSD - Clay and Sand	PTHM - Peat, Humus, and other Organic Material	
Elevations: Local Mean Sea Level (feet)	CLSL - Clay and Silt	SAPR - Saprolite	

■ FOIA § (b)(9), Well Information

CLIENT: JBPHH SITE: Red Hill Bulk Fuel Storage Facility

DATE: 9-10 October 2014 WELL NUMBER: RHMW06

DEVELOPER SIGNATURE: TMJ

DEVELOPMENT DESCRIPTION: Surged with block for 15 min, removed about 40 gallons on 9 October by surging and bailing with a clean 6-foot long, 3.5-inch-diameter, 4-gallon stainless steel bailer. Water was too turbid to measure accurately. Another 250 gallons were removed on 10 October until the turbidity was lower and the water relatively sediment free. A total of 290 gallons were removed. The evacuated groundwater was transferred to properly labeled 55-gallon drums and the on-site roll-off bin pending analytical results for proper off-site disposal.

Depth to well bottom (ft-btoc):	263.3	Water Column in Well Pipe (ft)	22.09
Depth to water (ft-btoc)	241.21	Well Pipe Diameter (in)	4.0
Water Column (ft)	22.09	Well Pipe Factor (gal/ft)	0.65
Sand Pack Length (ft)	46	**Water Volume in Well Pipe (gal)**	**14.36**
Water Column in Sand Pack (ft)	22.09	**One Well Volume (gal)**	**18.782**
Borehole Diameter (in)	8	Volumes to be removed (min)	10
Sand Pack Factor (gal/ft)	0.2	**Gallons to be removed (min)**	**187.78**
Water Volume in Sand Pack (gal)	**4.42**		

PURGE MEASUREMENTS: A Horiba U-52 meter with flow cell was used.

Purge Device: Stainless steel bailer Purge Rate (gal/hr): 40 to 50

Time	**Vol** (gal)	**Temp** (ºC)	**pH**	**Cond** (mS/cm)	**Turb** (NTU)	**DO** (mg/L)	**ORP** (mv)	**Comments**
1400	20	23.39	7.42	1.27	over	4.62	142	Turbid
1430	40	23.43	7.61	0.992	over	5.08	145	No drawdown
10/10								
0735	60	24.20	7.02	0.840	953	4.87	196	
0754	80	23.08	7.74	0.771	623	4.76	155	Sediment
0924	120	24.03	7.52	0.701	227	4.73	157	
1005	170	24.41	7.17	0.671	112	4.70	148	Let settle
1050	195	24.49	7.43	0.655	87.6	4.65	136	
1210	250	24.53	6.85	0.650	90.3	5.06	130	
1226	275	24.37	6.99	0.656	89.1	4.53	129	
1236	285	23.98	6.82	0.656	83.9	4.76	124	
1320	290	24.39	6.86	0.665	79.3	4.94	130	Some fine sand

Notes: Final water level was the same as pre-development. Final height of well casing was same as for development or about 2.5 ft above ground surface. Limited drawdown indicates good recharge and high permeability at this location.

Exhibit H

Appendix B.1
Field Logbooks

CONTENTS

PAGE	REFERENCE	DATE

Book # 11

Location Red Hill - Lower Tunnel Date 4-18-19

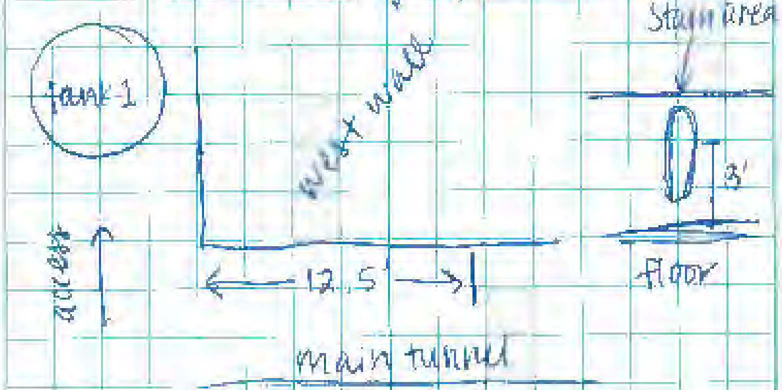
Project / Client

0630 Eric Wetzstein (EW) arrives WH
starts setting equipment
to gather

0820 Safety meeting at WH with FLOMMS
DH & EW

0920 DH & EW arrive on site [redacted]
FOIA §§ (b)(3), Critical Infrastructure; (b)(7), Law Enforcement
[redacted]

0941 mobilize to tank 1, took pictures
& took first sample (EK# 820)
12.5' from edge of tank wall



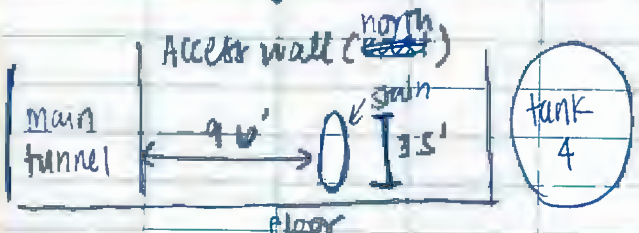
sample ID: tank 1 - west wall, collected @
0955

Book 11

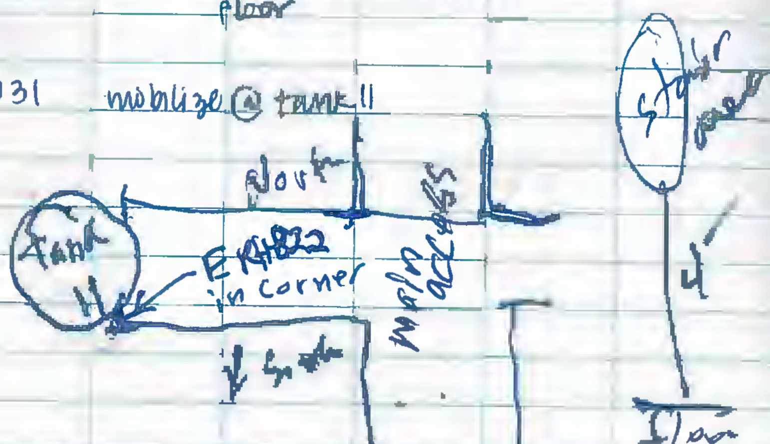
Location ~~Lower tunnel~~ Date 4-18-19

Project / Client

1005 noticed staining inside ~~access~~ walls of tank 4 staining coming from a drilled hole
ERH 821, collected @ 1014, petroleum odor
Sample ID: tank 4 north ~~east~~ wall ~~access tunnel~~
MultiRAE reading: oxygen = 20.9 % H_2S = 0 ppm VOC = 0 ppm
LEL = 0 % CO = 0 ppm



1031 mobilize @ tank 11



hydrocarbon odor noted at sample location
Sample collected @ 1041
Sample ID tank 11 - west drilled wall

Book 11

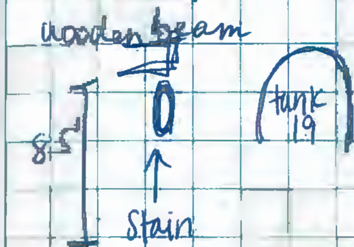
Location ~~Lower tunnel~~ Date 4-18-19

Project / Client

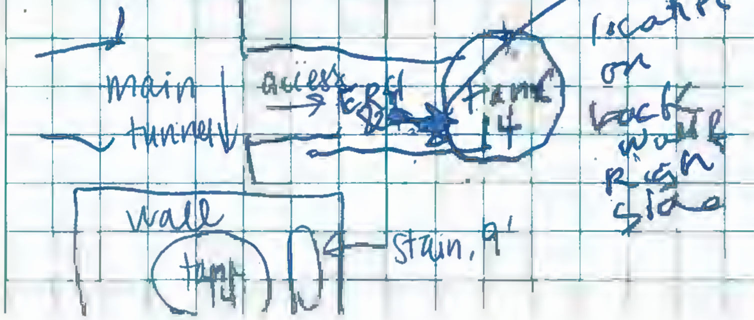
DH 4/18/19

1005 ~~noticed staining inside access wall of tank 4, staining coming from a drilled hole~~

1100 take elevator to UT, went to tank 19
took sample ERH 823
Sample ID tank 19 - beam wall @ 1134
sample was seep like



1227 Collecting Sample at tank #14
ERH 824



Book 11

Location Lower Tunnel   Date 4-18-19

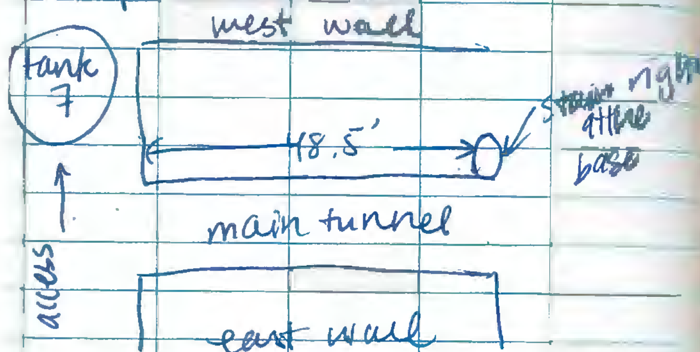
Project / Client

Mobilize to tank 7

no hydrocarbon odor

sample EEH 825 collected

sample ID tank 7-west wall



Departed site for WH (EW + DH)

DH + EW arrive at WH + unpack equipment

EW departs WH

DH ships samples from FedEx

departs FedEx to return to office

Location Lower tunnel   Date 4-18-19

Project / Client

1530: DH returns to office

DH 4/18/19

DH 4/18/19

Location Red Hill HCF RHMW12 Date 5/8/19
Project Client

0550 MH + Jack Flaherty (JF) @ warehouse to load equipment.
objective: Mobilize + set up @ RHMW12 for drilling / HSA / handclearing
weather: 40°, light variable wind, 70% humidity, partly cloudy
Personnel: AECOM (MH, JF, JK) VWO (RK, SS, BM)
0600 AECOM departs warehouse proceed to HCF
0615 AECOM + VWO arrive @ HCF discuss plan for the day + conduct H+S tailgate (see sign in sheet for details)
0640 sign in w/ guard shack + proceed to RHMW12. Setting up drill rig and ~~visqueen.~~ Borehole located ~ 13.5 ft North from edge of AC pavement.
0745 MH + JF take down orange fencing from RHTB01 + RHMW14 for use @ RHMW12. Also take orange delineators from RHTB01.
0830 MH + JF download mosdax

Location 5/8/19 cont. Date
Project Client

data from RHMW14. Data from 5/6/19 through 5/8/19 is suspect. Error code 'E' reported indicating probe communication error. Low battery icon displayed on mosdax upon arrival. changed battery.
0850 download data from RHMW11
0915 back @ RHMW12. VWO setting up plumbing for GAC.
0930 proceed to staging area to observe cores from RHTB01
1045 return to RHMW12
1130 VWO filling water tanks by pumping through GAC
1200 Fan belt on 1559 broke VWO working on repair.
1500 No part available for repair, clean up site
1515 depart site end field day

5/8/19 5/8/19

Location Red Hill RHMW12 5/9/19

Project Client

0550 MH + JF @ warehouse, load up equipment and calibrate
PID s/n 913390, Noise pro dosimeter
S/N NXS 050035 + Dustmeter
S/N 6770, see cal logs for details.

weather: Partly cloudy, 80°, light variable wind, 75% humidity

Personnel: AECOM (MH, JF) UWD (RK, SJ)

objective: collect potable water sample, hand clear @ RHMW12 to 5 ft bgs; then commence HSA

0615 depart warehouse, proceed to HCF

0635 @ HCF, UWD already in lot, sign in then proceed to RHMW12

0640 conduct H+S tailgate (see sign in sheet for details)

0650 UWD begins working on fan belt repair

0710 collect TB ERH 826 3×40mL voas w/HCl

0750 Drill rig repair complete. UWD filling water tanks,

0759 collect FB ERH 828* from near

Location RHMW12 5/9/19 cont. Date

Project / Client

drill rig working area while rig is running

0820 Driller concerned about moyno water pump output. says used to get ~70 gpm. Now only gets ~30 gpm. says may need new pump / rebuild

0930 UWD troubleshooting pump

0945 RK says pump needs to be repaired / replaced offsite. UWD demobbing drill rig.

*AECOM empties FB ERH 828 into IDW
will collect new sample next shift when pump is functional.

1030 UWD departs site w/ drill rig
AECOM begins hand augering

1130 hand auger to 4.3 ft bgs. encounter boulder making progress too difficult, clean up site.

1200 depart site, proceed to staging area to meet UWD. RK called and said pump is fine.

For Red Hill AOC Party Use Only

Location ______ Date ______

Project / Client 5/9/19 cont

VWO bringing rig to staging area.
1230 SS onsite w/ drill rig, position over RHMW12
1300 All depart site. MH + SF proceed to warehouse
1330 @ warehouse, end field day.

5/9/19

5/9/19

Location Red Hill RHMW1X2 JF Date ______

Project / Client 5/10/19

0550 MH + SF @ warehouse, load equipment + calibrate PID S/N 592-962229, Noise dosimeter S/N WXJ 050035, + dust meter S/N 6740. See cal logs for details.
Weather: Partly cloudy, 80°, mod. trade wind 70% humidity
Personnel: AECOM (MH, SF), VWO (RK, MS)
Objective: Re-collect potable water sample, HSA @ RHMW12
0605 depart warehouse, proceed to HCF
0630 @ HCF, VWO onsite already, sign in and proceed to RHMW12 conduct H+S tailgate see sign in sheet for details, VWO flushing drill rig pump + lines w/ alconox during meeting.
~~SF~~ MH
0645 end alconox flush. VWO plumbing in GAC filter.
* Note ERH 526 TB was collected during the prev. shift @ 1710 (5/9/19)

Exhibit I

Appendix F:
Petrographic Analytical Report

Table 1
Free Product Mobility Data
Water Drive Method

Petroleum Services

AECOM Technical Services Core Lab File No: 1703942

Project Name: Red Hill Bulk Fuel Storage Facility
Project No: 60481245
Project Location: Joint Base Pearl Harbor-Hickman, Oahu HI

		METHODS:	API RP 40		API RP 40	Core Lab, API RP40				
						Pore Fluid Saturations, frac pore volume				
Sample ID.	Depth ft.	Sample Orientation (1)	Density		Total Porosity, frac	Initial Fluid Saturations (2)		Injection Pressure, ft-wtr(4)	Final Fluid Saturations (2)	
			Bulk (Dry) g/cc	Grain g/cc		Water	NAPL (3)		Water	NAPL (3)
ERH 509 65.7-66.4	65.90	V	1.70	2.94	0.418	0.711	0.289	50.0	0.861	0.139
ERH 510 81.0-81.7	81.10	V	2.70	3.00	0.051	0.436	0.564	50.0	0.436	0.564
ERH 511 155.2-155.9	155.30	V	1.80	3.05	0.412	0.639	0.361	50.0	0.693	0.307
ERH 512 105.9	106.10	V	1.66	2.98	0.447	0.750	0.250	50.0	0.871	0.129
ERH 513 133.0	133.20	V	2.12	2.99	0.289	0.574	0.426	50.0	0.778	0.222
ERH 514 162.8	162.95	V	2.40	3.04	0.211	0.367	0.633	50.0	0.644	0.356
ERH 515 181.5	Unable to obtain sufficient sample for testing									
ERH 516 242.6	242.70	V	1.76	3.05	0.409	0.707	0.293	50.0	0.707	0.293
ERH 517 341.3	341.40	V	1.77	3.06	0.429	0.241	0.759	4.6	0.415	0.585
ERH 521 171.0-171.8	171.35	V	1.89	3.05	0.374	0.574	0.426	50.0	0.576	0.424
ERH 522 200.2-201	200.30	V	1.80	2.95	0.390	0.849	0.151	50.0	0.849	0.151
ERH 523 218.2-219	218.80	V	2.45	3.00	0.176	0.511	0.489	50.0	0.781	0.219
ERH 524 248.8-249.5	249.00	V	1.58	3.00	0.483	0.644	0.356	4.6	0.644	0.356
ERH 525 289-289.8	289.25	V	2.11	3.08	0.299	0.630	0.370	50.0	0.827	0.173
ERH 526 108.5-109	108.70	V	2.12	3.02	0.294	0.805	0.195	50.0	0.805	0.195
ERH 527 137.6-138.4	137.80	V	2.55	3.00	0.133	0.556	0.444	50.0	0.556	0.444
ERH 528 155.4-156	155.60	V	2.22	3.00	0.262	0.699	0.301	50.0	0.699	0.301
ERH 529 177.2-178	177.40	V	2.10	3.07	0.292	0.694	0.306	50.0	0.694	0.306
ERH 530 214.4-216.0	215.50	V	2.58	2.99	0.118	0.523	0.477	50.0	0.523	0.477
ERH 531 296.6-297.2	296.95	V	1.51	3.02	0.513	0.556	0.444	11.5	0.619	0.381

Table 1
Free Product Mobility Data
Water Drive Method

Petroleum Services

AECOM Technical Services — Core Lab File No: 1703942

Project Name: Red Hill Bulk Fuel Storage Facility
Project No: 60481245
Project Location: Joint Base Pearl Harbor-Hickman, Oahu HI

		METHODS:	API RP 40		API RP 40	Core Lab, API RP40				
						Pore Fluid Saturations, frac pore volume				
			Density			Initial Fluid Saturations (2)		Injection	Final Fluid Saturations (2)	
Sample ID.	Depth ft.	Sample Orientation (1)	Bulk (Dry) g/cc	Grain g/cc	Total Porosity, frac	Water	NAPL (3)	Pressure, ft-wtr(4)	Water	NAPL (3)
ERH 532 325.2-325.7	325.35	V	2.30	3.01	0.233	0.481	0.519	50.0	0.481	0.519
ERH 533 393.5-394.2	393.60	V	2.56	3.00	0.133	0.364	0.636	50.0	0.364	0.636
ERH 534 489.5-490.0	489.65	V	1.97	3.04	0.351	0.624	0.376	2.3	0.673	0.327
		Max	2.70	3.08	0.513	0.849	0.759	50.0	0.871	0.636
		Min	1.51	2.94	0.051	0.241	0.151	2.3	0.364	0.129
		Avg	2.08	3.02	0.305	0.588	0.412	42.0	0.659	0.341

(1) V = vertical, H = horizontal
(2) NAPL Density = 0.8066 g/cc
(3) NAPL = Jet Fuel supplied by AECOM
(4) 50ft-wtr = 21.7psi

Core Lab
RESERVOIR OPTIMIZATION

Table 2
VISCOSITY and DENSITY DATA
(METHODOLOGY: ASTM D445, ASTM D1481, API RP40)

PETROLEUM SERVICES

Company: **AECOM Technical Services**
Project Name: Red Hill Bulk Fuel Storage Facility
Project No: 60481245
Project Location: Joint Base Pearl Harbor-Hickman, Oahu HI

Core Lab File No: 1703942

Lab Sample No.	Project No.	Matrix	Sample Source	Sample Date	Analysis Date	Temperature °F	Density g/cc	°API	Viscosity centistokes	Viscosity centipoise
1703942-1	60481245	Jet Fuel	Client	N/A	8/17/18	60	0.8135	42.4	—	—
						76	0.8070		1.530	1.234
						80	0.8054		1.482	1.193
						91	0.8010		1.304	1.044

API measured by pycnometer
Viscosity measured by a Crossarm Viscometer

Table 3
INTERFACIAL / SURFACE TENSION DATA
(METHODOLOGY: DuNuoy Method - ASTM D971)

Phase Pair		Temp., °F	Interfacial Tension, Dynes/centimeter
Air	Water	60	69.9
Air	Jet Fuel	60	25.0
Water	Jet Fuel	60	15.7

Table 4
Basic Rock Properties
(METHODOLOGY: API RP40)

PETROLEUM SERVICES

AECOM Technical Services Core Lab File No: 1703942EN

Project Name: Red Hill Bulk Fuel Storage Facility
Project No: 60481245
Project Location: Joint Base Pearl Harbor-Hickman, Oahu HI

Sample ID	Depth, ft.	Measured at 250psi Net Confining Stress* Permeability to Air (Kair), md Pre-Test	Post Test Re-Run A –> B	Post Test Re-Run B –> A	Total Porosity %Vb	Helium Pore Volume cc	Helium Grain Volume cc	Grain Density g/cc	Core Description Provided by AECOM
ERH 509 56.7-66.4	65.90	619			41.6	21.94	30.57	2.94	Weathered a'a clinker
ERH 510 81.0-81.7	81.10	0.018			5.11	3.04	56.38	3.00	welded a'a clinker
ERH 511 155.2-155.9	155.30	7.05			41.2	23.35	33.35	3.05	massive a'a
ERH 512 105.9	106.10	3287	302	305	44.7	18.33	22.69	2.98	Weathered a'a clinker
ERH 513 133.0	133.20	21.8			28.9	16.19	39.84	2.99	pahoehoe
ERH 514 162.8	162.95	0.097			21.1	11.93	44.70	3.04	pahoehoe
ERH 515 161.5	Unable to obtain sufficient sample for testing								Weathered a'a clinker
ERH 516 242.6	242.70	0.241			40.9	22.41	32.44	3.05	massive a'a
ERH 517 341.3	341.40	53.3			42.9	24.36	32.42	3.06	pahoehoe
ERH 521 171.0-171.8	171.35	1.77			37.4	21.67	36.29	3.05	pahoehoe
ERH 522 200.2-201	200.30	5371	632	614	39.0	19.67	30.80	2.95	Weathered a'a clinker
ERH 523 218.2-219	218.80	31.6			17.6	7.24	33.94	3.00	welded a'a clinker
ERH 524 248.8-249.5	249.00	7873	16543	16543	48.3	28.25	30.21	3.00	pahoehoe
ERH 525 289-289.8	289.25	0.380			29.9	16.28	38.10	3.08	pahoehoe
ERH 526 108.5-109	108.70	4.96			29.4	17.25	41.38	3.02	welded a'a clinker
ERH 527 137.6-138.4	137.80	0.050			13.3	5.64	36.81	3.00	massive a'a
ERH 528 155.4-156	155.60	2.65			26.2	15.99	45.12	3.00	Weathered a'a clinker
ERH 529 177.2-178	177.40	0.284			29.2	16.26	39.47	3.07	pahoehoe
ERH 530 214.4-216.0	215.50	0.069			11.8	7.32	54.60	2.99	massive a'a

*250 psi confining stress to minimize bypass around sample
Vb = Bulk Volume

Core Lab

Table 4
Basic Rock Properties
(METHODOLOGY: API RP40)

PETROLEUM SERVICES

AECOM Technical Services — Core Lab File No: 1703942EN

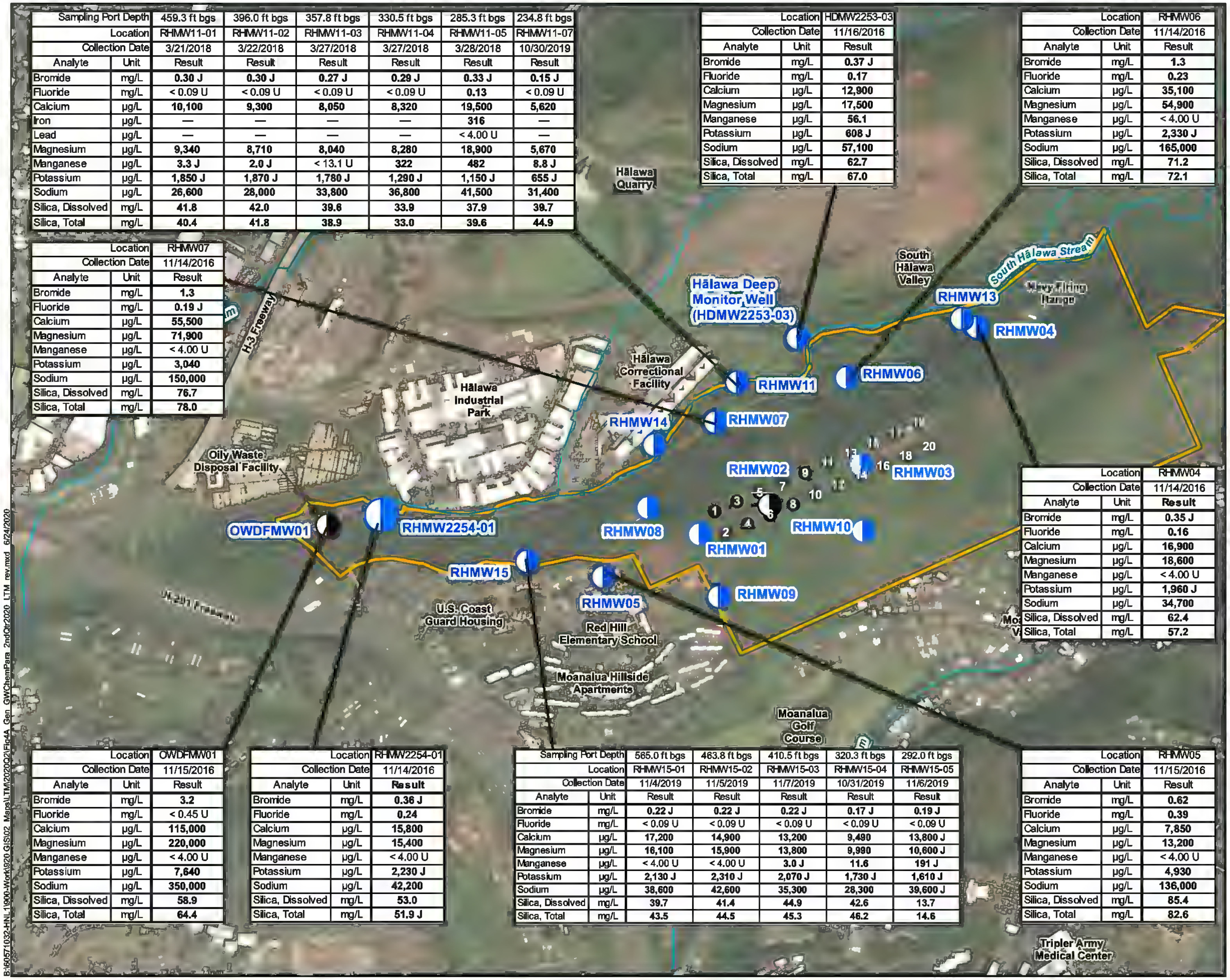
Project Name: Red Hill Bulk Fuel Storage Facility
Project No: 60481245
Project Location: Joint Base Pearl Harbor-Hickman, Oahu HI

Sample ID	Depth, ft.	Measured at 250psi Net Confining Stress*: Permeability to Air (Kair), md: Pre-Test	Post Test Re-Run A -> B	Post Test Re-Run B -> A	Total Porosity %Vb	Helium Pore Volume cc	Helium Grain Volume cc	Grain Density g/cc	Core Description Provided by AECOM
ERH 531 296.6-297.2	296.95	3917	4529	4529	51.3	30.08	28.60	3.02	Pahoehoe - oxidized dark reddish brown, highly vesicular 50%, small vesicles
ERH 532 325.2-325.7	325.35	0.098			23.3	13.35	44.01	3.01	Pahoehoe - gray, large vesicles 15%, some infilling in vesicles
ERH 533 393.5-394.2	393.60	0.149			13.3	7.70	49.99	3.00	Pahoehoe - gray, vesicular 25%, small to medium vesicles
ERH 534 489.5-490.0	489.65	11716	11716	11716	35.1	20.18	37.32	3.04	Pahoehoe - sl. oxidized reddish brown, vesicular 25%, small to medium vesicles
	Max	11716			51.3	30.1	56.4	3.08	
	Min	0.018			5.11	3.04	22.7	2.94	
	Avg	1496			30.5	16.7	38.1	3.02	

QC Check Samples	Assay, md	Measured, md	Diff %
Core Lab CK D	131	132	-0.76
Core Lab CK E	928	949	+0.76

*250 psi confining stress to minimize bypass around sample
Vb = Bulk Volume

Exhibit J



Sampling Port Depth		459.3 ft bgs	396.0 ft bgs	357.8 ft bgs	330.5 ft bgs	285.3 ft bgs	234.8 ft bgs
Location		RHMW11-01	RHMW11-02	RHMW11-03	RHMW11-04	RHMW11-05	RHMW11-07
Collection Date		3/21/2018	3/22/2018	3/27/2018	3/27/2018	3/28/2018	10/30/2019
Analyte	Unit	Result	Result	Result	Result	Result	Result
Bromide	mg/L	**0.30 J**	**0.30 J**	**0.27 J**	**0.29 J**	**0.33 J**	**0.15 J**
Fluoride	mg/L	< 0.09 U	< 0.09 U	< 0.09 U	< 0.09 U	**0.13**	< 0.09 U
Calcium	µg/L	**10,100**	**9,300**	**8,050**	**8,320**	**19,500**	**5,620**
Iron	µg/L	—	—	—	—	**316**	—
Lead	µg/L	—	—	—	—	< 4.00 U	—
Magnesium	µg/L	**9,340**	**8,710**	**8,040**	**8,280**	**18,900**	**5,670**
Manganese	µg/L	**3.3 J**	**2.0 J**	< 13.1 U	**322**	**482**	**8.8 J**
Potassium	µg/L	**1,850 J**	**1,870 J**	**1,780 J**	**1,290 J**	**1,150 J**	**655 J**
Sodium	µg/L	**26,600**	**28,000**	**33,800**	**36,800**	**41,500**	**31,400**
Silica, Dissolved	mg/L	**41.8**	**42.0**	**39.6**	**33.9**	**37.9**	**39.7**
Silica, Total	mg/L	**40.4**	**41.8**	**38.9**	**33.0**	**39.6**	**44.9**

Location		HDMW2253-03
Collection Date		11/16/2016
Analyte	Unit	Result
Bromide	mg/L	**0.37 J**
Fluoride	mg/L	**0.17**
Calcium	µg/L	**12,900**
Magnesium	µg/L	**17,500**
Manganese	µg/L	**56.1**
Potassium	µg/L	**608 J**
Sodium	µg/L	**57,100**
Silica, Dissolved	mg/L	**62.7**
Silica, Total	mg/L	**67.0**

Location		RHMW06
Collection Date		11/14/2016
Analyte	Unit	Result
Bromide	mg/L	**1.3**
Fluoride	mg/L	**0.23**
Calcium	µg/L	**35,100**
Magnesium	µg/L	**54,900**
Manganese	µg/L	< 4.00 U
Potassium	µg/L	**2,330 J**
Sodium	µg/L	**165,000**
Silica, Dissolved	mg/L	**71.2**
Silica, Total	mg/L	**72.1**

Location		RHMW07
Collection Date		11/14/2016
Analyte	Unit	Result
Bromide	mg/L	**1.3**
Fluoride	mg/L	**0.19 J**
Calcium	µg/L	**55,500**
Magnesium	µg/L	**71,900**
Manganese	µg/L	< 4.00 U
Potassium	µg/L	**3,040**
Sodium	µg/L	**150,000**
Silica, Dissolved	mg/L	**76.7**
Silica, Total	mg/L	**78.0**

Location		RHMW04
Collection Date		11/14/2016
Analyte	Unit	Result
Bromide	mg/L	**0.35 J**
Fluoride	mg/L	**0.16**
Calcium	µg/L	**16,900**
Magnesium	µg/L	**18,600**
Manganese	µg/L	< 4.00 U
Potassium	µg/L	**1,960 J**
Sodium	µg/L	**34,700**
Silica, Dissolved	mg/L	**62.4**
Silica, Total	mg/L	**57.2**

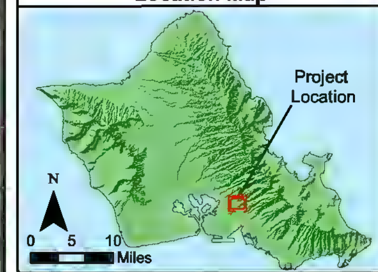
Location		OWDFMW01
Collection Date		11/15/2016
Analyte	Unit	Result
Bromide	mg/L	**3.2**
Fluoride	mg/L	< 0.45 U
Calcium	µg/L	**115,000**
Magnesium	µg/L	**220,000**
Manganese	µg/L	< 4.00 U
Potassium	µg/L	**7,640**
Sodium	µg/L	**350,000**
Silica, Dissolved	mg/L	**58.9**
Silica, Total	mg/L	**64.4**

Location		RHMW2254-01
Collection Date		11/14/2016
Analyte	Unit	Result
Bromide	mg/L	**0.36 J**
Fluoride	mg/L	**0.24**
Calcium	µg/L	**15,800**
Magnesium	µg/L	**15,400**
Manganese	µg/L	< 4.00 U
Potassium	µg/L	**2,230 J**
Sodium	µg/L	**42,200**
Silica, Dissolved	mg/L	**53.0**
Silica, Total	mg/L	**51.9 J**

Sampling Port Depth		565.0 ft bgs	463.8 ft bgs	410.5 ft bgs	320.3 ft bgs	292.0 ft bgs
Location		RHMW15-01	RHMW15-02	RHMW15-03	RHMW15-04	RHMW15-05
Collection Date		11/4/2019	11/5/2019	11/7/2019	10/31/2019	11/6/2019
Analyte	Unit	Result	Result	Result	Result	Result
Bromide	mg/L	**0.22 J**	**0.22 J**	**0.22 J**	**0.17 J**	**0.19 J**
Fluoride	mg/L	< 0.09 U	< 0.09 U	< 0.09 U	< 0.09 U	< 0.09 U
Calcium	µg/L	**17,200**	**14,900**	**13,200**	**9,490**	**13,800 J**
Magnesium	µg/L	**16,100**	**15,900**	**13,800**	**9,990**	**10,600 J**
Manganese	µg/L	< 4.00 U	< 4.00 U	**3.0 J**	**11.6**	**191 J**
Potassium	µg/L	**2,130 J**	**2,310 J**	**2,070 J**	**1,730 J**	**1,610 J**
Sodium	µg/L	**38,600**	**42,600**	**35,300**	**28,300**	**39,600 J**
Silica, Dissolved	mg/L	**39.7**	**41.4**	**44.9**	**42.6**	**13.7**
Silica, Total	mg/L	**43.5**	**44.5**	**45.3**	**46.2**	**14.6**

Location		RHMW05
Collection Date		11/15/2016
Analyte	Unit	Result
Bromide	mg/L	**0.62**
Fluoride	mg/L	**0.39**
Calcium	µg/L	**7,850**
Magnesium	µg/L	**13,200**
Manganese	µg/L	< 4.00 U
Potassium	µg/L	**4,930**
Sodium	µg/L	**136,000**
Silica, Dissolved	mg/L	**85.4**
Silica, Total	mg/L	**82.6**

Location Map



Legend

- Monitoring Well with Screening Criteria Exceedance(s)
- Existing Monitoring Well Location
- Red Hill Tank
- Stream
- Red Hill Facility Boundary

Notes

1. Map projection: NAD 1983 UTM Zone 4N
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Only analytes with detections and associated SGC data (if applicable) are shown.

ABBREVIATIONS:

FD	field duplicate sample
ID	identification
J	estimated value
N	primary (normal) sample
SGC	silica gel cleanup
SSRBL	site-specific risk based level
TPH-d	total petroleum hydrocarbon - diesel range organics
TPH-g	total petroleum hydrocarbon - gasoline range organics
TPH-o	total petroleum hydrocarbon - oil/residual organics
U	non-detect value (reported as less than the limit of detection)
µg/L	microgram per liter

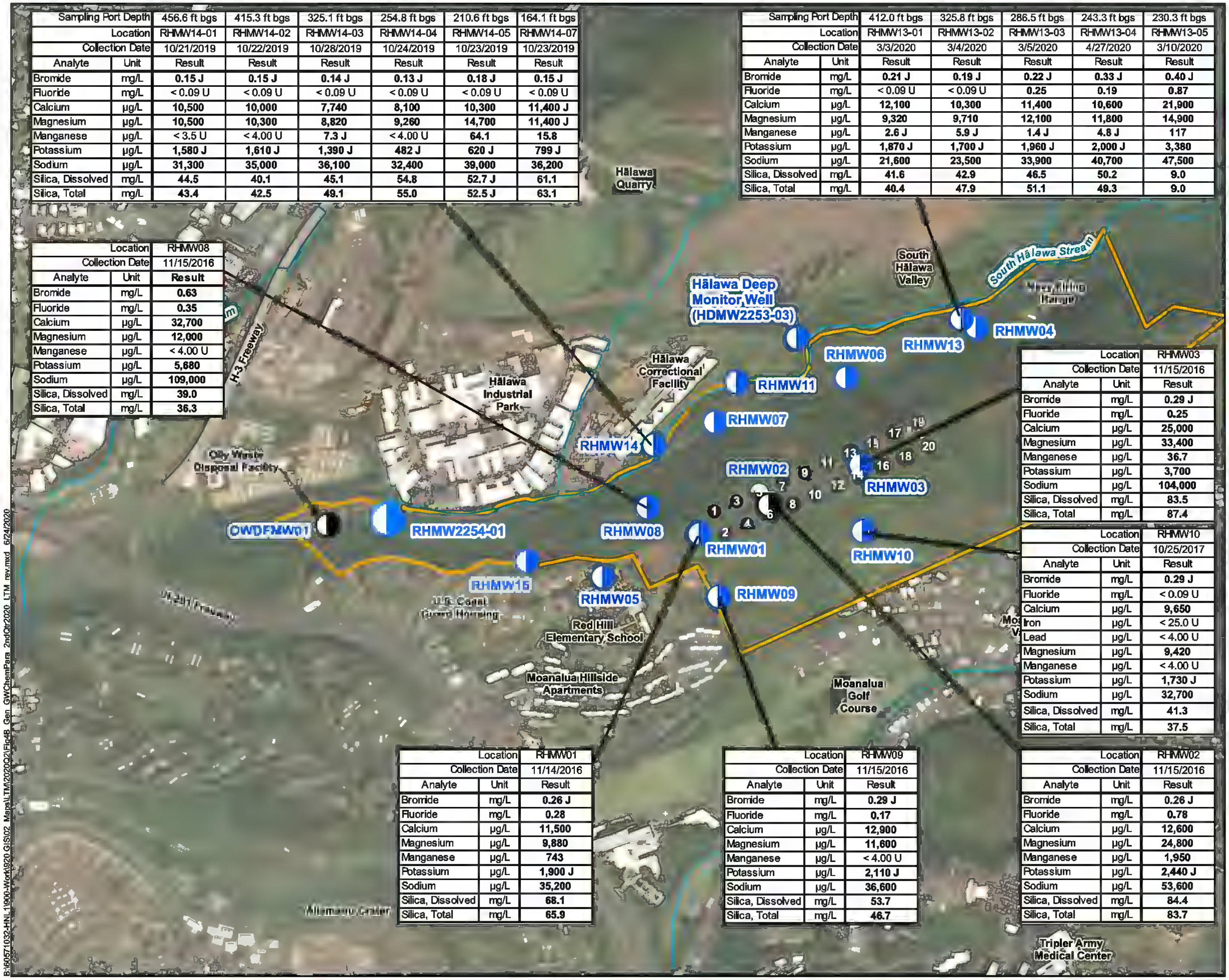
Monitoring Well with **COPC** Screening Criteria Exceedance(s)

N

0 400 800 1,600 Feet

Figure 4A
General Groundwater Chemistry Parameters
2nd Qtr 2020 Groundwater LTM Report
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

B:\60571032-HNL 1900-Work\920 GIS\02 Maps\LTM\2020\2Q\Fig4A Gen GWChemPara 2ndQtr2020 LTM rev.mxd 6/24/2020



Sampling Port Depth		456.6 ft bgs	415.3 ft bgs	325.1 ft bgs	254.8 ft bgs	210.6 ft bgs	164.1 ft bgs
Location		RHMW14-01	RHMW14-02	RHMW14-03	RHMW14-04	RHMW14-05	RHMW14-07
Collection Date		10/21/2019	10/22/2019	10/28/2019	10/24/2019	10/23/2019	10/23/2019
Analyte	Unit	Result	Result	Result	Result	Result	Result
Bromide	mg/L	0.15 J	0.15 J	0.14 J	0.13 J	0.18 J	0.15 J
Fluoride	mg/L	< 0.09 U	< 0.09 U	< 0.09 U	< 0.09 U	< 0.09 U	< 0.09 U
Calcium	µg/L	10,500	10,000	7,740	8,100	10,300	11,400 J
Magnesium	µg/L	10,500	10,300	8,820	9,260	14,700	11,400 J
Manganese	µg/L	< 3.5 U	< 4.00 U	7.3 J	< 4.00 U	64.1	15.8
Potassium	µg/L	1,580 J	1,610 J	1,390 J	482 J	620 J	799 J
Sodium	µg/L	31,300	35,000	36,100	32,400	39,000	36,200
Silica, Dissolved	mg/L	44.5	40.1	45.1	54.8	52.7 J	61.1
Silica, Total	mg/L	43.4	42.5	49.1	55.0	52.5 J	63.1

Sampling Port Depth		412.0 ft bgs	325.8 ft bgs	286.5 ft bgs	243.3 ft bgs	230.3 ft bgs
Location		RHMW13-01	RHMW13-02	RHMW13-03	RHMW13-04	RHMW13-05
Collection Date		3/3/2020	3/4/2020	3/5/2020	4/27/2020	3/10/2020
Analyte	Unit	Result	Result	Result	Result	Result
Bromide	mg/L	0.21 J	0.19 J	0.22 J	0.33 J	0.40 J
Fluoride	mg/L	< 0.09 U	< 0.09 U	0.25	0.19	0.87
Calcium	µg/L	12,100	10,300	11,400	10,600	21,900
Magnesium	µg/L	9,320	9,710	12,100	11,800	14,900
Manganese	µg/L	2.6 J	5.9 J	1.4 J	4.8 J	117
Potassium	µg/L	1,870 J	1,700 J	1,960 J	2,000 J	3,380
Sodium	µg/L	21,600	23,500	33,900	40,700	47,500
Silica, Dissolved	mg/L	41.6	42.9	46.5	50.2	9.0
Silica, Total	mg/L	40.4	47.9	51.1	49.3	9.0

Location		RHMW08
Collection Date		11/15/2016
Analyte	Unit	Result
Bromide	mg/L	0.63
Fluoride	mg/L	0.35
Calcium	µg/L	32,700
Magnesium	µg/L	12,000
Manganese	µg/L	< 4.00 U
Potassium	µg/L	5,680
Sodium	µg/L	109,000
Silica, Dissolved	mg/L	39.0
Silica, Total	mg/L	36.3

Location		RHMW03
Collection Date		11/15/2016
Analyte	Unit	Result
Bromide	mg/L	0.29 J
Fluoride	mg/L	0.25
Calcium	µg/L	25,000
Magnesium	µg/L	33,400
Manganese	µg/L	36.7
Potassium	µg/L	3,700
Sodium	µg/L	104,000
Silica, Dissolved	mg/L	83.5
Silica, Total	mg/L	87.4

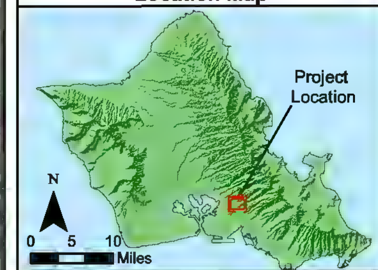
Location		RHMW10
Collection Date		10/25/2017
Analyte	Unit	Result
Bromide	mg/L	0.29 J
Fluoride	mg/L	< 0.09 U
Calcium	µg/L	9,650
Iron	µg/L	< 25.0 U
Lead	µg/L	< 4.00 U
Magnesium	µg/L	9,420
Manganese	µg/L	< 4.00 U
Potassium	µg/L	1,730 J
Sodium	µg/L	32,700
Silica, Dissolved	mg/L	41.3
Silica, Total	mg/L	37.5

Location		RHMW01
Collection Date		11/14/2016
Analyte	Unit	Result
Bromide	mg/L	0.26 J
Fluoride	mg/L	0.28
Calcium	µg/L	11,500
Magnesium	µg/L	9,880
Manganese	µg/L	743
Potassium	µg/L	1,900 J
Sodium	µg/L	35,200
Silica, Dissolved	mg/L	68.1
Silica, Total	mg/L	65.9

Location		RHMW09
Collection Date		11/15/2016
Analyte	Unit	Result
Bromide	mg/L	0.29 J
Fluoride	mg/L	0.17
Calcium	µg/L	12,900
Magnesium	µg/L	11,600
Manganese	µg/L	< 4.00 U
Potassium	µg/L	2,110 J
Sodium	µg/L	36,600
Silica, Dissolved	mg/L	53.7
Silica, Total	mg/L	46.7

Location		RHMW02
Collection Date		11/15/2016
Analyte	Unit	Result
Bromide	mg/L	0.26 J
Fluoride	mg/L	0.78
Calcium	µg/L	12,600
Magnesium	µg/L	24,800
Manganese	µg/L	1,950
Potassium	µg/L	2,440 J
Sodium	µg/L	53,600
Silica, Dissolved	mg/L	84.4
Silica, Total	mg/L	83.7

Location Map



Legend

Monitoring Well with Screening Criteria Exceedance(s)

Existing Monitoring Well Location

1 Red Hill Tank

Stream

Red Hill Facility Boundary

Notes

1. Map projection: NAD 1983 UTM Zone 4N
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Only analytes with detections and associated SGC data (if applicable) are shown.

ABBREVIATIONS:

FD	field duplicate sample
ID	identification
J	estimated value
N	primary (normal) sample
SGC	silica gel cleanup
SSRBL	site-specific risk based level
TPH-d	total petroleum hydrocarbon - diesel range organics
TPH-g	total petroleum hydrocarbon - gasoline range organics
TPH-o	total petroleum hydrocarbon - oil/residual organics
U	non-detect value (reported as less than the limit of detection)
µg/L	microgram per liter

Monitoring Well with **COPC** Screening Criteria Exceedance(s)

N

0 400 800 1,600 Feet

Figure 4B
General Groundwater Chemistry Parameters
2nd Qtr 2020 Groundwater LTM Report
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

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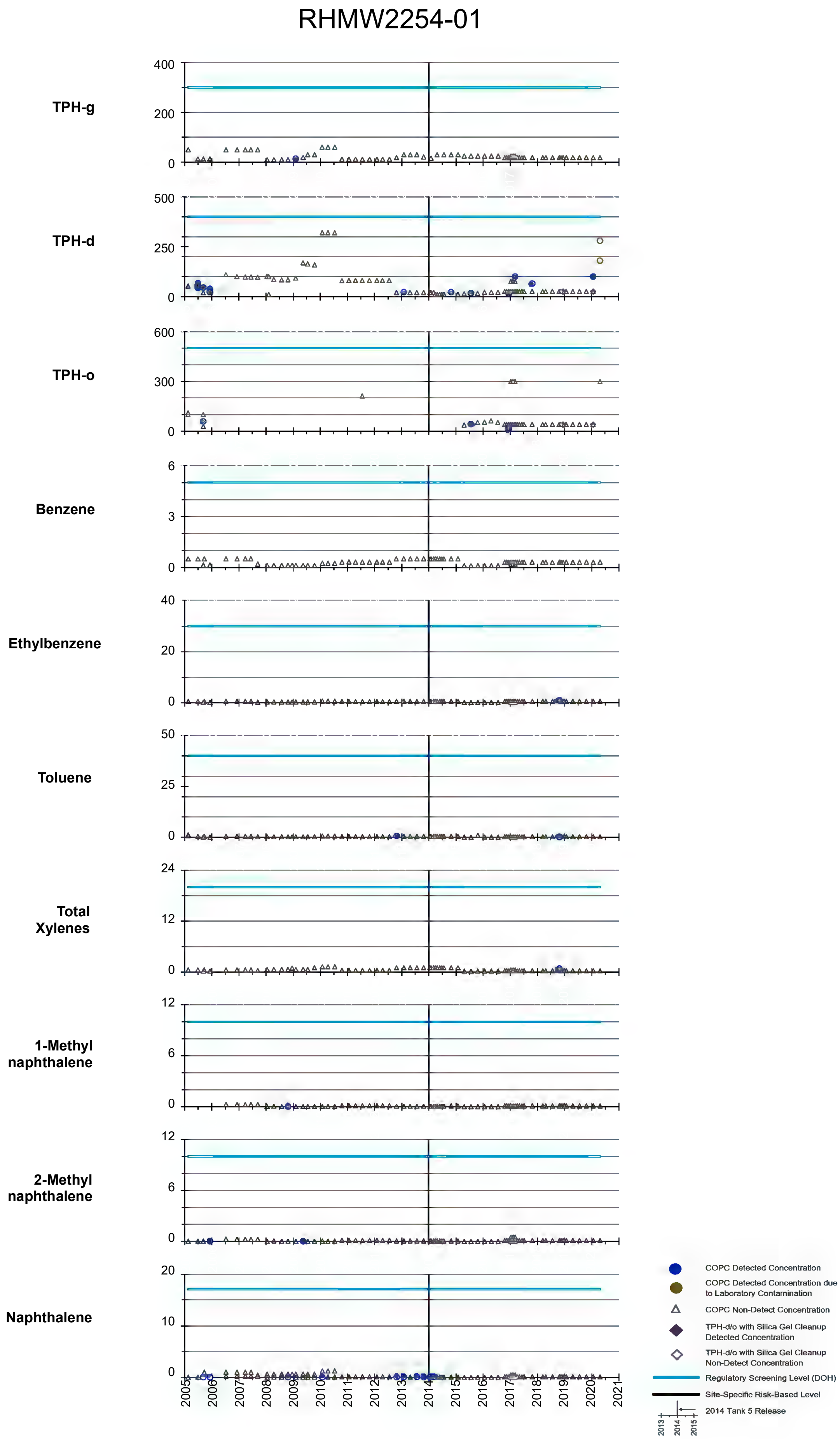
Appendix A.2:
Groundwater COPC Graphs

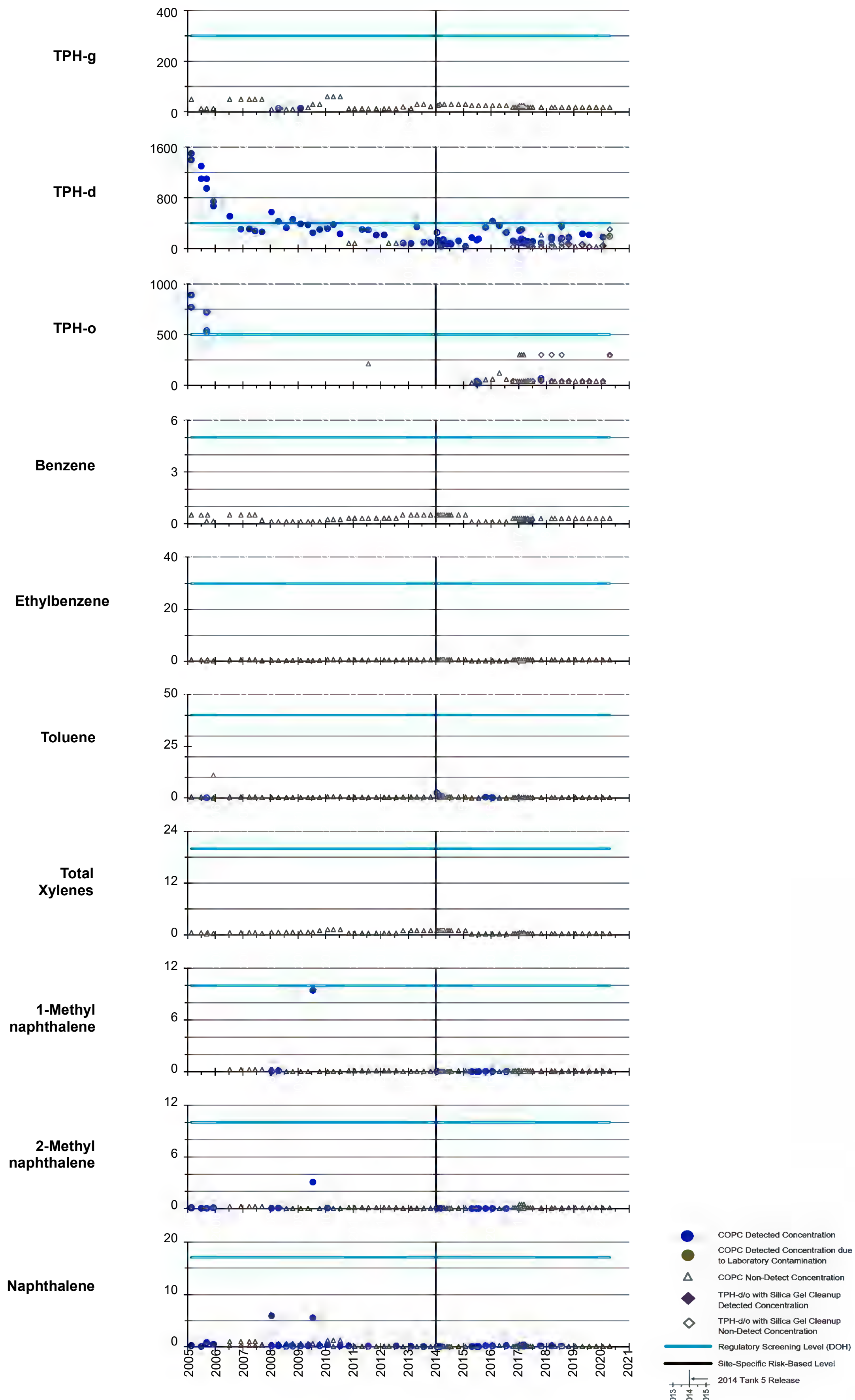


All results in micrograms per liter (µg/L or parts per billion).

EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.

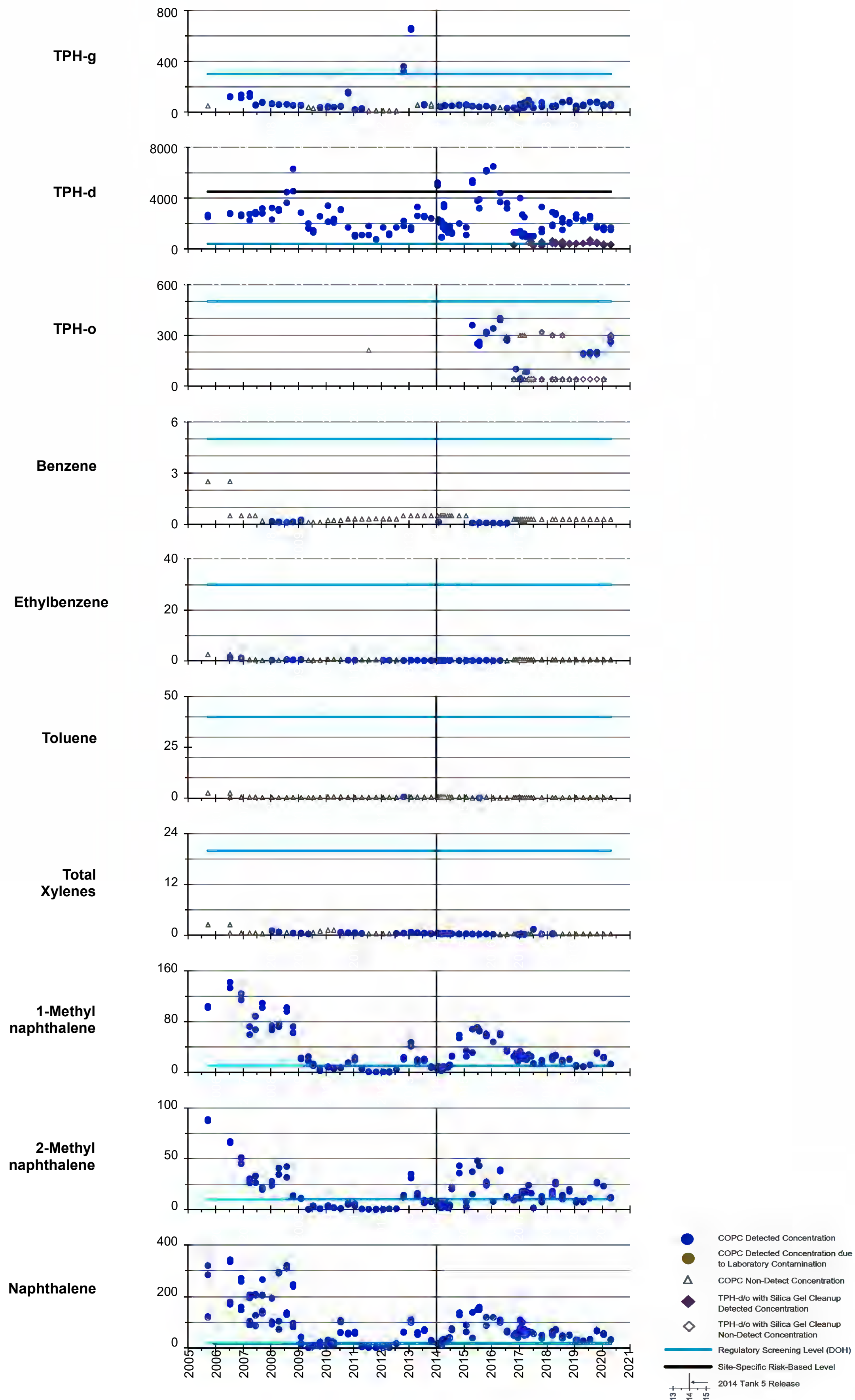
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW01



All results in micrograms per liter (µg/L or parts per billion).
EPA Region 9 Laboratory split sampling data from First to Fourth Quarters 2017, First Quarter 2018, and Third Quarter 2018 included in the graphs.
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW02

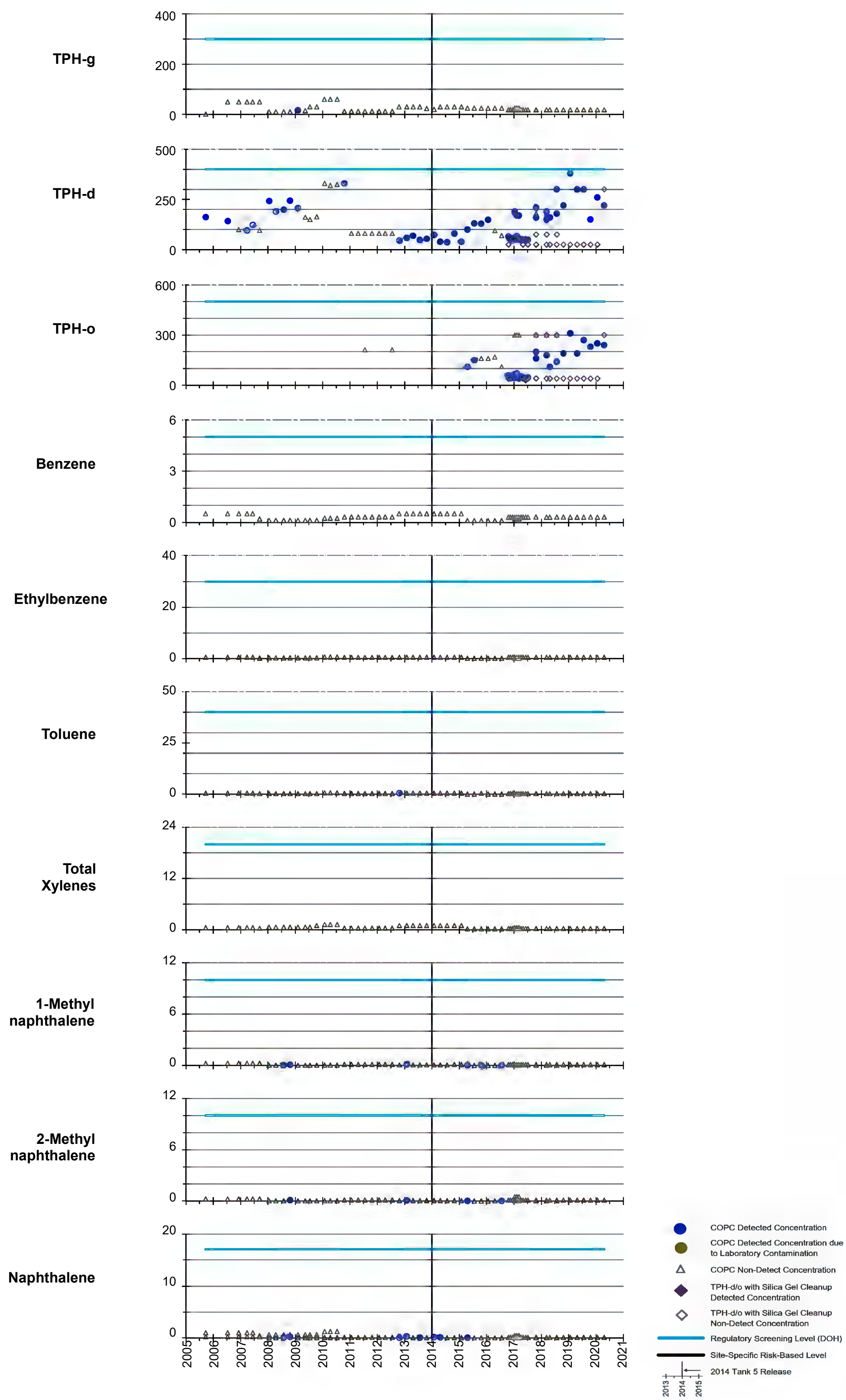


All results in micrograms per liter (µg/L or parts per billion).

EPA Region 9 Laboratory split sampling data from First to Fourth Quarters 2017, First Quarter 2018, and Third Quarter 2018 included in the graphs.

Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW03

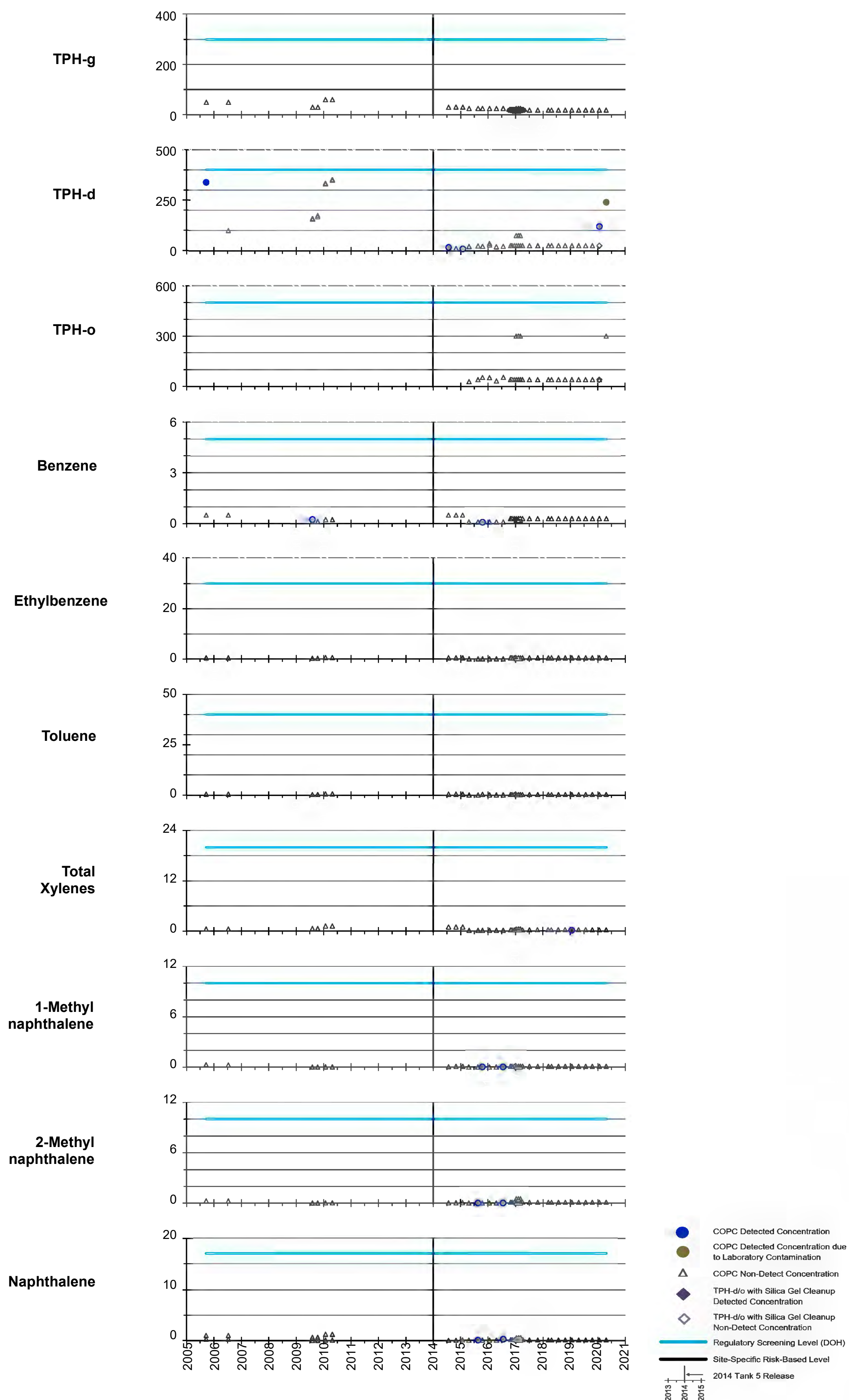


All results in micrograms per liter (µg/L or parts per billion).

EPA Region 9 Laboratory split sampling data from First to Fourth Quarters 2017, First Quarter 2018, and Third Quarter 2018 included in the graphs.

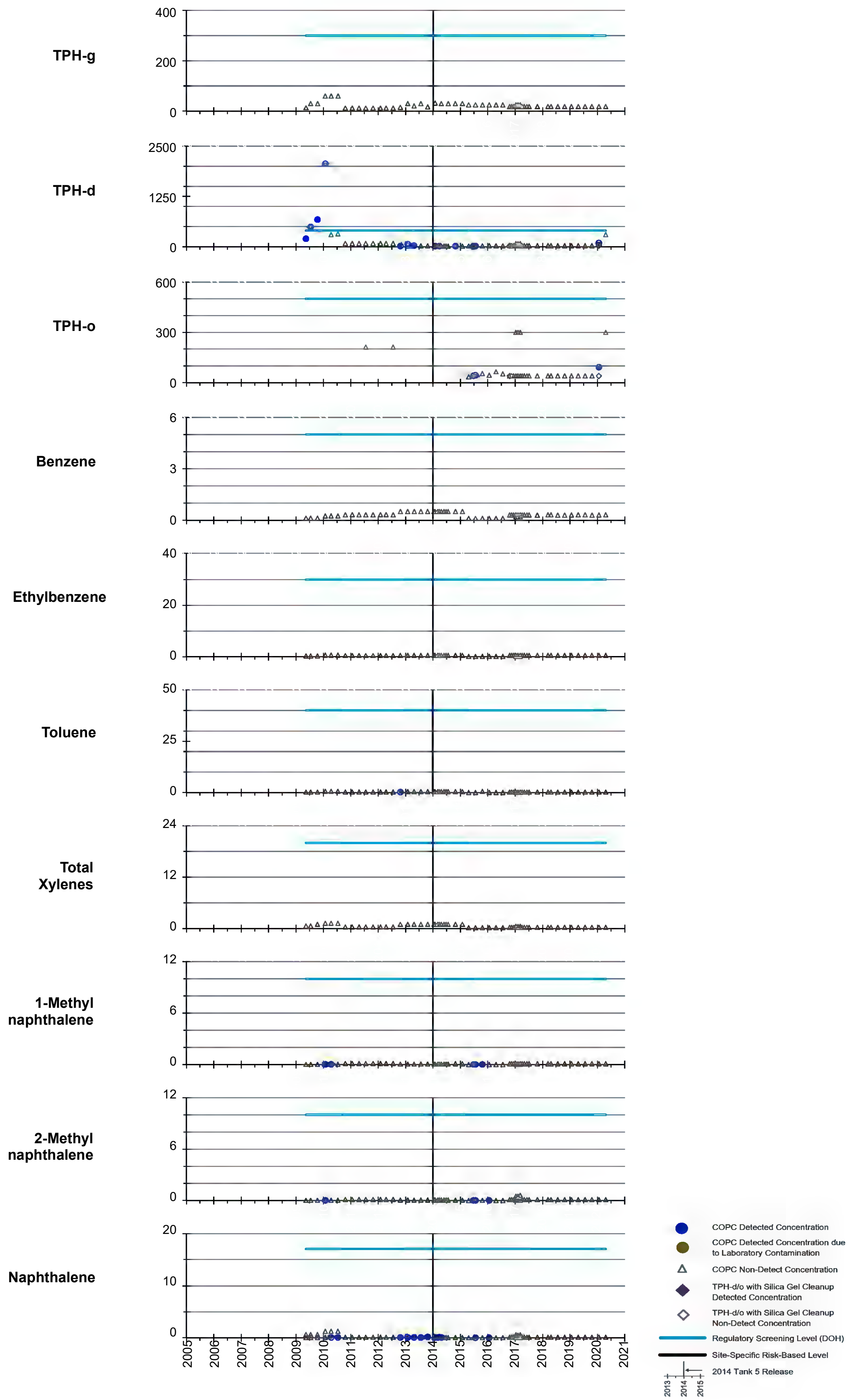
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW04



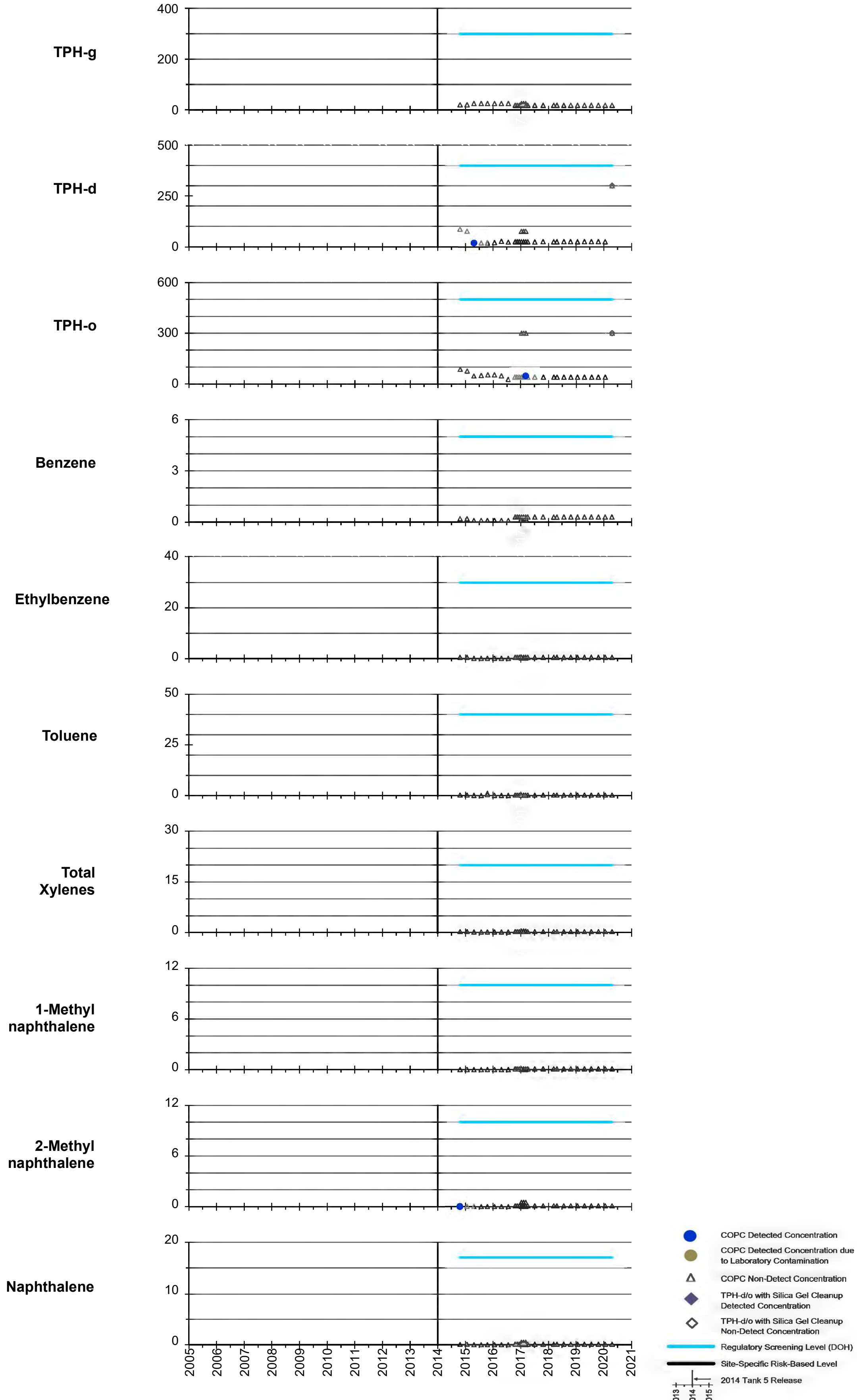
All results in micrograms per liter (µg/L or parts per billion).
EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW05



All results in micrograms per liter (µg/L or parts per billion).
EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW06

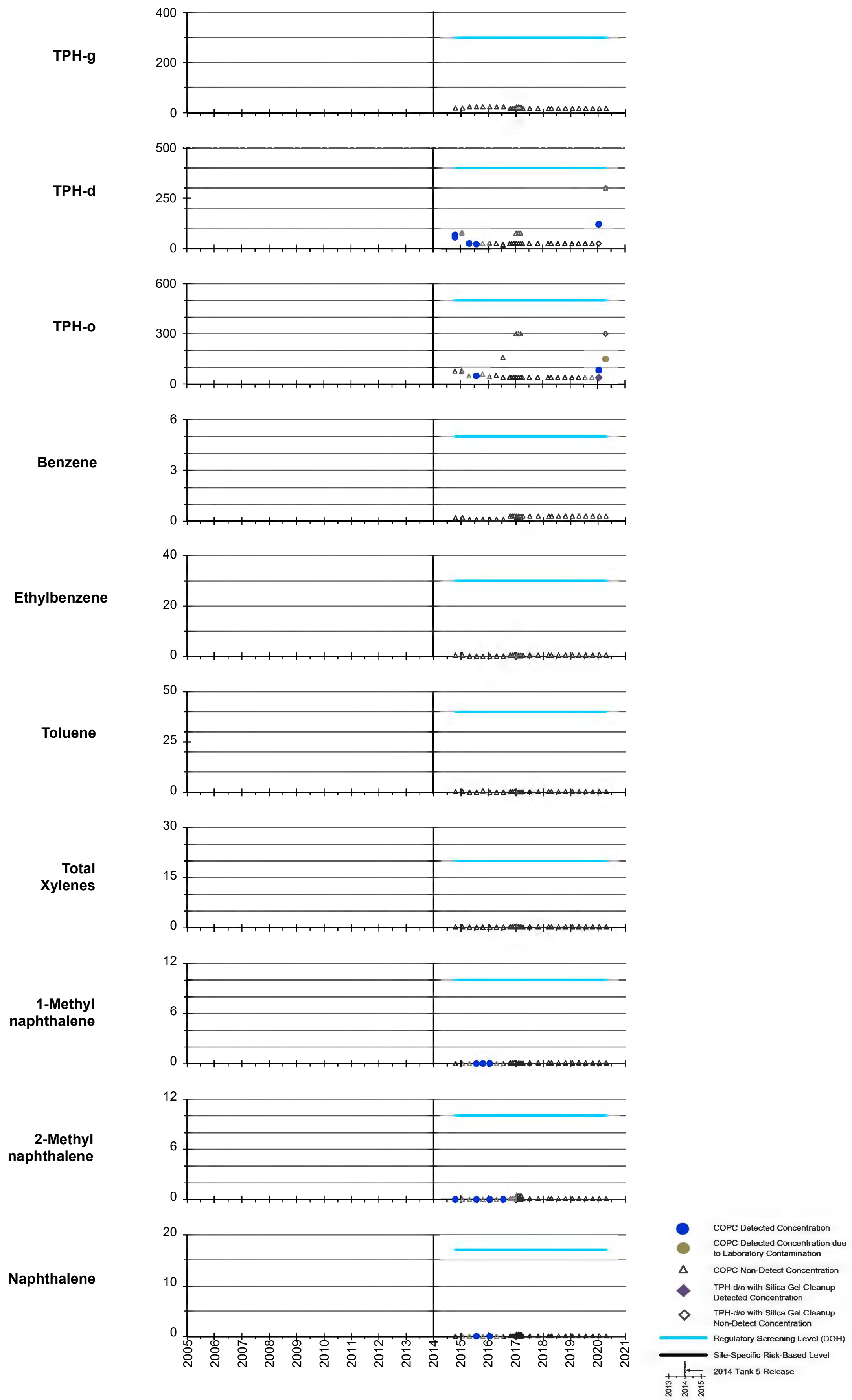


All results in micrograms per liter (µg/L or parts per billion).

EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.

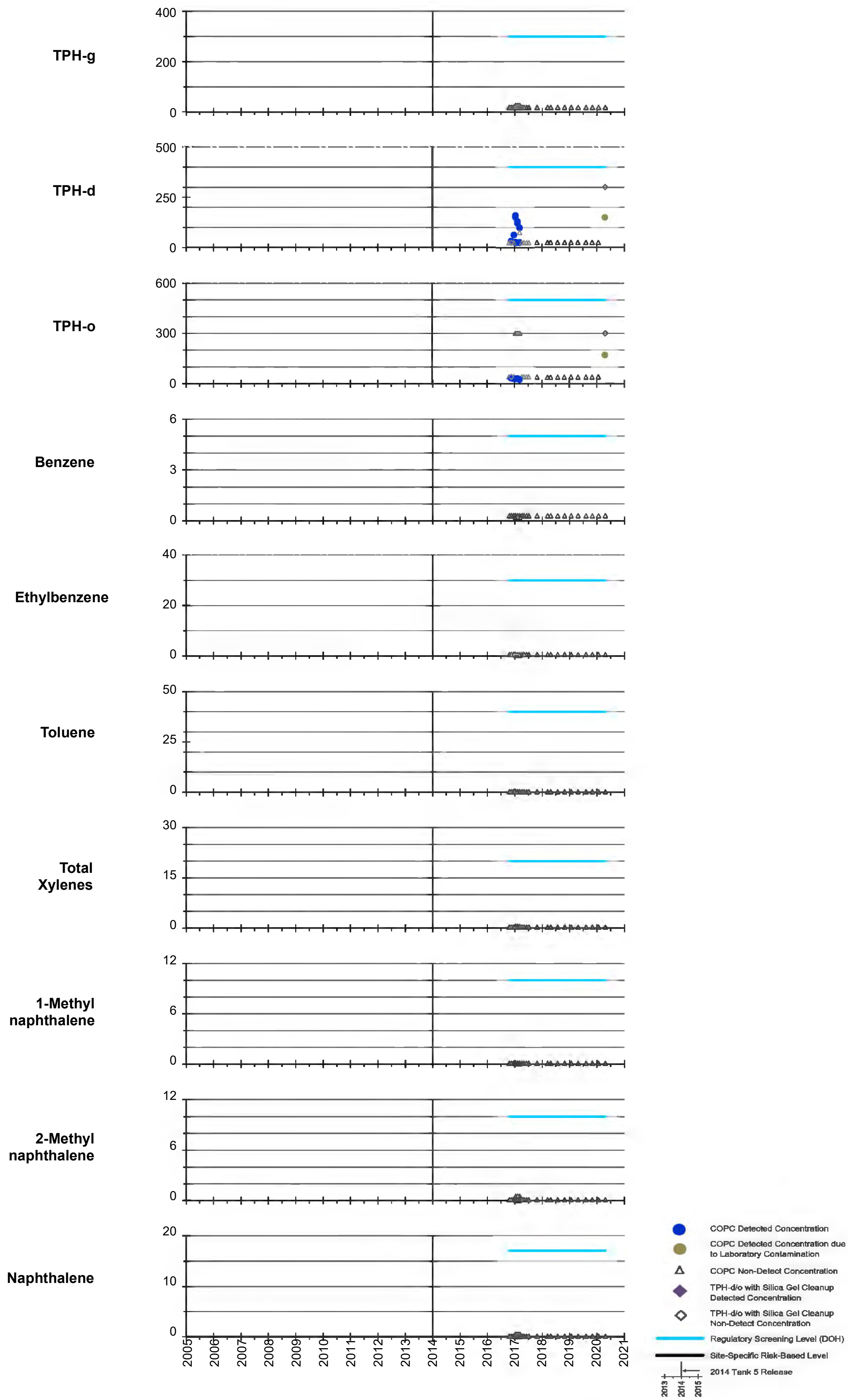
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW07

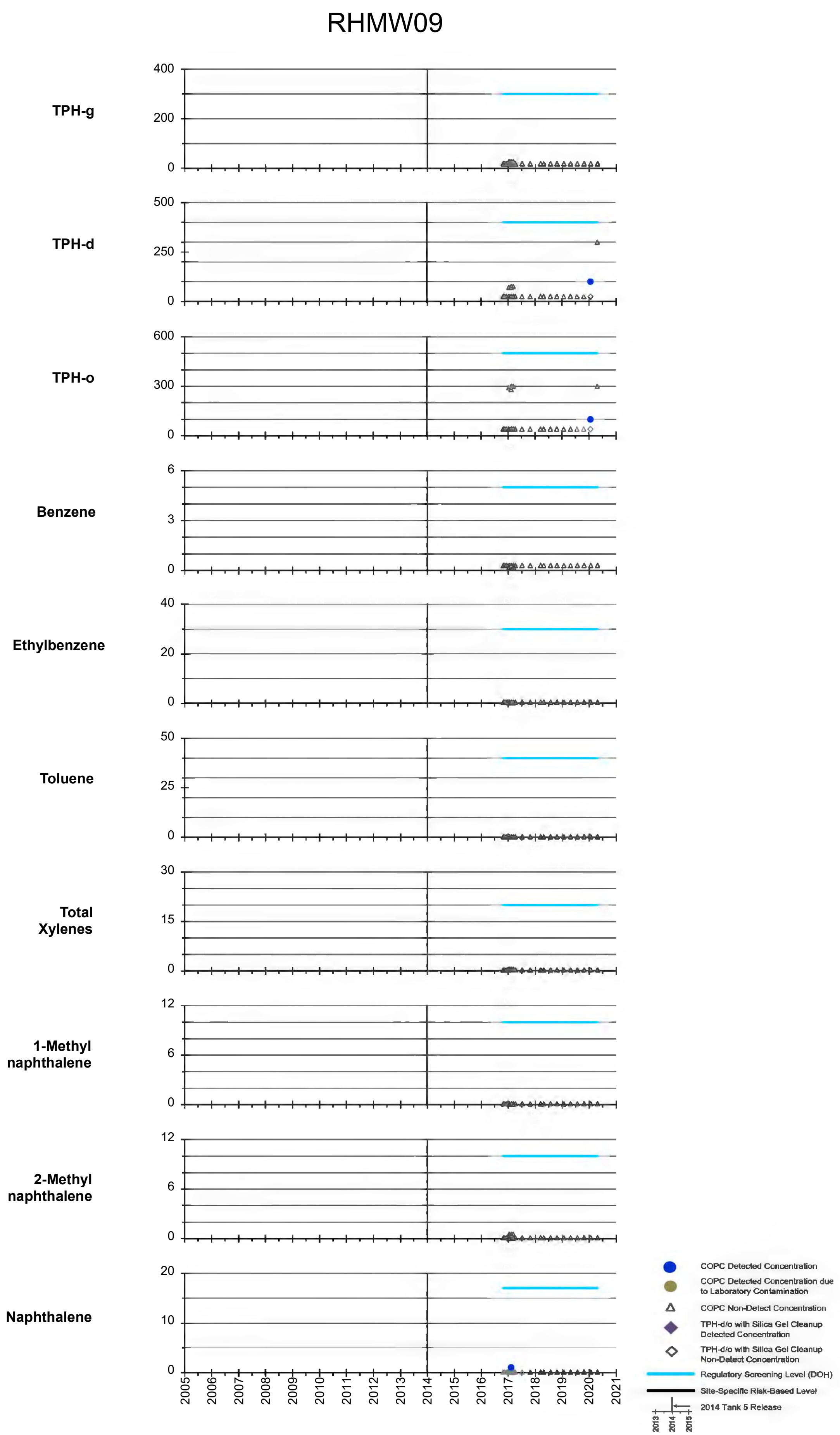


All results in micrograms per liter (µg/L or parts per billion).
EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW08



All results in micrograms per liter (µg/L or parts per billion).
EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).



