

Drinking Water Long-Term Monitoring Comprehensive Report

JOINT BASE PEARL HARBOR-HICKAM, O'AHU HI

2025 Revision

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Acronyms and Abbreviations

%	percent
µg/L	microgram per liter
AECOM	AECOM Technical Services, Inc.
CDC	child development center
CDH	child development home
COA	course of action
DOH	Department of Health, State of Hawai'i
DW	drinking water
EPA	Environmental Protection Agency, United States
EPDS	Entry point to distribution system
GIS	Geographic Information System
IDWST	Interagency Drinking Water System Team
ISP	Incident-specific parameter
JP-5	Jet Propellant 5
L	liter
LCR	Lead and Copper Rule
LTM	long-term monitoring
M	Month
MCL	Maximum Contaminant Level
MEQ	micro-extraction quench
NAH	Navy Aiea-Hālawa
Navy	Department of the Navy, United States
PACE	Pace Analytical
PFAS	per- and polyfluoroalkyl substances
ppb	part per billion
QC	quality control
SAP	sampling and analysis plan
SF	separatory funnel
SGS	SGS North American Inc
SVOC	semivolatile organic compound
TOC	total organic carbon
TPH	total petroleum hydrocarbons
UCMR5	Unregulated Contaminant Monitoring Rule 5
VOC	volatile organic compound

1 Introduction

Following the November 20, 2021 Red Hill Bulk Fuel Storage Facility emergency response, the Environmental Protection Agency (EPA), State of Hawai'i Department of Health (DOH), United States (US) Navy (Navy), US Army (Army), and a team of technical and subject matter experts formed the Interagency Drinking Water System Team (IDWST). The team collaborated to establish a suitable monitoring plan to assess drinking water quality and safety of the Joint Base Pearl Harbor-Hickam (JBPHH) and Aliamanu Military Reservation Public Water Systems (PWS). The objective of the Drinking Water Long Term Monitoring Plan (DW LTM Plan) was to show the Navy's continued commitment to ensure safe drinking water and that the water met all state and federal standards. The DW LTM Plan serves to validate DOH's certification of the JBPHH distribution system was safe upon completion of the system flushing conducted from January to March 2022.

Monitoring was established and performed in accordance with the *Drinking Water Sampling Plan for JBPHH, Oahu, Hawaii, Addendum 3, Version 10*, signed February 25, 2022, and subsequently by the Drinking Water Long-Term Monitoring Plan, (DW LTM Plan) approved by EPA and DOH and endorsed in June 2022, which superseded the drinking water section previous of the February 2022 approved sampling and analysis plans (SAP). The two PWS were considered as a single distribution system for monitoring purposes and divided into 19 zones, as defined in Table 3 of the DW LTM Plan.

The DW LTM Plan commenced March 11, 2022 at JBPHH with the Navy's contractor, AECOM Technical Services, Inc. (AECOM) and concluded on March 31, 2024. All DW LTM samples were analyzed in accordance with the final DW LTM Plan SAP, which provides methods and analytes in compliance with the EPA and DOH standards. The DW LTM Plan defined a two-year program, which was divided into multiple periods and specific details are offered in Section 2 of this report.

Validated analytical results were posted publicly throughout the two-year period on the Safe Waters public website (<https://jbphh-safewaters.org>) and provided to the regulatory agencies per terms of the Administrative Consent Order executed on June 2, 2023. This report summarizes the DW LTM activities for the twenty-four-month monitoring period ending in March 2024.

2 Methods: Sampling, Analysis, and Validation

2.1 Drinking Water Monitoring Periods and Zones

Section 4 of the DW LTM Plan defined the implementation and purposes of the monitoring program. Two phases were established: 0 – 3 months and 4-24 months after initial drinking water sampling. During the first phase, Period 1: March 2022, Period 2: April 2022, and Period 3: May 2022, samples were collected from 5% of the houses/buildings in a zone each month, with a minimum of 5 houses/buildings sampled in each zone. During the latter phase, Period 4: June - December 2022, Period 5: January – June 2023, Period 6: July – December 2023, and Period 7: January – March 2024, samples were collected from 10% of the houses/buildings in each zone. Locations sampled previously in Step 4 of the Red Hill Period 7 Months 22 to 24 (M22– M24) period, described in Section 4.2 of the DW LTM Plan, this event continued into March 2024, but will still be referred to as M22–M24.

As stated in the DW LTM Plan, it was assumed all zones would start the 0-3 month phase simultaneously, however in actuality the DOH advisory for each zone was amended in a staggered procession creating different DW LTM start dates per zone. With Navy and DOH approval, zones where sampling had

reached or exceeded the target percentage in a residential or non-residential category would be considered complete. The goal of the LTM was to collect samples from a comprehensive geographic representation of each of the 19 zones, in order to monitor across the span of the distribution system. Some zones comprised a smaller number of sample locations (residences or non-residences) but sufficient locations were monitored to achieve the 65% sample goal before the end of LTM. Once a zone achieved that milestone, the number of samples proposed for a category could be applied to a different zone to avoid locations being repeated. Locations were selected to avoid previous sampling locations but were distributed geographically for broad coverage. Sampling completed in March 2024 met two-year LTM requirements, obtaining at least 65 percent coverage of all residences and non-residential facilities in each zone.

The DW LTM Plan Table 2 lists the number of residential, non-residential, school, child development center (CDC), and distribution (hydrant) locations and the number of samples required in each zone. (Appendix B – DW LTM Plan (June 2022) Sampling Quantity Table) Samples were collected from zones depicted in Appendix A – LTM Zone Map.

The sampling data collected during each month, once validated, was posted on the Safe Waters public website, both in the interactive map and the individual zone pages. At the end of each sampling period, a Stage 5 summary report was created for each of the 19 sampling zones and posted after regulatory approval.

2.2 Sampling Analysis Methods and Reporting

Throughout each monitoring period, drinking water samples were collected and analyzed as described in Tables 4 and 5 of the approved DW LTM Plan. Initially, due to the volume of samples needed to be completed during each of the first three months of LTM (M1-3 or Periods 1-3), multiple EPA-certified laboratories were utilized to support sample analysis, including SGS North America Inc (SGS) in Wheatridge, Colorado; Eurofins in Seattle, Washington; and Pace Analytical in Ormand Beach, Florida. After Month 3, the Navy consolidated sample analysis with the use of a single laboratory, SGS Wheatridge. Pace and Eurofins laboratories were retained as alternate laboratories. During Period 6, Pace Analytical in Orlando, Florida, was utilized for the purpose of split sampling for comparative analysis. As part of the Unregulated Contaminant Monitoring Rule (UCMR) 5 sampling PFAS samples were analyzed by SGS in Orlando, Florida. All analytical required supplies, sample containers and preservatives, and shipping supplies were provided by the analytical laboratory. Drinking water analytical methods utilized throughout LTM are EPA-approved methods. The DW LTM sampling and analysis plan (pages 5 and 12) contain additional information on analytical methods used during this program.

2.2.1 Sampling & Analysis of Total Petroleum Hydrocarbons (TPH)

In addition to the two drinking water methods 524.2 and 525.2, the Navy was required to use EPA Method 8015 to screen for total petroleum hydrocarbons. Method 8015 is not designed with the intent of analyzing chlorinated drinking water but is intended for the analysis of wastewater and groundwater samples. It tests for non-halogenated volatile organic compounds, semi-volatile organic compounds, and petroleum hydrocarbons. Method 8015 was designed to analyze wastewater and groundwater samples, not chlorinated drinking water. During DW LTM, only drinking water samples which contain chlorine were analyzed. The residual chlorine interacted with a surrogate utilized in the laboratory during analysis to create halogenated by-products, which are observed in the TPH results but were determined *not* to be fuel related from a comparative analysis of chromatograms.

- In the fall of 2023, sample collection and methods were expanded in investigatory response to

low-level TPH detections.

- In November of 2023, SGS conducted an internal pilot study using the microextraction method (EPA Method 3511).
- Beginning in November 2023, and per LTM M22–M24 directive, each sampling location collected additional bottles to run TPH extractions via both the traditional separatory funnel (EPA extraction Method 3510) and the microextraction technique (extraction Method 3511), which used three 60 milliliter vials instead of two 1-liter (L) bottles to conduct EPA standard method 8015 TPH-Diesel and TPH-Oil method. The microextraction technique allowed the laboratory to minimize reused glassware and large volumes of solvent associated with the traditional preparation of the 8015 Separatory Funnel (SF) analyses by conducting the extraction within the 60-milliliter collection bottle, and thereby reduce potential for cross-contamination in the laboratory.
- Beginning in December of 2023, in agreement with the regulatory agencies, the Navy collected split samples from 10 percent of all DW LTM samples.
 - Samples consisted of a full-suite analysis from SGS and a duplicate of each analyte for full-suite analysis, as specified in Table 4 of the LTM Plan, between PACE and Eurofins. TPH analysis was conducted by Eurofins and all other analyses were conducted by PACE.
- In January 2024, the Navy assembled a new interagency team consisting of experts across the Navy and the private sector and involved discussion with both EPA and DOH.
 - The team was created to look at various aspects of the process to determine why the number of Method 8015 TPH detections were increasing through LTM periods 6 and 7. As part of the extraction process of a water sample, a known quantity of a surrogate compound is added.
 - This surrogate is a compound chemically similar to the analyte being extracted for analysis. It is used to determine how well the extraction process occurred or how well the analyte in question was removed from the matrix it was in, in this case water.
 - The surrogate that SGS uses is o-terphenyl and it is added to the samples. The amount of surrogate used was reduced from 2000 parts per billion (ppb) to 100 ppb. In wastewater samples the surrogate amount used is 2000 ppb which makes it easier to be detected/seen with the other compounds in that type of sample. Drinking water samples have less compounds so the surrogate amount was reduced to 100 ppb to be in line with the concentrations of TPH detections that were being seen. As a result of this change, a clear drop in percent of the detections occurred from 30 percent in January 2024 to 4 percent in February 2024, when this change was fully incorporated.
- In mid-February 2024, the quenching of samples at SGS laboratory was added to the Navy's protocol for Method 8015 to mitigate the impacts of the residual chlorine in the drinking water (note: Method 8015 was not originally designed or intended for use with drinking water). The Navy continued the separatory funnel extraction method for consistency, enabling a direct comparison of data collected across all periods of LTM.
 - The objective of the quenching technique is to remove any additional chlorine in the sample. Quenching is an optional step in the 8015 Method.
 - During the 'Swarm' Team investigation (late January 2024) it was determined that there were compounds (by-product) being created during the reaction between halogens (chlorine, bromine) and the o-terphenyl surrogate. These by-products were being detected in the TPH- range and being reported as TPH detections even though they weren't related to fuels (biased high)
 - Collection of two 1 L bottles for quenching continued from February 13 until February 20, 2024.
 - Beginning on February 21, 2024, the two 1 L bottles for the quenching technique were replaced with the existing microextraction bottleware, becoming the micro-extraction

quench (MEQ) samples.

- Each sample location retained the consistent 8015 SF method and incorporated the quenching within the microextraction bottle/ware.
 - Approximately 10 percent of all MEQ samples included matrix spike duplicate bottle/ware to support spiking with JP-5 for quality control (QC) at the laboratory.
- Following a directive from the EPA on February 27, 2024, EPA split sample kits were collected for the typical LTM full suite of analyses and naphthalene using Method 8270 and shipped to the EPA Region 9 laboratory in Corvallis, Oregon.
 - From February 27, 2024 until March 15, 2024, 16 EPA split samples were also collected for all residents who requested samples.
 - EPA requested an indefinite pause of split collection on March 26, 2024, during the last week of LTM sampling, due to internal EPA logistical issues.
 - Split samples were re-initiated in April 2024 under the Navy’s subsequent Extended Drinking Water Monitoring (EDWM) plan.

TABLE 5 LONG TERM MONITORING CONTAMINANTS AND COA FOR EXCEEDANCES/DETECTS

Contaminant	Chemical Abstracts Service (CAS) Number	DOH MCL ¹ (µg/L)	DOH Project Screening Level (µg/L)	Method Detection Limits (µg/L)	Method Reporting Limits (µg/L)	Sampling Method	Re-Sampling Method(s)	Distribution COA	Building COA	Detection COA
From Table 2 of the Guidance										
JP-5 as Combined Total Petroleum Hydrocarbons (TPH)-Gasoline, Diesel, and Oil Ranges ² [Incident Specific Parameter]	PCHG	Not Applicable	266	GRO, DRO, ORO = 50	GRO =100, DRO, ORO = 95	8260 PCHG / 8015 PCHD/O / PCIID/O	8260 PCHG / 8015 PCHD/O / 524.2	1	2	4
	PCHD									
	MOIL									
Benzene	71-43-2	5	5	0.5	0.5	524.2	524.2	1	2	3
Toluene	108-88-3	1,000	1,000	0.5	0.5	524.2	524.2	1	2	3
Ethylbenzene	100-41-4	700	700	0.5	0.5	524.2	524.2	1	2	3
Xylenes (total)	1330-26-7	10,000	10,000	0.5	0.5	524.2	524.2	1	2	3
	95-47-6									
1,1,1-Trichloroethane	71-55-6	200	200	0.5	0.5	524.2	524.2	1	2	4
1,1,2-Trichloroethane	79-00-5	5	5	0.5	0.5	524.2	524.2	1	2	4
1,1-Dichloroethylene	75-35-4	7	7	0.5	0.5	524.2	524.2	1	2	4
1,2,4-Trichlorobenzene	120-82-1	70	70	0.5	0.5	524.2	524.2	1	2	4
1,2-Dichlorobenzene	95-50-1	600	600	0.5	0.5	524.2	524.2	1	2	4
1,2-Dichloroethane (EDC)	107-06-2	5	5	0.5	0.5	524.2	524.2	1	2	4
1,2-Dichloropropane (DCP)	78-87-5	5	5	0.5	0.5	524.2	524.2	1	2	4
1,4-Dichlorobenzene	106-46-7	75	75	0.5	0.5	524.2	524.2	1	2	4
Carbon tetrachloride (CTC)	56-23-5	5	5	0.5	0.5	524.2	524.2	1	2	4
Chlorobenzene	108-90-7	100	100	0.5	0.5	524.2	524.2	1	2	4
cis-1,2-Dichloroethylene	156-59-2	70	70	0.5	0.5	524.2	524.2	1	2	4
Dichloromethane (aka methylene chloride)	75-09-2	5	5	0.5	0.5	524.2	524.2	1	2	4
Styrene	100-42-5	100	100	0.5	0.5	524.2	524.2	1	2	4

Figure 1: Long Term Monitoring Contaminants and COA for Exceedances/Detects from DW LTM Plan

Contaminant	Chemical Abstracts Service (CAS) Number	DOH MCL ¹ (µg/L)	DOH Project Screening Level (µg/L)	Method Detection Limits (µg/L)	Method Reporting Limits (µg/L)	Sampling Method	Re-Sampling Method(s)	Distribution COA	Building COA	Detection COA
Tetrachloroethylene	127-18-4	5	5	0.5	0.5	524.2	524.2	1	2	4
trans-1,2-Dichloroethylene	156-60-5	100	100	0.5	0.5	524.2	524.2	1	2	4
Trichloroethylene (TCE)	79-01-6	5	5	0.5	0.5	524.2	524.2	1	2	4
Vinyl Chloride	75-01-4	2	2	0.5	0.5	524.2	524.2	1	2	4
Total trihalomethanes (TTHM) (sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane)		80	80			524.2	524.2	1	2	4
Total Haloacetic acids (five) (HAA5) (sum of mono-, di-, trichloroacetic acids and mono- and dibromoacetic acids)		60	60	1	1	552.2 / 552.3	552.2 / 552.3	1	2	4
Benzo[a]pyrene	50-32-8	0.2	0.2	0.0095	0.019	525.2 / 525.3	525.2 / 525.3	1	2	4
Di(2-ethylhexyl)phthalate (DEHP) aka BEHP	117-81-7	6	6	0.38	0.57	525.2 / 525.3	525.2 / 525.3	1	2	4
Antimony	7440-36-0	6	6	0.1	0.4	200.8	200.8	1	2	-
Arsenic	7440-38-2	10	10	0.5	2	200.8	200.8	1	2	-
Barium	7440-39-3	2000	2000	0.5	2	200.8	200.8	1	2	-
Beryllium	7440-41-7	4	4	0.15	0.3	200.8	200.8	1	2	-
Cadmium	7440-43-9	5	5	0.05	0.15	200.8	200.8	1	2	-
Chromium	7440-47-3	100	100	0.5	2	200.8	200.8	1	2	-
Copper ^{3,4}	7440-50-8	1300	1300	0.5	2	200.8	200.8 ⁴	1	2	-
Lead ^{3,4}	7439-92-1	15	15	0.13	0.5	200.8	200.8 ⁴	1	2	-
Mercury	7487-94-7	2	2	0.025	0.1	245.1	245.1	1	2	-
Selenium	7782-49-2	50	50	0.3	0.7	200.8	200.8	1	2	-
Thallium	7440-28-0	2	2	0.05	0.2	200.8	200.8	1	2	-

Figure 2: Long Term Monitoring Contaminants and COA for Exceedances/Detects from DW LTM Plan Cont.