All results in micrograms per liter (µg/L or parts per billion).
EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.
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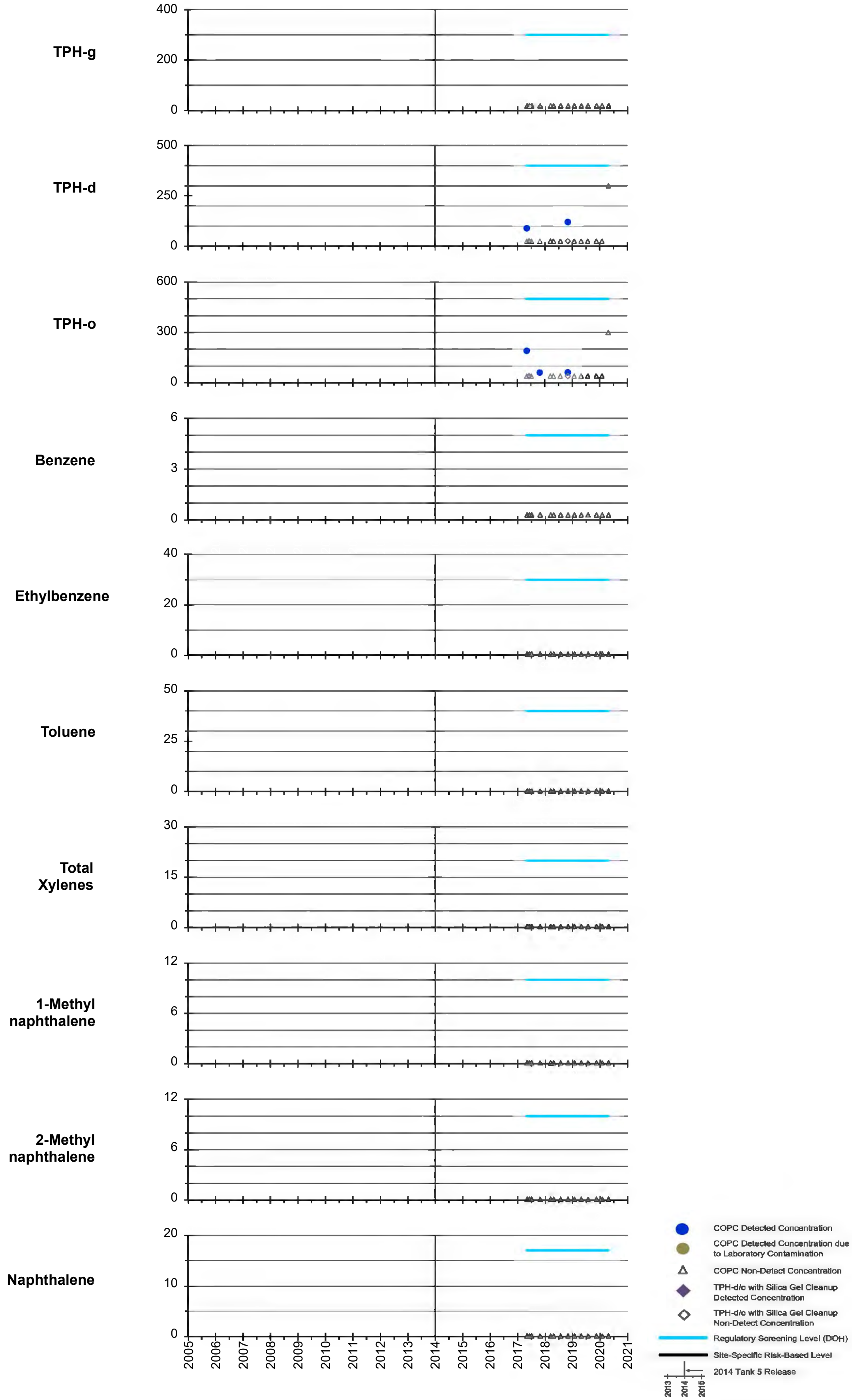
RHMW10



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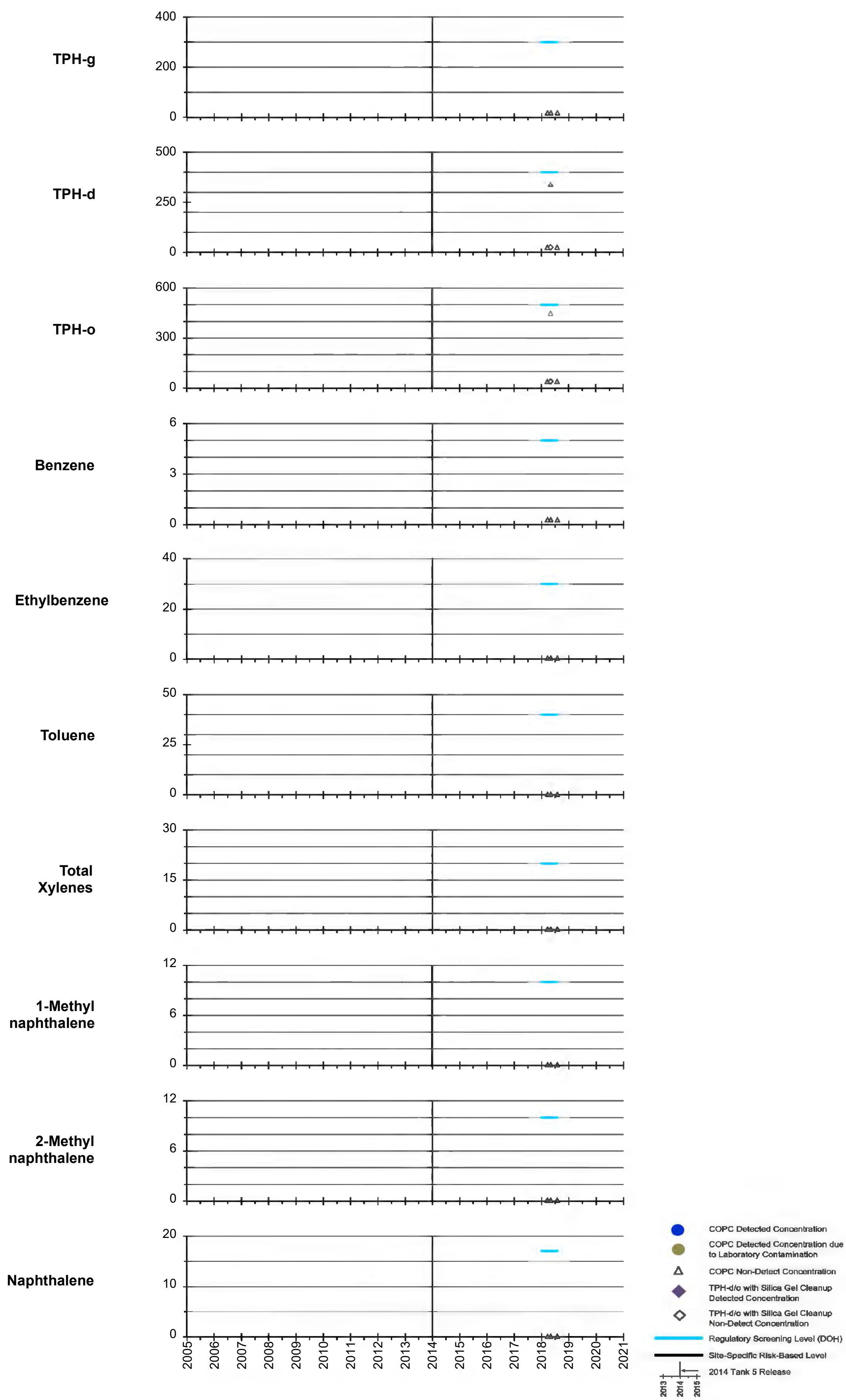

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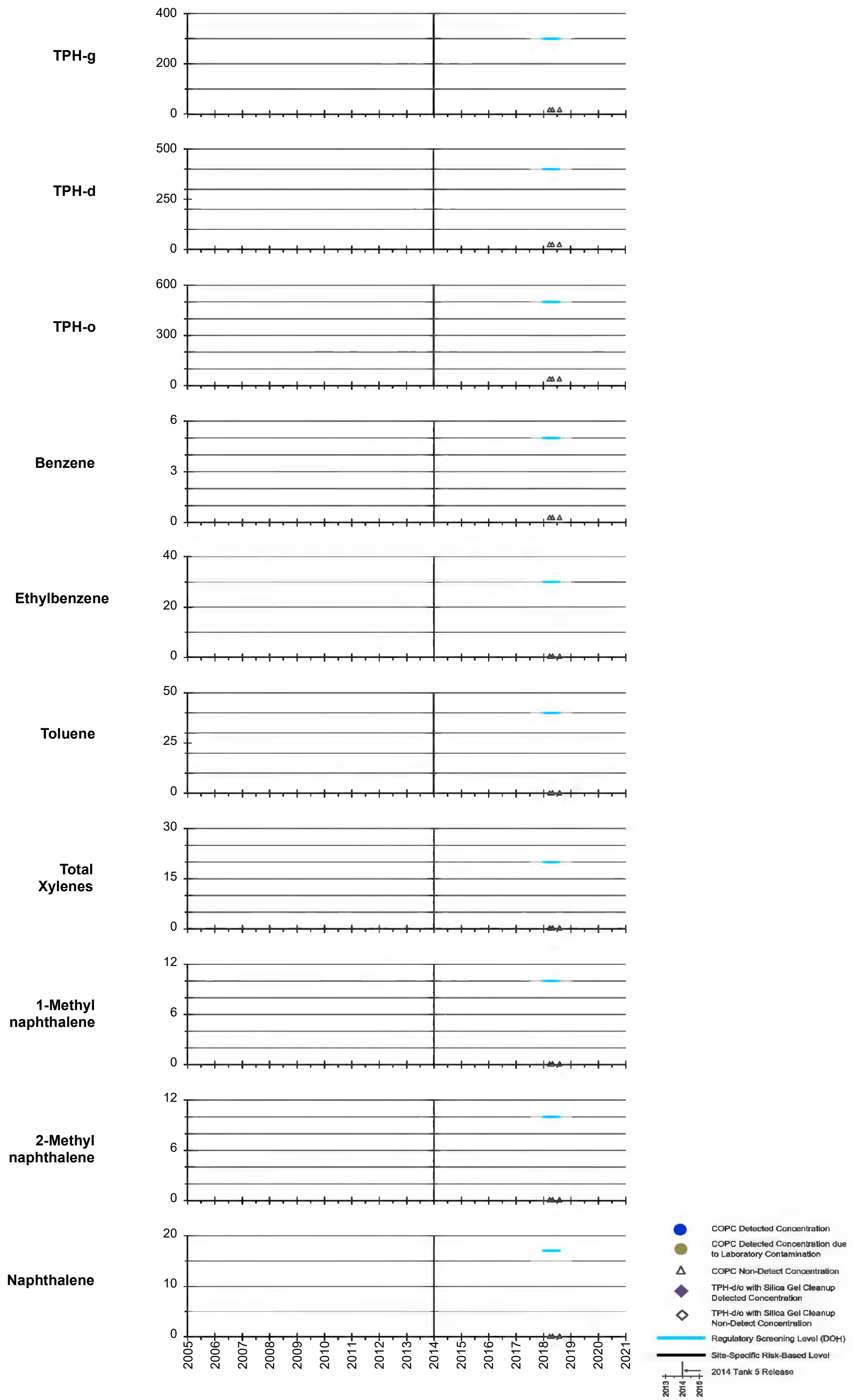

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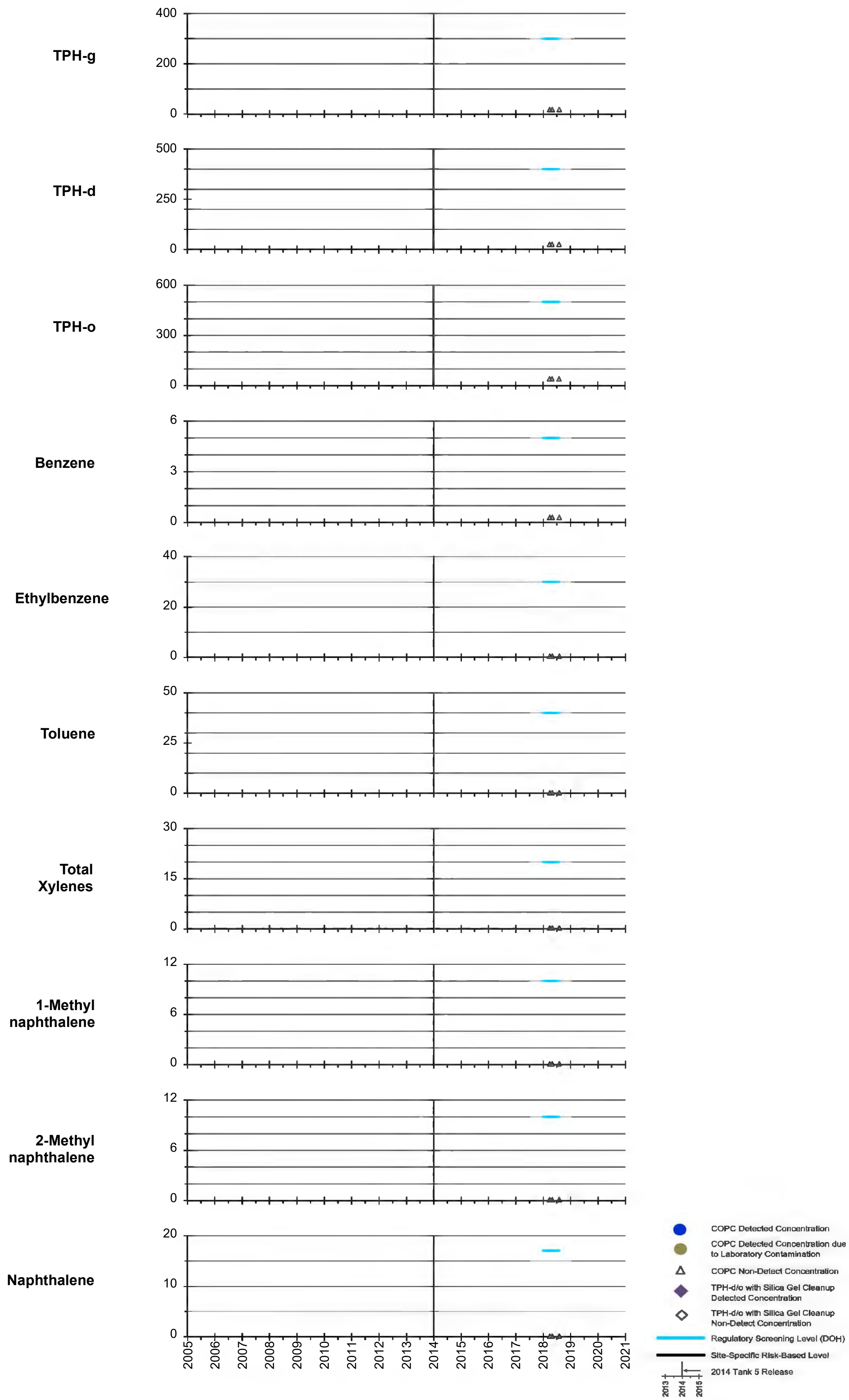

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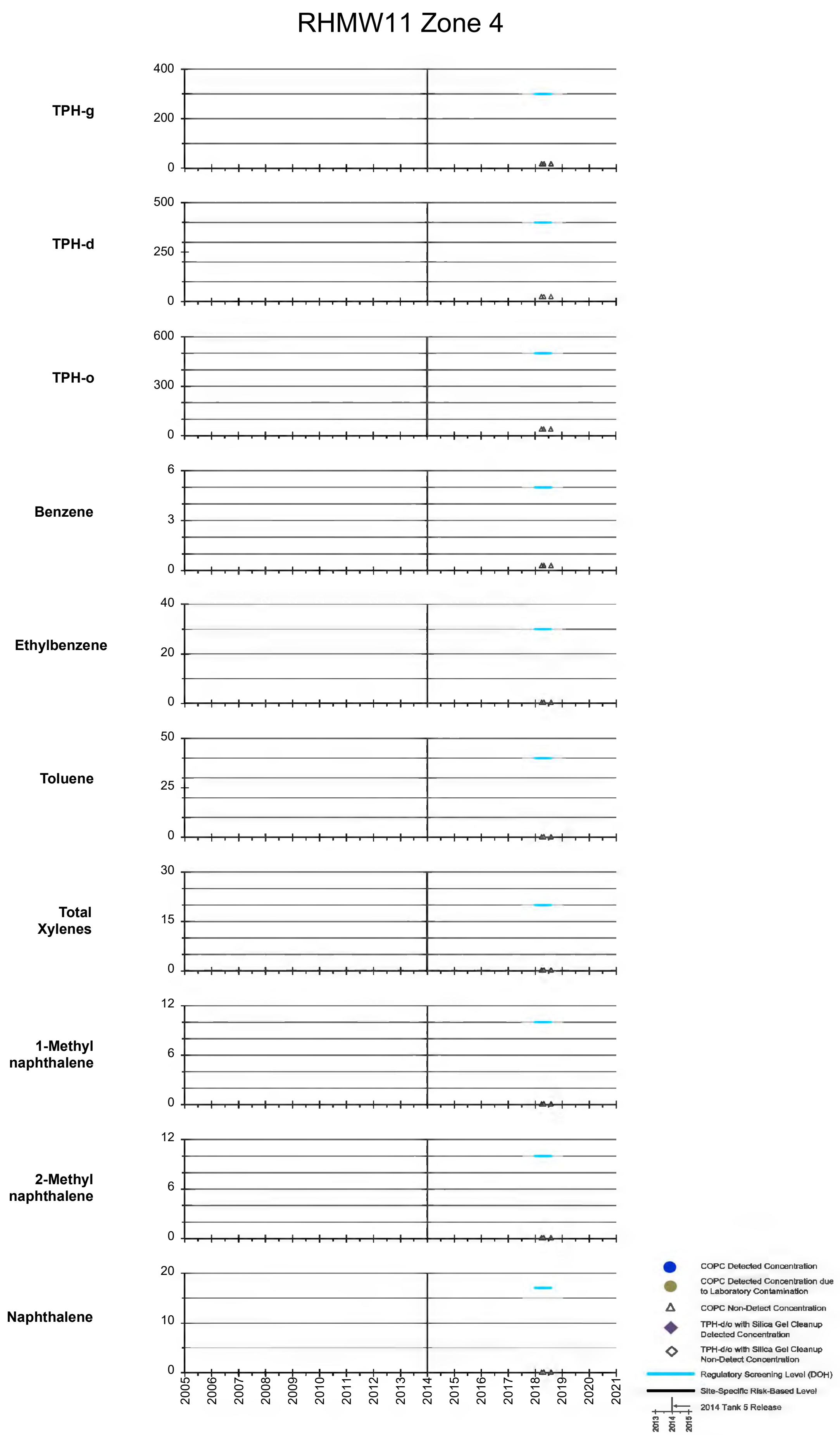

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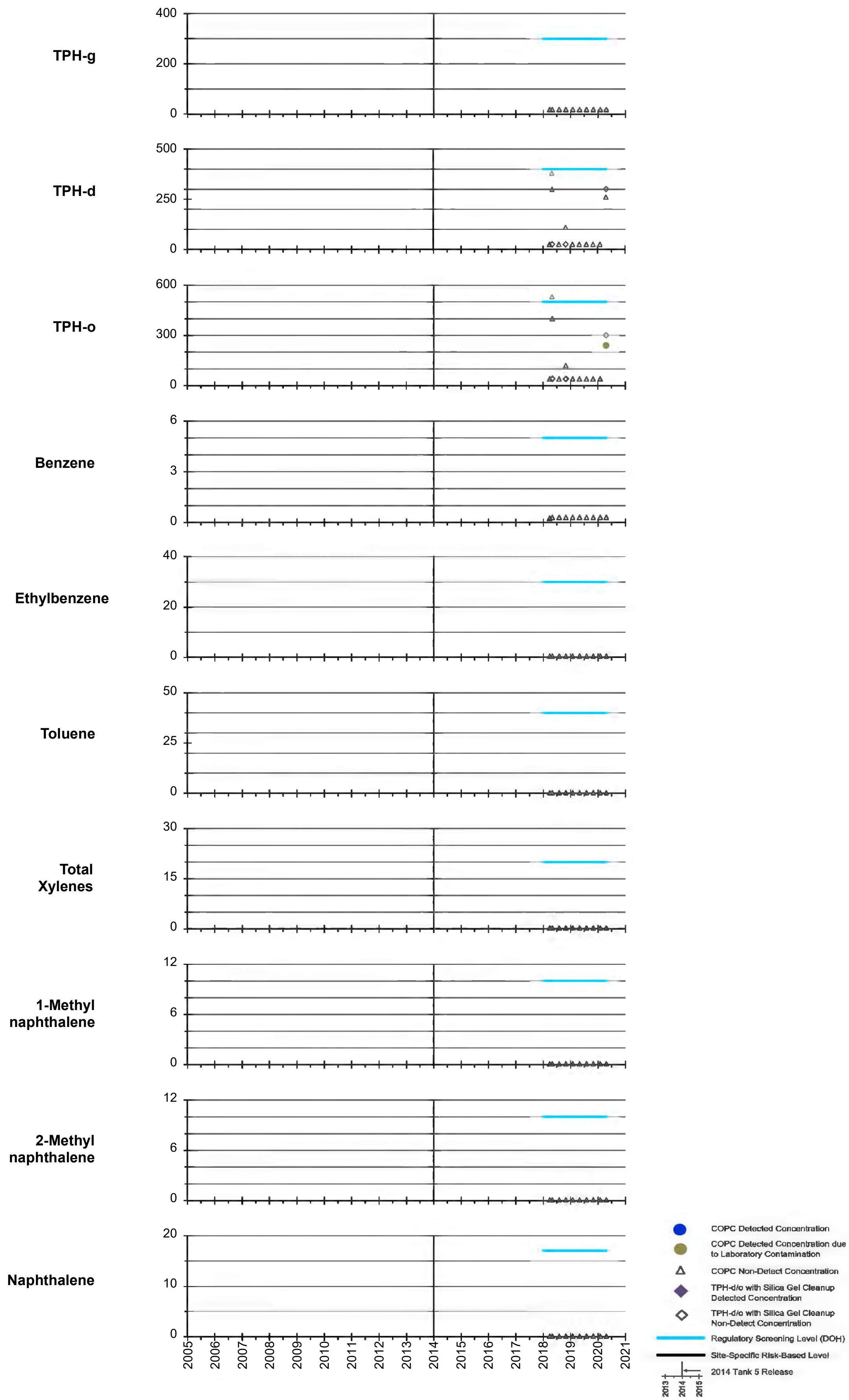
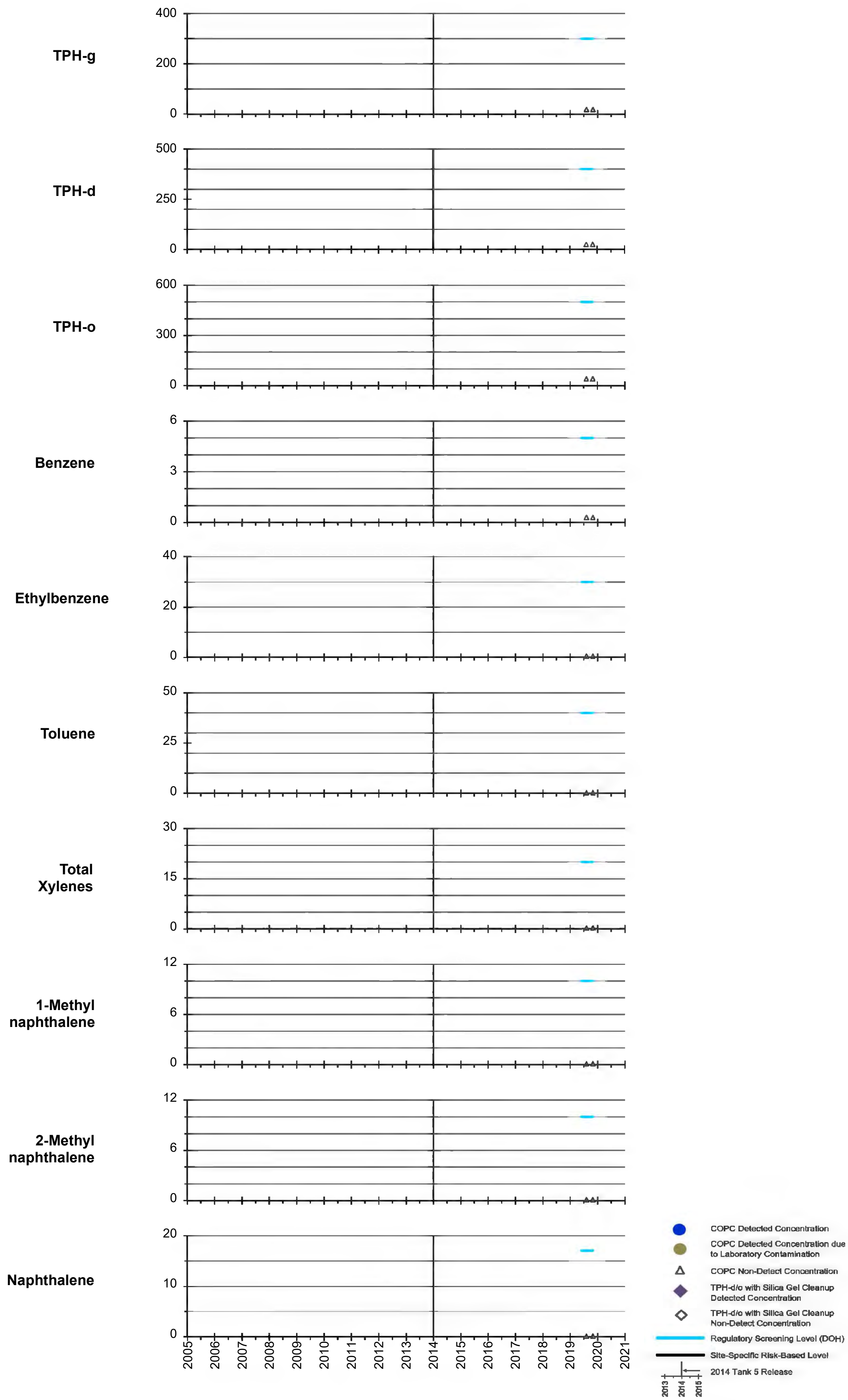


All results in micrograms per liter (µg/L or parts per billion).

Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW11 Zone 7



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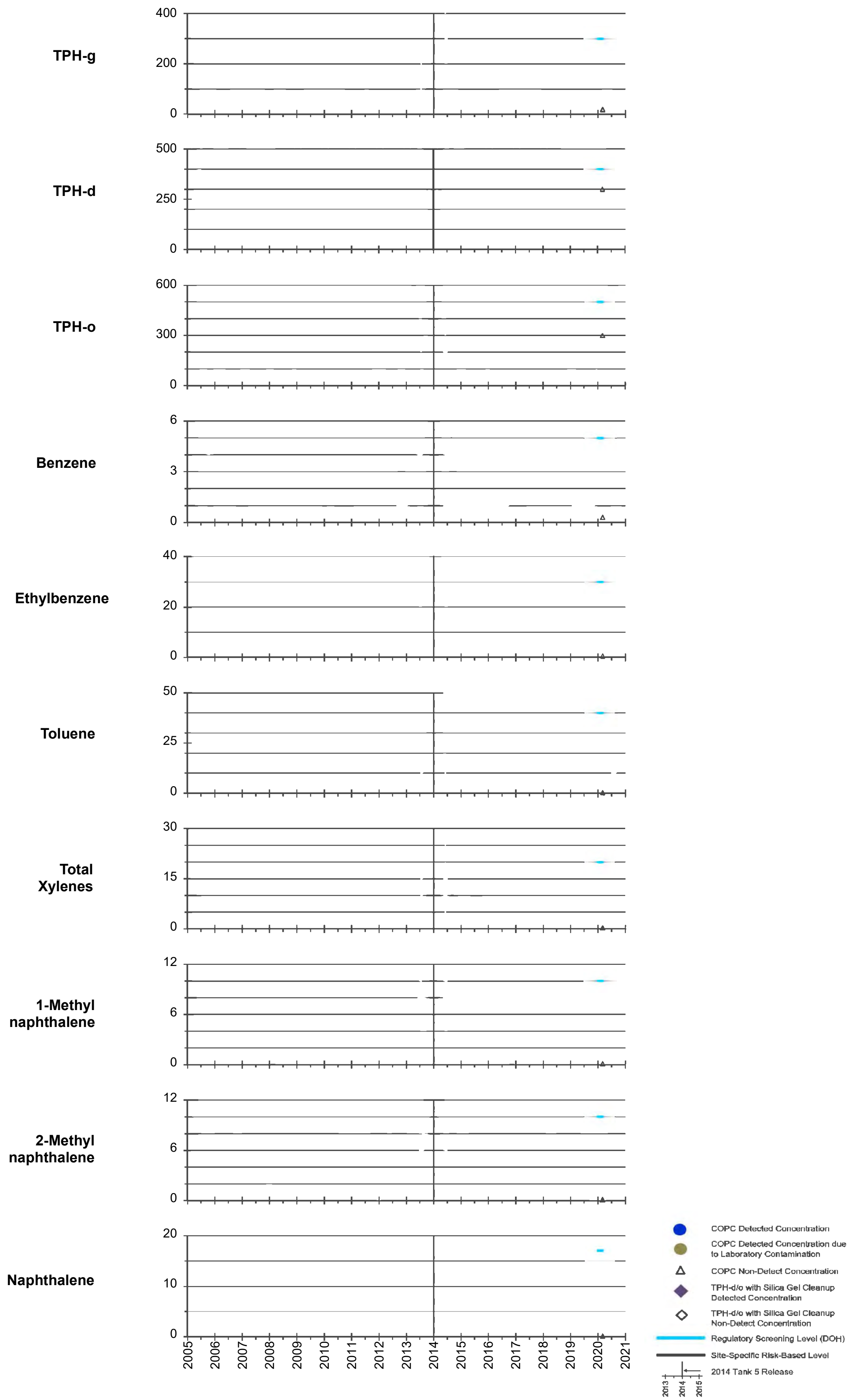

All results in micrograms per liter (µg/L or parts per billion).

Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

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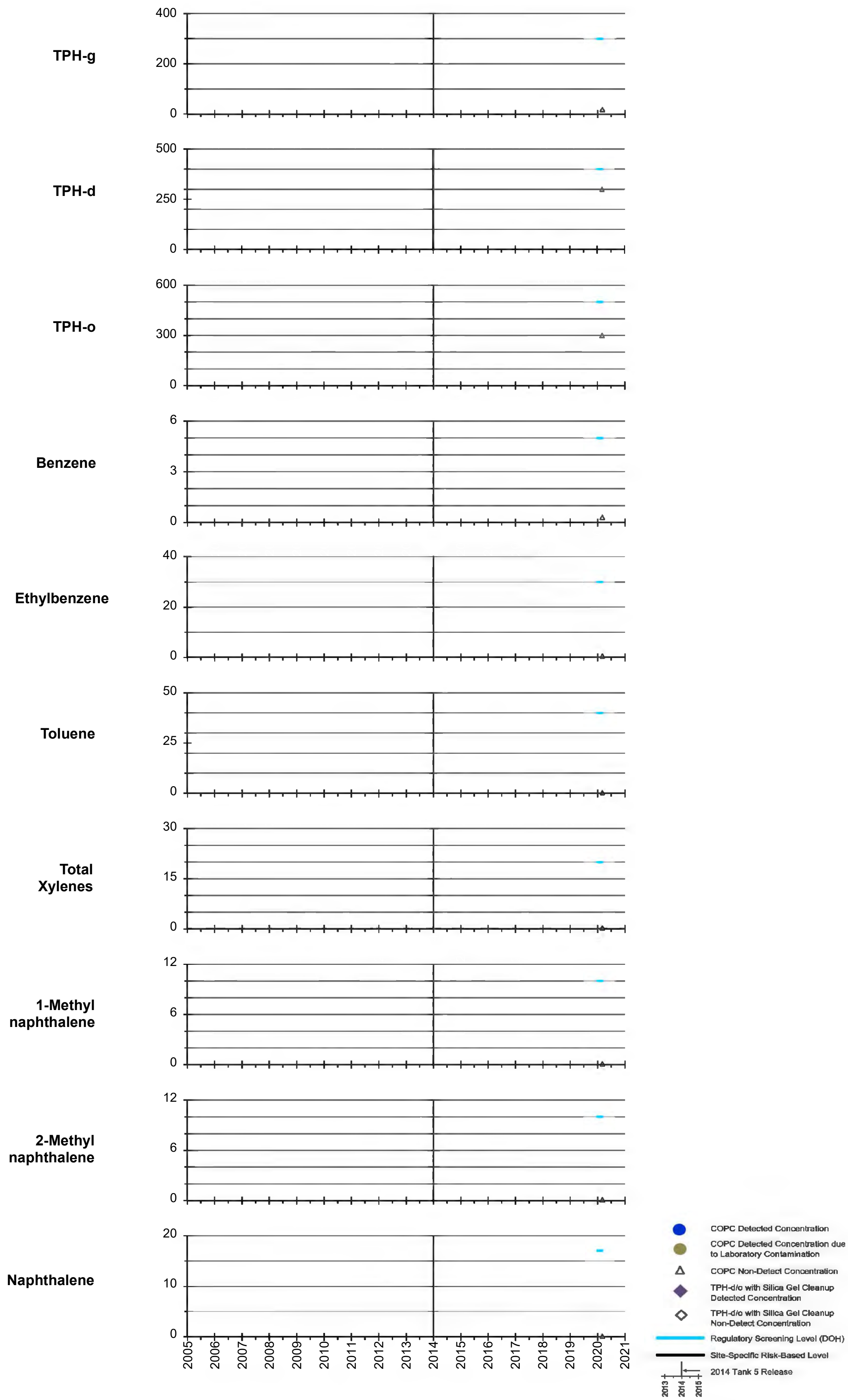

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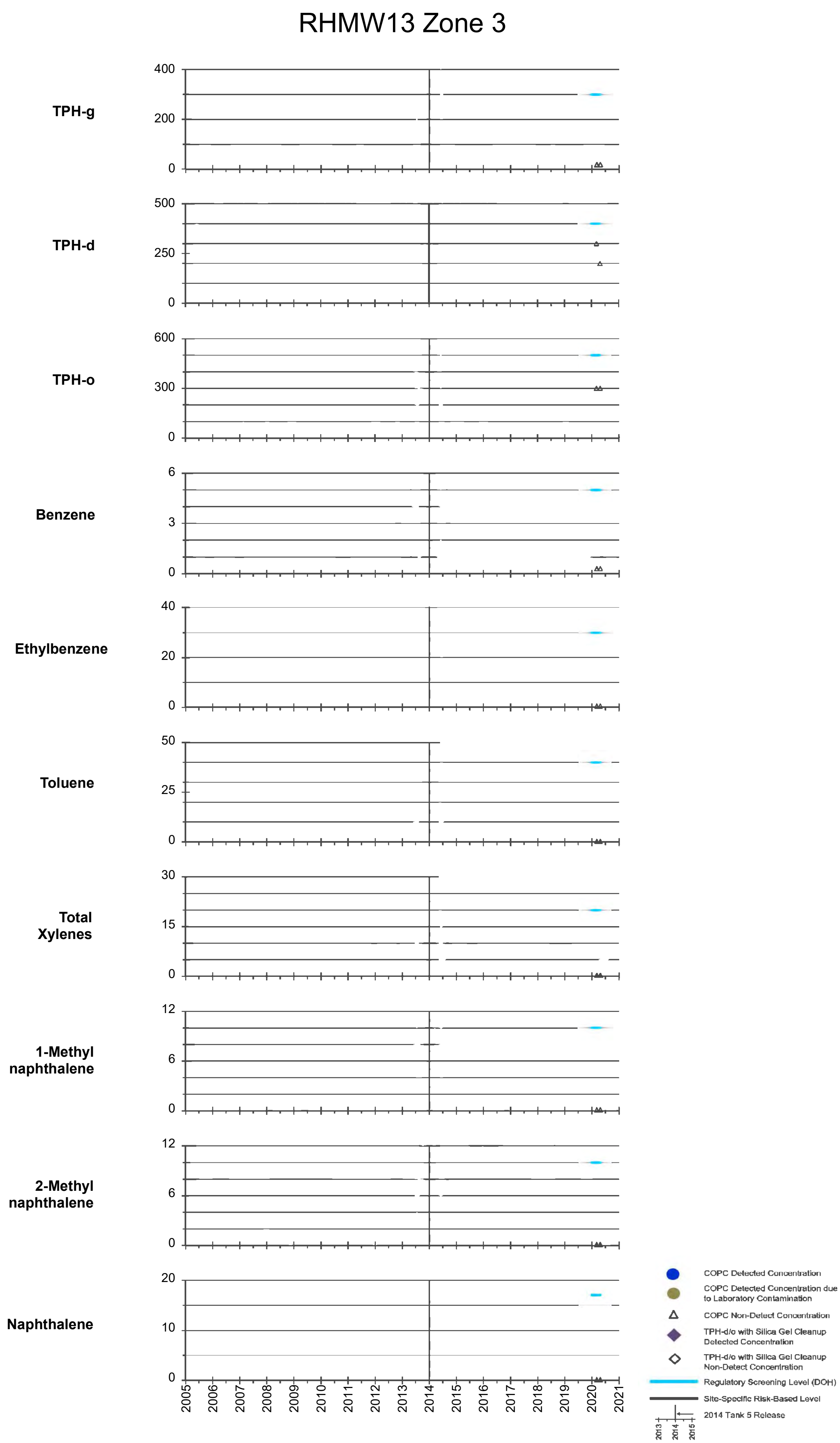
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).



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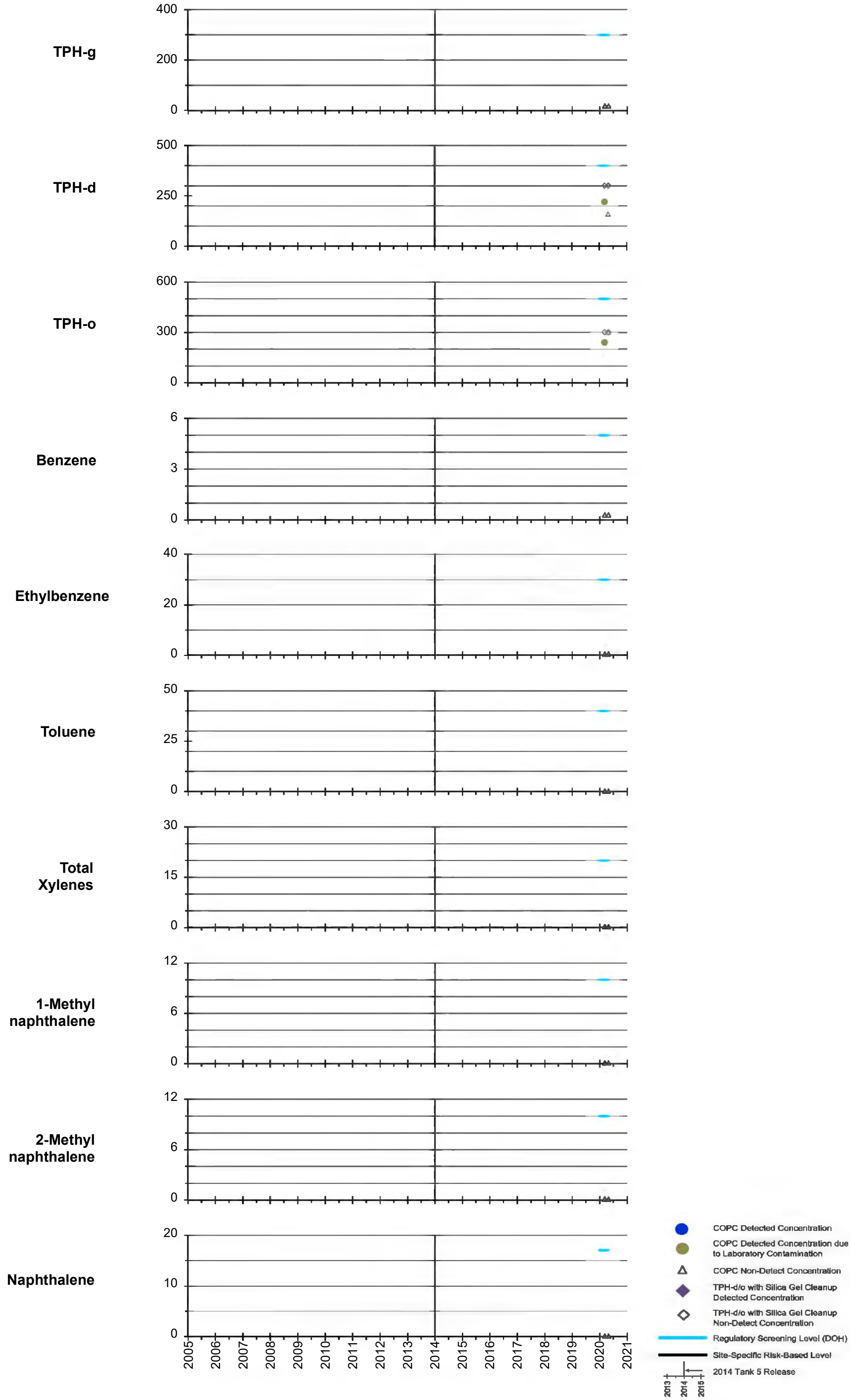
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

RHMW13 Zone 4



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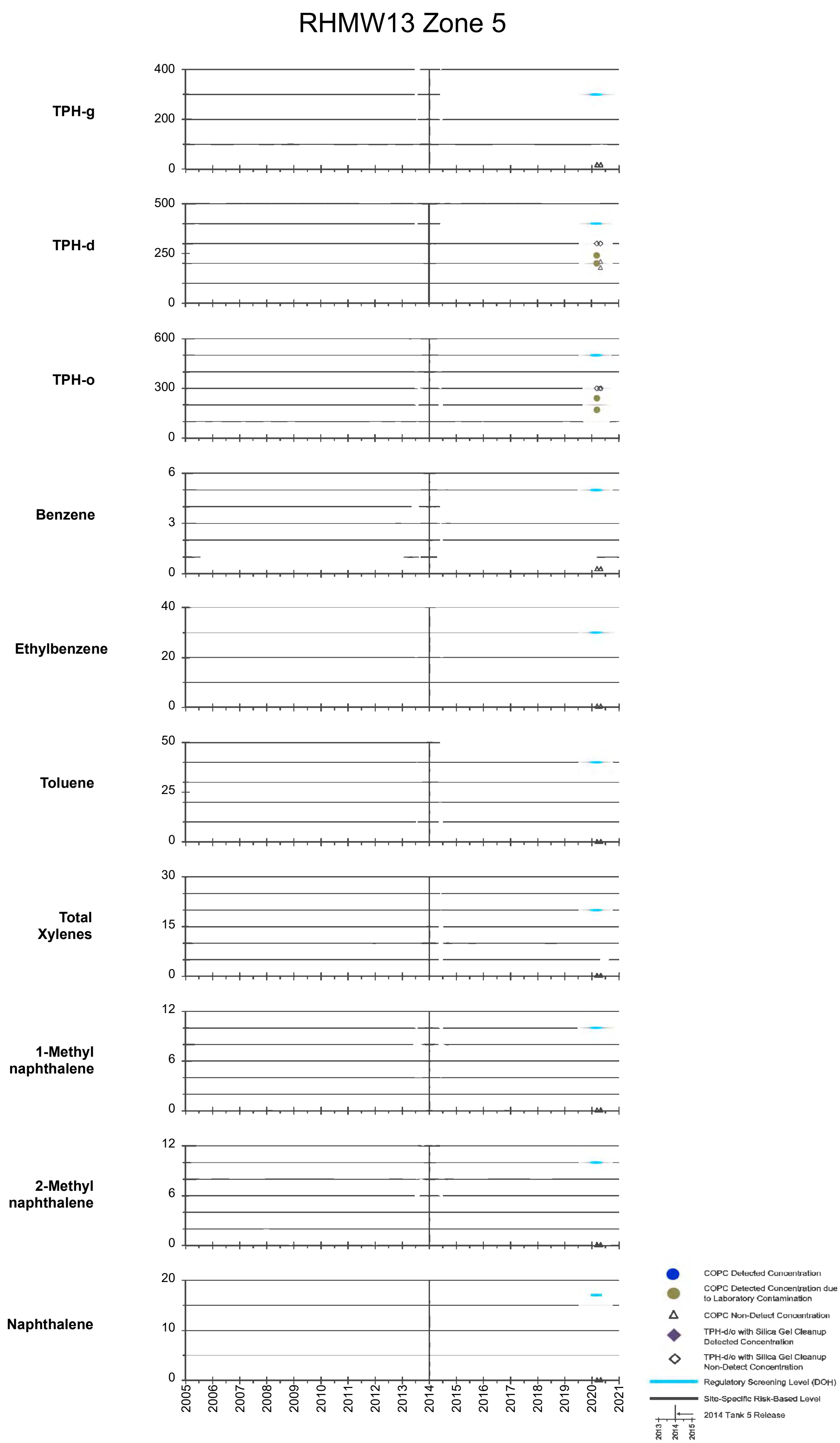

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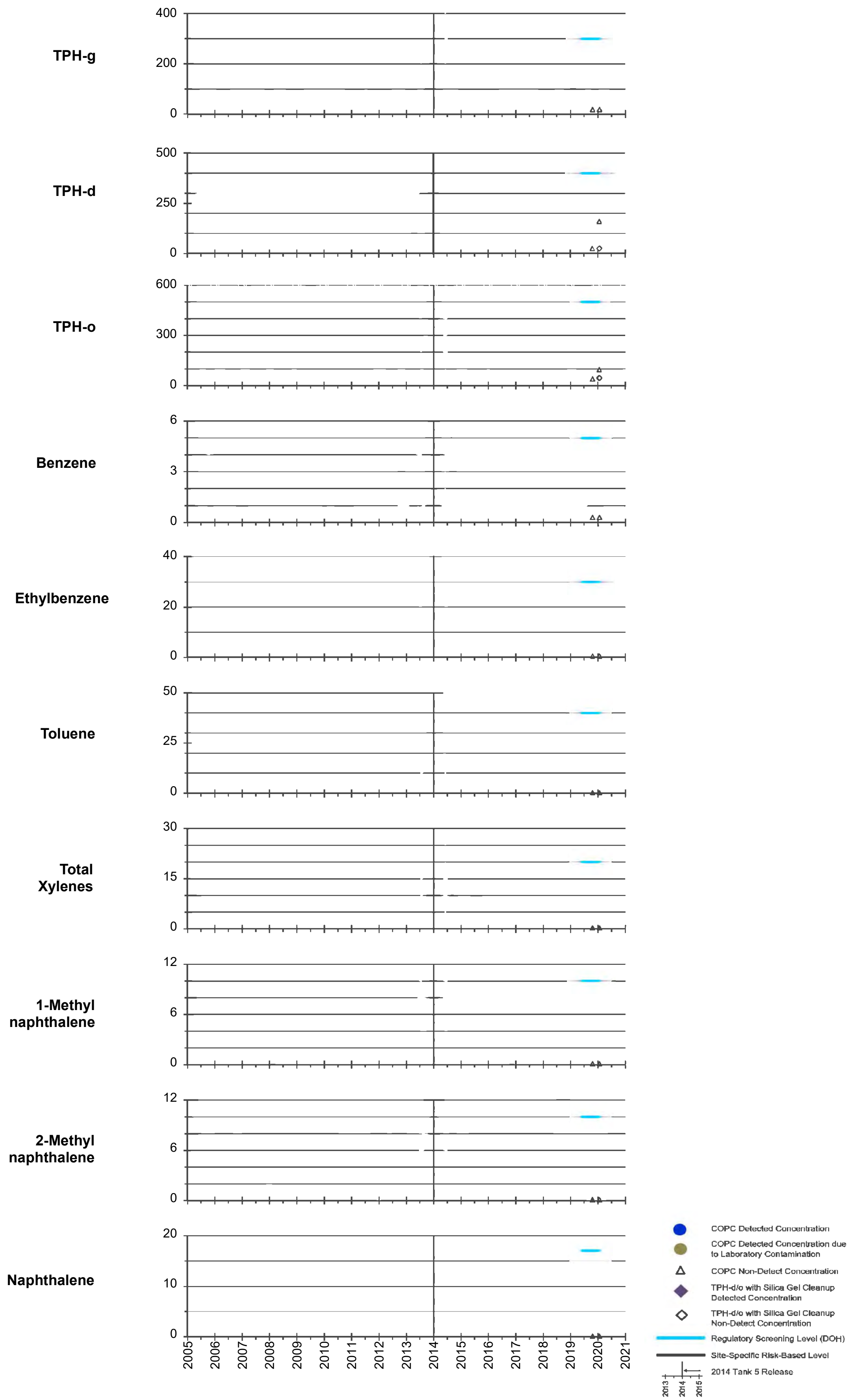

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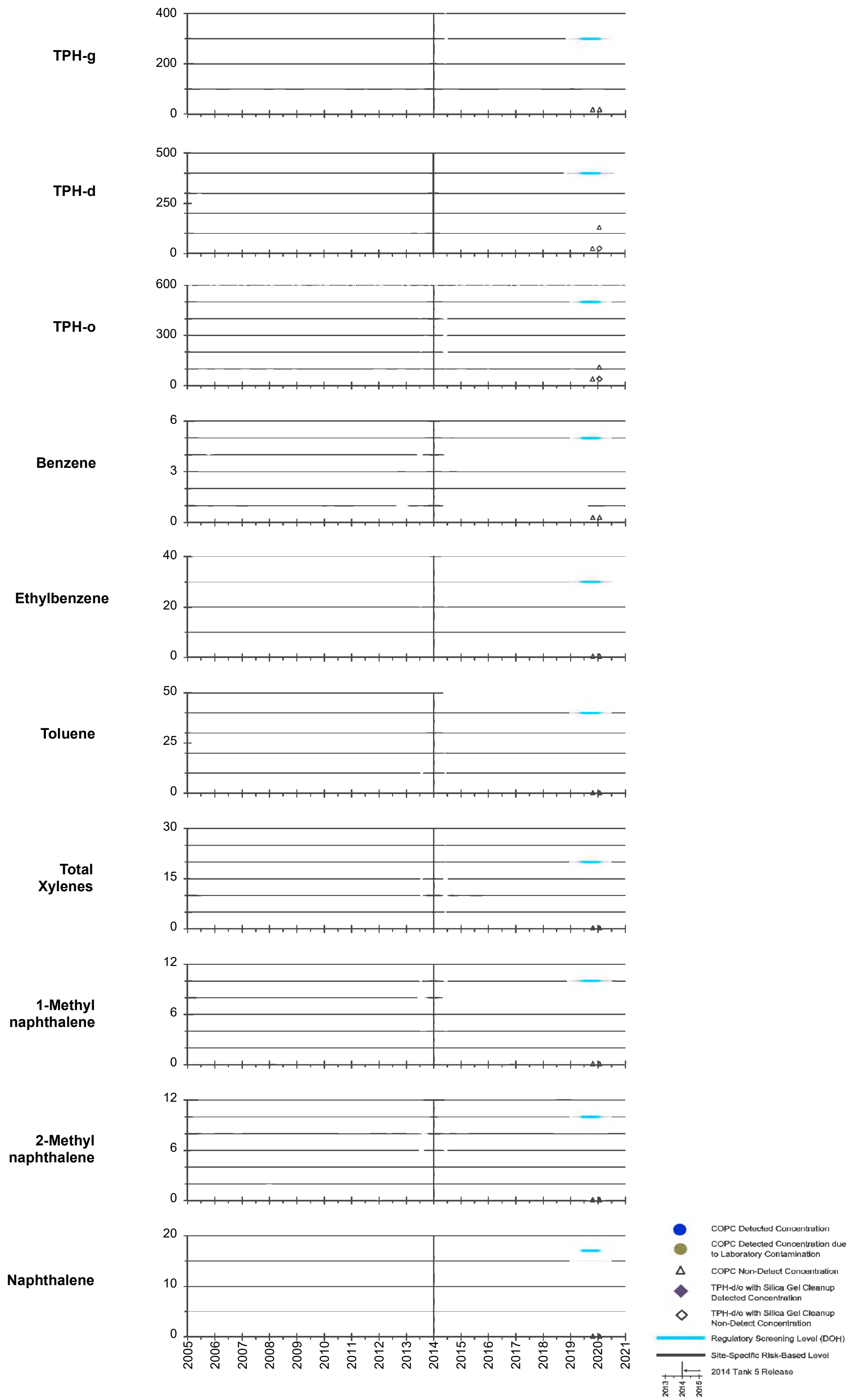
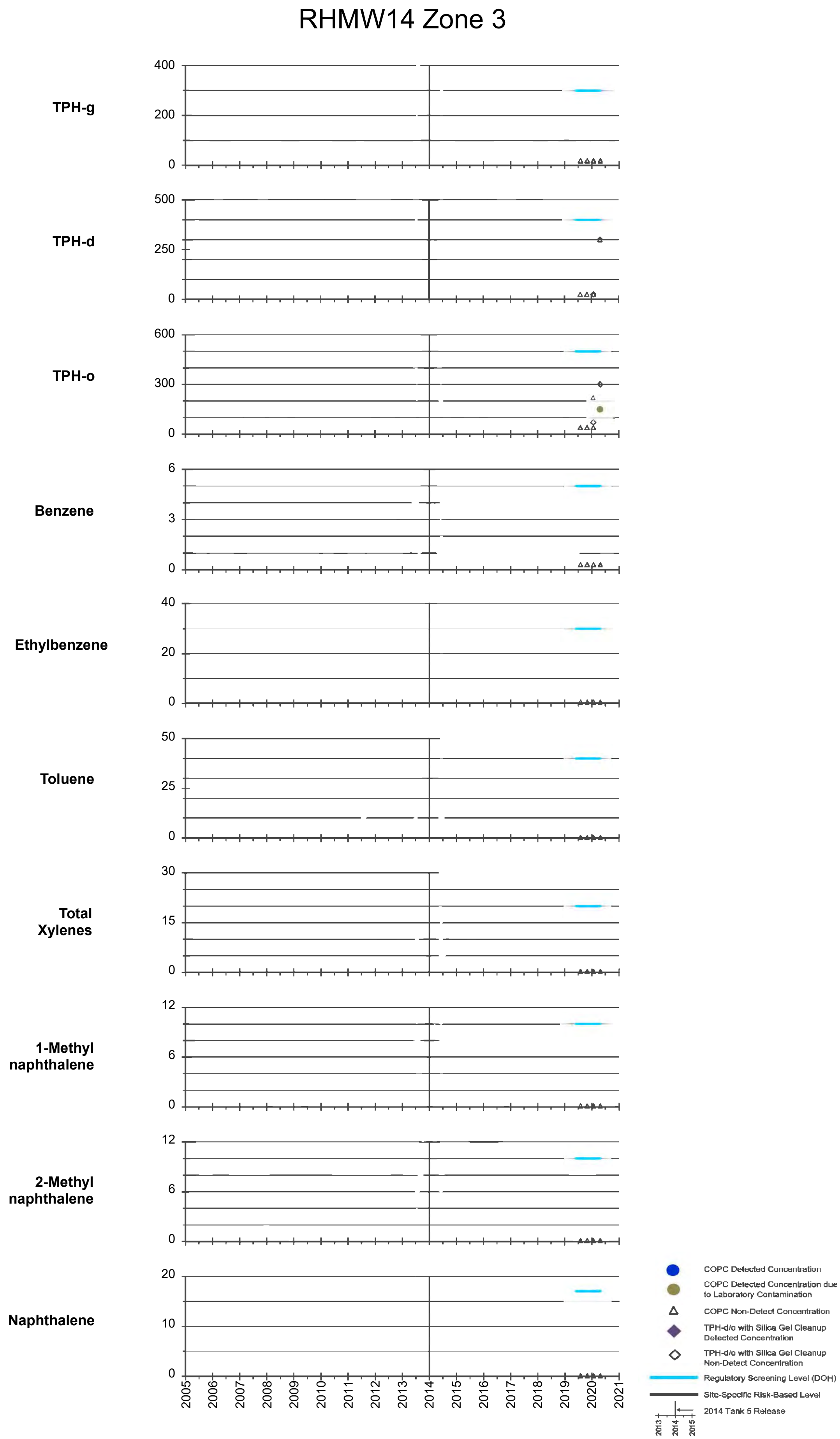


All results in micrograms per liter (µg/L or parts per billion).



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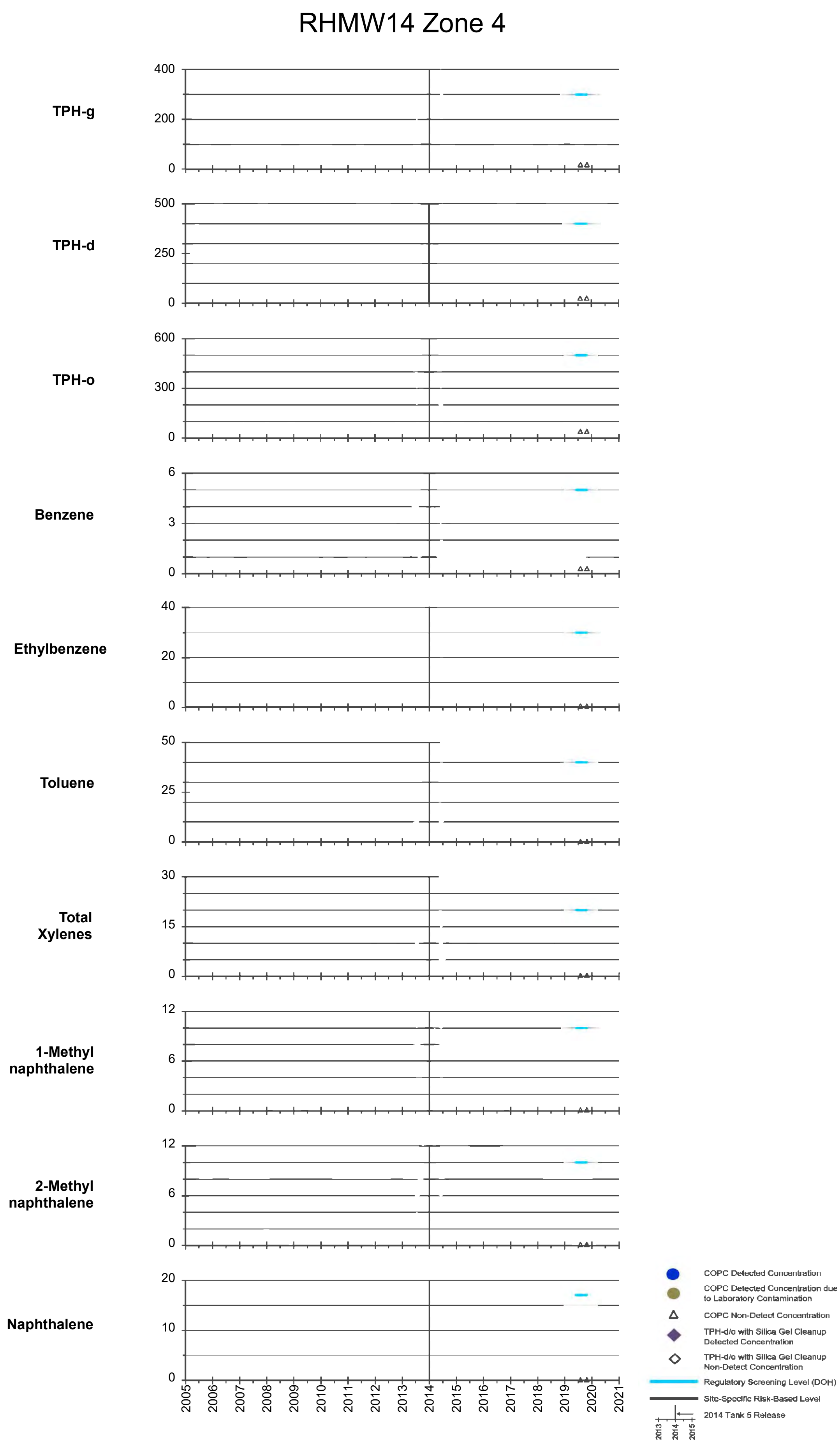

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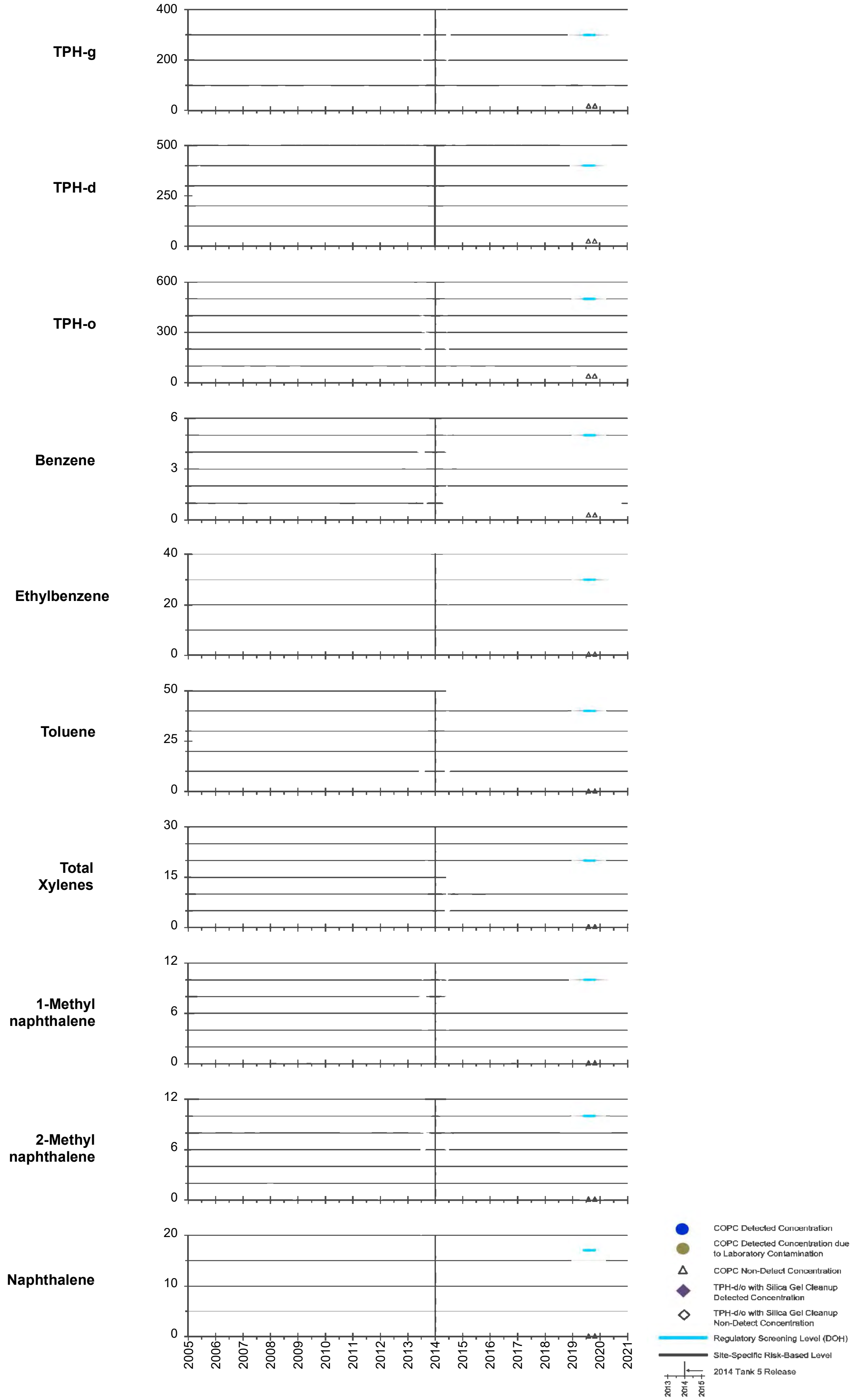

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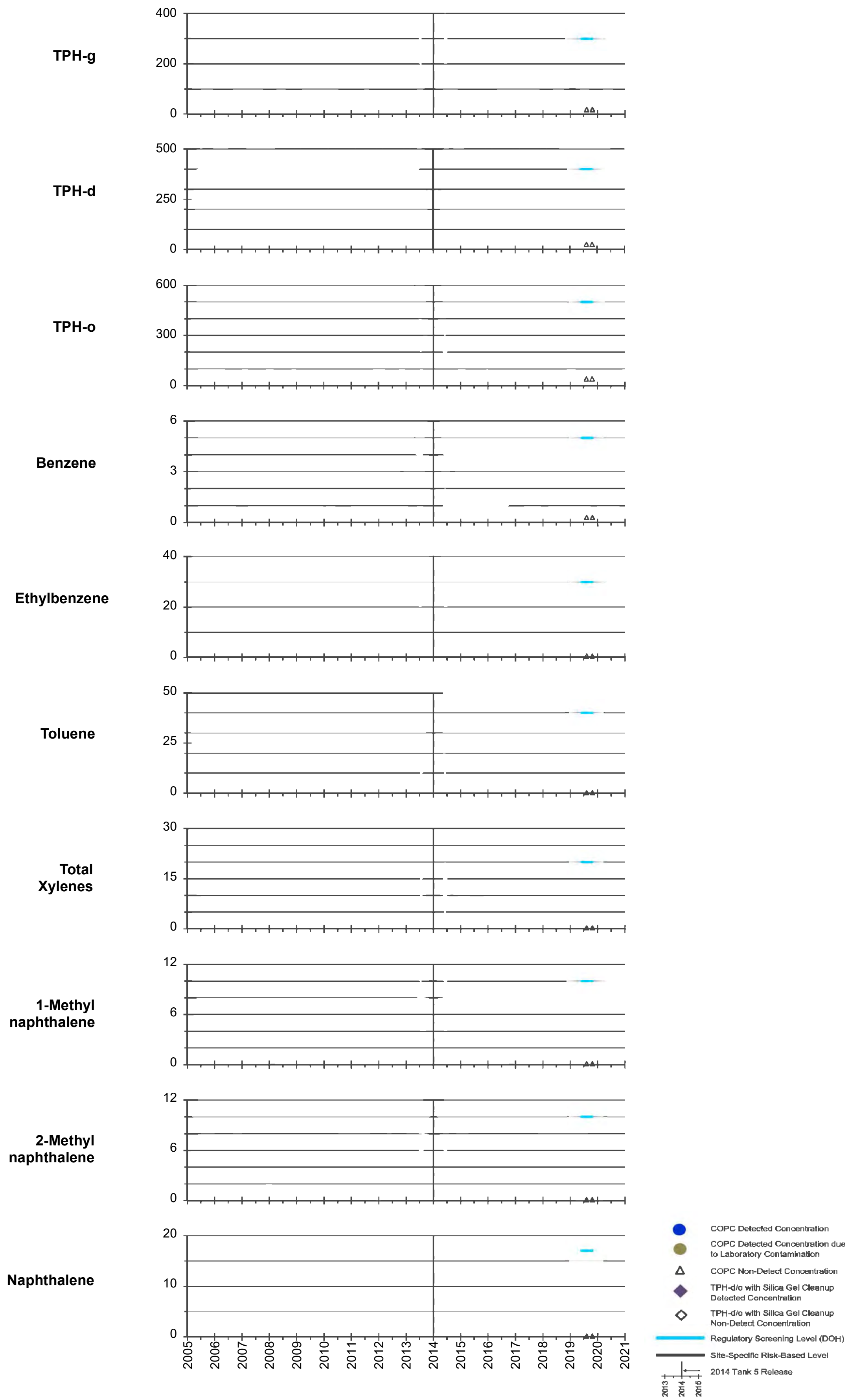
RHMW14 Zone 7



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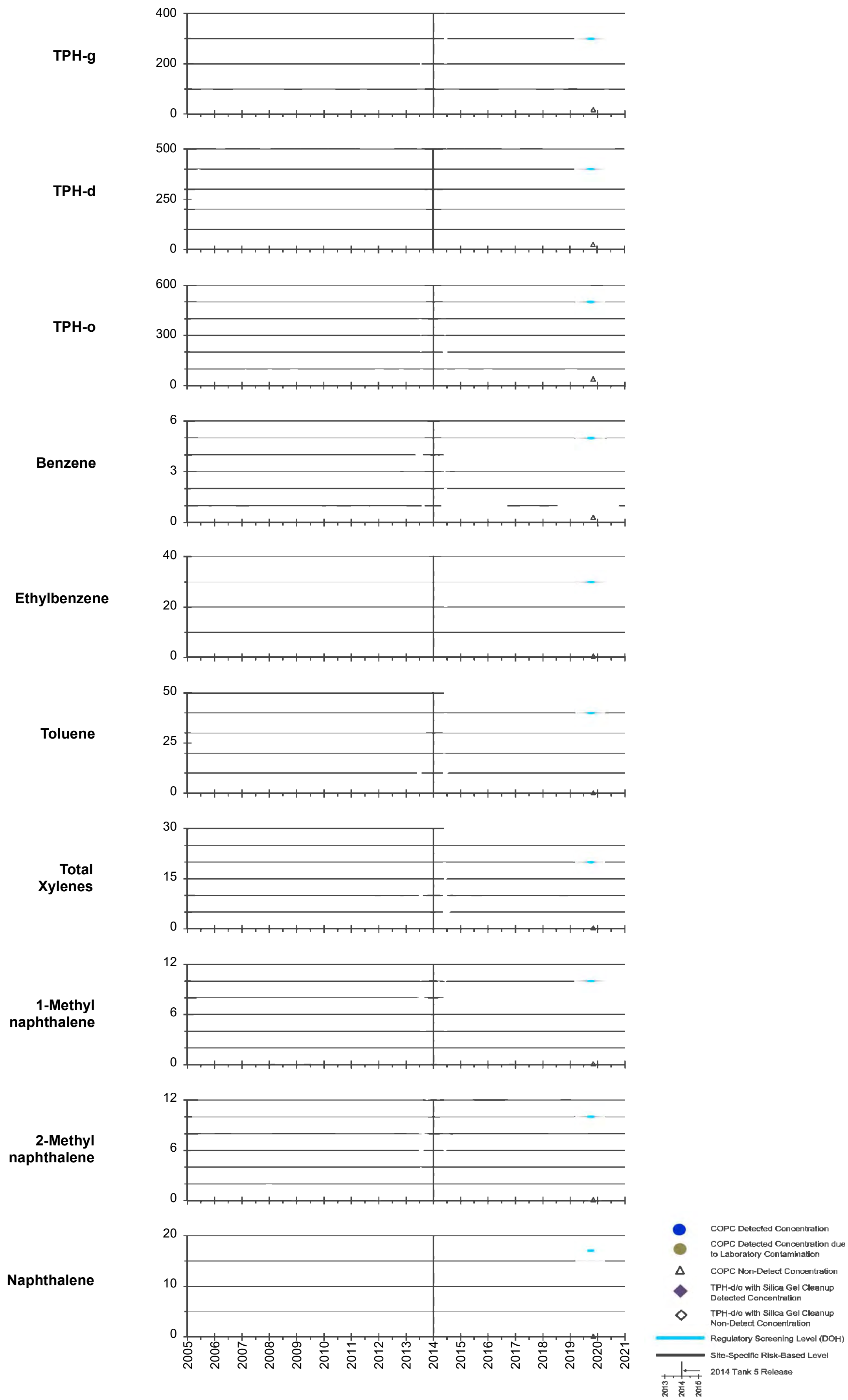
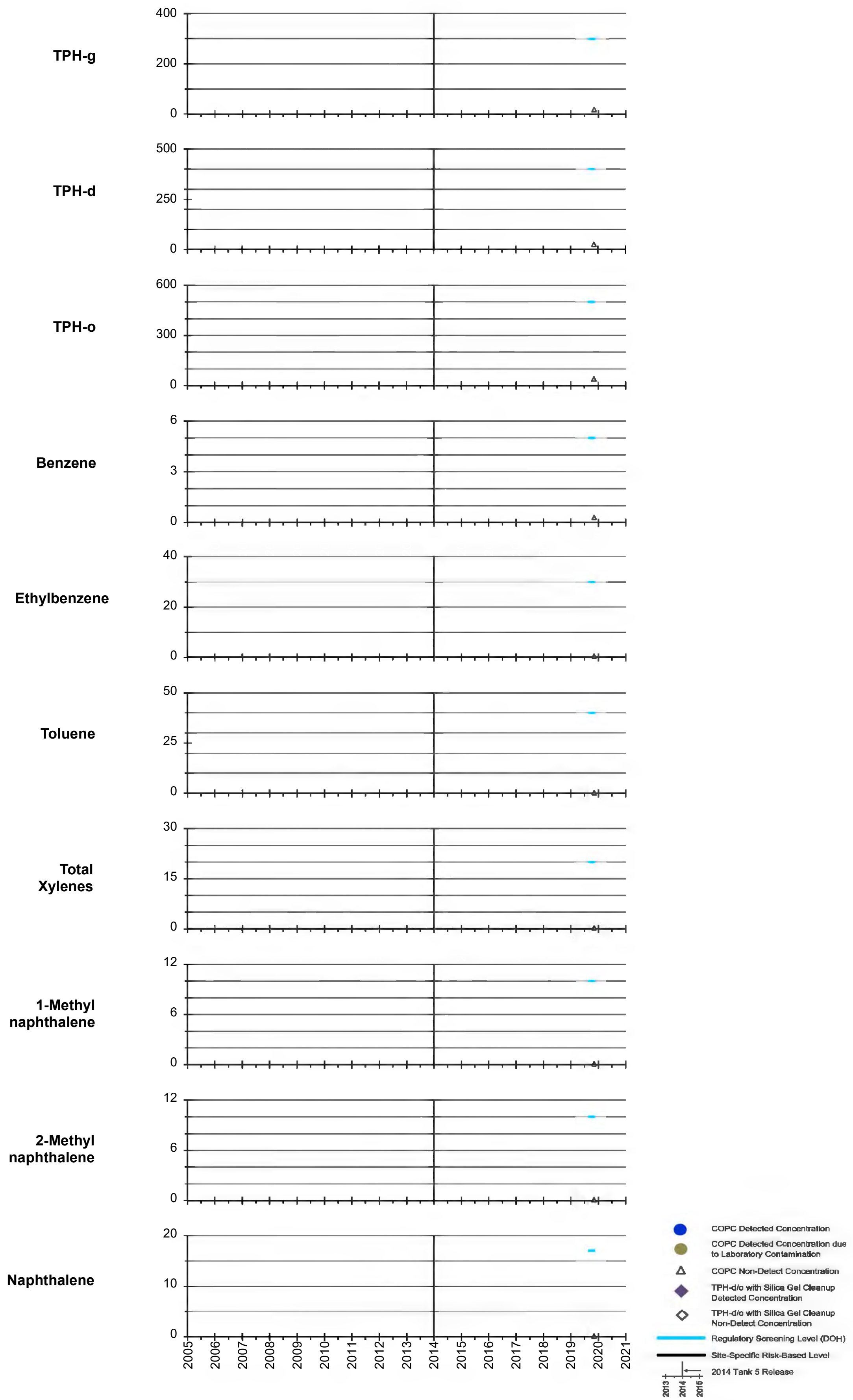
RHMW15 Zone 1



All results in micrograms per liter (µg/L or parts per billion).

RHMW15 Zone 2



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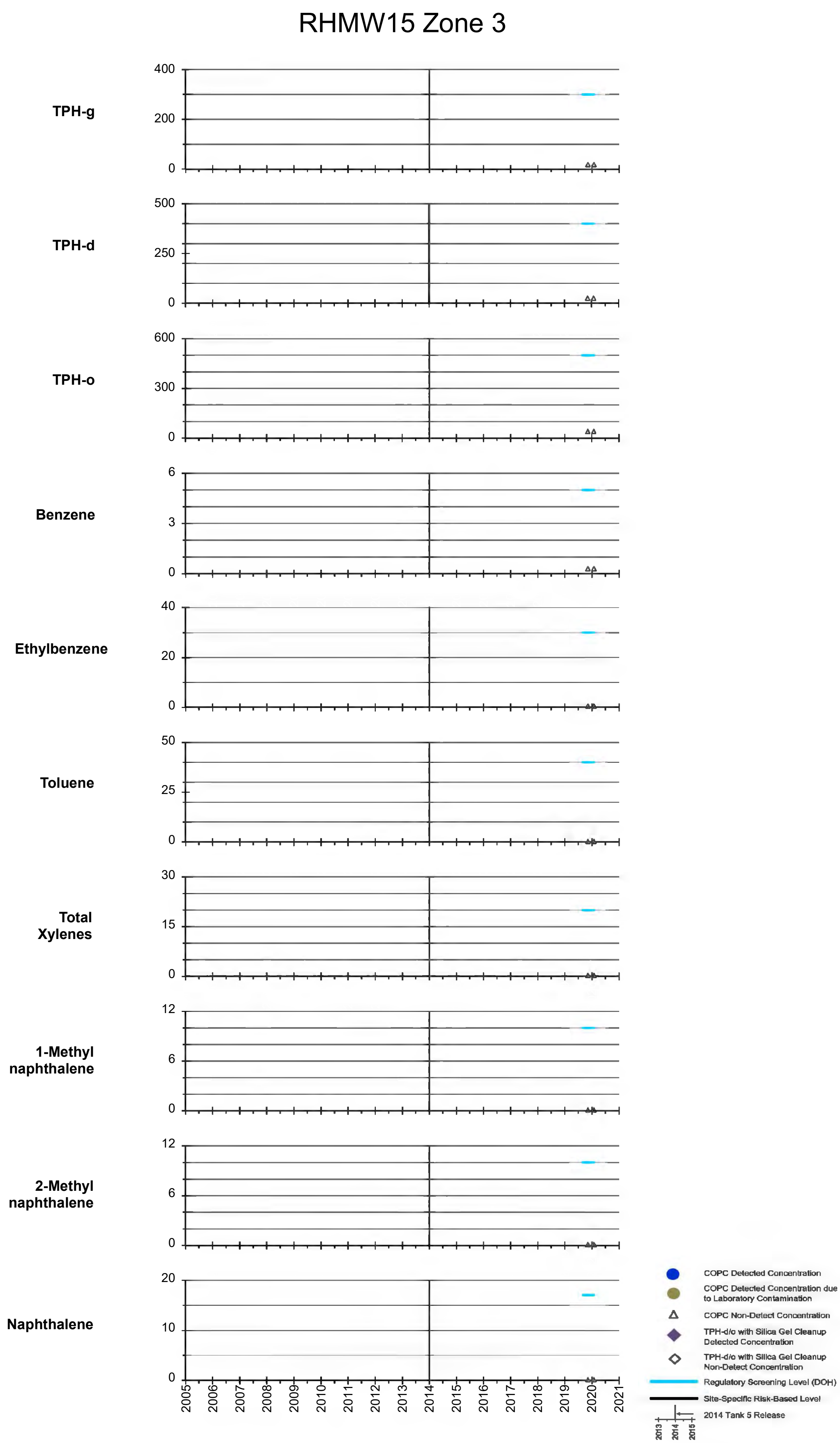

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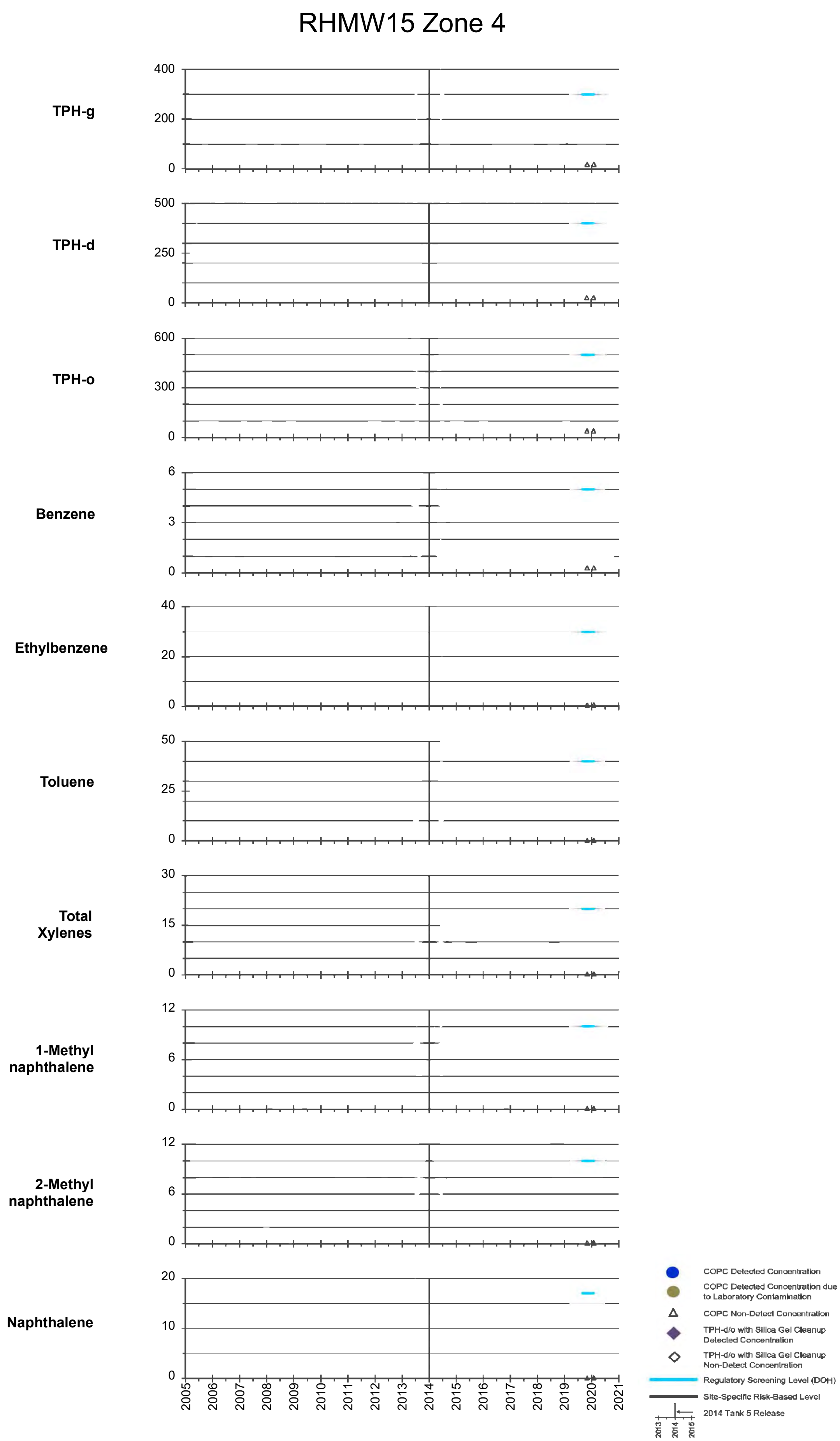

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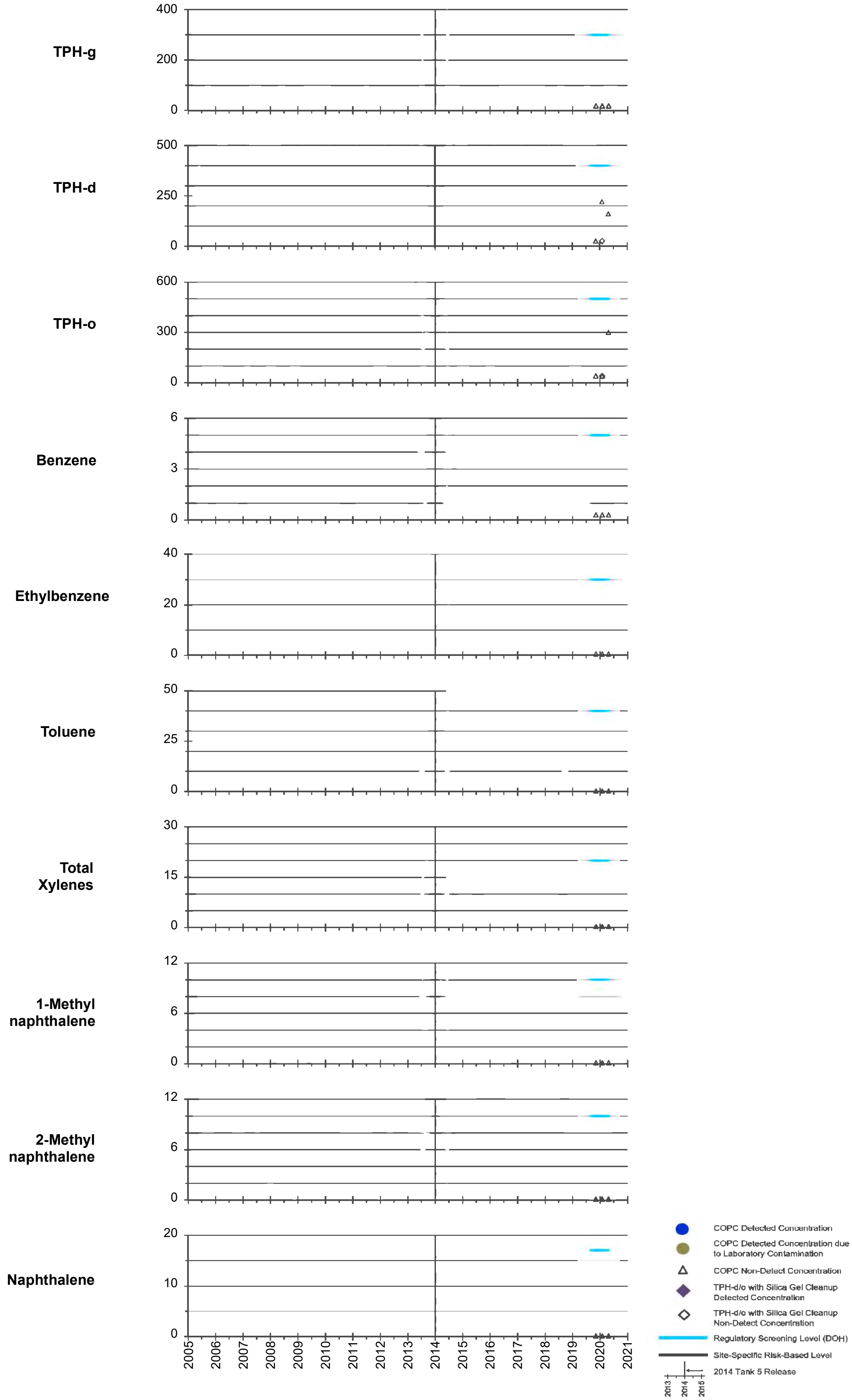
RHMW15 Zone 5



All results in micrograms per liter (µg/L or parts per billion).

Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

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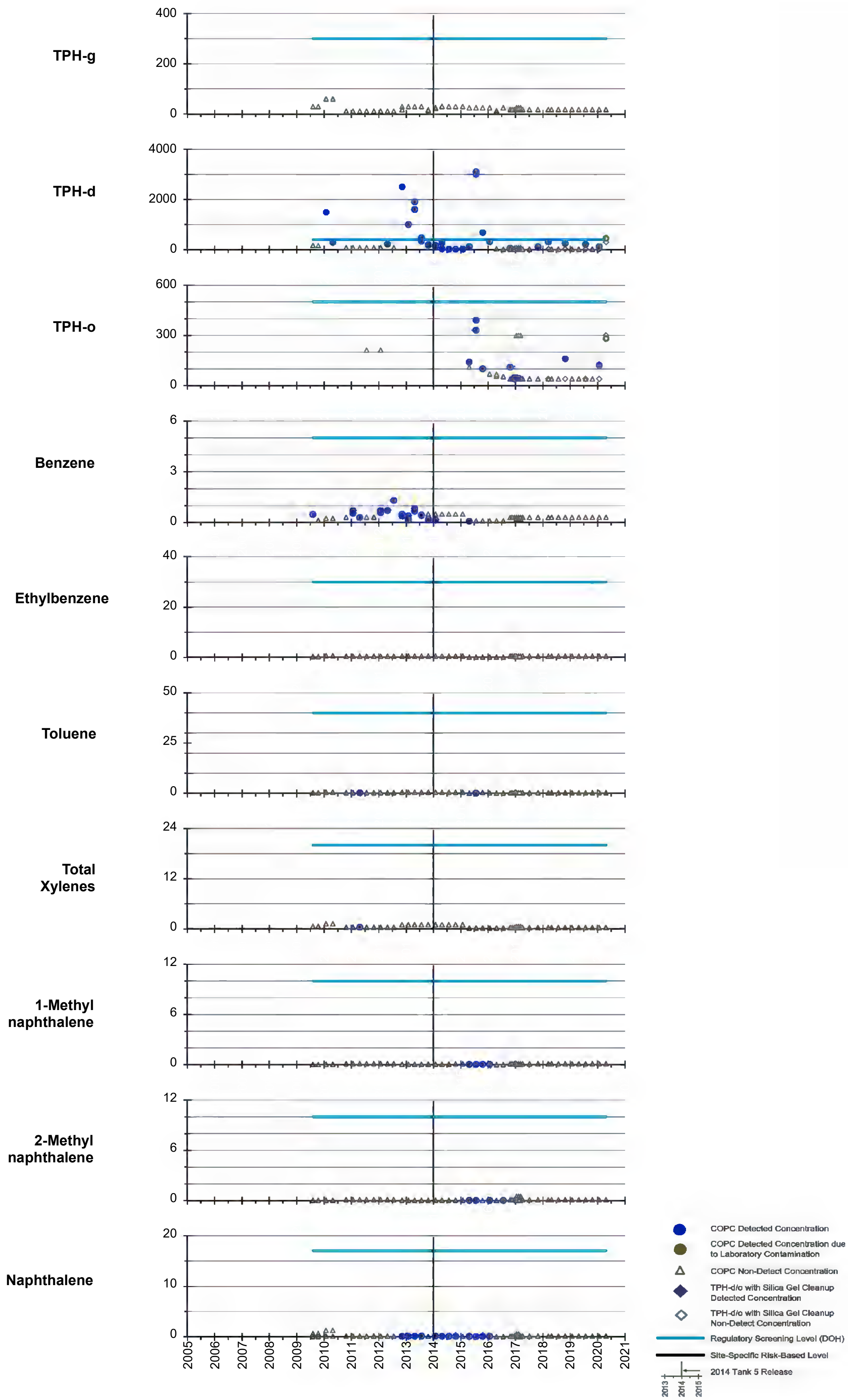
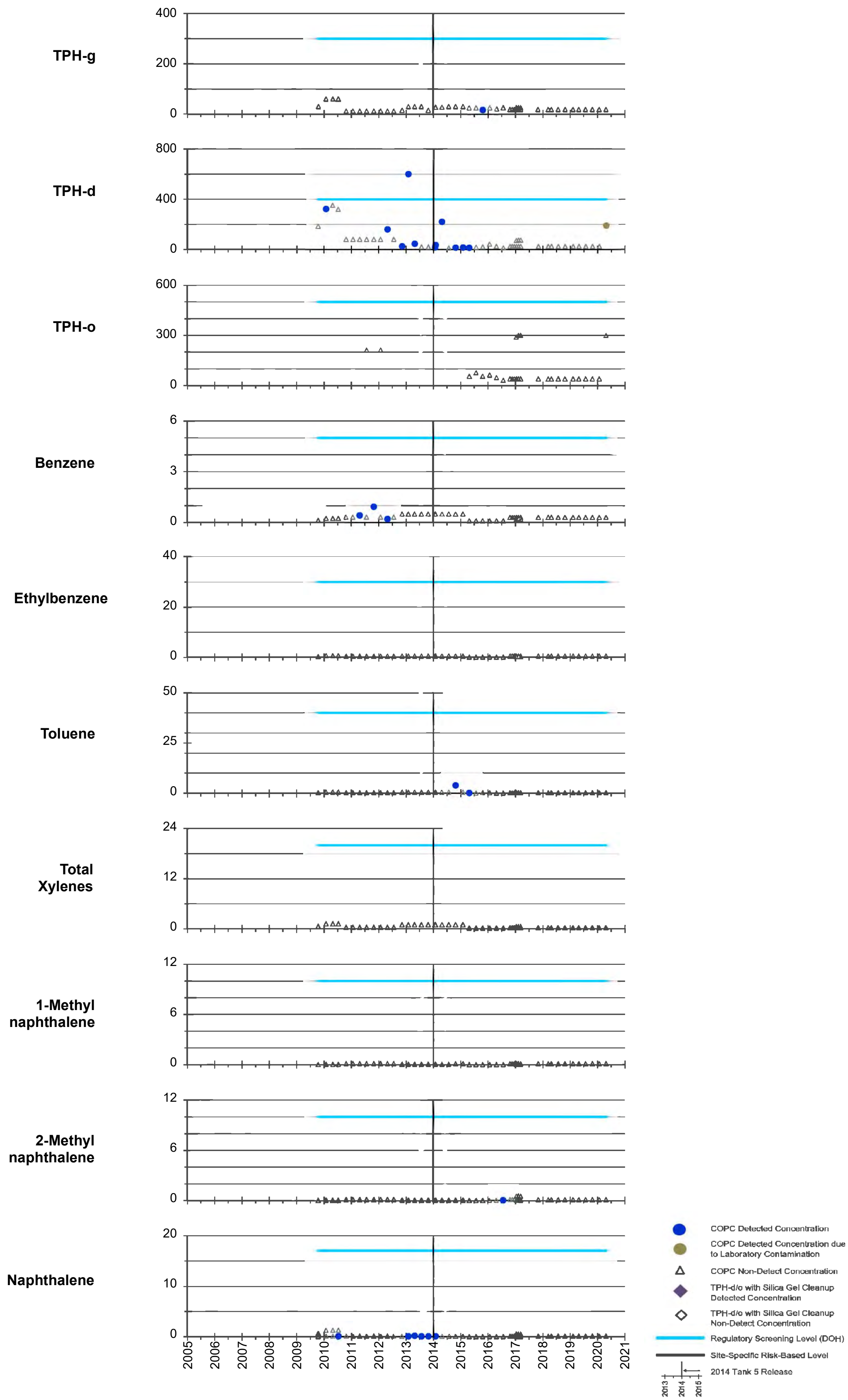


All results in micrograms per liter (µg/L or parts per billion).
EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.
Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

HDMW2253-03



All results in micrograms per liter (µg/L or parts per billion).

EPA Region 9 Laboratory split sampling data from First to Third Quarters 2017 included in the graphs.

Laboratory reporting limits for TPH-d and TPH-o were raised in March 2020 in accordance with the most current DoD QSM (2019), TNI Manual (2016), and 40 CFR Part 136 (Methods Update Rule 2017).

Exhibit K

5.1.7 Red Hill Geologic Framework Model

A geologic framework model was generated using CTECH's Earth Volumetric Studio (EVS) software. The lithologic information used to generate the model was derived from available borehole lithology and from a series of geologic cross sections in the vicinity of Red Hill. Interpolation of lithologic contacts from borehole lithology and cross sections was achieved via adaptive indicator kriging. The framework model was used to visualize the extent of clinker beneath the water table. Groundwater data from the November 2016 synoptic gauging event was incorporated into the model to serve as an upper domain relative to the model's geologic block.

The geologic framework model was also used to compute the estimated volume of clinker and pahoehoe within user-specified domains. The EVS volumetric module was used to compute the volume of clinker and pāhoehoe within each zone against the overall geometric volume to achieve a percent total. In addition to use in groundwater modeling, this geologic evaluation was also incorporated into the holding capacity analysis included in the *Groundwater Protection and Evaluation Considerations* report (DON 2018h).

Details are presented in Appendix E.

5.1.8 3D Regional Geologic Model

Geologic information from borehole logs, seismic profiles, developed cross sections, and relevant publications were incorporated into the development of a 3D regional geologic model of Red Hill and surrounding environs including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor. The model encompasses both the vadose and saturated zones and includes the various rock types present: unweathered basalt (undifferentiated), pyroclastic deposits, caprock deposits, and weathered basalt or saprolite. The 3D regional geologic model was developed to provide stratigraphic support for the Red Hill groundwater flow model; the model extent mirrored the extent of the groundwater flow model domain.

Several data sources were used to develop the 3D regional geologic model. These sources included:

- USGS caprock thickness structural contour data sets
- Regional geologic cross sections
- Geophysical investigation study
- Volcanic tuff and pyroclastic mapping
- Marine sediment mapping
- South Hālawa Valley base of saprolite interpretations

Details are presented in Appendix E.

5.1.9 Assessment of Subsurface Heterogeneity

Geologic logs and photographs of basalt cores from the Red Hill area show that the vadose zone surrounding the fuel tanks is composed of a heterogeneous series of layered basalt flows. Both types of basalt, pāhoehoe and a‘ā, are present.

Within the heterogeneous layered basalt formation that composes the vadose zone surrounding the fuel tanks, the spatial distribution of interconnected pore spaces (effective porosity) is the result of the basalt lava flow genesis and subsequent sub-aerial weathering that may occur prior to the next flow.

Appendix E:
Geologic Framework Model

CONTENTS

ATTACHMENTS

FIGURES

TABLE

ACRONYMS AND ABBREVIATIONS

3D	three-dimensional
EVS	Earth Volumetric Studio
ft	foot/feet
GIS	geographic information system
USGS	United States Geological Survey

1. Red Hill Geologic Framework Model

A geologic framework model was generated using CTECH's Earth Volumetric Studio (EVS) software. The lithologic information used to generate the model was derived from two primary sources and housed in a Microsoft Access database. The first data source came from available borehole lithology where lithologic contacts were pulled from borehole logs and tabulated in a simple flat-file format for inclusion into the lithology database. The second lithology source was derived from a series of geologic cross sections in the vicinity of Red Hill and several others throughout the groundwater flow model domain (Figure E-1). These cross sections were subdivided into a series of artificial boreholes with a horizontal spacing of 100–500 feet (ft). Lithologic contacts from these artificial boreholes were tabulated in a flat-file format and incorporated into the lithology database for interpolation.

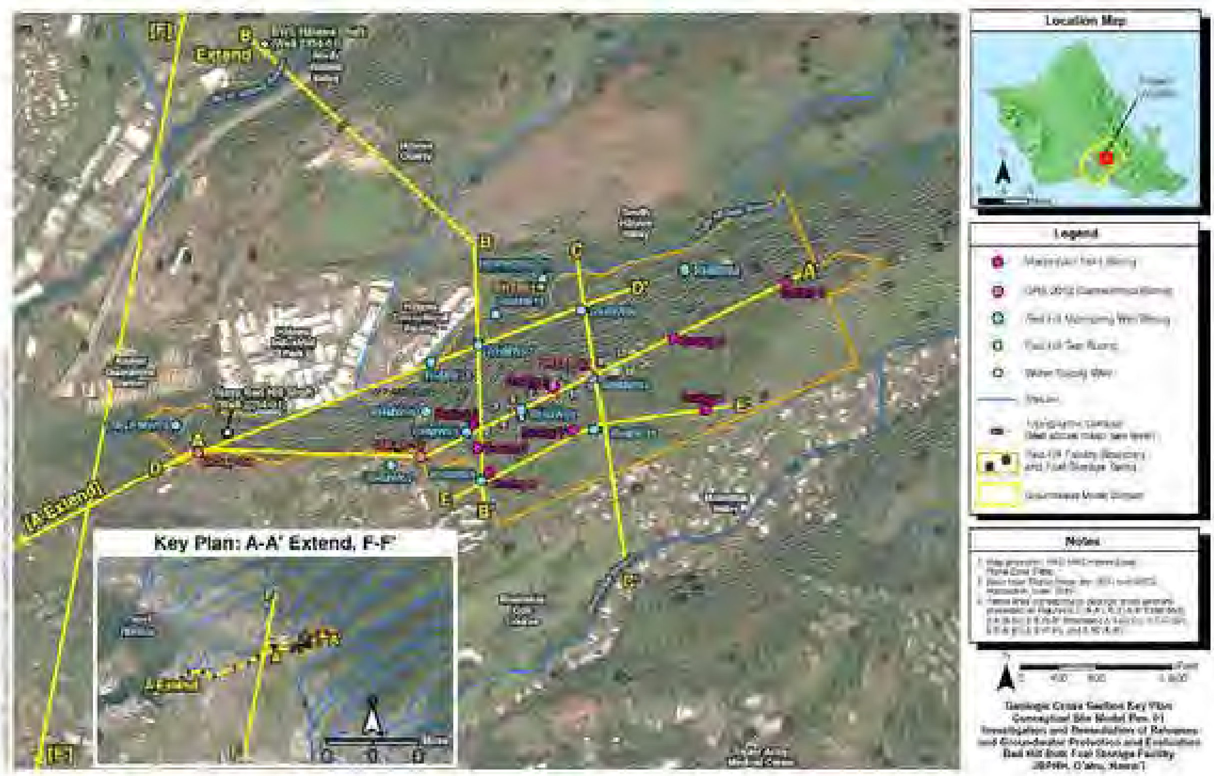


Figure E-1: Red Hill Geologic Cross Section Location Map

Interpolation of the lithologic contacts was achieved via adaptive indicator kriging. Adaptive indicator kriging applies kriging to a user-defined external grid and further refines it by splitting whole cells along boundaries between two or more materials to create smoother surfaces. The external grid used for the geologic framework model had an approximate horizontal cell size of 165 ft × 165 ft with 280 cells along the x-axis and 190 cells along the y-axis. Proportional gridding was used to establish the vertical thickness where a z-axis resolution of 100 was specified. Finally, the horizontal/vertical anisotropy was set at 100 (Figure E-2).

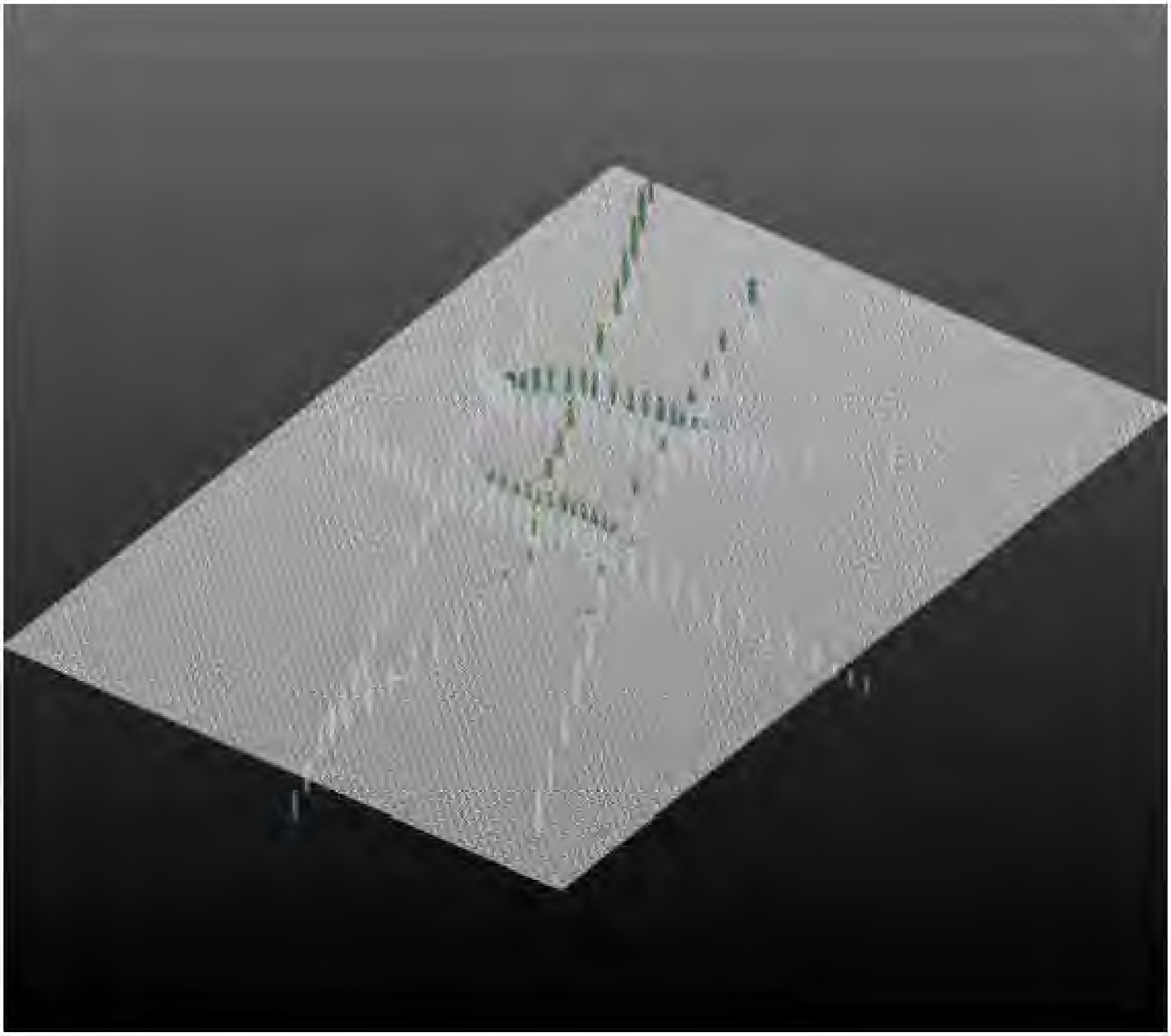


Figure E-2: External Grid (oblique view)

The resulting interpolation yielded a geologic block consisting of the following five primary soil/rock types: alluvium, saprolite, massive a‘ā basalt, a‘ā clinker, and pāhoehoe (Figure E-3).

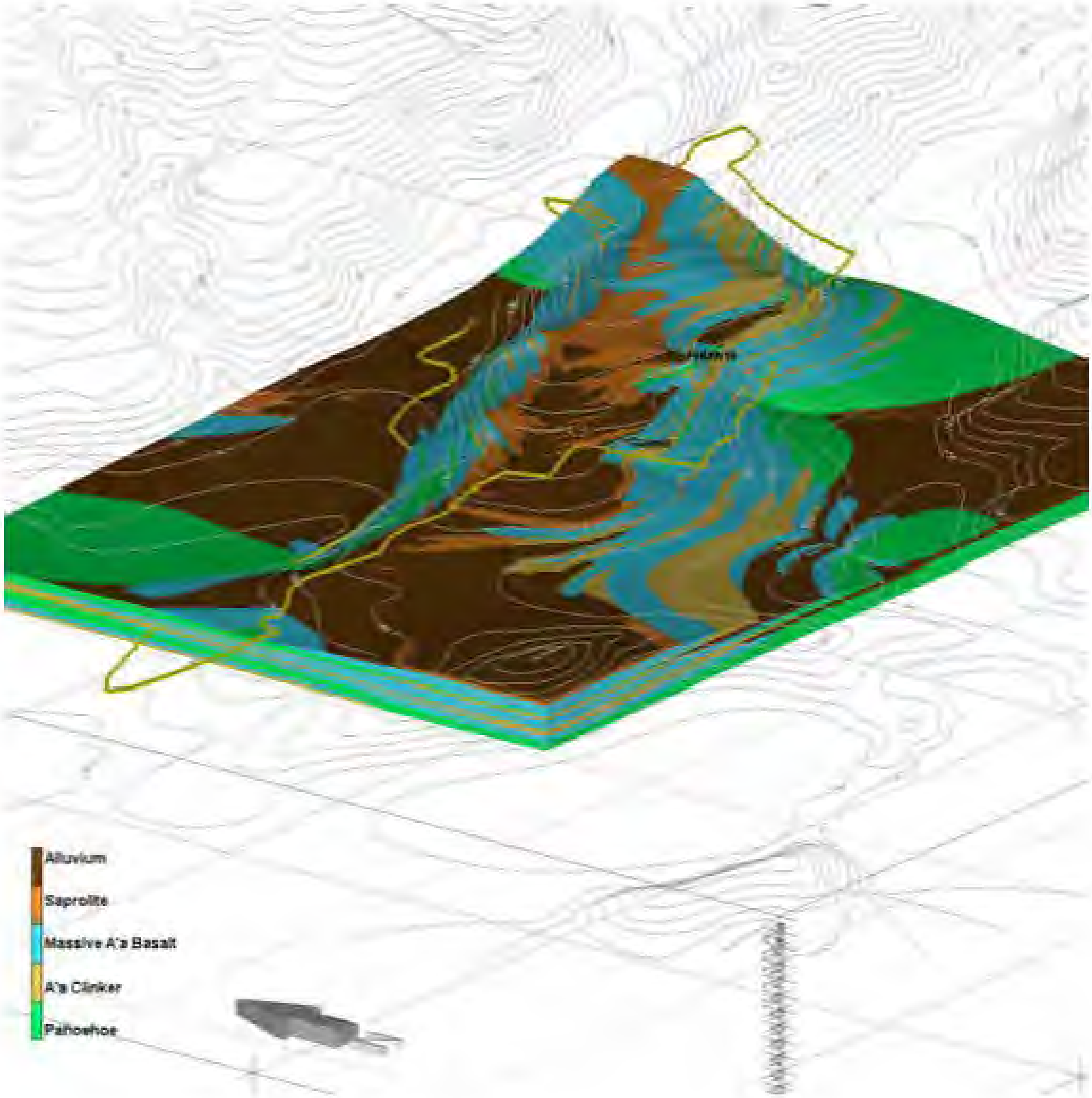


Figure E-3: Red Hill 3D Geologic Block Diagram

Various work products were developed from the geologic block. Specifically, fence diagrams in a variety of orientations along with volume calculations of specific material types from user-specified domains. A groundwater elevation surface was also introduced to visualize soil/rock types in the vadose zone versus saturated zone.

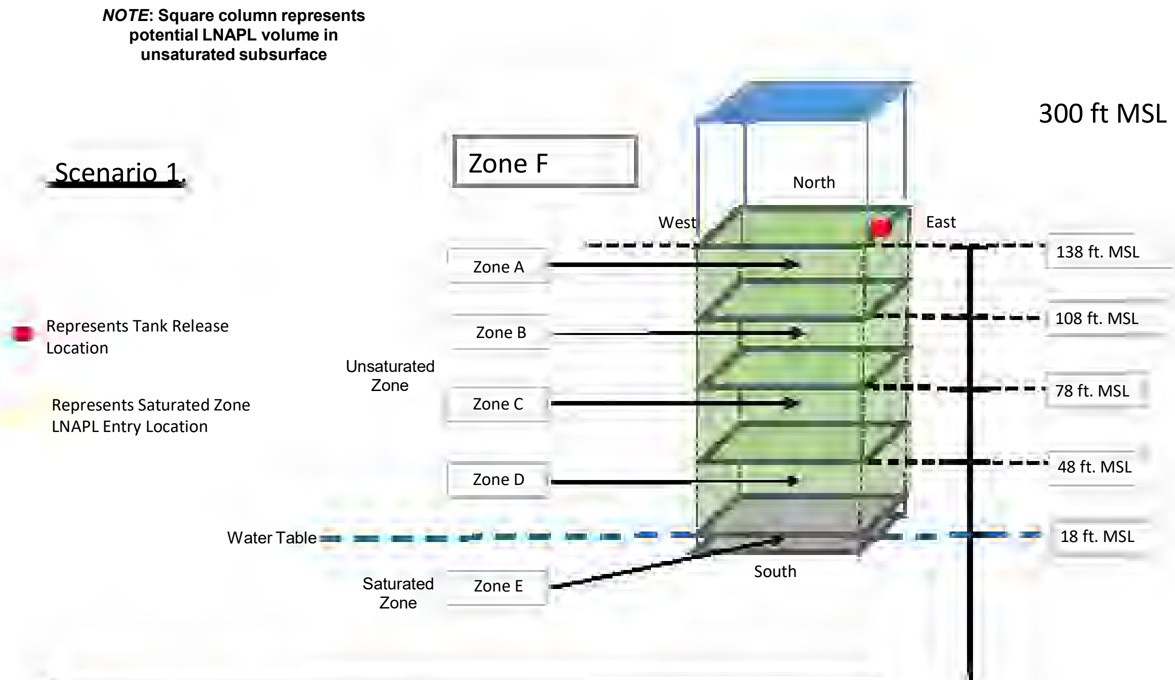
1.1 SATURATED CLINKER EVALUATION

The geologic framework model was used to visualize the extent of clinker beneath the water table. Groundwater data from the November 2016 synoptic gauging event was incorporated into the model to serve as an upper domain relative to the model's geologic block. The five soil/rock types that compose the geologic block were turned off with exception of the clinker rock type to reveal its extent below the water table (Figure E-4).

Figure E-4: Extent of Saturated Clinker (oblique view to the northeast)

1.2 Clinker/Pāhoehoe Volume Evaluation

The geologic framework model was used to compute the estimated volume of clinker and pahoehoe within user specified domains. Two cells (1,600 ft × 1,600 ft and 720 ft × 720 ft) with specific elevation intervals (i.e., zones; Figure E-5) were specified domains for these volume computations. The EVS volumetric module was used to compute the volume of clinker and pāhoehoe within each zone against the overall geometric volume to achieve a percent total (see Table E-1). In addition to use for groundwater modeling, this geologic evaluation was also incorporated into the holding capacity analysis that was part of the *Groundwater Protection and Evaluation Considerations* report (DON 2018b).



Geometric Summary						
Dimension	**Zone A**	**Zone B**	**Zone C**	**Zone D**	**Zone E**	*Unit*
Length	1,600	1,600	1,600	1,600	1,600	feet
Width	1,600	1,600	1,600	1,600	1,600	feet
Thickness	30	30	30	30	2	feet
Top Area	2,560,000	2,560,000	2,560,000	2,560,000	2,560,000	sq.ft.
Bottom Area	2,560,000	2,560,000	2,560,000	2,560,000	2,560,000	sq.ft.

Figure E-5: Scenario Zone Designations

Table E-1: Clinker / Pāhoehoe Percent Volume Results

Zone	Elevation Interval (ft)	Total Volume (cu. ft.)	Clinker Volume (cu. ft.)	Pāhoehoe Volume (cu. ft.)	% Clinker	% Pāhoehoe
Scenario 1 (1,600 ft × **1,600 ft Cell)**						
F	300–138	4.15E+08	1.04E+08	4.54E+07	25%	11%
A	138–108	7.68E+07	9.93E+06	3.88E+07	13%	50%
B	108–78	7.68E+07	1.48E+06	4.43E+07	2%	58%
C	78–48	7.68E+07	1.94E+06	5.73E+07	3%	75%
D	48–18	7.68E+07	3.02E+06	6.40E+07	4%	83%
E	18–16	5.12E+06	5.68E+04	4.98E+06	1%	97%
Scenario 2 (720 ft × **720 ft Cell)**						
F	300–138	8.40E+07	2.16E+07	8.82E+06	26%	11%
A	138–108	1.56E+07	1.11E+06	1.10E+07	7%	70%
B	108–78	1.56E+07	5.74E+03	9.78E+06	0.04%	63%
C	78–48	1.56E+07	2.49E+05	1.25E+07	2%	80%
D	48–18	1.56E+07	0.00E+00	1.45E+07	0%	93%
E	18–16	1.04E+06	0.00E+00	1.04E+06	0%	100%

2. Three-Dimensional (3D) Regional Geologic Model

In addition to the Red Hill-specific geologic model, a 3D regional geologic model was developed to provide stratigraphic support for the groundwater flow model. The model extent mirrored the extent of the groundwater flow model domain, which is approximately 9 miles along the northeast/southwest and approximately 6 miles in the northwest/southeast direction (Figure E-6).

Figure E-6: Extent of 3D Regional Geologic Model

2.1 Regional Geologic Model Data Sets

Several data sources were used to develop the 3D regional geologic model. These sources included:

- United States Geological Survey (USGS) caprock thickness structural contour data sets
- Regional geologic cross sections
- Geophysical investigation study
- Volcanic tuff and pyroclastic mapping
- Marine sediment mapping
- South Hālawa Valley base of saprolite interpretations

2.1.1 USGS Caprock Thickness Data Sets

On July 20, 2017, the USGS provided the Navy with two preliminary spatial data sets depicting the thickness of the Caprock hydrogeological unit and the structural surface elevation contours of the underlying undifferentiated basalt. These data sets were provided as geographic information system (GIS) shapefiles and served as the basis of the 3D regional geologic model as it relates to caprock thickness and surface elevation of the undifferentiated basalt.

2.1.2 Regional Geologic Cross Sections

Regional geologic cross sections were incorporated into the model to provide additional lithologic detail beyond what was provided in the USGS data sets. Cross-section locations are shown on Figure E-7; the cross-section diagrams are presented in Attachment E.1. Specifically, the geologic cross sections provided lithologic contact elevations for undifferentiated basalt, saprolite, alluvium, tuff, and marine deposits. These cross sections were subdivided into a series of artificial boreholes with a horizontal spacing of 500–1,000 ft. Lithologic contacts from these artificial boreholes were tabulated in a flat-file format and incorporated into the lithology database for interpolation.

Figure E-7: Regional Geologic Cross-Section Location Map

2.1.3 Geophysical Investigation

A geophysical investigation was performed to better understand the extent of saprolite in the valleys adjacent to the Red Hill site. A seismic refraction and reflection survey was performed along a series of transects located on Red Hill and **in North/South Hālawa and Moanalua Valleys. Findings from the** seismic study (DON 2018a) were incorporated into the regional geologic cross sections used in development of the 3D model (Figure E-8).

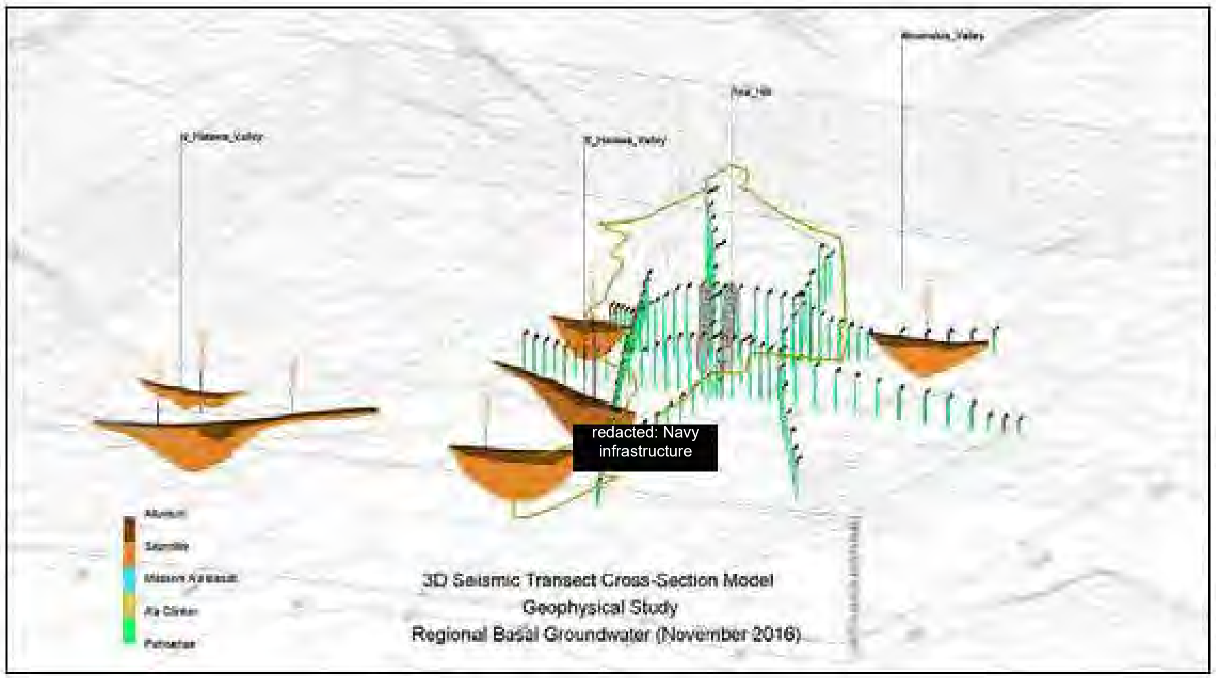
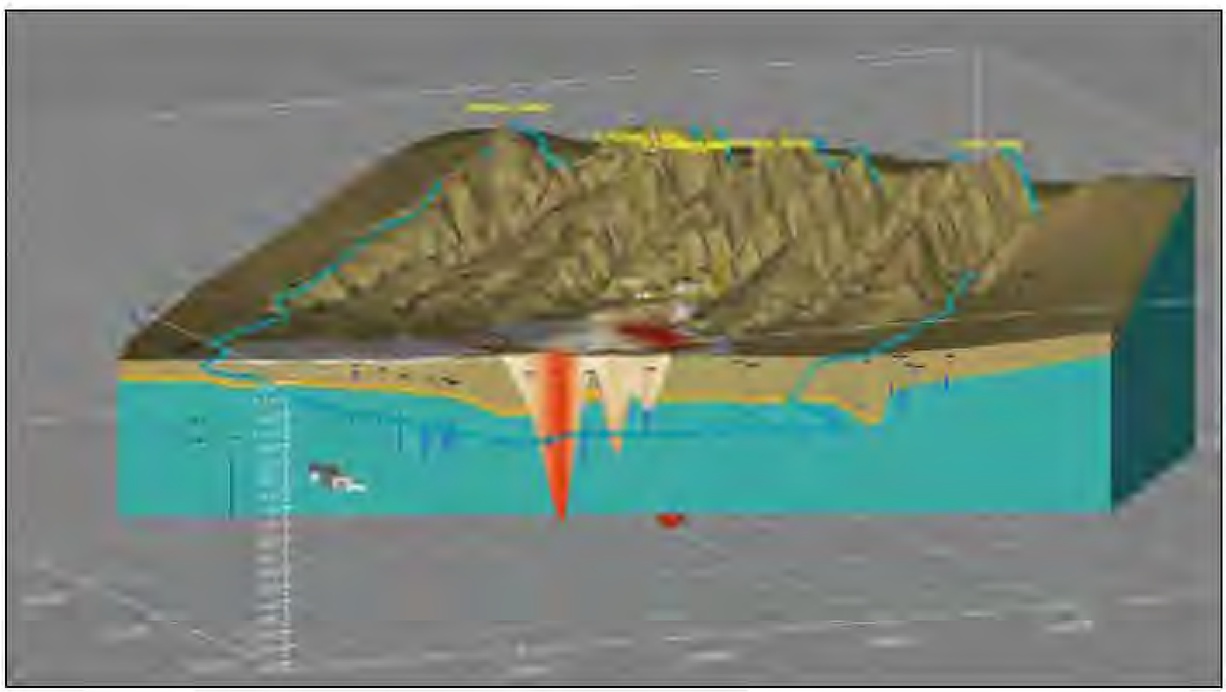


Figure E-8: Geophysical Investigation 3D Rendering

2.1.4 Volcanic Tuff Mapping

A series of pyroclastic craters and associated surface tuff deposits were incorporated into the 3D model based on a study of the Salt Lake Area by Pankiwskyj (1972). Figures from this study were used to delineate the crater rims and surface tuff extent through georeferencing in a GIS software platform. These features were then subsequently transferred into the 3D model for interpolation (Figure E-9 and Figure E-10).

1 **Figure E-9: Surface Tuff and Crater Rim Extent**



2 **Figure E-10: 3D Block Diagram of Tuff Complex**

2.1.5 Marine Sediments

Marine sediments were conceptually incorporated into the model and spatially situated based on available geologic mapping. The marine sediment lithology database and subsequent interpolation was generated in a fashion to show a transgression/regression pattern indicative of a coastal sediment depositional environment (Figure E-11).

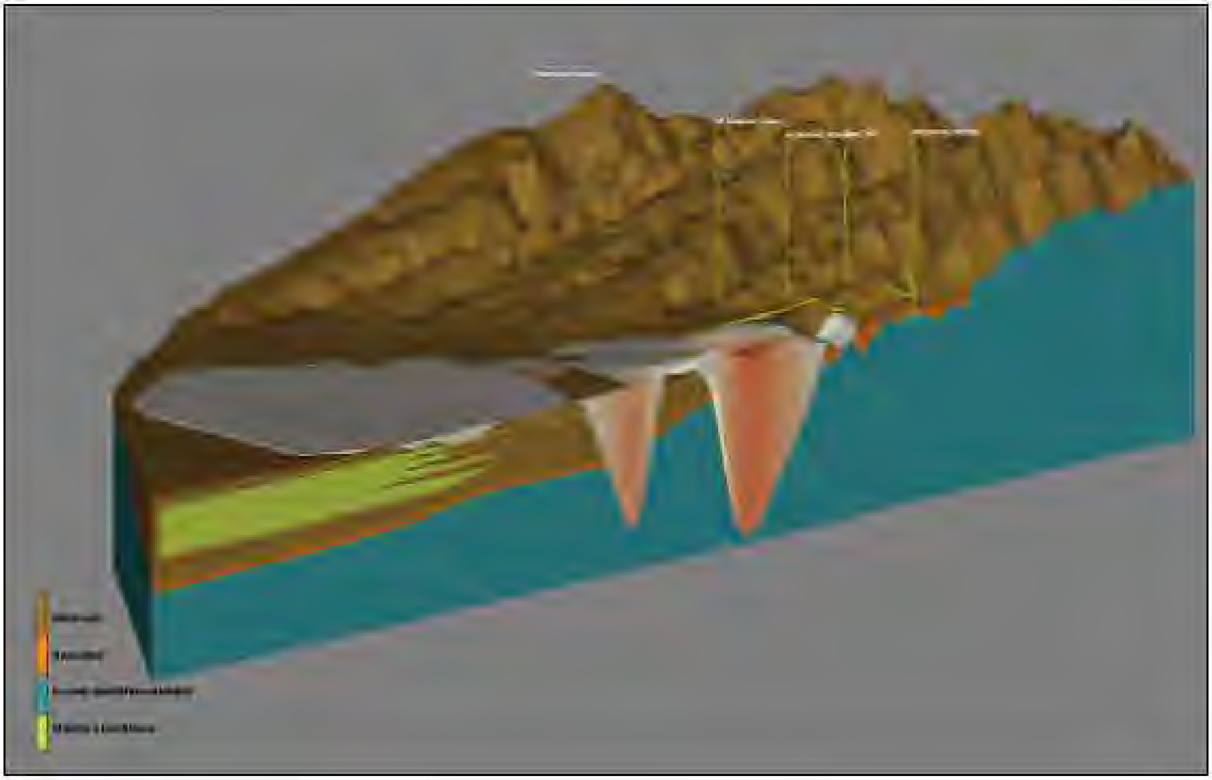


Figure E-11: 3D Block Diagram of Marine Sediments and Tuff Crater

2.1.6 South Hālawa Valley Base of Saprolite Interpretations

Two cross-section interpretations, an upper bound and a lower bound, situated along the South Hālawa Valley resulted in two versions of the 3D geologic model. These interpretations relate to the base of saprolite contact elevation with one version having a saprolite contact depth approximately 50 ft lower. As a result, two dedicated stand-alone geologic models were generated as the "Navy" and "DOH" interpretations (Figure E-12 and Figure E-13, respectively).

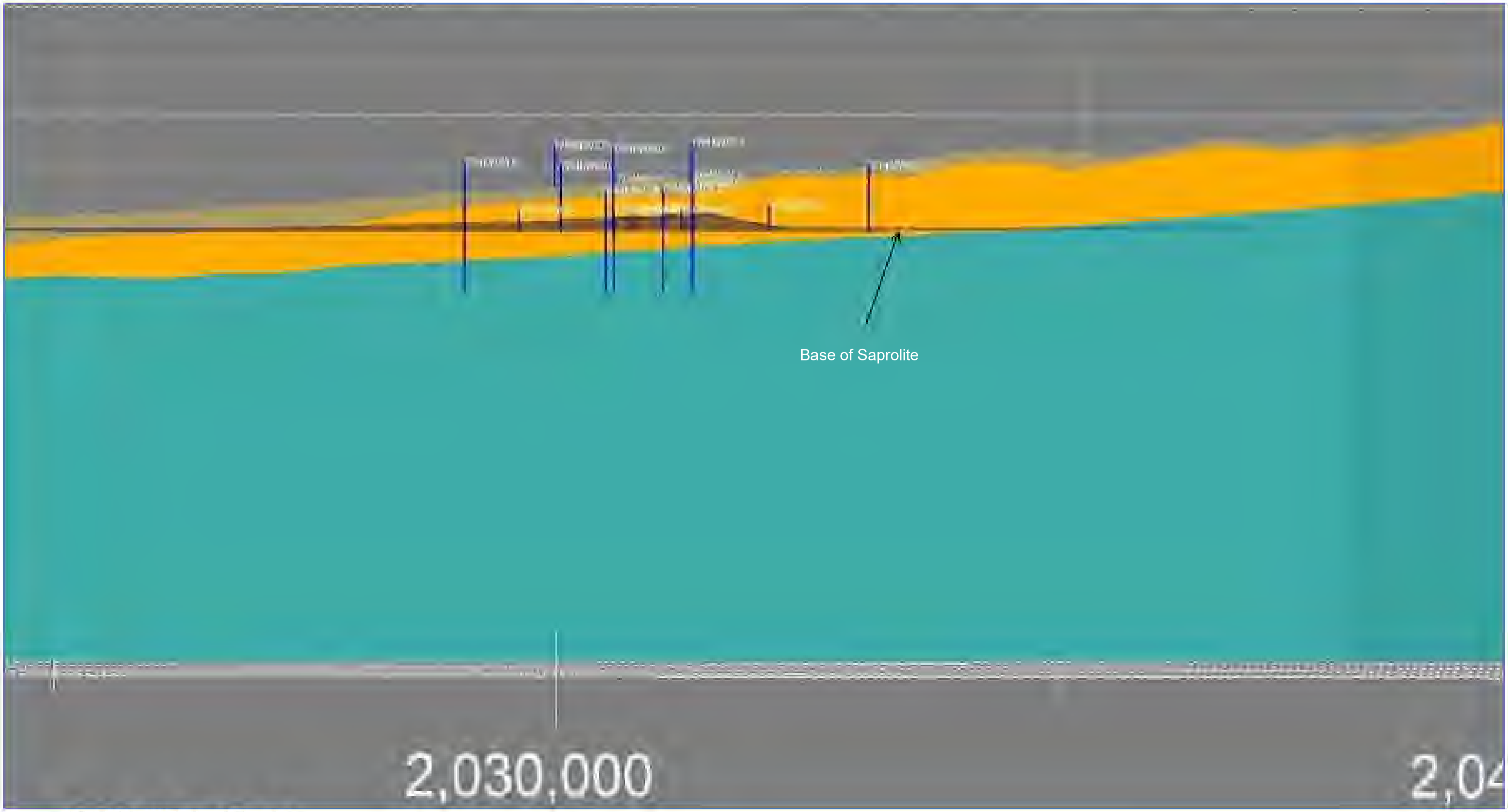


Figure E-12 South Halawa Valley Base of Saprolite (lower bound interpretation)

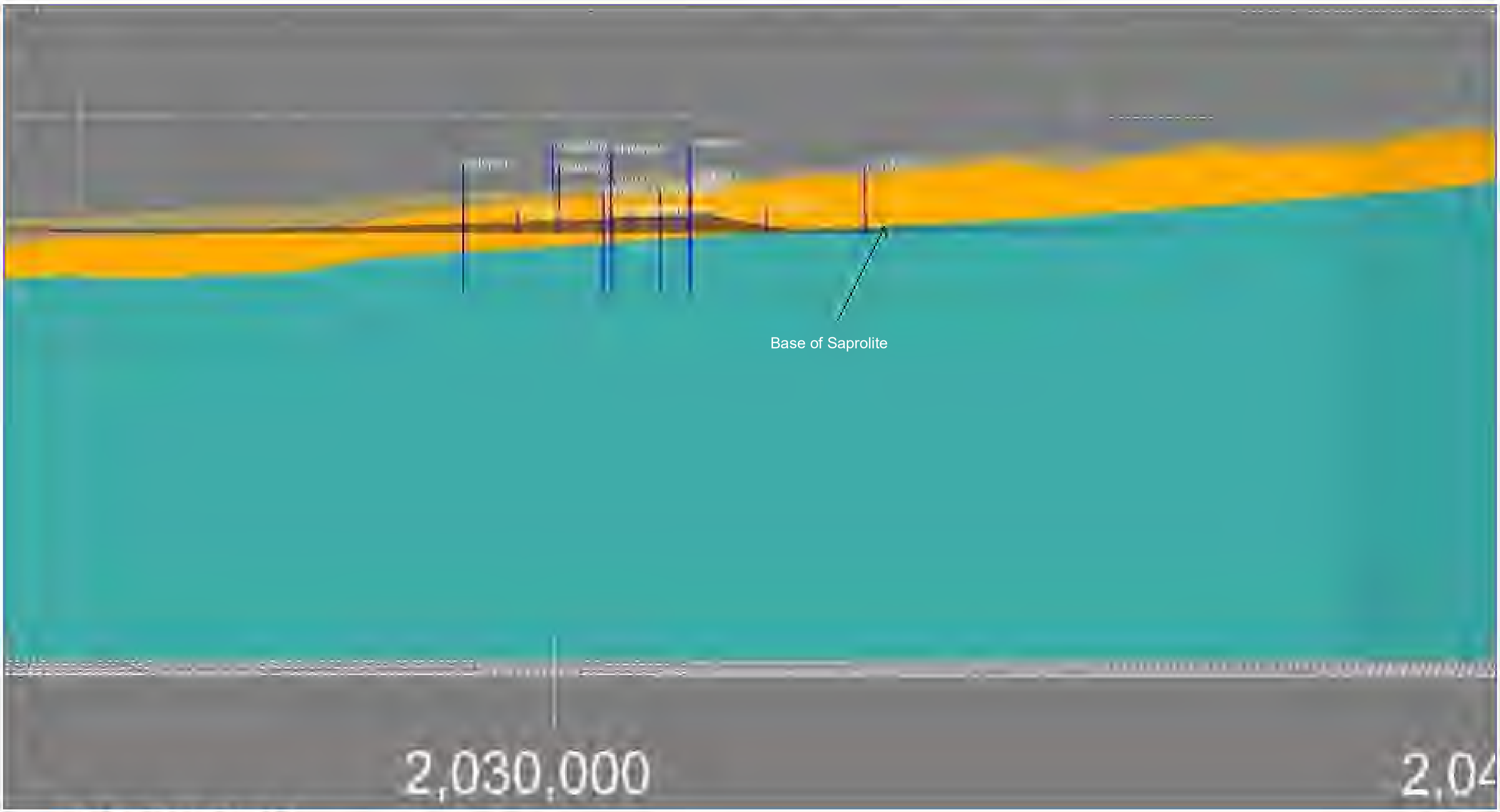


Figure E-13 South Halawa Valley Base of Saprolite (upper bound interpretation)

2.2 MODEL INTERPOLATION

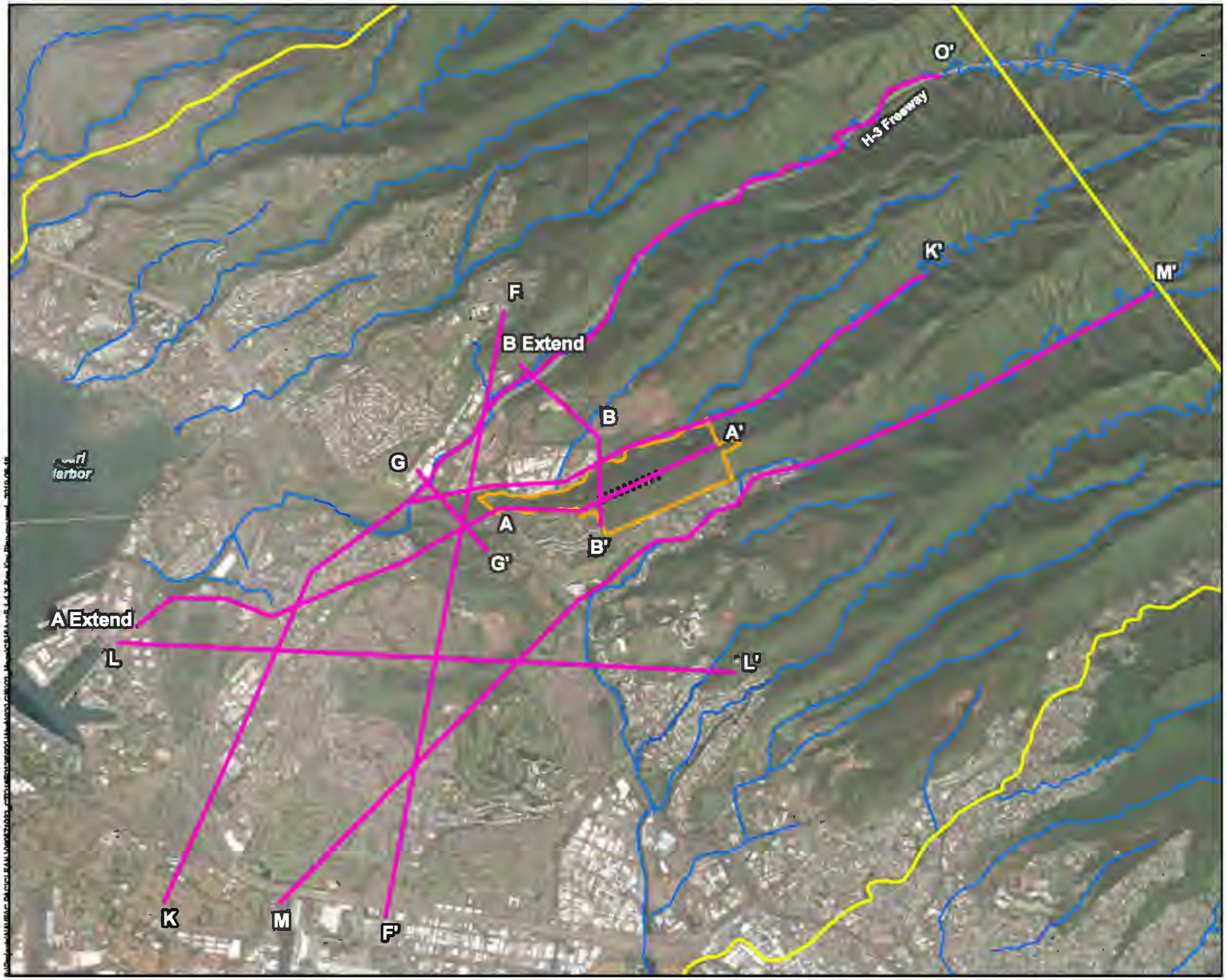
Pertinent geologic contacts from the aforementioned data sets were tabulated and housed in a Microsoft Access database consisting of 2,909 spatial data points. Each point represents the location of discrete geologic contacts (up to five depending on geology at that location). A higher concentration of data points resides in the nearby North/South Hālawa and Moanalua Valleys due to a variety of subsurface investigations in those areas (see Figure E-14). Interpolation of this spatial data set was performed in EVS via the krig_3D_geology module. This module interpolates data into a series of geologic horizons where each elevation represents a geologic surface at that point in space. Several kriging estimation methods within the krig_3D_geology module are available for use. The Natural Neighbors kriging estimation method was used to generate the 3D geologic block diagram.

Figure E-14: 3D Regional Geologic Model Spatial Data Set

3. References

Department of the Navy (DON). 2018a. *Seismic Profiling to Map Hydrostratigraphy in the Red Hill Area, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, O‘ahu, Hawai‘i; March 30, 2018, Revision 00.* Prepared by Lee Liberty and James St. Claire, Boise State University, Boise, ID, for AECOM Technical Services, Inc., Honolulu, HI. Boise State University Technical Report BSU CGISS 18-01. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.

Attachment E.1: Regional Geologic Cross Sections



Legend

- Geologic Cross Section
- Groundwater Model Domain
- Red Hill Facility Boundary and Fuel Storage Tanks
- Stream

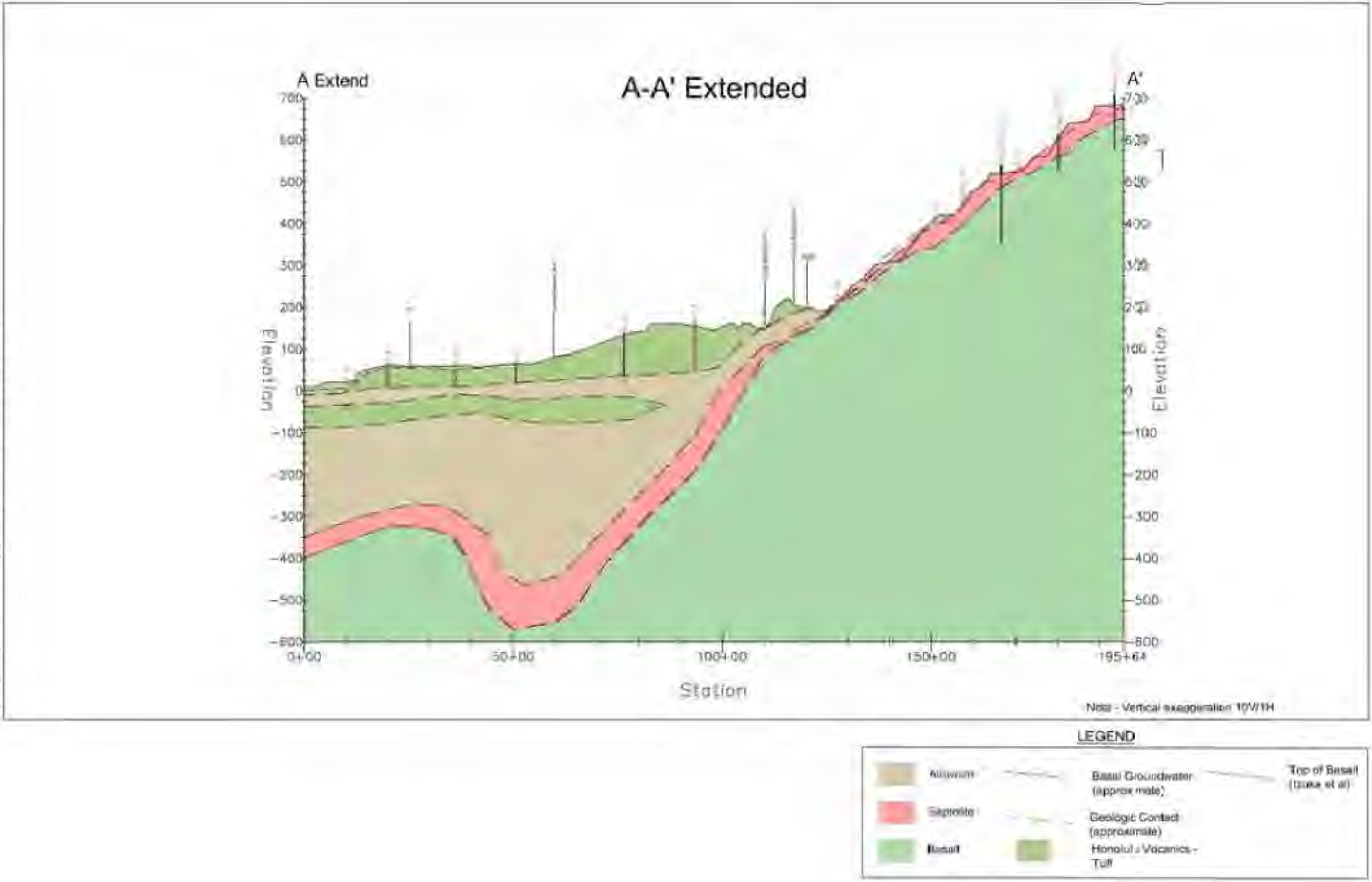
Notes

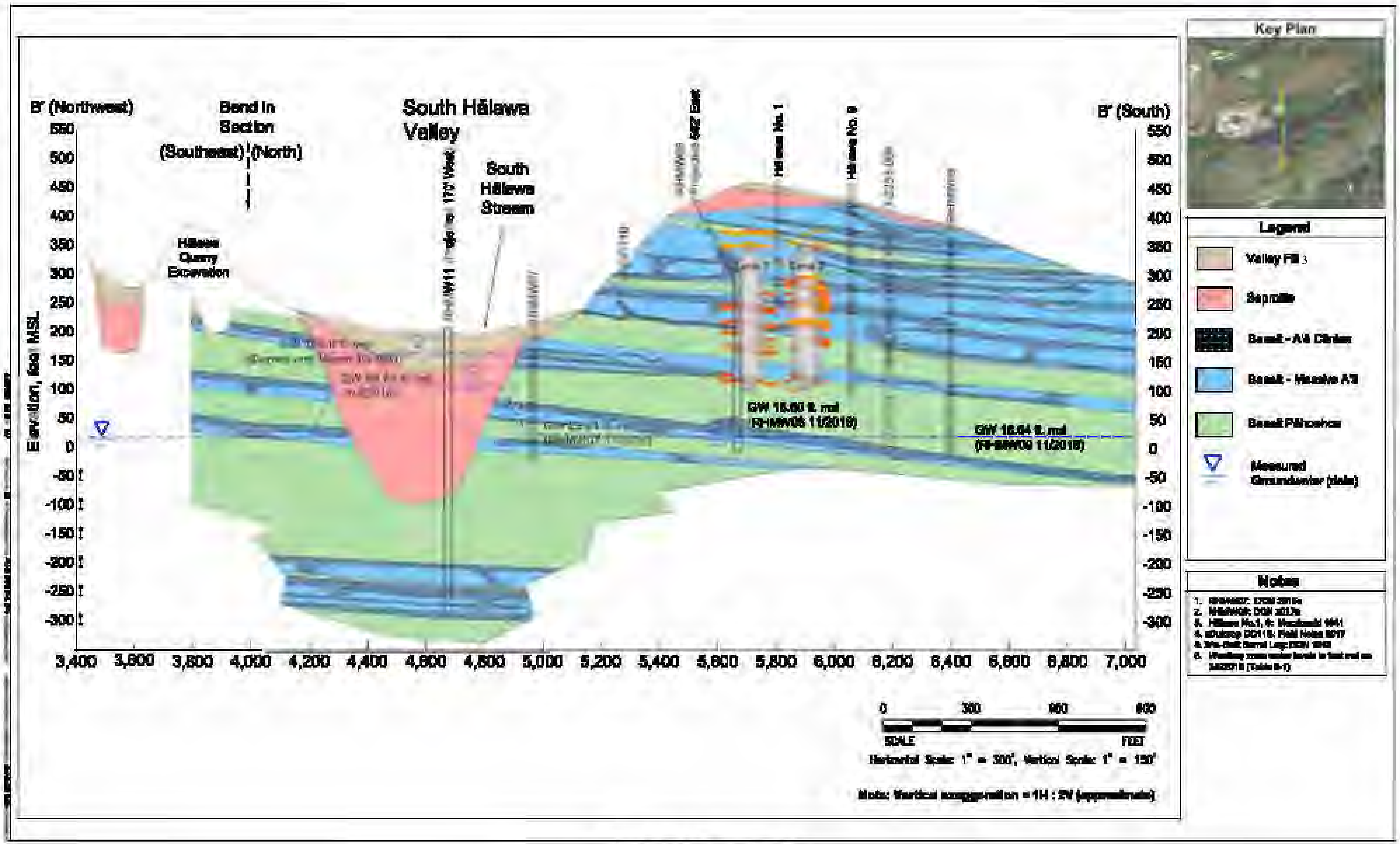
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet
2. DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015

N

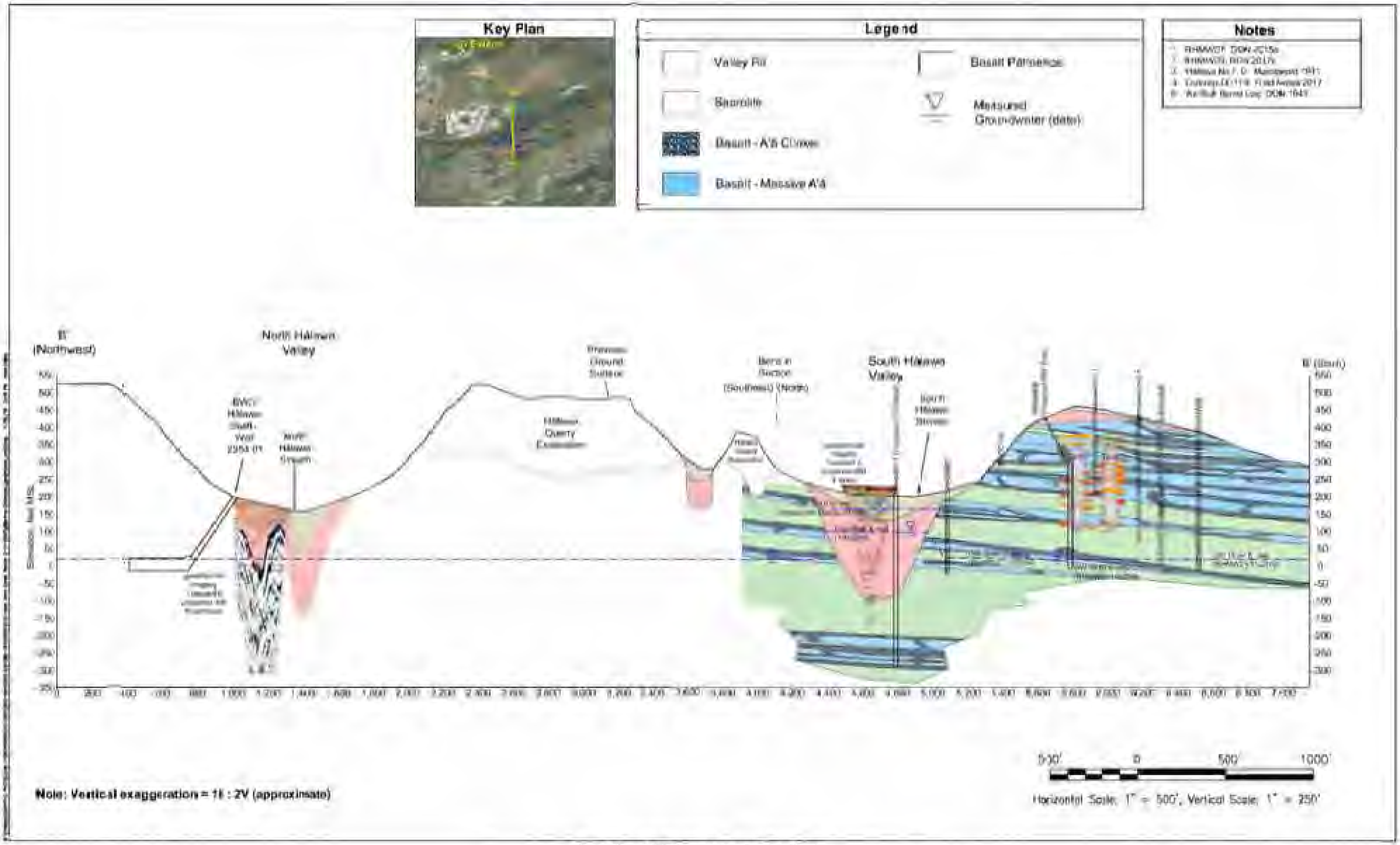
0 1,250 2,500 5,000 Feet

Figure E.1-1
Geologic Model Cross Section Key Plan
Conceptual Site Model Rev. 01
Investigation and Remediation of Releases and Groundwater Protection and Evaluation
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

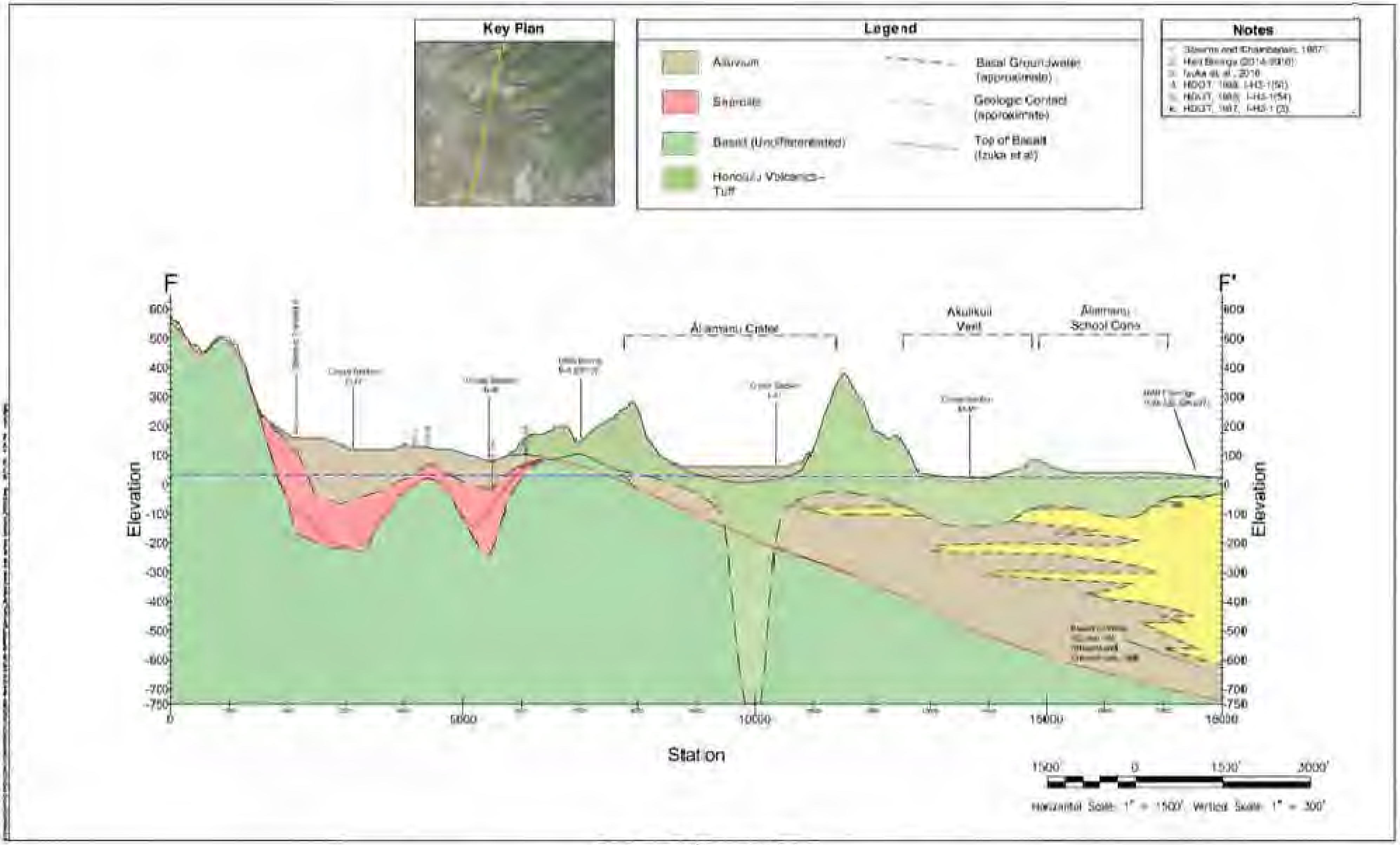

A-A' Extended
A Extend
A'
Elevation
Station
0+00
50+00
100+00
150+00
195+64
Note - Vertical exaggeration 10V/1H
LEGEND
Alluvium
Saprolite
Basalt
Basal Groundwater (approximate)
Geologic Contact (approximate)
Honolulu Volcanics - Tuff
Top of Basalt (Izuka et al)



Cross Section B-B' (View Looking East)
Conceptual Site Model Revision 01
Investigation and Remediation of Releases and Groundwater Protection and Evaluation Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

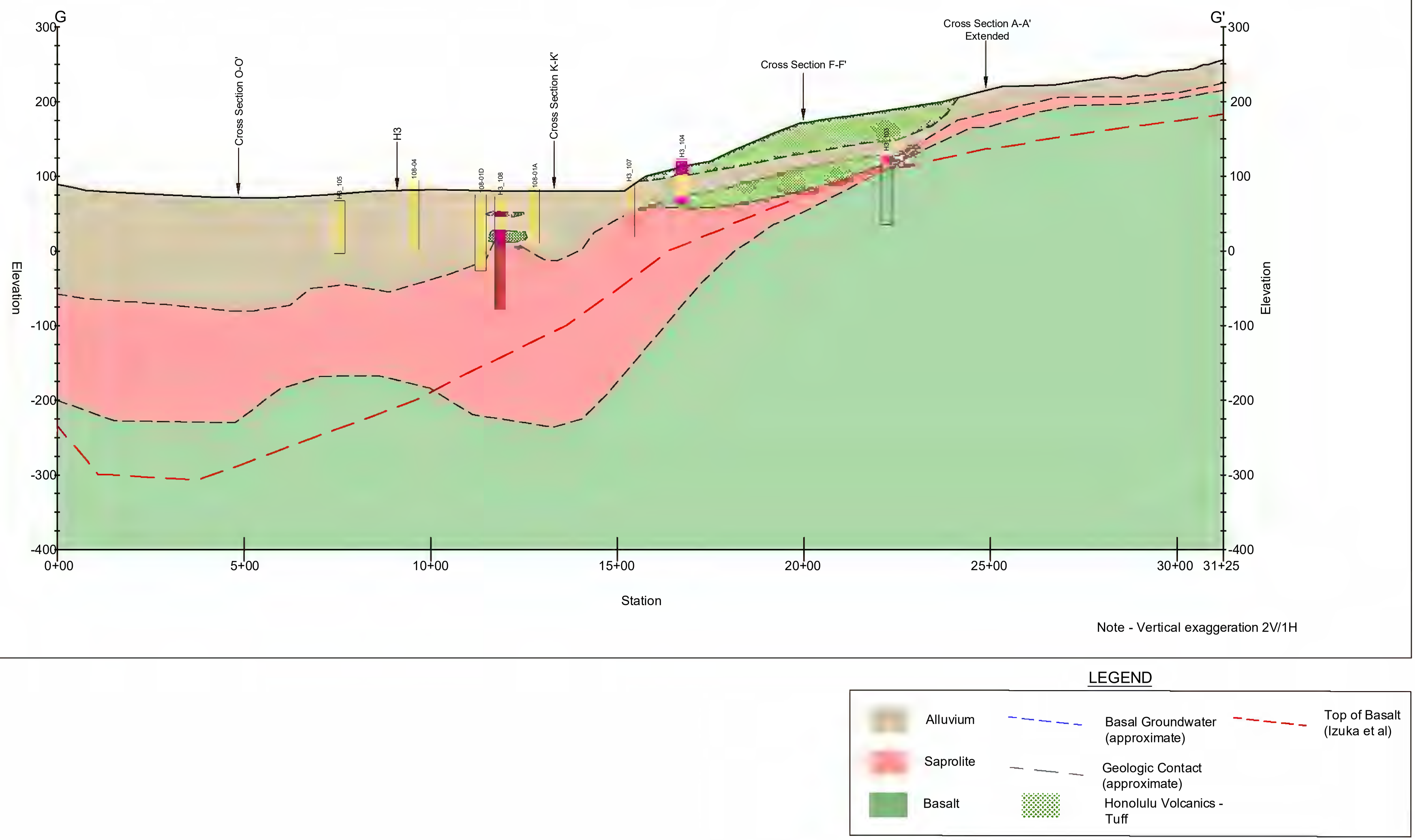


Cross Section B-B' Extended (View Looking East)
Conceptual Site Model Revision 01
Investigation and Remediation of Releases and Groundwater Protection and Evaluation
Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

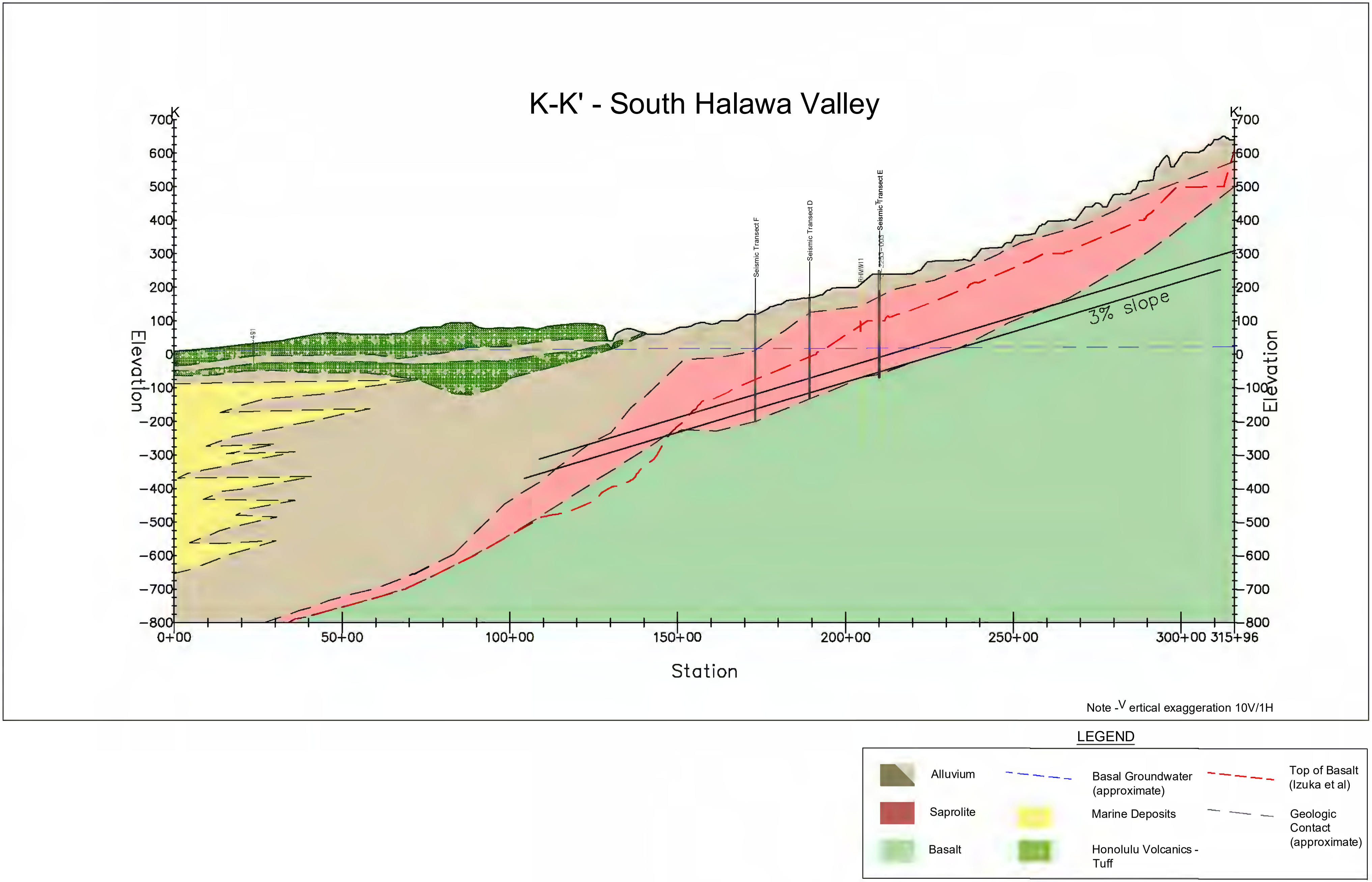


Cross Section F-F' Āliamanu Crater Section
Conceptual Site Model Revision 01
Investigation and Remediation of Releases and Groundwater Protection and Evaluation
Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i

G-G' - H3 interchange



C:\Users\Mark.Higley\Documents\Autodesk\model area surface contours_180910.dwg 9/11/2018 7:39 AM Mark.Higley



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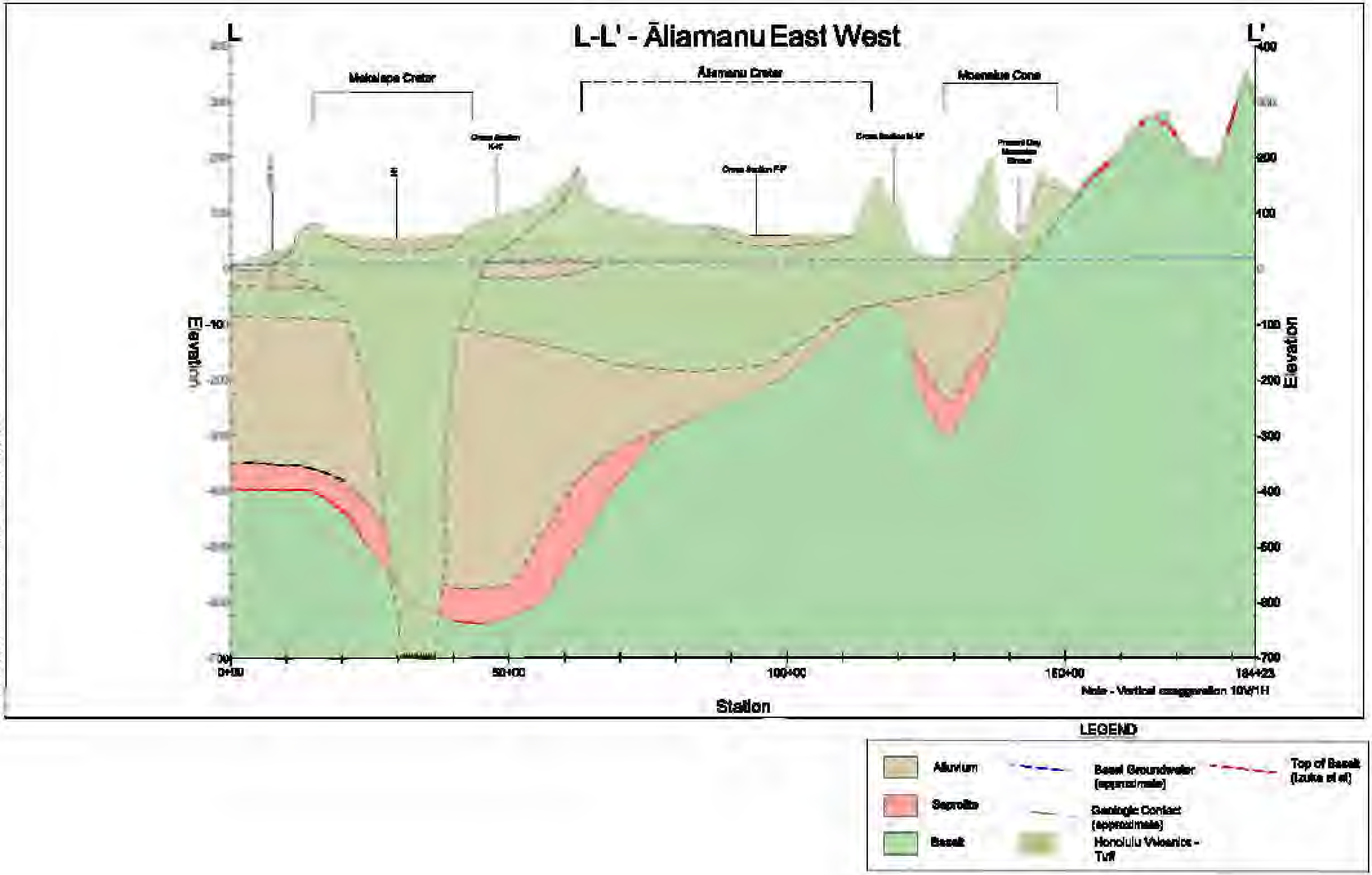
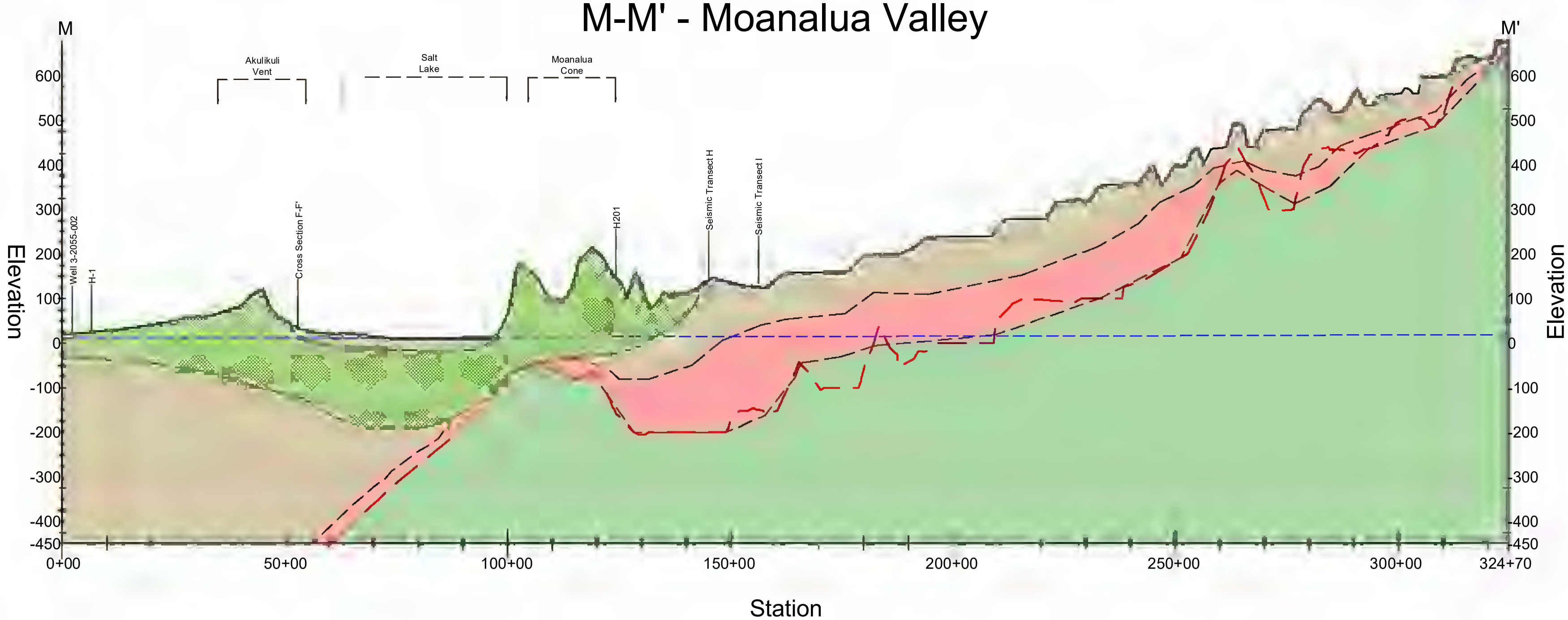


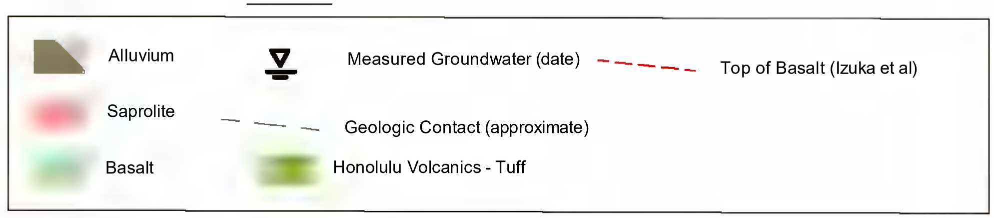
L-L' - Āliamanu East West
L
L'
Makalapa Crater
Āliamanu Crater
Moanalua Cone
Cross Section K-K'
Cross Section F-F'
Cross Section M-M'
Elevation
400
200
100
0
-100
-200
-300
-400
-500
-600
-700
0+00
50+00
100+00
150+00
184+23
Station
Note - Vertical exaggeration 10V:1H
LEGEND
Alluvium
Saprolite
Basalt
Basal Groundwater (approximate)
Geologic Contact (approximate)
Honolulu Volcanics - Tuff
Top of Basalt (Izuka et al)

M-M' - Moanalua Valley



Note - Vertical exaggeration 10V/1H

LEGEND



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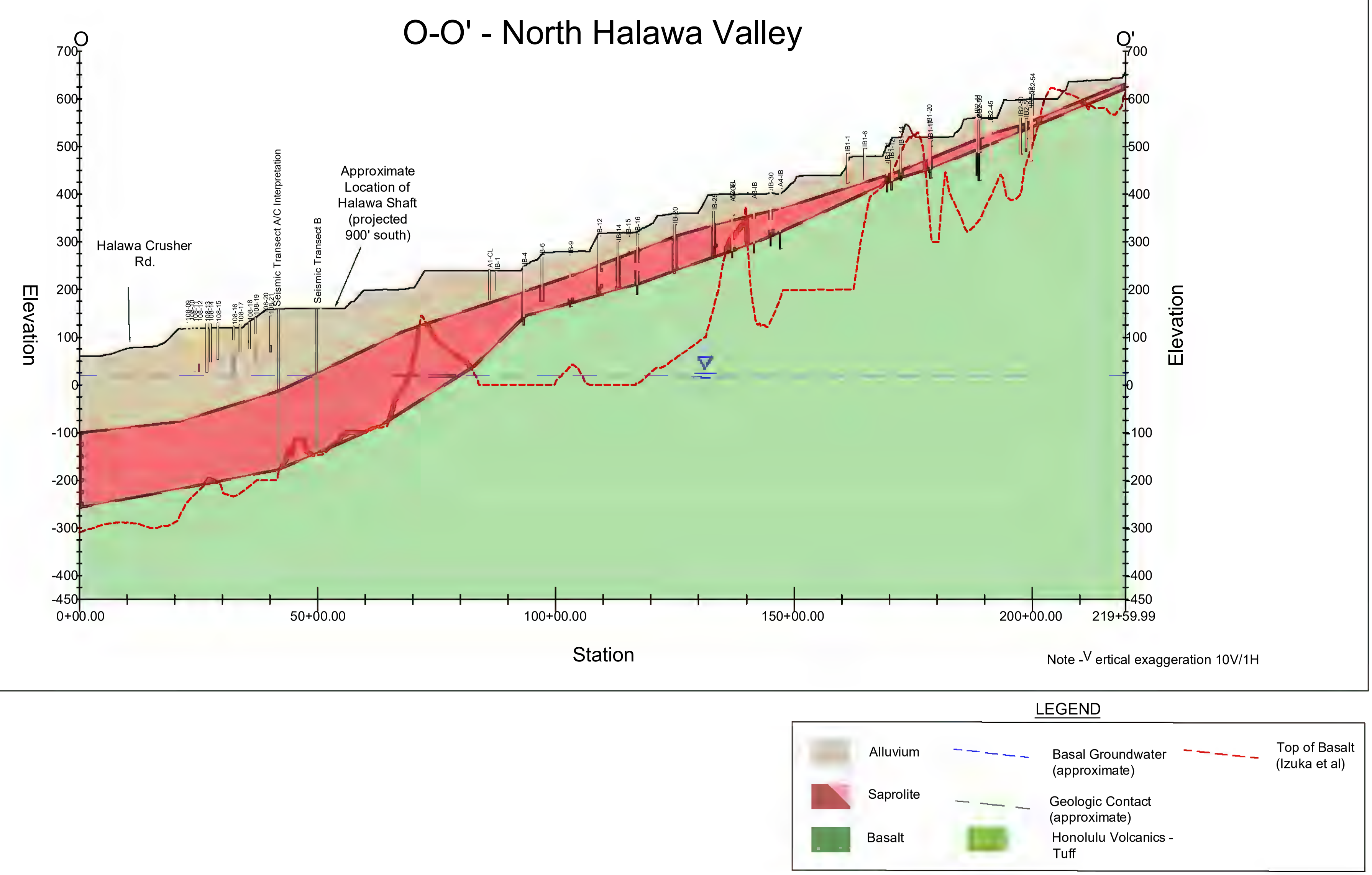

C:\Users\Mark.Higley\Documents\Autodesk\model area surface contours_180910.dwg 9/11/2018 7:39 AM Mark.Higley

Exhibit L

Macdonald (1941) writes: "*The pahoehoe flows are fed by lava moving through tubes in the interior of the flow, most of them only a foot or two across but a few reaching diameters of tens of feet. Sometimes the liquid lava drains away from these tubes leaving them partly or entirely empty.*" In highly weathered basalt and saprolite sequences, such as those found below valley fill deposits in South Hālawa Valley, lava tube structures, if present, would generally fail and collapse. Based on the drilling of thousands of feet through similar volcanic materials on Hawaiʻi Island, the occurrence of lava tubes was described as "rare" (D. Thomas, UH Hilo and DOH, pers. comm. 2018). Lava tubes are constrained by the width of the lava flow they are contained within. With that, it is highly unlikely that there may be lava tubes from Red Hill area that would provide a conduit or pathway toward Hālawa Shaft (i.e., the unlikely geometry that would allow a lava tube somewhere near the water table under the Red Hill Facility to be oriented all the way across [under or around] the saprolite in modern day North and South Hālawa Valleys, and then extend all the way to Hālawa Shaft).