Contaminant	Chemical Abstracts Service (CAS) Number	DOH MCL ¹ (µg/L)	DOH Project Screening Level (µg/L)	Method Detection Limits (µg/L)	Method Reporting Limits (µg/L)	Sampling Method	Re-Sampling Method(s)	Distribution COA	Building COA	Detection COA
From Table 3 of the Guidance										
1-methylnaphthalene	90-12-0	None	10	0.24	0.48	525.2 / 525.3	525.2 / 525.3	1	2	-
2-methylnaphthalene	91-57-6	None	10	0.24	0.48	525.2 / 525.3	525.2 / 525.3	1	2	-
Naphthalene	91-20-3	None	17	0.24	0.48	525.2 / 525.3	525.2 / 525.3	1	2	-
Total Organic Carbon (TOC) [Incident Specific Parameter]	TOC	None	4000	0.2	0.5	EPA approved method	EPA approved method	1	2	-
Chlorine, Free (Field Test)	CHLORINE	4000	4000	-	-	8021	8021	1	2	-

Notes:

¹ CONTAMINANTS REGULATED BY THE SAFE DRINKING WATER BRANCH (updated 7/19/14) at <https://health.hawaii.gov/sdwb/files/2014/07/MCL-Fct-2014-07-10.pdf>

² HDOH, 2017, Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater – Hawaii Edition (Fall 2017); Hawaii Department of Health, Office of Hazard Evaluation and Emergency Response. <https://health.hawaii.gov/beer/guidance/ehe-and-eals/>. HDOH, 2022, Recommended Risk-Based Drinking Water Action Levels for Total Petroleum Hydrocarbons (TPH)

³ Associated with Releases

⁴ Action Levels.

⁵ Analyze for the lead and/or copper, pH, alkalinity, calcium, conductivity, and temperature.

⁶ As a result of data collected during the first phase of LTM (Months 0-3), Lead and Copper samples will only be collected from residences, other buildings and the entry points to the distribution system during LTM Months 4-24.

Figure 3: Long Term Monitoring Contaminants and COA for Exceedances/Detects from DW LTM Plan Cont.

2.3 Sample Validation and Reporting

In general, data validation is an evaluation of the analytical quality of a specific data set. Information such as hold times, method blanks and quality control (QC) metrics are reviewed to identify any limitations and determine if any of the data needs have any qualifiers (i.e. J flags) added. Different stages of data validation have been developed to provide a framework for defining the level of complexity. The degree to which data is reviewed is divided into stages, with each stage building on

the previous one. The validation requirements determined in the DW LTM plan for use in this project include the designations, Stage 2A and Stage 4.

Stage 2 validation include holding times (extraction and analysis), laboratory method blank results, field reagent blank/trip blank results, blank spike recoveries, matrix spike recoveries, laboratory duplicate precision (measured as relative percent difference [RPD]), surrogate standard recoveries, and field duplicate precision (RPD). If necessary, qualifiers are applied to the result in accordance with the applicable data validation guidance, and each nonconformance is also assigned a reason code.

Stage 4 validation includes all of the elements of Stage 2A validation, as well as additional review parameters such as initial and continuing calibration data for all methods and, where applicable to the method, parameters including, but not limited to, instrument tuning, interference check standards, serial dilution, and internal standards.

Stage 2 validation was performed on 90% of the samples throughout LTM. An additional 10% of sample results were processed through Stage 4 validation.

A review of sample delivery group statistics for samples where analyses were validated in the last month of LTM indicates that the Level 2 validation was completed in an average of 18.2 days from receipt of the laboratory data. Level 4 validation was completed in an average of 26.2 days from receipt of the laboratory data.

Timelines in the DW LTM Plan provided for 9-day turnaround times from sample collection to Level 2 validation, and 20-day turnaround times from collection to Level 4 validation.

The laboratories were contracted to provide expedited turn-around time (TAT) on sample analytical results.

The laboratories were required to upload reports as follows:

- Level 2 laboratory reports and electronic data deliverable into the prescribed Data Management System within 3 calendar days of receipt of the samples.
- Level 2 laboratory reports for samples analyzed for PFAS into the prescribed Data Management System within 5 days of receipt of samples at the laboratory.
- Level 4 laboratory reports for all analyses into the prescribed Data Management System within 7 days of completion of Level 2 reports.

A review of sample delivery group statistics for samples analyzed in the last month of LTM indicates that the laboratory data was completed in an average of 13.1 days from sample receipt at the laboratory for both Level 2, Level 4, and PFAS laboratory reports.

Validated results were continuously posted to Safe Waters for public viewing throughout each of the LTM periods. Monthly Drinking Water LTM summary reports by zone were provided to regulators by the 15th of each month. Period Summary reports (Stage 5 Reports) for Period 1 (Month 1), Period 2 (Month 2), Period 3 (Month 3), Period 4 (M4-M9), Period 5 (M10-M15), Period 6 (M16-21) and Period 7 (M22-24) were provided to EPA and DOH and were made available on the JBPHH Safe Waters website. The reports identified locations sampled, number of samples, sampling phase, results, sample sites that had exceedances and required resampling, a GIS map of sample sites with location identifications, QC summary report, challenges incurred with recommendations for improvement and forward-looking plan for DW LTM for the following month. In addition to the LTM results, the analytical results for samples known on non-LTM samples collected due to customer requests or other purposes, were also provided to

the regulatory agencies directly and available for public viewing on the Safe Waters website.

Electronic copies of test reports were provided to the resident or building manager where sampling occurred as requested. After each sample was collected, AECOM provide documentation to the residents or building managers on how to request or access the results. All results and laboratory reports at a minimum were posted on the Safe Waters public website, <https://jbpph-safewaters.org>, and Navy staff provided demonstrations to residents on how to locate individual results at open houses and community outreach events.

3 Drinking Water Long-Term Monitoring Results

3.1. Results

From March 2022 through March 2024, over 9,200 samples were collected across the duration of LTM.

In accordance with the DW LTM Plan, the samples were collected for an expanded suite of DW analytes to provide confirmation on water quality for safe DW throughout the two-year period. The following section describes the findings of each analyte group across the program.

3.2 Total Petroleum Hydrocarbons

Total Petroleum Hydrocarbons (TPH) describes a large family of many chemicals that comprise petroleum hydrocarbons. Because there are so many different chemicals in the hydrocarbon family, it is not practical to measure each one separately; so instead they are grouped into common categories by ‘carbon range’ meaning the number of carbon elements in the individual compound. Red Hill drinking water samples are primarily tested for three hydrocarbon categories: Gasoline Range (TPH-g), Diesel Range (TPH-d), and Motor Oil Range (TPH-o). It is important to recognize that these tests are not for gasoline, diesel fuel, or oil specifically, but rather petroleum hydrocarbons that are in the “range” of those found in gasoline, diesel fuel, or oil carbon-chain range. Because petroleum hydrocarbons are complex to categorize, it is important that testing, analysis, and interpretation of TPH results are taken into careful consideration. Detections of TPH do not necessarily equate to the presence of JP-5 in drinking water.

- TPH-g are relatively short hydrocarbons that easily evaporate and are flammable. The TPH-Gasoline Range Organics analysis is used to measure the amount of hydrocarbon compounds with six to ten carbons (abbreviated C6-C10).
 - These compounds are commonly associated with an unpleasant odor. These are commonly found in solvents and motor vehicle gasoline fuel.
- TPH-d are medium length hydrocarbons that don’t evaporate as well as the smaller compounds. The TPH-Diesel Range Organics analysis is used to measure the amount of hydrocarbon compounds with 10 to 24 carbons (C10-C24). These compounds are generally flammable and produce a lot of energy when burned.
 - These are commonly found in many household, biological, and industrial products, such as mothballs, cooking oils, and diesel or kerosene fuels.
- TPH-o are larger hydrocarbons that don’t evaporate. The TPH-Oil Range Organics analysis is used to measure the amount of hydrocarbon compounds with 24 to 40 carbons (C24-C40).
 - These are commonly found in lotions, lubricants, and greases.

Of the 9,200 samples collected and analyzed with the SF TPH analysis, 2,750 samples had TPH detections, two of which exceeded the DOH’s TPH limit of 266 micrograms per liter ($\mu\text{g/L}$) total TPH Incident Specific Parameter (ISP). All exceedances were determined to be from non-petrogenic sources and unrelated to the November 2021 fuel spill. The details of each of these detections are fully explained

in Section 3 of this report. In the summer of 2023, during DW LTM, the Navy observed an increase in low-level detections, all below the DOH's ISP for TPH. When these TPH detections were analyzed, they did not match JP-5 (jet fuel) or other fuel-related compounds. In response, an investigation by the Navy determined that there were compounds (by product) being created during the reaction between chlorine and the o-terphenyl surrogate. These by-products were observed in sample results and were reported as TPH detections, although they weren't related to fuel. The Navy convened a team of experts to 'swarm' and conduct a root cause analysis of the TPH detections. Since the DW LTM plan sampled drinking water samples which contain chlorine, residual chlorine and bromine interacted with the laboratory surrogate, o-terphenyl, creating by-products. These new by-products were seen in the TPH range and were included in the TPH-Diesel totals. A summary technical memo of this 'Swarm' investigation and its findings is available on the Safe Waters website.

While still using EPA-approved analytical methods, various process adjustments were made throughout LTM to narrow the potential for laboratory-introduced artifacts leading to detections.

- Beginning in August 2022, after a TPH detection that was found to be from lab contamination, dedicated glassware (SFs, flasks, concentrators, etc.) were purchased at SGS for use only on DW LTM samples.
- In August 2023, the laboratory additionally dedicated two concentrators, a gas chromatogram, and cleaning equipment to the project samples only. Even though both glass wool and filter paper are both acceptable for use during extraction, SGS transitioned from using glass wool to filter paper during extraction due to the concern of range contamination, resulting in an influence of results in carbon chains between ranges of 10-31 on the gas chromatogram.
- In October 2023, the Navy initiated a preliminary premise plumbing assessment as a direct result of concerns reported to the United States Environmental Protection Agency (EPA) and the State of Hawai'i Department of Health (DOH) by six residents served by the Navy's Joint Base Pearl Harbor-Hickam (JBPHH) water distribution system. The assessment included condition investigations of premise plumbing in ten residences, Rapid Response Team (RRT) and Long-Term Monitoring (LTM) drinking water sampling, water heater assessment and sampling, and water distribution system sampling conducted at the appropriate fire hydrants. The laboratories used during this study were SGS-Wheatridge and Pace-Ormand Beach.

Maintaining ongoing SF techniques and alignment within method requirements, bottleware adjustments were incorporated to provide side-by-side data with the SF results, as described in Section 5.3 of the DW LTM Plan.

- In November 2023, select samples, and all samples beginning in January 2024, were paired with a TPH microextraction set of bottles.
 - The microextraction technique uses less reusable glassware, reagents, and solvent and eliminated the concentration step.
- Beginning in February 2024, additional volume was collected for SF quench analysis. A quenching agent, sodium thiosulfate, was added to the samples prior to extraction to remove residual chlorine, which is believed to react with either the solvent, surrogate mixture, or sample during extraction leading to detectable artifacts. Quenching chromatograms indicated elimination of peaks believed to be products of halogenation.
- On February 21, 2024, the separate quench and microextraction techniques were combined, becoming the MEQ samples. As shown in Table 2, Table 3, and Appendix C, microextraction and MEQ produced significantly fewer detections compared to the SF method due to the adjustments for chlorinated byproducts and reused glassware.
- In January 2024, the Navy assembled an interagency team of experts from across the Navy, Army, and private industry, and consulted with the EPA and DOH to evaluate potential causes

for these low-level TPH detections. The Navy prepared a technical memorandum explaining the team's evaluation, actions taken, and results found from its analysis. The interagency team of experts evaluated potential causes for low-level TPH detections and considered eleven (11) potential factors. When considered together, the lines of evidence support the conclusion that the low-level detections of TPH observed during LTM are not associated with the release of JP-5 or any other fuel-related product. A chemical used in Method 8015 was found to interact with chlorine present in the drinking water samples, producing an increased frequency of TPH readings in the sample results, which have unique chemical signatures that do not match the signature of JP-5 or any other fuel-related products. Chromatograms are unique profiles of sample results that are generated during analysis, and which are compared against known chemical standards as reference to complete an analysis. The chemical signatures reviewed in the sample chromatograms do *not* match those of JP-5. Additionally, pushing testing to such sensitive levels (trying to find any signature even at low concentrations) is challenging based on the design and intent of the method.

- Most significantly, in January 2024, the concentration of the surrogate, o-terphenyl, added to the samples was reduced from 2,000 ppb to 100 ppb. The lab completed a mass spectral analysis to study a common peak in sample results and had reasonable certainty that it was a brominated analog of the surrogate. Once the identity of this peak was determined, the laboratory dropped the surrogate concentration. Adjustments of this type are not considered method modifications, and the laboratory is not required to perform any performance studies. Surrogate concentrations may be chosen at the laboratory's discretion. As a result of this change, a clear drop in percent detections occurred from 30 percent in January 2024 to 4 percent in February 2024.

A summary of TPH detection data is presented in Tables 1, 2, 3 and Figure 4. Additional figures of sampling locations and status of TPH results by period and charts of the percent detection by month and by zone are included in Appendix C. In late 2023 an increased trend in the frequency of TPH detections was observed across zones. The Navy assessed that the TPH detections observed during LTM, to include Period 6, were associated with the reaction between chlorine/bromine and the surrogate o-Terphenyl and were not associated with petrogenic-TPH. A technical memo evaluating this trend is available on the Safe Waters website.

Table 1: TPH Percent Detection of Separatory Funnel Analysis by Month

Month of Interest	Number of Samples	Number of Detections	Separatory Funnel Percent Detection
Mar 2022	665	135	20%
Apr 2022	897	82	9%
May 2022	729	137	19%
Jun 2022	536	170	32%
Jul 2022	364	51	14%
Aug 2022	406	143	35%
Sep 2022	357	73	20%
Oct 2022	199	122	61%
Nov 2022	35	9	26%
Dec 2022	1	0	0%
Jan 2023	400	157	39%
Feb 2023	373	105	28%
Mar 2023	313	97	31%
Apr 2023	398	176	44%
May 2023	16	6	38%
Jun 2023	42	25	60%
Jul 2023	328	174	53%
Aug 2023	449	251	56%
Sep 2023	370	312	84%
Oct 2023	362	219	60%
Nov 2023	28	12	43%
Dec 2023	53	37	70%
Jan 2024	717	216	30%
Feb 2024	829	37	4%
Mar 2024	266	8	3%



Figure 4: TPH-Diesel Detection

The zone maps in Appendix C do not show any significant clustering of TPH detections or exceedances across zones. TPH detections peaked in relative proportion during Period 6 prior to the surrogate concentration change, and significantly dipped in Period 7 after the change was incorporated.

As part of a secondary assessment of a smaller grouping of residences, schools, and CDCs – to compare SF results against MEQ methods – two exceedances (detections above the ISP) were observed. These included elevated detections of TPH at D2-TW-0015498-23337-N-1-R1 collected from Hickam Elementary on February 26, 2024, and H1-TW-0013012-22152-A-R1 collected from a residence at 4445 Kobashigawa Street on February 28, 2024. In the event of an exceedance, the resident/tenant is notified the same day the Navy is notified of the issue.

- For the exceedance at the residence, the Navy notified the resident of the exceedance and bottled water was provided. The exceedance result was observed only in the original SF sample, and not the MEQ split sample, which was non-detect. In accordance with the DW LTM Plan, the Navy flushed all five (5) sinks in the home and resampled each; the results of which were non-detect for TPH.
- For the other exceedance, the Navy notified the school principal and the sink was secured. Bracketing samples were collected from onsite at Hickam Elementary on March 8, 2024, from both sinks in the room, in addition to the cafeteria sink. All sinks were flushed for 15 minutes prior to sampling; and the resample results were non-detect for TPH.

The two exceedances do not demonstrate a geographical trend of TPH, and were cleared through established, approved regulator protocols.

Table 2: Percent Detection of Microextraction and Microextraction-Quench Analysis by Month

Month of Interest	Number of ME Samples	Number of ME Detections	Microextraction Percent Detection	Number of MEQ Samples	Number of MEQ Detections	Microextraction Quench Percent Detection
Jan 2024	626	0	0%	0	0	—
Feb 2024	465	0	0%	360	6	2%
Mar 2024	0	0	—	266	0	0%

— no data
ME micro-extraction

In February 2024, in addition to the Navy collecting samples for analysis of TPH, DOH initiated an independent investigation of the JBPHH’s drinking water and collected a subset of twelve household drinking water and shaft samples that were analyzed at Alpha Analytical (Mansfield, Massachusetts) by EPA Method 8015D. Similar to the Navy’s DW LTM results, this 8015D analysis reported low-level TPH concentrations, below and just above the laboratory method reporting limit. The analysis determined that no petroleum distillates like jet fuel were detected. On May 22, 2024, DOH publicly announced the finding of its independent forensic investigation, which confirmed that no petroleum or jet fuel compounds were detected in the samples DOH collected.