5.1.2 Geologic Cross Sections and Mapping

Geologic cross sections have been prepared from available geologic logs of rock cores and from field mapping (Figure 5-1 through Figure 5-9). Geologic logs from the Red Hill groundwater monitoring network, from Macdonald (1941), and from Stearns (1943) (Figure 5-10) were used to correlate the stratigraphy of the basalt flows at Red Hill. Barrel logs developed during construction of the tanks also depict the stratigraphy of the rock formation (Figure 5-11). These logs encompass the 150-ft-tall cylinder interval of the tanks below the base of the upper dome and above the top of the lower dome, i.e., the middle 150 ft of the 250-ft-tall tanks.

In general, the upper stratigraphic section in Red Hill is composed predominantly of aʻā flows with some interbedded pāhoehoe flows (Figure 5-2). Field mapping also indicated a predominance of aʻā flows in exposed cliff-forming outcrops that correlate with the upper stratigraphic section. The lower section is composed primarily of thinner bedded pāhoehoe flows (see Photo 5-1). Correlation of boring logs at Red Hill indicates the presence of one or more intervals of aʻā flows (composed of several flows with aʻā clinker layers) within the pāhoehoe section that are approximately 30–60 ft thick.

A 1943 Navy as-built drawing, "Plan of Lava Tubes Cut by Tank 18," maps lava tubes connecting from Tank 20 to Tank 18 that were compass-surveyed (Figure 5-12). The survey shows these lava tubes are oriented downgradient in a south-southwest direction ranging from 187 to 241 degrees. These bounding orientations have a middle orientation of 214 degrees. Kriging correlation of lava tube and loose rock from barrel log data also presents similar orientations to the south-southwest (Figure 5-13).

Geologic mapping indicates the predominant dip direction (i.e., dip azimuth) is toward the south-southwest in the Red Hill area. Regionally, flows commonly dip 3–10 degrees from horizontal (i.e., dip magnitude) in the direction away from the eruptive axis of the volcano (Hunt Jr. 1996), and the dip direction is generally to the southwest. The average dip directions from geologic mapping in the Red Hill area are:

- Hālawa side of Red Hill: 194 degrees
- Active pit at Hālawa Quarry: 194 degrees
- Moanalua Water Tunnel: 206 degrees
- Moanalua side of Red Hill and Moanalua Golf Course: 209 degrees
- Moanalua side of Red Hill from Tripler Ridge and Moanalua Valley: 186 degrees

Geostatistical evaluation of dip azimuth and magnitude data collected during geologic mapping included generation of rose diagrams and Gaussian mixing models. To derive true dip, data included discrete field dip azimuth and dip magnitude (true dip) measurements as well as common plane-derived measurements using two apparent dips measured in the field (see Appendix C). Discrete measurements were collected from the Hālawa side of Red Hill, Moanalua Water Tunnel, Moanalua side of Red Hill, and Moanalua Golf Course (Figure 5-14).

Apparent dip data were collected in the active pit area at Hālawa Quarry and from the Moanalua side of Red Hill from Tripler Ridge and Moanalua Valley. Additional apparent dip azimuth and magnitude data were derived from clinker correlation, kriging correlation, and a Lower Beds correlation feature between Tanks 9–16 developed from models of three-dimensional (3D) barrel log data. Additionally, one dip azimuth and dip magnitude value was provided by DOH.

Weighting was applied to the mapping data as follows:

- All discrete field measurements (Hālawa side, Moanalua side, and Golf Course, Moanalua Tunnel) were weighted 1 point each (39 measurements).
- Common Plane measurements in Hālawa Quarry were weighted 10 points each (6 measurements).
- Common Plane measurements of Moanalua side of Red Hill from Tripler Ridge and Moanalua Valley were weighted 3 points each (9 measurements).
- Common Plane measurement of barrel log clinker correlation was weighted 5 points (1 measurement).
- Common Plane measurement of barrel log kriging correlation was weighted 5 points (1 measurement).
- Common Plane measurement of barrel log Lower Beds Tanks 9–16 was weighted 3 points (1 measurement).
- DOH dip azimuth and dip magnitude was weighted 10 points (1 measurement).

All data using weighting factors yielded an average dip azimuth of 197.4 degrees and an average dip magnitude of 6.5 degrees. With the objective to derive a range of dip azimuth and magnitude data and a best-estimate value, further review of that data set shows multiple dip-azimuth populations. Rose diagram plots of these data show what appear to be approximately 217- and 183-degree dip azimuths—an indication of a bi-modal distribution (Figure 5-14).

These azimuths have a slightly farther spread than what Gaussian distributions indicate (Section 5.1.3).

5.1.3 Gaussian Mixture Model

At least two subpopulations of dip azimuth were apparent in histograms of field measurements, and those two subpopulations appeared to overlap, preventing the separation of readings so that the mean dip azimuth of each subpopulation could be computed. Weighted pairs of dip azimuth and dip magnitude were analyzed using two-dimensional Gaussian Mixture Modeling (GMM), which estimates a separate mean and standard deviation for each subpopulation, in addition to evaluating the number of subpopulations present in the data. A common statistical analysis package was used to complete the analysis of the dip measurements (scikit-learn, implemented in Python at https://scikit-learn.org/stable/modules/mixture.html).

An evaluation of the GMM results indicated that the simplest combination of Gaussian models that fit the dip field measurements had three components, two of which were visually apparent when examining histograms of site data (Figure 5-16). The three components composing the GMM were (mean +/- standard deviation):

- Dip azimuth of 184.6 +/- 7.1 degrees, with a dip magnitude of 5.9 +/- 1.4 degrees
- Dip azimuth of 213.6 +/- 4.8 degrees, with a dip magnitude of 2.9 +/- 0.5 degrees
- Dip azimuth of 200.5 +/- 29.7 degrees, with a dip magnitude of 11.2 +/- 5.2 degrees

These components are illustrated on a polar plot of the GMM data analysis, Figure 5-17. The probability that dip azimuth will take a particular value is shown as unitless (see "p(Dip Azimuth)" on Figure 5-17); integrating under the blue curve will sum to a total probability of 1.0. The first two contributors to the GMM showed tall, narrow peaks with relatively small standard deviations, and the third component was a minor contributor with a broad peak (i.e., a comparatively large standard deviation) (Figure 5-16).

The bi-modal separation between the two major components (184.6 and 213.6 degrees) of the GMM is 29.0 degrees (see Figure 5-11 and Figure 5-17).

5.1.4 Assessment of Potential Preferential Pathways Related to Historical Lava Flow

Random walk modeling was performed using a recently developed probabilistic model, MrLavaLoba (Vitturi and Tarquini 2018), to evaluate the potential historical lava flow paths passing through the vicinity of the Red Hill tank farm. The purpose was to evaluate the likelihood of a flow path present from the tank farm area to Red Hill Shaft. Results are presented in Appendix D.

The model parameters used were based on Vitturi and Tarquini (2018) for simulating a Kilauea volcano eruption. The downslope was represented by a digital elevation model generated based on a dip orientation with an azimuth of 213.6 degrees and a dip angle of 2.9 degrees. A fractal dimension range between 1.13 and 1.23 was adopted (Bruno et al. 1992) to simulate pāhoehoe lava flow. The lava flow pathlines were simulated from a location upgradient from the tank farm.

A total of 10,000 Monte Carlo simulations of random lava flow pathlines were generated. Of these 10,000 simulated pathlines, 3,635 pathlines passed through the tank farm area with fractal dimensions in the range of 1.13–1.23. None of the pathlines through the tank farm area passed through the Red Hill Shaft area. Even if a pathline passes through the tank farm area and the Red Hill Shaft area, it might not pass through the elevation intervals of concern. In addition, a lava flow path does not imply a continuous channel that forms a preferential pathway for contaminant transport. Therefore, the results indicate that a preferential pathway occurring between the tank farm area and the Red Hill Shaft area in relation to historical lava flow is unlikely.

5.1.5 Overall Occurrence of Rock Types

The presence of nearly horizontal to gently dipping lava flows with layers (i.e., beds) of alternately greater and lesser resistance to erosion at the site were observed during rock coring for installation of Red Hill groundwater monitoring wells and site reconnaissance activities. No dikes were apparent in recovered cores or in observed outcrops at Red Hill.

Erosion of the less-resistant beds, such as a'ā clinker, has resulted in undercutting of the more resistant massive a'ā and pāhoehoe flows (Photo 5-2). Thinner bedded pāhoehoe flows are less resistant than

Appendix C:
Strike and Dip Data

Gaussian Mixed Model Evaluation Coordinates

	Strike	Dip Azimuth	Dip	Location	Notes	Formatted for Python	Latitude	Longitude
1	280	190	12	Halawa 1 pt		[190, 12],	21.375420	-157.890790
2	290	200	13	Halawa 1 pt		[200, 13],	21.374760	-157.892380
3	280	190	10	Halawa 1 pt		[190, 10],	21.375350	-157.891100
4	280	190	12	Halawa 1 pt		[190, 12],	21.375190	-157.891270
5	280	190	10	Halawa 1 pt		[190, 10],	21.374790	-157.892330
6	280	190	10	Halawa 1 pt		[190, 10],	21.370678	-157.900642
7	300	210	12	Halawa 1 pt		[210, 12],	21.370523	-157.901076
8	270	180	15	Halawa 1 pt		[180, 15],	21.373212	-157.895076
9	290	200	12	Halawa 1 pt		[200, 12],	21.373150	-157.896178
10	296	206	10	Halawa 1 pt		[206, 10],	21.373070	-157.896440
11	240	150	4	Halawa 1 pt		[150, 4],	21.373243	-157.896563
12	285	195	10	Halawa 1 pt		[195, 10],	21.373244	-157.896820
13	290	200	15	Halawa 1 pt		[200, 15],	21.373331	-157.896207
14	280	190	12	Halawa 1 pt		[190, 12],	21.373320	-157.896238
15	295	205	20	Halawa 1 pt		[205, 20],	21.372797	-157.897625
16	295	205	12	Halawa 1 pt		[205, 12],	21.372668	-157.897876
17	285	195	14	Halawa 1 pt		[195, 14],	21.372681	-157.898084
18	300	210	15	Halawa 1 pt		[210, 15],	21.371783	-157.899378
19	290	200	15	Halawa 1 pt		[200, 15],	21.371273	-157.901096
20	270	180	12	Halawa 1 pt		[180, 12],	21.370979	-157.902171
21	20	290	2	Moanalua 1 pt		[290, 2],	21.368495	-157.895831
22	300	210	10	Moanalua 1 pt		[210, 10],	21.365717	-157.895783
23	300	210	10	Moanalua 1 pt		[210, 10],	21.365783	-157.898400
25	320	230	10	Moanalua 1 pt		[230, 10],	21.365933	-157.898283
26	325	235	12	Moanalua 1 pt		[235, 12],	21.365933	-157.898283
27	290	200	5	Moanalua 1 pt		[200, 5],	21.368317	-157.896033
28	260	170	12	Moanalua 1 pt		[170, 12],	21.368317	-157.896033
29	280	190	12	Moanalua 1 pt		[190, 12],	21.368317	-157.896033
30	270	180	15	Moanalua 1 pt		[180, 15],	21.368300	-157.896133
31	265	175	8	Moanalua 1 pt		[175, 8],	21.368300	-157.896133
32	232	142	5	Moanalua Tunnel 1 pt		[142, 5],	04+45[1]	
33	265	175	8	Moanalua Tunnel 1 pt		[175, 8],	06+00[1]	
34	270	180	15	Moanalua Tunnel 1 pt		[180, 15],	10+25[1]	
35	390	300	30	Moanalua Tunnel 1 pt		[300, 30],	23+85[1]	
36	330	240	4.5	Moanalua Tunnel 1 pt		[240, 4.5],	25+65[1]	
45	310	220	4.5	Moanalua Tunnel 1 pt		[220, 4.5],	26+45[1]	
47	325	235	5.5	Moanalua Tunnel 1 pt		[235, 5.5],	28+38[1]	
48	275	185	13	Moanalua Tunnel 1 pt		[185, 13],	21.370741	-157.905226
49	272	182	20	Moanalua Tunnel 1 pt		[182, 20],	21.370741	-157.905226
50	307	217	3.085	Barrel log - Clinker Evaluation 2017 Weighted 5 pts		[217, 3.085],	n/a	n/a
51	307	217	3.085	Barrel log - Clinker Evaluation 2017 Weighted 5 pts		[217, 3.085],	n/a	n/a
52	307	217	3.085	Barrel log - Clinker Evaluation 2017 Weighted 5 pts		[217, 3.085],	n/a	n/a
53	307	217	3.085	Barrel log - Clinker Evaluation 2017 Weighted 5 pts		[217, 3.085],	n/a	n/a
54	307	217	3.085	Barrel log - Clinker Evaluation 2017 Weighted 5 pts		[217, 3.085],	n/a	n/a
55	309	219	2.732	Barrel log - Kriging Correlation 2018 Weighted 5 pts		[219, 2.732],	n/a	n/a
56	309	219	2.732	Barrel log - Kriging Correlation 2018 Weighted 5 pts		[219, 2.732],	n/a	n/a
57	309	219	2.732	Barrel log - Kriging Correlation 2018 Weighted 5 pts		[219, 2.732],	n/a	n/a
58	309	219	2.732	Barrel log - Kriging Correlation 2018 Weighted 5 pts		[219, 2.732],	n/a	n/a
59	309	219	2.732	Barrel log - Kriging Correlation 2018 Weighted 5 pts		[219, 2.732],	n/a	n/a

Gaussian Mixed Model Evaluation Coordinates (cont.)

	Strike	Dip Azimuth	Dip	Location	Notes	Formatted for Python	Latitude	Longitude
60	299.311	209.311	2.779	Barrel log - Kriging Correlation T9-16 2018 Weighted 3 pts		[209.311, 2.779],	n/a	n/a
61	299.311	209.311	2.779	Barrel log - Kriging Correlation T9-16 2018 Weighted 3 pts		[209.311, 2.779],	n/a	n/a
62	299.311	209.311	2.779	Barrel log - Kriging Correlation T9-16 2018 Weighted 3 pts		[209.311, 2.779],	n/a	n/a
63	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
64	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
65	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
66	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
67	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
68	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
69	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
70	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
71	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
72	307	217	2.732	DOH Weighted 10 pts		[217, 2.732],	n/a	n/a
73	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
74	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
75	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
76	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
77	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
78	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
79	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
80	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
81	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
82	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
83	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
84	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
85	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
86	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
87	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
88	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
89	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
90	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
91	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
92	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
93	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
94	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
95	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
96	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
97	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
98	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
99	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
100	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
101	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
102	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
103	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
104	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
105	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
106	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
107	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
108	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
109	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
110	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a

Gaussian Mixed Model Evaluation Coordinates (cont.)

	Strike	Dip Azimuth	Dip	Location	Notes	Formatted for Python	Latitude	Longitude
111	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
112	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
113	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
114	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
115	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
116	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
117	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
118	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
119	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
120	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
121	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
122	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
123	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
124	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
125	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
126	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
127	279.426	189.426	6	Quarry 10 pts		[189.426, 6],	n/a	n/a
128	284.347	194.347	6.017	Quarry 10 pts		[194.347, 6.017],	n/a	n/a
129	263.585	173.585	6.253	Quarry 10 pts		[173.585, 6.253],	n/a	n/a
130	274.772	184.772	6.025	Quarry 10 pts		[184.772, 6.025],	n/a	n/a
131	305.969	215.969	2.287	Quarry 10 pts		[215.969, 2.287],	n/a	n/a
132	296.366	206.366	3.838	Quarry 10 pts		[206.366, 3.838],	n/a	n/a
133	268	178	3.079	Moanalua Side, Weighted 3 pts		[178, 3.079],	n/a	n/a
134	297.5	207.5	3.129	Moanalua Side, Weighted 3 pts		[207.5, 3.129],	n/a	n/a
135	273	183	8.208	Moanalua Side, Weighted 3 pts		[183, 8.208],	n/a	n/a
136	273	183	7.356	Moanalua Side, Weighted 3 pts		[183, 7.356],	n/a	n/a
137	273	183	4.437	Moanalua Side, Weighted 3 pts		[183, 4.437],	n/a	n/a
138	272.4	182.4	4.27	Moanalua Side, Weighted 3 pts		[182.4, 4.27],	n/a	n/a
139	271.7	181.7	4.051	Moanalua Side, Weighted 3 pts		[181.7, 4.051],	n/a	n/a
140	267.1	177.1	3.09	Moanalua Side, Weighted 3 pts		[177.1, 3.09],	n/a	n/a
141	284	194	8.004	Moanalua Side, Weighted 3 pts		[194, 8.004],	n/a	n/a
142	268	178	3.079	Moanalua Side, Weighted 3 pts		[178, 3.079],	n/a	n/a
143	297.5	207.5	3.129	Moanalua Side, Weighted 3 pts		[207.5, 3.129],	n/a	n/a
144	273	183	8.208	Moanalua Side, Weighted 3 pts		[183, 8.208],	n/a	n/a
145	273	183	7.356	Moanalua Side, Weighted 3 pts		[183, 7.356],	n/a	n/a
146	273	183	4.437	Moanalua Side, Weighted 3 pts		[183, 4.437],	n/a	n/a
147	272.4	182.4	4.27	Moanalua Side, Weighted 3 pts		[182.4, 4.27],	n/a	n/a
148	271.7	181.7	4.051	Moanalua Side, Weighted 3 pts		[181.7, 4.051],	n/a	n/a
149	267.1	177.1	3.09	Moanalua Side, Weighted 3 pts		[177.1, 3.09],	n/a	n/a
150	284	194	8.004	Moanalua Side, Weighted 3 pts		[194, 8.004],	n/a	n/a
151	268	178	3.079	Moanalua Side, Weighted 3 pts		[178, 3.079],	n/a	n/a
152	297.5	207.5	3.129	Moanalua Side, Weighted 3 pts		[207.5, 3.129],	n/a	n/a
153	273	183	8.208	Moanalua Side, Weighted 3 pts		[183, 8.208],	n/a	n/a
154	273	183	7.356	Moanalua Side, Weighted 3 pts		[183, 7.356],	n/a	n/a
155	273	183	4.437	Moanalua Side, Weighted 3 pts		[183, 4.437],	n/a	n/a
156	272.4	182.4	4.27	Moanalua Side, Weighted 3 pts		[182.4, 4.27],	n/a	n/a
157	271.7	181.7	4.051	Moanalua Side, Weighted 3 pts		[181.7, 4.051],	n/a	n/a
158	267.1	177.1	3.09	Moanalua Side, Weighted 3 pts		[177.1, 3.09],	n/a	n/a
159	284	194	8.004	Moanalua Side, Weighted 3 pts		[194, 8.004],	n/a	n/a

[1] station along tunnel alignment

n/a dip azimuth and magnitude are derived from common plane calculations using apparent dip measurements taken at multiple locations

Halawa Quarry Active Pit Mapping - Outcrops used for Common Plane Analysis

	Start		End	
Outcrop	Lat	Long	Lat	Long
1	21.376207	-157.897226	21.376114	-157.897448
2	21.376114	-157.897448	21.375881	-157.897504
3	21.375796	-157.897416	21.375848	-157.896856

*Coordinates from google earth

Halawa Quarry - Active Quarry Pit

Common Plane - Azimuth & Plunge Pairs	Dip Direction	True Dip	Outcrop
190°/6° and 265°/1.5°	189.426	6	2,3
190°/6° and 265°/2°	194.347	6.017	2,3
190°/6° and 245°/2°	173.585	6.253	2,1
190°/6° and 245°/3°	184.772	6.025	2,1
245°/2° and 265°/1.5°	215.969	2.287	1,3
245°/3° and 265°/2°	206.366	3.838	1,3
True Average:	**194.0775**	**5.07**	

Moanalua side of Red Hill from Tripler Ridge and in Moanalua Valley Mapping - Outcrops used for Common Plane Analysis

	Start		End	
Outcrop	Lat	Long	Lat	Long
A	21.369935	-157.893144	21.369962	-157.892368
B	21.375157	-157.883559	21.375654	-157.882614
C	21.37105	-157.889755	21.372091	-157.888742
D	21.377935	-157.875661	21.378232	-157.874895

*Coordinates from google earth

Data collected looking at Moanalua side of Red Hill from Tripler Ridge and in Moanalua Valley

	View Direction	Plane Direction (perpendicular to View Direction, i.e., azimuth)	App Dip	Outcrop
3 from Tripler	3	93	0	A
4 from Tripler	4	94	0	A
5 from Moanalua	5	95	0	B
16 from Tripler	16	106	1	B
255 from Moanalua	255	165	7	C
286 from Moanalua	286	196	8	B
281 from Tripler	281	191	3	C
293 from Tripler	293	203	4	C
314 from Tripler	314	224	3	C
358 from Tripler	358	268	0	D

Common Plane - Azimuth & Plunge Pairs	Dip Direction	True Dip	
191º/3 and 268º/0º	178	3.079	C, D
191º/3º and 224/3º	207.5	3.129	C, C
93º/0º and 196º/8º	183	8.208	A, B
93º/0º and 165º/7º	183	7.356	A, C
93º/0º and 106º/1º	183	4.437	A, B
106º/1º and 203º/4º	182.4	4.27	B, C
106º/1º and 224º/3º	181.7	4.051	B, C
106º/1º and 191º/3º	177.1	3.09	B, C
165º/7º and 196º/8º	194	8.004	C, B
True Average:	**185.5222**	**5.0693**	

Exhibit M

CONTENTS

APPENDIXES (included on CD-ROM)

FIGURES (compiled at end of report)

TABLES

apparent gradients in shallow Facility basalt wells all point uphill toward RHMW04 on Figure 3.1-5a. On Figure 3.1-5b, these apparent gradients all point away from RHMW01 in all directions as though that was an area of high recharge. Therefore, the Facility well water level differences should not be overinterpreted, due to the very small difference values that are within the error limits of water level measurements at any one well.

3.2 PUMPING

Pumping information for the domain was obtained largely during the interim modeling study (DON 2018, Appendix A). That same pumping information is used for the current model update except for Red Hill Shaft and Hālawa Shaft, which use specific calibration-related pumping rates associated with the 2017–2018 synoptic study. Modeled pumping well/shaft locations are provided on Figure 3.2-1. Pumping rates used in the model are shown in Table 3-1. The different stress periods for Red Hill Shaft and Hālawa Shaft pumping are discussed further in Section 4 under model development and calibration.

Table 3-1: Modeled Pumping Rates

Well ID	Well Name	Screen Top (ft msl)	Screen Bottom (ft msl)	2017 Q (mgd)
2052-08	Kalihi Shaft	52	-5	7.70
2053-11	Fort Shafter	-154	-309	[redacted]
2057-04	Hickam Air Force Base	-18	-170	0
2153-02	Moanalua	-59	-269	0.02
2153-05	Moanalua Deep	-30	-1218	0
2153-07	TAMC1	-22	-272	[redacted]
2153-10	Moanalua 1	-114	-264	1.28
2153-11	Moanalua 2	-115	-265	0
2153-12	Moanalua 3	-150	-300	0
2154-01	Honolulu International Country Club	-89	-280	0.40
2255-32	'Aiea Hālawa Shaft	107	16	[redacted]
2255-37	Hālawa 2	-29	-78	0.88
2255-38	Hālawa 3	-37	-82	0
2255-39	Hālawa 1	-31	-135	0
2355-03	'Aiea Gulch 1	16	-38	0.77
2355-05	'Aiea Gulch 2	18	-40	0
2355-06	'Aiea 1	-32	-102	0.97
2355-07	'Aiea 2	-30	-100	0
2355-09	Kalauao P1	-61	-253	5.21
2355-10	Kalauao P4	-63	-254	0
2355-11	Kalauao P2	-60	-254	0
2355-12	Kalauao P3	-61	-254	0
2355-13	Kalauao P5	-68	-254	0
2355-14	Kalauao P6	-70	-253	0
2355-16	WG Minami 2007	-102	-202	0
2356-49	Waimalu I-1	-27	-225	0
2356-50	Waimalu I-2	-25	-225	0
2356-54	Pearl CC Golf	-21	-178	0.23

■ FOIA §(b)(3), Critical Infrastructure

Well ID	Well Name	Screen Top (ft msl)	Screen Bottom (ft msl)	2017 Q (mgd)
2356-55	Kaonohi I-2	-37	-291	0.78
2356-56	Kaonohi I-1	-44	-294	0
2356-58	Ka'amilo 1	-43	-192	0
2356-59	Ka'amilo 2	-42	-192	0
2356-60	Waimalu II-1	-77	-217	0
2356-61	Kaonohi II-1	-78	-218	0
2356-62	Kaonohi II-2	-83	-223	0
2356-63	Waimalu II-2	-179	-204	0
2356-64	Waimalu II-3	-143	-220	0
2356-65	Kaonohi II-3	-83	-223	0
2356-70	Lau Farm	40	-250	0.05
2455-02	Waimalu	-12	-78	0
2455-03	Waimalu	-80	-120	0
Red Hill Shaft SP1	Red Hill Shaft	9	3	[redacted]
Hālawa Shaft SP1 & 2	Hālawa Shaft	10	0	6.57
Red Hill Shaft SP2, 3 & 4	Red Hill Shaft	9	3	0
Hālawa Shaft SP3	Hālawa Shaft	10	0	6.33
Hālawa Shaft SP4	Hālawa Shaft	10	0	0

ID identification
Q pumping rate
SP stress period

3.3 DRAWDOWN AND PUMPING IN HĀLAWA SHAFT AND RED HILL SHAFT

Pumping and water level data were available for the 2017–2018 synoptic study. Synoptic impacts were also examined with then-available data for the interim model. Water level impacts within the pumping shaft provide a good estimate of the hydraulic conductivity surrounding the pumping location, and therefore the impacts were evaluated at Hālawa Shaft and Red Hill Shaft for their respective pumping rates.

A linear relationship between drawdown and pumping at Hālawa Shaft was estimated during the interim model to be 4.4 ft of drawdown for 10 mgd of pumping. The 2017–2018 synoptic study data indicated 3.8 ft of drawdown for every 10 mgd of pumping.

The relationship between drawdown and pumping at Red Hill Shaft was estimated during the interim model to be 1.5–3.5 ft of drawdown for [redacted] mgd of pumping. The 2017–2018 synoptic study data indicated 2.5 ft of drawdown for every [redacted] mgd of pumping. Variability was larger than at Hālawa Shaft, and therefore the water level data at Red Hill Shaft for specific pumping rates may not be as reliable.

Higher hydraulic conductivity values result in a smaller drawdown with a larger radius of influence than lower hydraulic conductivity materials. In that regard, pumping at Hālawa Shaft induces a greater drawdown than pumping at Red Hill Shaft; therefore, the hydraulic conductivity surrounding Red Hill Shaft is generally larger than that surrounding Hālawa Shaft. This is significant in calibrating and evaluating models with respect to each of these potential receptors, and therefore helps to assess the quality of a calibration in terms of the hydraulic connection of the Facility to Hālawa Shaft and Red Hill Shaft.

Table 5-2: Model Material Parameters

					51a	51b	51c	51d	51e	52	53	54	55	56	57	58	59
			Minimum Value	Maximum Value	Homogenous Basalt: Limit Horizontal Anisotropy	Homogenous Basalt: 10:1 Anisotropy	Homogeneous Basalt: Zoned Along Ridges	Homogeneous Basalt: Calibrate on Anisotropy	Homogeneous Basalt: Zoned Along Ridges and Within Valleys	Alternate Saprolite	Heterogeneous Basalt	Heterogeneous Basalt	Conceptual Clinker Zone	Structural Alterations to Tuff Cones	Recharge Uncertainty	Coastal Marine Discharge Variability	Lateral Inflow from SE
Geologic Material	Unit	Layer(s)	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Caprock Kh (marine)	ft/day	1	2.00	33,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	2,500	5,000	5,000	5,000
Caprock Kv (marine)	ft/day	1	2.00	33,000	9.45	11.87	10.00	11.87	10.00	9.45	10.00	10.00	9.45	0.18	9.45	9.45	9.45
Caprock Kh (alluvial)	ft/day	1	0.10	1.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	0.10	20.00	20.00
Caprock Kv (alluvial)	ft/day	1	0.60	0.60	20.00	0.10	20.00	0.10	20.00	20.00	20.00	20.00	20.00	0.09	0.10	19.50	20.00
Valley fills, Kh	ft/day	1	0.019	0.37	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	[illegible]	1.00	1.00	1.00
Valley fills, Kv	ft/day	1	0.058	0.066	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	[illegible]	0.001	0.001	0.001
Saprolite under valley fill, Kh	ft/day	2 and 3	0.0028	283.00	5.00	10.00	5.00	4.81	5.00	5.00	5.00	5.00	5.00	9.20	5.00	5.00	5.00
Saprolite under valley fill, Kv	ft/day	2 and 3	0.0028	283.00	0.015	0.011	0.010	0.009	0.010	0.015	0.010	0.010	0.035	0.008	0.002	0.003	0.80
Saprolite under caprock, Kh	ft/day	2 and 3	0.0028	283.00	5.00	10.00	5.00	4.81	1.00	5.00	0.80	0.80	5.00	9.20	5.00	5.00	5.00
Saprolite under caprock, Kv	ft/day	2 and 3	0.0028	283.00	0.015	0.011	0.050	0.009	0.025	0.015	0.087	0.038	0.035	0.008	0.002	0.003	0.80
Tuff overlying marine, Kh	ft/day	1	1.00	1,000	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	200.00	500.00	500.00	500.00
Tuff overlying marine, Kv	ft/day	1	1.00	100.00	0.010	0.10	0.010	0.10	0.010	0.010	0.010	0.010	0.010	0.48	0.010	3.17	0.010
Tuff overlying alluvial, Kh	ft/day	1	1.00	1,000	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	20.00	10.00	10.00	10.00
Tuff overlying alluvial, Kv	ft/day	1	1.00	100.00	0.001	0.10	0.001	0.10	0.001	0.001	0.001	0.001	0.001	0.18	0.001	0.014	0.001
Tuff cone, Kh	ft/day	2 to 9	1.00	1,000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.089	0.001	0.001	0.001
Tuff cone, Kv	ft/day	2 to 9	1.00	100	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.008	0.001	0.001	0.001
Basalt, Kh	ft/day	4 to 9	26.00	85,000	2,828	5,316	Zoned	8,280	Zoned	2,828	Zoned	Zoned	Zoned	3,747	1,814	1,995	2,444
Basalt, Kv	ft/day	4 to 9	7.40	7.50	[illegible]	[illegible]	Zoned	[illegible]	Zoned	200.00	Zoned	Zoned	Zoned	44.54	200.00	[illegible]	121.25
GHB South conductance	ft²/d	1			40.00	1,000,000	150.00	999,976	305.05	40.00	402.74	280.81	388.06	188.78	135.69	1.00E-05	1.87
GHB PH conductance	ft²/d	1			40.00	1,000,000	150.00	999,804	0.32	40.00	0.47	38.06	0.10	62,588	0.39	1,066	207.57
Kalauo Sp Farm conductance	ft²/d	1 to 4			7,000	10,924	17,000	11,279	13,724	7,000	61,960	11,363	8,026	10,448	7,665	9,461	9,632
Kalauao Sp conductance	ft²/d	1 to 4			3,000	4,841	7,000	5,883	9.05	3,000	8,523	4,948	3,000	5,399	218.14	4,671	4,198
Recharge multiplier SP1&2	(--)	1			0.83	1.00	1.00	1.00	1.00	0.83	1.00	1.00	0.83	1.00	0.70	0.83	0.83
Recharge multiplier SP3&4	(--)	1			0.56	0.73	0.73	0.70	0.72	0.56	0.72	0.72	0.55	0.73	0.42	0.55	0.56
Basalt anisotropy	(--)	4 to 9			0.33	0.10	Zoned	0.057	Zoned	0.33	Zoned	Zoned	Zoned	0.33	0.33	0.33	0.33
Red Hill Shaft skin 1	(--)	6			3,319	3,319	3,319	3,319	3,319	3,319	3,319	3,319	3,319	3,319	3,319	3,319	3,319
Red Hill Shaft skin 2					12.80	12.80	12.80	12.80	12.80	12.80	3,319	3,319	12.80	12.80	12.80	12.80	12.80
Hālawa Shaft skin	(--)	6			20,721	20,721	20,721	20,721	20,721	20,721	20,721	20,721	20,721	20,721	20,721	20,721	20,721
Caprock Ss (marine)	(--)	1			1.17E-06	9.69E-07	1.17E-06	9.69E-07	1.17E-06	1.17E-06	1.17E-06	1.17E-06	1.17E-06	4.48E-05	1.17E-06	1.17E-06	1.17E-06
Caprock Sy (marine)	1/ft	1	0.10	0.20	0.073	0.095	0.073	0.095	0.07	0.073	0.073	0.073	0.073	0.049	0.073	0.073	0.073
Caprock Ss (alluvial)	(--)	1			1.78E-06	1.72E-06	1.78E-06	1.72E-06	1.78E-06	1.78E-06	1.78E-06	1.78E-06	1.78E-06	1.65E-05	1.78E-06	1.78E-06	1.78E-06
Caprock Sy (alluvial)	1/ft	1	0.10	0.20	0.030	0.022	0.030	0.022	0.030	0.030	0.030	0.030	0.030	0.15	0.030	0.030	0.030
Valley Fills, Ss	(--)	1			6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06	6.91E-06
Valley Fills, Sy	1/ft	1	0.10	0.15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Saprolite, Ss	(--)	2 and 3			5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06	5.31E-06
Saprolite, Sy	1/ft	2 and 3	0.10	0.10	0.026	0.070	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Tuff overlying marine, Ss	(--)	1			1.27E-06	1.36E-06	1.27E-06	1.36E-06	1.27E-06	1.27E-06	1.27E-06	1.27E-06	1.27E-06	1.52E-05	1.27E-06	1.27E-06	1.27E-06
Tuff overlying marine, Sy	1/ft	1			0.056	0.070	0.056	0.070	0.056	0.056	0.056	0.056	0.056	0.15	0.056	0.056	0.056
Tuff overlying alluvial, Ss	(--)	1			2.41E-06	1.15E-06	2.41E-06	1.15E-06	2.41E-06	2.41E-06	2.41E-06	2.41E-06	2.41E-06	1.52E-06	2.41E-06	2.41E-06	2.41E-06
Tuff overlying alluvial, Sy	1/ft	1			0.061	0.062	0.061	0.062	0.061	0.061	0.061	0.061	0.061	0.015	0.061	0.061	0.061
Tuff cone, Ss	(--)	2 to 9			4.70E-06	7.12E-06	4.70E-06	7.12E-06	4.70E-06	4.70E-06	4.70E-06	4.70E-06	4.70E-06	7.70E-06	4.70E-06	4.70E-06	4.70E-06
Tuff cone, Sy	1/ft	2 to 9			0.058	0.070	0.058	0.070	0.058	0.058	0.058	0.058	0.058	0.026	0.058	0.058	0.058
Basalt, Ss	(--)	4 to 9	0.010	0.030	6.00E-05	9.88E-05	7.00E-05	9.09E-05	Zoned	6.00E-05	Zoned	Zoned	1.01E-04	1.06E-04	1.43E-04	1.19E-04	8.14E-05
Basalt, Sy	1/ft	4 to 9	0.040	0.080	0.01	0.002	0.010	0.010	Zoned	0.010	Zoned	Zoned	0.010	0.010	0.010	0.010	0.010

ft² square feet
GHB general head boundary
Kh horizontal hydraulic conductivity
Ky vertical hydraulic conductivity
Ss specific storage
SP stress period
Sy specific yield

Minimum and maximum values from Table 4-1.
Values at or below the minimum value are shaded light gray.
Values at or above the maximum value are shaded .

Table 5-3: Model Calibration Statistics

Run ID	Description	Comparison of Observed and Simulated Water Levels for Basalt Wells			Scatterplot of Water Level Differences Between Synoptic Study Wells: Difference with RHMW01			Scatterplot of Water Level Differences Between Synoptic Study Wells: Difference with RHMW04			Drawdown Hydrographs: SP2			Drawdown Hydrographs: SP4		
		Mean Residual (ft)	RMS Error (ft)	R-square (-)	Mean Residual (ft)	RMS Error (ft)	R-square (-)	Mean Residual (ft)	RMS Error (ft)	R-square (-)	Mean Residual (ft)	RMS Error (ft)	R-square (-)	Mean Residual (ft)	RMS Error (ft)	R-square (-)
51	Homogeneous basalt															
51a	Limit horizontal anisotropy (3:1)	0.54	0.95	0.60	0.05	0.51	0.74	0.44	0.67	0.79	0.06	0.41	0.82	0.07	0.13	0.96
51b	10:1 anisotropy	0.39	0.82	0.68	0.03	0.38	0.77	0.49	0.60	0.80	0.09	0.54	0.81	0.06	0.10	0.98
51c	Zoned along ridges	0.96	1.22	0.65	0.08	0.43	0.74	0.53	0.66	0.78	0.08	0.53	0.82	0.10	0.18	0.99
51d	Calibrate on anisotropy	0.55	0.88	0.71	0.04	0.38	0.77	0.47	0.59	0.80	0.07	0.50	0.82	0.05	0.09	0.98
51e	Zoned along ridges and within valleys	0.16	0.62	0.75	-0.02	0.38	0.79	0.48	0.60	0.83	0.04	0.25	0.86	-0.01	0.04	0.99
52	Alternate saprolite	0.54	0.95	0.60	0.05	0.51	0.74	0.44	0.66	0.79	0.06	0.41	0.82	0.07	0.13	0.96
53	Heterogeneous basalt	0.13	0.54	0.82	-0.02	0.31	0.88	0.35	0.46	0.90	-0.002	0.08	0.96	-0.01	0.04	0.99
54	Heterogeneous basalt	0.19	0.63	0.76	0.02	0.37	0.84	0.43	0.56	0.88	-0.01	0.09	0.95	-0.0004	0.04	0.99
55	Conceptual clinker zone	0.19	0.69	0.71	0.03	0.45	0.74	0.50	0.65	0.80	0.02	0.14	0.86	0.05	0.08	0.98
56	Structural alterations to tuff cones	-0.06	1.06	0.54	0.002	0.40	0.75	0.48	0.61	0.79	0.09	0.56	0.83	0.02	0.08	0.97
57	Recharge uncertainty	0.21	0.78	0.64	0.001	0.42	0.75	0.53	0.66	0.80	0.07	0.61	0.81	0.03	0.08	0.98
58	Coastal marine discharge variability	0.27	0.78	0.64	0.01	0.41	0.76	0.53	0.65	0.80	0.07	0.56	0.81	0.04	0.07	0.98
59	Lateral inflow from SE	0.26	0.70	0.74	-0.01	0.38	0.77	0.53	0.63	0.80	0.03	0.29	0.81	0.06	0.09	0.98

RMS root mean square
\- no unit of measure

Table 5-6: Model Travel Times (days) from Tanks to Receptors for Hālawa Shaft Pumping at 12 MGD and Red Hill Shaft Off

Run ID	Description	Hālawa Shaft		Kalauao Spring Farm		Well 2255-32		Well 2255-37		Well 2255-39		Well 2355-06		Well 2355-07		Pearl Harbor	
		Low End	High End	**Low End**	High End	**Low End**	High End	**Low End**	High End	**Low End**	High End	**Low End**	High End	**Low End**	High End	**Low End**	High End
51	Homogeneous basalt																
51a	Limit horizontal anisotropy (3:1)	374	518	—	—	754	850	724	800	724	800	—	—	—	—	—	—
51b	10:1 anisotropy	259	375	—	—	—	—	—	—	—	—	—	—	—	—	—	—
51c	Zoned along ridges	—	—	—	—	588	652	559	577	559	577	—	—	—	—	688	793
51d	Calibrate on anisotropy	254	382	—	—	—	—	—	—	—	—	—	—	—	—	—	—
51e	Zoned along ridges and within valleys	—	—	883	1,031	—	—	—	—	—	—	—	—	—	—	—	—
52	Alternate saprolite	351	527	—	—	755	852	738	797	738	797	—	—	—	—	—	—
53	Heterogeneous basalt	384	953	1,761	1,831	1,052	1,180	1,020	1,223	1,020	1,223	1,304	1,458	1,304	1,458	—	—
54	Heterogeneous basalt	229	414	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55	Conceptual clinker zone	295	580	1,236	1,252	708	864	685	757	685	757	—	—	—	—	1,938	1,938
56	Structural alterations to tuff cones	137	170	—	—	—	—	—	—	—	—	—	—	—	—	—	—
57	Recharge uncertainty	361	649	—	—	798	932	744	789	744	789	—	—	—	—	—	—
58	Coastal marine discharge variability	366	550	—	—	717	861	691	750	691	750	—	—	—	—	1,494	1,494
59	Lateral inflow from SE	251	463	—	—	539	595	523	590	523	590	—	—	—	—	635	671
60	Low-conductivity material extended partially up valleys	224	466	—	—	—	—	—	—	—	—	—	—	—	—	—	—

1 **Table 5-7: Summary of Multimodel Applicability for Risk-Based Decision Making**

Model #	Description	Significant Features	Weighting	Weighting Considerations
51	Homogeneous basalt with CSM saprolite	Evaluation of regional flow behavior		
51a	Limit horizontal anisotropy (3:1)	Assumed conservative assumption of previous modeling efforts	0.8	Good calibration metrics; fair calibration to water level differences; reasonable conceptual model and water budgets
51b	10:1 anisotropy	Evaluate impact of possible higher horizontal anisotropic conditions	0.9	Good calibration to all metrics; reasonable conceptual model and water budgets
51c	Zoned along ridges	Evaluate impact of possible higher horizontal anisotropic conditions	0.8	Good calibration metrics; fair calibration to water level differences; reasonable conceptual model and water budgets
51d	Calibrate on anisotropy	Evaluate what value of anisotropy best captures regional water level conditions (generally between 17 and 18)	0.9	Same as 51b
51e	Zoned along ridges and within valleys	Evaluate impact of additional zonation since zoned conditions of Model #51c did not adequately distinguish itself from the average conditions of homogeneous Model #51a	0.9	Good calibration to all metrics; reasonable conceptual model and water budgets
52	Alternate saprolite	Test impact of alternate (smaller) saprolite extent and depth below water table	0.8	Same as 51a
53	Heterogeneous basalt	Evaluate impacts of regional- and local-scale heterogeneities using pilot points using random initial parameter distributions	1	Excellent calibration to all metrics; reasonable conceptual model and water budgets
54	Heterogeneous basal	Evaluate alternate impacts of regional- and local-scale heterogeneities using pilot points using initial parameter distributions that block downhill flow from the Facility (tuff cone dam effect)	1	Excellent calibration to all metrics; reasonable conceptual model and water budgets
55	Conceptual clinker zone	Evaluate impact of fast-flow pathway in groundwater beneath the Facility	0.9	Good calibration to all metrics; reasonable conceptual model and water budgets; addresses impact of fast flow pathways
56	Structural alterations to tuff cones	Evaluate impact of a damming effect of tuff cones on flow down Red Hill	0.7	Good calibration to all metrics; reasonable water budgets; unlikely to have barrier as conceptualized
57	Recharge uncertainty	Evaluate impact of applying drought condition recharge inflow	0.8	Good calibration to all metrics; reasonable conceptual model low-end of water budgets
58	Coastal marine discharge variability	Evaluate impact of variability in discharge to ocean and Pearl Harbor	0.8	Good calibration to all metrics; reasonable conceptual model and water budgets
59	Lateral inflow from SE	Evaluate conceptual model of flow across valleys from Kalihi Valley to Pearl Harbor	0.8	Good calibration to all metrics; reasonable conceptual model; plausible water budgets

Addresses Regulatory Agencies' Top 10 issue

Addresses other regulatory issue

DEPARTMENT OF HEALTH
STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Permit Application	)	**CERTIFICATE OF SERVICE**

CERTIFICATE OF SERVICE

I hereby certify that, on this date, a true and correct copy of the foregoing documents were emailed to the following:

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Respectfully Submitted,

Dated: January 29, 2021

/S/ Marnie E. Riddle__________
Marnie E. Riddle
Agency Representative

EXHIBIT D

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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 PETITIONER HONOLULU BOARD OF WATER SUPPLY'S REPLY IN SUPPORT OF MOTION TO STRIKE THE TESTIMONY OF CURTIS STANLEY AND/OR FOR NEGATIVE INFERENCE ADDRESSING THE NAVY'S REFUSAL TO COMPLY WITH THE DECEMBER 30, 2020 ORDER TO PRODUCE INFORMATION; CERTIFICATE OF SERVICE

PETITIONER HONOLULU BOARD OF WATER SUPPLY'S REPLY IN SUPPORT OF MOTION TO STRIKE THE TESTIMONY OF CURTIS STANLEY AND/OR FOR NEGATIVE INFERENCE ADDRESSING THE NAVY'S REFUSAL TO COMPLY WITH THE DECEMBER 30, 2020 ORDER TO PRODUCE INFORMATION

The testimony of United States Department of the Navy ("Navy") witness Mr. Curtis Stanley should not be included in the record and can be afforded no probative value. In its effort to rehabilitate Mr. Stanley's testimony, the Navy confuses the relevant issues. Mr. Stanley's reliance on the data, information, analyses, and modeling that is the subject of this Motion is already a resolved matter. The Navy's attempts to reargue this reliance are inapt and irrelevant. The Navy has not and cannot demonstrate good cause for violating a direct order by Hearings Officer Louis L.C. Chang to produce a discrete set of documents unquestionably relevant to and absolutely critical for evaluating the veracity of Mr. Stanley's opinions. Any "prejudice" that the Navy would suffer if this testimony is struck or an adverse inference is assigned would not be unfair or unwarranted, but rather would be the appropriate response to the Navy's failure to comply with the December 30, 2020 order. To the extent the testimony of Mr. Stanley or his Facility Environmental Report ("FER") is allowed into the record, the Navy's and Mr. Stanley's own admissions under cross-examination so undermine the factual and technical bases for Mr. Stanley's opinions that the only reasonable conclusion is to render them no or negligible evidentiary weight.

I. Argument

The Navy's attempt to reframe this Motion to strike and/or for negative inference as an issue of reliance by Mr. Stanley is inappropriate. A hearings officer may disregard or strike direct testimony if opposing parties do not have an opportunity for cross-examination under Hawaii Administrative Rules § 11-1-38(h). Alternatively, under Hawaii Administrative Rules

§ 11-1-24(b)(5), a hearings officer "may draw inferences against the party if the evidence is not produced without good cause being shown." The issue of reliance in relation to these two standards has already been established by Hearings Officer Chang's December 30, 2020 order. The issue now is how the Navy's violation of the order affects the admissibility and/or weight of Mr. Stanley's testimony. Because the Navy cannot demonstrate good cause for failing to comply with the order, and in fact has not even made an attempt to establish the requisite good cause to excuse its conduct, striking Mr. Stanley's testimony or drawing a negative inference is the appropriate response.

A. The Navy Cannot Reargue An Issue That Has Already Been Resolved

The Navy simply does not want to produce the data and analyses that its own witness relied upon for opinions submitted as testimony in this contested case. The Navy already unsuccessfully argued that it should not be required to produce data and information relied on by Mr. Stanley on December 30, 2020.[1] Hearings Officer Chang disagreed with the Navy's argument that Mr. Stanley did not rely on certain data and analyses and *ordered* the Navy to produce a discrete set of documents containing this information. The Navy's arguments failed then, and the issue of Mr. Stanley's reliance was resolved. In its Opposition ("Opp."), the Navy attempts, again, to assert that Mr. Stanley did not rely on the specific data and analyses it was

[1] The Navy argues that it "successfully established that 'secondary' and 'tertiary' data ... was not encompassed by the order." Opp. at 6. The December 30, 2020 order says no such thing. In any event, the BWS is not asking for secondary nor tertiary data here. Mr. Stanley admitted that he is "one of the primary authors for *all* of the [Navy] reports" at issue in this proceeding. Testimony of Curtis Stanley, at 5:17-6:6 (emphasis added). As an author of previous reports that form the basis of his opinions as presented in the FER, Mr. Stanley evaluated the data, information, and models when authoring those reports. The fact that Mr. Stanley may not have re-reviewed or reanalyzed that data or information when drafting the FER is irrelevant as Mr. Stanley must have relied on his past assessments.

ordered to produce, which is inappropriate and irrelevant. The Navy's argument that the BWS "had the opportunity to probe the boundaries of Mr. Stanley's reliance on underlying data during cross-examination" (Opp. at 4) but failed to do so is also inaccurate and not relevant. There is no further burden on the BWS to demonstrate reliance on underlying data, information, and models because that issue was resolved three months ago. Any attempt by the Navy to reargue the issue of reliance demonstrates the Navy's confusion regarding the issues at the heart of this Motion and highlights the Navy's desperation to avoid its obligation to produce relied-upon data and analyses in direct violation of an order. To the extent there is any burden now, it does not fall on the BWS, but is on the Navy to demonstrate good cause to withhold the documents it was ordered to produce. The Navy has made no such showing of good cause, and thus Mr. Stanley's testimony should be struck or a negative inference drawn.

B. The Navy's Argument That Cross-Examination Need Not Be Meaningful Is Unfounded

The Navy's argument that the BWS was allowed to cross-examine Mr. Stanley and that there is no requirement for that cross-examination to be meaningful is unsupported and nonsensical. The Navy invokes Hawaii case law to argue that the general rule under Hawaii Rule of Evidence 702 is that expert testimony should be liberally admitted, but neglects to acknowledge that Hawaii Rule of Evidence 705 provides that an expert witness, on cross-examination, "may in any event be required to disclose the underlying facts or data" relied on to assert his opinions.[2] An expert may testify without disclosing underlying facts or data *only* "if

[2] The Navy's reliance on the Hawaii Rules of Evidence here is surprising given its earlier position. At the outset, it cannot be overlooked that it is two unambiguous provisions of the Department of Health's regulations, not the Hawaii Rules of Evidence, that are at issue. Further, the Navy has argued on numerous occasions that Hawaii state law regarding civil discovery is inapplicable to these proceedings, but it now seeks to use that same case law to assert its

the underlying facts or data have been disclosed in discovery proceedings." Haw. R. Evid. 705; *Acoba v. General Tire, Inc.*, 92 Haw. 1, 14 (1999). Otherwise, parties may be deprived of the very information needed to prepare a meaningful cross-examination. *See State v. Nofoa*, 135 Haw. 220, 233 (2015) (in a criminal proceeding, the Supreme Court of Hawaii stated that defendants are "denied the opportunity for meaningful cross-examination" when they do "not have access to relevant discovery materials that would have assisted in the cross-examination"); *see also U.S. v. Meyer*, 398 F.2d 66, 72 (9th Cir. 1968) ("Pretrial discovery is particularly important to preparation for effective cross-examination of such witnesses, and is commonly employed for that purpose.").

Under both the Hawaii Rules of Evidence and the Department of Health's Rules of Practice and Procedure, the Navy has deprived the BWS of critical information necessary to prepare a meaningful, effective cross-examination. Withholding such data and analyses, especially in violation of a direct order, denied the BWS of an opportunity to properly cross-examine Mr. Stanley. The Navy's assertion that the BWS should have probed Mr. Stanley's reliance on data during his cross-examination but failed to do so is also inaccurate. During the contested case hearing, Mr. Stanley was repeatedly questioned about and testified as to how important data and other inputs were to formulating and assessing the very models that the Navy has refused to produce. *See, e.g.,* Vol. 3, 661:17-18 ("looking at all this data over the years"); 677:17-22 (confirming that he had to look at data to evaluate models); 708:2-3 ("We have

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arguments. *See, e.g.*, *Navy's Response to BWS Amended Motion for Production of Navy Documents*, Case No. 19-UST-EA-01, Jul. 13, 2020, at 6 ("The parties have not stipulated to civil style discovery."); *Memorandum in Opposition to Sierra Club's Motion to Require the Navy to Provide Documents and Witnesses, Exhibits 1-3*, Case No. 19-UST-EA-01, Dec. 15, 2020, at 5 ("In a contested case hearing, civil-style discovery is disfavored."). The Navy cannot have it both ways.

multiple models we've developed…"); 750:13-14 ("…integrate that geologic model into our holding capacity analysis."); Vol. 4, 770:9-11 ("We used the seismic, we used the well logs, and integrated all that data and other data into the geologic model"); 813:19-20 ("based on the data I've looked at"). Rather than turn over this information as ordered, the Navy continues to choose to withhold the very information relied upon by Mr. Stanley that was necessary for the BWS to prepare the meaningful cross-examination that it was entitled to. As such, in accordance with Hawaii Administrative Rules § 11-1-38(h), Mr. Stanley's testimony should be struck from the record.

C. The Navy Did Not Produce All Information And Data It Was Ordered To Produce

The Navy's repeated claims that the information it was ordered to produce is already in the record is simply false. In another twisted effort to reargue reliance, the Navy points to certain data and analyses that have been produced to confuse the relevant issues. To be clear, not all of the data, analyses, and model files upon which Mr. Stanley ultimately relied have been produced, and the Navy has not provided most of the information required by the December 30, 2020 order, including the documents subject to this Motion. In addition to withholding the actual geologic model and groundwater flow models, the following categories of documents and/or data are still outstanding:

1. Modflow-USG files for the groundwater models discussed in the Navy 2020 Groundwater Flow Model Report;
2. Groundwater Vista files for the Navy groundwater models discussed in the Navy 2020 Groundwater Flow Model Report;
3. Tabulations of the simulated versus measured water levels used to calibrate the Navy groundwater models;

4. The Navy set of water levels for the USGS Synoptic Survey (July 2017 – February 2018) corrected for non-pumping impacts on the water level signal as discussed on pages 3-11 of the Navy 2020 Groundwater Flow Model Report;

5. Hourly pumping rates for the Navy's Red Hill Shaft during the USGS Synoptic Survey (July 2017 – February 2018);

6. Navy Red Hill Shaft pumping rates on at least daily intervals since the 2014 Tank 5 release;

7. CTECH's Earth Volumetric Studio (EVS) files for the Navy geologic model discussed on pages 5-11 and Appendix E of the 2019 Navy Conceptual Site Model Report;

8. Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure of clinker zones (including the strike and dip angles) produced by the Navy geologic model;

9. Interactive Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure of saprolite zones produced by the Navy geologic model;

10. Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure the different lava flows produced by the Navy geologic model;

11. Description of the methods used to measure the strike and dip information provided in Appendix C of the 2019 Navy Conceptual Site Model Report;

12. Complete sets of measured water levels from the multilevel Westbay wells RHMW11, RHMW13, RHMW14, and RHMW15 discussed on page 44 of the FER;

13. Geological logs for Navy Wells RHMW16A and RHMW19 discussed on page 44 of the FER; and

14. Environmental data set that explains why the analytical data in the FER differs from the data in the Navy 2015 Q2, 2015 Q4, and 2016 Q2 (specifically naphthalene compounds).

Mr. Stanley's opinions cannot be properly evaluated without this information. For example, it is undisputed that several of Mr. Stanley's opinions rely upon the modeling work performed by the Navy. But, in violation of the December 30, 2020 order, the Navy has never provided the model files demonstrating how raw data was calibrated or used as inputs in these models. Without the model files themselves, neither the BWS nor the Hearings Officer can verify the accuracy of the Navy's models or, by extension, Mr. Stanley's opinions. As the Navy's own witnesses concede, the method in which a model is built is of paramount importance. It is critical and particularly relevant in this matter as Mr. Stanley makes numerous conclusions about holding capacity, capture zones, and flow patterns based on these models. FER at 56. None of these conclusions can be verified, or even questioned properly, without the model files and their underlying data. The need for this type of assessment was confirmed by Mr. Stanley when he confirmed that "garbage in [means] garbage out" for model inputs. Vol. 3, 707:22-23.

In addition, the Navy improperly relies on submissions to the U.S. EPA and Hawaii Department of Health (collectively, "Regulatory Agencies") under the Red Hill Bulk Fuel Storage Facility Administrative Order on Consent ("AOC") to argue that all relevant data, information, and models has been produced. Opp. at 3-4. Under the AOC, sampling, testing, modeling, or other data generated is to be submitted to Regulatory Agencies. *Id.* However, this does not mean that the "sampling, testing, modeling, or other data generated" has been produced to the BWS or introduced into evidence in this proceeding. In fact, the AOC's requirement that the underlying data sets be produced to Regulatory Agencies demonstrates their importance to the models and reports. It is likewise vital that this information be included in the contested case record so that it can be evaluated in connection with a decision on the Navy's permit application. Because the data, analyses, and model files were not produced as ordered, pursuant to Hawaii Administrative Rules § 11-1-24(b)(5) it should be inferred that this information is unfavorable to the Navy's position.

D. Mr. Stanley's Assessments Lack Probative Value And His Testimony Should Be Disregarded

Considering the evidence in the record and the testimony during the contested case hearing, it is apparent that Mr. Stanley lacked any factual or technical basis for many of the opinions he offered in this proceeding. If the Navy's assertion that Mr. Stanley did not "re-investigate[], re-examine[], or validate[]" the relevant data (Gannon Decl., Ex. B to Motion) and "had no need to, and did not, rely on the modeling software files" is accepted (Opp. at 8), then Mr. Stanley's opinions should not be given any weight. During cross-examination, Mr. Stanley admitted that in order to assess models, he would have to assess underlying data. Vol. 3, 739:15-18 ("Q. … And again, to be able to assess those models you've got to look at the underlying data, make sure everything was good, right? A. Yes."). If "Mr. Stanley did not run the software files or rely on them in preparing his opinions" (Opp. at 10), then by Mr. Stanley's own admittance his testimony would not be meaningful. Mr. Stanley's opinions cannot be given any weight if he did not perform an independent assessment or evaluation of critical data and information to form his opinions and conclusions in the FER or in his oral testimony. The Navy's argument that the self-serving conclusions presented in its own reports are sufficient to form Mr. Stanley's opinions is also misplaced, particularly when regulatory agencies have repeatedly disagreed with the Navy's assessments. *Compare* Vol. 3, 674:16-20 ("A. Yeah. I'm only saying what I've seen in those reports. Q. Okay, right. So that you're just kind of summarizing other people's words. A. Yes, ma'am.") *with* BWS-28 at BWS007376 ("The Regulatory Agencies note that the degree of capture at Red Hill Shaft for a range of possible release scenarios has not yet been fully evaluated and remains unclear whether it is an adequate measure to prevent impact to other receptors."); BWS-349 at BWS0037973 (granting the Navy an extension in order to "correct the deficiencies in the conceptual site model [] and groundwater flow model…").

Mr. Stanley's testimony that is outside of his expertise should likewise be disregarded. A witness may qualify as an expert if he or she possesses a background of knowledge, skill, experience, training, or education. *Udac v. Takata Corp.*, 121 Haw. 143, 148 (2009); Haw. R. Evid. 702. The "extent of an expert's knowledge of the subject matter goes to the weight" of the testimony, where if the expert's knowledge is limited so should the weight of the evidence be limited. *Tabieros v. Clark Equipment Co.*, 85 Haw. 336, 351 (1997). Mr. Stanley testified about several central issues, including risk assessment, corrosion, UST regulations, and tank tightness testing, that were outside of his scope. *See* Vol. 3, 672:5-19 (admitting that he never studied corrosion and does not consider himself an expert on metals); 672:20-673:3 (admitting that he has no formal education and only limited experience related to tank integrity and tank tightness testing); 673:10-11 ("I would not consider myself an expert in engineering risk assessment."). Mr. Stanley admitted to not having any formal education or training in these areas. Under Hawaii law, Mr. Stanley's testimony related to issues outside of his limited hydrogeological expertise should not hold any weight because he admittedly does not have knowledge, skill, experience, training, or education in those areas.

II. Conclusion

The Navy's Opposition is a failed attempt to shift the burden to the BWS and confuse the issues. The record is clear – the Navy was ordered to produce a discrete set of documents relied upon by Mr. Stanley and refused to do so without good cause. Accordingly, Mr. Stanley's opinions drawing from such information should be struck or an adverse inference be imposed. In the event Mr. Stanley's testimony is to be admitted, the desperate efforts of the Navy to justify its refusal to produce these documents based on an absurd claim that Mr. Stanley did not examine or rely upon underlying data and analyses only means that Mr. Stanley's testimony lacked any factual or technical basis and thus can be afforded no meaningful evidentiary weight.

DATED: Honolulu, Hawaii, March 30, 2021.

PAUL S. AOKI
Acting Corporation Counsel

By */s/ Jeff A. Lau*
JEFF A. LAU
Deputy Corporation Counsel
Attorney for Petitioner
Board of Water Supply,
City and County of Honolulu

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing document was served upon the following, via email, to their last known email address on March 30, 2021:

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DATED: Honolulu, Hawaii, March 30, 2021.

PAUL S. AOKI
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By */s/ Jeff A. Lau*
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DEPARTMENT OF HEALTH

STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re: Red Hill Permit Application	Case No. 19-UST-EA-01 **NAVY SUR-REPLY IN OPPOSITION TO BWS MOTION TO STRIKE AND/OR NEGATIVE INFERENCE** CERTIFICATE OF SERVICE

SUR-REPLY IN OPPOSITION

In its reply brief in support of its motion to strike, BWS has listed fourteen new categories of documents it believes the Navy improperly withheld in violation of the December 30, 2020 minute order in this proceeding. That order directed the Navy to identify and produce documents relied upon by its expert that fell into certain broader categories that were named by

BWS at a December 2020 status conference.[1] (Gannon Dec., Exh. B.) BWS argues that the order made a finding that the Navy's expert *in fact* relied on all such documents in those categories and the Navy was therefore required to produce them. This argument is incorrect for two reasons.

First, the very next line of the order directs the Navy to "make a request for such documents" – that is, those documents the expert relied upon – "to its expert." (Gannon Dec., Exh. B.) If, as BWS claims, the order found that the Navy's expert relied on documents in those four categories, regardless of his actual or direct reliance on them, there would be no reason to ask the expert for the documents. Instead, the order treated *the Navy's expert* – not BWS – as the authoritative source of information regarding what documents he relied upon. The Navy duly complied with the order by promptly making a request for documents to its expert, who responded with a detailed declaration explaining that everything he relied on was already in the record and directing BWS to places in the record where information in the categories they sought could be found. (Gannon Decl., Exh. C, attaching January 8, 2021 Declaration of Curtis Stanley.)

Second, BWS has not proceeded, either before the hearing or during the hearing, as if the order required the production of the fourteen new "categories of documents and/or data"[2] it now

[1] The four categories are: "(1) environmental data set, (2) 3D geologic model, (3) strike and dip, lava flow, geology and (4) ground water flow modeling files" (Gannon Dec., Exh. B (attaching email from Hearings Officer Chang), which are distinct from the fourteen new "categories of documents and/or data" mentioned for the first time in BWS's Reply Brief at 5-6 (and necessitating this sur-reply to address them).

[2] Among others, which have still not been identified with sufficient particularity for the Navy to respond to the claim that they have been improperly withheld. For example, BWS claims that the "actual" geologic model and groundwater flow model have also been withheld (Reply at 5). Other than the information described in the Conceptual Site Model and Groundwater Flow Model Report and the computer files addressed in previous briefing, it

claims were withheld. BWS did not respond to Mr. Stanley's declaration by moving to compel the production of additional documents before the hearing. Nor did BWS ask to postpone the hearing or its cross-examination of Mr. Stanley until additional documents were produced.

Moreover, BWS did not cross-examine Mr. Stanley about any of the fourteen categories of documents they claim he relied on; there are no questions about Modflow-USG files, Groundwater Vista files, tabulations of simulated vs measured water levels, a corrected set of water levels for the USGS Synoptic Survey, hourly or daily pumping rates for Red Hill Shaft, Earth Volumetric Studio files, GIS files, how strike and dip information was measured, the completeness of water levels or geological logs for wells mentioned in a table on page 44 of the FER, or any differences between data in the FER and quarterly monitoring reports.[3] Since there is no indication in the record that BWS learned about the existence of these fourteen new documents and data sets from its cross-examination of Mr. Stanley, it is unclear why BWS did not request them before the hearing.

Instead, the Navy was left entirely in the dark about what "data" BWS believed was left out of Mr. Stanley's declaration, and thus in the dark about how BWS believed the order had been violated, prior to BWS's reply. If the Navy had actually violated the order, and if BWS actually needed these documents in order to meaningfully cross-examine Mr. Stanley, BWS's

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remains unclear what BWS believes the "actual" models consist of, nor what, if any, additional information about them was needed in order to cross-examine Mr. Stanley.

[3] Mr. Stanley did discuss something called "shape files" briefly in Volume 4, 771:3-11. He testified that he has "looked at some of them" but did not testify as to his use of or reliance on them apart from his use of the geologic model, which his January 8, 2021 declaration indicates can be found in pertinent part in the Conceptual Site Model, Exhibit B-352. There is no testimony to indicate that these "shape files" are among the file types specified in BWS's Reply Brief. More to the point, there is no testimony indicating that Mr. Stanley relied on such files in formulating his expert opinions for this proceeding, and Mr. Stanley did not claim to have relied on them in his January 8, 2021 declaration.

failure to request relief or identify the missing data before cross-examining Mr. Stanley would be inexplicable. Similarly, if BWS actually believed Mr. Stanley relied on the documents and data sets it named in its reply brief, its failure to cross-examine him about them would also be inexplicable. Instead, BWS said nothing and did nothing, proceeded with a cross-examination it now claims was "meaningless," and now asks that Mr. Stanley's testimony be struck and the Navy be sanctioned with a negative inference. The Navy did as it was directed, inquired with its expert regarding documents on which he relied, and timely provided the result of that inquiry. BWS's motion is meritless and should be denied.

Respectfully Submitted,

Dated: April 6, 2021 /S/ Marnie Riddle
David Fitzpatrick
Marnie E. Riddle

DEPARTMENT OF HEALTH
STATE OF HAWAII

IN THE MATTER OF Contested Case Hearing Re Permit Application	)	**CERTIFICATE OF SERVICE**

CERTIFICATE OF SERVICE

I hereby certify that, on this date, a true and correct copy of the foregoing documents were emailed to the following:

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Respectfully Submitted,

Dated: April 6, 2021 /S/ Marnie Riddle _

Marnie E. Riddle
Agency Representative

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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 PETITIONER HONOLULU BOARD OF WATER SUPPLY'S SUR-REPLY IN SUPPORT OF MOTION TO STRIKE THE TESTIMONY OF CURTIS STANLEY AND/OR FOR NEGATIVE INFERENCE ADDRESSING THE NAVY'S REFUSAL TO COMPLY WITH THE DECEMBER 30, 2020 ORDER TO PRODUCE INFORMATION; DECLARATION OF ELLA FOLEY GANNON; EXHIBITS A THROUGH D; CERTIFICATE OF SERVICE

PETITIONER HONOLULU BOARD OF WATER SUPPLY'S SUR-REPLY IN SUPPORT OF MOTION TO STRIKE THE TESTIMONY OF CURTIS STANLEY AND/OR FOR NEGATIVE INFERENCE ADDRESSING THE NAVY'S REFUSAL TO COMPLY WITH THE DECEMBER 30, 2020 ORDER TO PRODUCE INFORMATION

The United States Department of the Navy ("Navy") has not and cannot accurately marshal the facts or present a consistent, credible argument when it comes to its violation of a direct order by Hearings Officer Louis L.C. Chang to produce certain categories of data and analyses relied upon by Navy witness Mr. Curtis Stanley. First, the Navy contended it should not have to produce this information. Hearings Officer Chang flatly rejected that argument. Then the Navy claimed – contrary to all reason and Mr. Stanley's own prior written testimony – that Mr. Stanley did not rely upon the data and analyses that were ordered to be produced. But Mr. Stanley subsequently testified that he would have to, and did, rely upon this information. Now the Navy argues that the documents the Honolulu Board of Water Supply ("BWS") requested more than four months ago and that the Navy continues to refuse to produce are somehow "new" and that it has been "entirely in the dark" about its ongoing violation of Hearings Officer Chang's December 30, 2020 order. This is simply wrong, and nothing more than the Navy's latest effort to manufacture a basis upon which to avoid producing a discrete set of documents necessary for evaluating the veracity of Mr. Stanley's opinions and the Navy's position in this contested case. It is unclear what the Navy is trying to hide, but failing to produce this information as ordered has consequences. The appropriate recourse under the Department of Health's Rules of Practice and Procedure is to strike Mr. Stanley's testimony and/or draw an adverse inference against the Navy. The BWS' Motion should be granted.

The Navy's arguments in its Sur-Reply in Opposition are without merit. There are no "new categories of documents" at issue in this Motion. Navy Sur-Reply, at 1. The data and analyses the BWS has identified as still unproduced are completely encompassed by the four categories of documents listed in Hearings Officer Chang's December 30, 2020 order.[1] To the extent the Navy is confused about the documents that remain outstanding, it has only itself to blame. The BWS has attempted for over four months to identify for the Navy the missing data and analyses relied upon by Mr. Stanley. But the Navy has refused to produce any of these documents, and has declined offers to meet and confer to discuss the scope of the documents it was ordered to produce.[2]

At every opportunity, the BWS has raised the issue of the improperly withheld data and analyses relied upon by Mr. Stanley. The BWS received Mr. Stanley's testimony on December 1, 2020. *See* Declaration of Ella Foley Gannon ("Gannon Sur-Reply Decl."), ¶ 3. On December

[1] The four categories of documents in the December 30, 2020 order were (1) environmental data set, (2) 3D geological model, (3) strike and dip, lava flow, geology, and (4) ground water flow modeling files. Declaration of Ella Foley Gannon in Support of Petitioner Honolulu Board of Water Supply's Motion to Strike the Testimony of Curtis Stanley and/or for Negative Inference Addressing the Navy's Refusal to Comply with the December 30, 2020 Order to Produce Information, Ex. B. The groundwater flow modeling files include: (1) Modflow-USG files for the groundwater models discussed in the Navy 2020 Groundwater Flow Model Report; (2) Groundwater Vista files for the Navy groundwater models discussed in the Navy 2020 Groundwater Flow Model Report; (3) tabulations of the simulated versus measured water levels used to calibrate the Navy groundwater models; (4) the Navy set of water levels for the USGS Synoptic Survey (July 2017 – February 2018) corrected for non-pumping impacts on the water level signal as discussed on pages 3-11 of the Navy 2020 Groundwater Flow Model Report; (5) hourly pumping rates for the Navy's Red Hill Shaft during the USGS Synoptic Survey (July 2017 – February 2018); (6) Navy Red Hill Shaft pumping rates on at least daily intervals since the 2014 Tank 5 release; (12) complete sets of measured water levels from the multilevel Westbay wells RHMW11, RHMW13, RHMW14, and RHMW15 discussed on page 44 of the FER; and (13) geological logs for Navy Wells RHMW16A and RHMW19 discussed on page 44 of the FER. The 3D geologic model category includes data sets related to: (7) CTECH's Earth Volumetric Studio (EVS) files for the Navy geologic model discussed on pages 5-11 and Appendix E of the 2019 Navy Conceptual Site Model Report; (8) Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure of clinker zones (including the strike and dip angles) produced by the Navy geologic model; (9) Interactive Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure of saprolite zones produced by the Navy geologic model; (10) Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure the different lava flows produced by the Navy geologic model; and (11) descriptions of the methods used to measure the strike and dip information provided in Appendix C of the 2019 Navy Conceptual Site Model Report. Environmental data sets include (14) environmental data set that explains why the analytical data in the FER differs from the data in the Navy 2015 Q2, 2015 Q4, and 2016 Q2 (specifically naphthalene compounds).

[2] At times the Navy has indicated that it was open to meeting and conferring on this issue. For example, at the close of the contested case hearing, counsel for the Navy suggested that the parties might be able to convene a meeting amongst the technical experts to view the unproduced data and analyses. But Navy counsel never followed up on its suggestion.

10, 2020, the BWS made its first request to the Navy to produce the missing documents relied upon by Mr. Stanley. *Id.* at ¶ 4, Ex. A. Although the Navy incorrectly claims in its Sur-Reply in Opposition that it had no idea about the unproduced data and analyses, the initial request asked for specific information, including, for example, the Navy's "groundwater flow modeling files, including Model USG and GW Vista files." *Id*. The Navy refused. *Id*. On December 30, 2020, the BWS and the Navy presented oral argument concerning the need for production of the data and analyses relied upon by Mr. Stanley. *Id.* at ¶ 5. Later that day, Hearings Officer Chang issued an order for the Navy to produce four discrete categories of documents relied upon by Mr. Stanley by January 9, 2021. *Id.* On January 6, 2021, the BWS requested to meet and confer with the Navy regarding the production of the data and analyses ordered to be produced pursuant to Hearings Officer Chang's December 30, 2020 order, and the Navy declined this offer. *Id.* at ¶ 6, Ex. B.[3] The Navy cannot now contend, after refusing to undertake a search for the relied-upon documents or meet and confer on the very issue, that the fourteen sets of data and analyses identified by the BWS in connection with this Motion are somehow a surprise.

On January 11, 2021, after the Navy's failure to comply with Hearings Officer Chang's order, the BWS made abundantly clear that "[b]ecause the Navy has refused to provide these categories of information as ordered, the BWS will seek an adverse inference for each of Mr. Stanley's opinions reliant upon this information." *Id.* at ¶ 7, Ex. C. Just prior to the contested case hearing, on January 31, 2021, the BWS filed a pre-hearing statement addressing the Navy's refusal to comply with the December 30, 2020 order. *Id.* at ¶ 8, Ex. D. The BWS explained,

[3] The BWS knew that the missing documents would be highly technical in nature and requested the parties' respective experts discuss the logistics of the production that the Navy never made. *See* Gannon Sur-Reply Decl., ¶ 6, Ex. B.

among other things, that "[t]he BWS is [] deprived of its right to cross-examine Mr. Stanley regarding this information, and the Navy reports that characterize it, if the underlying data and analyses are not provided." *Id*. At no time did the Navy object to the BWS bringing this Motion after the contested case hearing. To the contrary, at the January 22, 2021 status conference, it was counsel for the Navy who suggested that the issue be briefed *after* the hearing once the parties had an opportunity to examine Mr. Stanley on the bases for his testimony. The Navy's belated claim that the BWS should have sought to postpone the hearing or requested relief before cross-examining Mr. Stanley is disingenuous at best. *See* Navy Sur-Reply, at 2-4.