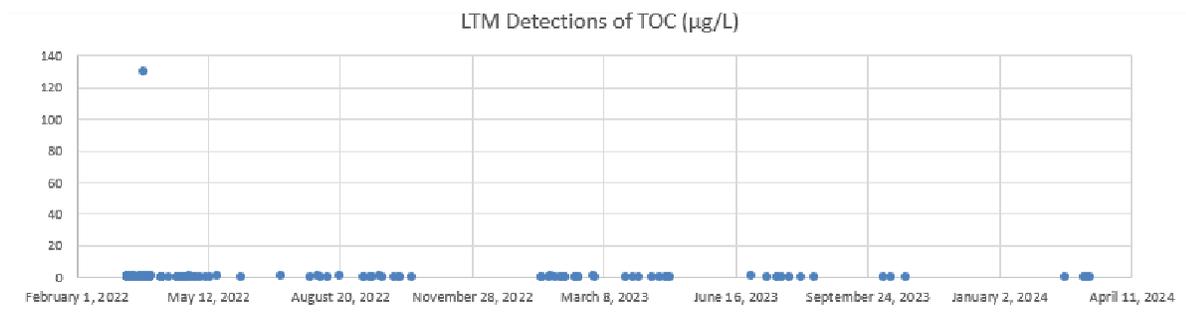
Table 3: Percent Detection of Separatory Funnel, Microextraction, and Microextraction-Quench Analysis by Zone

Zone of Interest	Number of Samples in Zone	Number of Detections in Zone	Separatory Funnel Percent Detection	Number of ME Samples in Zone	Number of ME Detections in Zone	ME Percent Detection	Number of MEQ Samples in Zone	Number of MEQ Detections in Zone	MEQ Percent Detection
A1	481	129	27%	77	0	0%	14	0	0%
A2	450	130	29%	57	0	0%	28	1	4%
A3	1081	270	25%	171	0	0%	35	0	0%
B1	187	59	32%	12	0	0%	21	0	0%
C1	184	52	28%	3	0	0%	14	0	0%
C2	134	29	22%	2	0	0%	8	0	0%
C3	67	14	21%	1	0	0%	2	0	0%
D1	501	183	37%	35	0	0%	64	1	2%
D2	1408	463	33%	200	0	0%	116	4	3%
D3	1042	346	33%	126	0	0%	75	0	0%
D4	86	23	27%	1	0	0%	3	0	0%
E1	197	45	23%	8	0	0%	22	0	0%
F1	685	218	32%	72	0	0%	54	0	0%
F2	1175	358	30%	120	0	0%	72	0	0%
G1	46	8	17%	0	0	—	2	0	0%
H1	745	246	33%	102	0	0%	63	0	0%
H2	189	49	26%	24	0	0%	12	0	0%
H3	273	75	27%	50	0	0%	12	0	0%
I1	150	30	20%	23	0	0%	9	0	0%

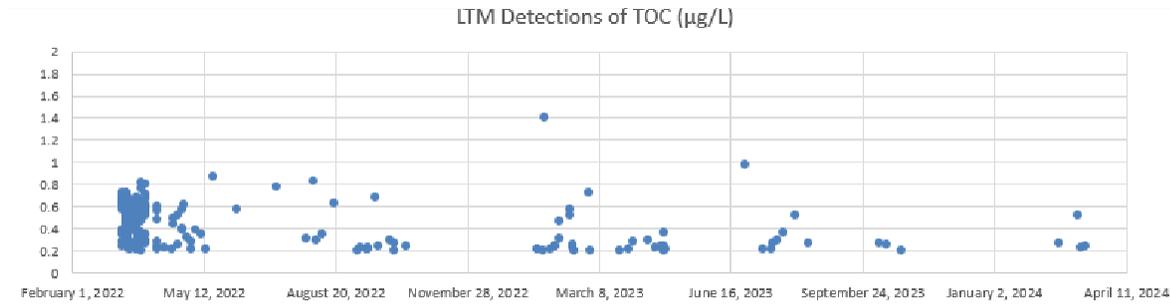
— no data
 ME micro-extraction

3.3 Total Organic Carbon

TOC detections across all LTM events were broadly low-level periodic detections, with a median detection value of 0.49 µg/L, with one exceedance in March 2022 in zone F2. The ISP for TOC is 2 µg/L. The one TOC exceedance was resampled and bracketed with four hydrant samples. TOC was not found in any of the resamples. There were two TOC exceedances initially reported in Period 7 - one in Zone H2 (8.1 ug/L) and one in Zone H3 (7.1 ug/L) – both were found to be a sampling error.



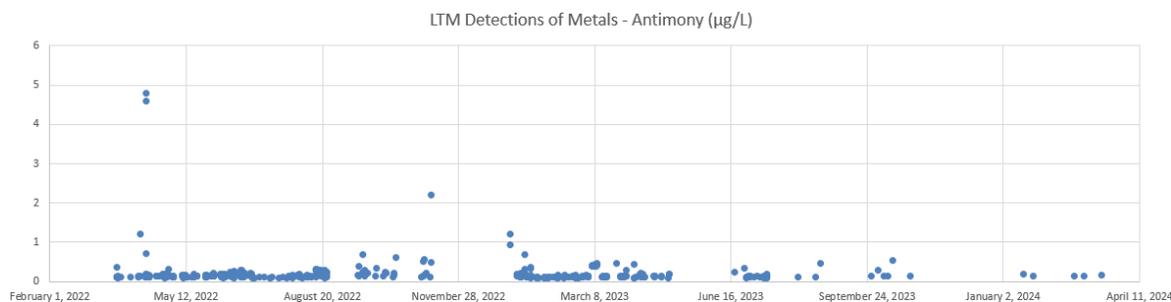
Detection details for values below 2 µg/L are provided below to prevent skewing from the outlying data points.



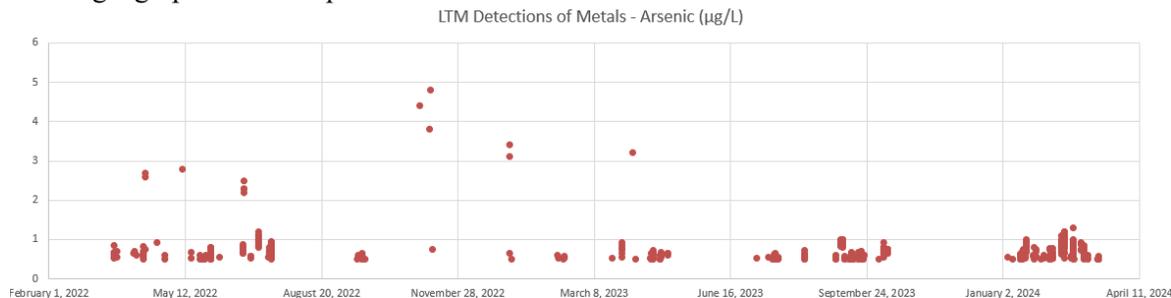
3.4 Metals

All the metals sampled as part of the DW LTM program are separate from the Navy’s compliance monitoring program. The Navy executed a multi-layered approach to lead monitoring, which well exceeds normal measures. The lead sampling as part of the LTM program was conducted as a screening tool, above and beyond conducting normal Lead and Copper Rule (LCR) compliance sampling, in addition to Lead in Priority Area monitoring. The sampling protocols for the LTM sampling were very different. Lead is screened as a potential fuel indicator and as such, protocol varied to meet this objective. The Navy performs regulator-approved protocol for LCR-related sampling. The metals sampled as part of LTM are for screening purposes only and are therefore not sampled for in the same way as compliance samples. Metal detections during the LTM events were broadly low-level periodic detections. Across all metal analyses no trends were observed with respect to time or region. Below is a summary for each individual metal.

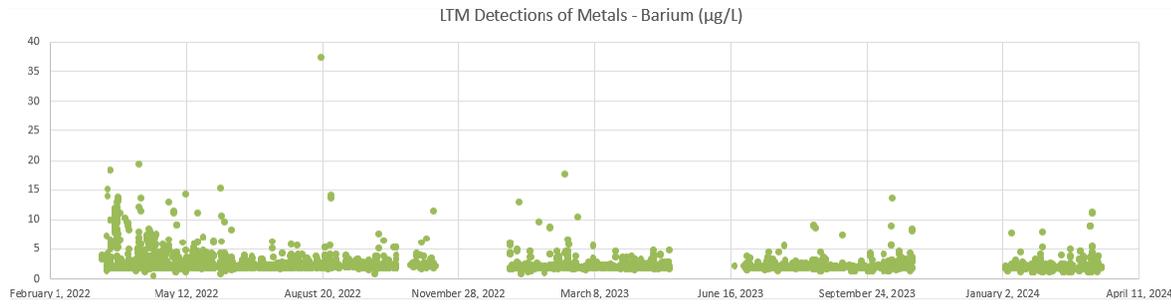
Antimony: The ISP and DOH MCL for antimony is 6 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



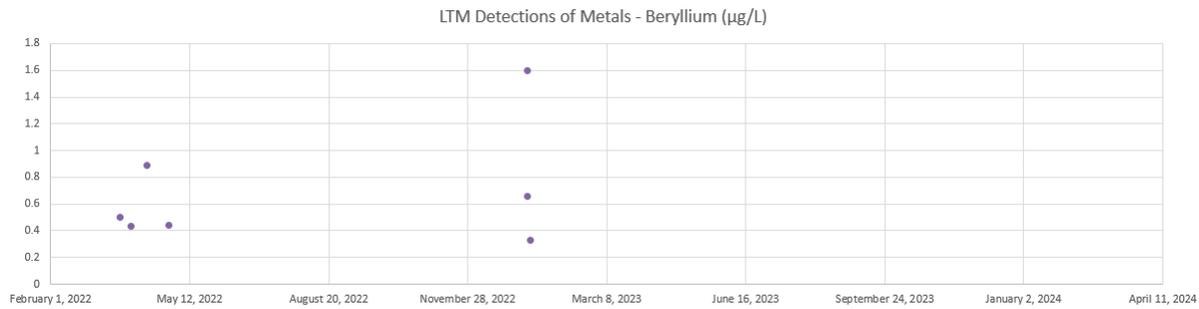
Arsenic: The ISP and DOH MCL for arsenic is 10 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



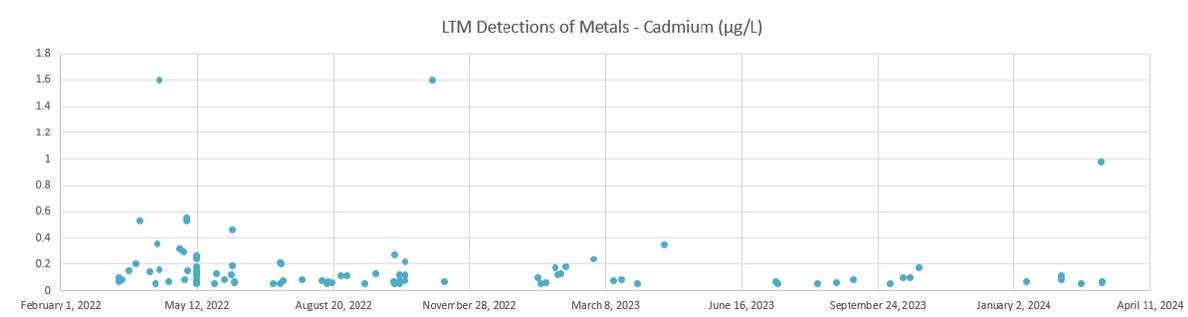
Barium: The ISP and DOH MCL for barium is 2,000 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



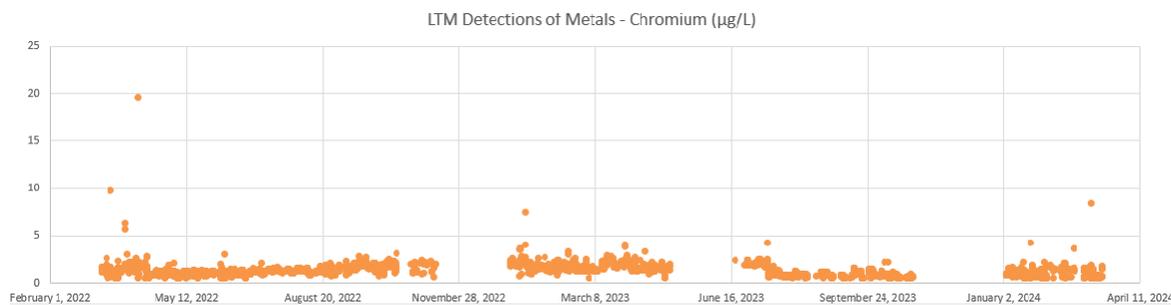
Beryllium: The ISP and DOH MCL for beryllium is 4 $\mu\text{g/L}$. Detections were all below the ISP and did not have a geographical or temporal trend.



Cadmium: The ISP and DOH MCL for cadmium is 5 $\mu\text{g/L}$. Detections were all below the ISP and did not have a geographical or temporal trend.

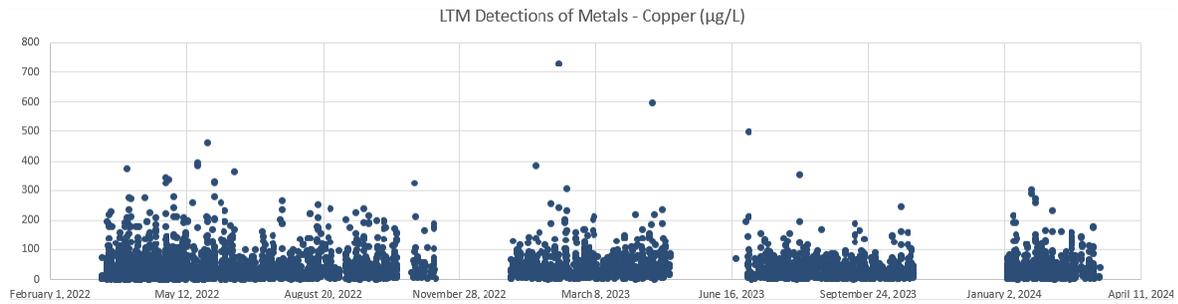


Chromium: The ISP and DOH MCL for chromium is 100 $\mu\text{g/L}$. Detections were all below the ISP and did not have a geographical or temporal trend.



Copper: The ISP and DOH AL for copper is 1,300 $\mu\text{g/L}$. Detections were all below the ISP and did not

have a geographical or temporal trend.



Lead: The ISP and DOH AL for lead is 15 µg/L. Detections were observed throughout all event periods. Lead detections above the ISP did not have a temporal or geographical trend. Exceedances were as follows:

- Five exceedances across five zones were observed in Period 1
- Six exceedances across three zones were observed in Period 2
- Two exceedances across two zones were observed in Period 3
- Four exceedances across three zones were observed in Period 4
- Three exceedances across three zones were observed in Period 5
- Four exceedances across three zones were observed in Period 6
- Two exceedances across two zones were observed in Period 7

All exceedances were remediated with flushing and resampling, or fixture replacement when resampling indicated a continuous localized issue in accordance with established protocols of the approved DW LTM Plan. Table 4 demonstrates that the relative lead detections were most present in zones H1 and H2; however, the proportion of exceedances amongst all zones was under 1 percent.

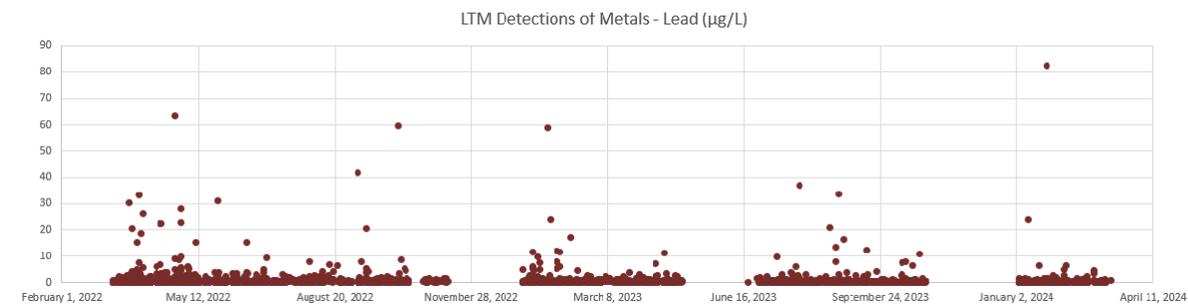
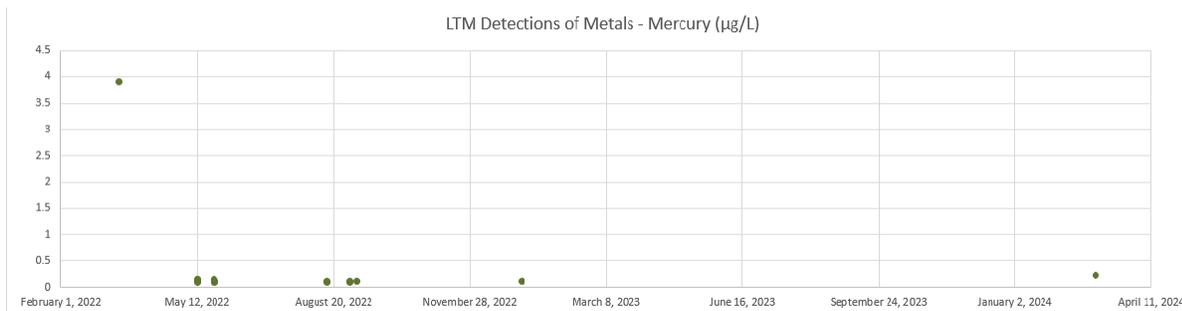


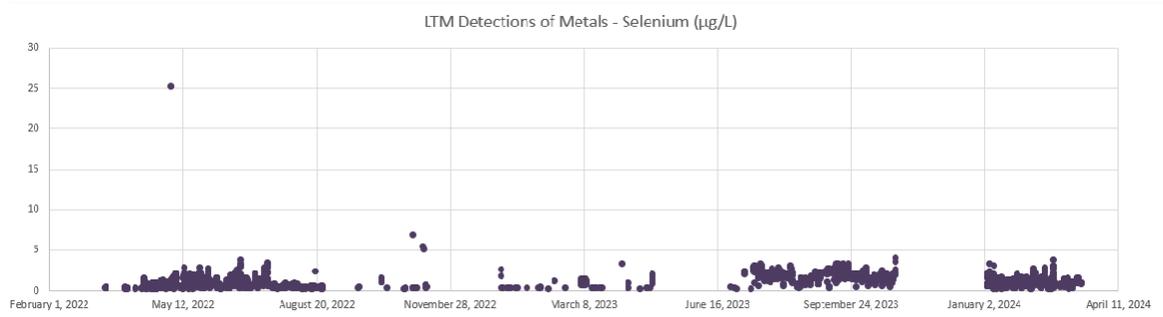
Table 4: Lead Detections by Zone

Zone	No. Lead Detections	No. Lead Exceedances	Zonal RE+NR Total	Detection %	Exceedance %
A1	152	1	667	22.8%	0.1%
A2	345	0	523	66.0%	0.0%
A3	778	1	1492	52.1%	0.1%
B1	115	0	265	43.4%	0.0%
C1	83	0	183	45.4%	0.0%
C2	64	0	158	40.5%	0.0%
C3	36	0	143	25.2%	0.0%
D1	267	2	582	45.9%	0.3%
D2	800	6	1801	44.4%	0.3%
D3	627	1	1027	61.1%	0.1%
D4	60	0	148	40.5%	0.0%
E1	101	1	152	66.4%	0.7%
F1	355	4	843	42.1%	0.5%
F2	806	7	1494	53.9%	0.5%
G1	31	0	59	52.5%	0.0%
H1	676	3	930	72.7%	0.3%
H2	169	0	232	72.8%	0.0%
H3	212	0	379	55.9%	0.0%
I1	87	0	141	61.7%	0.0%

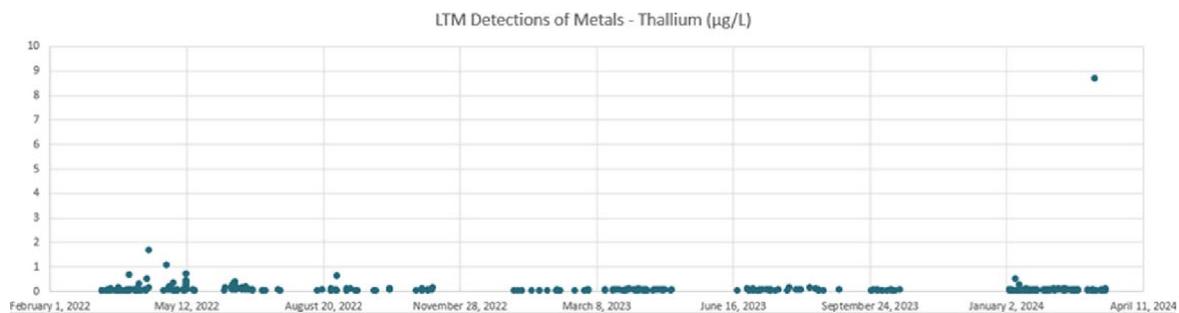
Mercury: The ISP and DOH MCL for mercury is 2 µg/L. Mercury detections across LTM were broadly low-level periodic detections, with a median detection value of 0.12 µg/L. There was one mercury exceedance in March 2022 in zone D1 at Pearl Harbor Kai Elementary School. The school was notified on the same day of the exceedance. The exceedance was remediated with fixture replacement after flushing and resampling did not eliminate the elevated detections. After fixture replacement, additional sampling confirmed mercury was no longer present. The mercury detections did not indicate a geographical or temporal trend.



Selenium: The ISP and DOH MCL for selenium is 50 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



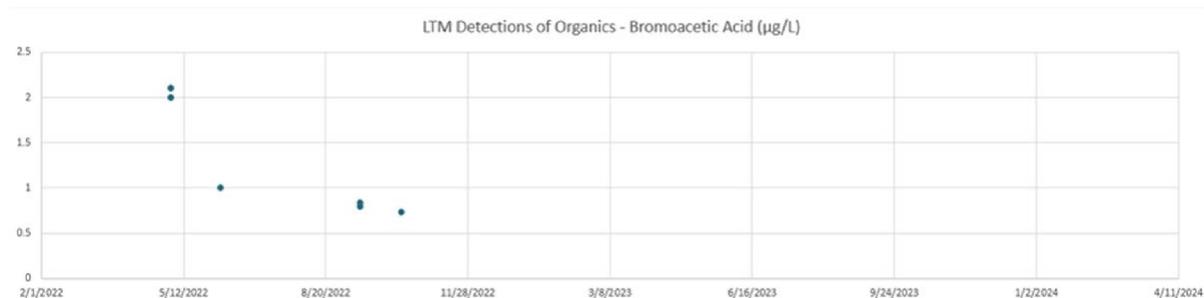
Thallium: The ISP and DOH MCL for thallium is 2 µg/L. Thallium detections across all LTM events were broadly low-level periodic detections, with a median detection value of 0.07 µg/L. There was one exceedance in March 2024 in zone F1; a hydrant detection of 8.7 ppb. The hydrant was flushed, split samples were collected and analyzed by SGS and Pace, two independent, EPA-certified laboratories. The resample result for SGS was .051 ppb while the Pace result was non-detect. The thallium detections did not indicate a geographical or temporal trend.



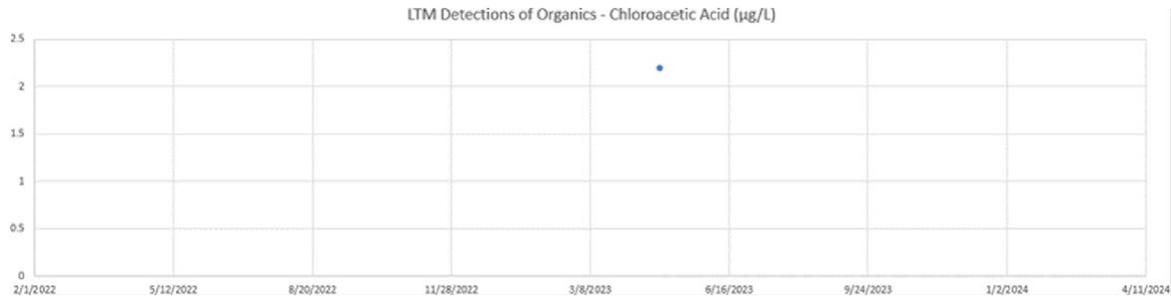
3.5 Organics

The detection of organic molecules across all LTM samples were broadly low-level periodic detections. No trends were observed in time or region for any organic compound detected. Below is a summary for each individual organic compound.

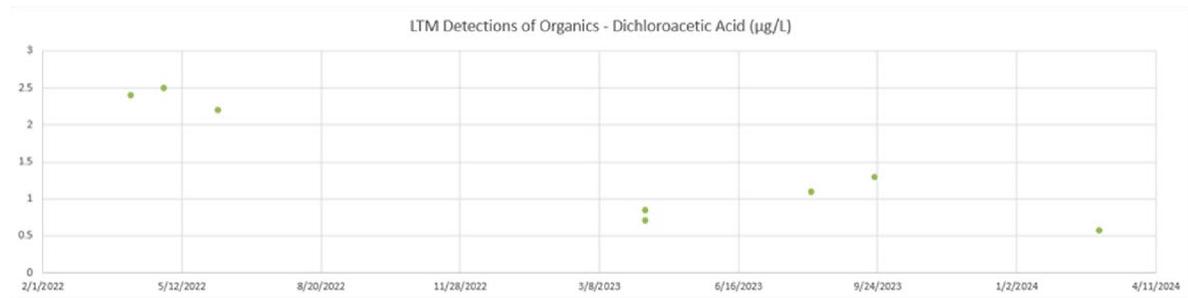
Bromoacetic Acid: Any detections for Bromoacetic acid are included under the Total Haloacetic Acids MCL of 60ug/L. Detections were sporadic and low with no geographical or temporal trend.



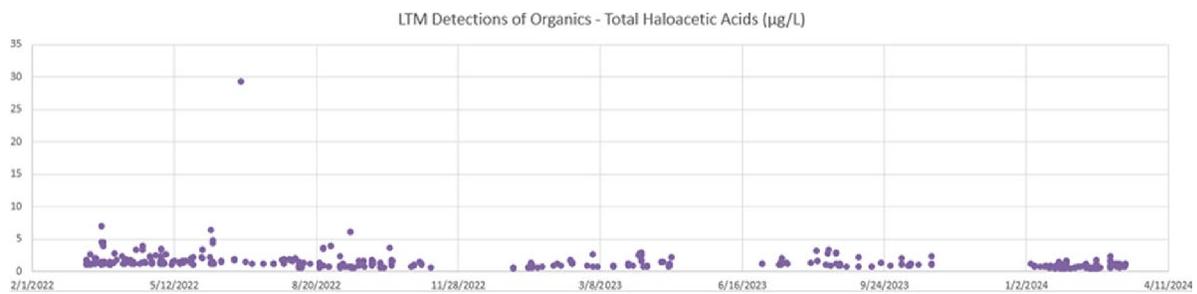
Chloroacetic Acid: There is no DOH MCL and ISP limit for chloroacetic acid. There was one detection during all LTM events with no geographical or temporal trend.



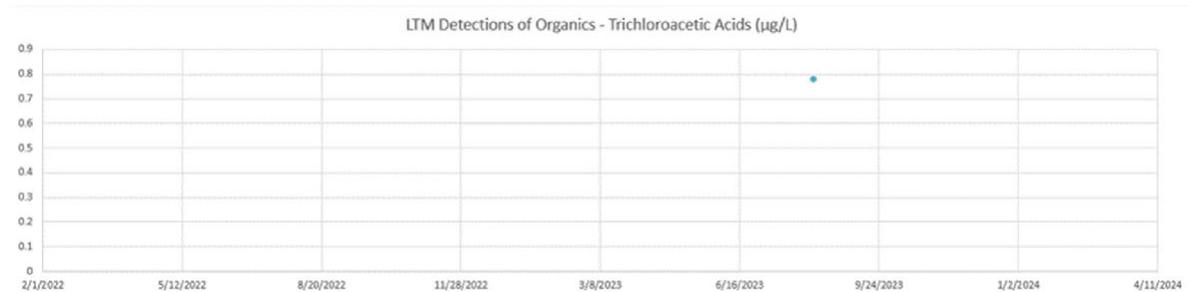
Dibromoacetic Acid: There are no DOH MCL and ISP limit for dibromoacetic acid. Detections were sporadic and low with no geographical or temporal trend.



Total Haloacetic Acid: The ISP and DOH MCL for total haloacetic acids is 60 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



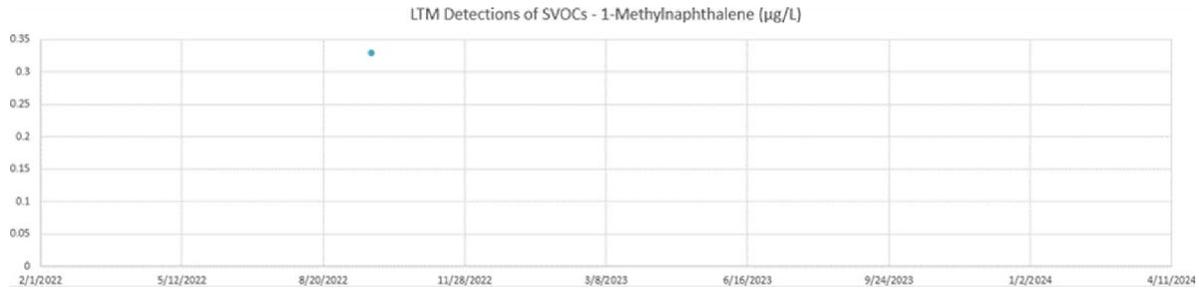
Trichloroacetic Acid: There are no ISP and DOH MCL limit for trichloroacetic acid. There was one detection during all LTM events with no geographical or temporal trend.



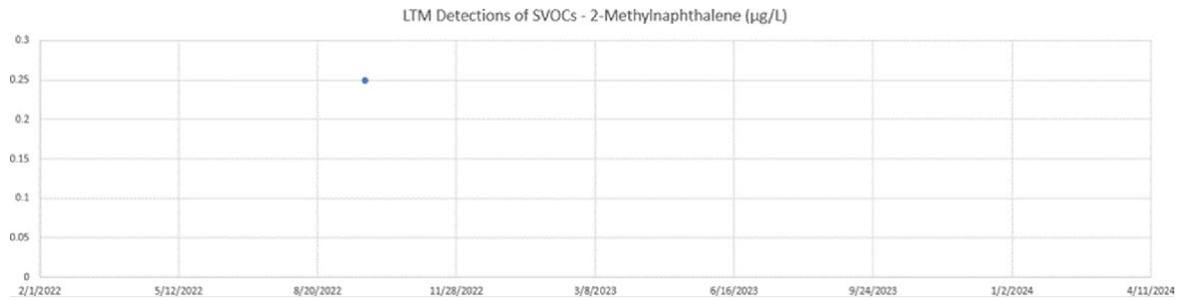
3.6 Semi-volatile Organic Compounds

Semi-volatile organic compound (SVOC) detections across all LTM events were broadly low-level periodic detections. No SVOCs exhibited trends with respect to time or region. Below is a summary of each individual SVOC.

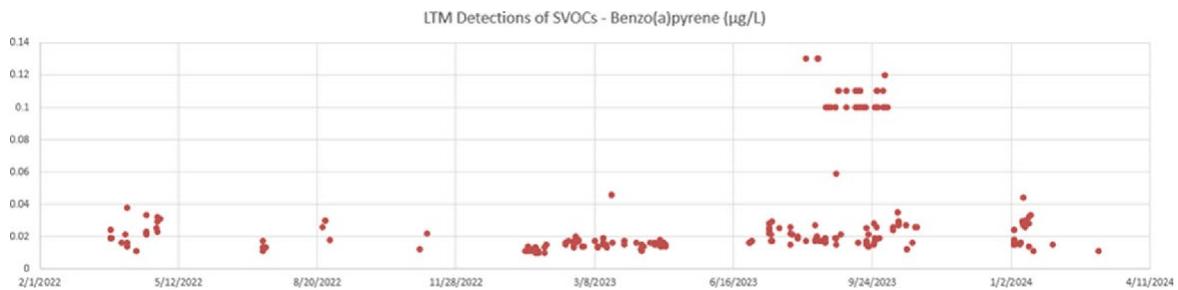
1-methylnaphthalene: There are no ISP and DOH MCL limit for 1-methylnaphthalene. There was one detection across all LTM events with no geographical or temporal trend.



2-methylnaphthalene: There are no ISP and DOH MCL limit for 2-methylnaphthalene. There was one detection across all LTM events with no geographical or temporal trend.



Benzo(a)pyrene: The ISP and DOH MCL for benzo(a)pyrene is 0.2 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



Bis(2-ethylhexyl)phthalate: The ISP and DOH MCL for bis(2-ethylhexyl)phthalate is 6 µg/L. Bis(2-ethylhexyl)phthalate detections above the ISP did not have a temporal trend. All exceedances, but not all detections, of bis(2-ethylhexyl)phthalate were observed in zone A3, as summarized in Table 5, and contributed to 0.3 percent exceedances across all LTM samples collected in that zone. Periodic detections were remediated with flushing or fixture replacement. Multiple exceedances were observed at 6224A Ibis Ave in October 2023 (Zone A3), which were associated to one home with continued elevated

concentrations. Through bracketing and resampling, the source of the contamination was determined to be the kitchen sink, which was replaced on October 28, 2023; results from the resample were below the ISP.