At the contested case hearing, and contrary to the Navy's assertion that the "BWS did not cross-examine Mr. Stanley about any of the fourteen categories of documents," the BWS repeatedly asked Mr. Stanley about his reliance on data and analyses that were ordered to be produced. *Compare* Navy Sur-Reply at 3 *with* Vol. 3, 658:2-4 ("we've got soil vapor monitoring data we've looked at. We've looked at the data from all the borings"); 661:17-18 ("looking at all this data over the years"); 677:5-6 ("we look at data points all around"); 677:20-21 (confirming that he had to have looked at data to evaluate models); 679:3-5 (confirming that he is familiar with water level elevation data); 738:12-13 (confirming that an "analysis on the data" was necessary); Vol. 4, 770:9-11 ("We used the seismic, we used the well logs, and integrated all of that data and other data into the geological model."); 775:4-5 ("we have a pretty good understanding of where the past releases are at based on the data we've got"); 813:19-20 ("based on the data I've looked at"); 849:9-10 ("groundwater monitoring data in conjunction with the soil vapor monitoring data"). Mr. Stanley testified that he was familiar with the data and analyses and that in order to assess the Navy's models, he had to view and assess underlying data sets.

Vol. 3, 739:15-18 ("Q. … And again, to be able to assess those models you've got to look at the underlying data, make sure everything was good, right? A. Yes.").

After Mr. Stanley's testimony at the contested case hearing confirmed that he did indeed rely on the improperly withheld documents, the BWS then filed this Motion. In its Opposition, the Navy insisted that the BWS provide more specificity as to which documents it was seeking, claiming that the BWS "lacked access to *unspecified* 'data'" (Opp. at 2 (emphasis added)), and that the BWS did not "demonstrate[] the existence of withheld data" (Opp. at 12). The Navy's claims were again false. The BWS identified this information in its Motion. *See* Motion at 8-14, Ex. A. Nevertheless, in response to the Navy's Opposition, the BWS provided in its Reply a numbered list of the missing data and analyses. By doing so, the BWS is not seeking new or supplemental information, it is merely clarifying, as requested, the precise documents that remain outstanding in violation of the December 30, 2020 order. The Navy apparently does not dispute that these documents remain unproduced. Despite requesting the ability to file a Sur-Reply in Opposition, the Navy's brief does not – for *any* of the fourteen listed sets of data and analyses – argue that the documents have been produced or otherwise should not be produced. That the Navy cannot articulate a single reason why any of the fourteen document types should not be produced is telling.

Mr. Stanley's testimony should not be included in the record and his opinions can be afforded no or negligible evidentiary weight. The record is clear: the Navy was ordered to produce a discrete set of documents relied upon by Mr. Stanley in forming the opinions he presented as testimony in this contested case; the Navy refuses to produce at least fourteen sets of this data and analyses as ordered; and the Navy has not demonstrated good cause for its brazen disregard for the order. As a result, there was no meaningful opportunity for cross-examination and Mr. Stanley's testimony should be struck pursuant to Hawaii Administrative Rules § 11-1-38(h) or a negative inference should be drawn against the Navy under Hawaii Administrative Rules § 11-1-24(b)(5). The Navy's tired attempts to reargue reliance are misplaced as Mr. Stanley's reliance on the data, information, analyses, and modeling that is the subject of this Motion cannot be reasonably disputed given Mr. Stanley's own written testimony and admissions under cross-examination. To the extent Mr. Stanley's testimony is allowed into the record, the factual and technical bases for Mr. Stanley's opinions have been so undermined by the Navy's arguments and his own declaration that the only reasonable conclusion is to render them no probative value.

DATED: Honolulu, Hawaii, April 13, 2021.

PAUL S. AOKI
Acting Corporation Counsel

By _/s/ Jeff A. Lau_
JEFF A. LAU
Deputy Corporation Counsel
Attorney for Petitioner
Board of Water Supply,
City and County of Honolulu

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 DECLARATION OF ELLA FOLEY GANNON; EXHIBITS A THROUGH D

DECLARATION OF ELLA FOLEY GANNON

I, ELLA FOLEY GANNON, declare as follows:

1. I represent Petitioner Honolulu Board of Water Supply in the above-entitled action. I am an attorney licensed to practice law in California and I am admitted pro hac vice to practice in the state of Hawaii.

2. I make this declaration based upon personal knowledge and I am competent to testify as to all matters stated herein. I make this Declaration in support of Petitioner Honolulu Board of Water Supply's Sur-Reply in Support of Motion to Strike the Testimony of Curtis Stanley and/or for Negative Inference Addressing the Navy's Refusal to Comply with the December 30, 2020 Order to Produce Information.

3. The BWS received Navy witness Mr. Curtis Stanley's testimony by mail on December 1, 2020.

4. On December 10, 2020, the BWS made its first request to the Navy to produce documents relied on by Mr. Stanley. A true and correct copy of this email communication and the Navy's reply is attached as Exhibit A.

5. On December 30, 2020, the BWS and the Navy presented oral argument concerning the data and analyses relied upon by Mr. Stanley. Later that day, Hearings Officer Louis L.C. Chang emailed the parties ordering production of certain documents relied upon by Mr. Stanley. A true and correct copy of this order was attached as Exhibit B to my declaration to the Motion.

6. On January 6, 2021, the BWS requested to meet and confer with the Navy regarding the documents ordered produced by Hearings Officer Chang's December 30, 2020 order, and the Navy declined this offer. A true and correct copy of this email communication is attached as Exhibit B.

7. On January 11, 2021, after the Navy's failure to comply with Hearings Officer Chang's December 30, 2020 order, the BWS emailed the parties and Hearings Officer Chang informing them that it would seek an adverse inference for each of Mr. Stanley's opinions reliant upon the improperly withheld information. A true and correct copy of this email communication is attached as Exhibit C.

8. Prior to the contested case hearing, on January 31, 2021, the BWS filed a pre-hearing statement addressing the Navy's refusal to comply with the December 30, 2020 order. A true and correct copy of this statement is attached as Exhibit D.

DATED: San Francisco, California, April 13, 2021.

<u>/s/ Ella Foley Gannon</u>

ELLA FOLEY GANNON

Exhibit A

Brown, David K.

From:	Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>
Sent:	Wednesday, December 16, 2020 10:13 AM
To:	Brown, David K.; Riddle, Marnie E CIV USN OGC WASH DC (USA); Minott, Karrin H CIV USN OGC WASH DC (USA)
Cc:	Foley Gannon, Ella; 'jlau3@honolulu.gov' (jlau3@honolulu.gov)
Subject:	RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]
David,

Good morning. The Navy has made a good faith effort to produce unredacted documents and evidence responsive to the Board of Water Supply's Amended Motion for the Production of Documents from the Navy. The Navy produced a less-redacted copy of its permit application and attachments, and provided the BWS with an index identifying the nature of any information still withheld in the application attachments.

The Navy met and conferred with the BWS, conducted a reasonable search, and produced documents identified with particularity in Exhibit A to the BWS's motion. The Navy 1) timely responded to the BWS's concerns over missing documents, 2) made additional productions of documents the BWS requested; 3) assisted the BWS in identifying documents in the productions; and 4) is assisting the BWS with a request for information that was not included in the BWS's motion. As the BWS has acknowledged, the parties have not stipulated to civil style discovery, which is not permitted in contested case proceedings except upon a showing of good cause. HAR § 11-1-24(b)(5), (e).

As to the BWS's requests for information referred to in Navy witness testimony or in documents the Navy has produced, the Navy will make the witnesses available for cross-examination at the hearing. If the hearings officer requires the production of additional evidence at that time, the Navy will endeavor to add it to the record, in accordance with HAR § 11-1-38(i).

Respectfully,

Jon

From: Brown, David K. <david.brown@morganlewis.com>
Sent: Tuesday, December 15, 2020 1:24 PM
To: Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Cc: Foley Gannon, Ella <ella.gannon@morganlewis.com>; 'jlau3@honolulu.gov' (jlau3@honolulu.gov) <jlau3@honolulu.gov>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

Jon:

The BWS appreciates the Navy's continued efforts to meet and confer concerning certain documents requested in connection with the contested case. As to your response below, we seek clarification from the Navy as to the following.

Request 2: *Documentation of releases from the Red Hill USTs*

Thank you for the explanation addressing the Whitacre 2014 emails. We understand your response as representing that the substance of these documents, while produced by the Navy in a different form with a different file name, are the same. Please let us know if that is not the case.

You did not directly address our request for photos and/or videos documenting releases from Red Hill USTs. We provided an example of one such document that was included as part of Exhibit B-7. We consider such photos and/or videos as clearly responsive to the BWS' request for "[a]ll documentation of releases from the Red Hill Bulk Fuel Storage Facility …." Accordingly, we reiterate our request that such documents be produced or, alternatively, that the Navy provide an explanation of the basis for its denial of this request.

Request 3: *Reports of all work done inspecting and/or certifying the condition of each of the Red Hill USTs*

Thank you for agreeing to produce certain of the missing documents identified.

You did not directly address our request for documents related to the coupon samples referenced in the recently-produced Tank 19 repair documentation [RDHLCC0027623, at 27625]. We consider such documents as clearly responsive to the BWS' request for "reports of all work done inspecting and/or certifying the condition of each of the Red Hill Bulk Fuel Storage Facility underground storage tanks …." Accordingly, we reiterate our request that such documents be produced or, alternatively, that the Navy provide an explanation of the basis for its denial of this request.

Documents Referenced and Relied Upon by Navy Witnesses

We hereby reiterate our request that the Navy provide the information identified in my December 10, 2020 email that has been referenced in Navy witness testimony and relied upon by Navy witnesses. While the BWS recognizes that these documents may not be responsive to the categories of documents set forth in Exhibit A of BWS' Amended Motion for Production of Documents, we maintain that it is improper for the Navy to withhold such documents as they form the basis of the opinions of Navy witnesses. Without access to the very information underlying these opinions, the BWS is deprived of a meaningful opportunity to evaluate these opinions or cross-examine Navy witnesses. Please let us know as soon as possible if you do not agree that sharing such documents is appropriate and necessary. If these issues are not resolved, we will seek assistance from the Hearings Officer at tomorrow's conference. We further reserve the right to seek an adverse inference and/or move to strike the implicated testimony.

Our review of Navy documents remains ongoing and the BWS reserves its right to amend, modify, or supplement these requests in the future. Please do not hesitate to contact us if you have any questions or would like to discuss this matter further. We still intend to update the Hearings Officer as to the status of these meet and confer efforts tomorrow.

Best,

David K. Brown
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From: Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>
Sent: Tuesday, December 15, 2020 10:03 AM
To: Brown, David K. <david.brown@morganlewis.com>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Cc: Foley Gannon, Ella <ella.gannon@morganlewis.com>; 'jlau3@honolulu.gov' (jlau3@honolulu.gov) <jlau3@honolulu.gov>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]

David,

Good morning. Below is the Navy's response to your email of December 10, 2020.

Request 2: The documents identified in your email as responsive to "Request 2" are not outstanding. The Navy produced them in its first production, and they can be located at Bates range RDHLCC0000820 to RDHLCC0000927. Specifically:

- **Whitacre 2014a:** Tank 16 – RDHLCC0000820-833
- **Whitacre 2014b:** Tank 1 – RDHLCC0000853-869
- **Whitacre 2014c:** Tank 6 & 7 – RDHLCC0000898-915
- **Whitacre 2014d:** Tank 8 & 10 – RDHLCC0000884-897
- **Whitacre 2014e:** Tank 11-13 – RDHLCC0000870-883
- **Whitacre 2014f:** Tank 14 & 15 – RDHLCC0000842-852
- **Whitacre 2014g:** Tank 17 & 18 – RDHLCC0000834-841
- **Whitacre 2014h:** Tank 2-5: RDHLCC0000916-927

Request 3: The Navy has located and will produce the following documents responsive to "Request 3" in your email of December 10, 2020:

- Tank 5 Pre-Inspection Reports
- WGS Warranty Repair & NDE Inspection Certification Report dated September 15, 2016
- Tank 5 Post-Repair Inspection Reports

The Navy has located and produced tank histories that report historic inspection and repairs of tanks at the facility. See e.g. RDHLCC0000821, RDHLCC0000835-841, RDHLCC0000843-852, RDHLCC0000854, RDHLCC0000871-883, RDHLCC0000885-897, RDHLCC0000899-915, RDHLCC0000917-927, RDHLCC0000928-935, and RDHLCC0027755-27756.

The Navy has located and will produce the "the data spreadsheet referenced in Section 1.2 of the report titled Red Hill Bulk Fuel Storage Facility Destructive Testing Results Report, AOC/SOW 5.3.3 prepared by Naval Facilities Engineering Command (Jan. 7, 2019)."

The Defense Innovation University (DIU), not the Navy, is under contract with GTT North America to conduct a feasibility study. Currently the Navy does not control documents responsive to your request, but has forwarded the request to the DIU.

The remainder of the requests in your email do not fall within the categories of documents set forth in Exhibit A of BWS's Amended Motion for Production of Documents. Since the parties to this contested case hearing have not stipulated to civil style discovery, we do not plan to undertake a search for responsive documents.

Respectfully,

Jon

From: Brown, David K. <david.brown@morganlewis.com>
Sent: Thursday, December 10, 2020 1:25 PM

To: Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Cc: Foley Gannon, Ella <ella.gannon@morganlewis.com>; 'jlau3@honolulu.gov' (jlau3@honolulu.gov) <jlau3@honolulu.gov>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

Jon:

I write to continue to meet and confer regarding the documents missing from the Navy productions to date in response to the BWS' motion pending before Hearings Officer Chang in the contested case concerning the Navy's Red Hill UST permit application. As we have discussed on several occasions, the Navy still has not produced certain documents essential to preparation for and resolution of the issues central to this contested case. There is no dispute these documents do or should exist, and we have done everything in our power to identify them with particularity – even going so far as to refer to many by file name or as referenced in the Navy's own documents. Nevertheless, certain of these critical records remain missing from the Navy's document productions and have not been accounted for in any of the provided *Vaughn* indices. Specifically, we identify the following documents or categories of documents that have yet to be produced.

Request 2: *Documentation of releases from the Red Hill USTs*

- On October 20, 2020, we provided a list of leak history records referenced in previously-produced documents that were not included in any Navy production. In a response dated November 6, 2020, the Navy responded that it had located these documents and would be producing them. The following documents remain outstanding:

- **Whitacre 2014a.pdf** [RDHLCC0000657]
- **Whitacre 2014b.pdf** [RDHLCC0000657]
- **Whitacre 2014c.pdf** [RDHLCC0000657]
- **Whitacre 2014d.pdf** [RDHLCC0000657]
- **Whitacre 2014e.pdf** [RDHLCC0000657]
- **Whitacre 2014f.pdf** [RDHLCC0000657]
- **Whitacre 2014g.pdf** [RDHLCC0000657]
- **Whitacre 2014h.pdf** [RDHLCC0000657]

- Photos and/or videos documenting releases from Red Hill USTs (*see, e.g.*, Exhibit BWS-007).

Request 3: *Reports of all work done inspecting and/or certifying the condition of each of the Red Hill USTs*

- Inspection documentation, reports, and/or certifications for Tank 5, including the extensive evaluation, repairs, and testing conducted after the January 2014 fuel release and before Tank 5 was returned to service as reported in March 2020.

  The BWS acknowledges receipt of "Tank 5 Final API 653 Inspection Report REV 1 (sent) SIGNED.pdf". However, it appears that the Navy did not produce:

- "**WGS Warranty Repair & NDE Inspection Certification Report dated September 15, 2016**" [RDHLCC0028613, at 28634]; or
- Any return to service documentation in 2013 or 2019/2020 certifying that repairs were made prior to returning Tank 5 to service.

  Further, the BWS finds it surprising that in the aftermath of the fuel release of at least 27,000 gallons from Tank 5 reported in January 2014, the Navy would not have devoted considerable resources to immediately investigate and inspect this tank in an attempt to stop the release of fuel into the environment and to address the serious tank integrity problem. Since the Navy has produced no other documentation of any inspections performed on Tank 5 in the 2014 to 2020 time period, the only conclusion that can be reached is that the Navy has no documentation that such work was ever performed.

- Inspection documentation, reports, and/or certifications for Tank 14, including the extensive evaluation, repairs, and testing conducted before and after collection of steel liner samples in June 2018 and, specifically, **the data spreadsheet referenced in Section 1.2 of the report titled Red Hill Bulk Fuel Storage Facility Destructive Testing Results Report, AOC/SOW 5.3.3 prepared by Naval Facilities Engineering Command (Jan. 7, 2019)**.

  We know the Navy shared this document with the EPA and DOH in connection with the selection of steel liner samples collected from Tank 14.

- Inspection documentation, reports, and/or certifications, including API 653 or modified API 653 inspections reports for Tanks 1, 3, 4, 9, 11, 12, 18, and/or 19.

  Since the Navy has produced no inspection reports for these tanks, the only conclusion that can be reached is that the Navy has no documentation that such work was ever performed.

- Tank 19 repair documentation provided in the Navy's last supplemental production states:

  "From the 4 or 5 coupons cut from Red Hill tanks other than Tank 19 supplied by Tom Kitchen, it appears that the backside of the steel liners are suffering from two types of corrosion. The first type is a generalized corrosion attack that has resulted in broad areas of metal loss. These areas had corrosion pits of 1/2 to 1 1/2 inches in diameter. The second type of corrosion evident on the coupons is a very localized pitting with holes as small as 1/8 of an inch in diameter that had fully penetrated the 1/4 inch thick steel." [RDHLCC0027623, at 27625]

  Please provide all documentation related to these coupon samples, including the tanks and locations from which the coupons were extracted, data collected from these coupons, testing and analyses performed on these coupons, and/or reports generated in connection with the coupon removal, testing, or analysis.

- A copy of the contract or contracts by or between GTT North America and the Department of Defense or its Defense Innovation Unit to conduct a feasibility study to develop technologies for potential implementation at Red Hill, including related proposals and scopes of work, feasibility study descriptions, reports or analyses generated in connection with this work, if any, and documents relating to whether or not the Navy has committed to implementing such upgrades at Red Hill.

  In addition, we hereby request that the Navy provide the following information that has been referenced in Navy witness testimony and relied upon by Navy witnesses to form the basis of their opinions.

- AOC SOW Section 5.4 draft work plan sent to EPA and DOH on November 16, 2020 as described in the testimonies of Donald Panthen and Robert Jamond, and any request for or response to this work plan (or any drafts thereof) from EPA or DOH.
- Documents relied upon by Curtis Stanley to form his expert opinions as described in the Facility Environmental Report (FER), including:

- "Red Hill is probably the most extensively studied UST system in the State of Hawaiʻi with the largest environmental data set of any UST system in the State. The Navy has collected a plethora of data that have greatly expanded understanding of the geology and hydrogeology at Red Hill, as well as conditions in the underlying groundwater aquifer, which has enabled the studies and conclusions briefly summarized above. The data serve as the foundation for the Navy's AOC environmental investigation findings and will continue to do so as more data are collected and investigations, evaluations, and decision making continue (see Section 3)." [FER, at 18]

  Please produce the referenced and relied upon environmental data set, including all: geophysical and drilling logs; water level, chemistry, and temperature measurements; and petrophysical measurements.

- "The Navy developed a geologic framework model and a three-dimensional regional geologic model of Red Hill and surrounding environs (including North and South Hālawa Valleys, Moanalua Valley, the Salt Lake area, and Pearl Harbor) to provide geologic support for its groundwater flow modeling effort. The three-dimensional geologic model encompassed the groundwater flow model domain and incorporated information from borehole logs, subsurface structural geology surveys, developed cross sections, and published literature. The Navy used this and other data to prepare detailed geologic cross sections by correlating available geologic logs of cores and the results of field mapping conducted with experts from DOH and the University of Hawaiʻi ("UH") along multiple outcrops in the vicinity of Red Hill and within the Moanalua Tunnel." [FER, at 20]

  Please produce the referenced and relied upon Navy three-dimensional regional geologic model.

- "[T]he Navy determined accurate strike and dip measurements of the lava flows and the presence of highly porous clinker units within Red Hill. Strike and dip of a rock outcrop can be used to determine the general direction that a fluid can flow. The measurements were used to identify a general dip direction for Red Hill (south-southwest), which can influence groundwater flow. The Navy then oriented the groundwater flow model to match the general dip direction for Red Hill." [FER, at 20]

  Please produce the referenced and relied upon Navy measurements of strike and dip of lava flows and clinker units.

- "Understanding the direction and rate of groundwater flow under a variety of reasonable supply well pumping scenarios is critical to assessing the risk that any hypothetical future fuel leak could pose to local drinking water. Initially, the AOC SOW scoped the groundwater flow model effort as one of updating a model developed for a previous 2007 Facility environmental investigation (DON 2007). The Navy modeling team found that updating the 2007 model was insufficient and recommended additional work, including entirely rebuilding, providing more detail, and expanding the model. Working with the AOC Parties and other stakeholders, the Navy refined the modeling domain to extend approximately 51 square miles from Waimalu Valley in the northwest to Kalihi Valley in the southeast, and from near the Koʻolau crest in the northeast to Pearl Harbor and the Pacific Ocean in the southwest (see Location Map, Figure 1), far beyond where any impacts might reasonably be expected. Since there are a range of factors that require consideration, the Navy developed a multi-model approach to bound expected flow conditions (Ajami et al. 2006). Such an effort requires additional work on behalf of the Navy but results in a more reliable range of predictions under given scenarios." [FER, at 48]

  Please produce the referenced and relied upon groundwater flow modeling files, including Model USG and GW Vista files for all of the groundwater flow models generated as part of the Navy's March 2020 Groundwater Flow Model Report.

The BWS appreciates the parties' ongoing efforts to meet and confer to address the exchange of information crucial to the resolution of this contested case. Given the issues associated with the Navy's prior document productions, our review of Navy documents remains ongoing and the BWS reserves its right to amend, modify, or supplement these requests in the future.

Please do not hesitate to contact us if you have any questions or would like to discuss this matter forward. We intend to update the Hearings Officer as to the status of these meet and confer efforts next week.

Best,

David K. Brown
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Direct: +1.213.680.6816 | Main: +1.213.612.2500 | Fax: +1.213.612.2501
david.brown@morganlewis.com | www.morganlewis.com
Assistant: Walker Clegg | +1.213.612.7406 | walker.clegg@morganlewis.com

-----Original Message-----
From: Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>
Sent: Monday, November 30, 2020 5:41 PM
To: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Brown, David K. <david.brown@morganlewis.com>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]

Ella,

We are available Thursday for a brief call before 1pm Pacific.

Jon

-----Original Message-----
From: Foley Gannon, Ella <ella.gannon@morganlewis.com>
Sent: Monday, November 30, 2020 8:36 AM
To: Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Brown, David K. <david.brown@morganlewis.com>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

Hope everyone had a good Thanksgiving! We would like to set up a call for later this week to meet and confer regarding the Navy's production of documents requested. Please let me know your teams availability on Thursday or Friday for a brief call.

Best,

Ella

Ella Foley Gannon
Morgan, Lewis & Bockius LLP
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Assistant: Elizabeth Stewart | +1.415.442.1679 |
elizabth.stewart@morganlewis.com

-----Original Message-----
From: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>
Sent: Tuesday, August 11, 2020 10:24 AM
To: Brown, David K. <david.brown@morganlewis.com>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]

Yes, we will circulate a number. Karrin and Marnie will be joining.

-----Original Message-----
From: Brown, David K. <david.brown@morganlewis.com>
Sent: Tuesday, August 11, 2020 10:22 AM
To: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

Thanks Jon. To confirm, that is tomorrow at 12:30 pm PT?

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Assistant: Walker Clegg | +1.213.612.7406 | walker.clegg@morganlewis.com

-----Original Message-----
From: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)
<jonathan.c.mckay@navy.mil>
Sent: Tuesday, August 11, 2020 10:18 AM
To: Brown, David K. <david.brown@morganlewis.com>; Riddle, Marnie E CIV USN
OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Minott, Karrin H CIV
USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]

David,

We are available for a call at 1230.

Jon

-----Original Message-----
From: Brown, David K. <david.brown@morganlewis.com>
Sent: Monday, August 10, 2020 1:34 PM
To: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)
<jonathan.c.mckay@navy.mil>; Riddle, Marnie E CIV USN OGC WASH DC (USA)
<marnie.riddle@navy.mil>
Cc: Foley Gannon, Ella <ella.gannon@morganlewis.com>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

Jon:

I hope all is well. Ella and I would like to ensure that we continue to stay in contact with you concerning the status of the Navy's document collection and production efforts related to the Red Hill contested case. We are generally available on Wednesday for a call. Please let us know if that works for you. Thanks.

Best,

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Assistant: Walker Clegg | +1.213.612.7406 | walker.clegg@morganlewis.com

-----Original Message-----
From: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)
<jonathan.c.mckay@navy.mil>
Sent: Thursday, July 30, 2020 10:45 AM
To: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Riddle, Marnie E CIV
USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: Brown, David K. <david.brown@morganlewis.com>
Subject: RE: [Non-DoD Source] RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]

Ella,

Thank you.

Jon

Sent with BlackBerry Work
(https://urldefense.com/v3/__http://www.blackberry.com__;!!DuJIhUBmA6S-!U4yZ
hqFAUQhNa3Is_FPdztOL6dw_wCcRxTFg3ecP0wZqLnmEzY7-x3riS9a6V3cxUdMJsw$)

From: Foley Gannon, Ella
<ella.gannon@morganlewis.com<mailto:ella.gannon@morganlewis.com>>
Date: Thursday, Jul 30, 2020, 10:30 AM
To: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)
<jonathan.c.mckay@navy.mil<mailto:jonathan.c.mckay@navy.mil>>, Riddle,
Marnie E CIV USN OGC WASH DC (USA)
<marnie.riddle@navy.mil<mailto:marnie.riddle@navy.mil>>
Cc: Brown, David K.
<david.brown@morganlewis.com<mailto:david.brown@morganlewis.com>>
Subject: [Non-DoD Source] RE: Meet and Confer - Red Hill

It was nice to speak with you both yesterday. We have conferred with our client and the BWS believes that there have been no developments that should impact the timing of the contested case since the briefing hearing schedule was agreed to by the parties. Accordingly, we are not willing to stipulate to an extension at this time.

Best regards,

Ella

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://urldefense.com/v3/__https://no-click.mil/?http:**Awww.morganlewis.com*__;
Ly8v!!DuJIhUBmA6S-!U4yZhqFAUQhNa3Is_FPdztOL6dw_wCcRxTFg3ecP0wZqLnmEzY7-x3riS
9a6V3dja1AwCg$ >
Assistant: Elizabeth Stewart | +1.415.442.1679 |
elizabth.stewart@morganlewis.com

From: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)
<jonathan.c.mckay@navy.mil>
Sent: Wednesday, July 29, 2020 9:29 AM
To: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Brown, David K.
<david.brown@morganlewis.com>; Riddle, Marnie E CIV USN OGC WASH DC (USA)
<marnie.riddle@navy.mil>
Subject: RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]
For our 1100 call, we can use the following conference number:
301-909-7353
62892570#

Thanks,
Jon

From: Foley Gannon, Ella
<ella.gannon@morganlewis.com<mailto:ella.gannon@morganlewis.com>>
Sent: Tuesday, July 28, 2020 9:54 AM
To: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)

<jonathan.c.mckay@navy.mil<mailto:jonathan.c.mckay@navy.mil>>; Brown, David K. <david.brown@morganlewis.com<mailto:david.brown@morganlewis.com>>
Subject: [Non-DoD Source] RE: Meet and Confer - Red Hill

Please circulate a call in number as we are working remotely.

Ella Foley Gannon
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https://no-click.mil/?http://www.morganlewis.com<https://no-click.mil/?https
://urldefense.com/v3/__https://no-click.mil/?http:**Awww.morganlewis.com*__;
Ly8v!!DuJIhUBmA6S-!U4yZhqFAUQhNa3Is_FPdztOL6dw_wCcRxTFg3ecP0wZqLnmEzY7-x3riS
9a6V3dja1AwCg$ >
Assistant: Elizabeth Stewart | +1.415.442.1679 |
elizabth.stewart@morganlewis.com<mailto:elizabth.stewart@morganlewis.com>

From: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)
<jonathan.c.mckay@navy.mil<mailto:jonathan.c.mckay@navy.mil>>
Sent: Tuesday, July 28, 2020 9:52 AM
To: Foley Gannon, Ella
<ella.gannon@morganlewis.com<mailto:ella.gannon@morganlewis.com>>; Brown, David K. <david.brown@morganlewis.com<mailto:david.brown@morganlewis.com>>
Subject: RE: Meet and Confer - Red Hill

[EXTERNAL EMAIL]
Thank you. Can I call your office number at 11, or should I circulate an invite with a conference line?

From: Foley Gannon, Ella
<ella.gannon@morganlewis.com<mailto:ella.gannon@morganlewis.com>>
Sent: Monday, July 27, 2020 7:05 PM
To: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)
<jonathan.c.mckay@navy.mil<mailto:jonathan.c.mckay@navy.mil>>; Brown, David K. <david.brown@morganlewis.com<mailto:david.brown@morganlewis.com>>
Subject: [Non-DoD Source] RE: Meet and Confer - Red Hill

Good afternoon. We are available for a call on Wednesday at 11 or 2 pdt. Look forward to speaking with you.

Best,

Ella
Sent with BlackBerry Work
(https://urldefense.com/v3/__http://www.blackberry.com__;!!DuJIhUBmA6S-!U4yZ
hqFAUQhNa3Is_FPdztOL6dw_wCcRxTFg3ecP0wZqLnmEzY7-x3riS9a6V3cxUdMJsw$
<https://no-click.mil/?https://urldefense.com/v3/__https://no-click.mil/?htt
p:**Awww.blackberry.com__;Ly8!!DuJIhUBmA6S-!U4yZhqFAUQhNa3Is_FPdztOL6dw_wCcR
xTFg3ecP0wZqLnmEzY7-x3riS9a6V3ep0gBEoQ$ >)

From: Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)
<jonathan.c.mckay@navy.mil<mailto:jonathan.c.mckay@navy.mil>>
Date: Monday, Jul 27, 2020, 5:51 PM
To: Foley Gannon, Ella
<ella.gannon@morganlewis.com<mailto:ella.gannon@morganlewis.com>>, Brown, David K. <david.brown@morganlewis.com<mailto:david.brown@morganlewis.com>>
Subject: Meet and Confer - Red Hill

[EXTERNAL EMAIL]

Ella and David,

Good afternoon. If you are available, I was hoping to schedule some time on Wednesday to discuss the Navy's effort with the documents concerning the Red Hill matter. I am available between 9 and 12, and again after 1:30. I physically located in San Diego and on PST.

Thanks and I look forward to speaking with you.

Best,
Jon

Jon McKay
Senior Associate Counsel
Navy Region Southwest
937 N. Harbor Dr.
San Diego, CA 92132
Office: 619-532-1428
iPhone: 619-894-2426

Exhibit B

Brown, David K.

From:	Brown, David K.
Sent:	Friday, January 8, 2021 11:16 AM
To:	Riddle, Marnie E CIV USN OGC WASH DC (USA); Foley Gannon, Ella; Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA); Fitzpatrick, David CIV USN (USA); Law, Michael B CIV USN (USA); marnier+NLO@gmail.com; Minott, Karrin H CIV USN OGC WASH DC (USA)
Cc:	'David Kimo Frankel'; ''Lau, Jeff A''; ''Paige, James C''
Subject:	RE: production of information relied upon by experts

Marnie:

We appreciate the update. Given the categories of information that Hearings Officer Chang ordered be produced, we would anticipate that quite a volume of data needs to be transferred and, as such, had hoped to discuss the logistics of doing so. Since we have not had the opportunity to speak with you to facilitate the production, when the Navy provides this information we request that access be simultaneously granted to our expert Nicole DeNovio (Nicole_DeNovio@golder.com). Please confirm that the Navy will do so. Thank you.

Best,

David K. Brown
Morgan, Lewis & Bockius LLP
300 South Grand Avenue, Twenty-Second Floor | Los Angeles, CA 90071-3132
Direct: +1.213.680.6816 | Main: +1.213.612.2500 | Fax: +1.213.612.2501
david.brown@morganlewis.com | www.morganlewis.com
Assistant: Walker Clegg | +1.213.612.7406 | walker.clegg@morganlewis.com

From: Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Sent: Friday, January 8, 2021 9:08 AM
To: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Fitzpatrick, David CIV USN (USA) <david.fitzpatrick2@navy.mil>; Law, Michael B CIV USN (USA) <michael.b.law@navy.mil>; marnier+NLO@gmail.com; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>
Cc: 'David Kimo Frankel' <davidkimofrankel@hawaiiantel.net>; Brown, David K. <david.brown@morganlewis.com>; ''Lau, Jeff A'' <jlau3@honolulu.gov>; ''Paige, James C'' <james.c.paige@hawaii.gov>
Subject: RE: production of information relied upon by experts

[EXTERNAL EMAIL]
Good morning Ella,

I wanted to let you know that we don't anticipate producing anything that will require technical assistance. We expect that we'll be able to send our complete response by early afternoon today, and would be happy to discuss afterwards if there are still questions.

Best regards,
Marnie

Marnie Riddle
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Naval Litigation Office
Office of the General Counsel
720 Kennon Street SE, Bldg. 36, Rm. 233
Washington Navy Yard, DC 20374-5013
(703) 835-7563

From: Foley Gannon, Ella <ella.gannon@morganlewis.com>
Sent: Friday, January 8, 2021 10:36 AM
To: Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Fitzpatrick, David CIV USN (USA) <david.fitzpatrick2@navy.mil>; Law, Michael B CIV USN (USA) <michael.b.law@navy.mil>; marnier+NLO@gmail.com; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: 'David Kimo Frankel' <davidkimofrankel@hawaiiantel.net>; Brown, David K. <david.brown@morganlewis.com>; ''Lau, Jeff A'' <jlau3@honolulu.gov>; ''Paige, James C'' <james.c.paige@hawaii.gov>
Subject: [Non-DoD Source] RE: production of information relied upon by experts

Good morning Jon – wanted to check back in and see when would be a good time to connect today regarding the technical side of the production we anticipate receiving tomorrow. Please let us know as soon as possible so we can make sure our technical people are available.

Thanks.

Ella

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ella.gannon@morganlewis.com | www.morganlewis.com
Assistant: Elizabeth Stewart | +1.415.442.1679 | elizabth.stewart@morganlewis.com

---

From: Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>
Sent: Wednesday, January 6, 2021 2:46 PM
To: Foley Gannon, Ella <ella.gannon@morganlewis.com>; Fitzpatrick, David CIV USN (USA) <david.fitzpatrick2@navy.mil>; Law, Michael B CIV USN (USA) <michael.b.law@navy.mil>; marnier+NLO@gmail.com; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: 'David Kimo Frankel' <davidkimofrankel@hawaiiantel.net>; Brown, David K. <david.brown@morganlewis.com>; ''Lau, Jeff A'' <jlau3@honolulu.gov>; ''Paige, James C'' <james.c.paige@hawaii.gov>
Subject: RE: production of information relied upon by experts

[EXTERNAL EMAIL]

Ella,

Friday would be better, we are still working with AECOM.

Jon

From: Foley Gannon, Ella <ella.gannon@morganlewis.com>
Sent: Wednesday, January 6, 2021 1:24 PM
To: Fitzpatrick, David CIV USN (USA) <david.fitzpatrick2@navy.mil>; Law, Michael B CIV USN (USA) <michael.b.law@navy.mil>; marnier+NLO@gmail.com; Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Cc: 'David Kimo Frankel' <davidkimofrankel@hawaiiantel.net>; Brown, David K. <david.brown@morganlewis.com>; ''Lau, Jeff A'' <jlau3@honolulu.gov>; ''Paige, James C'' <james.c.paige@hawaii.gov>
Subject: [Non-DoD Source] RE: production of information relied upon by experts

Greetings – we thought it would be useful to have a call tomorrow or Friday, with our technical people present, to discuss how the Navy intends to produce the information described below. Jon et al., please let us know what works for the Navy.

Best,

Ella

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Direct: +1.415.442.1171 | Main: +1.415.442.1000 | Cell: +1.415.846.3663
ella.gannon@morganlewis.com | www.morganlewis.com
Assistant: Elizabeth Stewart | +1.415.442.1679 | elizabth.stewart@morganlewis.com

---

From: Lou Chang <louchang@hula.net>
Sent: Wednesday, December 30, 2020 12:31 PM
To: 'David Kimo Frankel' <davidkimofrankel@hawaiiantel.net>; Brown, David K. <david.brown@morganlewis.com>; Foley Gannon, Ella <ella.gannon@morganlewis.com>; 'Fitzpatrick, David CIV USN (USA)' <david.fitzpatrick2@navy.mil>; ''Lau, Jeff A'' <jlau3@honolulu.gov>; 'Law, Michael B CIV USN (USA)' <michael.b.law@navy.mil>; ''Luka, Jean'' <Jean.Luka@doh.hawaii.gov>; marnier+NLO@gmail.com; 'Mckay, Jonathan C CIV USN COMNAVREG SW SAN CA (USA)' <jonathan.c.mckay@navy.mil>; 'Minott, Karrin H CIV USN OGC WASH DC (USA)' <karrin.minott@navy.mil>; ''Paige, James C'' <james.c.paige@hawaii.gov>; 'Riddle, Marnie E CIV USN OGC WASH DC (USA)' <marnie.riddle@navy.mil>; ''Steven Jacobson'' <steven.jacobson@doh.hawaii.gov>
Subject: production of information relied upon by experts

[EXTERNAL EMAIL]
Dear Advocates:

Confirming elements of our status conference discussion today:

1. With respect to documents and sources relied upon by the Navy and BWS expert witnesses,
    a. BWS has requested that the Navy produce or provide information to allow BWS to access information or sources relied upon the Navy expert witness. The categories of documents are (1) environmental data set, (2) 3D geologic model, (3) strike and dip, lava flow, geology and (4) ground water flow modeling files.
    b. The Navy will make a request for such documents and sources info to its expert today and will plan to produce such by Jan. 9, 2021.
    c. The Navy will make a request to BWS by Jan. 8, 2021 for documents and sources relied upon by the BWS expert witnesses.
    d. BWS will plan to produce such by Jan. 15, 2021.
2. We agreed to start our hearings at 8 AM each day.
3. Parties will have an opportunity to make an oral opening statement on the first day of hearings. Oral and written closing statements are also OK.

I hope that your planned meet and confer tomorrow will be useful and productive. Any agreements you can reach for stipulations or for the further streamlining of our planned hearings will be much appreciated. Thank you for your efforts and cooperation.

Hope you all have a festive and safe New Year holiday!

Aloha,
Lou

Hearing Officer

Mediation Arbitration Neutral Services Lou Chang, ALC
Attorney At Law
P.O. Box 61188 Honolulu, Hawaii 96839
Tel: (808) 384-2468 E-Mail: louchang@hula.net
National Academy of Arbitrators
Mediation & Arbitration Panel Member:
AAA, DPR, FMCS, HLRB
LouChang.com

Exhibit C

Brown, David K.

From: Foley Gannon, Ella
Sent: Monday, January 11, 2021 5:15 PM
To: Riddle, Marnie E CIV USN OGC WASH DC (USA); Lou Chang; 'David Kimo Frankel'; Brown, David K.; Fitzpatrick, David CIV USN (USA); ''Lau, Jeff A''; Law, Michael B CIV USN (USA); ''Luka, Jean''; marnier+NLO@gmail.com; Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA); Minott, Karrin H CIV USN OGC WASH DC (USA); ''Paige, James C''; ''Steven Jacobson''
Subject: RE: production of information relied upon by experts

Hearing Officer Chang:

The BWS is surprised and disappointed that the Navy has failed to comply with your December 30, 2020 order to produce the information relied upon by Navy witness Mr. Curtis Stanley. The Navy's belated assertion that Mr. Stanley did not rely upon the information it was ordered to produce is not credible, reasonable, or consistent with either the facts or your order. The order required the Navy to provide by January 9, 2021 its (1) environmental data set, (2) 3D geologic model, (3) strike and dip, lava flow, geology, and (4) ground water flow modeling files. Instead of producing this information as ordered, the Navy now claims for the first time that Mr. Stanley did not rely upon it. The Navy's position appears to be based on the false premise that it need not provide the information relied upon by Mr. Stanley if he did not re-investigate, re-examine, or again validate this data and analyses as he prepared his testimony or the Facility Environmental Report. This is an attempt to rewrite the order, not comply with it.

If Mr. Stanley relied upon the information to form his opinions, it must be produced. At a fundamental level, the timing of the reliance by Mr. Stanley (or those upon whom he relied) on the yet unproduced data and analyses is irrelevant. Mr. Stanley's own sworn testimony states that he was "one of the primary authors for all of the reports submitted under the AOC", including the Navy's Conceptual Site Model Report, Groundwater Protection and Evaluation of Considerations for the Red Hill Bulk Fuel Storage Facility, Groundwater Flow Model Report, and Investigations and Remediation of Releases Report. Stanley Testimony at 5:17-6:6. These reports, authored by Mr. Stanley, rely upon this information, and both the Navy and Mr. Stanley concede that he relies upon these reports. Many of the conclusions in these reports remain unapproved by the Hawaii Department of Health and the U.S. EPA and/or have been expressly rejected by the regulators. Without the underlying data and analyses, these conclusions cannot be meaningfully assessed and there can be no meaningful cross-examination of Mr. Stanley. Even if we were to accept that Mr. Stanley chose to simply adopt, without any scrutiny, the Navy's position as set forth in each of the referenced reports, the data and analyses informing those reports should be and were ordered to be produced. Because the Navy has refused to provide these categories of information as ordered, the BWS will seek an adverse inference for each of Mr. Stanley's opinions reliant upon this information.

The Navy's claim that it needs to protect Department of Defense critical infrastructure security information is a distraction. First, neither the location of Red Hill Shaft nor the Navy's pumping information from that water source (approximately four million gallons per day) is a secret to any of the parties in this proceeding. Second, the vast majority of the information the Navy was ordered to produce – including the Navy's environmental data set, three-dimensional regional geologic model, and measurements of strike and dip of lava flows and clinker units – can and should be produced as they do not implicate the locations of or pumping rates at Navy wells. Third, a water utility like the BWS regularly does and certainly is capable of managing sensitive water pumping data. But to the extent it would be appropriate or necessary, the Navy's groundwater model files can be provided without the Navy well pumping information. Indeed, some of the Navy model files are simulations that involve Red Hill Shaft not pumping at all and even where Red Hill Shaft pumping is simulated by the model such information could easily be stripped from those files.

Finally, the BWS notes that the Navy's request for water quality testing results is outside the scope of your December 30, 2020 order and certainly misplaced in light of the Navy's own refusal to comply with the order. Nevertheless, the BWS remains willing to be transparent throughout this process and will provide the requested information.

Best regards,
Ella

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Morgan, Lewis & Bockius LLP
One Market, Spear Street Tower | San Francisco, CA 94105
Direct: +1.415.442.1171 | Main: +1.415.442.1000 | Cell: +1.415.846.3663
ella.gannon@morganlewis.com | www.morganlewis.com
Assistant: Elizabeth Stewart | +1.415.442.1679 | elizabth.stewart@morganlewis.com

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From: Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>
Sent: Friday, January 8, 2021 2:27 PM
To: Lou Chang <louchang@hula.net>; 'David Kimo Frankel' <davidkimofrankel@hawaiiantel.net>; Brown, David K. <david.brown@morganlewis.com>; Foley Gannon, Ella <ella.gannon@morganlewis.com>; Fitzpatrick, David CIV USN (USA) <david.fitzpatrick2@navy.mil>; ''Lau, Jeff A'' <jlau3@honolulu.gov>; Law, Michael B CIV USN (USA) <michael.b.law@navy.mil>; ''Luka, Jean'' <Jean.Luka@doh.hawaii.gov>; marnier+NLO@gmail.com; Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>; ''Paige, James C'' <james.c.paige@hawaii.gov>; ''Steven Jacobson'' <steven.jacobson@doh.hawaii.gov>
Subject: RE: production of information relied upon by experts

[EXTERNAL EMAIL]
Dear Hearing Officer Chang and Advocates,

The attached Declaration of Curtis Stanley ("Declaration") is submitted in response to the Hearing Officer's order of December 30, 2020 that the Navy produce to BWS certain categories of "information or sources relied upon by the Navy expert witness." The Declaration addresses the Facility Environmental Report ("FER") statements quoted by BWS in its request, and indicates where the information relied upon to make these statements can be found in the references listed by the FER. The information relied upon is available in reports that were previously prepared and issued by the Navy pursuant to the Administrative Order on Consent ("AOC") and other publicly available documents. The raw data and model files underlying those reports were not re-investigated, re-examined, or validated in the course of preparing the FER, and Mr. Stanley's conclusions relied on the information as it was presented in the Navy's AOC reports. (Declaration at ¶2.)

It is the Navy's understanding that secondary and tertiary data that may underlie other reports, but that was not reviewed or relied upon to derive the conclusions in Mr. Stanley's testimony or the FER, need not be obtained and produced. As his Declaration makes clear, the information relied on by Mr. Stanley to prepare his conclusions for this contested case hearing can be found in documents that are already available to the parties. Therefore, no additional data is being produced at this time.

Regarding the groundwater flow model files specifically requested by BWS: Mr. Stanley's work for the FER did not require the use of these model files, but in any event, the model files incorporate information about the locations and pumping rates of Navy wells that has been deemed DoD critical infrastructure security information (DCRIT). The DCRIT determination dated June 19, 2018, is attached to this email. The 2018 email exchange between Red Hill Regional Program Director Mark Manfredi and BWS's Erwin Kawata, also attached, indicates BWS's awareness that the information must be protected from public disclosure, and that the Navy "cannot provide this information to one or any organization we do not have a signed NDA with."

Mr. Kawata states, in ¶22(b) of his testimony, that "[o]n January 14, 2014, the BWS began performing additional water quality testing at the five well stations that are in close proximity to the RHBFSF. This water quality testing is in addition to and goes above and beyond the BWS' regular water quality testing. Weekly testing occurred in January 2014, monthly testing occurred in February and March 2014, and quarterly testing has occurred from April 2014 to the present." In ¶22(c), Mr. Kawata states that "[o]n August 31, 2017, the BWS completed construction of a monitoring well at its Moanalua Reservoir No. 405 property designed to detect potential petroleum contamination from the RHBFSF." In ¶3, Mr. Kawata states that his "work over the past 38 years has been in the chemical, microbiological, biological, and radiological testing of the water served by the department". Finally, in ¶35, Mr. Kawata attests that his conclusions are "[b]ased on my work experience at BWS and knowledge about the RHBFSF," including "[i]ts close proximity (100 feet) to the groundwater table and the groundwater's vulnerability to contamination" and "contamination detected in the groundwater underneath the RHBFSF." The Navy therefore requests that BWS produce the results of all water quality testing performed "at the five well stations that are in close proximity to the RHBFSF" and at the "monitoring well … designed to detect potential petroleum contamination."

Best regards,

Marnie Riddle
Senior Trial Attorney
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(703) 835-7563

From: Lou Chang <louchang@hula.net>
Sent: Wednesday, December 30, 2020 3:31 PM
To: 'David Kimo Frankel' <davidkimofrankel@hawaiiantel.net>; david.brown@morganlewis.com; ''Ella Gannon'' <ella.gannon@morganlewis.com>; Fitzpatrick, David CIV USN (USA) <david.fitzpatrick2@navy.mil>; ''Lau, Jeff A'' <jlau3@honolulu.gov>; Law, Michael B CIV USN (USA) <michael.b.law@navy.mil>; ''Luka, Jean'' <Jean.Luka@doh.hawaii.gov>; marnier+NLO@gmail.com; Mckay, Jonathan Cross (Jon) CIV USN COMNAVREG SW SAN CA (USA) <jonathan.c.mckay@navy.mil>; Minott, Karrin H CIV USN OGC WASH DC (USA) <karrin.minott@navy.mil>; ''Paige, James C'' <james.c.paige@hawaii.gov>; Riddle, Marnie E CIV USN OGC WASH DC (USA) <marnie.riddle@navy.mil>; ''Steven Jacobson'' <steven.jacobson@doh.hawaii.gov>
Subject: [Non-DoD Source] production of information relied upon by experts

Dear Advocates:

Confirming elements of our status conference discussion today:

1. With respect to documents and sources relied upon by the Navy and BWS expert witnesses,
   a. BWS has requested that the Navy produce or provide information to allow BWS to access information or sources relied upon the Navy expert witness. The categories of documents are (1) environmental data set, (2) 3D geologic model, (3) strike and dip, lava flow, geology and (4) ground water flow modeling files.
   b. The Navy will make a request for such documents and sources info to its expert today and will plan to produce such by Jan. 9, 2021.
   c. The Navy will make a request to BWS by Jan. 8, 2021 for documents and sources relied upon by the BWS expert witnesses.
   d. BWS will plan to produce such by Jan. 15, 2021.
2. We agreed to start our hearings at 8 AM each day.
3. Parties will have an opportunity to make an oral opening statement on the first day of hearings. Oral and written closing statements are also OK.

I hope that your planned meet and confer tomorrow will be useful and productive. Any agreements you can reach for stipulations or for the further streamlining of our planned hearings will be much appreciated. Thank you for your efforts and cooperation.

Hope you all have a festive and safe New Year holiday!

Aloha,
Lou

Hearing Officer

Mediation Arbitration Neutral Services Lou Chang, ALC
Attorney At Law
P.O. Box 61188 Honolulu, Hawaii 96839
Tel: (808) 384-2468 E-Mail: louchang@hula.net
National Academy of Arbitrators
Mediation & Arbitration Panel Member:
AAA, DPR, FMCS, HLRB
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Exhibit D

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David K. Brown (*admitted pro hac vice*)
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david.brown@morganlewis.com

Attorneys for Petitioner
Board of Water Supply,
City and County of Honolulu

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 PETITIONER HONOLULU BOARD OF WATER SUPPLY'S PRE-HEARING STATEMENT ADDRESSING THE NAVY'S REFUSAL TO COMPLY WITH THE DECEMBER 30, 2020 ORDER TO PRODUCE INFORMATION; CERTIFICATE OF SERVICE

PETITIONER HONOLULU BOARD OF WATER SUPPLY'S PRE-HEARING STATEMENT ADDRESSING THE NAVY'S REFUSAL TO COMPLY WITH THE DECEMBER 30, 2020 ORDER TO PRODUCE INFORMATION

Under Hawaii Administrative Rules § 11-1-24(b)(5), the hearings officer may "order a party to produce non-privileged evidence, and may draw inferences against the party if the evidence is not produced without good cause being shown." Here, the Navy was ordered to produce specific categories of documents and sources relied upon by Mr. Stanley but has not done so, and refuses to do so.

The Navy argues that the "BWS has not shown good cause for the Navy to produce the modeling files or any other additional information not contained in the FER references." Navy Opposition Brief at 2. The Navy is improperly shifting the burden to the BWS. Hearings Officer Chang has already ordered the Navy to produce data and information under his December 30, 2020 order. Under HAR § 11-1-24(b)(5), the Navy, not the BWS, must demonstrate good cause to withhold information in violation of an order. And the Navy admitted in its response that it has not produced all information it was ordered to produce. Navy Opposition Brief at 2.

The Navy's claim that Mr. Stanley has not relied upon the data and analyses it was ordered to produce also misrepresents the central issue here. The most critical part of this dispute is that the Navy brazenly disregarded its obligation to comply with an order by the Hearings Officer. The BWS does not have an obligation to demonstrate that it is entitled to this information, even though Mr. Stanley's reliance on this information is obvious. Rather, the Navy is obligated to demonstrate good cause for purposely violating an order.

Even if Mr. Stanley's reliance on these documents was under dispute, his testimony and Facility Environmental Report ("FER") repeatedly reference the unproduced data and modeling work and purport to characterize what they mean. For example, in his assertion that operation of the Red Hill Facility is "currently protective of human health and the environment," Mr. Stanley specifically references the environmental data and modeling as forming the basis for the conclusions presented in various Navy reports that he authored:

> Extensive evaluation of the environmental monitoring data using a wide variety of methods and approaches, including state of the art analyses, has fed into the development of a complex conceptual site model ("CSM") and a set of groundwater flow models describing a range of potential flow conditions as a result of various pumping scenarios. This work is summarized in a host of reports which provide raw and analyzed data and associated evaluations ….

FER at 10. Neither the complete set of the underlying environmental monitoring data, nor the modeling files referenced, have been produced by the Navy in this matter, but Mr. Stanley relies on that data and analyses to form his opinion about whether the Facility can operate in a manner that is protective of human health and the environment.

In addition, by Mr. Stanley's own admission, subsurface structural geology surveys and geologic field mapping, including strike and dip surveys, groundwater level data, geotechnical borings, and borings from other investigations are all used as inputs to the geologic model, groundwater flow modeling, and used to assess groundwater level data. *Id.* at 20. Not only has the groundwater flow data been examined for the FER but it is also the basis of many other studies and surveys relied on by both the Navy and Mr. Stanley.

The Navy's misguided attempt to manufacture a basis by which it could withhold this data and analyses relied upon by Mr. Stanley defies logic. It is clear from Mr. Stanley's testimony and the FER that he relied upon the environmental data and groundwater flow modeling to support or formulate his opinions. Mr. Stanley admits that he relies upon the Navy reports. Mr. Stanley is the author of these Navy reports. The environmental data and modeling work have been represented by both the Navy and Mr. Stanley as the basis for the conclusions presented in these reports. As such, Mr. Stanley unquestionably relied on underlying data and information to support or formulate his opinions, whether or not he re-analyzed it at the time he prepared his testimony or the FER. Because Mr. Stanley relies on the underlying data and information in the reports to form his opinions, the BWS is entitled to cross-examine Mr. Stanley on the bases of his opinions. However, without the underlying data and information, such a task is impossible. Under Hawaii Administrative Rules § 11-1-38(h), the hearings officer may disregard or strike direct testimony if opposing parties do not have an opportunity for cross-examination.

As such, the Navy has not demonstrated good cause for withholding the underlying information and a negative inference is warranted. Withholding this information is improper. It does not give the Honolulu Board of Water Supply or the Hearings Officer the opportunity to independently examine the data and determine whether the Navy's representations of the data and analyses are accurate. The BWS is also deprived of its right to cross-examine Mr. Stanley regarding this information, and the Navy reports that characterize it, if the underlying data and analyses are not provided. Most importantly, the Navy has also directly violated an order and has not demonstrated good cause for its violation.

DATED: Honolulu, Hawaii, January 31, 2021.

PAUL S. AOKI
Acting Corporation Counsel

By *_/s/ Jeff A. Lau_*
JEFF A. LAU
Deputy Corporation Counsel
Attorney for Petitioner
Board of Water Supply,
City and County of Honolulu

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing document was served upon the following, via email, to their last known email address on January 31, 2021:

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DATED: Honolulu, Hawaii, January 31, 2021.

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STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing document was served upon the following, via email, to their last known email address on April 13, 2021:

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DATED: Honolulu, Hawaii, April 13, 2021.

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EXHIBIT G

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ORDER DENYING MOTION TO STRIKE THE TESTIMONY OF CURTIS STANLEY AND/OR FOR NEGATIVE INFERENCE

In re US Navy's Application for a UST Permit
for the Red Hill Bulk Storage Facility   Docket No. 19-UST-EA-01

On March 16, 2021, the Board of Water Supply filed a Motion to Strike the Testimony of Curtis Stanley And/Or For Negative Inference Addressing The Navy's Refusal To Comply With The December 30, 2020 Order To Produce Information. The Navy filed its opposition to such motion on March 23, 2021 and the Board of Water Supply filed its reply in support of its motion on March 30, 2021. Following a Sur-reply in Opposition filed by the Navy on April 6, 2021 and a further Sur-reply in support of the motion filed by the Board of Water Supply on April 13, 2021, the matter was taken under submission.

The Rules of Practice and Procedure of the Department of Health Hawaii Administrative Rules provide the hearing officer with the general duties and powers to conduct a hearing of a contested case. Section 11-1-24 states that the hearings officer shall conduct the hearing and any related pre-hearing and post-hearing activities as may be required or appropriate and states that: the hearings officer may:

> (4) Issue subpoenas for people, documents, and things as authorized by law;
> (5) For good cause shown, upon motion or the hearings officer's own initiative, order a party to produce non-privileged evidence, and may draw inferences against the party if the evidence is not produced without good cause being shown;
> ...
> (9) Rule on motions, requests, and offers of proof;
> (10) Admit, receive, and exclude evidence;
> ...
> (12) Enter such orders and rulings against any party who fails to comply with these rules or any other order of the hearings officer, including without limit orders under section 11-1-36(c); and
> (13) Perform such other functions and duties, and issue such orders necessary for the proper conduct of the hearing and the resolution of the case.

In the course of this contested hearing matter, the Board of Water Supply requested that the Navy produce or provide information to allow BWS to access information or sources relied upon by the Navy expert witness. The categories of documents requested were: (1) environmental data set, (2) 3D geologic model, (3) strike and dip, lava flow, geology and (4) ground water flow modeling files. By an order dated December 30, 2020, the Hearing Officer directed the Navy to make a request for such documents from its expert witness and to produce such documents and sources relied upon from its expert witness.

While extensive information, source documents, investigations and reports were provided by the Navy in connection with and in support of its expert witness testimony, the BWS maintains that very specific technical information and data were not provided and the BWS asserts that is been prejudiced in its ability to cross-examine the Navy expert witness, Curtis Stanley, with regard to his testimony and opinions rendered. Specifically, the BWS asserts that the following information was necessary and was not produced:

> The groundwater flow modeling files include: (1) Modflow-USG files for the groundwater models discussed in the Navy 2020 Groundwater Flow Model Report; (2) Groundwater Vista files for the Navy groundwater models discussed in the Navy 2020 Groundwater Flow Model Report; (3) tabulations of the simulated versus measured water levels used to calibrate the Navy groundwater models; (4) the Navy set of water levels for the USGS Synoptic Survey (July 2017 – February 2018) corrected for non-pumping impacts on the water level signal as discussed on pages 3-11 of the Navy 2020 Groundwater Flow Model Report; (5) hourly pumping rates for the Navy's Red Hill Shaft during the USGS Synoptic Survey (July 2017 – February 2018); (6) Navy Red Hill Shaft pumping rates on at least daily intervals since the 2014 Tank 5 release; (12) complete sets of measured water levels from the multilevel Westbay wells RHMW11, RHMW13, RHMW14, and RHMW15 discussed on page 44 of the FER; and (13) geological logs for Navy Wells RHMW16A and RHMW19 discussed on page 44 of the FER. The 3D geologic model category includes data sets related to: (7) CTECH's Earth Volumetric Studio (EVS) files for the Navy geologic model discussed on pages 5-11 and Appendix E of the 2019 Navy Conceptual Site Model Report; (8) Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure of clinker zones (including the strike and dip angles) produced by the Navy geologic model; (9) Interactive Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure of saprolite zones produced by the Navy geologic model; (10) Graphical Information System (GIS) files, which can be queried, showing the three-dimensional structure the different lava flows produced by the Navy geologic model; and (11) descriptions of the methods used to measure the strike and dip information provided in Appendix C of the 2019 Navy Conceptual Site Model Report. Environmental data sets include (14) environmental data set that explains why the analytical data in the FER differs from the data in the Navy 2015 Q2, 2015 Q4, and 2016 Q2 (specifically naphthalene compounds).

HAR §11-1-24(b)(5) states that "[i]n any contested case, the hearings officer may … (5) For good cause shown, upon motion or the hearings officer's own initiative, order a party to produce nonprivileged evidence, and may draw inferences against the party if the evidence is not produced without good cause being shown." In addition, HAR § 11-1-38(h) states that "[t]he hearings officer may disregard or strike direct testimony if opposing parties do not have an opportunity for cross-examination."

Upon review and consideration of the files, exhibits, testimony and cross-examination of Curtis Stanley, the Hearing Officer does not find good cause to strike the testimony of Curtis Stanley nor to draw a negative inference with regard to issues in this case because of any refusal or failure to make a good faith response to the Hearing Officer's order of December 30, 2020. In this matter, the objections and assertions of the BWS with regard to the testimony of Curtis Stanley and the supporting files and records produced relating thereto will be considered by the Hearing Officer in determining the appropriate weight to be afforded to such testimony. Accordingly, the Motion to Strike the Testimony of Curtis Stanley And/Or For Negative Inference Addressing The Navy's Refusal To Comply With The December 30, 2020 Order To Produce Information filed by the BWS is hereby denied.

Dated and served: April 28, 2021.

Hearing Officer

Please note: The Rules of Practice and Procedure of the Department of Health, available on-line on the Department of Health's website, will govern the procedures utilized in this contested case.

EXHIBIT H

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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 SECOND UPDATED WRITTEN TESTIMONY OF NICOLE M. DENOVIO; CERTIFICATE OF SERVICE

SECOND UPDATED WRITTEN TESTIMONY OF NICOLE M. DENOVIO

1. I provide this written testimony on behalf of the Honolulu Board of Water Supply (BWS) in the above-captioned contested case before the Hawaii Department of Health (DOH).

2. I am a Principal and Practice Leader with Golder Associates Inc. (Golder) as well as the Leader of its Water Practice Area. Golder is a global consulting, design and construction services firm that specializes in consulting for the oil and gas, manufacturing, mining, and power and infrastructure industries.

3. I have substantial experience in groundwater flow, contaminant transport, fractured rock flow and transport, volatile and emerging contaminants, and numerical modeling.

4. I have a Ph.D. in Civil Engineering from the University of Colorado, Boulder. Additionally, I have a Master's degree in Environmental Science from the University of Virginia and a Bachelor of Science degree in Geosciences from Juniata College.

5. I am a Licensed Hydrogeologist and a Licensed Geologist in the state of Washington.

6. I serve as Executive Director of East King County Regional Water Association. I am also a member of the Scientific Advisory Committee for the industry leading MODFLOW & More Conference and a member of EPA's Modeling Technical Advisory Committee for the San Fernando Valley Basin (the primary source of groundwater for the City of Los Angeles).

7. I was asked to provide my expert opinion on the hydrology, groundwater flow, and contaminant fate and transport as applied to the Red Hill Bulk Fuel Storage Facility (Facility), the environment in the vicinity of the Facility, the irreplaceable sole-source aquifer

beneath the Facility, and past and future fuel releases from the underground fuel storage tanks (USTs) at the Facility.

8. In developing my expert opinion on these issues, I reviewed the testimony of United States Department of the Navy (Navy) witness Mr. Curtis Stanley, the Facility Environmental Report for Contested Case Hearing No. 19-UST-EA-01 (Facility Environmental Report) prepared by AECOM and GSI Environmental, and other relevant documents regarding the Navy's historical and current operations at the Facility. I also relied upon conversations with my colleagues at Golder, BWS personnel, its legal counsel, and consultants.

9. My expert opinions, and the data and analyses that support my opinions, are set forth in the report attached to this testimony. Among the important findings presented in this report are:

a. The Facility is located in a highly complex and sensitive environment directly above a federally designated sole-source aquifer for which there is no reasonably available alternative;

b. There have been impacts to the sole-source aquifer resulting from episodic releases of fuel from the Facility;

c. The Navy has failed to install an adequate monitoring network to understand the location and extent of the fuel present in the subsurface environment or to determine where this fuel has and will go;

d. The available data supports the conclusion that natural attenuation is not occurring at a rate that is sufficient to prevent the fuel constituents released into the environment from reaching the sole-source aquifer; and

e. Groundwater sampling concentrations from monitoring wells in the heart of the Facility show statistically significant trends for total petroleum hydrocarbon middle distillates (TPH-d) from 2015 to present.

10. Given these findings and the irreplaceable nature of the sole-source aquifer, it is my opinion that Facility operation as described in the Navy's permit application is not protective of human health and the environment.

I, NICOLE M. DENOVIO, do declare under the penalty of law that the foregoing is true and correct to the best of my knowledge.

DATED: Sammamish, Washington, March 12, 2021.

Nicole M DeNovio

NICOLE M. DENOVIO

REPORT

Evaluation of Hydrology, Groundwater Flow and Contaminant Fate and Transport

Red Hill Bulk Fuel Storage Facility

Submitted to:

Honolulu Board of Water Supply

Submitted by:

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200, Redmond, Washington, USA 98052

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20140469

Revision 2

December 29, 2020

ENGAGEMENT

Golder Associates Inc. (Golder) was retained by Morgan, Lewis & Bockius LLP on behalf of its client, the Honolulu Board of Water Supply (BWS), to provide its expert opinion in response to certain technical issues raised by the United States Department of the Navy (Navy) witness Mr. Curtis Stanley and/or presented in the Facility Environmental Report for Contested Case Hearing No. 19-UST-EA-01 (Facility Environmental Report 2020) prepared by AECOM and GSI Environmental. Golder was asked to review this testimony and report as well as other relevant documents regarding the Navy's historical and current operations at the Red Hill Bulk Fuel Storage Facility (Facility) and to provide expert opinions and prepare this report as to hydrogeology, groundwater flow, and contaminant fate and transport as applied to the Facility, the environment in the vicinity of the Facility, the irreplaceable sole-source aquifer beneath the Facility, and past and future fuel releases from the underground fuel storage tanks (USTs) at the Facility. This report provides a statement of, and the technical basis for Golder's opinions on these issues.

Golder is a global consulting, design, and construction services firm that specializes in consulting for the oil and gas, manufacturing, mining, power, and infrastructure industries. Nicole DeNovio, Ph.D., LHg (WA), is a Principal and Practice Leader with Golder as well as the Leader of its Water Practice Area. She has substantial experience in groundwater flow, contaminant transport, fractured rock flow and transport, volatile and emerging contaminants, and numerical modeling. Dr. DeNovio's resume is provided in (Appendix A). Golder is being compensated for her services at a rate of $250.00 per hour.

This report was prepared by Golder under the supervision of Dr. DeNovio. The findings contained in this report represent Golder's professional opinion based upon information generated or reasonably available at the time the report was produced and arrived at in accordance with applicable professional standards. The documents that were made available, reviewed in part or whole, and/or considered in developing these expert opinions are cited and referenced within this report (Appendix B). In preparing these opinions, Golder also relied upon conversations with BWS personnel, its legal counsel, and consultants. This report is intended only for use by Golder's client and any other party specifically identified, in writing, by Golder.

EXECUTIVE SUMMARY

The United States Department of the Navy's (Navy) Red Hill Bulk Fuel Storage Facility (Facility) is an active, operational military fuel storage facility located near Pearl Harbor on the island of Oahu, State of Hawaii that supports military operations in the Pacific. With its 250-million-gallon fuel storage capacity spread among 20 tanks; the United States Environmental Protection Agency (EPA) has identified it as the largest underground fuel storage facility in the United States (2020) [B-391]. The Facility's underground storage tanks (USTs) are only located about 100 feet above a basal, drinking water aquifer. Maintaining the drinking water supply's quality is paramount as it is a federally designated Sole-source groundwater aquifer (Sole Source Aquifer) for which there is no reasonably available alternative. Given the critical and irreplaceable nature of this resource, human health and the environment can be considered protected only if it can be demonstrated that fuel released from the USTs, an event which is known to have occurred throughout the life of the Facility and is anticipated to occur in the future, will not reach the Sole Source Aquifer.

The Navy has failed to adequately characterize the fate of fuel released from the Facility. Accordingly, there is not sufficient information to understand where past fuel releases have, or future fuel releases may arrive at the Sole Source Aquifer or what happens to the fuel constitutes once they reach this drinking water resource. What is clear is that fuel has been released from the Facility to the environment and those fuel constituents are present in the Sole Source Aquifer. It is also clear that the Sole Source Aquifer is an irreplaceable drinking water resource from which the people of Oahu rely upon for their drinking water. Therefore, the Facility is not protective of human health and the environment.

Navy witness Mr. Curtis Stanley's conclusions to the contrary are not supported by the available data. This finding is based on the following:

- **There have been impacts to the Sole Source Aquifer resulting from episodic releases of fuel from the Facility.** The Facility has released more than 178,000 gallons of fuel and the data shows that at least some of the released fuel has traveled through the subsurface environment resulting in migration of fuel constituents to the Sole Source Aquifer.
- **The subsurface environment surrounding the USTs is extremely complex and there appears to be numerous pathways for fuel constituents to reach the Sole Source Aquifer; the Navy has failed to install an adequate monitoring network to understand the location and extent of the fuel present in the subsurface environment or to determine where this fuel has and will go.** Releases have occurred from most of the tanks, but only two 2-inch groundwater monitoring wells have been installed within the tank area footprint. Accordingly, the Navy is simply incapable of assessing how fuel has and will migrate through the subsurface environment.
- **The available data supports the conclusion that natural attenuation is not occurring at a rate that is sufficient to prevent the fuel constituents released into the environment from reaching the Sole Source Aquifer; by contrast, there is evidence that fuel constituents move through the subsurface and reach the Sole Source Aquifer.** The Navy is depending on processes provided by resident microbes to biodegrade the fuel and interpreting the rock as a "sponge" to protect the Sole Source Aquifer. However, the Navy's estimation of biodegradation rates is not consistent with monitoring data. Specifically, thermal profiles and carbon dioxide readings are not consistent with the Navy's assumed biodegradation rates. Further, there is evidence of fuel constituents reaching the Sole Source Aquifer, thereby providing direct evidence that unsaturated zone, natural source zone depletion processes, are insufficient for containing the

fuel constituents. The complex subsurface, characterized by a complicated network of high-speed pathways that can distribute the contaminants, does not prevent the fuel constituents from reaching the Sole Source Aquifer.

- **The regulatory agencies with jurisdiction over the Facility have rejected the Navy's conclusions regarding the fate of fuel released into the environment.** Historical and recent fuel releases from the tanks have resulted in an administrative order overseen by the EPA and State of Hawaii Department of Health (DOH) forcing the Navy to complete certain Facility investigations and upgrades. To date, many of these proposed improvements are only plans that have not been approved or implemented. The most recent Navy proposals have resulted in regulatory disapproval, indicating that the Navy's approach is not in keeping with the expectations of regulatory oversight, not working, and not protective.

Given these findings and the irreplaceable nature of the Sole Source Aquifer, it is essential that the DOH recognize that Facility operation as described in the permit application is not protective of human health and the environment.

Table of Contents

TABLES

FIGURES

APPENDICES

List of Acronyms

AOC	Administrative Order of Consent
bgs	below ground surface
BWS	Honolulu Board of Water Supply
CO_2	Carbon Dioxide
CSM	Conceptual Site Model
DOH	Department of Health, State of Hawaii
EPA	United States Environmental Protection Agency
FISC	Fleet and Industrial Supply Center
gal/acre/yr	gallons per acre per year
gal/yr	gallons per year
GWPP	Groundwater Protection Plan
HAR	Hawaii Administrative Rules
IRR	Investigation and Remediation Release Report
JP-8	Jet Propulsion Fuel No. 8
LNAPL	light non-aqueous phase liquid
LTM	long-term monitoring
MNA	monitored natural attenuation
msl	mean sea level
NAPL	non-aqueous phase liquid
NSZD	Natural Source Zone Depletion
PAH	polynuclear aromatic hydrocarbons
PID	photoionization detector
ppbv	Part per billion (volume)
ppm	parts per million
SSRBL	Site-Specific Risk-Based Levels
SVM	Soil vapor monitoring
SVMP	Soil vapor monitoring point

SVMW	Soil vapor monitoring well
TFH	total fuel hydrocarbons
TPH-d	total petroleum hydrocarbons-diesel
TPH	total petroleum hydrocarbon
TUA	Tank upgrade alternatives
UK	Unknown
UST	Underground storage tanks
VOCs	Volatile organic compounds

1.0 INTRODUCTION

The United States Department of the Navy's (Navy) Red Hill Bulk Fuel Storage Facility is an active, operational military fuel storage facility located near Pearl Harbor on the island of Oahu, State of Hawaii that supports military operations in the Pacific (hereafter referred to as "Tank Farm" or "Facility"). The Facility's 250-million-gallon fuel storage capacity is about 10,000 times more than a typical gas station (EPA 2020) [B-391]. United States Environmental Protection Agency (EPA) describes the Facility as the largest underground fuel storage facility in the United States (2020) [B-391].

The Facility, when built, was clearly of strategic national importance with a critical mission and remains so today. However, the nearly 80-year-old Facility should be evaluated in the context of the potential impact on critical drinking water resources. The Facility's underground storage tanks (USTs) are built into a hillslope, with the bottoms of the USTs located approximately 100 feet above a basal, drinking water aquifer. There is a critical need to protect this aquifer and maintain its quality because it is a unique fresh drinking water supply, for which there is no reasonably available alternative (Sole Source Aquifer) as designated in 52 Fed. Reg. 45496 (Nov. 30, 1987) [B-375].[1]

The Facility Environmental Report for Contested Case Hearing No. 19-UST-EA-01 (Facility Environmental Report) prepared by AECOM and GSI Environmental (2020)[2] provides a curated catalog of the findings of about two decades of reporting, characterization, analysis, and modeling activities at the Facility. The Facility Environmental Report notes that the Facility is the most extensively studied UST site in Hawaii while neglecting to mention why this is the case. Recent investigations and analysis have been necessary to address decades of fuel releases from the Facility into the environment. Despite these studies, the understanding of the Facility has been evolving, and even the Facility Environmental Report recognizes that there is much work left to do to understand the environment where these USTs are located and fulfill the expectations of stakeholders.

The need for additional work has been well documented by EPA, the State of Hawaii Department of Health (DOH), and stakeholders. These concerns focus on the failure of the Navy to adequately characterize the nature and extent of the fuel it has released into the subsurface environment, to develop a sufficient understanding of how releases from the Facility travel into and contaminate the Sole Source Aquifer, or to implement the safeguards necessary to minimize risk and impact to drinking water resources. Over the last several years, the Navy has received multiple deficiency, and conditional approval letters documenting these and other problems (*see* Appendix B Reference List). The October 26, 2020 Notice of Deficiency for the Tank Upgrade Alternatives (TUA) Decision Document and New Release Detection Alternative Decision Document for Red Hill Administrative Order (DOH 2020) on Consent Statement of Work Sections 3.5 and 4.8 issued by EPA and DOH [B-28], summarizes many of the ongoing technical issues. The regulatory agencies made clear that the Navy, in proposing Facility upgrades that go beyond what is included in the Navy's permit application, "has not demonstrated to the Regulatory Agencies that the proposed alternative is the most protective of the groundwater and drinking water resources and other options are either less protective or impractical; and that the proposed alternative adequately mitigates release risk." [B-28 at BWS007367].

[1] The Sole Source Aquifer designation is authorized by Section 1424(e) of the Safe Drinking Water Act of 1974 (Public Law 93-523, 42 U.S.C. 300 et. seq).

[2] AECOM and GSI Environmental, 2020. Testimony of Curtis Stanley. Facility Environmental Report for Contested Case Hearing No. 19-UST-EA-01. November 2020.

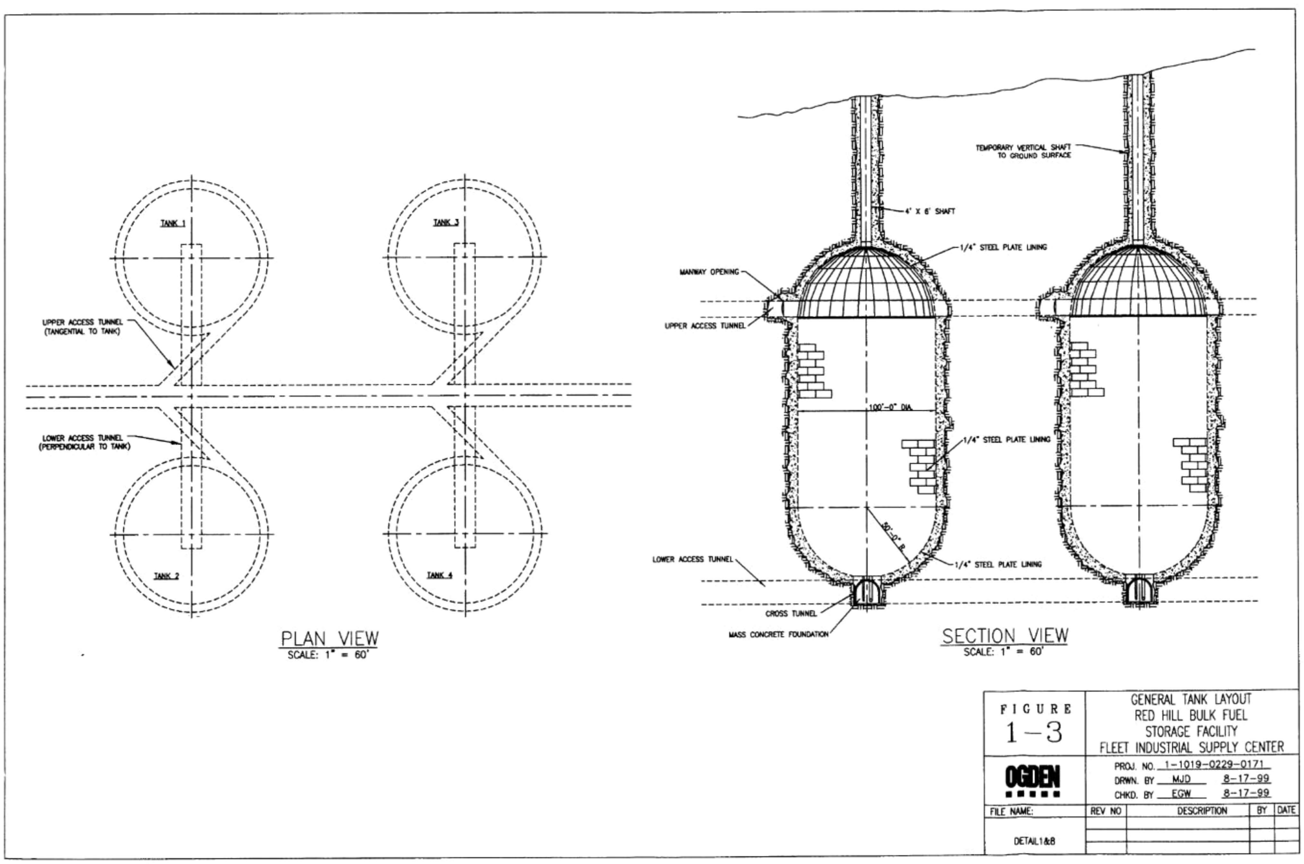
Document Organization

This report has two primary sections. The first introduces the Facility and describes the highly complex and ecologically sensitive environment in which the Facility is located. The focus will be on the most critical history of the Facility and the subsurface hydrogeology to properly frame the critical information needed to understand the relationship between the Facility, the surrounding subsurface environment, and the underlying Sole Source Aquifer. The second section of this report presents the data and analyses in support of Golder's conclusion that the existing data, investigative activities, and technical analysis do not provide a technically justifiable basis to conclude that operations at the Facility are protective of human health and the environment.

1.1 Facility Overview

Basic Information

The Facility was constructed by the U.S. Government in the early 1940s by boring into the subsurface and field constructing 20 USTs each capable of storing about 12.5 million gallons of fuel. Each UST is approximately 250 feet (height) by 100 feet (width), with the upper dome of the tanks approximately 100 to 175 feet below ground surface (bgs). The USTs were constructed in a parallel series of two rows sloping south by southwest towards Pearl Harbor. The tank bottoms are situated approximately 100 to 130 feet above an underlying basal aquifer that is a designated Sole Source Aquifer from which municipal and military drinking water is provided.



Source: AMEC 2002 [B-9]

Figure 1.1-1 Schematic of Tank Farm and Tunnel Layout

Fuel Releases and Facility Investigations

Episodic fuel releases from the Facility have been documented in the historical record. At least 72 fuel release events in total have been reported by the Navy or other sources (Table 1.1-1, provided at the end of this Report).

It is undisputed that these fuel releases have contaminated the environment in the Tank Farm, including the Sole Source Aquifer. Due to the previously classified status of the Facility, public access and independent investigations were not conducted before 1995. However, based on the historical record that the Navy has known about these releases for decades. Some of the known environmental impacts are documented in several incomplete efforts to design or implement environmental monitoring programs that appear to have begun in the 1990s including:

- **Historical Fuel Release Evaluation 1998 to 2002:** The occurrence of historical fuel releases (i.e., releases that may have occurred before 1998–2002) was characterized through the completion of angle borings below each active tank between 1998 and 2002 (AMEC 2002) [B-9]. These results indicate historical light non-aqueous phase liquid (LNAPL)[3] releases from several of the tanks; however, the Navy was unable to determine the timing and magnitude of these releases.
- **Groundwater Monitoring 2000:** A deep groundwater monitoring well (HDMW2253-03) was installed at the east of Hālawa Correctional Facility; 1,000 feet N of Tank 13 to monitor the groundwater between Tank Farm and Hālawa Shaft.
- **Groundwater Monitoring 2001:** To monitor groundwater quality directly under the Tank Farm, RHMW01 was installed inside the lower access tunnel southwest of Tanks 1-2. Groundwater was monitored for 2-Methylnaphthalene, Naphthalene and TPH during March and August 2001. 2-Methylnaphthalene and Naphthalene concentrations were reported around 0.005 parts per million (ppm) while TPH increased from 0.883 ppm in March to 1.07 ppm in August.
- **Soil Vapor Monitoring (SVM):** Soil vapor samples were collected and analyzed at monitoring locations SV06M, SV13D, and SV17D for 2-Methylnaphthalene, Naphthalene, and TPH during January and August 2001. 2-Methylnaphthalene concentrations ranged from 0.005 ppm (SV17D) to 36.8 ppm (SV06M) while TPH concentrations ranged from 2.39 ppm (SV13D) to 29500 ppm (SV06M). Naphthalene was reported at 0.005 ppm (SV17D). Groundwater and SVM were discontinued from August 2001.
- **Red Hill Long-term Monitoring (LTM) System:** The Red Hill groundwater LTM program began in February 2005, when the network consisted of four wells namely RHMW01 through RHMW04. Three nested soil vapor monitoring wells (SVMWs), each with three soil vapor monitoring points (SVMPs) in existing slant borings under Tanks 2, 14, and 16 were installed in June 2005. The installation of this monitoring network resulted from the Ogden (1999) [B-376] investigation findings identifying a petroleum mixture in the bedrock beneath Tank 16, which had been suspected of leaking. Later documentation by NAVY (2008) specifies that the monitoring wells were installed to evaluate the risk posed to drinking water originating from the tanks in the upgradient sections of the Facility (NAVY 2008) [B-10]. The monitoring network has evolved and additional wells have been added to the network over the years. To comply with Hawaii Administrative Rules (HAR) 11-281, Subchapter 7, the Navy began quarterly groundwater sampling at existing wells in February 2005 (NAVY 2007) [B-8].

[3] LNAPLs are organic chemicals that are hydrophobic, less dense than water, and immiscible in water. As a liquid it is expected to “float” on top of water. Examples of LNAPLS are gasoline, jet fuel, diesel, and kerosene.