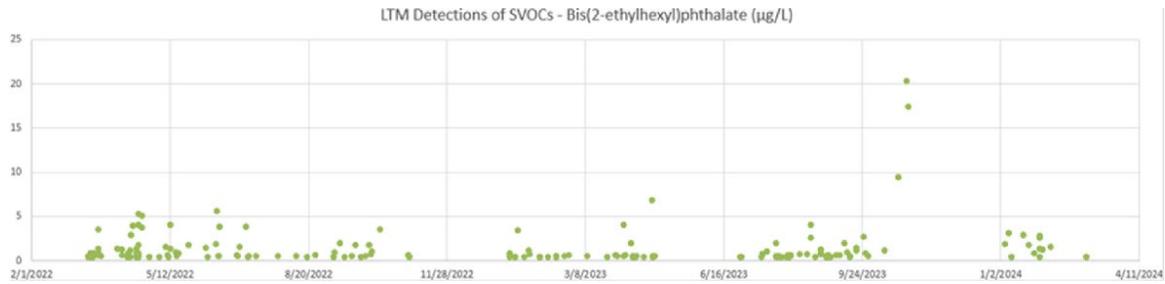
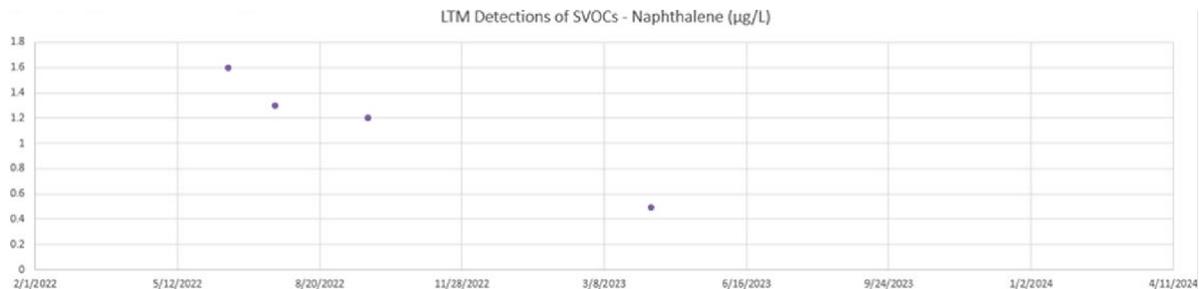


Table 5: Bis(2-ethylhexyl)phthalate Detections by Zone

Zone	No. Detections	No. Exceedance	Zonal RE+NR Total	Detection %	Exceedance %
A1	14	0	667	2.1%	0.0%
A2	15	0	523	2.9%	0.0%
A3	16	4	1492	1.1%	0.3%
B1	6	0	265	2.3%	0.0%
C1	7	0	183	3.8%	0.0%
C2	2	0	158	1.3%	0.0%
C3	0	0	143	0.0%	0.0%
D1	47	0	582	8.1%	0.0%
D2	26	0	1801	1.4%	0.0%
D3	8	0	1027	0.8%	0.0%
D4	2	0	148	1.4%	0.0%
E1	6	0	152	3.9%	0.0%
F1	19	0	843	2.3%	0.0%
F2	33	0	1494	2.2%	0.0%
G1	4	0	59	6.8%	0.0%
H1	31	0	930	3.3%	0.0%
H2	1	0	232	0.4%	0.0%
H3	7	0	379	1.8%	0.0%
I1	6	0	141	4.3%	0.0%

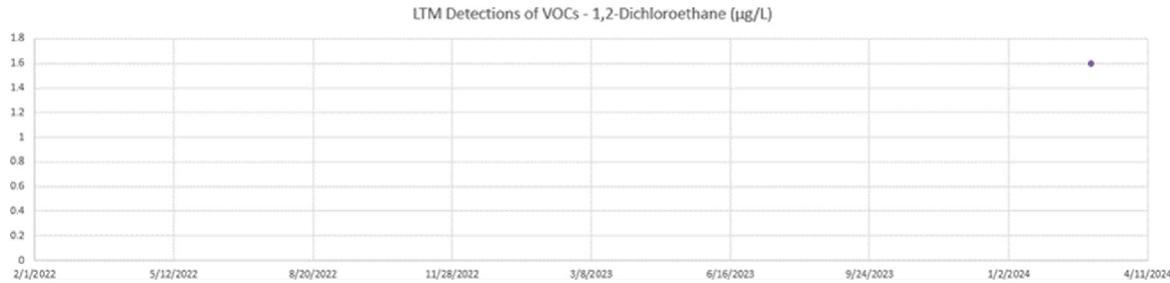
Naphthalene: There is no ISP limit for naphthalene. Detections were sporadic and low with no geographical or temporal trend.



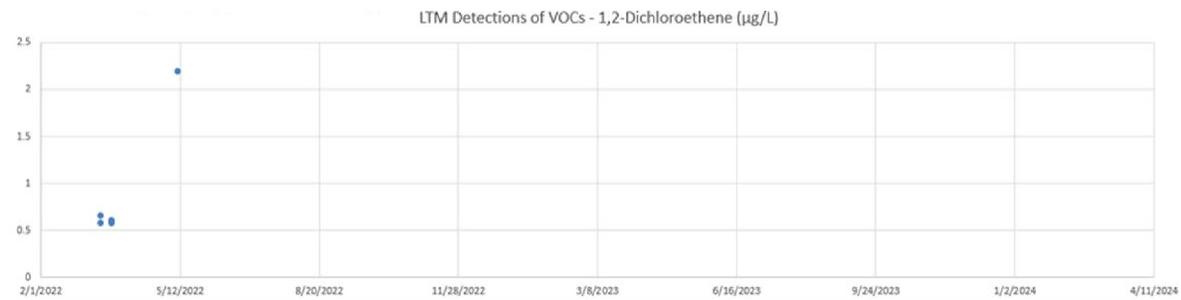
3.7 Volatile Organic Compounds

Volatile organic compound (VOC) detections across all LTM events were broadly low-level periodic detections. No trends were observed with respect to time or region for any VOC. Below is a summary of each individual VOC.

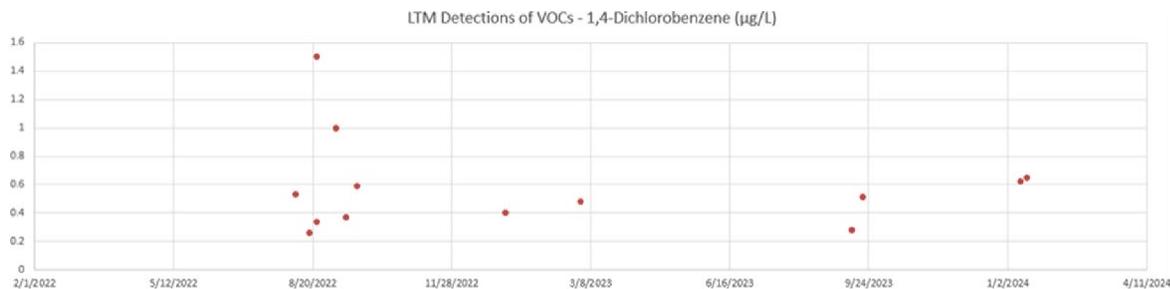
1,2-dichloroethane: The ISP for 1,2-dichloroethane is 5 µg/L. There was one detection across all LTM events with no geographical or temporal trend.



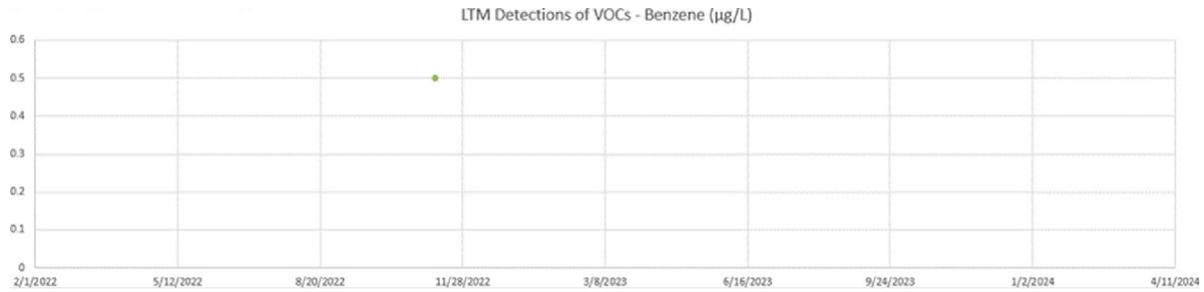
1,2-dichloroethene: The ISP for 1,2-dichloroethene is 70 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



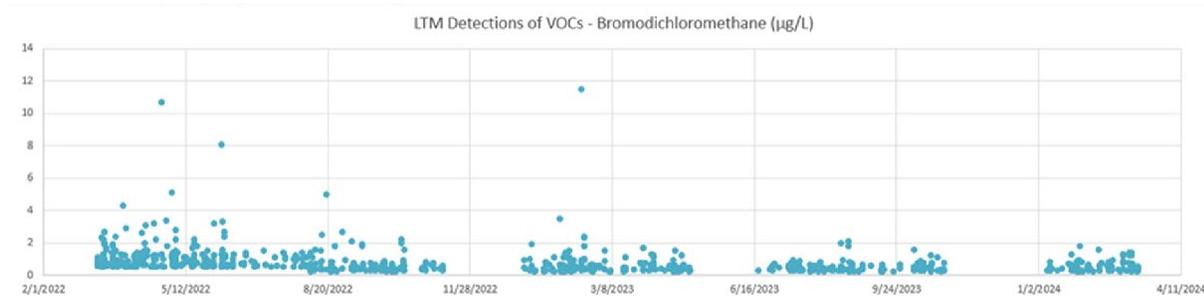
1,4-dichlorobenzene: The ISP for 1,4-dichlorobenzene is 75 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



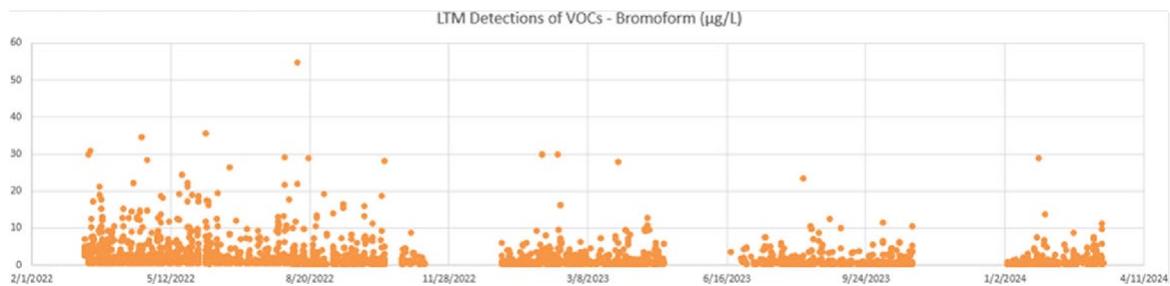
Benzene: The ISP for benzene is 5 µg/L. Multiple detections were observed, mostly at the detection limit of 0.5 µg/L, well below the ISP; and did not have a geographical or temporal trend.



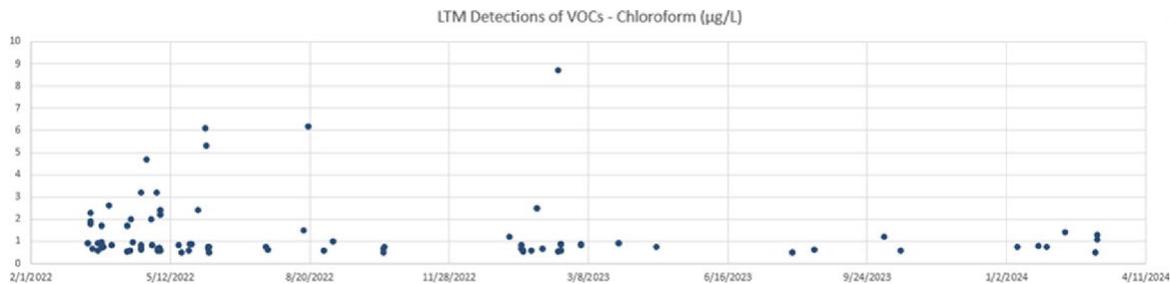
Bromodichloromethane: There is no individual ISP limit for bromodichloromethane. Any results were included in the Total Trihalomethanes count that has a MCL of 80 ppb. Detections were sporadic and low with no geographical or temporal trend.



Bromoform: There is no individual ISP limit for bromoform. Any results were included in the Total Trihalomethanes count that has a MCL of 80 ppb. Detections were sporadic and low with no geographical or temporal trend.

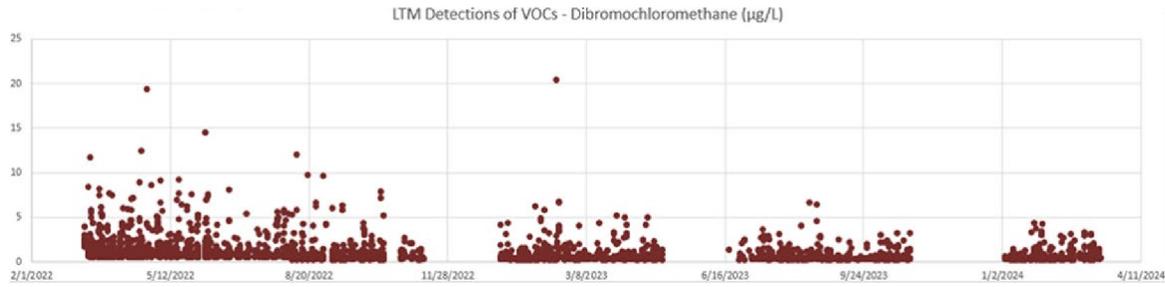


Chloroform: There is no individual ISP limit for chloroform. Any results were included in the Total Trihalomethanes count that has a MCL of 80 ppb. Detections were sporadic and low with no geographical or temporal trend.

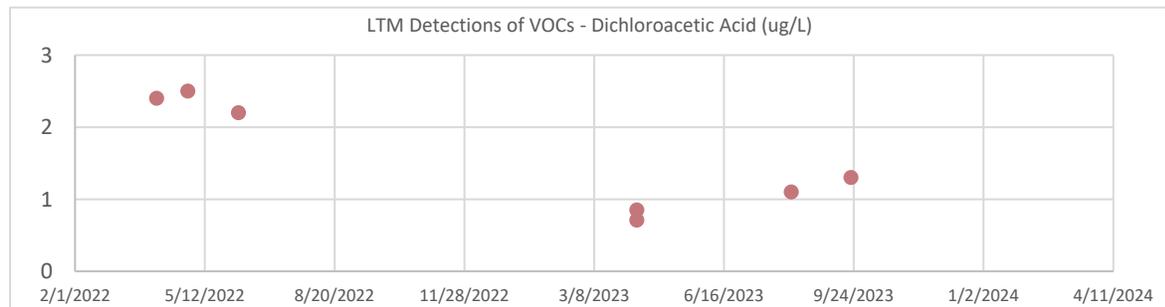


Dibromochloromethane: There is no individual ISP limit for dibromochloromethane. Any results were

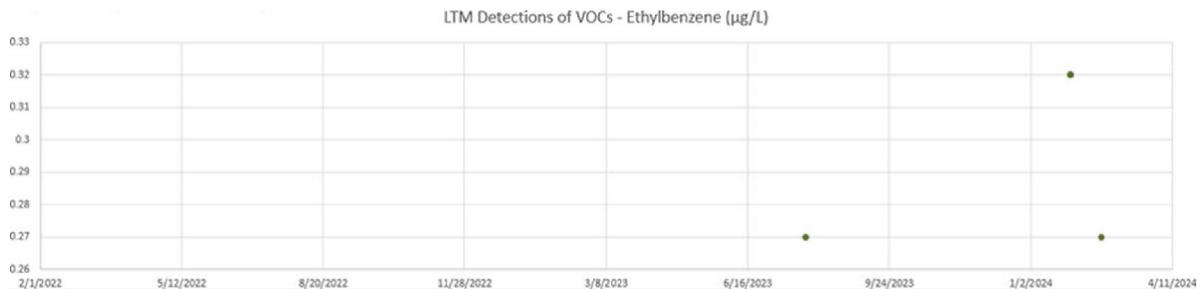
included in the Total Trihalomethanes count that has a MCL of 80 ppb. Detections were sporadic and low with no geographical or temporal trend.



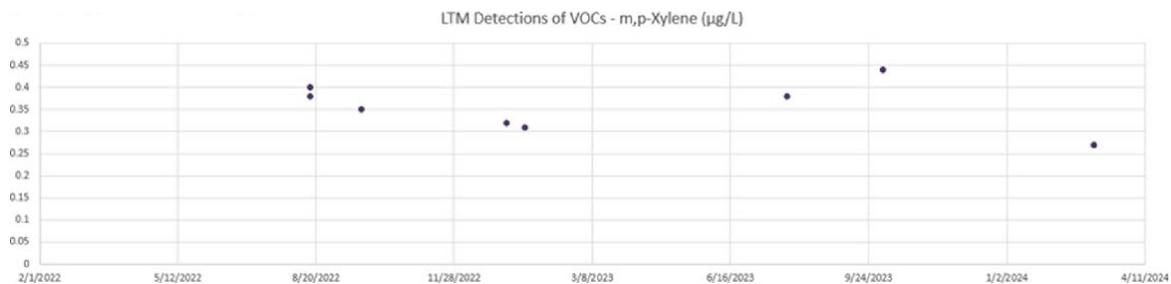
Dichloroacetic Acid: Any detections for Dichloroacetic acid are included under the Total Haloacetic Acids MCL of 60ug/L. There is also an individual MCLG (non-enforceable goal) of 0 ppb. There were 7 detections of 9,304 samples collected; with a decreasing trend.



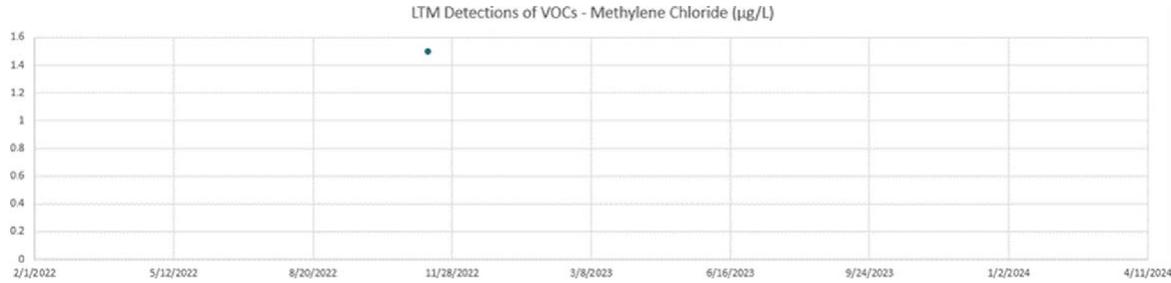
Ethylbenzene: The ISP for ethylbenzene is 700 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



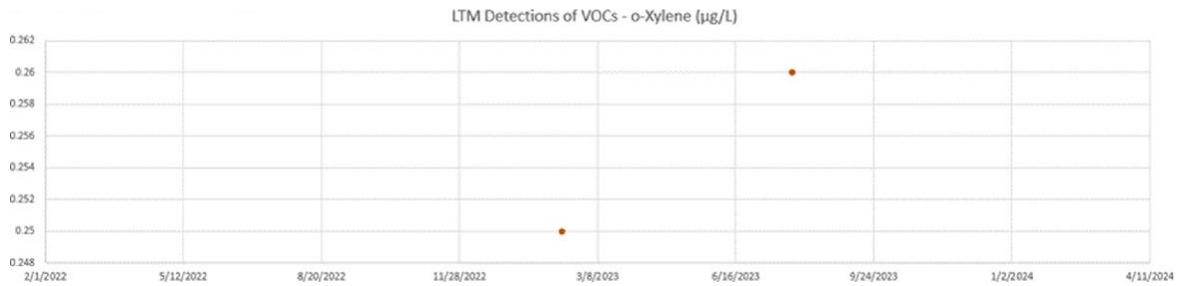
m,p-xylene: The ISP for m,p-xylene is 10,000 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



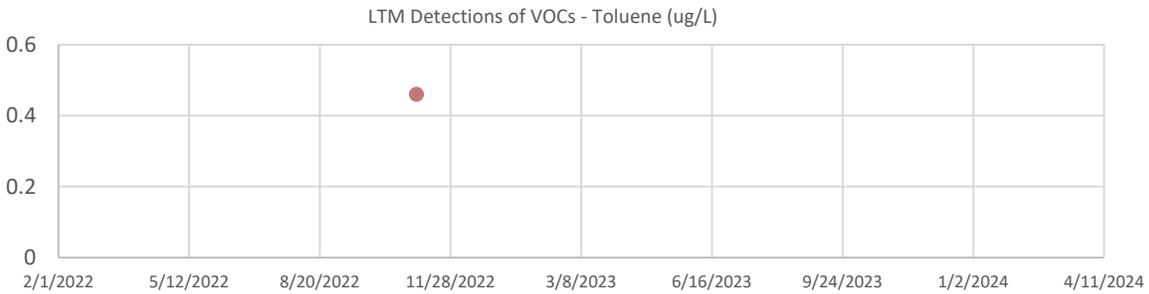
Methylene Chloride: The ISP for methylene chloride is 5 µg/L. There was one detection across all LTM events with no geographical or temporal trend.



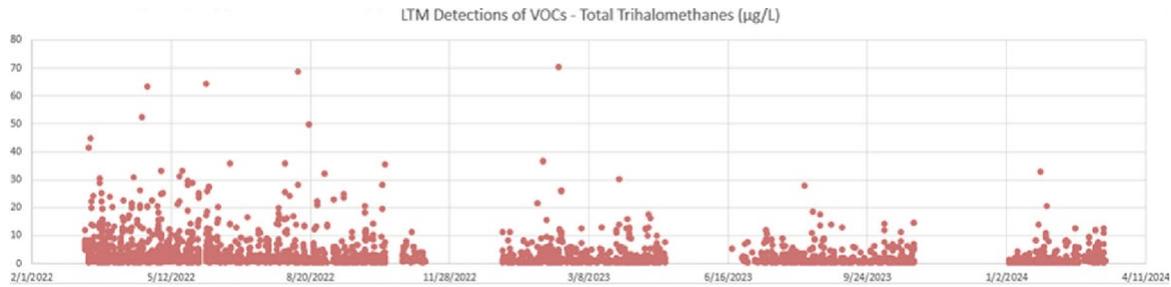
o-xylene: The ISP for o-xylene is 10,000 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



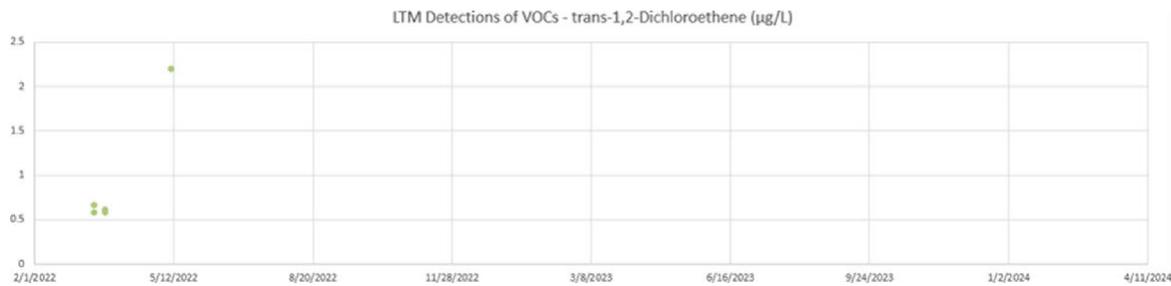
Toluene: The ISP for toluene is 1,000 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



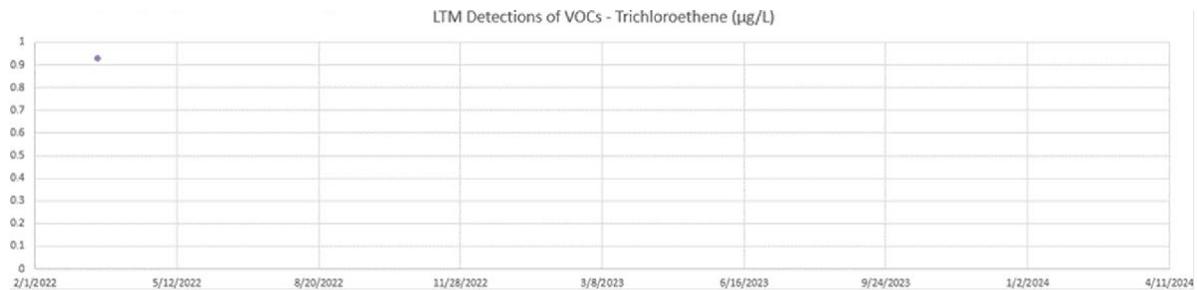
Trihalomethanes: The ISP of total trihalomethanes is 80 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



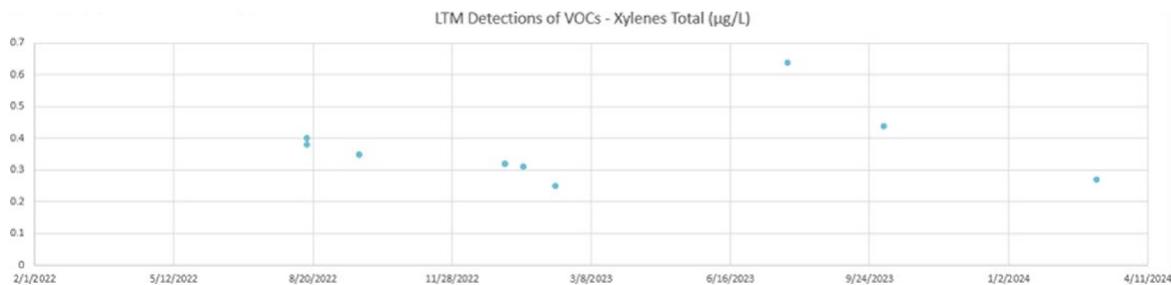
Trans-1,2-dichloroethene: The ISP for trans-1,2-dichloroethene is 100 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



Trichloroethene: The ISP for trichloroethene is 5 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



Xylenes: The ISP for xylenes is 10,000 µg/L. Detections were all below the ISP and did not have a geographical or temporal trend.



4 Removal Action Reports

As stated in DOH’s Guidance on the Approach to Amending the Public Health Advisory, Addendum 1,

dated February 12, 2022, “DOH’s priority is to protect the public health of the people of Hawaii. The guidance is based on “lines of evidence” (Table 1 [of the referenced guidance]) that must be met before DOH will amend the health advisory and issue notices that the water can be used for drinking. The Navy must also commit to following the DW LTM of system water quality for this incident under the IDWST Drinking Water Sampling Plan, as amended.” References made to “Memo” in Sections 6.1 – 6.3 refer to the memorandum for record provided in the identified sections of the Removal Action Report (RAR) submitted by the Navy to the IDWST for each zone. These RARs provided the framework for the lines of evidence used by DOH to amend each zone per the previously stated guidance. In connection with DOH’s amendment of the Public Health Advisory, prospective actions were required for certain Zones. Those conditions and, where appropriate, the steps for fulfilling them are set forth in this Plan. At the start of DW LTM, these specific actions are summarized below.

In January of 2022, sample results from 10 homes in Camp Smith Housing (Zone G1) were above the Incident Specific Parameter (ISP) of two (2) ppm for Total Organic Carbon (TOC). DOH issued a requirement to complete a cross-connection survey of the Camp Smith Housing Area prior to performing follow on sampling. The survey was completed and identified no deficiencies. The follow-on sampling occurred May 9th- May 11th, 2022. All re-sample results were below the ISP and the report was sent to DOH for closeout.

There was an exceedance of methylene chloride at the Hickam Officer’s Club (Zone D2) above the MCL of 5 ppb. During a follow-on investigation, it was identified that an unused custodial filling station was connected to the outdoor spigot where the initial sample was taken. The Navy collected bracketing samples which confirmed that the contamination was localized to the single specific fixture. The fixture was replaced and resampled (results below the MCL), and the report was sent to DOH for closeout October 25, 2022.

As a precaution to reduce the flow of impacted water following the initial release, an inactive submerged water distribution line that connected Bishop Point (Zone D2) and Iroquois Point (A3) was secured on December 5, 2021. On October 17, 2022, the Navy flushed the line’s stagnant water into the JBPHH sanitary sewer. The line was flushed and disinfected according to American Water Works Association (AWWA) standards. The confirmatory sample results were all below ISP standards and met DOH standards for safe drinking water. The Navy submitted a summary of actions and received final approval to return the interconnection into service on October 20, 2022.

5 Conclusion

During the week of 29 January 2024, an interagency team comprised of subject matter experts (SMEs) from the Navy and contractors met to discuss low-level TPH detections reported in drinking water samples collected from the JBPHH Drinking Water System. Representatives from DOH and EPA were consulted during the process. The SMEs evaluated numerous potential root causes for the low-level TPH detections and concluded that the most likely root causes were laboratory and method challenges. Other root causes that were evaluated by the interagency team included: TPH within source water, regulated disinfection byproducts, residual jet propellant (JP-5) fuel in the System from the November 2021 release from the Red Hill Bulk Fuel Storage Facility (Red Hill), biofilm activity, premise plumbing concerns, water line scaling, pesticides, change in system operations, and contaminants introduced during line breaks. All of these potential causes were evaluated to have either a low likelihood or extremely low likelihood of being the potential root cause. A summary technical memorandum of these findings is available independent of this report at the JBPHH Safe Waters website.

Through comparison of the analytical chromatograph with a JP-5 standard chromatograph, the TPH results were determined to be from sources unrelated to JP-5 jet fuel. In over 9,200 samples, no sheens or

petroleum odors were observed by the sampling teams. The analytical procedure (EPA SW846 Test Method 8015) used to test for TPH was not designed for analyzing drinking water samples, and it does not include steps to prevent analytical interferences/reactions that may occur due to the presence of disinfectants (e.g., free chlorine) in drinking water samples. The majority of TPH detections were low-level concentrations, between the method detection limit (MDL) and the method reporting limit (MRL), which indicates the challenge of laboratory reporting of detected concentrations at the MDL, rather than the MRL. Additionally, as the EPA Method was correctly conducted, the TPH detections reported during LTM are valid but, the results biased high due to the influence of analytical byproducts. It was determined that an interaction was occurring between the remaining chlorine in the drinking water sample and the surrogate standard added as part of the method extraction process. This interaction created by-products that were seen in the TPH- range during analysis and counted toward the final TPH totals but were not fuel related. This was a conservative approach to monitoring for TPH.

TPH detections appear to be randomly distributed throughout all Zones. The majority (85% to 100% depending on Zone and LTM Period) of TPH detections were less than 100 µg/L. Temporal changes in TPH levels from one LTM period to the next were consistent across all Zones. The temporal variation and spatial distribution of TPH levels in the JBPHH System and evaluation of sampling data in zones with inline GAC treatment) supports the hypothesis that TPH detections are not associated with the November 2021 JP-5 release and/or another release from Red Hill in the JBPHH System. Free chlorine in the drinking water samples reacts with organic precursors, resulting in ‘ghost peaks’ that appear as TPH detections. These ‘ghost peaks’ occurred due to chemical reactions taking place in the sample during the sample preparation and the extraction process. In addition to the ghost peaks, laboratory method blank/cross contamination issues were frequently observed and impacted sample analysis and quantitation. This was observed in drinking samples collected from all Zones (spatial) and LTM Periods (temporal). These observations strongly indicate that the low-level TPH detections are not associated with JP-5 (or other fuel-related TPHs).

Further analysis of DW parameters beyond TPH did not demonstrate any clustering of JP-5 degradation products, such as with VOCs or SVOCs, nor was there any clustering of generalized water quality issues, such as elevated metals results.

The two-year LTM study underscored that drinking water in the Navy’s JBPHH water distribution system has met EPA and DOH standards (including the established TPH ISP limit of 266 ppb). Sample results for over 9,200 samples are valid for all constituents analyzed and the data collected demonstrates that the water remains safe to consume. These results are available on the Drinking Water webpage of the JBPHH Safe Waters website (<https://jbphh-safewaters.org/>).

From observations made during the Navy’s interagency root cause analysis of TPH detections, the Navy developed a follow-on, enhanced drinking water monitoring program in coordination with EPA and DOH. This plan, titled the Extended Drinking Water Monitoring (EDWM) Plan, incorporates an additional zone of residential sampling, increased frequency of priority locations (e.g. schools, clinics, drinking water source) and a more investigatory approach to the analysis of potential fuel-related constituents; ultimately to deliver on the Navy’s commitment to extend enhanced monitoring of the JBPHH drinking water system, further demonstrate that the JBPHH drinking water system has recovered from the November 2021 event, and restore consumer trust in the drinking water system.

6 References

Department of Health, State of Hawaii; Department of the Navy, United States; and Department of the Army, United States, Aliamanu Military Reservation (DOH, DON, and DA). 2022. *Drinking Water Long-Term Monitoring Plan, Joint Base Pearl Harbor-Hickam Public Water System #HI0000360 and*

Aliamanu Military Reservation PWS #HI0000337, O‘ahu, Hawai‘i. June 2022.

Appendix A: LTM Zone Map



RESTORE DRINKING WATER AUGMENTED AND FACILITY / RESIDENCE DISTRIBUTION SAMPLING



SITE LOCATION



LEGEND



Flushing Zone



*Any Hydrants, Schools, or Child Development Centers are Planned Locations which were sampled in Step 4.