A release of approximately 27,000 gallons **(about 0.2 percent of the maximum tank capacity**) of Jet Propulsion Fuel No. 8 (JP-8) from Tank 5 was reported by the Navy in January 2014. To address the potential impacts to human health and the environment from this fuel release as well as historical and potential future fuel releases from the Facility, the Navy, the Defense Logistics Agency (the owner of the fuel), the EPA, and the DOH signed an **Administrative Order on Consent (AOC) requiring that the Navy perform additional investigative actions and technical analyses** [B-81, B-82]. The tasks and requirements for work include:

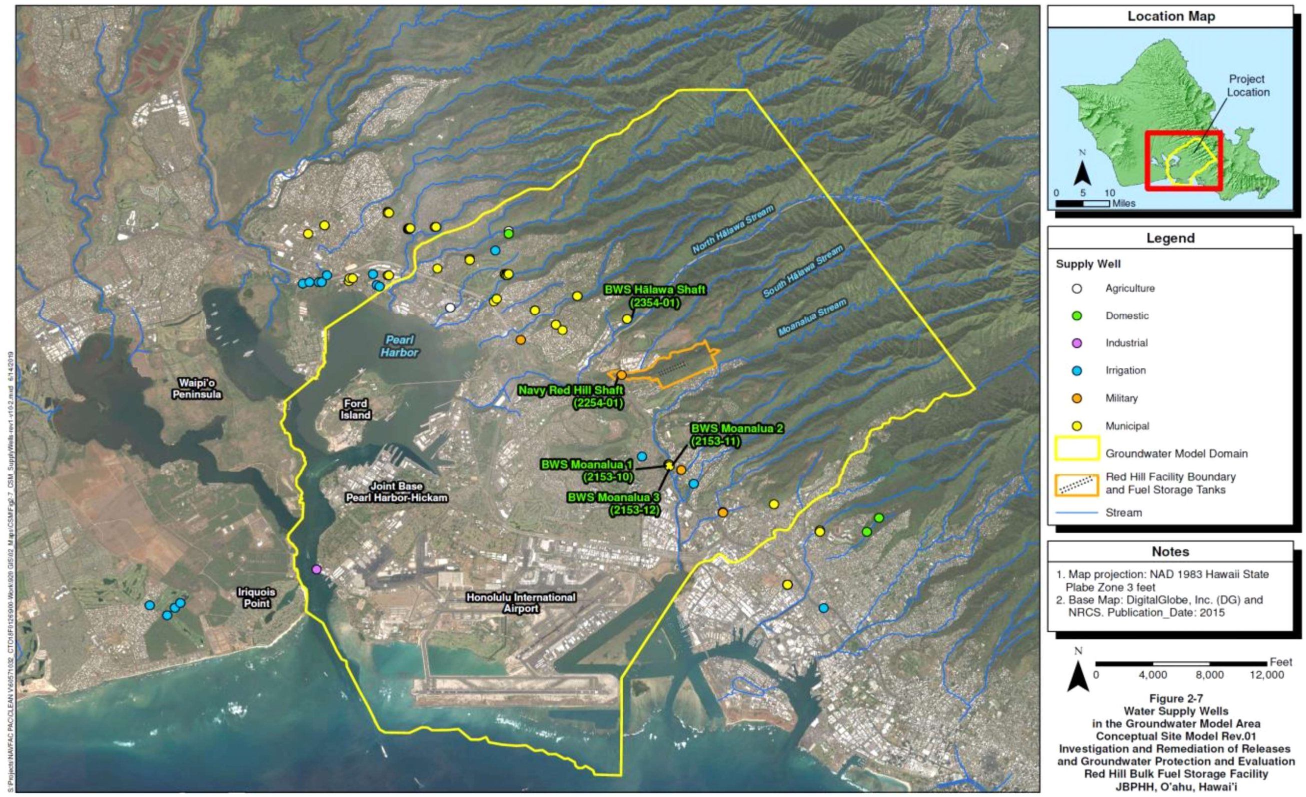
- Improving existing tank inspection and repair processes.
- Investigating the feasibility of upgrading the tank structures including, but not limited to, installing secondary containment.
- Evaluating improvements to the tank release detection capabilities.
- Developing models to better understand groundwater flow in the areas around the Facility and evaluate the fate and transport of contaminants in the subsurface around the Facility.
- Developing a risk/vulnerability assessment to further understand the potential for and potential impacts of fuel releases from the Facility and to inform ongoing and future planning decisions [B-82 at BWS008965-66].

The status of and conclusions that can be drawn from these investigations are discussed in Section 2.0 of this report.

1.2 Setting

Topography

The 144-acre Facility is located in south-central Oahu approximately 2 to 3 miles east of Pearl Harbor within the Red Hill ridge that divides South Hālawa Valley from Moanalua Valley on southwest flank of Oahu's Koʻolau Mountain Range. Red Hill is one of the ridges in Honolulu County. It is located at an approximate elevation is 535 feet (163 meters) above sea level. The ridge is a local topographic high and receives northeast trending trade winds bringing moisture in the form of precipitation much of the year.



Notes: Named domestic supply wells shown in green are the local municipal and military drinking water sources located near the Facility. Source: NAVY (2019) [B-352]

Figure 1.2-1 Facility Setting and Locations of Water Supply Wells and Surface Water Features

Climate

Climate plays an important role by creating time-varying inputs of water that must move past the USTs and either remain perched in rock layers above the regional groundwater system or migrate downward to reach the groundwater flow zones. Rainfall, once it infiltrates, can impact local groundwater flow directions.

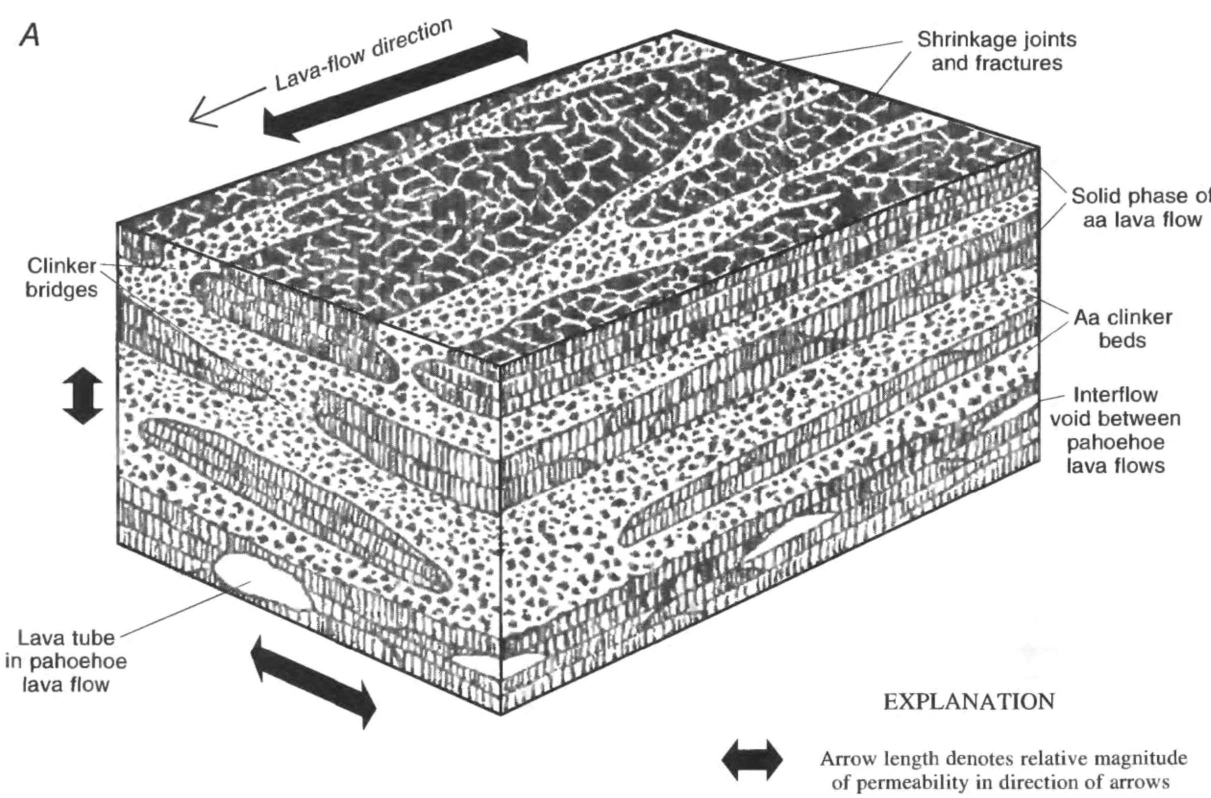
Oahu has two precipitation seasons: October through April is generally the wet season, and May through September is generally the dry season. Precipitation can be as high as 300 inches per year in some places on the island, most of Oahu receives 20 to 75 inches per year (NAVY 2019) [B-352]. Precipitation is spatially variable and is from fog drip, cloud vapor, and rain. On the Koʻolau Range's leeward slopes, precipitation generally increases up-valley as elevation increases, and decreases down-valley. Average annual precipitation in upper North Hālawa Valley and Moanalua Valley, near the ridgeline of the Koʻolau Mountains, is approximately 139 and 137 inches, respectively (NAVY 2019) [B-352]. Downgradient in North Hālawa Valley near the Hālawa Shaft, formerly active precipitation gages (2005–2009) have recorded average annual precipitation of 35 to 41 inches (NAVY 2019) [B-352]. Recharge is typically about 10 to 50 percent of the precipitation (USGS 2016) [B-394]. Recharge decreases where slopes are steep, or rain falls on poorly permeable land surfaces.

1.3 Subsurface Environment

The Facility was constructed in geologic rock formations. These rock formations, long before the tanks were built, provided a pathway for precipitation to enter and move through the subsurface to replenish the Sole Source Aquifer. The following section provides an overview of the types of rock formations in the subsurface and describes how water is distributed in them. The U.S. Geological Survey (2016) [B-394] compiled a summary description of the groundwater in Hawaii which can supplement the information provided here.

1.3.1 Geology

The subsurface at the Facility consists of the engineered USTs and associated infrastructure surrounded by the Ko'olau formation, a geologic rock formation comprised of a series of fractured rock layers formed from basaltic lava flows. The lava flows range in thickness from several feet to 80 feet, averaging about 10 feet thick (Hunt 1996) [B-377]. These lava flows are highly variable with each lava layer having flow and transport characteristics. Because of the layered nature of the lavas, fluid flow generally prefers to follow the layers rather than moving vertically through the layers (Figure 1.3-1).



Source: From Hunt (1996) Figure 7a [B-377]

Figure 1.3-1 Conceptual Distribution of Basaltic Lava Flows

The main types of lava present at the Facility are shown in Figure 1.3-1. Both “pahoehoe” and “a’a” lavas are present; these lavas are interspersed with a’a clinker beds and lava tubes. The permeability of these lavas once cooled into rock formations, is variable. A simple explanation for each of these lavas is summarized based on Hunt (1996) [B-377] and provided below:

Pahoehoe: Thin lava flows that spread out. They may sometimes be thick accumulations of lava with very little fracturing. Most pahoehoe lava contains voids caused by cooling or breaks in the rock due to local variability at the time of the eruption. Pahoehoe flows are likely to have more permeability along with the layer (horizontally), rather than perpendicular to it (vertically).

a’a: Lava flows typically containing a surface of coarse rubble (clinker) and a central core of massive rock several feet to tens of feet thick. As these lava flows harden, they tend to break up into angular rubble. Permeability tends to be low.

Clinker: Layers of coarse, fragmental (gravely) rock that often forms on the top of the a’a flows. These units typically provide preferential (fast) paths for fluid through the subsurface system.

Lava tube: A natural tunnel within a solidified lava flow, formed when lava hardens at the surface and the flowing molten lava below it leaks out and leaves a void within a lava shell. These structures also provide preferential flow pathways.

Saprolite: These units (not shown in Figure 1.3-1) are regularly exposed to the climate (e.g., precipitation) causing the lava to weather (break down and make smaller) to low permeability clayey units. Saprolite can be found on ridge tops and valley bottoms.

These lavas, clinker zones, and lava tubes are found intermixed, forming complex pathways for fluids to move through the subsurface. Figure 1.3-2 provides an image from a quarry face cut during mining activities near the Facility. The image provides a sense of the subsurface complexity that exists at Red Hill.

Google Earth Image of the quarry face located north of South Halawa River

Source: Google Earth, accessed November 2020 [B-395]

Figure 1.3-2 Image of Quarry Face with Lavas like those encountered at the Facility

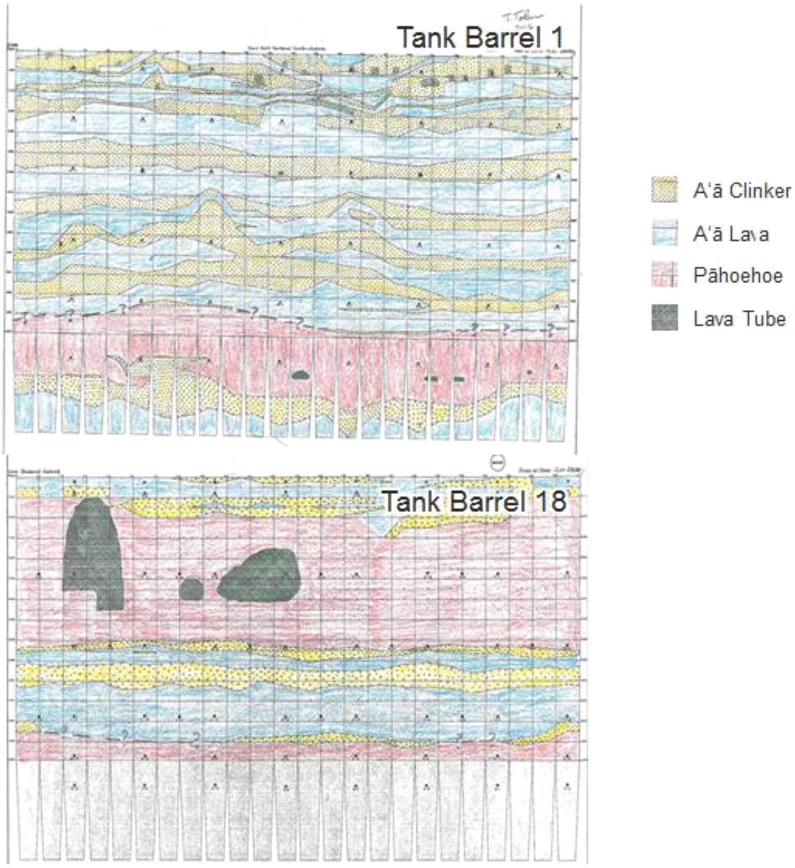
1.3.2 Groundwater

Groundwater is water found underground in the cracks and spaces in the basaltic rocks. When the water fills the spaces in the rock this is called an aquifer. In aquifers, water is stored in and moves through the geologic formations. The primary water-bearing zone begins near sea level in a deeper region where the freshwater forms a free-floating lens above the saltwater, this is called a basal aquifer. This lens of freshwater is about a foot thick near the edge of the island and increases to a few tens of feet above mean sea level toward the uplands. The top of this lens is called the water table, which separates the pores that are fully saturated by water and those rock pores which have a mixture of air and water. This is a large body of water in the subsurface and it flows freely through high permeability rocks.

Oahu's basal aquifer is a unique fresh drinking water supply, for which there is no reasonably available alternative as defined by the Safe Drinking Water Act Sole Source Aquifer Program [B-375]. Throughout this report, the basal aquifer is referred to as the Sole Source Aquifer to help in clearly identifying topics related to this resource.

1.3.3 Unsaturated Zone

The unsaturated zone is the area of the subsurface between the land surface and the water table. The rock in this zone is not fully saturated by water but has pores filled with air through which water can flow. At the Facility, the complexity and heterogeneity of the unsaturated zone is best illustrated by the Tank Barrel Logs, which are maps of the geologic conditions encountered along the barrel of each UST during excavation and construction activities (see Figure 1.3-3). The connections that occur among layers in the unsaturated zone provide the important pathways for water from the land surface to reach the water table, which is critical for maintaining the water supply. They can also provide pathways for other liquids such as fuel released from the Tank Farm, to reach the water table.



Source: NAVY 1943 [B-85]

Figure 1.3-3 Subsurface Heterogeneity illustrated by the Tank Barrel Logs

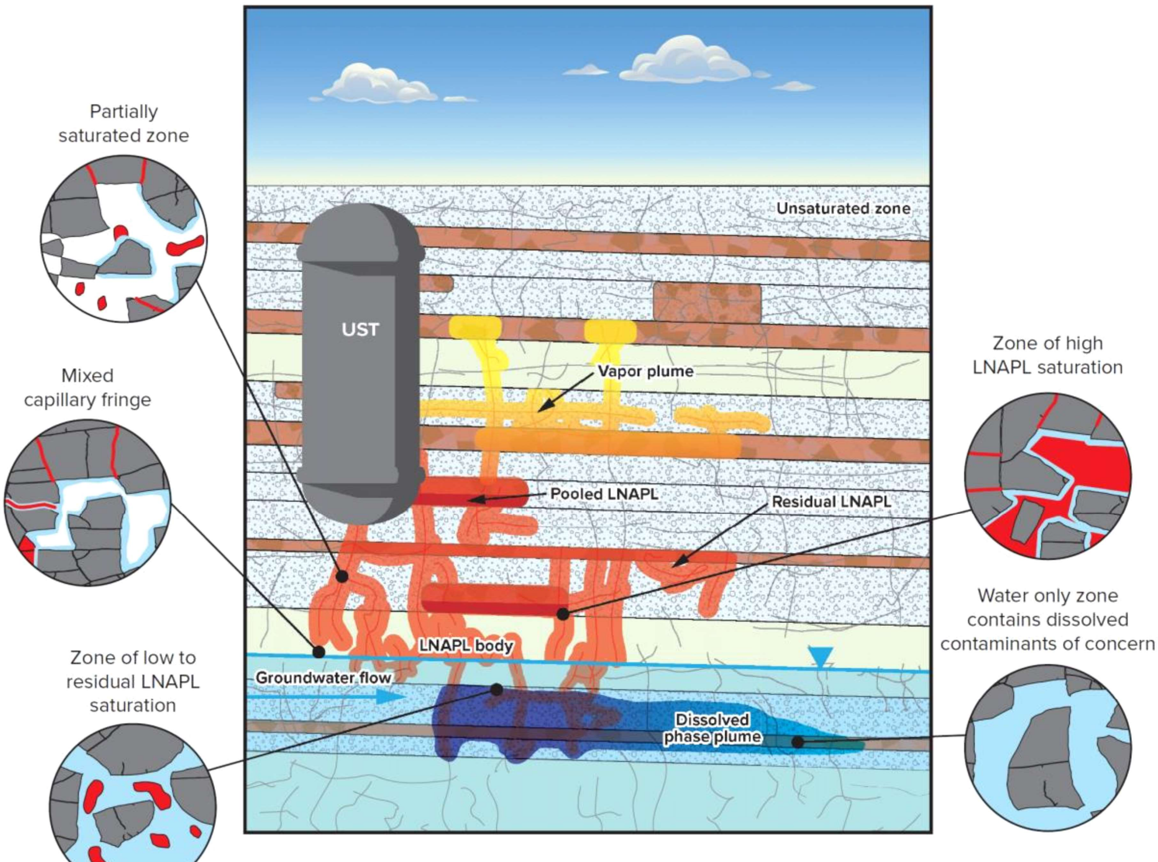
1.3.4 Groundwater Withdrawals

Groundwater withdrawals for domestic supply purposes near the Facility include:

- Red Hill Shaft: The Navy's water supply shaft located west of the Facility. It was constructed as a tunnel near the water table and is designed to collect freshwater from the top of the Sole Source Aquifer. Wentworth (1951) describes the sump and shaft as driven below sea level, where water is collected in an approximately 1,100 feet long tunnel with the invert about 5 feet above sea level [B-380 at BWS041450]. Withdrawals began in 1943.
- Hālawa Shaft: The Honolulu Board of Water Supply (BWS) water supply shaft located northwest of the Facility. It was constructed as 919-foot inclined shaft with an invert elevation of about -2 feet (Wentworth 1951) [B-380].
- Moanalua Wells 1, 2 and 3 – BWS wells located south of the Facility.

1.4 Flow and Transport Processes

Fractured, volcanic rocks have unique characteristics in that water and contaminants (liquid and vapor) travel in discrete pathways that may be highly spatially variable, fragmented, and discontinuous, and directionally dependent. For locations like Red Hill, the presence of LNAPL like the fuels stored in the Tank Farm means that further considerations are needed to understand how capillary pressures and the relative percent saturation of the liquid will influence the distribution of these constituents in the subsurface. Given the number of factors that influence the flow, the complex nature of the environment in which it traverses, there is great uncertainty in predicting the direction and magnitude of LNAPL migration. Figure 1.4-1 provides an overview of the key processes relevant to the Facility.



Notes: Figure after ITRC (2018) [B-387]

Figure 1.4-1 Conceptual model example of a multi-phase system through a typical LNAPL body in a fractured rock environment. Image shows some key flow and transport processes contributing to the complexities at the Red Hill Facility.

1.4.1 Fractured Rock Hydrogeology

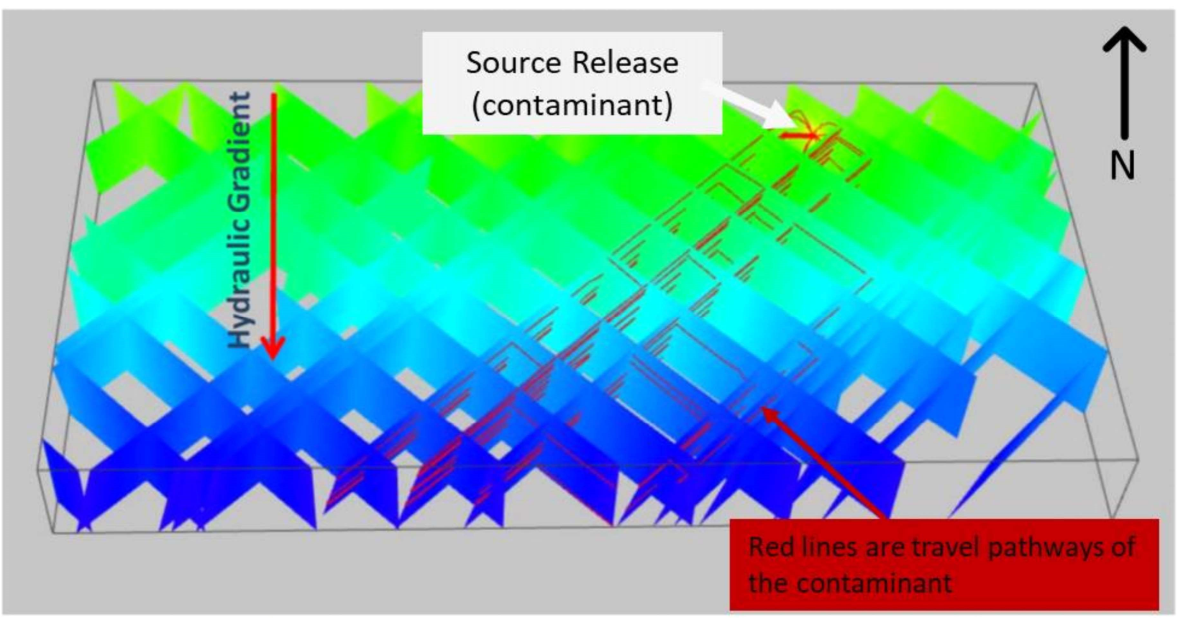
The movement of fluids in the basalt subsurface is highly complex. It often helps to think of fractured rock hydrogeology as the network of pathways through the rock that operates at different scales. The largest of the fractures (by aperture) will provide the dominant flow pathway. The fractures at each scale, however, have a role to play in how fluids can move through the system.

In general, the physical principles of flow apply to these networks. SABCS (2010a) [B-383] summarizes the key processes as follow:

- Fluxes (volume per area) and velocity (distance per time) are proportional to the gradient.

- Gravitational forces influence how fluids moving through the rock fractures. The fluids move from locations of high elevations to lower elevation or high to lower pressure.
- Flow in a fracture or fault zone may act almost like a pipe, where the fluid stays confined to the open portion of the rock and does not substantively deviate from this path.
- Complex geometric relationships among connected fractures often means that flow does not follow the shortest path from high to low head (groundwater elevation).
- The direction of groundwater flow is based on the direction of the gradient and the orientations and properties of the pathways.

Figure 1.4-2 provides a simplified representation of how flow would move through an anisotropic network of simple fractures. Anisotropy in this case means that the hydraulic properties vary by orientation of the fracture. Here there are two directions of fractures, but they are rotated about 90 degrees from the direction of the hydraulic gradient. Based solely on the hydraulic gradient, flow would move along a straight path parallel to the gradient. Instead, because the fractures are not aligned with the gradient, the water and contaminant (shown by the red pathlines) must find their way into the fractures. This causes the contaminant to spread into many pathways and travel along a pathway not expected if only using the hydraulic gradient for interpretation. This results in misinterpreting the direction of transport by not accounting for the orientation of the fractures.



Fracture network model with boundary conditions as shown (no flow top and bottom). NE trending fractures have twice the transmissivity as the NW-trending fractures. The colours in the fractures show a head varying from 100 m (green) to 0 m (blue). Model scale is 200-m on the side; the top and bottom boundary conditions are no flow boundaries. Red lines are particle tracks showing how fracture anisotropy controls flow direction from a point source in the upper right.

Source: From SABCS (2010b) [B-384]

Figure 1.4-2 Simplified fracture representation where the orientation of the fractures influences the direction water would move through the fractures from a hypothetical point source (well).

Therefore, for the purposes of a robust site assessment, two critical items need to be identified:

1. The orientation of the preferred pathways. In basalts like those found at Red Hill, orientation of preferred pathways is due to either or both the orientation of the fractures or the orientation of the bedding planes that best describe the layering direction of the basalt units. For those massive pahoehoe and a'a zones, the fractures that provide a pathway for flow between the layers will be the most critical, but for the clinker and thinly layered pahoehoe flows, the bedding orientations will be the most dominant flow pathways.
2. Hydraulic gradient. For the purposes of Red Hill, hydraulic gradient is the direction and magnitude of the change in hydraulic head from a fuel release point to a receptor of interest. That is, water or fuel will generally flow from high (upgradient) to low (downgradient) hydraulic heads along a hydraulic gradient.

1.4.2 LNAPL Transport

Fate and transport of LNAPL in the environment are influenced by the physical and chemical nature of the LNAPL and the subsurface geologic conditions through which it travels. Conceptually, the migration pathways can be simplified to consist of two stages (as shown in Figure 1.4-3):

1. The unsaturated zone which is the portion of the subsurface at Red Hill between land surface and the Sole Source Aquifer. This portion of the subsurface includes the large USTs which are surrounded and supported by basalt. Any release from the USTs to the environment passes through the unsaturated zone.
2. Once transport has reached the Sole Source Aquifer, LNAPL will rest along the top surface of the water. A little at a time, the LNAPL will dissolve into the aquifer water and can then be transported from upgradient to downgradient along with the water in the aquifer.

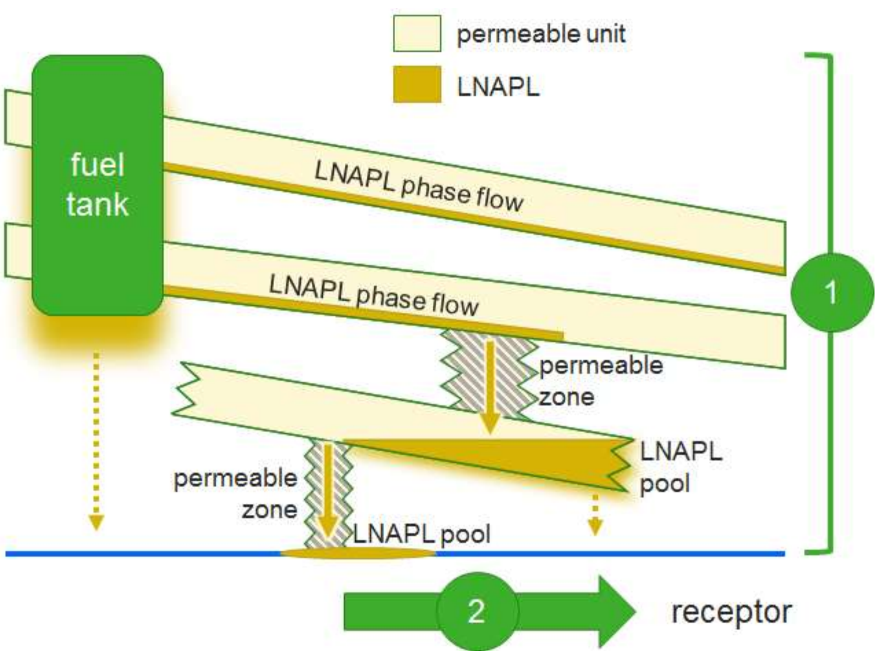


Figure 1.4-3 Schematic Representation of Potential Migration Pathways

Each of the lava types found at Red Hill has a unique ability to transmit and hold LNAPLs. The most likely of the units to transmit LNAPL are lava tubes (which are often open conduits), high-permeability a'a clinker zones, and high-permeability, thin pahoehoe flows. The massive a'a flows and pahoehoe flows have limited capacity to either transmit or hold LNAPL due to limited pore spaces. The analysis provided by the Navy fails to consider any of the preferential fracture information needed to estimate LNAPL transport.

2.0 ANALYSIS

The introduction to the Facility provided in Section 1.0 describes a uniquely engineered and constructed facility located in a highly complex and sensitive environment. While historical and recent fuel releases from the Tank Farm have resulted in an AOC requiring the Navy to complete certain investigations and technical reports intended to inform an assessment of the potential for contamination of the Sole Source Aquifer, the foundational data remain sparse, the understanding of the subsurface remains uncertain, and the analysis of contaminant fate and transport remains incomplete. As a result, the protection of human health and the environment cannot be assured.

This overarching conclusion is consistent with the concerns raised by the EPA and DOH in recent disapproval of the Navy's Tank Upgrade Decision Document, which stated:

> "Given the very complex geology at Red Hill, a limited ability exists to determine the precise 'fate' of releases; however, there are several magnitudes of releases that should be examined for their potential fate and transport. We agree that further analysis is needed to evaluate the consequences of a range of release scenarios and identify appropriate mitigation measures." (EPA and DOH 2020) [B-28 at BWS007383].

These EPA and DOH comments underscore the gaps in the Navy's current understanding of the subsurface environment in the vicinity of the Facility and the considerable uncertainties that exist when attempting to determine the pathways in which fuel is migrating from the Tank Farm to the Sole Source Aquifer.

Navy witness Mr. Curtis Stanley, on the other hand, contends that the Navy's past, current, and planned environmental investigations and analyses demonstrate that operation of the Facility is and will continue to be protective of human health and the environment. Simply put, this is not consistent with the history of releases from the Tank Farm or supported by sufficient data. First, the Navy cannot even find the fuel it has already released into the environment. Neither the vertical nor lateral extent of the contamination in the vicinity of the Facility has been characterized, and the Navy's monitoring network cannot be relied upon to even detect future fuel releases. Mr. Stanley does not recognize or address this critical deficiency. Second, Mr. Stanley ignores or downplays the fact that episodic fuel releases from the Tank Farm have occurred and likely will continue to occur, and that these releases have impacted the environment, including the Sole Source Aquifer. Third, Mr. Stanley relies heavily upon poorly understood, site-specific biological processes to attempt to justify the existence of past, current, and future contamination of the environment, but the available data and analysis do not support the level of natural attenuation suggested. Finally, Mr. Stanley improperly suggests the Navy should receive credit for future Facility improvements even though he admits that such work has not been approved by the necessary regulatory agencies and, in many cases, the improvement plans have been disapproved and the Navy itself has not even committed to implementing them. The Facility Environmental Report (AECOM and GSI 2020) does not demonstrate that Facility operations can be conducted in a manner that will safeguard the Sole Source Aquifer.

This section of the report will discuss each of these topics. References to introductory material to facilitate understanding of the complex topics is provided and comments from EPA, DOH, and their consultants are referenced as applicable.

2.1 Limited Dataset Creates Uncertainties in Contaminant Distributions and Groundwater Flow Paths

The Facility is in an extremely complex environment with multiple pathways for fuel constituents to reach the Sole Source Aquifer, but the Navy has failed to install a monitoring network that is sufficient to characterize the subsurface conditions. Without sufficient monitoring, there is simply not enough known about the potential fate of the fuel that has been and will be released from the Tank Farm to conclude that operations at the Facility are protective of human health and the environment.

Navy Position

> "Red Hill is probably the most extensively studied UST system in the State of Hawai'i with the largest environmental data set of any UST system in the state." Page 18. Facility Environmental Report (AECOM and GSI 2020).
>
> And
>
> "[G]iven that the extensive environmental monitoring network continues to be regularly sampled, tested, and analyzed, the extensive environmental data set confirms that operation of the Facility is currently 'protective of human health and the environment' …." Page i. Facility Environmental Report (AECOM and GSI 2020).

Response

The Navy's reliance on what is described as an "extensive" Red Hill dataset is misplaced, particularly given the considerable deficiencies in its Tank Farm monitoring well network. To demonstrate that operations at the Facility are sufficiently protective of human health and the environment, there would need to be robust data and thorough technical analysis to document that drinking water resources are safeguarded from the risk associated with having hundreds of millions of gallons of fuel located 100 feet above the Sole Source Aquifer. There is not. To the contrary, the Facility Environmental Report (AECOM and GSI 2020) fails to recognize the Sole Source Aquifer as a receptor, let alone adequately account for, the considerable uncertainties arising from the insufficiency of the data collected by the Navy's inadequate monitoring well network and the resulting challenges in characterizing the groundwater flow system and the nature and extent of groundwater contamination at and around the Tank Farm. These uncertainties are compounded by the complex subsurface conditions near the Facility, where fuel migration occurs in a highly heterogeneous basalt containing preferential flow paths. With only two wells within the footprint of the Tank Farm and only three wells within 450 feet of the USTs, it is neither surprising nor remarkable that the Navy has been unable to find the fuel released from the Facility in its monitoring wells.

Most notably, the Facility Environmental Report (*e.g.,* Figure 6b, AECOM and GSI 2020) omits three key limitations of the monitoring well network at the Tank Farm. These limitations include:

- Inadequate monitoring density within the Tank Farm given the size and complexity of the Facility leads to insufficient characterization or early warning of groundwater contamination.
- Insufficient data to reliably determine groundwater flow directions.
- Biased monitoring well construction (e.g., short screens completed below the water table) within the Tank Farm thereby reducing the applicability of the data.

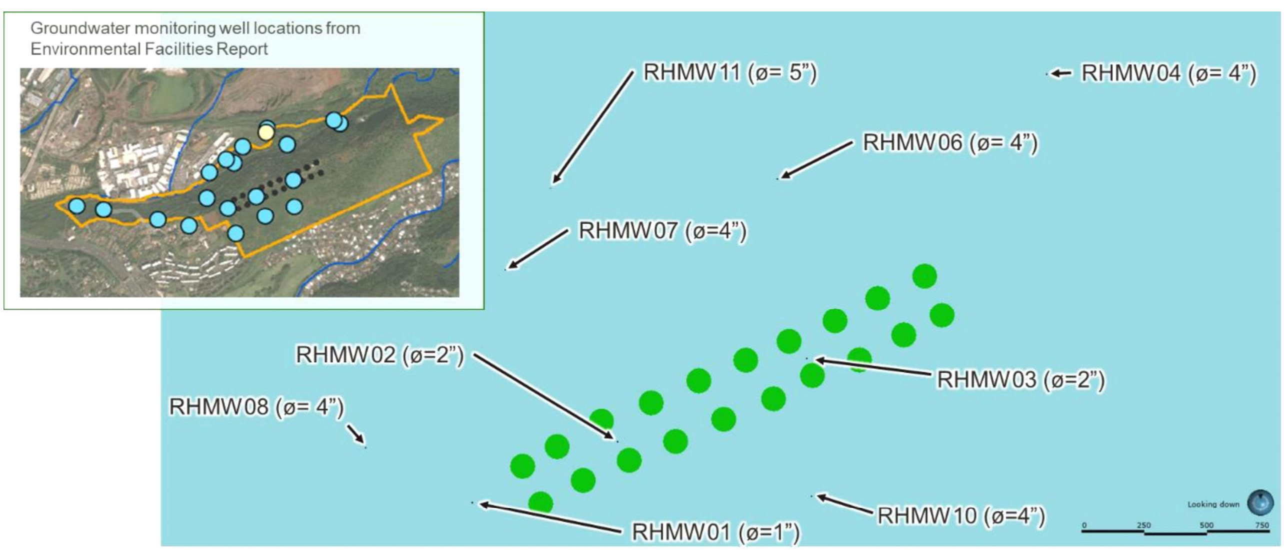
These limitations result in conclusions about the safety of operations at the Facility, at least as they concern the fate and transport of contamination from the Tank Farm, that are premature and speculative.

EPA and DOH (October 29, 2018) [B-349] have recognized these same problems and commented on the uncertainties and lack of characterization data in the Tank Farm, as follows:

> "Groundwater data- Interpretations of groundwater data from before and following the time of the 2014 release do not adequately consider limited data density and the range of plausible interpretations, including the probability of northerly contaminant transport. Additionally, general water quality indicators including nitrate and dissolved oxygen should be closely examined as lines of evidence for transport and attenuation of past releases." [B-349 at BWS037976].
>
> "Absent additional source zone characterization data, the LNAPL residual capacity will remain unconstrained along with other important elements to the LNAPL transport regime. As noted, this is one of several critical factors in the dynamic evaluation of LNAPL transport and potential risks to the groundwater system. **Where measurements and data are absent, a greater degree of conservatism in the estimation approaches is necessary to allow for that uncertainty."** [B-349 at BWS038006] (emphasis added).

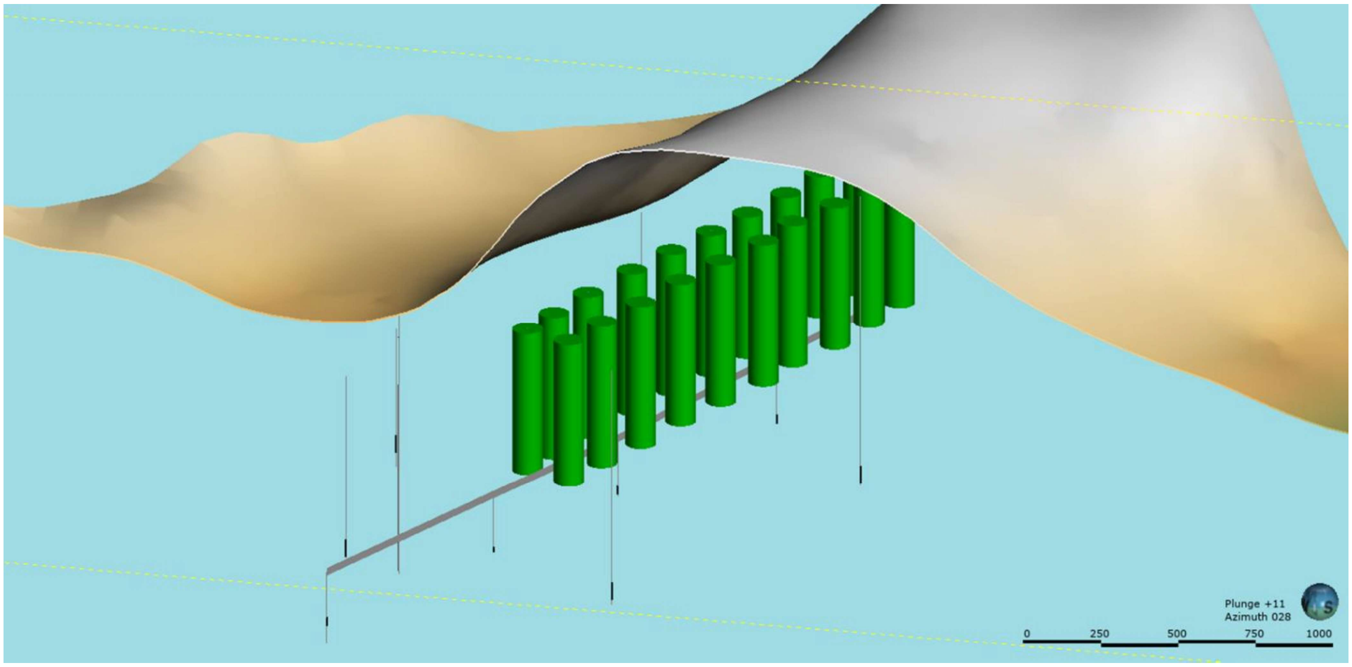
2.1.1 Insufficient Monitoring Network Near the Tank Farm

As previously noted, the Navy has installed and relies upon a sparse network of monitoring wells to characterize the subsurface environment at the Tank Farm and to determine the fate and transport of released fuel. To illustrate how the resolution of the water quality sampling network at the surface compares to the size and location of the tanks, Figure 2.1-1 was prepared showing the USTs and the monitoring well sizes to scale. As this figure clearly shows groundwater monitoring beneath the Tank Farm relies on two older, narrow wells (RHMW02 and RHMW03) within the Tank Farm footprint. In addition to their small size, the usefulness of these wells to characterize site conditions is limited by the lack of detailed geologic data (televiewer logs) (Figure 2.1-2). Given the heterogeneity of the subsurface and the likely preferential transport of fuel releases through the unsaturated zone, the likelihood that these two, 2-inch monitoring wells would encounter appreciable LNAPL is very small even if there was a large amount of LNAPL present under the Tank Farm.



Notes: Monitoring well locations from (DOH 2010) [B-324]. Tank locations approximated from TEC (2007) [B-8].

Figure 2.1-1 Groundwater Monitoring Wells in the Tank Farm Area

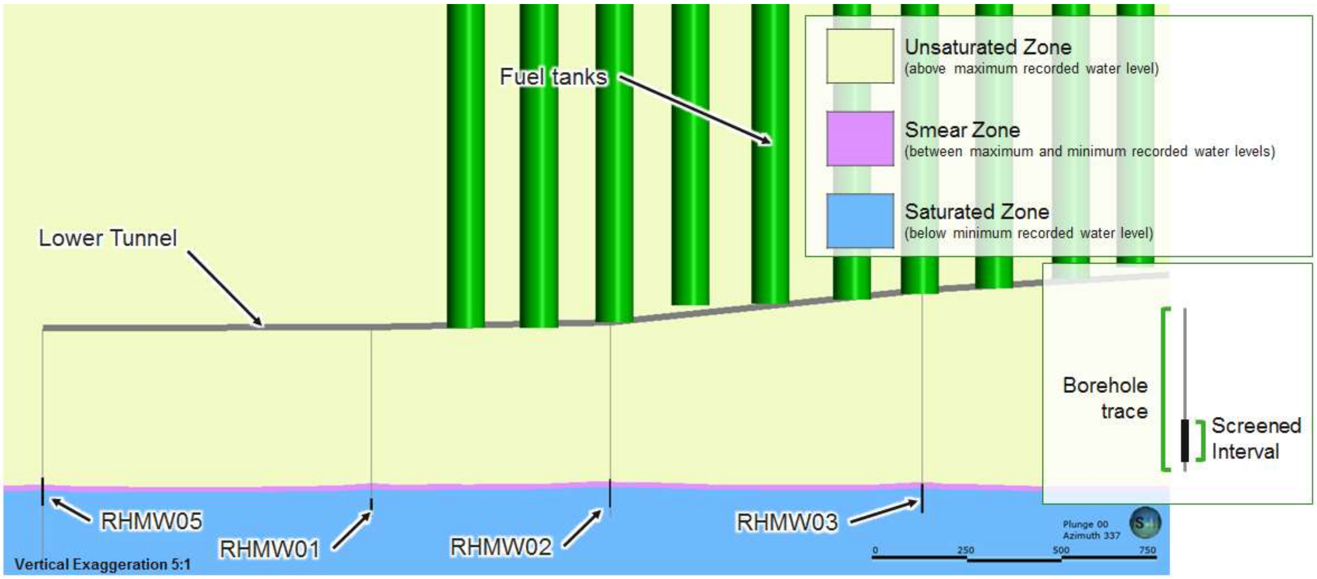


Notes: Surface topography from https://geoportal.hawaii.gov/datasets/oahu-elevation-contours-100ft [B-390]. Monitoring Well locations from (DOH 2010) [B-324]. Lower tunnel and fuel tank locations approximated from TEC (2007) [B-8]. Geology interpolated from cross-sections AA, CC, and DD from Chapter 5 of NAVY (2019, CSM) [B-352].

Figure 2.1-2 Red Hill Monitoring Well Network within the Tank Farm

In addition to the small number of wells relative to the size of the Tank Farm, the wells are also characterized by:

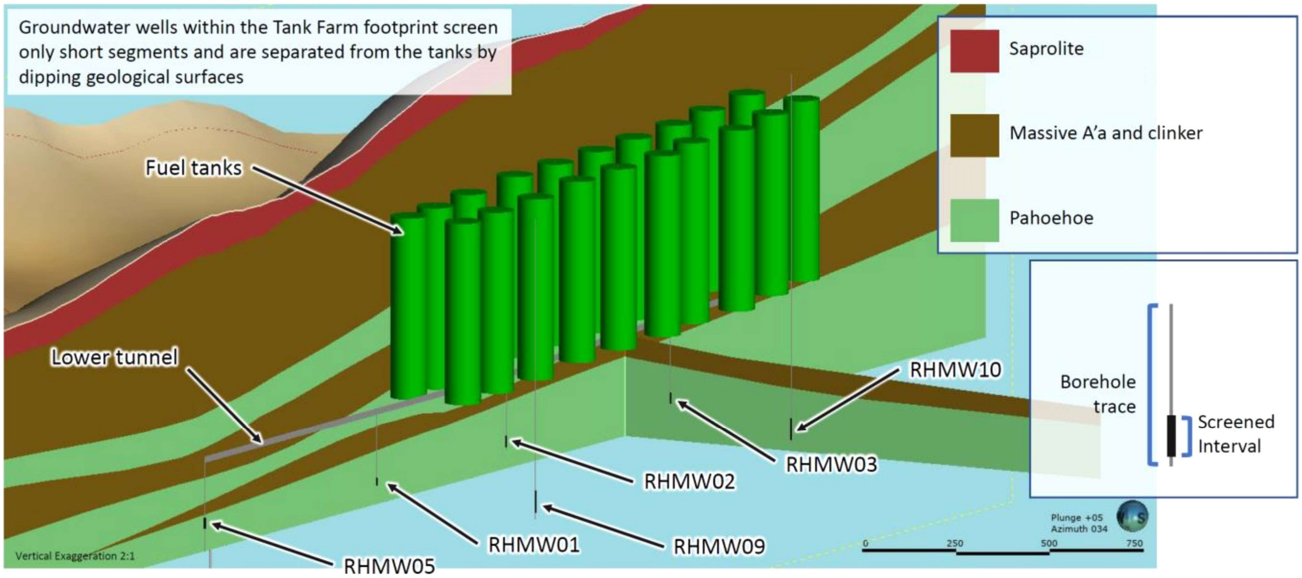
- Relatively short screen intervals. Monitoring well screen intervals are very important because LNAPL will generally float on the top of the water table once it reaches the saturated zone (before slowly dissolving into the water or diffusing into the rock) and, as a result, the ability to detect LNAPL at any particular monitoring point is dependent on the LNAPL pool intersecting the monitoring screen. The monitoring wells nearest the Tank Farm (RHMW-01, RHMW-02, RHMW-03) have very short if any, screen intervals placed such that LNAPL detection is unlikely (Figure 2.1-3). By decreasing the likelihood of observing LNAPL during sampling events, large amounts of LNAPL could be present and still not be detected at the wells and therefore, negative results do not provide sufficient information to make any supportable conclusion regarding the presence or absence of LNAPL.



Notes: Monitoring Well locations from (DOH 2010) [B-324]; Lower tunnel and fuel tanks locations approximated from TEC (2007) [B-8]; Water levels from (NAVY 2020, IRR) [B-338].

Figure 2.1-3 Schematic Cross-Section along Lower Tunnel

- Screen intervals below the water table. Some monitoring wells (like RHMW01 and deeper intervals in perimeter, multilevel wells) are screened below the water table, effectively eliminating the likelihood of observing LNAPL. Sampling methods similarly rely on dedicated pumps installed below the water table, which prevents observed LNAPL in groundwater samples. Depth-specific sampling methods would provide clearer indications of the presence of fuel and fuel constituents.
- Difficulty intersecting preferential flows. The preferential flow paths through the basalts complicate monitoring, as a monitoring well must directly intersect a flow path to directly detect and for samples to be representative of the chemical composition of the contaminant transport. The lavas found at the base of the tanks are pahoehoe flows, which can hold and transmit fuels, however, the dominant lava where the Tank Farm monitoring wells are located in a massive a’a with interbedded clinker zones (Figure 2.1-4). The LNAPL leaving the near-tank area is likely to stay and follow the layers present in the pahoehoe lavas and transport laterally until the pahoehoe lavas meet the water table or significant connections are encountered through fractures or joints to the underlying a’a lavas.



Notes: Surface topography from https://geoportal.hawaii.gov/datasets/oahu-elevation-contours-100ft [B-390]. Lower tunnel and fuel tank locations approximated from TEC (2007) [B-8]. Geology interpolated from cross-sections AA, CC, and DD from Chapter 5 of NAVY (2019, CSM) [B-352].

Figure 2.1-4 Groundwater Monitoring Wells shown with Large Scale Lavas

Based on the review of the monitoring well network within the Tank Farm footprint, there are not enough wells to reasonably interpret that no LNAPL fuel products are at the water table of the Sole Source Aquifer or, by extension, that operations at the Facility are protective of human health and the environment. EPA and DOH comments provided in April 2019 [B-356] are consistent with this finding:

> "Light Non-Aqueous Phase Liquid ("LNAPL") Presence: Persistent detections of TPH and individual fuel constituents in groundwater are typically interpreted to result from the presence of an LNAPL source. **Due to the frequency of elevated detections in RHMW01, RHMW02, and RHMW03, along with the occurrence of occasional detections in distal wells, the Regulatory Agencies conclude it is reasonable to assume that residual LNAPL is present in the subsurface from past releases.** Furthermore, despite consensus on the anticipated dilution rates caused at Red Hill Shaft, trace levels of petroleum compounds have been detected in approximately 12% of the samples collected there.[4] The Regulatory Agencies interpret this information as implying that Red Hill Shaft is a likely receptor, and that some LNAPL mass from the facility may be the cause of those detections." [B-356 at BWS039280] (emphasis added).

2.1.2 Groundwater Flow Paths

The Facility Environmental Report (AECOM and GSI 2020) appropriately recognizes that understanding the direction and rate of groundwater flow is an important consideration when determining whether Facility operations are protecting human health and the environment (Section 3.1.5, page 49). It does not, however, present information concerning the current groundwater flow directions from the Facility, especially within the Tank Farm footprint where contamination was already detected in the Sole Source Aquifer. Understanding the groundwater flow near the Tank Farm and potential pathways to transport contaminants away from releases is critical information when evaluating whether monitoring systems and risk assessments are complete and protective.

Comments from the EPA and DOH have pointed out inconsistencies and errors in the Navy's interpretation of groundwater flow directions. DOH has reiterated as recently as October 26, 2020 that, "we continue to disagree with fundamental conclusions made in the 2019 CSM." (EPA and DOH 2020) [B-28 at BWS007386]. These concerns are multifaceted, but a significant focus by DOH is on the Navy's interpretation of groundwater flow directions.

The complexity of the subsurface and groundwater conditions creates considerable uncertainty in the groundwater flow directions. Some of these uncertainties include:

- High transmissivity (or the ability for the rock to transmit flow) leads to very small hydraulic head differences. The basalts which comprise the Sole Source Aquifer have sufficient high-transmissivity pathways, such as clinkers, that there is little resistance to groundwater flow resulting in very small differences in the elevation of water measured in monitoring and pumping wells.
- Because these differences are so small, the measurements of water elevations are very challenging. To be meaningful, they need to be accurately measured to hundredths of a foot. Also, water levels in wells respond to sources of "environmental noise" such as barometric pressure changes, ocean tides, earth tides, and temperature differences. Each of these makes interpretation of groundwater flow directions confounding when the measurements are very similar over a large area. As a result, even relatively small changes in observed water levels result in the complete change of the apparent groundwater flow direction.
- The actual flow paths in the saturated zone are further affected by the high heterogeneity of the subsurface. Even without considering lava tubes, the typical values of hydraulic conductivity for different lava types in Hawaii span 4 orders of magnitude (Kreyns et al. 2020) [B-388]. Therefore, the placement of specific lavas along a transport or flow pathway can result in enormous differences in groundwater flow directions or contaminant arrival times.

DOH (2019) [B-374] has summarized the many interpretations of potential groundwater flow directions and provided comments to the Navy in a document named "Hawaii Department of Health Evaluation of Groundwater Flow Paths in the Moanalua, Red Hill and Hālawa Regions, Revision 2." DOH's findings are summarized in Figure 2.1-5, which clearly shows a component of groundwater flow direction from the Facility toward Hālawa Shaft.

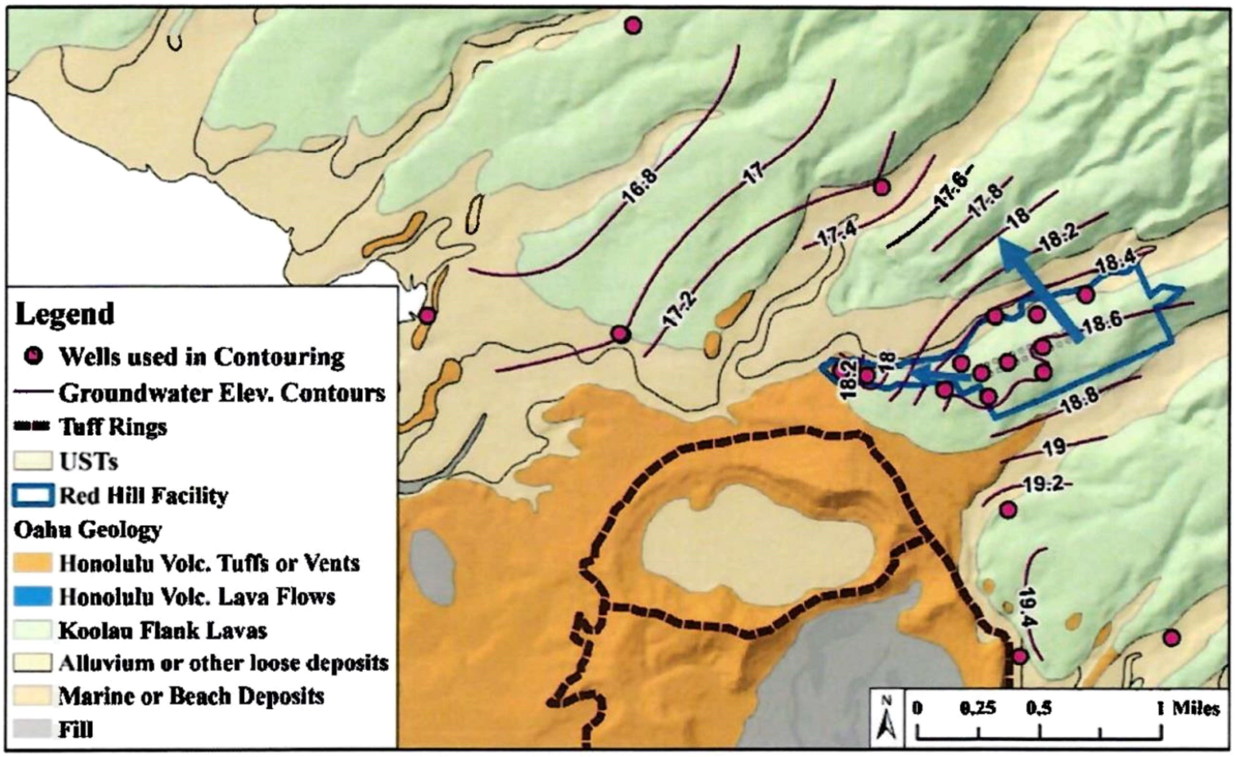


Figure 5. Groundwater elevation contours for the Moanalua/Red Hill/Halawa region when the Red Hill Shaft is pumping at a normal rate and the Halawa Shaft has been off for 9 days. Arrows indicate the implied groundwater flow direction based on the groundwater elevation contours. Data are taken from Figure 6-10 in the Red Hill CSM (DON, 2018a)

Source: DOH (2019) [B-374]

Figure 2.1-5 Interpreted Groundwater from Red Hill Facility toward Hālawa Shaft

2.1.3 Protection of the Sole Source Aquifer Uncertain due to Limited Dataset describing Contaminant Distributions and Groundwater Flow Paths

Basic expectations for any contaminated site include sufficient investigation and site characterization. At the Facility, there remains many uncertainties in this regard. Specifically, there is currently insufficient data to characterize the actual makeup of the heterogeneous basalt subsurface beneath the Tank Farm, to predict the groundwater flow direction near the Facility, to understand the volume and distribution of fuel contamination in the Sole Source Aquifer, and to evaluate the ability (or inability) of the Navy's monitoring network to detect fuel contamination. These data gaps prevent the Navy from demonstrating that the Facility can be operated in a manner that is protective of human health and the environment. The data and reporting transparency prevented further analysis of the potential impact of operating the Facility on human health and the environment.

2.2 Episodic Fuel Releases and Detection of Fuel Constituents

A long history of fuel releases from the Tank Farm and the detection of fuel constituents in the nearby subsurface are inconsistent to the Navy's suggestion that operations at the Facility are protective of human health and the environment.

Navy Position

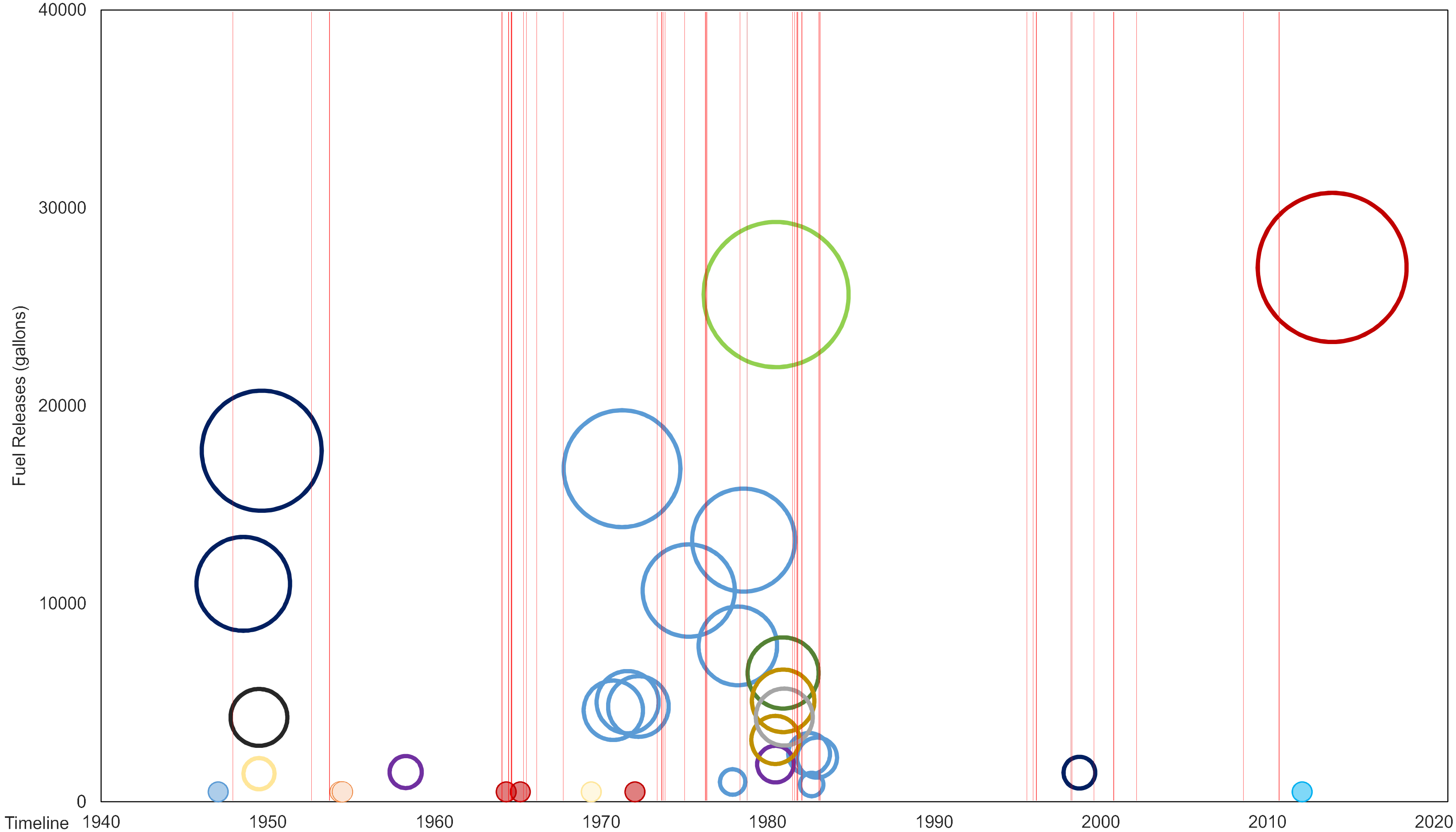
> "All the available environmental data … indicate that operation of the Facility is currently protective of human health and the environment. Importantly:
>
> - Fuel product has never been measured in any groundwater monitoring or supply well.
> - The Navy's drinking water supply well, which is tested frequently, remains safe.
> - BWS has confirmed that groundwater at its near by drinking water supply well also remains safe."
>
> Page 10 of the Facility Environmental Report (AECOM and GSI 2020).

Response

Available environmental data demonstrates that pathways exist for fuel releases from the Tank Farm to migrate through the unsaturated zone and contaminate the Sole Source Aquifer upon which the BWS, the Navy, and others rely for their drinking water. Episodic fuel releases are documented in Facility history. The fact that the released fuel is present in the environment and can reach the Sole Source Aquifer is apparent from an examination of rock cores removed from under the Tank Farm, evaluation of vapor sampling results, and analysis of groundwater trend data. The conclusion that released fuel can migrate to the Sole Source Aquifer is consistent with the Navy's own recent IRR (NAVY 2020, IRR), which acknowledges that ***"there is an indication that LNAPL is at or near the water table upgradient from RHMW02."*** [B-339 at BWS034975]. Collectively, these data indicate that fuel releases to the Sole Source Aquifer have occurred in the past and are likely ongoing. Accordingly, operations at the Facility are not currently protective of human health and the environment.

2.2.1 Most of the Facility USTs have Released Fuel into the Environment

Fuel releases from the Tank Farm have been reported with episodic spikes for as long as the Tank Farm has been in operation. At least 72 fuel release events in total, on average a release per year, have been reported by the Navy or other sources. Based on these data, a history of fuel releases is presented graphically in Figure 2.2-1. Fuel release events where release volumes were reported are shown quantitatively with circles, whereas events with unreported or uncertain release volumes are depicted by a red dotted line. Detections of fuel constituents in environmental sampling conducted since 1997 suggest other fuel releases may have occurred that are not reflected in the figure.



Vertical Lines Indicate Fuel Releases of Unknown Quantity
Bubbles Indicate Fuel Releases of Known Quantity

Note: 1. The tank number is identified by color of the dot; the size of the dot is based on the reported release volume for known releases greater than 100 gallons.

Note 2. Tank 2 known releases in 1954 and unknown releases in 2008 are shown but may be difficult to differentiate due to the close timing of the events.

Tank 1 | Tank 2 | Tank 3 | Tank 5
Tank 7 | Tank 9 | Tank 10 | Tank 11
Tank 12 | Tank 16 | Tank 17 | Tank Unknown

Shaded bubbles are less than 100 gallons (not to scale)

CLIENT
Honolulu Board of Water Supply

PROJECT
Red Hill Bulk Fuel Storage Facility

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-12
DESIGNED	AN
PREPARED	AN/TH
REVIEWED	ND
APPROVED	ND

TITLE
Fuel Releases reported from Facility Histories, API 653 Inspections, and Navy Release Notifications

PROJECT NO.	CONTROL	REV.	FIGURE
20140469	0000	2	2.2-1

A cumulative fuel release volume of over 178,000 gallons during the life of the Facility has been quantitatively reported (Figure 2.2-2). Since it is likely that not all releases have been documented, and not all documented releases have volume estimates, this total release volume should be considered a lower bound estimate and likely underrepresents the total volume of fuel released from the Tank Farm. It is also noteworthy when examining Figure 2.2-2 that the cumulative releases are characterized by episodic increases in fuel release followed by smaller, more frequent releases.

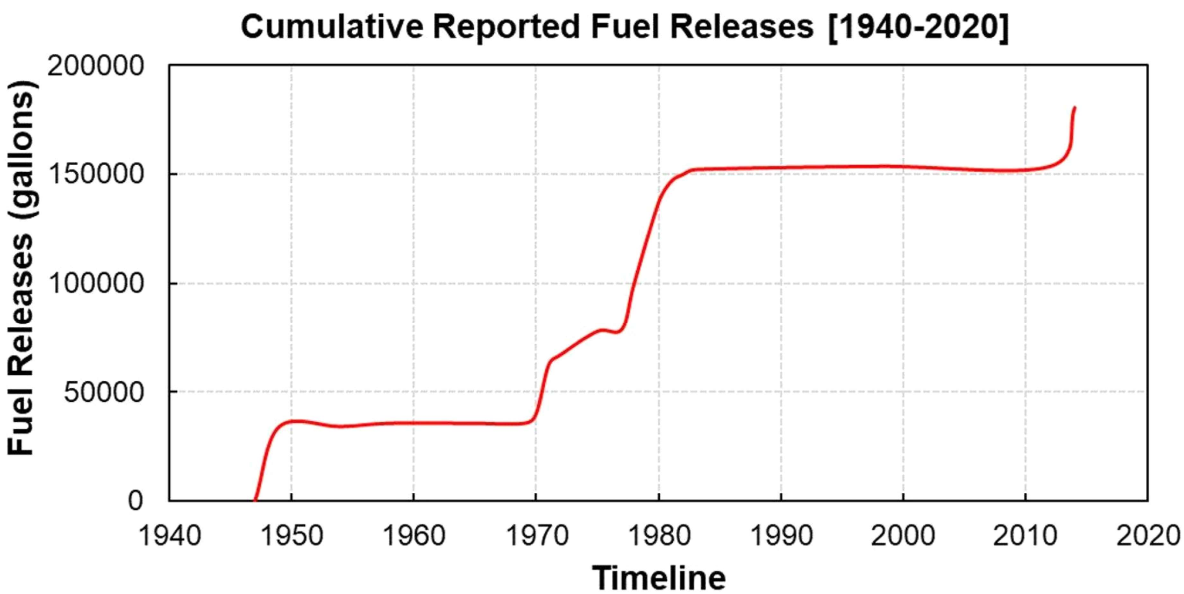


Figure 2.2-2 Cumulative fuel release volumes as reported from Facility histories, API 653 inspections, Navy release notifications, and Navy witness testimony.

2.2.2 Detection Frequency for Fuel Constituents is likely Biased Low Compared to the Historical Fuel Release Record

Groundwater sampling is conducted as part of the Red Hill groundwater LTM program described in the Red Hill Groundwater Protection Plan (GWPP) (NAVY 2014b) [B-373]. While the program has existed, there have been documented quality concerns leading to low-concentration biases and the timing of the samples are not aligned with the timing and magnitude of the fuel releases.

Uncertain Sample Analysis Quality

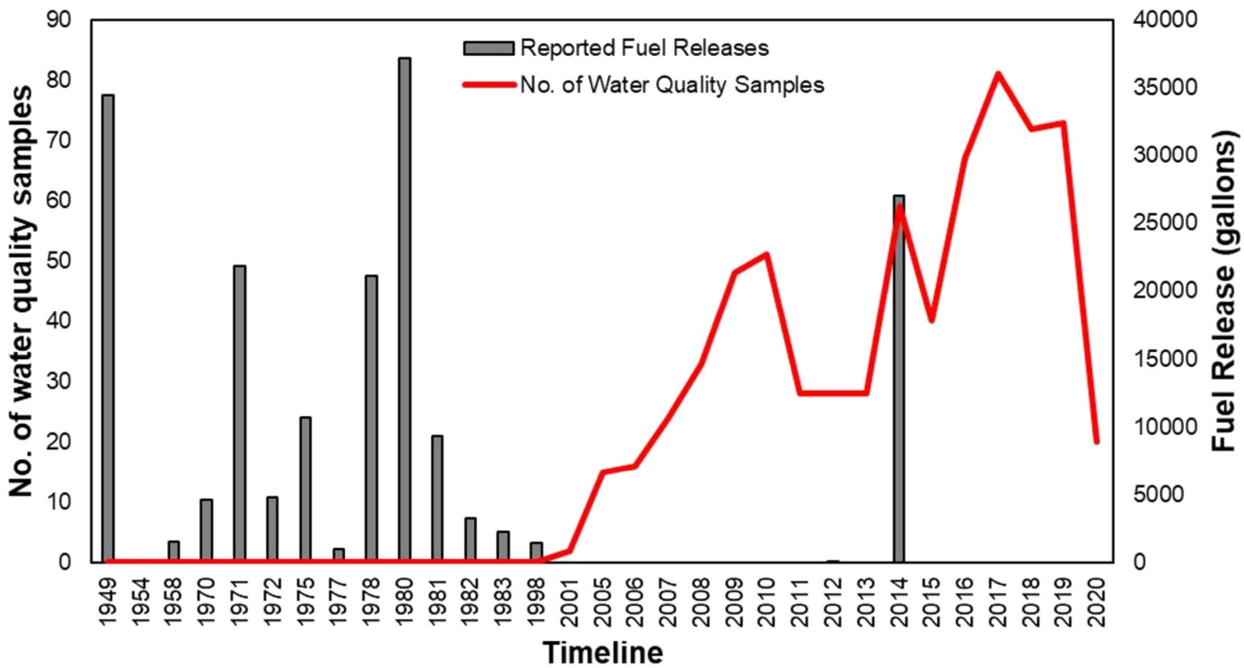
To provide conclusions which can be relied upon, there must be sufficient certainty that the sample analyses being conducted are consistent and accurate. Beginning in January 2017, split sampling was conducted during six groundwater monitoring events at select Facility monitoring wells, with samples analyzed by both the Navy contracted laboratory and the EPA Region 9 laboratory (EPA 2017a) [B-393]. **Analytical results initially showed large differences in recoveries for total petroleum hydrocarbons-diesel (TPH-d) and polynuclear aromatic hydrocarbons (PAHs), with data generated by the Navy contracted laboratory approximately 65% lower than results reported by the EPA Region 9 laboratory**. NAVY (2020) [B-339] later reported the Navy-contracted laboratory's recoveries significantly improved after the January 2017 split sampling event by optimizing its analytical methods to better match those of the EPA laboratory. Adjustments included changes to sample preparation, extraction, concentration, and quantitation steps.

In addition to the potentially low bias of monitoring results, the Navy states that samples collected in October of 2017 may have a sampling bias that is unknown if it is high or low compared to the true value (NAVY 2018) [B-348]. The Relative Percent Difference was about 200 percent resulting in considerable uncertainty in the true concentrations.

The lack of confidence in the Navy's ability to properly sample its monitoring network, including a known low bias in groundwater monitoring data, limits the interpretation of plume extent, reasonable groundwater attenuation rates, and transport velocities.

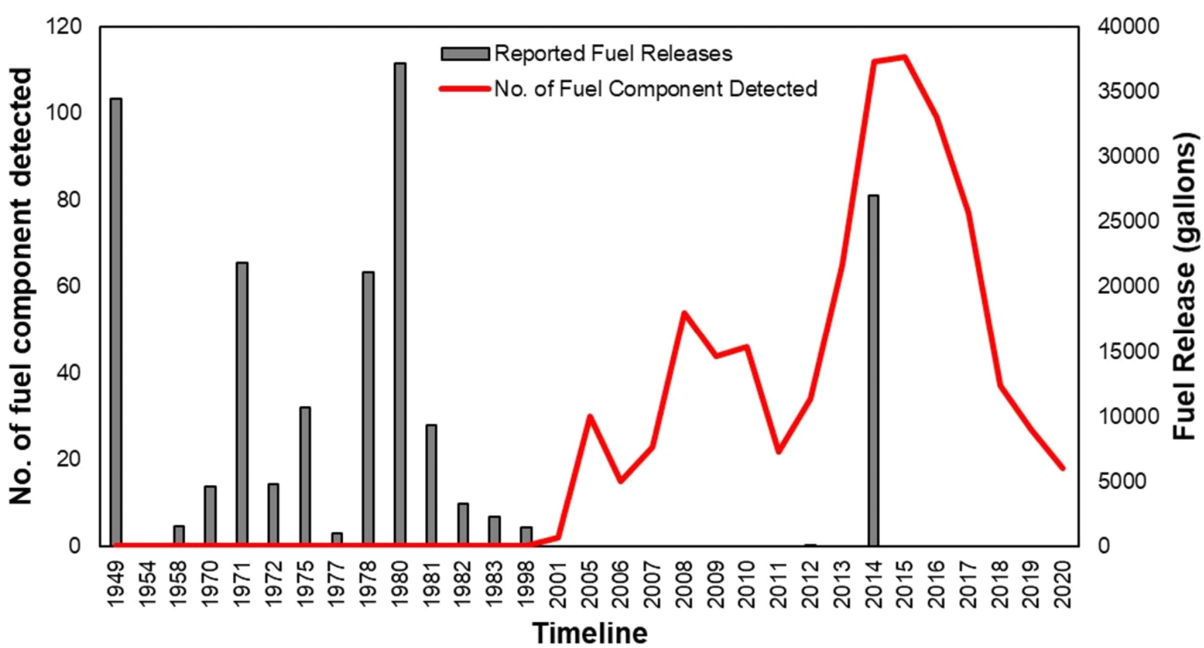
Sample Collection Timing

To accurately assess the impact of fuel releases on groundwater, samples must be taken following release events. Historically, there has not been a correlation between the timing of Navy groundwater sample collection efforts and the known or estimated fuel releases. Before the early 1980s, fuel release volumes were better documented, but there were no corresponding groundwater monitoring data. Figure 2.2-3 and Figure 2.2-4 show the reported fuel release volumes from the Facility and the timing and number of observed fuel components in the monitoring network, respectively. Because there is limited correspondence in the timing of samples taken/fuel components observed and the reported volumes released from the Tank Farm, the understanding of which releases are being observed in the monitoring system and the ability to have any confidence that the monitoring system can or will detect releases of significance is reduced. What is clear is that the **documented 2014 fuel release corresponds to increases in fuel constituents observed in groundwater**.



Notes: Only fuel releases with known volumes are included for reference.

Figure 2.2-3 Frequency of Water Quality Samples (1949 to March 2020)



Notes: Only fuel releases with known volumes are included for reference

Figure 2.2-4 Frequency of Detected Fuel Components in Groundwater Quality Samples (1949 to March 2020)

2.2.3 Evidence of Fuel Releases, Subsurface Fuel and Fuel-Component Migration is Present in Rock and Vapor Samples

Not only does the Facility Environmental Report minimize the clear history of episodic fuel releases from the Tank Farm, but it also ignores key observations that demonstrate this fuel is migrating from the Facility through the environment and into the Sole Source Aquifer. Evidence of fuel releases, subsurface fuel and fuel-component migration includes:

- Drill core, the rock removed from boring into the ground during a subsurface investigation, contains staining, odors, sludges, and sheens from fuel products.
- Vapor samples suggest vapor transport pathways and eventual migration to groundwater is not well understood or characterized, further adding to the uncertainty regarding how released fuel moves through the subsurface environment.

LNAPL Present in Rock

Rock core samples taken from underneath the Facility in 1998 provide clear visual evidence of subsurface contamination caused by fuel releases from the Tank Farm. Direct observations of petroleum staining/saturation were observed in rock cores collected beneath Tank 16 at two locations and three intervals. In boring 16A staining was observed at approximately 83 to 86 feet and 101 to 104 feet and boring 16C between 60 and 69 feet (Ogden, 1999) [B-376 at BWS041142]. A thickness of about 1.2 feet of separated phase petroleum was present in Boring B16C [B-376 at BWS041143]. Results at boring 16C were confirmed about 2 months later. Photographs showing the petroleum-stained rock core are provided in Figure 2.2-5. The Navy Fleet and Industrial Supply Center (FISC) Fuels Laboratory at Pearl Harbor could not definitively identify the hydrocarbon but indicated it was within the diesel and motor oil range and appeared at 16C to be more heavily weathered than the sample at 16A.

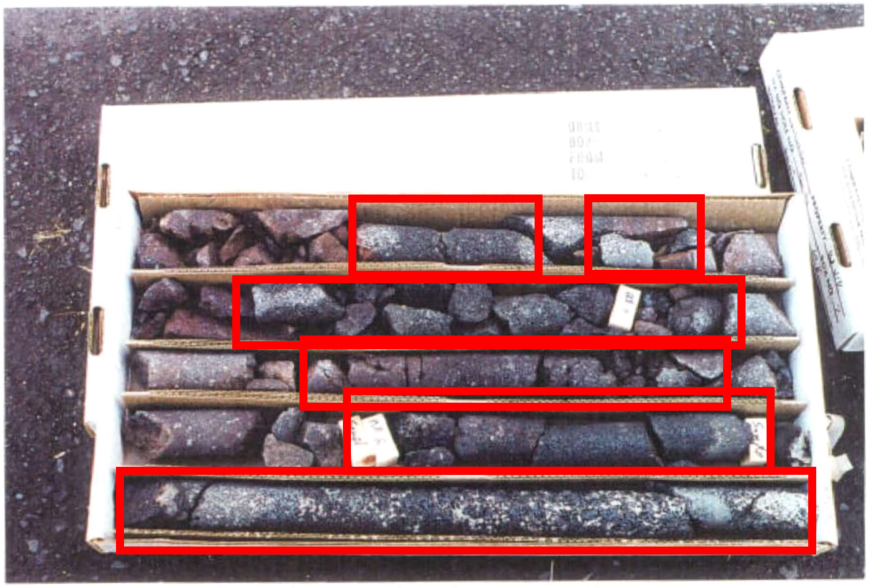


Figure 4-7 Petroleum Stained Core – B16C, 49' to 60'

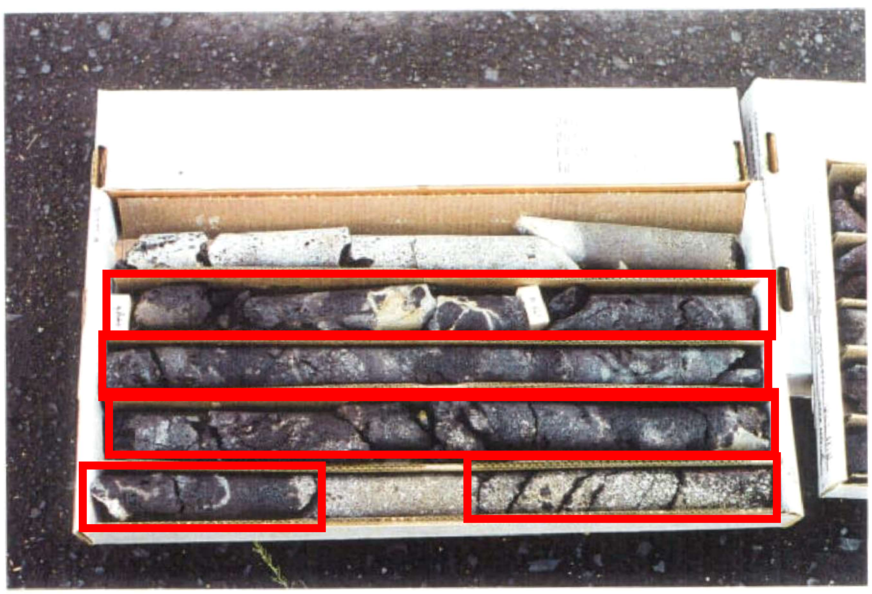


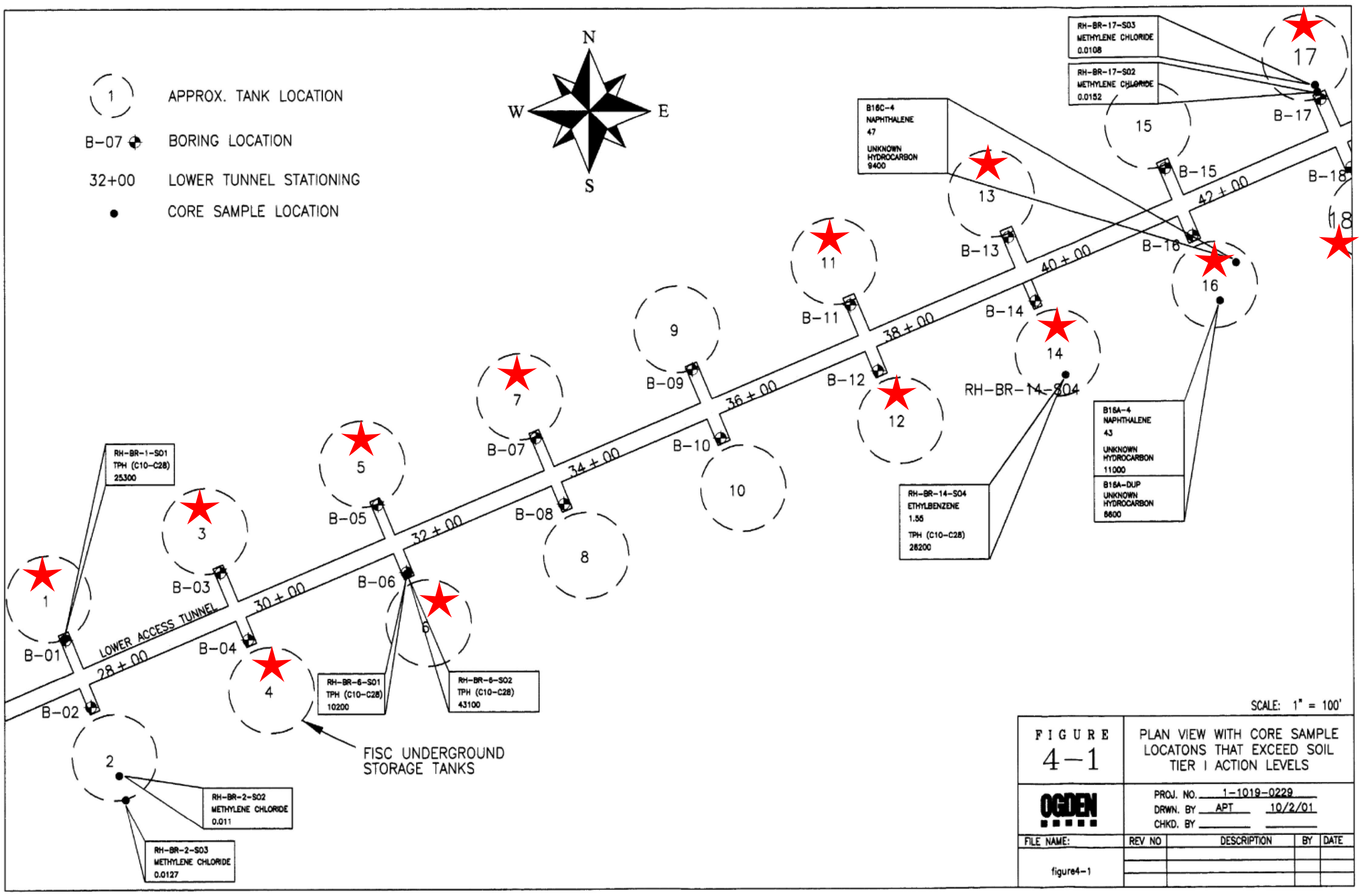
Figure 4-8 Petroleum Stained Core – B16C, 60' to 69'

Notes: The lower photograph shows the petroleum staining both in the main body of the rock and along fractures. Red boxes added to photographs to help in identifying the stained rock core. During the Phase II Site characterization, 19 of 20 USTs had some form of petroleum observed in the subsurface.

Source: (Ogden 1999) [B-376]

Figure 2.2-5 Photographs Showing Petroleum-Stained Rock Core Indicated by Black Coloring of Rock in both Photographs of Core from Beneath Tank 16

During the second stage of this field investigation in 2000-2001 eighteen angled sampling boreholes were completed beneath the centerline of Tanks 1-8, 10-15, and 17-20. Hydrocarbons odors and elevated detections of fuel constituents were measured by Photoionization Detector (PID) at 15 of the USTs (Tanks 1, 3, 4, 5, 6, 7, 11, 12, 13, 14, 16, 17, 18, 19 and 20). A summary of the observed hydrocarbon contamination based on PID measurements is provided in Figure 2.2-6.



Notes: Red stars have been added to Tanks 1-18 where hydrocarbon contamination was detected using PID during the Phase II investigation. Tanks 19 and 20 had observed hydrocarbon contamination using PID but are not shown on the figure because soil tier I actions levels were not exceeded.

Source: (AMEC 2002) [B-9]

Figure 2.2-6 Figure Summarizing Center-Line Core Samples with PID Hydrocarbon Contamination

The Navy contractor performing this work concluded: “It is clear, based upon the site investigations conducted to-date that petroleum product releases have occurred at the site. Recent investigations indicate that **LNAPL, which has typically only been observed as a sheen on observed waters, is present in several monitoring wells at the site**.” [B-9 at BWS001608] (emphasis added).

Provided here as Figure 2.2-7 is a figure from the Navy’s recent IRR (NAVY 2020, IRR) [B-339] summarizing the vertical distribution of LNAPL data derived from six of these boreholes based on either odor encountered during drilling or rock core with a sheen, staining, saturation, or sludge distributed from about 120 to 90 feet mean sea level (msl). These indicators of LNAPL pre-date the 2014 fuel release described earlier in this document and indicate that **LNAPL is likely distributed in specific elevation intervals within the Tank Farm area**.

~~For Red Hill AOC Party Use Only~~

March 25, 2020 *Investigation and Remediation of Releases Report* *Appendix E.3:*
Revision 00 *Red Hill Bulk Fuel Storage Facility, JBPHH, O‘ahu, HI* *Chronic Release*

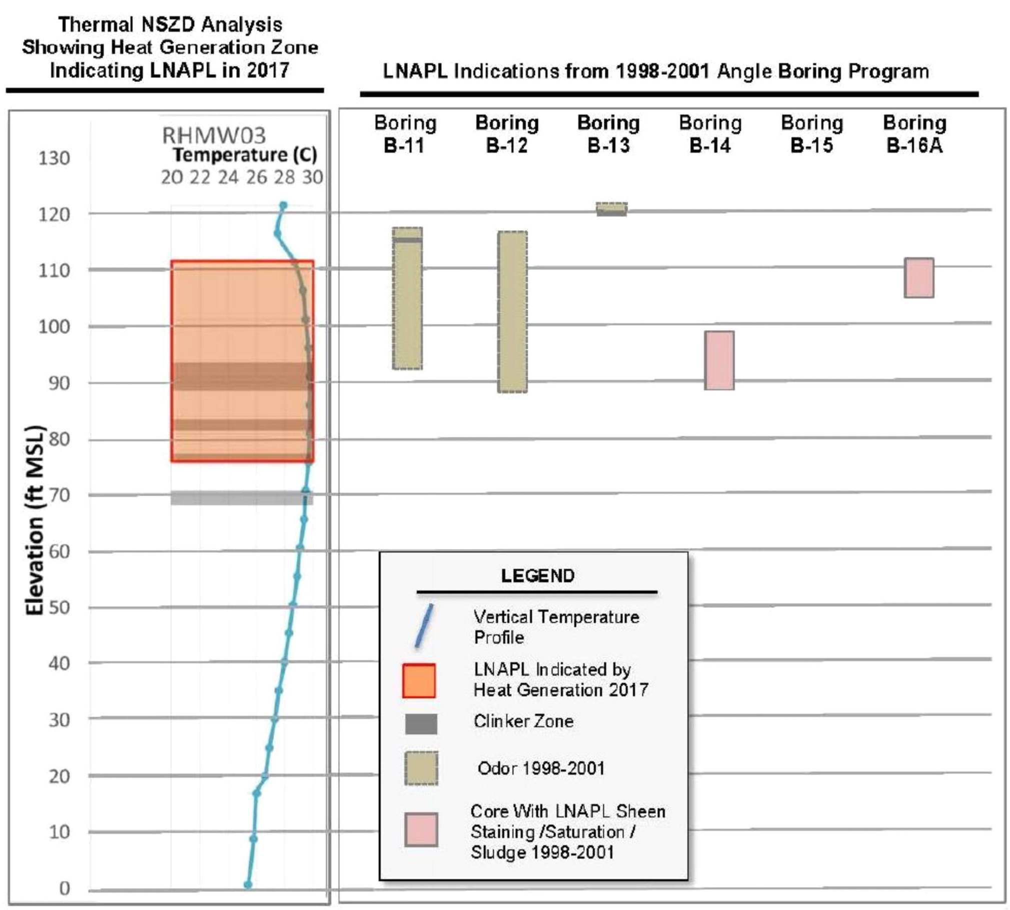


Figure 2: LNAPL Distribution near Monitoring Well RHMW03 as Indicated from 2017 Thermal NSZD Program (DON 2019 Appendix B.1) and 1998–2001 Angle Boring Program (DON 1999, 2002)

Source: (NAVY 2020, IRR) [B-339]

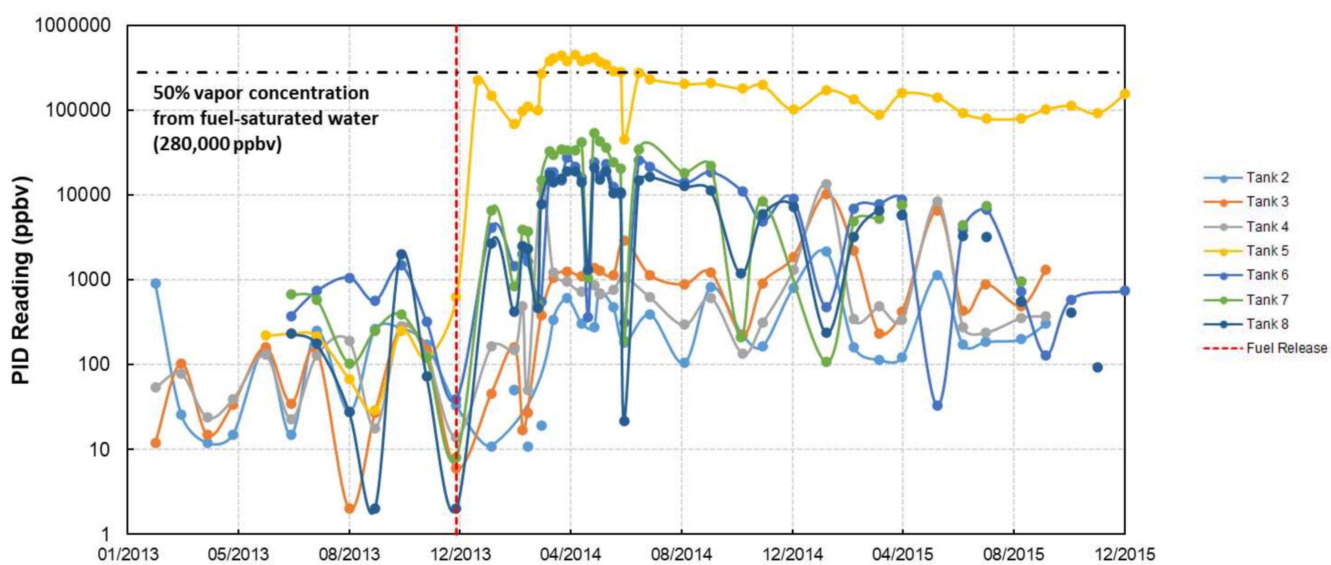
Figure 2.2-7 Summarized Angel Boring LNAPL Data from 1998-2001 in the Tank Farm during Site Investigation Activities

Fuel Indicators Present in Vapor

SVM data provides further evidence of the subsurface contamination caused by fuel releases from the Tank Farm. As described in Section 1.0, a formal groundwater monitoring program was not initiated until 2005 which corresponds to the SVM program initiation in the mid-2000s with the installation of soil vapor probes at variable distances from the point of entry of the angled borings from the lower tunnel. Results from these vapor monitoring locations indicate the presence of several fuel components.

Reviewing trends in concentration data helps to establish an understanding of the distribution and time-varying nature of fuel-derived constituents in the monitoring network. Following the 2014 release, soil hydrocarbon vapor levels were collected from the three-point SVMW system under the tanks. Concentrations under Tank 5 measured on December 23, 2013, and on January 15, 2014, increased as follows: from 50 to 96 part per billion volume (ppbv) (shallow), from 622 to 225,000 ppbv (middle), and from 794 to 204,000 ppbv (deep). The high concentration of 225,000 ppbv measured on January 15, 2014 initially decreased to 100,000 ppbv on February 24, 2014, but later increased even higher to 450,000 ppbv on May 1, 2014 (see Figure 2.2-8). The time-varying pulses of concentration peaks suggest that Tank 5 releases may have occurred along multiple migration pathways with some pathways taking longer than others.

Vapor concentrations of fuel constituents also increased over pre-January 2014 conditions in nearby SVMPs at Tanks 3, 6, 7, and 8 but generally exhibited average vapor concentrations – less than 10 percent of the Tank 5 vapor concentration – over the next year (Figure 2.2-8). The fuel constituents detected by PID measurements suggest that the vapor from beneath Tank 5 migrated towards the east (beneath Tanks 6, 7, and 8) an order of magnitude more than that of the west (beneath Tanks 2, 3, and 4). This eastward direction of vapor migration is noteworthy because it is away from Red Hill Shaft, which is expected to be the primary groundwater flow direction described by the Navy (NAVY 2019 CSM) [B-352]. At present, the Navy has not accounted for a vapor fate and transport model which describes these observations.



Notes: The 50% vapor concentration line of fuel-saturated water is now used as a screening benchmark for tank leaks.

Source: GWPP (NAVY 2014b) [B-373]

Figure 2.2-8 Logarithmic Scale Graph of Monthly PID Monitoring Results from 2013 to 2015 for SWM points below Tank 5 and Adjacent Tanks

Since August 2015, only SVMPs at Tank 5, Tank 7, and Tank 18 have detected fuel constituents in PID readings above 10,000 ppbv. At Tank 7, six large 1-month spikes have been observed:

- 51,000 ppbv in April 2015
- 96,000 ppbv in Nov 2015
- 112,000 ppbv in April 2017
- 176,000 ppbv in June 2017
- 131,000 ppbv in April 2018
- 81,000 in August 2018 (Figure 2.2-8).

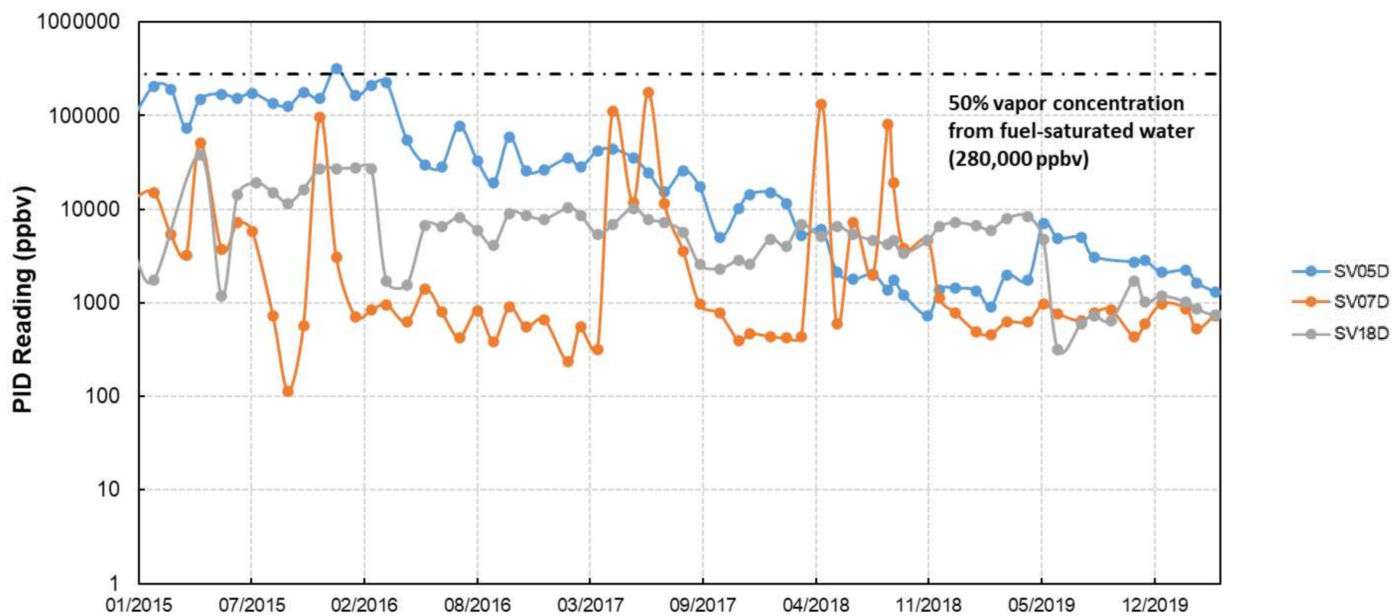


Figure 2.2-9 Logarithmic scale graph of PID monitoring results from 2015 to 2020 for SVMPs below Tank 5, Tank 7, and Tank 18

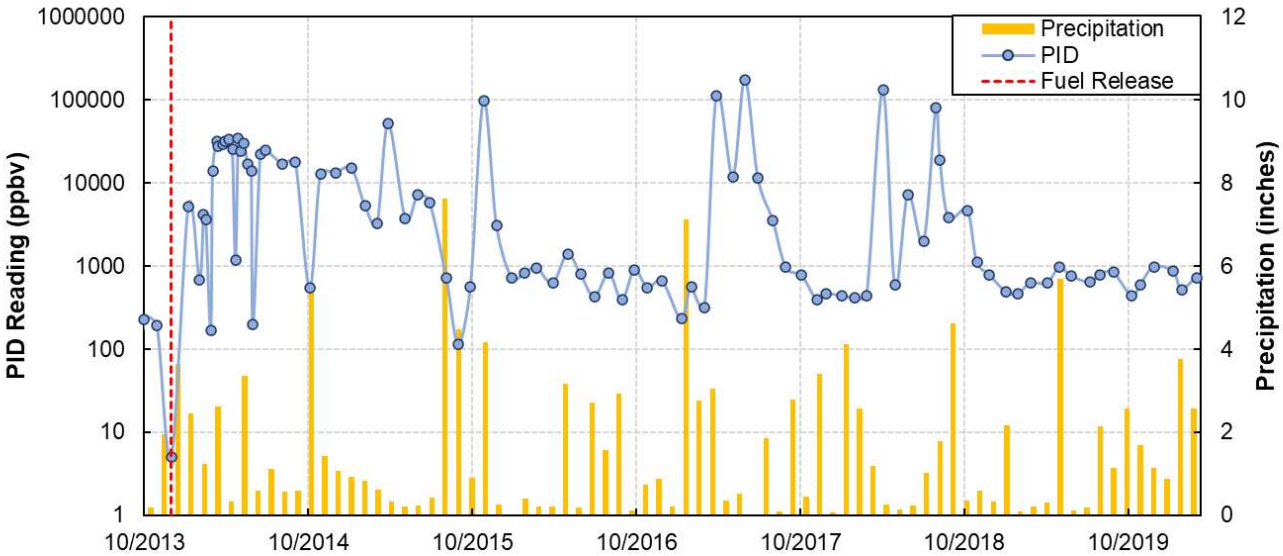


Figure 2.2-10 Logarithmic scale graph of PID monitoring results from 2015 to 2020 for SVMPs below Tank 7

The four Tank 7 PID concentration spikes which have occurred since April 2017 are higher than the observed values at Tank 5. Some of these peaks appear to respond to large precipitation events (Figure 2.2-10), which could be indicative of fast, pulsed transport pathways for fuel released into the unsaturated zone causing a response in soil vapor. Efforts by the Navy to further characterize these vapors have been inconclusive. Thus, after nearly 20 years of monitoring, very little additional insight has been gained on the distribution of fuel and fuel constituents in the subsurface, only adding to the considerable uncertainty regarding the nature and extent of contamination under the Facility and the potential risk to human health and the environment.

2.2.4 Increasing Groundwater Concentration Trend Located in the Tank Farm (2015 to present)

Groundwater concentration trend analysis indicates the potential for ongoing impacts to the Sole Source Aquifer from fuel releases at the Facility. The Navy has been unable to interpret contaminant concentration trends and attenuation rates between the Tank Farm and Red Hill Shaft (NAVY 2019, CSM) [B-352]. Repeated statements in the recent 2019 CSM and predecessor documents suggest that groundwater contaminant concentrations at monitoring wells near the Tank Farm are sporadic (NAVY 2019, CSM) [B-352 at BWS038371-72]. The Facility Environmental Report 2020 includes statements that contaminant concentrations are not "increasing over the life of the groundwater monitoring program (page 18)." Such statements appear to be contradicted by evaluating the more recent data, which indicates:

- Increasing concentration trends at RHMW03, located in the heart of the Tank Farm, including statistically significant increasing TPH-middle distillates concentration trends from 2015 to present; and
- This increasing trend is inconsistent with the wide-spread biodegradation of fuel released in 2014 and suggests that the fuel may be moving toward RHMW03 and away from Red Hill Shaft.

These conclusions are based upon an analysis of the trends in the recent sampling of the primary Facility groundwater monitoring wells. Water quality trends were calculated for the nearest Tank Farm monitoring wells: RNMW01, RNMW02, and RNMW03. Given the documented quality concerns with the Navy's laboratory sampling described in Section 3.1.2, two approaches were used when EPA laboratory data were available: (1) use Navy-laboratory data as reported and (2) substitute EPA laboratory data for Navy-laboratory data. The results of the trend analysis were similar using both datasets. A normality test (Anderson Darling) indicated data were not normally distributed thereby indicating non-parametric statistical trend analyses were appropriate. Data were considered in two timeframes (a) the full dataset for each well and (b) only 2015 to present due to the documented 2014 release from Tank 5. A seasonal Mann-Kendall test was applied to determine at a 95 percent confidence threshold if there is a detectable monotonic trend in the data. Table 2.2-1 summarizes the results. Using this method, trends can be identified as increasing, decreasing, or no trend. The use of a seasonal Mann-Kendall analysis accommodates time-varying influences such as recharge (precipitation), temperature, and groundwater elevations.

Table 2.2-1 Seasonal Mann-Kendall Trends for Red Hills Monitoring Wells

		All Data		2015 and Later Data	
Well Name	Analyte	N	Trend	N	Trend
RHMW01	TPH (middle distillates)	73	Decreasing	26	No Trend
RHMW01	1-Methylnaphthalene	65	No Trend	26	No Trend
RHMW01	2-Methylnaphthalene	73	No Trend	28	No Trend
RHMW01	Naphthalene	77	No Trend	30	No Trend
RHMW02	TPH (middle distillates)	71	No Trend	27	Decreasing
RHMW02	1-Methylnaphthalene	69	No Trend	27	Decreasing
RHMW02	2-Methylnaphthalene	70	No Trend	28	No Trend
RHMW02	Naphthalene	73	No Trend	31	Decreasing
RHMW03	TPH (middle distillates)	61	No Trend	27	Increasing
RHMW03	1-Methylnaphthalene	59	No Trend	27	No Trend
RHMW03	2-Methylnaphthalene	62	No Trend	30	No Trend
RHMW03	Naphthalene	67	No Trend	33	No Trend

Notes: N is the number of samples in each dataset.

The computed trends (shown in Figure 2.2-11 and 2.2-12) indicate several key findings. These include:

- Concentrations are declining for TPH-middle distillates, 1-Methylnaphthalene, and Naphthalene at RHMW02. This finding indicates that there is a change in the rate of fuel release to the Sole Source Aquifer because concentrations are decreasing through time.

- Concentrations at RHMW01 do not have a trend. This finding indicates that processes that may reduce contaminant concentrations are not active. While no trend is reasonable in instances where there was no fuel spill and no significant attenuation processes, Navy trend analyses suggest wide-spread and significant biodegradation processes which limit the migration of fuel components to the groundwater system. Consequently, a declining trend would be expected if conditions were similar at RHMW01 as those observed at RHMW02. This result does not indicate the plume is in a stable configuration.

- While data local to Tank 5 from RHMW02 show decreasing trends for TPH (middle distillates), 1-Methylnapthalene and Naphthalene during this time, an increasing trend for TPH (middle distillates) is observed at RHMW03 which is inconsistent with wide-spread biodegradation of historical fuel releases or fuel released in 2014. This suggests that the fuel may be moving away from Red Hill shaft because RHMW02, which is located between RHMW03 and Red Hill Shaft, is showing a persistent, declining concentration trend.

These trend analyses do not support the statement in the Facility Environmental Report (AECOM and GSI 2020) in Sidebar 10 which states that “there was little to no change in dissolved constituents as measured prior to and after the release…” Nor are they indicative of Facility operations that are protective of human health and the environment as they suggest that there may be ongoing impacts to the Sole Source Aquifer.

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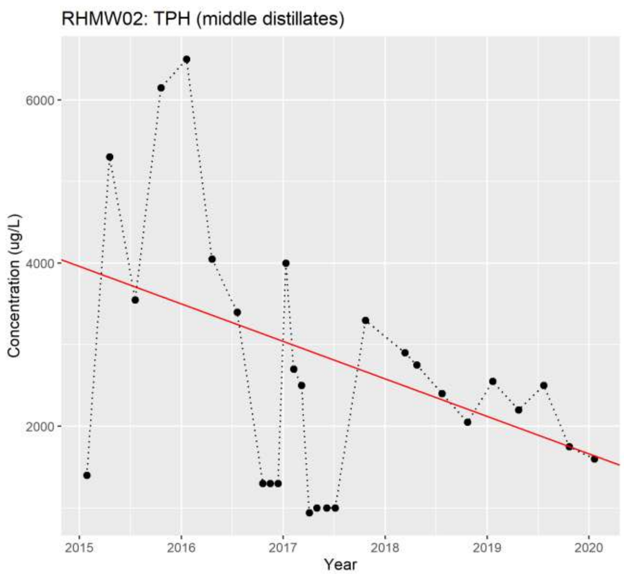


Figure 2.2-11 Concentration of TPH-D at RHMW02 2015 to 2020

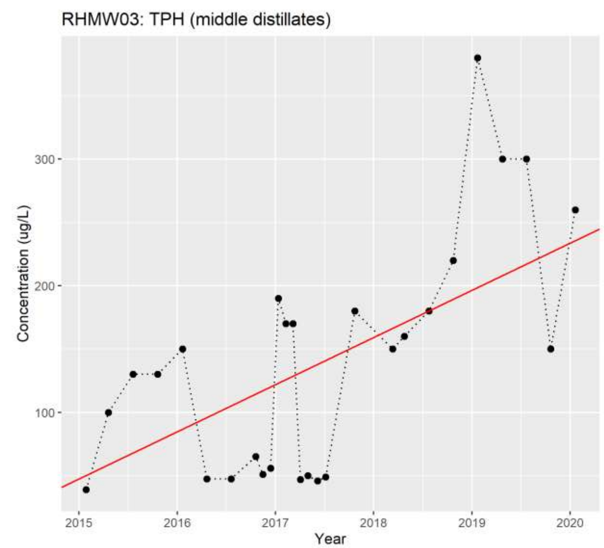


Figure 2.2-12 Concentration of TPH-D at RHMW03 2015 to 2020

2.2.5 Episodic Fuel Release Synopsis

Numerous fuel releases from the Tank Farm have been reported by the Navy or other sources. Most of the USTs have released fuel into the environment and releases have occurred throughout the operational life of the Facility (Figure 2.2-13). Once the fuel enters the subsurface, it may reach the water table of the Sole Source Aquifer, but the movement of the fuel is dependent on the highly complex geologic environment and multi-phase flow processes. Evidence of these fuel releases include:

- Facility histories, API 653 inspections, and Navy release notifications show repeated releases of fuels from the tanks.
- Detection frequency for contaminants determined based on the timing of water quality samples is likely biased low compared to the historical record because few recently reported releases have been sampled extensively, but many reported releases in the past have gone uncharacterized.
- Fuel releases are described in reports and evidence of subsurface fuel and fuel-component migration has included the following media:
  - Drill core contains staining, odors, sludges, and sheens from fuel products.
  - Vapor samples, which clearly show patterns consistent with the 2014 fuel release, and the migration of these vapors away from the Red Hill Shaft suggests vapor transport pathways and eventual migration to groundwater may not be well-characterized based on assumed flow toward Red Hill Shaft.
- Increasing concentration trends at RHMW03, located in the heart of the Tank Farm, shows statistically significant increasing TPH-middle distillates concentration trends from 2015 to the present. The increasing trend for TPH (middle distillates) is inconsistent with the wide-spread biodegradation of fuel released in 2014 and suggests that the fuel may be moving away from Red Hill shaft (See Section 2.2). The Facility CSM is inconsistent with this observation.
- Trend analysis presented here is contrary to the statement in the Facility Environmental Report (AECOM and GSI 2020) in Sidebar 10 which states that "… there was little to no change in dissolved constituents as measured before and after the release…" Instead, we see statistically significant increasing TPH-middle distillates at RNMW03 and statistically significant decreasing trends for TPH (middle distillates), 1-Methylnaphthalene, and Naphthalene at RNMW02.

Given these well-documented releases and fuel constituents encountered, the observations of increasing and decreasing trends indicate that the rocks beneath the facility are not a "sponge" as described on page 17 of the Facility Environmental Report (AECOM and GSI 2020) capable of continuing to hold all contaminants from both historical spills and up to 120,000 gallons of new releases. The numerous documented releases and concentration trends observed in the Tank Farm monitoring wells suggest that a considerable mass could be in the subsurface of the Facility and able to migrate under future conditions indicating that the current Facility operation is not protective of human health and the environment.

RED HILL FUEL STORAGE TANK INCIDENTS 1944-TO PRESENT

Release Events Reported by U.S. Navy 1944 to 2020										
1944 to 1963	2	1	0	0	1	0	0	0	1	0
1964 to 1983	20	0	3	3	2	1	2	1	2	1
1984 to 2003	1	0	0	1	1	0	0	0	0	2
2004 to 2020	0	0	2	0	0	0	0	0	0	0

Release Events Reported by U.S. Navy 1944 to 2020										
1944 to 1963	3	0	1	0	0	0	0	2	0	0
1964 to 1983	0	0	0	0	4	3	1	3	0	0
1984 to 2003	0	0	1	0	2	0	1	1	0	0
2004 to 2020	2	0	0	0	0	0	0	0	0	0

LEGEND for 1998 to 2002 Site Investigation

Basalt Under Fuel Tanks found to have LNAPL/Petroleum Indicators during field investigation

No Petroleum Stains found under tank

Notes: updated data, Figure prepared after DOH document https://health.hawaii.gov/shwb/files/2013/06/19-of-20-tanks-diagram.pdf [B-163]

Figure 2.2-13 Tank Releases from 1944 to Present with notations of Phase II Characterization Observations of LNAPL/Petroleum Indicators during Field Investigation (data provided in Table 1.1-1)

2.3 Applicability of Processes Relied Upon by the Navy to Deplete Released Fuel Are Uncertain or Unproven

The ability of natural processes to inhibit the movement of fuel released from the Tank Farm into the Sole Source Aquifer is overstated and the data provided in support of the Navy's position are highly uncertain.

Navy Position

> "While historical releases (prior to 2014) have resulted in some impacts to the aquifer in the immediate vicinity of the tank farm, "natural attenuation" processes continue to bioremediate and otherwise prevent the petroleum hydrocarbons from spreading far from the tanks." Page i.

Response

The available data does not support the Navy claims that natural attenuation processes such as Natural Source Zone Depletion (NSZD), Monitored Natural Attenuation (MNA), and Holding Capacity are preventing fuel releases from reaching the Sole Source Aquifer. Nor does data support the suggestion that the subsurface beneath the Tank Farm is a "sponge" capable of retaining any released fuel so that it cannot reach the Sole Source Aquifer. Further, there are considerable uncertainties associated with the Navy's data and analyses as described below. Specifically:

- The Navy overestimated NSZD rates provide a misleading understanding of "protection" of the Sole Source Aquifer.
- The presence of MNA indicators demonstrates that NSZD and the holding capacity of the unsaturated zone are unable to protect human health and the environment.
- The Navy's assumed area for occurrence of Tank 5 spill degradation is inconsistent with water quality measurements (dissolved oxygen) and historical measurements of temperatures at key monitoring locations.

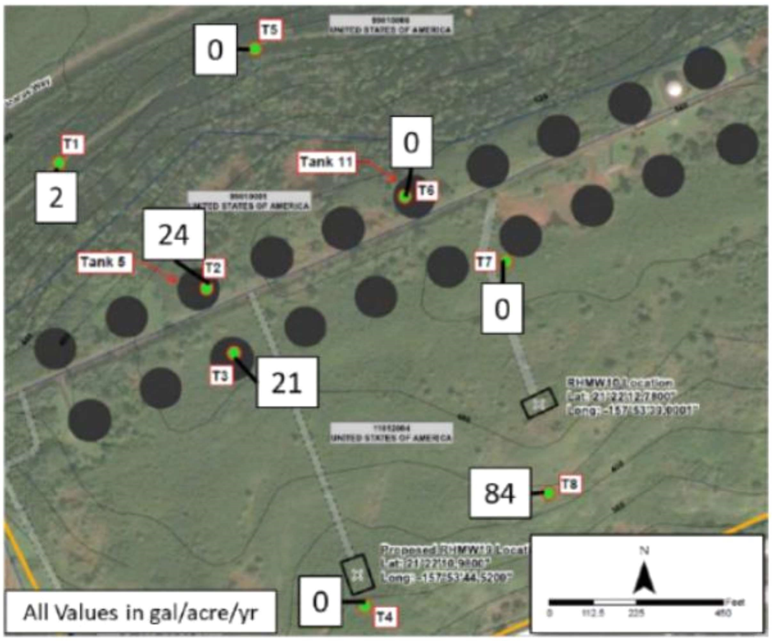
2.3.1 Application of NSZD Rates to Entire Facility Area is not Supported by Data

NSZD is the active process whereby LNAPL is degraded in the subsurface by biodegradation and other naturally occurring processes. NSZD is the primary mechanism upon which the Navy appears to rely to remove the fuels and fuel constituents in the subsurface in the case of a release.

The NSZD rate estimates can be used to evaluate the LNAPL assimilative capacity at the Facility and there are a number of methods for calculating NSZD rates. It should be noted that these methods have generally been developed from and for sites with better characterization of the existing subsurface conditions, where groundwater flows were well understood and where a significant groundwater monitoring network was installed; conditions that do not exist at the Facility. When LNAPL biodegrades, there is an increase in localized temperatures. NSZD rates can be quantified by measuring the magnitude and distribution of subsurface temperatures and then calculating the net heat flux being generated by biodegradation processes. Biodegradation in aerobic conditions described at the Tank Farm typically results in a rapid decrease of gaseous oxygen concentrations and an increased production of carbon dioxide (EPA 1995) [B-389]. Accordingly, NSZD rates can also be estimated based on the ground surface carbon dioxide (CO_2) flux (E-flux method). NAVY (2019) [B-352] estimates a total NSZD rate of 9,900 gallons per year (gal/yr), with a likely annual range of 2,600 to 17,300 gallons. NAVY concludes that given the high capacity for NSZD in the Tank Farm, there will be little, or no concern related to the fuel release from the facility.

CO_2 Flux Measurement Method

The Navy measured CO_2 flux at the ground surface in order to calculate NSZD rates, but the results do not support the Navy's assumptions regarding the subsurface environment at the Facility. Eight carbon traps (T1 to T8) were installed at different locations in the Tank Farm and north and south of the Tank Farm to measure CO_2 flux at the ground surface (see Figure 2.3-1). Traps located far north and far south from the Tank Farm were installed to capture potential CO_2 flux migrating laterally from the main LNAPL source area (estimated by NAVY to be centered around Tank 5).



Notes: CO_2 flux rates measured using the different traps indicated low and sometimes zero flux
Source: NAVY 2019, CSM (Appendix B.1; Figure 3-1) [B-352]

Figure 2.3-1Carbon Trap Locations near the Tank Farm

Interpretation of CO_2 flux allowed calculation of NSZD rates in gal/acre/yr for the different traps. NSZD rates were estimated to vary between 0 gal/acre/yr to 84 gal/acre/yr. The highest NSZD rate (84 gal/acre/yr) was calculated from trap T8 located about one thousand feet from Tank 5. The NSZD rate calculated at T8 is significantly higher than the rates calculated from traps T2 (24 gal/acre/yr) and T3 (21 gal/acre/yr) located in the LNAPL source area (Tank 5). The Navy concluded that the **measured CO_2 flux at T8 was explained by the potential presence of preferential flow pathways induced by clinker zones that enhanced migration of CO_2 to the ground surface far from the LNAPL source area. The Navy's analysis did not take into account the complexity of the subsurface at the Facility, the presence of lava tubes, or the strike and dip of the clinker zones nor the relative position of these zones with respect to the known area with fuel constituents.** To confirm the Navy's conclusion, a differential pressure study was conducted. This study indicated that advective air flow is dominantly from the unsaturated zone into the tunnel, the reverse of what one would see if the Navy's conclusions were correct (NAVY 2019) [B-352 at BWS038473]. **Therefore, the differential pressure study results appear inconsistent with CO_2 emissions migrating the 1,000 feet outside the Tank Farm area**.

NSZD Rate Estimation Inconsistent with Tank Farm Area

The Navy utilized an area that is more than 5 times greater than the Tank Farm to determine the NSZD rate without sufficient evidence. Based on an average NSZD rate of 16 gal/acre/yr and the area covered by traps T1 to T8 (61 acres), the estimated NSZD rate is about 1,000 gal/yr. The area encompassed by the Tank Farm is estimated to be 13.1 acres and is more representative of the LNAPL source area. Based on the average NSZD rate of 16 gal/acre/yr and the area of the Tank Farm (13.1 acres), the estimated NSZD rate is much lower than reported by the Navy (NAVY 2019) [B-352]. A more reasonable estimate considering these data is about 210 gal/yr, not the 1,000 gal/yr described above. This reduction in rate directly influences the interpretation of how much LNAPL released from a tank will reasonably biodegrade before reaching the Sole Source Aquifer.

Temperature Distribution Methods

The observed temperature differentials at the Tank Farm do not support the Navy's estimated NSZD rates. Temperatures measured at the different well locations between 2017 and 2019 were similar. These results have been interpreted as showing a consistent biodegradation rate resulting from a continuing LNAPL source term. If NSZD is, in fact, occurring at a relatively constant rate, it should be at the lower end of the range because otherwise a decrease in temperature profiles between 2017 and 2019 would have likely been observed if there were no additional significant spill or releases since the documented 2014 event from Tank 5.

From the data collected, the temperature difference is the highest at RHMW03 compared to RHMW05 (background well). This temperature differential is interpreted as indicative of active biodegradation near RHMW03. However, other available data does not support this conclusion. For example, PID readings at T7 (Tank 14) and close to RHMW03 did not show <u>any</u> detectable volatile organic compounds (VOCs). In addition, only low levels of CO_2 were measured from RHMW03 well headspace over time. The Navy's simplified comparative assessment of temperature profiles between a specific well and a background well assumes that only NSZD processes are affecting temperature differences. Considering the complex site setting, this assumption is not justified and as stated by the researchers, would result in this being the only site <u>ever</u> documented where direct LNAPL biodegradation is occurring under aerobic conditions in the unsaturated zone (McHugh et al. 2020) [B-309].

Assuming that biodegradation is occurring, the best estimate for the total NSZD rate from the different temperature distribution methods utilized is a range of 2,600 to 17,300 gal/yr. This range assumed a Tank Farm area of 13.1 acres. It must be noted that this range is very different from the NSZD rate estimated using the CO_2 flux for the same area (210 gal/yr).

Temperature vs. Biodegradation

In the aerobic conditions found in the unsaturated zones at the Tank Farm, one would expect to see a rapid decrease in gaseous oxygen concentrations when biodegradation occurs. No evidence of gaseous oxygen concentration depletion has been measured at the Facility underneath the Tank Farm nor is there significant carbon dioxide production (NAVY 2019) [B-352]. Historical monitoring data collected using the vapor monitoring probes installed underneath the Tank Farm also supports the conclusion that there has not been any oxygen depletion observed in the unsaturated zone (NAVY 2019) [B-352]. The assumptions put forward in the CSM to explain the prevalence of aerobic degradation reactions despite no evidence of oxygen depletion in the unsaturated zone underneath the Tank Farm are essentially based on the permeable nature of the bedrock formation and the presumed presence of a constant influx of air driven by the tunnel ventilation system.

Under these conditions, with no evidence of oxygen depletion in the unsaturated zone underneath the Tank Farm and low production levels for CO_2, the use of temperature as indirect evidence of active biodegradation reactions become a key parameter to support CSM assumptions. Therefore, much emphasis has been placed on the temperature differences between background conditions and Facility conditions, both for the unsaturated and saturated zones. These temperature differences are interpreted as being caused by the presence of active biodegradation reactions of TPH.

The Navy suggests that the elevated groundwater temperature at the inside-tunnel wells is attributable to NSZD processes (NAVY 2020, IRR) [B-339]. It is assumed that the heat generated by NSZD processes is transferred down to the groundwater through thermal conduction and that this energy transfer from the unsaturated zone heat source creates a source of warm groundwater (NAVY 2020, IRR) [B-339].

Historical groundwater temperatures as related to known spills and releases, however, do not support this model. Figure 3-4 (NAVY 2019) [B-352] outlines the historical groundwater temperature at several monitoring wells. **Groundwater temperature at RHMW02 seems to be relatively constant over time and increases in groundwater temperature following the 2014 spill is not noticeable.** Groundwater temperature at RHMW01, located downgradient from RHMW02, appears to be decreasing historically and does not show an increase associated with the 2014 Tank 5 release. **Considering the hypothesis that elevated groundwater temperature was caused by heat transfer from NSZD processes then the stable RHMW02 groundwater temperature shows <u>no</u> response to the 2014 release.** It is important to outline that some wells located outside the Facility showed an increasing temperature trend recently (RHMW07; RHMW11-05 showed a historical high in 2018). It seems more likely that some other processes are present and influencing groundwater temperature.

EPA and DOH (October 2018) [B-349 at BWS038012] share similar concerns:

> The groundwater temperature in RHMW03 measured during sampling has remained unchanged at about 26.5 ^{o}C since first sampled in 2005 to the present, indicating that the temperature profile recently measured by the Navy likely existed when RHMW03 was first drilled. Consequently, this locally-elevated temperature does not directly relate to the migration or distribution of LNAPL arising from the 2014 release but relates (at least, predominantly) to past releases.

NSZD in the Context of a One-Tank Release

As described throughout this section, there are significant discrepancies between NSZD rates estimated using the thermal methods and the NSZD rate estimated using the carbon dioxide flux method. The following table shows the average NSZD rates calculated using the thermal and carbon dioxide methods (Table 2.3-1).

Table 2.3-1 Natural Source Zone Depletion Average Rates

NSZD Estimation Method		NSZD Average Rate(gal/acre/yr)
Thermal Profile	Net (background-corrected) (Thermal Method 1)	759
	Model-corrected (Thermal Method 2)	847
Carbon Dioxide Flux		16

The NSZD rates have been applied to different scales to estimate a volume per year of LNAPL degraded (see Table 2.3-2). The Tank Farm area has been estimated at 13.1 acres.

Table 2.3-2 Volume of LNAPL Degraded using Different Scale Assumptions

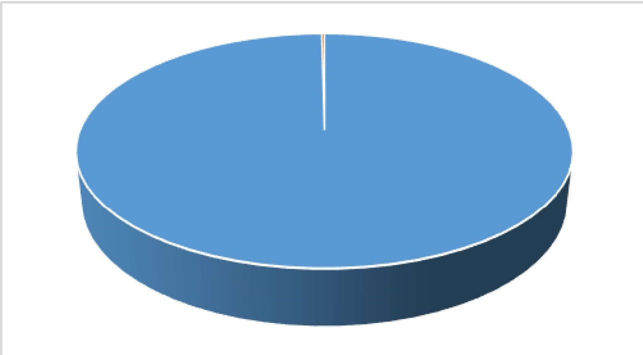
NSZD Estimation Method	LNAPL Volume Degraded over the Tank Farm Area (gal/yr)	LNAPL Volume Degraded in Tank areas showing 10,000 ppbv (PID readings) in 2014 (Tank 5, 6, 7) (gal/yr)	LNAPL Volume Degraded for Tank 5 Area (gal/yr)
Thermal Method 1	9,942	1,480	493
Thermal Method 2	11,095	1,660	550
Carbon Dioxide Flux	209	32	10

The Facility Environmental Report (AECOM and GSI 2020) indicates that NSZD will help ensure human health and the environment are protected by degrading any fuel release. However, if a release occurs at a specific tank, this release will likely not be distributed over the entire Tank Farm. For instance, after the 2014 release from Tank 5, the PID monitoring results from the vapor monitoring points located underneath the Tank Farm indicated that the release impacted soil vapor probes underneath Tank 5 and the vapor probes located in the immediate vicinity of this tank. Vapor probes located further away from Tank 5 showed a far more modest increase in PID readings. The NSZD rates for the Tank 5 area is calculated to be 10 to 550 gal/yr (Table 2.3-3).

Table 2.3-3 LNAPL Degraded Volume over Tank 5 Area

Component	Volume (gallon) or Volume per time (gal/yr)
Tank 5 Capacity	12,500,000 gallons
Tank 5 Release (2014)	27,000 gallons
LNAPL degraded per year at Tank 5	10 to 550 gal/yr
LNAPL Degraded since 2014 at Tank 5	60 to 3,300 gallons

The following graph shows the magnitude difference between the 2014 release volume (27,000 gallons) and volume of LNAPL degraded at the scale of Tank 5.



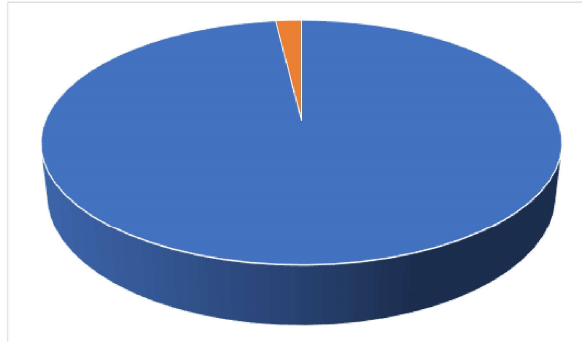


Figure *2.3-2a Comparison of Tank 5 Volume Capacity* and 2014 LNAPL Release Volume from Tank 5

***Figure 2.3-2b. Comparison of 2014 Tank 5* Release Volume (blue) and Annual LNAPL Degraded Volume (highest rate) (orange).**

It is important to note that the 2014 release only represents 0.2 percent of the Tank 5 capacity (Figure 2.3-2a). **The NSZD rate estimated at the Tank Farm is likely not high enough to manage significant spill from the Tank Farm, even if the Navy's unsupported rates are accepted**. At a rate of 10 to 550 gal per year, **the 27,000 gal released in 2014 would require between 49 and 2,700 years to be fully degraded.** This is assuming a constant NSZD rate (as assumed in the CSM) and no other fuel in the subsurface. As the LNAPL source is exhausted, the NSZD rate would likely decrease with time and could reach even lower rates.

2.3.2 NSZD Synopsis

- Biodegradation is occurring at the Facility near the Tank Farm due to existing LNAPL in the subsurface from both historical and the 2014 releases.
- The assumed area where the 2014 spill is being degraded is inconsistent with water quality measurements and historical measurements of temperatures at key monitoring locations leading to an overestimation in the potential for the NSZD to effectively protect human health and the environment.
- There are conflicting assumptions used to develop the rate calculations, for example preferential flow paths can transport CO_2 far away from the Tank Farm, but preferred pathways would not lead to uncontrolled LNAPL migration.
- If calculations are applied at a Tank-scale, which is more consistent with the Facility release history, LNAPL may require decades to thousands of years to degrade.

2.3.3 Presence of MNA indicators demonstrate NSZD and Holding Capacity Rates are not Protective

Appendix B-5 of the CSM Report (NAVY 2019) [B-352 at BWS038628-69] outlines the secondary lines of evidence to assess MNA in groundwater and Figure 3-1 (NAVY 2019) [B-352 at BWS038158] presents the concentration of electron acceptors and reaction by-products for different monitoring wells. It is concluded that spatial and temporal trends for several parameters (O_2, NO_3^-, SO_4^{2-}, etc.) provide strong evidence for aerobic and anaerobic TPH degradation within the Tank Farm groundwater. The spatial distribution of MNA parameters concentration confirmed active MNA processes in groundwater within the Tank Farm area, but **the very existence of consistent MNA indicators in groundwater demonstrates that there have been impacts to groundwater from the Facility releases and that NSZD processes in the unsaturated zone have been**

unable to protect the Sole Source Aquifer from the releases. This finding is contrary to the holding capacity description and efficient NSZD which the Facility Environmental Report (AECOM and GSI 2020) provides as evidence of the system-upon-system approach to protect human health and the environment.

2.3.4 Summary of Processes Relied Upon to Prevent Release Migration to Groundwater Uncertain or Unproven

There is current evidence that the Sole Source Aquifer has already been impacted by Facility releases due to the presence of MNA indicators. These indicators demonstrate that NSZD and the holding capacity of the unsaturated zone are unable to protect human health and the environment, as asserted by AECOM and GSI (2020).

Holding Capacity Analysis which conflicts with the well-documented releases and contaminants encountered the observations of increasing and decreasing trends indicate that the rocks beneath the facility are not a "sponge" as described on page 17 of the Facility Environmental Report (AECOM and GSI 2020) capable of continuing to hold all contaminants from both historical spills and up to 120,000 gallons of new releases. The numerous documented releases and concentrations observed in the Tank Farm monitoring wells suggest that a considerable mass could be in subsurface of the Facility and able to migrate under future conditions indicating that the current facility operation is not protective of human health and the environment.

EPA and DOH (October 29, 2018) [B-349 at BWS037975] comment that:

> The Navy's current CSM and statistical Non-Aqueous Phase Liquid ("NAPL") holding model do not adequately address potential impacts to groundwater from fuel releases, account for Light Non-Aqueous Phase Liquid ("LNAPL") migration processes or explain lines of evidence for historical transport observed in the field.

The NSZD Rate estimated at the Tank Farm indicate that the biodegradation rates are not high enough to manage significant spills from the Tank Farm. At a NSZD rate of 10 to 550 gal per year, the 27,000 gal released in 2014 would require between 49 and 2,700 years to be fully degraded. This is assuming a constant NSZD rate (as assumed in the CSM) and no other fuel in the subsurface. As the LNAPL source is exhausted, the NSZD rate would likely decrease with time and could reach even lower rate. **The presence of MNA indicators in groundwater clearly demonstrate that NSZD is insufficient to prevent the introduction of contaminants into the Sole Source Aquifer.**

2.4 Planned Improvements do not Ensure Facility is Protective

The Navy should not receive credit for planned Facility improvements that have not been approved by the necessary regulatory agencies or for which the Navy has not committed to implementing.

Navy Position

> "[C]ontinued protectiveness is being ensured by additional work that has been and continues to be conducted under the auspices of the Red Hill Groundwater Protection Plan ("GWPP") and the Red Hill Administrative Order on Consent ("AOC"). Most of this work significantly exceeds regulatory mandates, is specifically designed to ensure the ongoing safety of the Facility, and is extensively overseen by the environmental regulators and their expert consultants." Page ii.

Response

The fact that historical and recent fuel releases from the Tank Farm have resulted in an administrative order forcing the Navy to complete certain Facility upgrades does not mean that releases of fuel to the Sole Source

Aquifer will necessarily stop or that the Navy's future operations will be protective of human health and the environment. To date, Navy operations have resulted in multiple releases of fuel to the environment, including the Sole Source Aquifer, indicating that the operation is not protective. The sheer number of potential future process changes and structural upgrades being considered indicates the number of concerns associated with current operations. Plans are not yet reviewed, approved, or implemented and may be adjusted under the AOC process, making the assurances of additional safety suggested in the Facility Environmental Report uncertain. Further, it is not clear that these contemplated improvements, if implemented, would be effective as they are unproven and rely on incomplete data and lack of source zone characterization which are necessary to establish critical mechanisms and transport pathways. Finally, the recent regulatory disapproval, deficiency, and conditional approval letters indicate that the Navy's approach is not in keeping with the expectations of regulatory oversight, not working, and not protective.

Specifically, the EPA and DOH recently commented in a deficiency letter (October 2020) [B-28 at BWS007376] that "The Overall Strategy Needs to Provide a Fail-Safe Plan for Water Protection." The agencies further comment that:

- The overall objective of both DOH's and EPA's underground storage tank programs is to protect human health and the environment from releases at underground storage tank facilities.
- Prevention, detection, and response systems are required.
- Given the importance of the Sole Source Aquifer below the Tank Farm as a major source of drinking water, the Navy needs to establish a contingency strategy to assure no impairment of drinking water quality and no disruption in drinking water availability.

The Facility Environmental Report (AECOM and GSI 2020) mentions that the control of fuel releases from the Facility may be achieved if Red Hill Shaft is pumped at its regulatory-permitted pumping limit because numerical modeling performed by the Navy indicates that the fuel will be captured at the Red Hill Shaft (Sidebar 16 and page 49).

EPA and DOH (2020) do not agree [B-28 at BWS007376]:

> "The Regulatory Agencies note that the degree of capture at Red Hill Shaft for a range of possible release scenarios has not yet been fully evaluated and remains unclear whether it is an adequate measure to prevent impact to other receptors."

Historical data also do not indicate pumping at Red Hill Shaft will fully protect drinking water resources. The Red Hill Shaft has been operating since the 1940s, however detectable concentrations of fuel constituents at RHMW02 have not been observed at the Shaft consistently. Given the long history of observed contamination at RHMW02 and the pumping at Red Hill Shaft, the Navy has failed to provide direct evidence that pumping at the shaft will be a means to fully capture all contamination reaching the Sole Source Aquifer from the Tank Farm.

Attempts to provide data-based evidence for this suggested capture have not been successful. During hydraulic tests, where pumping rates are adjusted and water levels are monitored to see if there is a hydraulic response from the pumping event, there was less connection to the Facility area wells and observed changes were characterized as an increase in the generally gentle southwest dipping gradient (NAVY2019, CSM) [B-352 at BWS038251]. Consequently, using the numerical model results to support pumping Red Hill Shaft as a groundwater protection strategy is inconsistent with data and unsupported by EPA and DOH regulators resulting in an unapproved, unproven plan to protect the Sole Source Aquifer.

Table

Table 1.1-1 Record of Known Fuel Release Events at the Red Hill Facility

Release	Tank	Year	Volume (gallons)	Reference
1	1	1947	5	B-15 at BWS005166; B-195 at BWS027743; B-214; B-216.
2		1953	UK	B-15 at BWS005166; B-195 at BWS027744; B-197 at BWS027814; B-214; B-216.
3		1964	UK	B-15 at BWS005166; B-195; B-197 at BWS027814; B-214; B-216.
4		1964		B-15 at BWS005166; B-195 at BWS027745; B-197 at BWS027814; B-214; B-216.
5		1964		B-15 at BWS005166; B-195 at BWS027745; B-197 at BWS027814; B-214; B-216.
6		1965	UK	B-15 at BWS005166; B-195 at BWS027747; B-197 at BWS027814; B-214; B-216.
7		1965	UK	B-15 at BWS005166; B-195 at BWS027747; B-197 at BWS027814; B-214; B-216.
8		1966	UK	B-15 at BWS005166; B-195 at BWS027747; B-197 at BWS027814; B-214; B-216.
9		1967	UK	B-15 at BWS005166; B-195 at BWS027747; B-197 at BWS027814; B-214; B-216.
10		1970	4623	B-15 at BWS005166; B-216; B-214; B-195 at BWS027748; B-197 at BWS027814.
11		1971	16830	B-15 at BWS005166; B-195 at BWS027748; B-197 at BWS027814; B-214; B-216.
12		1971	5031	B-15 at BWS005166; B-195 at BWS027748; B-197 at BWS027814; B-214; B-216.
13		1972	4810	B-15 at BWS005166; B-195 at BWS027748; B-197 at BWS027814; B-214; B-216.
14		1975	10671	B-15 at BWS005166; B-195 at BWS027750; B-197 at BWS027814; B-214; B-216.
15		1977	999	B-15 at BWS005166; B-195 at BWS027750, B-197 at BWS027814; B-214; B-216.
16		1978	7874	B-15 at BWS005166; B-195 at BWS027750; B-197 at BWS027814; B-214; B-216.
17		1978	13221	B-15 at BWS005166; B-195 at BWS027751; B-197 at BWS027814; B-214; B-216.

Release	Tank	Year	Volume (gallons)	Reference
18	1	1982	2417	B-15 at BWS005166; B-195 at BWS027752; B-197 at BWS027814; B-214; B-216.
19		1982	871	B-15 at BWS005166; B-195 at BWS027753; B-197 at BWS027814; B-214; B-216.
20		1983	2229	B-15 at BWS005166; B-195 at BWS027754; B-197 at BWS027814; B-214; B-216.
21		1983	-1090	B-15 at BWS005166; B-195 at BWS027755; B-214; B-216.
22		`1983	-1004	B-15 at BWS005166; B-195 at BWS027755; B-214; B-216.
23		1999	UK	B-15 at BWS005166; B-195 at BWS027755; B-214; B-216.
	1	1997	Out of Service	B-197 at BWS027904.
24	2	1947	UK	B-15 at BWS005166; B-197 at BWS027814; B-214; B-216; B-231.
25		1954	0.375	B-15 at BWS005166; B-214; B-216; B-231 at BWS028473.
26		1954	10	B-15 at BWS005166; B-214; B-216; B-231 at BWS028473.
27		2008		B-15 at BWS005166; B-216; B-238 at BWS029230.

Release	Tank	Year	Volume (gallons)	Reference
28		2008		B-15 at BWS005166; B-216; B-238 at BWS029230.
29	**3**	1949	4260	B-15 at BWS005166; B-216; B-214.
	4		No Leaks	B-197 at BWS027814; B-213.
30	5	1964	1	B-15 at BWS005166; B-214; B-216; B-231 at BWS028479.
31		1965	1	B-15 at BWS005166; B-197 at BWS027815; B-214; B-216; B-231 atBWS028479.
32		1972	0.5	B-15 at BWS005166; B-197 at BWS027815; B-214; B-216; B-231 at BWS028480.
33		2010	UK	B-15 at BWS005166; B-214; B-216; B-242 at BWS029889.
34		2014	27000	B-15 at BWS005166; B-214; B-216.
35	**6**	1952	UK	B-15 at BWS005166; B-190 at BWS025861; B-216.
36		2002	UK	B-15 at BWS005166; B-216.
37	**7**	1973	UK	B-15 at BWS005166; B-184 at BWS025697; B-196 at BWS027765; B-197 at BWS027815; B-216.
38		1978	UK	B-15 at BWS005166; B-184 at BWS025697; B-197 at BWS027815; B-214; B-216.
39		1980/81	6505	B-15 at BWS005166; B-184 at BWS025698; B-197 at BWS027815; B-214; B-216.
40		1998	UK	B-187 at BWS025779.
No Leaks	**8**	----	No Leaks	B-197 at BWS027815; B-213 at BWS028411.
41	9	1958	1500	B-15 at BWS005166; B-197 at BWS027815; B-214 at BWS028414; B-216; B-285.
42		1978		B-15 at BWS005166; B-197 at BWS027815; B-216.
43		1980	1900	B-15 at BWS005166; B-197 at BWS027815; B-214 at BWS028414; B-216; B-285.
44		1996	UK	B-197 at BWS027815; B-233 at BWS028517.
45	**10**	1973	UK	B-15 at BWS005166; B-176 at BWS025438; B-197 at BWS027815; B-214 at BWS028414; B-216.
46		1976	UK	B-15 at BWS005166; B-176 at BWS025438; B-196 at BWS027766; B-216.

Release	Tank	Year	Volume (gallons)	Reference
47		1980	3123	B-15 at BWS005166; B-176 at BWS025439; B-214 at BWS028414; B-216.
48		1981	5097	B-15 at BWS005166; B-176 at BWS025439; B-197 at BWS027815; B-216.
49		1996	UK	B-228 at BWS028466; B-233 at BWS028529.
50		1998	UK	B-180 at BWS025588.
51	**11**	1980	25,628	B-15 at BWS005166; B-197 at BWS027816; B-214 at BWS028414; B-216; B-226 at BWS028445.
52	**12**	1964	UK	B-15 at BWS005166; B-197 at BWS027816; B-216; B-226 at BWS028447.
53		1973	UK	B-15 at BWS005166; B-197 at BWS027816; B-216; B-226 at BWS028447.
54	**12**	1981	4280	B-15 at BWS005166; B-197 at BWS027816; B-214 at BWS028414; B-216; B-226 at BWS028446.
55	**13**	1976	UK	B-15 at BWS005166; B-197 at BWS027816, B-216; B-226 at BWS028443, BWS028451.
56		1981	UK	B-15 at BWS005166; B-197 at BWS027816; B-216; B-226 at BWS028443, BWS028451.
57	**14**	1982	UK	B-15 at BWS005166; B-216.
58		1995	UK	B-223 at BWS028433; B-233 at BWS028617.
59	**15**	1981	UK	B-15 at BWS005166; B-197 at BWS027816; B-214 at BWS028414; B-216; B-223 at BWS028439.
60	**16**	1948/49	11009	B-15 at BWS005166; B-194; B-197 at BWS027816; B-214 at BWS028414; B-216.
61		1949	17737	B-15 at BWS005166; B-194; B-197 at BWS027816; B-214 at BWS028414; B-216.
62		1973	UK	B-15 at BWS005166; B-194 at BWS027728; B-197 at BWS027816; B-214 at BWS028414; B-216.
63		1981	UK	B-15 at BWS005166; B-194 at BWS027730; B-214 at BWS028414; B-216.
64		1981	UK	B-15 at BWS005166; B-194 at BWS027730; B-197 at BWS027817; B-214 at BWS028414; B-216.

Release	Tank	Year	Volume (gallons)	Reference
65		1998	1469	B-15 at BWS005166; B-194 at BWS027738, BWS027739; B-214 at BWS028414; B-216.
66	**17**	1949	1420	B-15 at BWS005166; B-214 at BWS028414; B-216.
67		1969	1	B-15 at BWS005166; B-197 at BWS027817; B-214 at BWS028414; B-216; B-221 at BWS028425.
68		1975	UK	B-15 at BWS005166; B-197 at BWS027817; B-214 at BWS028414; B-216; B-221 at BWS028426.
No Leaks	**18**	-----	No Leaks	B-197 at BWS027817; B-213 at BWS028412.
69	**19**	1964	UK	B-15 at BWS005166; B-191 atBWS026699; B-197 at BWS027817; B-214 at BWS028414; B-216; B-232.
70		2000	UK	B-204 at BWS028333
		1997	Out of Service	B-197 at BWS027904.
71		1998	UK	B-15 at BWS005166; B-197 at BWS027817; B-214 at BWS028414; B-216.
72	**UK**	2012	6	B-198 at BWS028133.
		TOTAL VOLUME	**178,434 gallons**	

Notes: UK = Unknown

APPENDIX A

Resume of Nicole DeNovio, Ph.D., LHg

Nicole M. DeNovio, PhD, LHg (WA)

Water Practice Area Leader/Principal

Education

PhD Civil Engineering, University of Colorado, Boulder, Colorado, 2003

MS Environmental Science, University of Virginia, Charlottesville, Virginia, 2001

BS Geosciences, Juniata College, Huntingdon, Pennsylvania, 1997

Certifications

Licensed Hydrogeologist, Washington, #2801

Licensed Geologist, Washington, #2801

PROFESSIONAL SUMMARY

Dr. Nicole DeNovio is a Principal and Practice Leader at Golder Associates Inc. in Redmond, Washington. Nicole is a Washington-registered hydrogeologist and geologist specializing in water resources and water quality issues. Nicole has groundwater flow and contaminant transport experience for projects including the largest contaminated site in the United States, a Superfund Mega Site. Additionally, she has groundwater supply, hydrologic assessment and modelling, water right planning and implementation, groundwater modelling, vadose zone characterization, geochemical characterization, emerging contaminants, and water quality contamination and transport experience. Her projects frequently involve complex stakeholder relationships and briefings to regulatory agencies, along with regulatory negotiation.

Nicole develops conceptual models of complex systems and implements these into quantitative models of reservoirs and aquifer systems. She has extensive experience in using advanced calibration tools (e.g., PEST) in models to achieve high-quality history matches that are subject to extensive peer- and regulatory-review. She serves as Executive Director of East King County Regional Water Association, is a Scientific Advisory Committee member since 2011 for the industry leading MODFLOW & More Conference, sponsored by the Integrated Groundwater Modelling Centre, and member of EPA's Modelling Technical Advisory Committee for the San Fernando Valley Basin (the primary source of groundwater for the City of Los Angeles). Nicole also leads Golder's global technical community of groundwater modelers, site investigation and remediation technical network and global water practice team.

RELEVANT EXPERIENCE

Hewitt Site; Vulcan Materials Inc.

Burbank, California

Managing hydrogeologist and hydrogeochemist for site characterization of a backfilled sand and gravel mine. The site soil, vadose zone and groundwater is impacted with chlorinated solvents, metals, and emerging contaminants. Performed conceptual site model development, hydrostratigraphic framework refinement, source characterization, groundwater modelling, and pilot remedial design. Prepared state and federal work plans and investigation, feasibility, and design reports. Supported hydrogeologic interpretation and reporting for routine compliance reports. Prepared conceptual site model, data evaluations, and numerical groundwater modelling contributing to the site human health risk assessment. Ongoing work includes detailed remedial design, interpretation of natural attenuation mechanisms, and optimization and assessment of basin-wide

San Fernando Valley groundwater model to improve representation of site conditions. Management of litigation support project focusing on contaminant apportionment among large group of responsible parties. Regulatory negotiation focused on staging of remedial activities and identification of contaminants of concern.

Former Satralloy Site; Freeport McMorran Copper and Gold
Cross Creek Township, Ohio

Lead hydrogeologist responsible for site investigation design, hydrogeologic conceptual model development, data evaluation and assessment for the remedial investigation/feasibility study (RI/FS), interim action activities, and feasibility investigations supporting site closure. The Satralloy Site is a 325-acre Ohio State Superfund site comprised of a collapsed underground mine and ferro-alloy manufacturing facility; much of the site is covered with slag piles. The primary constituents of concern include chromium and arsenic, and key receptors are water supply wells and surface water bodies. Completed data evaluation and regulatory support focused on surface water-groundwater pathways, fractured bedrock fate and transport, geochemical redox processes, and organometallic complex formation to support monitored natural attenuation site-wide closure strategy. Led integration of conceptual site model with risk-based ecological assessment in support of agency negotiation. Litigation support for corporate risk evaluations. Current work is focused on management and interpretation of integrated drilling, hydrogeologic, geologic, geophysical, geotechnical, and geochemical data collection to support a feasibility assessment of moving slag to the collapsed mine and use of native soils for facility cap design.

Blackbird Mine Site Performance Monitoring; Blackbird Mine Site Group
Salmon, Idaho

Blackbird Mine is a former copper/cobalt property which was historically a significant contributor of copper loading to Blackbird and Panther Creek (a tributary of the Salmon River) due to seepage from acid-generating waste rock piles. Early actions resulted in substantive decreases in metal loading, however long-term compliance with a site-wide Performance Monitoring Plan (PMP) pursuant to an Administrative Order on Consent (AOC) with the US Environmental Protection Agency (EPA) and the Natural Resource Trustees (Idaho Department of Environmental Quality [DEQ], National Marine Fisheries Service, and US Forest Service [USFS]) have created considerable sampling and analysis requirements. Worked with the Blackbird Mine Site Group and consultant project team to develop a regulatory strategy to modify the PMP resulting in an approximately 50% reduction in number of samples and leading to significant reductions in site contact hours. Currently serving as the site Quality Assurance Project Plan director and senior technical reviewer on monitoring and data-interpretation reports and supporting the Blackbird Mine Site Group on regulatory strategy which includes both active remediation and monitored natural attenuation.

Mine Operations; Confidential Client
Western Australia

Senior technical advisor for a MODFLOW model used to quantify the operational risk of potential migration of contaminants (location and concentration) due to dewatering operations at three critical ore bodies. Sensitivity, uncertainty methods coupled to particle tracking analysis were implemented to identify dewatering strategies that will minimise the risk of mobilizing contaminants into dewatering bores. The contaminants of interest are per and polyfluoroalkyl substances (PFAS) and total petroleum hydrocarbons (TPH). The geologic framework includes fractured rock aquifers and structural controls. PEST sensitivity techniques and machine learning algorithms are being implemented to improve decision support.

Johns Creek Hydrogeology Study for Conceptual Hydrogeologic and 3D Groundwater Models; Washington State Department of Ecology
Mason County, Washington

Performed hydrogeological characterization and conceptual model development; three-dimensional hydrostratigraphic model review and refinement; numerical groundwater model development, including development of steady-state and transient models; evaluation of the extent of exempt well withdrawal within the basin; and evaluation of management options using the numerical model. Technical work was used to establish the State of Washington's position on pending litigation. Managed stakeholder cooperation with the Tribe to work toward consistent modeling and analysis approaches within the area.

Underground Test Area Project, Nevada Test Site Groundwater USDOE Review Committee, Yucca Flat CAU; USDOE
Las Vegas, Nevada

Groundwater-modeling member and lead of a multi-disciplinary USDOE review committee ensuring technical quality and appropriateness of site characterization activities, analysis and documentation and groundwater fate and transport modeling evaluations. Provided guidance on regulatory compliance strategy.

Underground Test Area Project, Nevada National Security Site Groundwater Flow and Contaminant Transport Modelling, Pahute Mesa CAU; US Department of Energy (USDOE)
Mercury, Nevada

Project manager or technical lead for developing integrated strategies to address groundwater flow and contaminant transport in fractured rocks. Incorporated lithologic rock properties, borehole geophysical data, and geochemical data to establish conceptual models of groundwater flow. Interpreted aquifer tests and long-term water level monitoring data to constrain interpretations of hydrogeology. Developed integrated strategies to address groundwater flow and contaminant transport in fractured rocks. Constructed and calibrated discrete fracture network models and reservoir models. Incorporated multi-scale geologic data to develop statistical rock properties controlling flow pathways and barriers. Interpreted deep, multiple-well interference tests affected by high temperature subsurface conditions. Managed meetings with state environmental regulators and an internal expert guidance panel. Responsible for project proposals, schedules, budgeting, quality assurance, and client service.

Underground Test Area Project, Nevada Test Site Groundwater Flow and Contaminant Transport Modelling, Frenchman Flat CAU; USDOE
Mercury, Nevada

Project manager or technical lead for equilibrium and reactive transport modelling of radionuclide transport from underground nuclear tests. Understanding of flow and transport processes in critical locations depended on the interpretation of basalt and other fractured volcanic unit characteristics. Developed alternative conceptual models of groundwater flow. Implemented complex three-dimensional groundwater flow models and extensive groundwater flow model calibration using advanced regularization and singular-value decomposition features in PEST. Extensive stakeholder interactions including state environmental regulators, public review panel, and external expert review panel. Successfully achieved site closure. Provided expert opinion which was used to modify federal/state closure agreements. Responsible for project proposals, schedules, budgeting, quality assurance, and client service.

Confidential Superfund Site
New Jersey

Lead groundwater flow and contaminant transport modeler (MODFLOW) for an impacted site with a complex fractured bedrock system. This work has led to the development of a conceptual hydrogeologic design for refinement of an extraction and treatment system to address site impacts in support of a Pre-Design Investigation (PDI). Site contaminants range from organic solvents to reactive metals. Stakeholder presentations to the US Environmental Protection Agency (EPA) Mega Site Project Team.

Triumph Mine Adit and Stormwater Management Analysis; Idaho Department of Lands
Blaine County, Idaho

Lead hydrogeologist on adit and stormwater management alternatives analysis comprising of conceptual site model development, guidance for field data collection including geochemical water and sediment characterization, hydraulic property analysis, geophysical and fracture analysis, and infiltration capacity analysis in a joint project with Idaho Department of Lands (IDL) and Idaho Department of Environmental Quality (IDEQ).

Escondida Copper Mine Numerical Pit Inflow Modeling; BHP Billiton
Atacama Desert, Chile

Senior review and PEST implementation guidance for pit inflow model update. Focus of efforts were incorporation of recharge from key sedimentary units, improved definition of structural framework in MODFLOW-USG to evaluate seepage, pit slope pressures and effectiveness of dewatering wells, drainage galleries, tunnels, and drains.

Buckhorn Mine Operational Support Services; Crown Resources (Kinross)
Chesaw, Washington, USA

Development of modeling strategy to use geomechanical information to incorporate faults in FEFLOW groundwater models used to support mine dewatering operations and monitoring of potential impacts to local groundwater and surface water system. Established routine model calibration workflow incorporating PEST methodology.

High Rock Quarry; Cadman Inc. a division of Lehigh-Hanson Inc./Heidelberg Cement
Monroe, Washington

Project Director and water-services technical lead for hydrogeological and engineering services to support the expansion of the mine, pit-slope stability analyses, and reclamation planning.

- In support mine expansion, work included shallow groundwater investigation and stormwater infiltration feasibility. Key deliverables were a hydrogeological study establishing the hydrogeologic conditions and baseline water quality characterization, Targeted Stormwater Report, and stormwater drawings. Extensive stakeholder interaction and support. Led technical team supporting client through the successful hearing process (with no comments or appeals) to achieve County permits for mine expansion.
- In the existing mine, Golder installed a groundwater monitoring network in the mine and nearby domestic wells. Evaluation of the monitoring data and demonstration of water sources through hydrogeological response monitoring, geochemical and water quality fingerprinting provided the technical basis for a variance from existing mine plan negation with Washington Department of Natural Resources (DNR). Extensive stakeholder interaction and support focusing on the interpretation of water quality criteria and trends.
- In the existing mine, a pit slope failure led to a stability and mitigation analysis. Several boreholes were drilled in the pit floor and pit slopes and instrumented with vibrating wire piezometers. Golder completed slope stability analyses and developed an engineered slope stability design that included specific evaluation of groundwater conditions and future condition analysis of the mine. Provided DNR briefings on investigation findings and actionable steps to stabilize slide.

- To address mine expansion and stability, a reclamation plan allowing for backfill on DNR-owned land was developed and submitted. This plan incorporates a detailed water quality, quantity and backfill monitoring protocols. Established baseline and long-term water quality monitoring program requirements. Ongoing support of negotiations with DNR for backfill acceptance strategy, adaptive water quality monitoring and soil-assay criteria.

Red Dog Mine Tailings Main Dam; Teck
Kotzebue, Alaska

Senior hydrogeological lead on a tailing main dam wing wall extension. Project involves integration of civil, dam, material, and hydrogeologic teams to assess design alternatives, support includes pore-pressure and mounding analysis for stability and water treatment needs. Technical review of FEFLOW modelling work.

Chino Mines Mine Closure Study; Phelps Dodge
Silver City, New Mexico

Planned and coordinated a large-scale geochemical testing program at a copper and molybdenum mine to determine runoff water quality from waste rock piles. Performed interpretation and modelling of water quality data to identify hydrologic and geochemical controls on contaminants of concern and contaminant loading for a proposed water treatment facility.

Interstate-5 Widening Adjacent to Joint Base Lewis McChord Superfund Site; Washington State Department of Transportation
Tacoma, Washington

Project manager for soil and groundwater characterization program to provide baseline extent of metals, chlorinated solvents, and petrochemicals (including TPH) within construction-site boundaries. Characterization activities included drilling, sampling, and hydrogeologic testing; collection of soil samples through a 6-mile-long corridor; construction dewatering test well design and pumping test. Hydrogeologic evaluations conducted to address large-scale storm water management alternatives, the potential for construction-related impacts to an existing pump, treat and injection remedy and long-term influences of decommissioning existing storm water management sumps.

Elemental Phosphorus Plant Remedial Investigation / Feasibility Studies
Soda Springs, Idaho

Groundwater modeling strategy and workplan for remedial investigation/feasibility study (RI/FS) activities at an operating elemental phosphorus plant. Groundwater investigations included well installation, pump testing, groundwater flow, and transport modeling of redox sensitive contaminants.

Confidential Client
New England, USA

Peer review of pre-RI/FS basin-scale groundwater flow and contaminant fate and transport modeling. Regional soil and groundwater contamination resulting air dispersion and deposition related to perfluorooctanoic acid (PFOA) releases during textile manufacturing.

Black Diamond Gravel Pit; Cadman Inc. a division of Lehigh-Hanson Inc.
Black Diamond, Washington

Project manager for a 20-acre mine expansion including rezoning, permitting, reclamation planning, environmental, hydrogeological, and engineering services. Golder provided a critical areas assessment for wetlands, streams, and geologic hazards. Engineering design has focused on stormwater management, mine grading, and reclamation grades. Hydrogeological services have focused on surface water-groundwater interactions, stormwater-groundwater interactions, and application of existing baseline water quality criteria. Planning services have included DNR SM8 application and associated reclamations plans for the existing and expansion areas. Strategic advice and identification of expert testimony to achieve successful rezone application.

Groundwater Flow and Contaminant Transport Modeling; TCO Tengiz Field
TENGIZCHEVROIL
Kazakhstan

Provided senior review for fate and transport modelling of impacts to the Sulphur Area Remediation project and Evaporation Pond Closure at the Tengiz refinery. The model was used to support future remedial alternative design. The project assessed, evaluated, and implemented a remedial strategy aiming to address community and Republic of Kazakhstan expectations while maximizing value to the client. As part of the site characterization, the geochemical characteristics of possible contaminant sources (e.g., surface soils and acidic runoff) and the nature and extent of contamination were characterized.

Finite-Element Model for Nuclear Waste Repository; Korea Atomic Energy Research Institute
South Korea

Provided technical review and evaluation of FEFLOW model used to predict the groundwater flow and potential for contaminant transport from a proposed low-level nuclear waste facility. Developed a methodology for incorporating effective aquifer properties derived through discrete fracture network modeling into a finite element mesh.

Geothermal Evaluation; Magma Energy
Nevada

Evaluated wellfield management scenarios to optimize groundwater withdrawal temperatures for energy production. Work included review of existing data, and development of a reservoir and thermal model (FEFLOW) for the site focused on discrete fluid migration pathways.

VICTORIAN DESALINATION PLANT; Thiess Degremont Joint Venture
Wonthaggi, Australia

Groundwater flow and contaminant transport modeling to assess the potential environmental effects of disturbed acid sulfate soils at the Victorian Desalination Plant. We were engaged during the construction phase following the excavation of over 1 million cubic meters of soil, confirmed to mostly comprise acid sulphate soils. Modeling work included 3D dimensional geological model in Earth Volumetric Studio; MODFLOW-SURFACT for an area of 6.5 square kilometres; PEST calibration, integration of hydraulic aquifer testing including multiple pump tests, slug test and surface and groundwater level measurements. Fate and transport of contaminants of concern were investigated using both MODPATH and MODFLOW-SURFACT.

Mitigation Demand Forecast Evaluation and Update, City of North Bend
Washington, USA

Project director and client contact for Golder who worked with the municipal water purveyor, City of North Bend, to update and modernize its water supply and mitigation demand forecast. These forecasts incorporate basin-scale processes that influence the water available for public water supply and evaluate the timing and risk associated with depleting surface waters that are critical for maintaining fisheries. Data compilation and analysis include reviewing historical data for two adjoining water systems, comparing actual water use to projected water use, and developing a tool to update the mitigation (water offset) forecast based on current water supply and demand projections.

The tool addresses historical water use trends include the influence of supply availability and climate effects. Golder worked with the City to refine the representation of zoning and the timing of future demands based on building permits and population growth forecasts and support the development of water sustainability targets and conservation strategies.

The water and mitigation demand forecast tool was developed as a dynamic model for use by the City to update calculations in the future during ongoing planning and water management activities. The tool is designed to allow a user to select different options to evaluate different scenarios. The scenario options include water demand service area, changing zoning, mitigation sources, water rights, water use efficiency, and water supply operational decisions.

Hydrogeology and Well Management; City of North Bend
North Bend, Washington

Project manager and lead hydrogeologist for the City of North Bend projects. Ongoing support for the municipal supply well includes aquifer testing and analysis and long-term aquifer monitoring. Additional work focuses on assessment and monitoring of mitigation water supplies and includes well siting and installation, surface water and habitat monitoring, and utilizing water quality indicators to determine groundwater and surface water flow paths. Project included design of wellhead protection plan, aquifer vulnerability, and susceptibility assessment. Presentations to City Council and stakeholder groups. Technical expert support for hearing examiner proceedings, water supply contract negotiation, and real estate transactions.

Basement Brine Injection; Confidential Client
Queensland, Australia

Assessed proposed fractured basement deep brine injection as a disposal route for reverse osmosis brine streams associated with coal steam gas production. The work included analysis and characterization of around 10 deep basement boreholes and fracture flow modelling using the highly specialized modelling toolset. Results have informed future data collection and the reprioritization of injection as a potential brine management option.

SHINE Medical Technologies, Facility Preliminary Safety Analysis
Wisconsin

Senior technical review and evaluation of vadose zone and advective groundwater travel times. Identification and analysis of accident scenarios and support in designing monitoring frequencies and remedial options. Response to Nuclear Regulatory Commission comments.

Site Investigation; Confidential Client
Livorno, Tuscany

Lead hydrogeochemist for site investigation at a costal industrial facility. The site investigation focused on the tidally influenced dynamics of soil and groundwater contamination that forced an emergency site closure. Industrial activities were restored after conceptual site model indicated a long-term source originating from chemical storage tanks.

Wellfield Management; Confidential Client
Washington

The client operates a wellfield in an aquifer adjacent to the Colombia River near a major hydroelectric facility. The wellfield is used to supply water to an on-site hatchery as well as for regional water supply. Currently serving as project manager, senior hydrogeologist, and groundwater flow modeller for evaluating wellfield management scenarios to optimize groundwater withdrawal temperatures for hatchery use. Work included a review of existing data; development of a conceptual groundwater model for the site; three-dimensional, density-dependent numerical groundwater flow, and heat transport calculations; ongoing data collection and management; alternatives development and recommendations; and identification of data gaps. Expert opinion and recommendations used to establish strategy for potential litigation.

Data Management System; City of North Bend
North Bend, Washington

Project manager and technical lead for an online database to implement the City of North Bend's daily mitigation requirement as part of its groundwater right. Developed a detailed daily mitigation algorithm and water right requirements for development of the online database by the database developer. Developed a user training manual and training session to the City of North Bend's water system operators. The database was designed to interface with the City of North Bend's telemetry system and automatically analyze the water system usage, mitigate supplies, and determine the daily mitigation requirements. The database is also designed to house the City of North Bend's monitoring data, produce mitigation status reports and event reports, and support data retrieval by multiple stakeholders.

Fulmer Wellfield; City of Auburn
Auburn, Washington

Hydrogeologic task leader for evaluation of excessive manganese and iron in the City of Auburn Fulmer Wellfield. Evaluated existing information, designed water quality sampling campaign, completed well inspection and testing of current well pump, and performed hydraulic testing of the wellfield. Developed conceptual model of surface water-groundwater interactions in the wellfield and provided wellfield management strategies to achieve manganese and iron concentrations below water-quality criteria without the need for (planned) construction of a water treatment facility.

Water Right Application; City of North Bend
North Bend, Washington

Performed interpretation and modelling of surface water and groundwater interactions for surface water mitigation needs, including development of stream depletion and lag functions. Managed well development, long-term pumping tests, and data interpretation. Developed an operation and management plan for instream water mitigation using multiple hydrologic sources (groundwater and surface water). Affidavit preparation in response to water right challenge.

Coupled Groundwater-Surface Water Investigation; East King County Regional Water Association
King County, Washington

Developed a groundwater model to explore conjunctive water management to protect threatened and endangered fish. The project included exploratory drilling and aquifer testing and analysis. Developed a comprehensive conceptual model for surface water and groundwater interactions and implemented MODFLOW. The model was calibrated using PEST. Explored various pumping and surface water augmentation scenarios to understand the feasibility of enhancing streamflow using groundwater resources.

Colloid Mobilization and Transport Investigation; US National Science Foundation
Leadville, Colorado

Developed, planned, and executed a National Science Foundation-funded study to understand the mobilization of colloids in the vadose zone. This work focused on understanding and distinguishing the mechanisms at the colloid-porous media interface that led to colloid mobilization. An additional focus of the project was to understand how metal contaminants bound to colloids were mobilized in a physically and geochemically heterogeneous environment. Performed vadose zone modelling with HYDRUS-2D and mechanistic geochemical modelling that accounted for air and water transport in a physically heterogeneous porous media.

PUBLICATIONS

Book Chapter

DeNovio, N.M. and J. Moreno. 2020. Chapter 5: Groundwater *in* Conrad, J.W. (ed) Environmental Science Deskbook – Environmental Law Series. Thomson Reuters, Rel. 18, 7/2020.

Refereed Journal Articles

DeNovio, N.M., J.E. Saiers and J.N. Ryan. 2004. Colloid movement in unsaturated porous media: recent advances and future directions. Vadose Zone Journal, 3, p. 338-351.

El-Farhan, Y.H., N.M. DeNovio, J.S. Herman and G.M. Hornberger. 1999. Mobilization and transport of soil particles during infiltration experiments in an agricultural field, Shenandoah Valley, Virginia. Environmental Science and Technology, 34 (17), p. 3555-3559.

Conference Proceedings

DeNovio, N.M. 2018. Use of Machine Learning for Site Remediation Optimization. Science Advisory Board for Contaminated Sites in British Columbia; Innovation in Data Acquisition, Analytics and Automation for Contaminated Sites and Mining Environmental Applications, Vancouver, BC. Invited.

DeNovio, N.M. Randall, J., LaPointe, P., Holom, D., Iverson, J., Einberger, C. 2017. Droughts, Floods, and Groundwater Management, Oh My! Integrated Groundwater Modeling Center: MODFLOW and More. Invited.

DeNovio, N.M. and Ruskauff, G. 2015. Model Evaluation: What are We Trying to Accomplish? Integrated Groundwater Modeling Center: MODFLOW and More. Invited.

DeNovio, N.M. and Ruskauff, G. 2015. Nevada National Security Site Environmental Remediation Using EPA's Model Evaluation Guidance to Move to Closure. Waste Management Symposia. Invited.

Ruskauff, G. and DeNovio, N.M. 2015. Large-scale Multi-Well Aquifer Tests Used to Define Flow Systems. Waste Management Symposia. Invited.

DeNovio, N.M., Dershowitz, W., Doe, T., Cottrell, M., Hoffman, T. 2013. Hydraulic Fracturing: Using a Discrete Fracture Network to Investigate Hydrogeologic Effects. Integrated Groundwater Modeling Center: MODFLOW and More. Invited.

DeNovio, N.M., B. Anderson, and A. Neir. 2007. Streamflow augmentation using multiple water sources as mitigation for a new water right, North Bend, WA. American Water Works Association. Kennewick, Washington.

DeNovio, N.M., Kwicklis, E., Aly, A., and Gable, C.W. 2006. Calibration of a Groundwater Flow Model of the Frenchman Flat Basin, Nye County, Nevada for Prediction of Radionuclide Transport. MODFLOW and More 2006: Managing Groundwater Systems. International Groundwater Modeling Center.

Aly, A., and N.M. DeNovio. 2004. Uncertainty in hydrodynamic dispersion: using data quality weights and statistical techniques to develop parameter estimates and distributions. Annual Fall Meeting, American Geophysical Union. San Francisco, California.

DeNovio, N.M. and J.N. Ryan. 2004. Effect of simulated rainfall on the facilitated transport of metals in unsaturated soil cores from a flood plain contaminated by mine wastes. Annual Fall Meeting, American Geophysical Union. San Francisco, California.

DeNovio, N.M. and J.N. Ryan. 2003. The effect of flow heterogeneity on the mobilization. Annual Fall Meeting, American Geophysical Union. San Francisco, California.

DeNovio, N.M. and J.N. Ryan. 2003. Mobilization of colloids in unsaturated sand columns. Annual Spring Meeting, American Geophysical Union, and European Geophysical Union. Nice, France.

DeNovio, N.M. and J.N. Ryan. 2002. Colloid mobilization in simplified soil columns under unsaturated conditions. International Workshop on Colloids and Colloid-Facilitated Transport of Contaminants in Soils and Sediments. Danish Institute of Agricultural Sciences. Tjele, Denmark.

Other

DeNovio, N.M. *2018-2020 Numerous*. Water Rights: City of North Bend. Community Meeting. Invited.