REVISION DATE:

4/7/2022

PLAN VERSION:

AREA ID:

LTM ZONE MAP

Figure 5: LTM Zone Map

Appendix B: DW LTM Plan Sampling Quantity Table

Drinking Water Long-Term Monitoring Plan

NUMBER OF SAMPLES BY ZONE AND BY MONTH OR MONITORING PERIOD

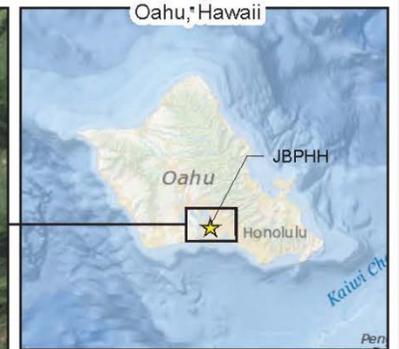
Zone Name	Zone	Residences ¹	Non-residences ¹	CDHs ²	CDCs ³	Schools ⁴	MDVs ⁵	Distribution (Hydrants) ⁶	Total Buildings	Samples (M0-M3) ⁷	Samples (M4-M24) ⁸		
Pearl City Peninsula	A1	635	32	1	-	-	-	6	422	41	74		
Ford Island	A2	413	112	3	1	-	-	10	392	42	65		
Iroquois Point	A3	1,459	33	-	-	2	-	8	961	93	168		
McGrew/Halawa	B1	227	38	-	-	-	-	2	177	16	29		
Sub Base	C1	-	183	-	2	-	4	6	160	24	12		
Hale Alii, Marine Barracks, Hospital Point	C2	32	126	-	-	-	1	7	118	16	8		
		6	137					2					
Shipyard Hospital Point	C3	508	74	-	-	-	-	6	55	10	2		
Hale Moku Hokulani	D1	1,577	224	-	2	1	-	11	424	45	74		
Hickam Hale, Na Koa Officer Field Area, Onizuka Village	D2	912	115	-	1	1	2	8	1,197	111	27		
		-	148					2					
Earhart Village	D3	89	63	-	6	4	1	4	922	93	159		
Hawaii Air National Guard	D4	752	91	-	-	-	1	8	76	11	3		
Makalapa	E1	1,435	59	-	-	2	-	14	184	19	27		
NEX Moanalua Terrace	F1	10	49	-	-	2	2	1	571	60	102		
Catlin Park, Maloelap, Doris Miller, Halsey Terrace, Radford Terrace	F2	918	12					3					
		230	1	2	2	-	-	3	1,007	95	188		
		379	-										
Camp Smith	G1	135	6	-	-	-	-	1	35	4	1		
Aliamanu Military Reservation (AMR)	H1	635	32	2	4	-	-	6	644	60	118		
		413	112					10					
AMR	H2	1,459	33	2	-	-	-	8	166	18	28		
AMR	H3	227	38	-	-	-	-	2	242	22	47		
Red Hill Housing	I1	-	183	-	-	1	-	6	120	14	21		
Total		9,717	1,503	10	18	13	11	105	11,220	792	1,357		
										Samples/Month	792	228	
										Resamples	120	35	
										Samples/Month	911	262	
										Samples/Day	46	14	
										# Teams	10	3	
										M0-M3	M4-M24	Total	
										Total # samples	3,143	6,327	9,470

Resamples, Field Duplicate (FD), Trip Blank (TB)	15%
Samples / Team / Day	5
Working Days / Month	20

Footnotes:

1. Samples will be taken from 5% of houses/buildings in each of the first 3 months; samples will be taken from 10% of houses/buildings for each period of sampling from Month 4-24 (three 6-month periods; one 3-month period).
2. One sample will be taken from each CDH each sampling period and will not be included as part of the houses/buildings percentage. Quantities subject to change based on resident participation in CDH program.
3. Two samples will be taken from each CDC each sampling period and will not be included as part of the houses/buildings percentage.
4. Five samples will be taken from each School each sampling period and will not be included as part of the houses/buildings percentage.
5. One sample will be taken from each Medical/Dental/Veterinary clinic each sampling period and will not be included as part of the houses/buildings percentage.
6. One sample will be taken from each hydrant each sampling period; samples collected from hydrants previously sampled in Step 4.
7. Samples required per month in Phase 1 (Months 0-3).
8. Samples required per period in Phase 2 (Months 4-24); three 6-month periods and one 3-month period.

Appendix C: Zone Maps of TPH Data by Period and TPH Percent
Detection Charts



Legend

LTM Period 1 Sampling Locations

- Non-Detect
- Less than 100 ug/L
- 100 ug/L ≤ X < 200 ug/L
- 200 ug/L ≤ X < 266 ug/L
- Greater than 266 ug/L
- LTM Zones

Notes:
 The Total TPH ISP is 266 ug/L.
 A total of 561 residential drinking water samples were collected during LTM Period 1 and analyzed for Total TPHs. Total TPHs were detected in 126 of 561 (22%) residential samples with detected concentrations ranging between 50 ug/L and 163 ug/L.



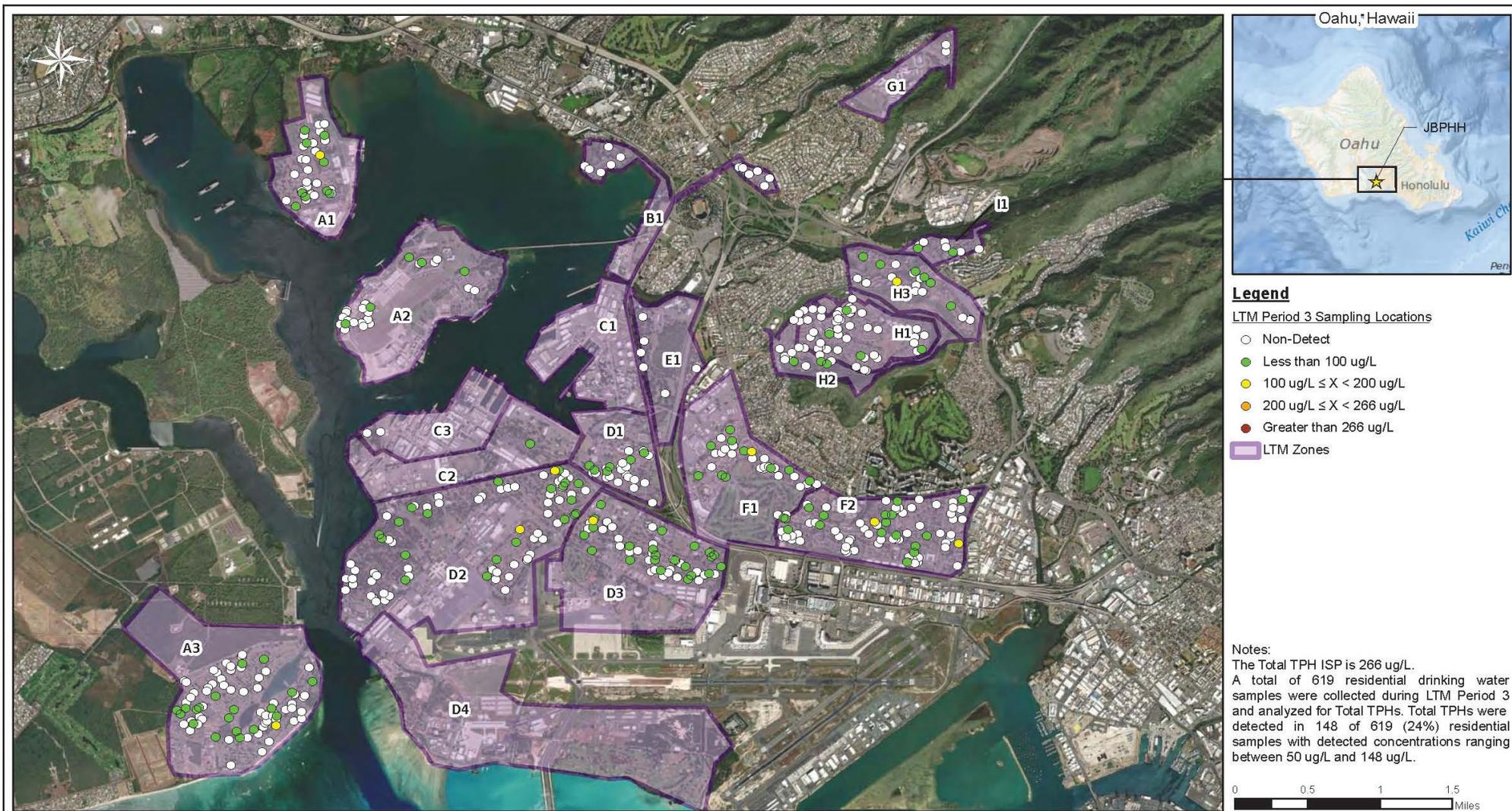
LTM Period 1 Residential Drinking Water Total TPH Results
 Joint Base Pearl Harbor-Hickam

Figure A-4



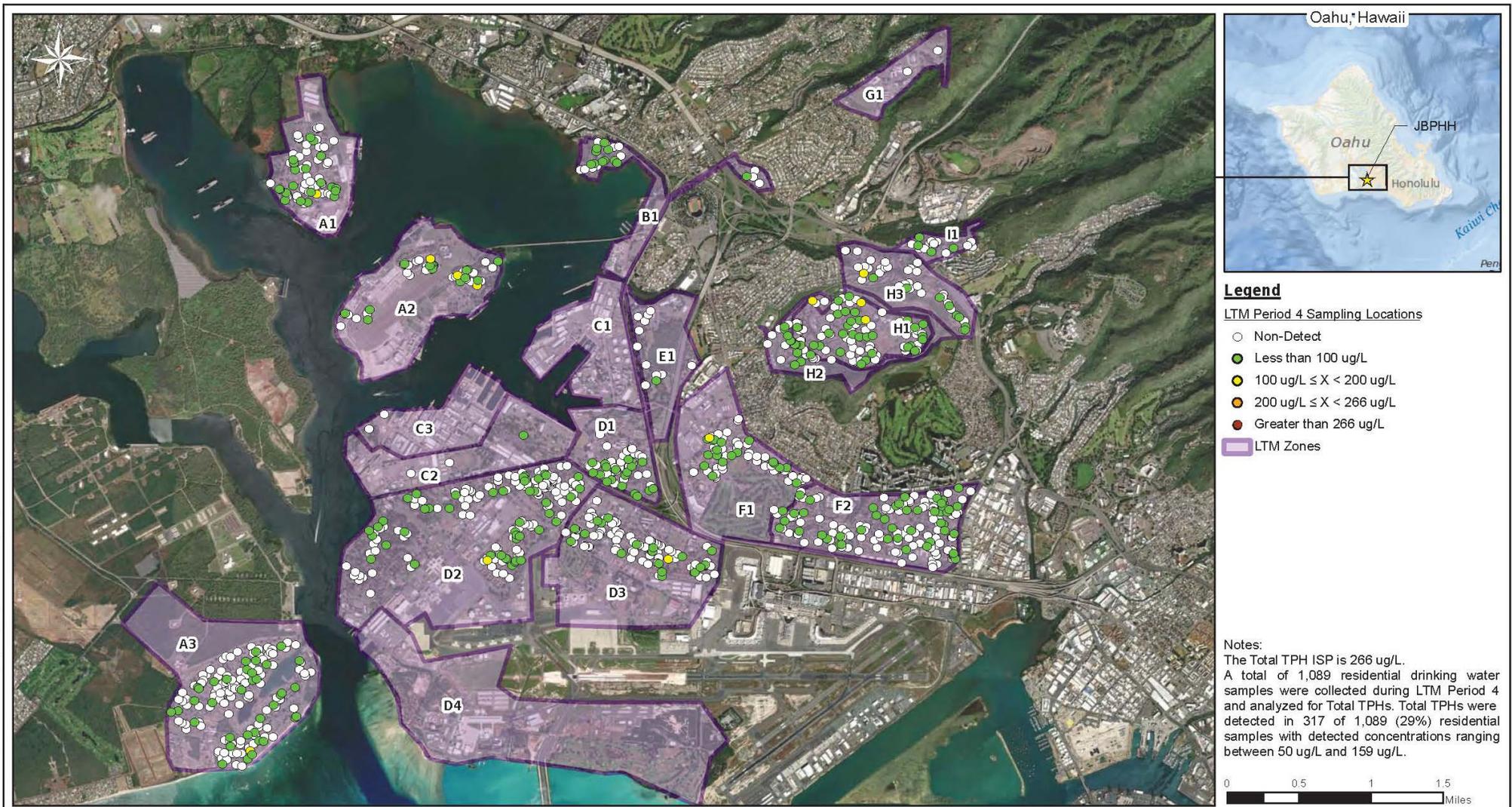
LTM Period 2 Residential Drinking Water Total TPH Results
 Joint Base Pearl Harbor-Hickam

Figure A-5



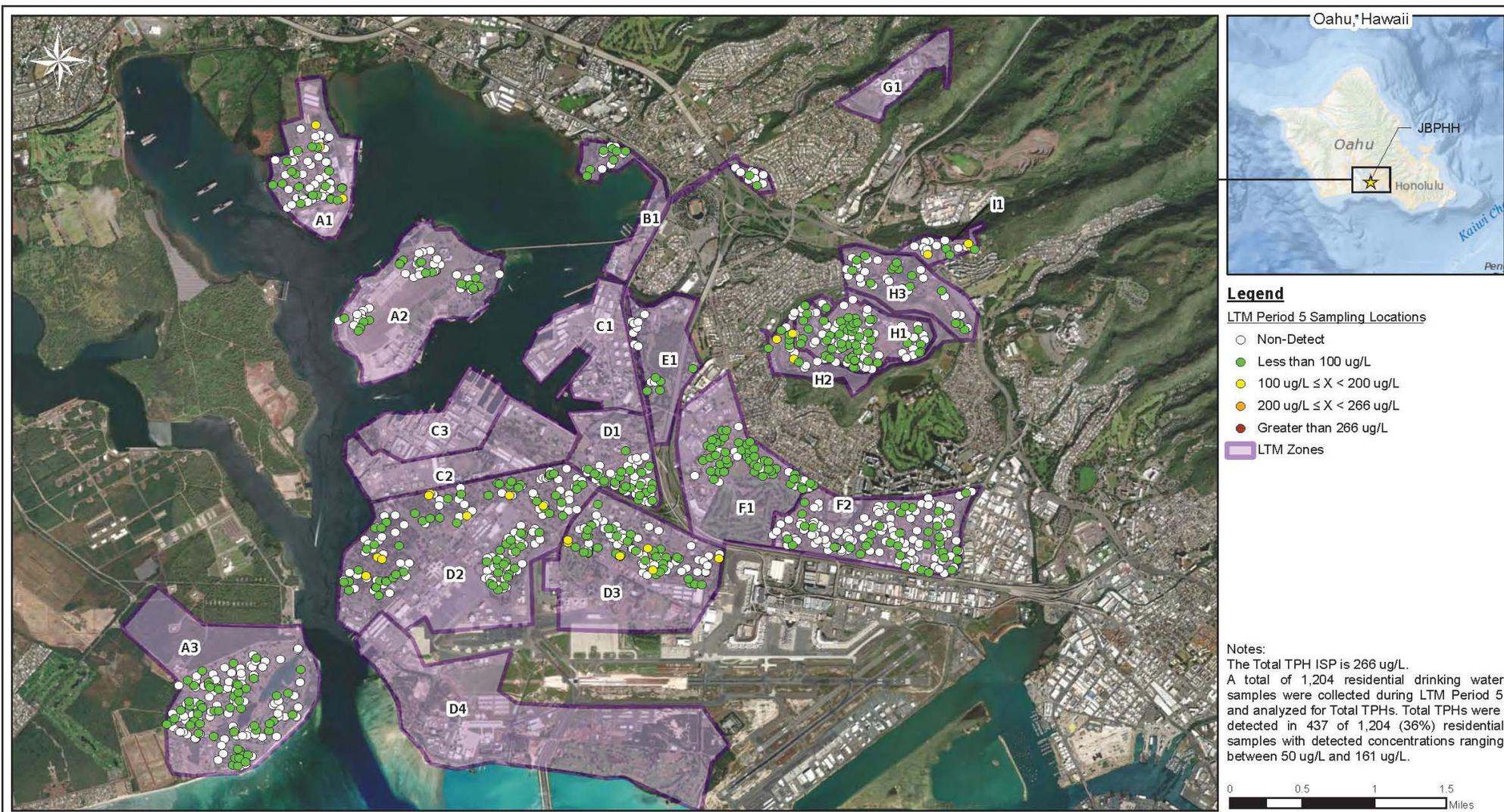
LTM Period 3 Residential Drinking Water Total TPH Results
 Joint Base Pearl Harbor-Hickam