DeNovio, N. and Farnham, I. Frenchman Flat Long-Term Monitoring Plan (Closure Report). DOE Nevada Site Specific Advisory Board. Invited.

Fenelon, J. and DeNovio, N. 2015. Water Levels 101. Educational Session for the DOE Nevada Site Specific Advisory Board. Invited.

Ruskauff, G. and DeNovio, N.M. 2015. Progress in the Frenchman Flat Corrective Action Unit (98), Underground Test Area Project. DOE Nevada Site Specific Advisory Board. Invited.

DeNovio, N., Ruskauff, G., Aly, A., Pickens, J., Ewing, J., Fryer, W., Jones, T., and Farnham, I. 2006. Phase II Groundwater Flow Model of Corrective Action Unit 98: Frenchman Flat, Nevada Test Site, Nye County, Nevada. Stoller-Navarro Joint Venture: S-N/99205-074.

Beard, T., Brooks, K., DeNovio, N.M., Ewing, J., Farnham, I., Fryer, W., Jones, T., McCord, J., Pickens, J., Rose, J. 2004. Phase II Hydrologic Data for the Groundwater Flow and Contaminant Transport Model of Corrective Action Unit 98: Frenchman Flat, Nye County Nevada. Stoller-Navarro Joint Venture: S/N/99205-032.

DeNovio, N.M. 2003. Particle and Particle-Facilitated Contaminant Transport in the Vadose Zone: Doctor of Philosophy Thesis, University of Colorado, Boulder, CO.

DeNovio, N.M. 2001. The Transport of Atrazine and Dissolved Organic Carbon during Multiple Infiltration Experiments: Master of Science Thesis, University of Virginia, Charlottesville, VA.

APPENDIX B

References

REFERENCES

Note: Documents listed in *italics* were produced by the Navy in connection with this proceeding with the referenced file name and numeric identifier.

Identifier	Citation
B-6	NAVFAC Naval Facilities Engineering Command Engineering and Expeditionary Warfare Center. SITE SPECIFIC REPORT, SSR-NAVFAC EXWC-CI-1655, 11 October 2016, Red Hill Facility, Tank Inspection, Repair, and Maintenance Report, Administrative Order on Consent (AOC) Statement of Work (SOW), Section 2.2. Prepared by Ms. Terri Regin, PE, Mr. Frank Kem, PE, Mr. James Gammon, and Mr. Lean-Miquel Sanpedro (https://www.epa.gov/sites/production/ files /2016-1O/documents/red-hill-aoc-sect ion-2-2-tirm-report-2016 - 10 - 11.pdf).
B-8	2007. Red Hill Bulk Fuel Storage Facility Final Technical Report, Pearl Harbor, Hawaii. Prepared by TEC, Inc., Honolulu, HI. Prepared for Naval Facilities Engineering Command, Pacific, Pearl Harbor, HI. August.
B-9	2002. Red Hill Bulk Fuel Storage Facility Investigation Report (Final) for Fleet Industrial Supply Center (FISC), Oahu, Hawaii. Prepared by AMEC Earth & Environmental, Inc., Huntsville, AL. Prepared for Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, HI. August.
B-10	Red Hill Bulk Fuel Storage Facility Final Groundwater Protection Plan, Pearl Harbor, Hawaii, Prepared for: Department of the Navy, Commander Naval Facilities Engineering Command, Pacific Pearl Harbor, HI 96860-3134, January 2008 https://health.hawaii.gov/shwb/files/2014/08/2008-Final-Groundwater-Protection-Plan.pdf
B-15	2018. Quantitative Risk and Vulnerability Assessment Phase 1 (Internal Events without Fire and Flooding). Red Hill Bulk Fuel Storage Facility NAVSUP FLC Pearl Harbor, HI (PRL). 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. Prepared by ABS Consulting. November 12.
B-16	2017. Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater. Volume 2: Background Documentation for the Development of Tier 1 Environmental Action Levels. Appendix 1: Detailed Lookup Tables. Prepared by Hawaii Department of Health, Environmental Management Division. Page 39 of 152. Fall 2017. (https://health.hawaii.gov /heer/files/2019/11/Volume-2-App-1-HDOH-2017.pdf)
B-22	Honolulu Board of Water Supply. 2019a. Subject: Honolulu Board of Water Supply (BWS) Comments on the Underground Storage Tank (UST) Permit Application for the Red Hill Bulk Fuel Storage Facility (Red Hill), Joint Base Pearl Harbor Hickam (JBPHH), Oahu, Department of Health (DOH) Facility ID NO. 9-102271. June 24.
B-28	2020. United States Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH). Notice of Deficiency for the Tank Upgrade Alternatives Decision Document and New Release Detection Alternatives Decision Document, for Red Hill Administrative Order on Consent Statement of Work Sections 3.5 and 4.8. Letter to Captain Gordie Meyer, Commander Navy Region Hawaii from Mr. Steve Linder, P.E., Red Hill Project Coordinator, EPA Region 9 and Ms. Roxanne Kwan, Interim Red Hill Project Coordinator, DOH. October 26. (https://www.epa.gov/sites/production/files/2020-10/documents/red-hill-tua_proposal_final_combined_response-2020-10-26.pdf)
B-39	Board of Water Supply (BWS). 2015a. Subject: August 7, 2015 Meeting Between the Board of Water Supply (BWS), United States Environmental Protection Agency (EPA), and Hawaii Department of Health (DOH) to Discuss BWS Comments to the Proposed Administrative Order on Consent (AOC) and Statement of Work (SOW) on the Red Hill Bulk Fuel Storage Facility. Pages 2 and 3. August 17.

Identifier	Citation
B-40	Board of Water Supply (BWS). 2015c. Subject: Board of Water Supply Recommendations to Consider in the Development of the Red Hill Administrative Order on Consent (AOC) Work Plans. December 3.
B-41	Board of Water Supply (BWS). 2016a. Subject: Board of Water Supply (BWS) Recommendations for Inclusion into the Red Hill Bulk Fuel Facility Administrative Order on Consent (AOC) Work Plans. April 25
B-42	Board of Water Supply (BWS). 2016b. Subject: Board of Water Supply (BWS) Comments to the Work Plans Being Developed Under the Red Hill Bulk Fuel Storage Facility Administrative Order on Consent (AOC) Statement of Work (SOW) Sections 2 through 5 and 8. May 27.
B-43	Board of Water Supply (BWS). 2016c. Subject: Board of Water Supply (BWS) Comments to the Work Plans Being Developed Under the Red Hill Bulk Fuel Storage Facility Administrative Order on Consent (AOC) Statement of Work (SOW) Sections 3, Tank Upgrade Alternatives. September 30.
B-44	Board of Water Supply (BWS). 2016d. Subject: Board of Water Supply (BWS) Comments Discussed with the United State Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH) at the October 4 and 5, 2016 meeting to discuss the Work Plans Developed Under Sections 2, 3, 4, and 8 of the Red Hill Fuel Facility Administrative Order on Consent (AOC) Statement of Work. November 4.
B-45	Board of Water Supply (BWS). 2016e. Subject: Board of Water Supply Comments to the Tank Inspection, Repair and Maintenance (TIRM) Report Being Developed Under the Red Hill Bulk Fuel Storage Facility (RHBFSF) Administrative Order on Consent (AOC) Statement of Work (SOW) Section 2. November 21.
B-46	Board of Water Supply (BWS). 2017a. Subject: Board of Water Supply (BWS) Comments to the Work Plan Being Developed Under the Red Hill Bulk Fuel Storage Facility Sections 2, 3, 4, and 8 of the Red Hill Field Facility Administrative Order on Consent (AOC) Statement of Work Section 5.3. February 13.
B-47	Board of Water Supply (BWS). 2017b. Subject: Board of Water Supply (BWS) Comments Pertaining to the Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH) February 15, 2017 Administrative Order on Consent (AOC) Sections 2, 3, 4, 5 and 8 Meeting. March 9.
B-49	Board of Water Supply (BWS). 2017d. Subject: Board of Water Supply (BWS) Comments to the Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Tank Inspection, Repair, and Maintenance (TIRM) Procedure Decision Document Section 2.4 Dated April 24, 2017. June 1.
B-50	Board of Water Supply (BWS). 2017e. Subject: Board of Water Supply (BWS) Comments to the Conditional Approval Scope of Work for Destructive Testing Dated May 30, 2017 submitted to the Regulatory Agencies Pursuant to Section 5.3.2 of the Red Hill Administrative Order on Consent, dated July 7, 2017. July 14.
B-51	Board of Water Supply (BWS). 2017f. Subject: Board of Water Supply (BWS) Comments to the Conditional Approval of Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Deliverable-3.2 Tank Upgrade Alternatives Scope of Work, Red Hill Bulk Fuel Storage Facility (RHBFSF) dated December 8, 2016. August 7.
B-52	Board of Water Supply (BWS). 2018a. Subject: Board of Water Supply (BWS) Comments on the Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Section 3 Tank Upgrade Alternatives (TUA) Report dated December 8, 2017. February 12.
B-53	Board of Water Supply (BWS). 2018b. Subject: Comments on the Michael Baker International's Report: Test Plan for Evaluating Leak Detection Methods at the Red Hill Bulk Fuel Storage Facility (RHBFSF), Joint Base Pearl Harbor-Hickam, Oahu, Hawaii in support of Administrative Order on Consent (AOC) Statement of Work (SOW) Sections 4.5: New Release Detection Alternatives and 4.6: New Release Detection Alternatives Report. March 23.
B-54	Board of Water Supply (BWS). 2018c. Subject: Comments on the Department of the Navy (Navy) Report: Seismic Profiling to Map Hydrostratigraphy in the Red Hill Area, Red Hill Bulk Fuel Storage Facility (RHBFSF) Joint Base Pearl Harbor-Hickam, Oahu, Hawaii, March 30, 2018. Completed under Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Sections 6 and 7. April 20.

Identifier	Citation
B-55	Board of Water Supply (BWS). 2018d. Subject: Board of Water Supply Comments on the Hawaii Department of Health Proposed Underground Storage Tank Regulations (Proposed Repeal of Chapter 11-281 and Adoption of Chapter 11-280.1 Hawaii Administrative Rules, Updated April 26, 2018). June 1.
B-56	Board of Water Supply (BWS). 2018e. Subject: Honolulu Board of Water Supply (BWS) Comments on the Red Hill Bulk Fuel Storage Facility (RHBFSF), New Release Detection Alternatives Report, Administrative Order on Consent (AOC) – Section 4.6, dated July 25, 2018, and the Navy's presentation of this topic at the August 14 and 15, 2018 AOC Meetings in Honolulu. September 17.
B-57	Board of Water Supply (BWS). 2018f. Subject: Board of Water Supply (BWS) Comments on the Groundwater Protection and Evaluation Considerations for the Red Hill Bulk Fuel Storage Facility (RHBFSF) Report, dated July 27, 2018. October 2.
B-58	Board of Water Supply (BWS). 2018g. Subject: Honolulu Board of Water Supply (BWS) Comments on draft "Report to the Thirtieth Legislature, State of Hawaii, 2019, Pursuant to Section 342L-62 Hawaii Revised Statutes, The Third Annual Fuel Tank Advisory Committee Meeting to Study the Issues Related to Leaks of Field-Constructed Underground Storage Tanks at Red Hill Bulk Fuel Storage Facility and Four Other DOD Facilities", Prepared By: State of Hawaii, Department of Health (DOH), Underground Storage Tank Section, dated December 2018. December 24.
B-59	Board of Water Supply (BWS). 2019a. Subject: Honolulu Board of Water Supply (BWS) Comments to IMR Test Labs Destructive Analysis of 10 Steel Coupons Removed from Red Hill Fuel Storage Tank #14, REPORT No. 201801967, Dated December 17, 2018. March 5.
B-60	Board of Water Supply (BWS). 2019c. Subject: Underground Storage Tank (UST) Permit Application for Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor Hickam (JBPHH), Oahu, DOH Facility ID NO. 9-102271. March 28.
B-61	Board of Water Supply (BWS). 2019e. Subject: Honolulu Board of Water Supply (BWS) Comments on the Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Sections 6 and 7 Groundwater Modeling Working Group Meeting No. 14 Held on March 15, 2019. April 12
B-62	Board of Water Supply (BWS). 2019f. Subject: Underground Storage Tank (UST) Permit Application for Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor Hickam (JBPHH), Oahu, DOH Facility ID No. 9-102271. May 17.
B-63	Board of Water Supply (BWS). 2019g. Subject: Honolulu Board of Water Supply (BWS) Comments on ABS Consulting (ABS) Report "Quantitative Risk and Vulnerability Assessment Phase 1 (Internal Events without Fire and Flooding) dated November 12, 2018" and "Navy's Risk and Vulnerability Assessment Summary" and Cover Letter dated May 29, 2019 as per Red Hill Bulk Fuel Storage Facility (RHBFSF) Administrative Order on Consent (AOC) Statement of Work (SOW) Section 8. September 5.
B-64	Board of Water Supply (BWS). 2019h. Subject: Honolulu Board of Water Supply Comments on Navy's "AOC SOW Section 5 Corrosion and Metal Fatigue Practices, Destructive Testing Results Report" dated July 7, 2019 and IMR's Report "Destructive Analysis of 10 Steel Coupons Removed Red Hill Fuel Storage Tank #14" dated December 17, 2019. October 7.
B-65	Board of Water Supply (BWS). 2019i. Subject: Honolulu Board of Water Supply (BWS) Comments on Navy's Conceptual Site Model (CSM), Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility (RHBFSF) Revision 1 dated June 30, 2019. October 7.
B-66	Board of Water Supply (BWS). 2019j. Subject: Comments of the Honolulu Board of Water Supply on United States Department of the Navy's "Red Hill Bulk Fuel Storage Facility Administrative Order on Consent Tank Upgrade Alternatives and Release Detection Decision Document" dated September 2019 as per Red Hill Bulk Fuel Storage Facility Administrative Order on Consent Statement of Work Sections 3 and 4. October 22.

Identifier	Citation
B-67	Board of Water Supply (BWS). 2020a. Subject: Honolulu Board of Water Supply (BWS) Comments on ABS Consulting (ABS) document "8.2 Risk/Vulnerability Assessment Phase 2 Scope of Work" dated September 6, 2019 and associated Navy's Cover Letter "Risk and Vulnerability Assessment (RVA) Phase 2 for the Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Section 8" dated November 19, 2019. January 23.
B-68	Board of Water Supply (BWS). 2020c. Subject: Honolulu Board of Water Supply (BWS) Comments on the Navy's Investigation and Remediation of Releases (IRR) Report, Red Hill Bulk Fuel Storage Facility (RHBFSF) Revision 00 dated March 25, 2020. August 1.
B-69	Board of Water Supply (BWS). 2020d. Subject: Honolulu Board of Water Supply (BWS) Comments on the Navy's Groundwater Flow Model Report, Red Hill Bulk Fuel Storage Facility (RHBFSF) Revision 00 dated March 25, 2020. September 25.
B-70	Department of Health (DOH). 2019. Application for an Underground Storage Tank Permit, Red Hill Bulk Fuel Storage Facility, Facility ID No. 9-102271. Letter from Ms. Lene Ichinotubo, PE, Acting Chief, Solid Hazardous Waste Branch, DOH to Ms. Raelynn Kishba, Commander, Navy Region Hawaii. April 12. https://health.hawaii.gov/shwb/files/2019/05/Red-Hill-U0416HM-9-102271.pdf
B-73	Department of the Navy (Navy). 2019. UST Permit Application for Red Hill Bulk Fuel Storage Facility, JBPHH, Oahu, DOH Facility ID NO. 9-102271. Submitted to State of Hawaii Department of Health on March 13, 2019, signed by Captain, M.R. Delao, with enclosure DOH Form No. 2, Application for an Underground Storage Tank Permit for Red Hill Bulk Fuel Storage Facility, DOH Facility ID No. 9-102271. https://health.hawaii.gov/shwb/files/2019/03/redhillpermitapplication.pdf
B-74	Department of the Navy (Navy). 2019. Response to DOH Letter. UST Permit Application for Red Hill Bulk Fuel Storage Facility, JBPHH, Oahu, DOH Facility ID NO. 9-102271. Submitted to State of Hawaii Department of Health on May 15, 2019, signed by Captain, M.R. Delao, with enclosure Revised DOH Form No. 2, Application for an Underground Storage Tank Permit for Red Hill Bulk Fuel Storage Facility, DOH Facility ID No. 9-102271. https://health.hawaii.gov/shwb/files/2019/05/Navy-Region-Hawaii-Response-to-DOH-letter-U0416HM-May-23-2019-OCR-scan.pdf
B-75	Environmental Protection Agency (EPA). EPA UST regs CFR Title 40, Chapter I, Parts 280 and 281. (https://www.ecfr.gov/cgi-bin/text-idx?SID=121ab75da7d3f71d24fd5426266d365c&mc=true&node=pt40.29.280&rgn=div5 https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=686342a687bb63b2d302e75bb0e5ebf2&mc=true&r=PART&n=pt40.29.281).
B-77	Department of the Navy (Navy). 2019. June 12, 2019 Permit Application Corrections. https://health.hawaii.gov/shwb/files/2019/06/UST-permit-application-for-Red-Hill-Bulk-Fuel-Storage-Facility-JBPHH-June-12-2019-corrections.pdf
B-78	Department of the Navy (Navy). 2019. June 12, 2019 Permit Application Draft Permit Application with Corrections. https://health.hawaii.gov/shwb/ust-rh-permit-application/
B-79	2019. Hawaii Department of Health. Public Comments on Draft Permit Application. October 22. https://health.hawaii.gov/shwb/files/2019/10/Comments-received-RH-draft-permit.pdf
B-80	Department of the Navy (Navy). 2019. UST Permit Application for Red Hill Bulk Fuel Storage Facility, JBPHH, Oahu, DOH Facility ID NO. 9-102271. Submitted to State of Hawaii Department of Health on May 15, 2019, signed by Captain, M.R. Delao, with enclosure Revised DOH Form No. 2, Application for an Underground Storage Tank Permit for Red Hill Bulk Fuel Storage Facility, DOH Facility ID No. 9-102271. https://health.hawaii.gov/shwb/files/2019/05/UST-permit-application-for-Red-Hill-Bulk-Fuel-Storage-Facility-JBPHH-May-23-2019-OCR-scan.pdf

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B-81	2015. Department of Health (DOH) and Environmental Protection Agency (EPA). Administrative Order on Consent. In the Matter of Red Hill Bulk Fuel Storage Facility. EPA Docket No. RCRA 7003-R9-2015-01 and DOH Docket No. 15-UST-EA-01. September 29. https://health.hawaii.gov/shwb/files/2015/09/Red-Hill-AOC_Final_29SEP151.pdf
B-82	2015. Department of Health (DOH) and Environmental Protection Agency (EPA). Administrative Order on Consent. In the Matter of Red Hill Bulk Fuel Storage Facility. EPA Docket No. RCRA 7003-R9-2015-01 and DOH Docket No. 15-UST-EA-01. Attachment A. Statement of Work. September 29. https://health.hawaii.gov/shwb/files/2015/09/Red-Hill-SOW__11SEP15.pdf
B-83	2020. Department of the Navy (Navy). Red Hill Bulk Fuel Storage Facility. Second Quarter 2020 – Quarterly Groundwater Monitoring Report. DOH Facility ID No. 9-102271. DOH Release ID Nos. 990051, 010011, 020028, and 140010. July 24. (4 parts listed as 136a, b, c, and d). https://health.hawaii.gov/shwb/files/2020/10/2020-07-24-2nd-qtr-gw-monitoring-rept-cover-ltr.pdf and https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-1.pdf and https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-2.pdf and https://health.hawaii.gov/shwb/files/2020/10/2020-07-2nd-qtr-gw-monitoring-rept-part-3.pdf
B-84	Red Hill Bulk Fuel Storage Facility Revisions to the Groundwater Protection Plan, Pearl Harbor, Hawaii. Prepared for: Department of the Navy, Commander Naval Facilities Engineering Command, Pacific Pearl Harbor, HI 96860-3134. December 2009. (https://health.hawaii.gov/shwb/files/2014/12/990051-1209Groundwater_revisions.pdf)
B-85	Department of the Navy (Navy). Underground Fuel Storage, Log of Formations In Tank Excavation ("Tank Barrell Logs"). Fourteenth Naval District, Pearl Harbor, Hawaii. May 23, 1943.
B-86	Department of the Navy (Navy). 120 Day Short-Long Term Release Response Report: Tank 16 Release. February 23, 1999.
B-156	Honolulu Board of Water Supply (BWS). Comments on the Red Hill Bulk Fuel Storage Facility (RHBFSF), Scope of Work for Destructive Testing Supplement - Destructive Testing Plan, Supplement to Administrative Order on Consent (AOC) and Statement of Work (SOW) Section 5.3.2, dated June 1, 2018 and Our Inspection on June 25, 2018 of Coupons Removed from Tank 14.
B-163	Department of Health (DOH). Red Hill Storage Tank Incidents 1944 to 1983. https://health.hawaii.gov/shwb/files/2013/06/19-of-20-tanks-diagram.pdf
B-166	Meeting Between the Board of Water Supply (BWS), United States Environmental Protection Agency (EPA), and Hawaii Department of Health (DOH) to Discuss BWS Comments to the Proposed Administrative Order on Consent (AOC) and Statement of Work (SOW) on the Red Hill Bulk Fuel Storage Facility. August 7, 2015.
B-176	*Tk 10 '98 api 653 part 1.pdf* [RDHLCC0001128]
B-180	*Tk 10 '98 api 653 part 5.pdf* [RDHLCC0001270]
B-184	*TK7 '98 API 653 PART 1.PDF* [RDHLCC0004566]
B-187	*TK7 '98 API 653 PART 4.PDF* [RDHLCC0004655]
B-190	*Tank 6 Final API 653 Inspection Report-Tk 6_2007.pdf* [RDHLCC0003796]
B-191	*TO0176-Final API-653 Inspection Report-Tk15_2007.pdf* [RDHLCC0001513]
B-194	*RH HIST Tank 16_1.pdf* [RDHLCC0000821]
B-195	*RH HIST Tank 1_2.pdf* [RDHLCC0000854]
B-197	*2008-Final-Groundwater-Protection-Plan.pdf* [RDHLCC0000001]

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B-198	*Gabbard 26 Sep RFI.docx* [RDHLCC0000360]
B-213	*History of Estimated Releases.pdf* [RDHLCC0000642]
B-214	*RH_CompUnverLeakHistories_DEC17.xlsx* [RDHLCC0000646]
B-216	*RedHill_Releases(Initiators)_080318.xlsx* [RDHLCC0000657]
B-221	*RH HIST Tank 17 and 18_1.pdf* [RDHLCC0000835]
B-223	*RH HIST Tank 14 and 15_1.pdf* [RDHLCC0000843]
B-226	*RH HIST Tank 11 to 13_1.pdf* [RDHLCC0000871]
B-228	*RH HIST Tank 8 and 10_1.pdf* [RDHLCC0000885]
B-231	*RH HIST Tank 2 to 5_1.pdf* [RDHLCC0000917]
B-232	*RH HIST Tank 19 and 20_1.pdf* [RDHLCC0000928]
B-233	*CLEAN 9 RED HILL TANKS, PCM MODIFICATIONS_000192EE.pdf* [RDHLCC0000936]
B-238	*Red Hill Tank 2 final 9-29-2008_Part1.pdf* [RDHLCC0002979]
B-242	*54118 Final Inspection Report r0 Transmitted by WGS 08 Aug 2016.pdf* [RDHLCC0003192]
B-285	*17. RH_Tank09_UnverifiedHistory.pdf* [RDHLCC0027755]
B-308	Board of Water Supply (BWS) comments on the Red Hill Administrative Order of Consent (AOC) Statement of Work (SOW) Sections 6 and 7 Meeting Held November 16, 2017 and the Groundwater Modelling Working Group Meeting No. 5 Held on November 17, 2017. Letter to Mr. Bob Pallarino and Ms. Roxanne Kwan. December 19, 2017.
B-309	McHugh, Thomas, et. al. 2020. Direct aerobic NSZD of a basalt vadose zone LNAPL source in Hawaii. Journal of Contaminant Hydrology 235 (2020) 103729. 2020.
B-314	Board of Water Supply (BWS). 2019b. Subject: IMR Test Labs Destructive Analysis of ten (10) Steel Coupons Removed from Red Hill Fuel Storage Tank #14, Report No. 201801967, dated December 17, 2018 pursuant to Section 5.3 of the Red Hill Bulk Fuel Storage Facility (RHBFSF) Administrative Order on Consent (AOC) Statement of Work. March 6.
B-315	Board of Water Supply (BWS). 2017g. Subject: Red Hill Bulk Fuel Facility Administrative Order on Consent (AOC) – Board of Water Supply (BWS) Comments Regarding the 31 August 2017 AOC Meeting Regarding Tank Upgrade Alternatives, and Quantitative Risk and Vulnerability Assessment. September 12.
B-316	Board of Water Supply (BWS). 2017h. Subject: EPA Letter Regarding: Revision to the Conditional Approval of Scope of Work for Destructive Testing Dated May 30, 2017 Submitted to the Regulatory Agencies Pursuant to Section 5.3.2 of the Red Hill Administrative Order on Consent. October 16
B-317	Board of Water Supply (BWS). 2017i. Subject: Approval of Red Hill Administrative Order on Consent (“AOC”) Statement of Work (“SOW”) Section 2.4- Tank Inspection, Repair, and Maintenance (“TIRM”) Procedures Decision Document and Clarifications dated September 5, 2017. October 18.
B-318	Board of Water Supply (BWS). 2017j. Subject: Red Hill Bulk Fuel Storage Facility – Tank Upgrade Alternative Decision Process Document Dated September 29, 2017. October 19.
B-319	Board of Water Supply (BWS). 2017k. Subject: Red Hill Bulk Fuel Storage Facility – Red Hill Tanks 14, 17, and 18 Non-Destructive Examination Plan Document Dated October 2017. November 9.
B-320	Board of Water Supply (BWS). 2015b. Subject: September 28, 2015 United States Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH) Response to Comments (RtC). December 3.

Identifier	Citation
B-321	Board of Water Supply (BWS). 2020b. Subject: Request for Update on United States Department of the Navy's "AOC SOW Section 5 Corrosion and Metal Fatigue Practices, Destructive Testing Results Report" dated July 7, 2019. March 5.
B-322	Board of Water Supply (BWS). 2016. Subject: Honolulu Board of Water Supply (BWS) Recommendations to the United States Environmental Protection Agency (EPA) for Characterization Activities While the Navy Red Hill Shaft is Pumping at Low Volumes. October 24.
B-324	Department of Health, State of Hawaii (DOH). 2010. (https://health.hawaii.gov/shwb/files/2014/10/2010RedHillTierIII.pdf. Accessed December 11, 2020).
B-325	US Navy Proposed Chemicals of Potential Concern (COPC) List Recommendations for the long-term monitoring (LTM) for the Red Hill Bulk Fuel Storage Facility. January 12, 2016. (https://www.epa.gov/sites/production/files/2016-03/documents/navy_proposed_copc_list_12_jan_2016.pdf).
B-326	United States Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH). Approval of AOC Section 6 and 7 Scope of Work and Response to Navy List of Recommended Chemicals of Concern. Letter to Mr. James A. K. Miyamoto, PE, Deputy Operations Officer, Naval Facilities Engineering Command, Hawaii from Mr. Bob Pallarino, Red Hill Project Coordinator, EPA Region 9 and Mr. Steve Chang, DOH Red Hill Project Coordinator. February 4, 2016. (https://www.epa.gov/sites/production/files/2016-03/documents/regulatory_agency_approval_section_6 _7_scope_of_work_and_copc_approval_4_feb_2016.pdf).
B-327	US Navy Proposed Chemicals of Potential Concern (COPC) List Recommendations Fuel Additives for the Red Hill Bulk Fuel Storage Facility. June 28, 2016. (https://www.epa.gov/sites/production/files/2016-07/documents/red_hill_navy_fuel_additives_list.pdf).
B-328	United States Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH). Disapproval of Red Hill Administrative Order on Consent (AOC) – Attachment A Statement of Work (SOW) Deliverable for Sections 6 and 7 – Work Plan/Scope pf Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Facility (Facility). Letter to Mr. James A. K. Miyamoto, PE, Deputy Operations Officer, Naval Facilities Engineering Command, Hawaii from Mr. Bob Pallarino, Red Hill Project Coordinator, EPA Region 9 and Mr. Steve Chang, DOH Red Hill Project Coordinator. September 15, 2016. (https://www.epa.gov/sites/production/files/2016-09/documents/disapproval_of_section_6_and_7_scopes_of_work_15_sep_2016.pdf).
B-329	NAVFAC Naval Facilities Engineering Command. Work Plan/ Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, 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. May 4, 2016. (https://www.epa.gov/sites/production/files/2016-05/documents/epa-r09-ust-2015-0441-red-hill-aoc-section-6-7-sow-appendices-2016-05-04.pdf).
B-330	United States Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH). Conditional Approval of Red Hill AOC SOW Deliverable under Sections 6 and 7 – Work Plan/ Scope pf Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Facility, November 5, 2016 Revision 01. December 2, 2016. (https://www.epa.gov/sites/production/files/2016-12/documents/red-hill-aoc-section_6-7_sow_conditional_approval_2_december_2016.pdf).

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B-331	NAVFAC Naval Facilities Engineering Command. Existing Data Summary and Evaluation Report for Groundwater Flow and Contaminant Fate and Transport Modeling, 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, Revision 00. March 5, 2017. (https://www.epa.gov/sites/production/files/2017-03/documents/existing_data_summary_and_evaluation_report_5_march_2017.pdf).
B-332	NAVFAC Naval Facilities Engineering Command. Data Gap Analysis Report, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, 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, Revision 00. April 25, 2017. (https://www.epa.gov/sites/production/files/2017-04/documents/red_hill_data_gap_analysis_report_25-april-2017.pdf).
B-333	NAVFAC Naval Facilities Engineering Command. Sampling and Analysis Plan Addendum 01, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, 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, Revision 00. September 1, 2017. (https://www.epa.gov/sites/production/files/2017-09/documents/red_hill_sampling_and_analysis_plan_addendum_2017-09-01.pdf).
B-334	NAVFAC Naval Facilities Engineering Command. Attenuation Evaluation Plan, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, 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, Revision 00. September 1, 2017. (https://www.epa.gov/sites/production/files/2017-09/documents/red_hill_attenuation_evaluation_plan-2017-09-01.pdf).
B-335	NAVFAC Naval Facilities Engineering Command. Conceptual Site Model Development and Update Plan, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, 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, Revision 00. September 1, 2017. (https://www.epa.gov/sites/production/files/2017-09/documents/red_hill_conceptual_site_model_development_plan_2017-09-01.pdf).
B-336	NAVFAC Naval Facilities Engineering Command. Risk-Based Decision Criteria Development Plan, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, 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, Revision 00. December 11, 2017. (https://www.epa.gov/sites/production/files/2017-12/documents/rh_aoc_sections67_rbdcdp_13dec17.pdf).
B-337	NAVFAC Naval Facilities Engineering Command. Sentinel Well Network Development Plan, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, 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, Revision 00. December 11, 2017. (https://www.epa.gov/sites/production/files/2017-12/documents/rh_aoc_sections67_swndp_13dec17.pdf).

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B-338	United States Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH). Regulatory Agency Comments on Recently Submitted Derivative Deliverables under Administrative Order on Consent Sections 6 and 7. Letter to Mr. Mark Manfredi, Red Hill Regional Program Director, from Mr. Bob Pallarino, US EPA Region IX and Ms. Roxanne Kwan, DOH. December 20, 2017. (https://www.epa.gov/sites/production/files/2018-02/documents/regulatory_agency_comments_on_navy_derivative_deliverables_20_december_2017.pdf).
B-339	NAVFAC Naval Facilities Engineering Command. Investigation and Remediation of Releases Report, 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, Revision 00. March 25, 2020. (https://www.epa.gov/sites/production/files/2020-04/documents/red-hill-investigation-and-remediation-of-releases-report-rev00-redacted-2020-03-25.pdf).
B-340	NAVFAC Naval Facilities Engineering Command. Groundwater Flow Model Progress Report 01, 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, Revision 00. April 5, 2017. (https://www.epa.gov/sites/production/files/2017-04/documents/red-hill-gw-model-progress-rpt01-rev00-2017-04-05.pdf).
B-341	United States Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH). Regulatory Agency Comments on Derivative Deliverables Existing Data Summary and Evaluation Report for Groundwater Flow and Contaminant Fate and Transport Modeling, Red Hill Bulk Fuel Storage Facility dated March 5, 2017 and Data Gap Analysis Report, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility dated April 25, 2017. Letter to Mr. Mark Manfredi, Red Hill Regional Program Director, from Mr. Bob Pallarino, EPA Red Hill Project Coordinator and Mr. Steven Chang, PE, DOH Red Hill Project Coordinator. June 7, 2017. (https://www.epa.gov/sites/production/files/2017-06/documents/red-hill-aoc-6-7-ltr-data-summ-data-gap-2017-06-07.pdf).
B-342	NAVFAC Naval Facilities Engineering Command. Groundwater Flow Model Progress Report 02, 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, Revision 00. August 4, 2017. (https://www.epa.gov/sites/production/files/2017-08/documents/groundwater_flow_model _progress_report_02 _for_red_hill_bulk_fuel_storage_facility_submitted_august_4_2017.pdf).
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B-347	NAVFAC Naval Facilities Engineering Command. 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, Revision 00. April 5, 2018. (https://www.epa.gov/sites/production/files/2018-04/documents/red-hill-gw-model-progress-rpt04-rev00_2018-04-05.pdf).
B-348	NAVFAC Naval Facilities Engineering Command. Groundwater Protection and Evaluation Considerations for the 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 Investigation and Remediation of Releases, and Section 7 Groundwater Protection and Evaluation. Revision 00. July 27, 2018. (https://www.epa.gov/sites/production/files/2018-09/documents/red_hill_interim_groundwater_flow_model-rev00_2018-07-27-redacted.pdf).
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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing document was served upon the following, via email, to their last known email address on March 12, 2021:

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Corporation Counsel

By */s/ Jeff A. Lau*
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EXHIBIT I

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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 WRITTEN REPLY TESTIMONY OF NICOLE M. DENOVIO; CERTIFICATE OF SERVICE

WRITTEN REPLY TESTIMONY OF NICOLE M. DENOVIO

1. I provide this written testimony on behalf of the Honolulu Board of Water Supply (BWS) in the above-captioned contested case before the Hawaii Department of Health (DOH).

2. I was asked to provide my expert opinion in reply to certain statements made by United States Department of the Navy witness Mr. Curtis Stanley in his Responsive Testimony dated December 28, 2020.

3. My expert opinions, and the data, analyses, and references that support my opinions, are set forth in the report attached to this testimony. Among the important findings presented in this report are:

a. The Southern Oahu Basal Aquifer (Sole Source Aquifer) is the sole or principal source of drinking water for the people of Oahu;

b. From 2015 through 2019, the Sole Source Aquifer provided 77 percent of the total water supplied by the BWS;

c. The Sole Source Aquifer is dominated by one major hydrogeologically-connected groundwater area identified by the United States Geological Survey as the "Southern Oahu Groundwater Area";

d. From 2015 through 2019, the Southern Oahu Groundwater Area provided 97 percent of the total water supplied from the Sole Source Aquifer by the BWS; and

e. The Red Hill Bulk Fuel Storage Facility (Facility) overlies the Southern Oahu Groundwater Area within the Sole Source Aquifer.

4. Given these findings and the irreplaceable nature of the Sole Source Aquifer, it is my opinion that the Southern Oahu Groundwater Area, if contaminated by the Facility, would create a significant hazard to public health.

I, NICOLE M. DENOVIO, do declare under the penalty of law that the foregoing is true and correct to the best of my knowledge.

DATED: Sammamish, Washington, January 15, 2021.

Nicole M DeNovio

NICOLE M. DENOVIO

REPORT

Sole Source Aquifer

Reply Testimony

Submitted to:

Honolulu Board of Water Supply

Submitted by:

Golder Associates Inc.

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20140469

15 January 2021

Acronym List

BWS	Honolulu Board of Water Supply
EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

Introduction

In Responsive Testimony submitted as part of the contested case 19-UST-EA-01, Navy witness Mr. Curtis Stanley provides his opinion regarding the definition and relevancy of the Sole Source Aquifer designation for the Southern Oahu Basal Aquifer. Rather than provide explanation or contextualization related to the meaning and significance of the Sole Source Aquifer designation, instead, Mr. Stanley's testimony attempts to minimize the importance of this critical drinking water resource by relying upon an outdated understanding of the aquifer system and ignoring crucial elements related to the Sole Source Aquifer designation. This testimony is intended to address these deficiencies.

Sole Source Aquifer

In 1987, the United States Environmental Protection Agency (EPA) determined that the Sole Source Aquifer "is the sole or principal source of drinking water for the entire Districts of Wahaiwa and Ewa, and the portions of the Honolulu District west of the Manoa Stream Channel and this aquifer, if contaminated, would create a significant hazard to public health." 52 Fed. Reg. 45496 (Nov. 30, 1987)[1] (B-375). EPA further found that this aquifer provided the principal source of drinking water for the approximately 763,000 permanent residents within the Pearl Harbor area [in 1987]. This designation was made following a detailed review and technical verification of the hydrology of the aquifer as well as the portion of the population reliant on the source. The sole source delineation process considered the aquifer, water system service supplied by the aquifer, aquifer recharge area including the streamflow source areas which contribute water to the aquifer system (EPA 1989) (B-398). Each of these components of the source delineation were carefully reviewed and evaluated by EPA.

As is described in testimony submitted by Water Quality Division Program Administrator Erwin M. Kawata, the Honolulu Board of Water Supply (BWS) relies heavily on supplies from this Sole Source Aquifer to provide drinking water to its customers. Figure 1 shows the designated Sole Source Aquifer boundary and the BWS wells. The boundaries of the Sole Source Aquifer are dominated by the coast to the south, and recharge sources to the east, west and north. The boundary of the Sole Source Aquifer includes the key areas required by the EPA review and verification. **From 2015 through 2019, the Sole Source Aquifer provided 77 percent of the total water supplied by the BWS**. This groundwater supply continues to be the critical water source for the people of Oahu.

The Sole Source Aquifer is dominated by one major groundwater area known as the Southern Oahu Groundwater Area. This aquifer is best described in 1996 by the United States Geological Survey (USGS) (B-377). The USGS reviewed many descriptions and interpretations of the Oahu groundwater system which were published from the 1920s through early 1990s (including the Mink and Lau report (B-4) referenced by Mr. Stanley and others). The USGS concluded the island of Oahu has seven major groundwater/geohydrologic areas which are shown in Figure 2. It has been determined that within each of these seven areas, hydraulic continuity is high (Hunt 1996) (B-377). This Southern Oahu Groundwater Area also provides the principal source of water for the residents of the island. From 2015 through 2019, this hydrogeologically-connected area provided 97 percent of the total water supplied from the Sole Source Aquifer by the BWS. Clearly, the Southern Oahu Groundwater Area is the primary source from which the majority of the water the BWS supplies to the people of Oahu comes.

[1] The Sole Source Aquifer designation is authorized by Section 1424(e) of the Safe Drinking Water Act of 1974 (Public Law 93-523, 42 U.S.C. 300 et. seq.).

Based on the EPA review and significant water supply provided by the Sole Source Aquifer, Mr. Stanley's responsive testimony is, at best, misleading. For example, Mr. Stanley's testimony reads:

> ***First**, the SSA designation is an administrative boundary, not a hydrogeologically delineated single "aquifer."*

Response

While it is true that the Sole Source Aquifer may not constitute "a singular aquifer", it is more than just an administrative line drawn on a map. It is made up of an area of connected groundwater resources, supporting recharge areas and provides the primary source of drinking water for the people of Oahu. As the EPA explained:

> *"The aquifer is composed of a basal fresh water lens floating on sea water. The basal fresh water lens is a continuous, but compartmental aquifer…" [52 Fed. Reg. 45496] [B-375]*

The Sole Source Aquifer designation is based on the public health threat posed by potential contamination because there is no reasonable alternative water supply. As stated before, this is the major source of Oahu's water and during the last 5 years of available data, provided 77 percent of all water withdrawals by the BWS (B-399). Therefore, rather than just being an administrative boundary, it is the drinking water supply area for a majority of the Oahu population.

The distinction is also meaningful because it reflects the determination that this groundwater area is truly of critical importance, a factual determination that is rarely made. Only nine aquifers have been designated as Sole Source Aquifers in EPA Region IX which covers Hawaii, California, Guam, Nevada and Arizona.

Of the total land area of the United States, only 3.5 percent of the area has been afforded the Sole Source Aquifer designation under the Safe Drinking Water Act of 1974 (B-400), which reinforces the uniqueness of the resource within and its importance as a critical supply and for the people of Oahu.

Mr. Stanley's testimony later reads:

> *"The oft-cited "Mink and Lau" report documenting this study identified a total of 24 aquifer systems on the island of Oahu based on scientific data related to hydrogeology. Of these 24, 12 aquifer systems lie within the administrative boundary of the SSA… Thus, impacts to one aquifer system within the SSA administrative boundary would not necessarily impact other aquifer systems within the SSA, let alone the SSA as a whole.*

Response

The statement above referring to multiple distinct aquifer systems confuses historical nomenclature for subordinate aquifer descriptions with the current understanding of different levels of hydrogeologic barriers within a large continuous entity. When the EPA evaluated the Sole Source Aquifer designation, the agency recognized that the aquifer has a compartmental nature. But the compartmentalization does not mean, as Mr. Stanley suggests, separate, wholly-disconnected aquifers.

The differentiations within this large entity are considered subordinate to the inter-relationships because:

- the boundaries do not result in large-scale changes in groundwater level (Hunt 1996) (B-377) as would be seen if they were not hydrologically connected,
- exhibit hydraulic continuity in the form of very flat hydraulic gradients (Hunt 1996) (B-377), and

- have consistent groundwater isotopic composition indicating the water chemistry is similar throughout the aquifer (Dores 2020) (B-396).

The location of the Sole Source Aquifer beneath the Red Hill Bulk Fuel Storage Facility (Facility) has been established for decades and is largely comprised of the Southern Oahu Groundwater Area described by the USGS (Hunt 1996) (B-377). The Facility's position on an upland topographic ridge over the Sole Source Aquifer increases the risk for contamination to this drinking water source. A release of fuel from this upland area has the potential to reach two of the subordinate areas historically defined within the Sole Source Aquifer (Figure 3). In fact, the Navy's most recent groundwater models show a high degree of connectivity between the Facility and Halawa Shaft when Red Hill Shaft is not pumping. The Navy's models indicate that groundwater flow times between the Facility and the Halawa Shaft are as short as 137 days (DON 2020, Table 5-9) (B-361).

Mr. Stanley's Testimony:

> *BWS has approximately 335 supply wells on the island of O'ahu, 181 of which are within the SSA, and 48 of which are located within the two aquifer systems near Red Hill (the Waimalu and Moanalua aquifer systems). Based on the data provided, the BWS' Halawa Shaft groundwater supply well composes only approximately 2.88 per cent of BWS' permitted water supply capacity on the island of O'ahu.*

Response

Using the number of wells instead of permitted/actual extraction masks the importance of water supply from the historically defined Waimalu and Moanalua areas underlying the Facility. These two areas provide 31 percent of the potable water withdrawn from the BWS from 2015 to 2019 (Figure 4). The underrepresentation of these areas in terms of number of wells highlights the reliance on only a few large facilities such as Halawa Shaft, which is responsible for 5 percent of the total island-wide water supply and nearly a quarter of the water supplied to metropolitan Honolulu. This makes water supply in these areas much more sensitive to interruptions and the consequences of contamination much greater.

Further, even if the permitted use of all BWS sources is considered, there is not enough supply to compensate contamination of sources in Waimalu - Moanalua areas, not even on the island-wide basis. The spare permitted capacity outside of Waimalu and Moanalua areas (26.8 mgd) is lower than total extraction in these two areas (43.6 mgd) (B-399). While interruption of the groundwater extraction at all facilities in these areas is unlikely, it highlights the relative lack of spare capacity in the system. Furthermore, the size of the island complicates long-distance water distribution from distant areas to the population centers. Therefore, disappearance of the single large source like Halawa Shaft (7.6 mgd) can put a strain on a water supply, particularly if it coincides with closure/reduced capacity at any other large source (B-399).

This situation was noted in the 1987 Federal Register notification and indicates that the EPA explicitly considered if the BWS has other wells that could supply the community but concluded that there was no demonstration that those other sources are capable of meeting the long-term water needs of the community [*52 Fed. Reg. 45496*] (B-375).

Summary

The responsive testimony of Curtis Stanley submitted for the contested case 19-UST-EA-01 is misleading. It does not describe the evaluation and verification undertaken by the EPA in designating the Sole Source Aquifer nor does it consider the current interpretation of the USGS concerning the nature of the Southern Oahu

Groundwater Area, the primary groundwater area within the Sole Source Aquifer. The testimony also attempts to minimize the importance of the Sole Source Aquifer to the people of Oahu who rely on this resource for the vast majority of their water supply and have no reasonable alternative. The existing data and the current science are consistent with the Sole Source Aquifer designation – the aquifer underlying the Facility, if contaminated, would create a significant hazard to public health.

ATTACHMENTS:

Appendix A - Figures

- Figure 1 – Sole Source Aquifer and BWS Pumping Rates
- Figure 2 – Southern Oahu Groundwater Area and Sole Source Aquifer Overlay
- Figure 3 – Historical Subordinate Aquifer Designations and Sole Source Aquifer Overlay
- Figure 4 – Historical Subordinate Aquifer Designations and BWS Pumping Rates

Appendix B – References

APPENDIX A

FIGURES

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LEGEND

RED HILL FACILITY BOUNDARY

SOLE SOURCE AQUIFER

2015-2019 MEAN PUMPING RATE, MGD

- >10
- 5 - 10
- 2.5 - 5
- 1 - 2.5
- 0.5 -1
- 0.25 - 5
- < 0.25

0 1 2 3 4 5

1:300,000 MILES

REFERENCE(S)

RED HILL FACILITY BOUNDARY DIGITISED FROM DON, 2019 FIGURE E-1 (B-352)
SOLE SOURCE AQUIFER BOUNDARY FROM EPA, 2020 (B-400)
PUMPING FACILITIES COORDINATES FROM HGGRC, 2020 (B-397)
PUMPING RATES FROM BWS, 2021 (B-399)

CLIENT
BOARD OF WATER SUPPLY

PROJECT
BWS RED HILL FACILITY

TITLE
SOLE SOURCE AQUIFER AND BWS PUMPING RATES

CONSULTANT: GOLDER

YYYY-MM-DD	2021-01-15
DESIGNED	IP
PREPARED	IP
REVIEWED	ND
APPROVED	ND

PROJECT NO.	PHASE	REV.	FIGURE
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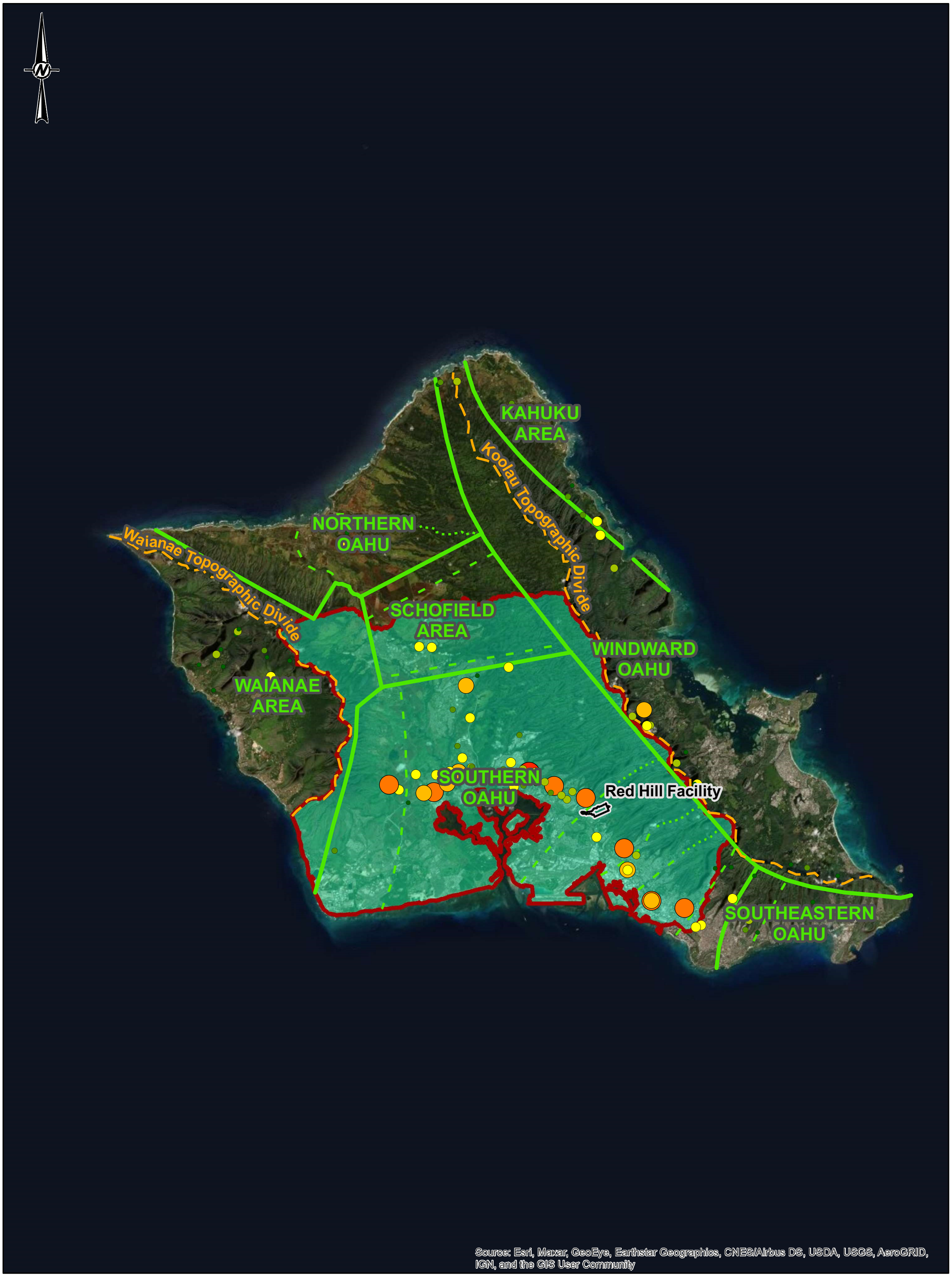

LEGEND

RED HILL FACILITY BOUNDARY

SOLE SOURCE AQUIFER

2015-2019 MEAN PUMPING RATE, MGD

- >10
- 5 - 10
- 2.5 - 5
- 1 - 2.5
- 0.5 -1
- 0.25 - 5
- < 0.25

TOPOGRAPHIC DIVIDE FROM HUNT, 1996

BOUNDARIES FROM HUNT, 1996

MAJOR GEOHYDROLOGIC BOUNDARY

SUBORDINATE GEOHYDROLOGIC BOUNDARY

SUBORDINATE GEOHYDROLOGIC BOUNDARY (UNCERTAIN)

0 1 2 3 4 5

1:300,000 MILES

REFERENCE(S)
GEOHYDROLOGICAL BOUNDARIES DIGITISED FROM HUNT, 1996 (B-377)
RED HILL FACILITY BOUNDARY DIGITISED FROM DON, 2019 FIGURE E-1 (B-352)
SOLE SOURCE AQUIFER BOUNDARY FROM EPA, 2020 (B-400)
PUMPING FACILITIES COORDINATES FROM HGGRC, 2020 (B-397)
PUMPING RATES FROM BWS, 2021 (B-399)

CLIENT
BOARD OF WATER SUPPLY

PROJECT
BWS RED HILL FACILITY

TITLE
SOUTHERN OAHU GROUNDWATER AREA AND SOLE SOURCE AQUIFER OVERLAY

CONSULTANT

GOLDER

YYYY-MM-DD	2021-01-15
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PREPARED	IP
REVIEWED	ND
APPROVED	ND

PROJECT NO.	PHASE	REV.	FIGURE
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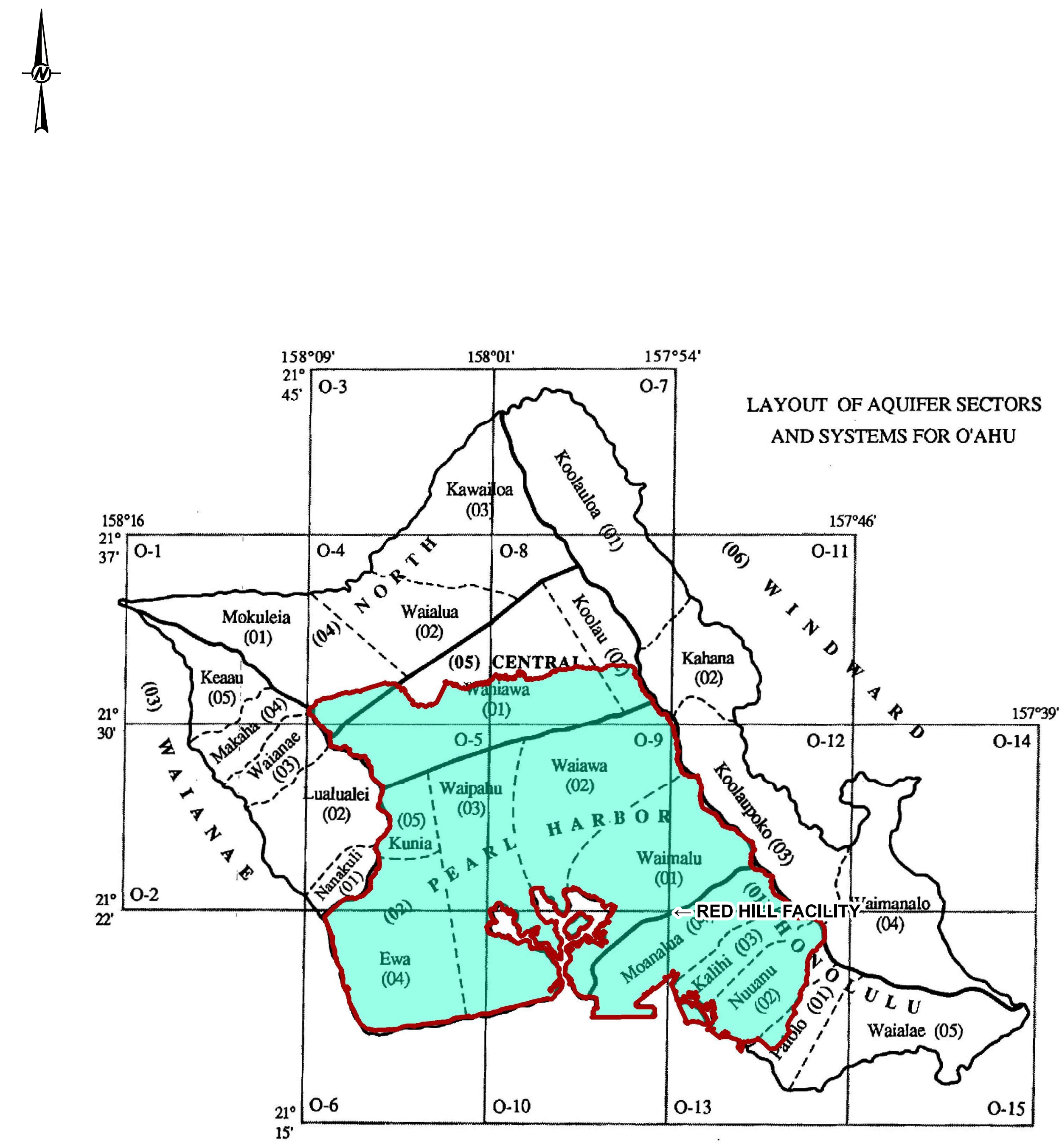

LEGEND

SOLE SOURCE AQUIFER

0 1 2 3 4 5

1:300,000 MILES

REFERENCE(S)
BACKGROUND GEOREFERENCED FROM MINK&LAU, 1990 (B-4)
SOLE SOURCE AQUIFER BOUNDARY FROM EPA, 2020 (B-400)

CLIENT
BOARD OF WATER SUPPLY

PROJECT
BWS RED HILL FACILITY

TITLE
HISTORICAL SUBORDINATE AQUIFER DESIGNATIONS AND SOLE SOURCE AQUIFER OVERLAY

CONSULTANT

GOLDER

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PREPARED	IP
REVIEWED	ND
APPROVED	ND

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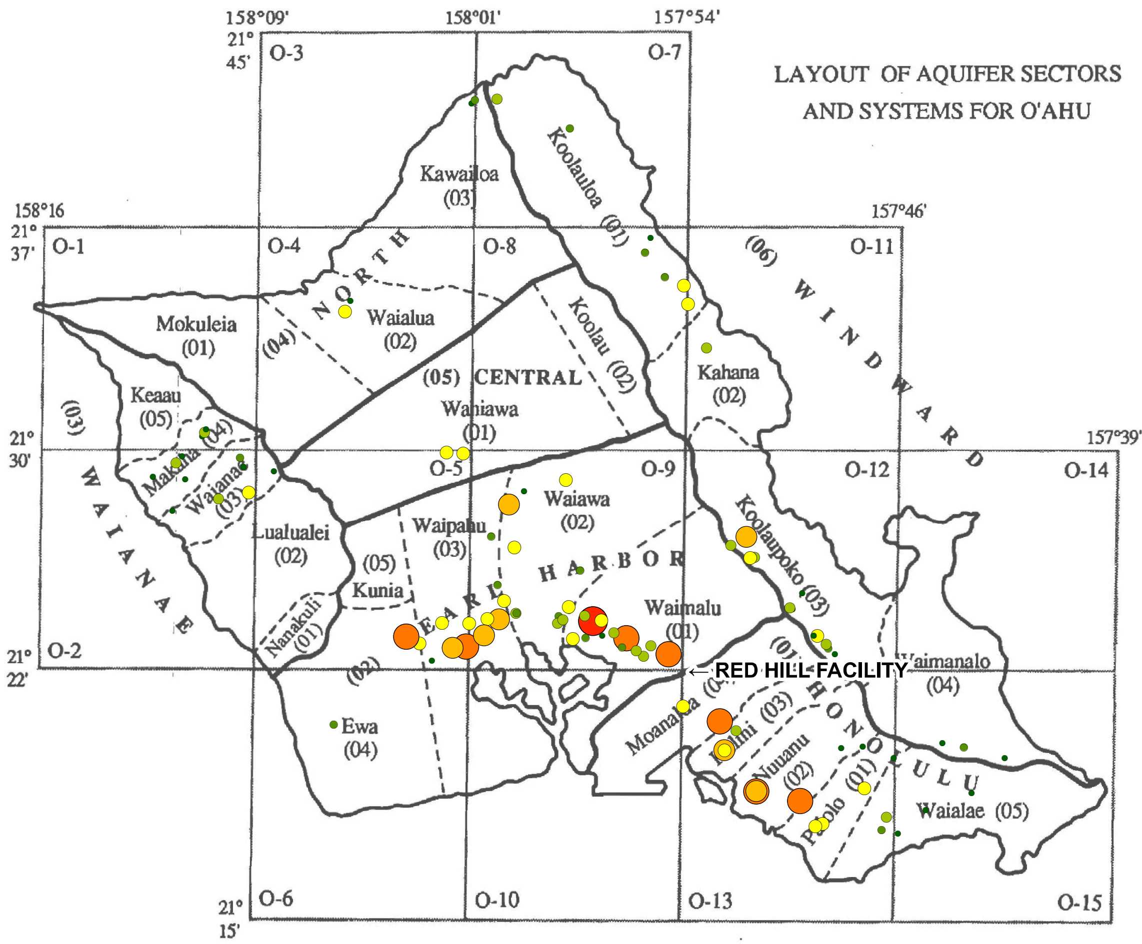

LEGEND

2015-2019 MEAN PUMPING RATE, MGD

- >10
- 5 - 10
- 2.5 - 5
- 1 - 2.5
- 0.5 -1
- 0.25 - 5
- < 0.25

0 1 2 3 4 5

1:300,000 MILES

REFERENCE(S)
BACKGROUND GEOREFERENCED FROM MINK&LAU, 1990 (B-4)
PUMPING FACILITIES COORDINATES FROM HGGRC, 2020 (B-397)
PUMPING RATES FROM BWS, 2021 (B-399)

CLIENT
BOARD OF WATER SUPPLY

PROJECT
BWS RED HILL FACILITY

TITLE
HISTORICAL SUBORDINATE AQUIFER DESIGNATIONS AND BWS PUMPING RATES

CONSULTANT

GOLDER

YYYY-MM-DD	2021-01-15
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PREPARED	IP
REVIEWED	ND
APPROVED	ND

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APPENDIX B

References

References

Identifier	Citation
B-4	Mink, John F. and Lau, Stephen L., 1990. Aquifer identification and classification for Oahu: Groundwater protection strategy for Hawaii. Prepared for Water Resources Research Center, university of Hawaii at Manoa. Technical Report No. 179. February 1990 (Rev.)
B-361	United States Department of the Navy (DON). 2020. Groundwater Flow Model Report, Red Hill Bulk Fuel Storage Facility: Joint Base Pearl Harbor-Hickam, O'ahu, Hawai'i. Administrative Order on Consent (AOC) in the Matter of the Red Hill Bulk Fuel Storage Facility. EPA Docket No.: RCRA 7003-R9-2015-01; DOH Docket No.: 15-UST-EA-01. March 25, 2020 (Rev 00)
B-375	Southern Oahu Basal Aquifer in the Pearl Harbor Area of Oahu; Principal Source Aquifer Determination, 52 Fed. Reg. 45496 (Nov. 30, 1987)
B-377	Hunt, Charles. D. Jr., 1996. Geohydrology of the island of Oahu, Hawaii: U.S. Geological Survey Professional Paper 1412-B.
B-396	Dores, Daniel, et al. 2020. Implications for groundwater recharge from stable isotopic composition of precipitation in Hawai'i during the 2017-2018 La Niña. Wiley, Hydrological Process. 2020;34:4675-4696.
B-397	Hawaii Groundwater & Geothermal Resources Center (HGGRC), 2020. Hawaii State Water Wells Data. www.higp.hawaii.edu/hggrc/wells/wells.php Assessed 08-Jan-2021
B-398	United States Environmental Protection Agency (EPA) 1989. Sole Source Aquifer Designation Petitioner Guidance. U.S. EPA Office of Water, Office of Ground-Water Protection. February, 1987 (Rev. November, 1989)
B-399	Board of Water Supply, 2021 (BWS). Water Sources Pumpage Data for Calendar Years 2015 through 2019.
B-400	United States Environmental Protection Agency (EPA) 2020. EPA Sole Source Aquifers. Downloaded From https://catalog.data.gov/dataset/national-sole-source-aquifer-gis-layer on 10-Jan-2021

golder.com

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing document was served upon the following, via email, to their last known email address on January 15, 2021:

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DATED: Honolulu, Hawaii, January 15, 2021.

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Corporation Counsel

By */s/ Jeff A. Lau*
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Deputy Corporation Counsel
Attorney for Petitioner
Board of Water Supply,
City and County of Honolulu

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DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 UPDATED SUPPLEMENTAL WRITTEN TESTIMONY OF NICOLE M. DENOVIO; EXHIBITS B-404 THROUGH B-407; CERTIFICATE OF SERVICE

SUPPLEMENTAL WRITTEN TESTIMONY OF NICOLE M. DENOVIO

1. I provide this written testimony on behalf of the Honolulu Board of Water Supply (BWS) in the above-captioned contested case before the Hawaii Department of Health (DOH).

2. I was asked to provide my expert opinion concerning the reported release of jet fuel from the Red Hill Bulk Fuel Storage Facility (Facility) that occurred on or about May 6, 2021.

3. In developing my expert opinion on this issue, I reviewed the documents submitted in this proceeding on May 27, 2021 by the United States Department of the Navy (Navy) and the DOH, including soil vapor data collected at the Facility in response to the May 6, 2021 fuel release. I also considered the testimony of the various witnesses during the contested case hearing that occurred in February 2021 as well as other relevant documents regarding the Navy's historical and current operations at the Facility that have been admitted into the record for this proceeding. I further relied upon conversations with my colleagues at Golder, BWS personnel, its legal counsel, and consultants.

4. My expert opinions, and the data and analyses that support my opinions, are set forth in this testimony and the exhibits attached hereto.

5. Exhibits B-404 and B-405 are graphical depictions of the concentrations of volatile fuel constituents detected in the soil vapor in the bedrock monitoring points underneath Tanks 15, 16, 17, 18, and 20 from February 2021 through May 2021. These data indicate pronounced spikes or elevated values after the May 2021 fuel release, well above background monitoring levels observed during the preceding months beneath the Facility.

6. Exhibit B-406 is a tabular depiction of the concentrations of volatile fuel constituents detected in the soil vapor in the bedrock monitoring points underneath Tanks 15, 16,

17, 18, and 20 in April 2021 (before the May 6, 2021 fuel release) as compared to May 2021 (after the May 6, 2021 fuel release). These data indicate that after the May 6, 2021 fuel release concentrations of volatile fuel constituents detected in the soil vapor in the bedrock points underneath the Facility increased by a factor of at least three and as high as 1300 times the levels detected just weeks earlier.

7. Exhibit B-407 is an updated version of Figure 2.2-1, titled "Fuel Releases reported from Facility Histories, API 653 Inspections, and Navy Release Notifications," that was provided in my December 29, 2020 report. The figure has been updated to account for the May 6, 2021 fuel release from the Facility.

8. As I explained in my December 29, 2020 report, there appears to be numerous pathways in the subsurface underlying the Facility for fuel constituents to reach Oahu's sole source groundwater aquifer. Based on the information submitted in connection with the above-captioned contested case before the DOH, including the soil vapor data collected at the Facility in response to the May 6, 2021 fuel release, it is my opinion that:

a. A release of jet fuel from the Facility, as reported by the Navy, occurred on or about May 6, 2021;

b. The May 6, 2021 fuel release was not contained by the Navy in the lower access tunnel; and

c. Volatile fuel constituents from the May 6, 2021 release were detected outside the Facility in the bedrock environment in the vicinity of Tanks 15, 16, 17, 18, and 20.

9. It remains my opinion that Facility operation as described in the Navy's permit application is not protective of human health and the environment.

I, NICOLE M. DENOVIO, do declare under the penalty of law that the foregoing is true and correct to the best of my knowledge.

DATED: Sammamish, Washington, July 13, 2021.

NICOLE M. DENOVIO

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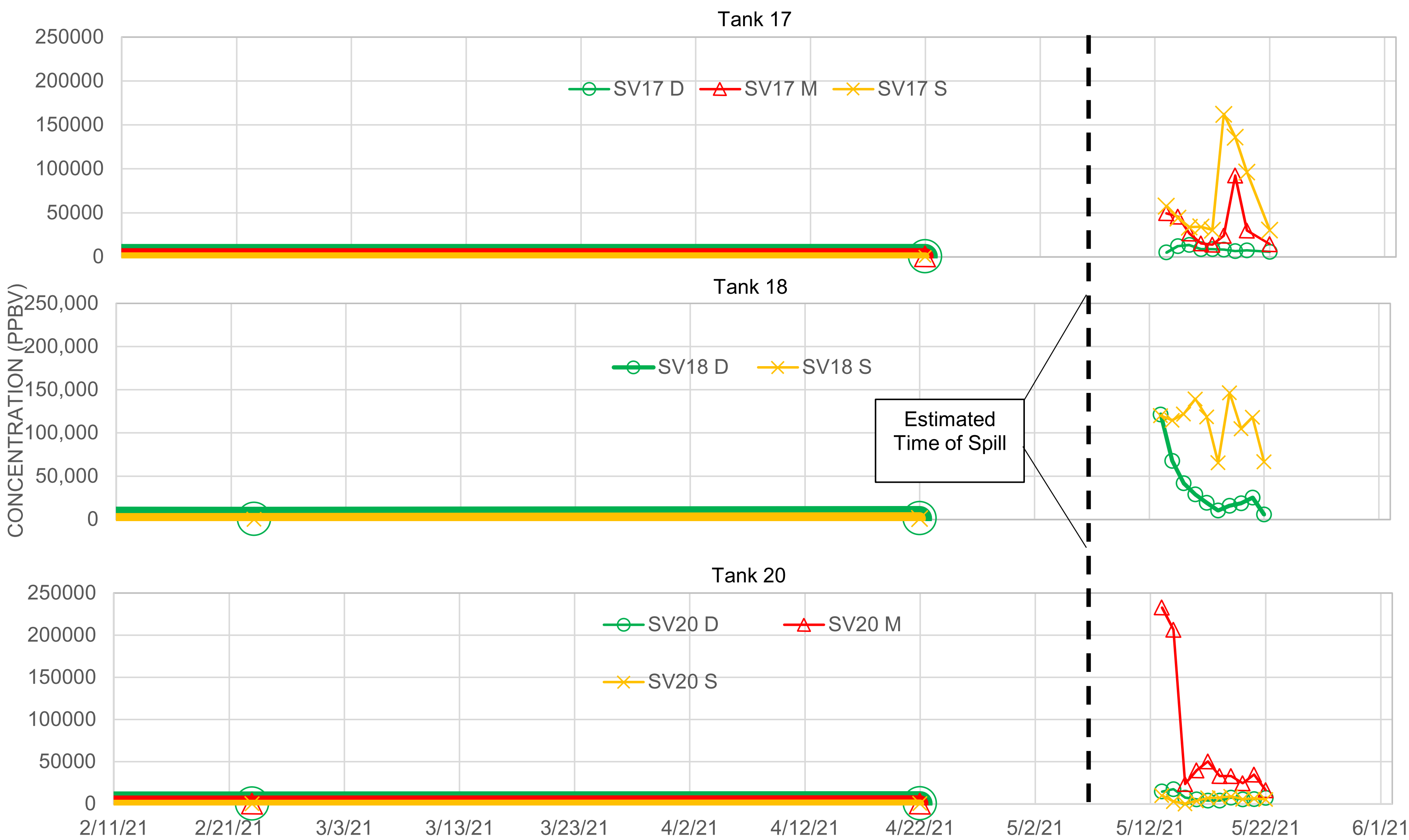

Notes

Before May 13, 2021 measurements were typically collected monthly.
In all cases shown here, these data plot on top of each other.

Concentration (PPBV) is measured using Photoionization Detection (PID) which generally measures volatile organic compounds, including certain fuel constituents.

Parts per Billion per Volume (PPBV), Shallow (S), Middle (M), Deep (D)

CLIENT
Honolulu Board of Water Supply

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	5/28/2021
DESIGNED	GK
PREPARED	GK
REVIEWED	ND
APPROVED	ND

PROJECT
Red Hill Bulk Fuel Storage Facility

TITLE
Tanks 17, 18, and 20, Soil Vapor Concentration History February to May 2021

PROJECT NO.	PHASE	REV.	FIGURE
20140469	100	1	1

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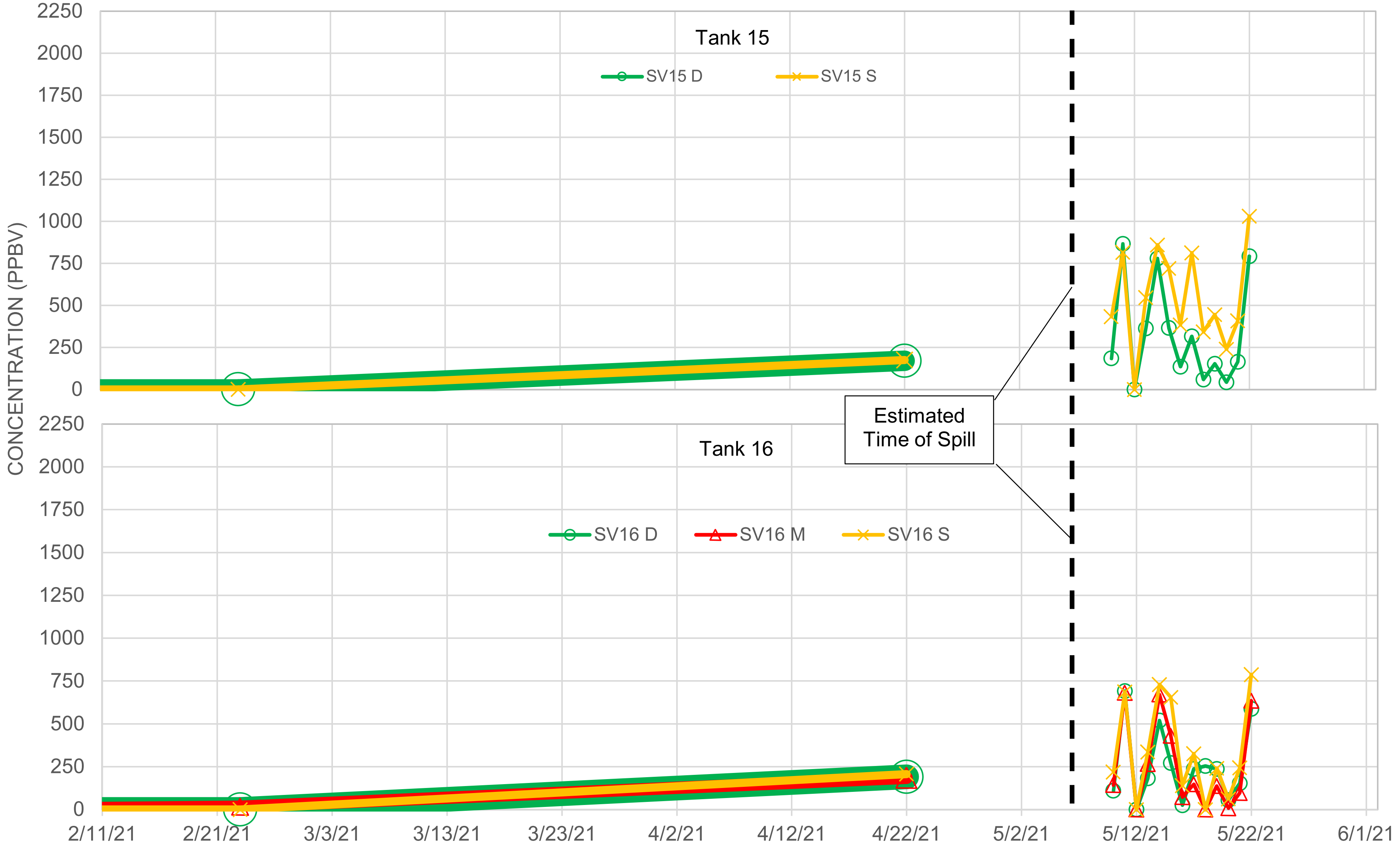

Notes

Monitoring point SV15M is obstructed. Data have not been available since December 2020.

Before May 10, 2021 measurements were typically collected monthly. In many cases, these data plot on top of each other.

Concentration (PPBV) is measured using Photoionization Detection (PID) which generally measures volatile organic compounds, including certain fuel constituents.

Parts per Billion per Volume (PPBV), Shallow (S), Middle (M), Deep (D)

CLIENT
Honolulu Board of Water Supply

PROJECT
Red Hill Bulk Fuel Storage Facility

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	5/28/2021
DESIGNED	GK
PREPARED	GK
REVIEWED	ND
APPROVED	ND

TITLE
Tanks 15 and 16 Soil Vapor Concentration History February to May 2021

PROJECT NO.	PHASE	REV.	FIGURE
20140469	100	1	2

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Measured Concentration 04/22/2021

Tank Number and Relative Position	15 / 16	17 / 18	19 / 20
Shallow (15, 17, 19)	175 04/22/2021	289 04/22/2021	NA
Shallow (16, 18, 20)	207 04/22/2021	1009 04/22/2021	223 04/22/2021
Medium (15, 17, 19)	NA	320 04/22/2021	NA
Medium (16, 18, 20)	185 04/22/2021	NA	173 04/22/2021
Deep (15, 17, 19)	170 04/22/2021	363 04/22/2021	NA
Deep (16, 18, 20)	191 04/22/2021	1184 04/22/2021	184 04/22/2021

Peak May 2021 Measured Concentration

Tank Number and Relative Position	15 / 16	17 / 18	19 / 20
Shallow (15, 17, 19)	1,030 05/22/2021	162,300 05/18/2021	NA
Shallow (16, 18, 20)	788 05/22/2021	146,667 05/19/2021	9,837 05/13/2021
Medium (15, 17, 19)	NA	92,333 05/19/2021	NA
Medium (16, 18, 20)	682 05/11/2021	NA	232,667 05/13/2021
Deep (15, 17, 19)	866 05/11/2021	13,337 05/15/2021	NA
Deep (16, 18, 20)	691 05/11/2021	121,333 05/13/2021	17,277 05/14/2021

Multiplication Factor: April 22 2021 to May 2021 Peak

Tank Number and Relative Position	15 / 16	17 / 18	19 / 20
Shallow (15, 17, 19)	5.89x	561.59x	NA
Shallow (16, 18, 20)	3.81x	145.36x	44.11x
Medium (15, 17, 19)	NA	288.54x	NA
Medium (16, 18, 20)	3.69x	NA	1344.90x
Deep (15, 17, 19)	5.09x	36.74x	NA
Deep (16, 18, 20)	3.62x	102.48x	93.90x

LEGEND

NA = Not Applicable; no measurement during May 2021 or April 22, 2021; no measurements for one or both values used for calculation in Multiplication Factor table

Concentration (PPBV) is measured using Photoionization Detection (PID) which generally measures volatile organic compounds, including certain fuel constituents.

Parts per Billion per Volume (PPBV)

CLIENT
Honolulu Board of Water Supply

CONSULTANT
GOLDER MEMBER OF WSP

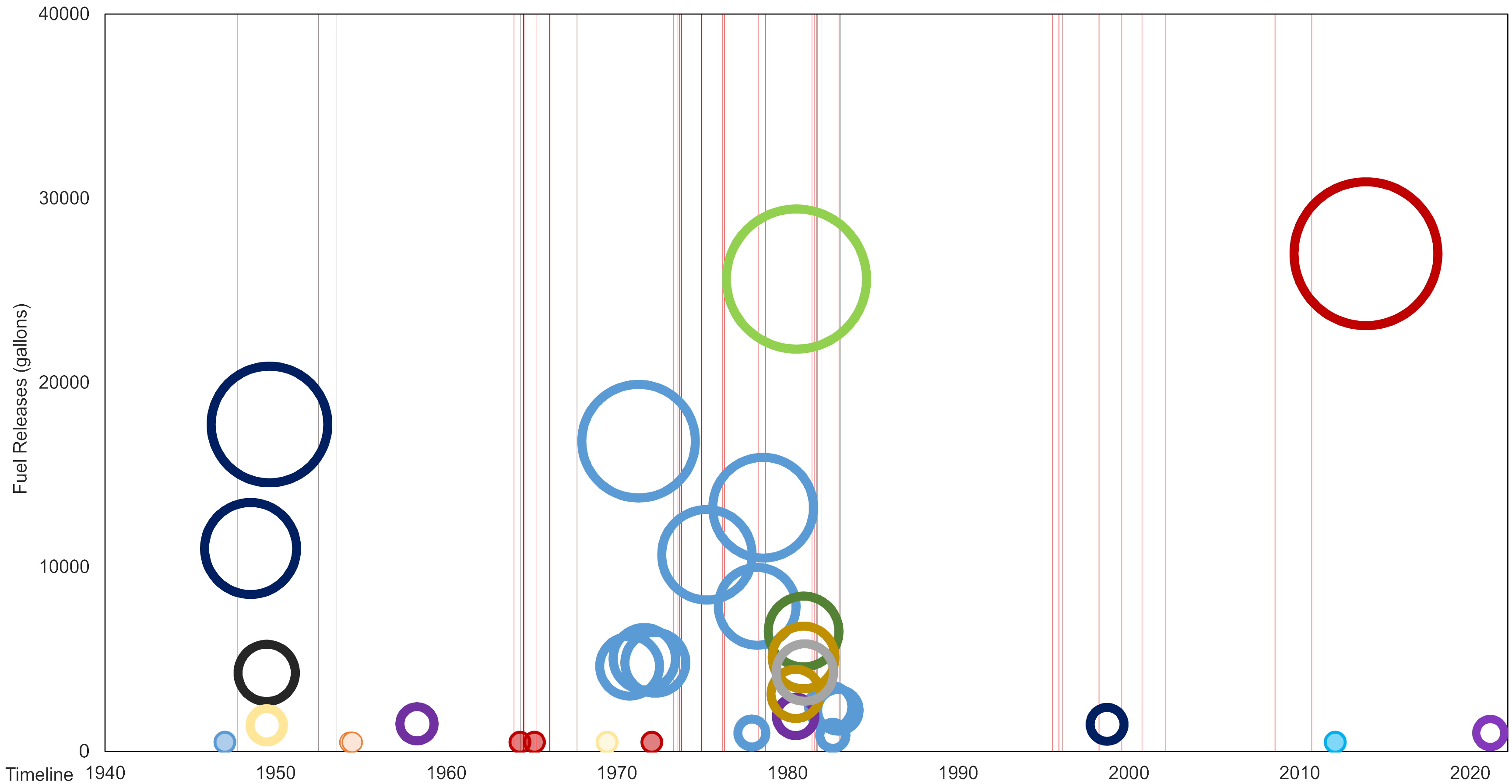
YYYY-MM-DD	5/28/2021
DESIGNED	GK
PREPARED	GK
REVIEWED	ND
APPROVED	ND

PROJECT
Red Hill Bulk Fuel Storage Facility

TITLE
Soil Vapor Concentration (PPBV) Peak Tables, April 2021 to May 2021 Factor Change

PROJECT NO.	PHASE	REV.	FIGURE
20140469	100	00	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A



Vertical Lines Indicate Fuel Releases of Unknown Quantity
Bubbles Indicate Fuel Releases of Known Quantity

Note 1: The tank number is identified by color of the dot; the size of the dot is based on the reported release volume for known releases greater than 100 gallons.
Note 2: Tank 2 known releases in 1954 and unknown releases in 2008 are shown but may be difficult to differentiate due to the close timing of the events.
Note 3: May 6, 2021 release volume unconfirmed; displayed as 1,000 gallons.

- Tank 1
- Tank 2
- Tank 3
- Tank 5
- Tank 7
- Tank 9
- Tank 10
- Tank 11
- Tank 12
- Tank 16
- Tank 17
- Tank 20 Supply Piping
- Tank Unknown
- Shaded bubbles are less than 100 gallons (not to scale)

CLIENT
Honolulu Board of Water Supply

PROJECT
Red Hill Bulk Fuel Storage Facility

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-12
DESIGNED	AN
PREPARED	AN/TH
REVIEWED	ND
APPROVED	ND

TITLE
Fuel Releases reported from Facility Histories, API 653 Inspections, and Navy Release Notifications

PROJECT NO.	CONTROL	REV.	FIGURE
20140469	0000	4	4

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Application of UNITED STATES NAVY For an Underground Storage Tank Permit for the Red Hill Bulk Fuel Storage Facility	DOCKET NO. 19-UST-EA-01 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing document was served upon the following, via email, to their last known email address on July 13, 2021:

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DATED: Honolulu, Hawaii, July 13, 2021.

DANA M.O. VIOLA
Corporation Counsel

By */s/ Jeff A. Lau*
JEFF A. LAU
Deputy Corporation Counsel
Attorney for Petitioner
Board of Water Supply,
City and County of Honolulu

DEPARTMENT OF HEALTH

STATE OF HAWAII

In the Matter of the Emergency Order to UNITED STATES NAVY For Emergency Change-In-Service and Defueling of 20 Underground Storage Tanks, Red Hill Bulk Fuel Storage Facility	DOCKET NO. 21-UST-EA-02 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing documents were served upon the following, via email, to their last known email address on December 19, 2021:

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DATED: Honolulu, Hawaii, December 19, 2021.

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Corporation Counsel

By *_/s/ Jeff A. Lau_*
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Board of Water Supply,
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