Figure A-6



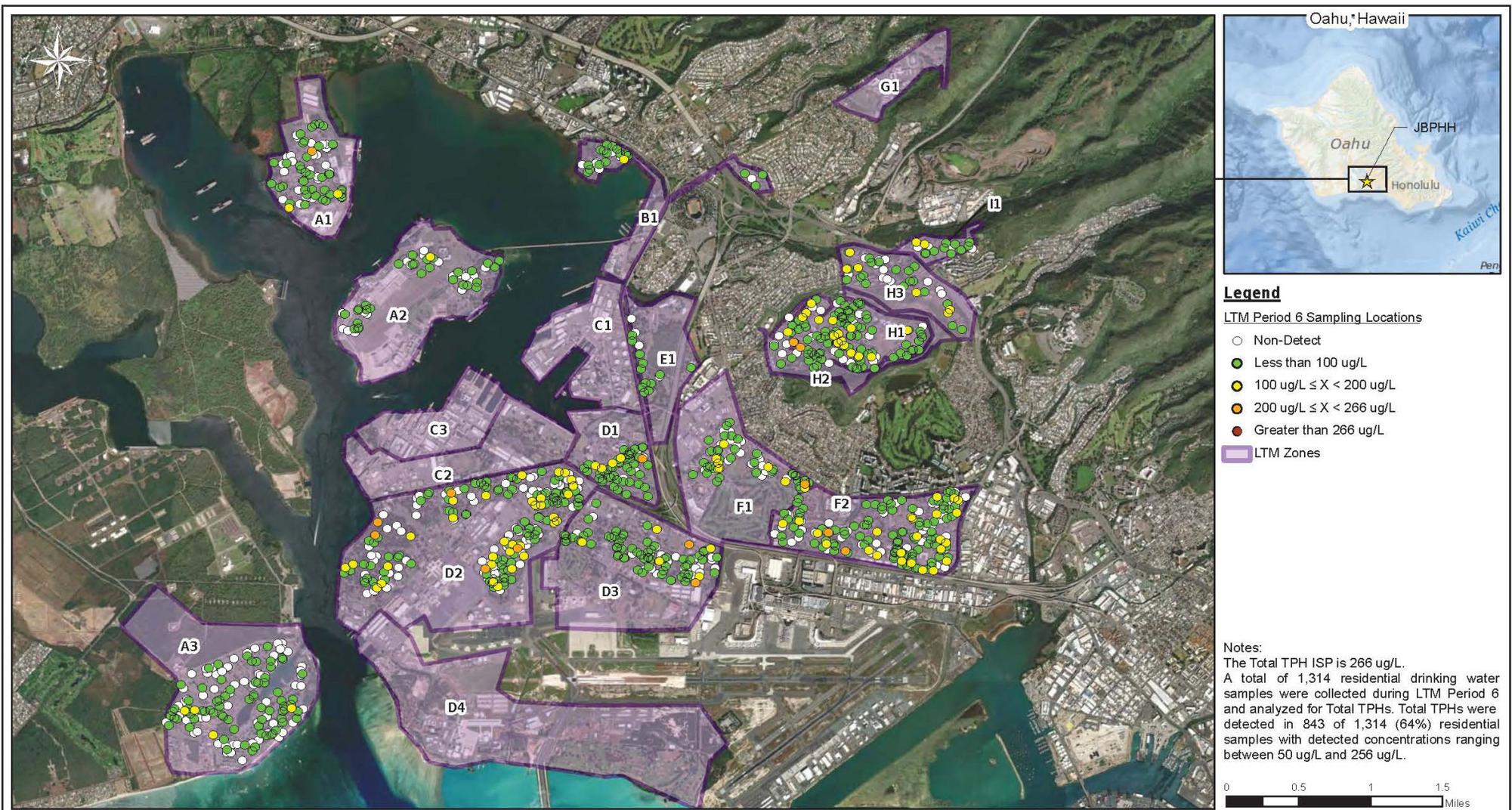
LTM Period 4 Residential Drinking Water Total TPH Results
 Joint Base Pearl Harbor-Hickam

Figure A-7



LTM Period 5 Residential Drinking Water Total TPH Results
 Joint Base Pearl Harbor-Hickam

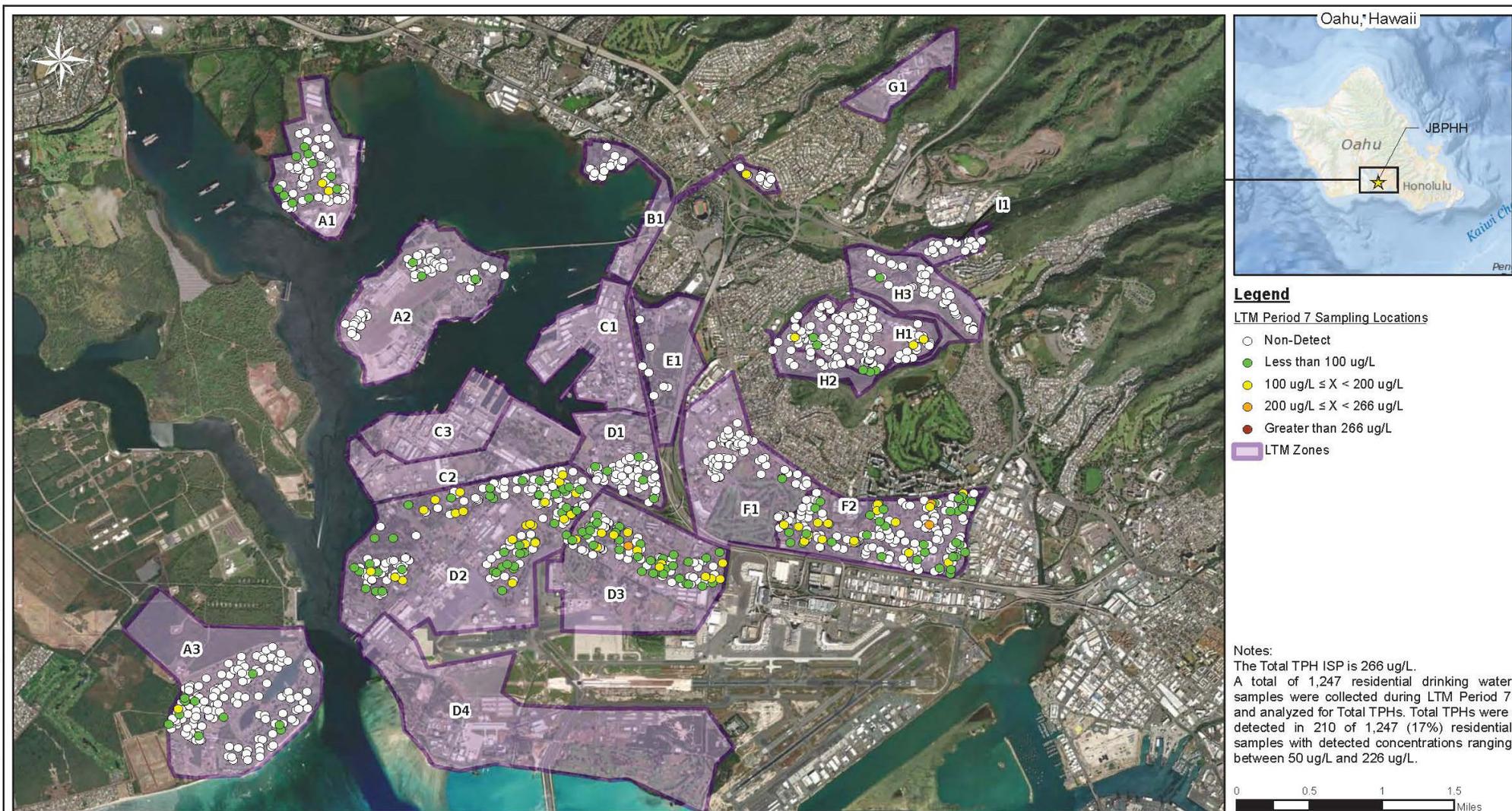
Figure A-8



PIONEER
TECHNOLOGIES CORPORATION

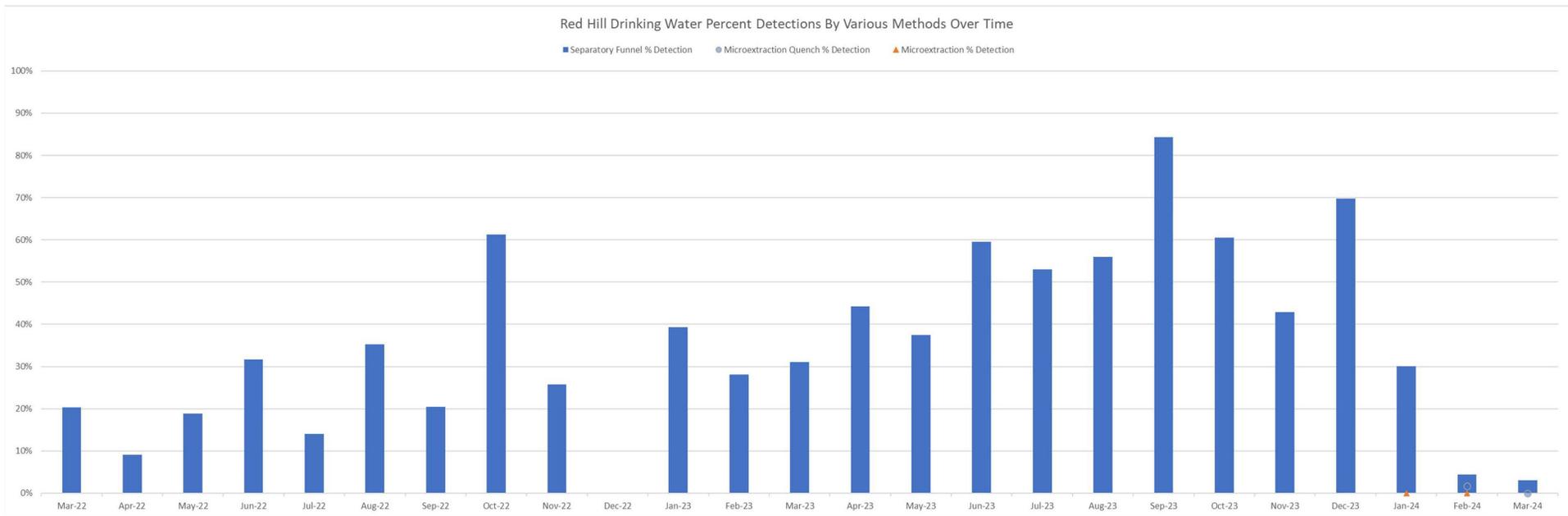
LTM Period 6 Residential Drinking Water Total TPH Results
Joint Base Pearl Harbor-Hickam

Figure A-9

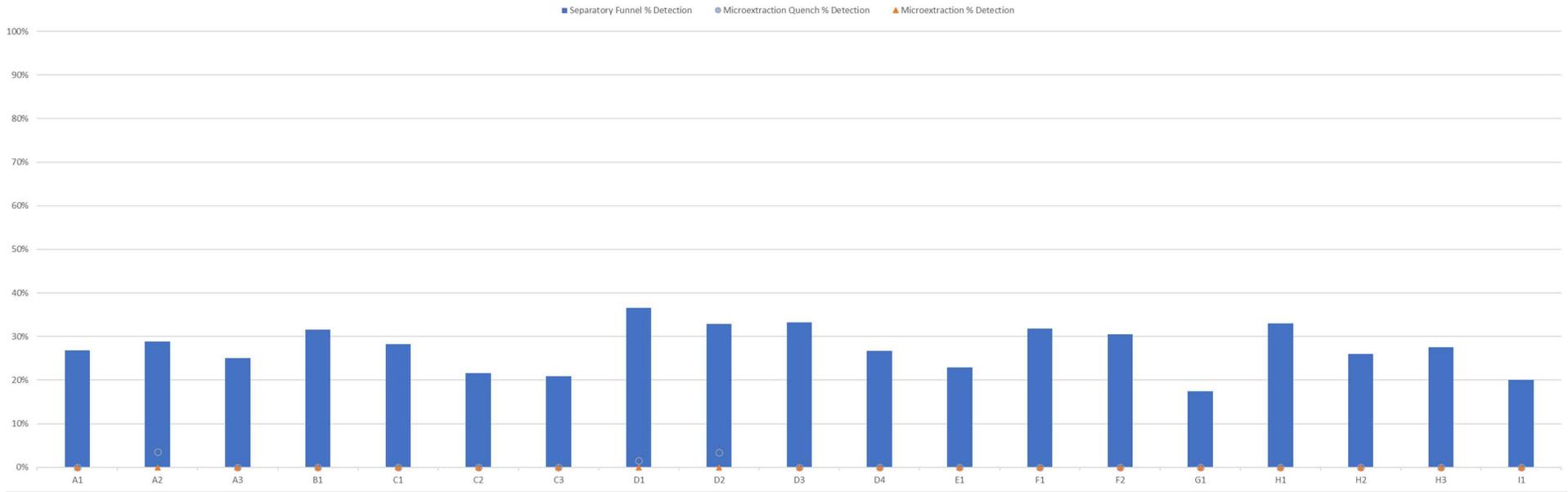


LTM Period 7 Residential Drinking Water Total TPH Results
 Joint Base Pearl Harbor-Hickam

Figure A-10



Red Hill Drinking Water Percent Detections By Various Methods Per Zone





TECHNICAL MEMORANDUM

Date: 25 September 2024
To: (b) (6), Naval Facilities Engineering Systems Command (NAVFAC) Pacific
Copy: (b) (6), PE, NAVFAC Hawaii, Navy Closure Task Force - Red Hill (NCTF-RH)
Subject: Contract N6247019D4001 CTO Mod N6274224F0123-P00001:
Drinking Water Complaint Investigation and Response Plan for Joint Base Pearl Harbor-Hickam. Task 1. iii-iv) Review and Analysis of Current and Historical Water Quality Complaints

1. INTRODUCTION

In November 2021, a release of JP-5 fuel from the Red Hill Bulk Fuel Storage Facility (Red Hill) impacted the Joint Base Pearl Harbor-Hickam's (JPBHH's) drinking water system. (b) (3) (A)

[REDACTED]

[REDACTED] In March 2022, after the Navy spent several months flushing and sampling the water system, the Hawaii Department of Health (HDOH) declared the water in the system safe to drink¹. Under an approved 2-year Long-Term Monitoring (LTM) plan, the Navy has collected approximately 8,000 water samples from homes, schools, child development centers, other buildings, and hydrants and found no fuel-related chemicals. After completion of the LTM in March 2024, the Navy voluntarily adopted an Extended Drinking Water Monitoring (EDWM) Plan and established a Water Quality Action Team that visits residences in response to customer concerns. Between April and June 2024, more than 1,500 additional samples have been collected under the EDWM program, and more than 70 residences have been visited by the WQAT.

AH Engineering Consultants (AH) was tasked to collect and analyze call center logs of water quality concerns by residents and building occupants within the JPBHH service area, review response procedures and water quality data, and perform field investigations. In this comprehensive

¹ Internet: <https://health.hawaii.gov/news/newsroom/doh-declares-four-navy-drinking-water-distribution-system-zones-safe/> (Accessed: June 2024)

analysis, the reported concerns regarding water quality and health within the community from February 2022 to April 2024 were evaluated. In addition, this memorandum summarizes findings from over 50 home visits conducted between February and May 2024. It is important to note that the provided records of customer concerns started after the water system had already been flushed. The call logs do not reflect the complaints received immediately following the release of JP-5 in November 2021.

The data collected and presented herein reflect the community's reactions to the spill after the conclusion of the emergency response phase and highlight the ongoing issues and sentiments that pervade over an extended period. The figures included in this document illustrate various aspects of the concerns raised, ranging from water quality perceptions, such as taste and odor, to health-related issues like skin and gastrointestinal (GI) complaints. These concerns are analyzed through multiple lenses, including the categorization of complaint types, the temporal distribution of calls, and spatial variations across water system zones. This data analysis aims to elucidate the underlying factors contributing to these concerns and inform the Navy's response actions to customer concerns in the future.

Section 2 discusses current procedures for responding to customer concerns. Section 3 provides the analysis and discussion of historical call logs. Section 4 includes a summary of home visits conducted between February and May 2024. Section 5 summarizes the findings of this work.

2. CURRENT RESPONSE PROCEDURES

Figure 1 illustrates the procedures in response to calls regarding water quality concerns as of May 2024. Calls are currently managed by the JBPHH Emergency Operations Center (EOC), which forwards information to the public works department (PWD). If requested, NAVFAC Hawaii PWD personnel will schedule a visit to the residence or building. During scheduling, the Senior Enlisted Leader may gather additional information. The Water Quality Action Team (WQAT) visiting the residence or building consists of the Community Planning and Liaison Officer (CPLO), PWD enlisted staff, a contracted 2-person sampling team (AECOM), and the contracted Water Quality Investigator (AH or AECOM). Prior to the addition of the Water Quality Investigator, the WQAT was referred to as the Rapid Response Team (RRT). The Navy is in the process of developing a more robust water quality complaint system for addressing residents' concerns, including a wider range of analytes (in addition to JP-5 and other fuels) to address specific water quality issues.

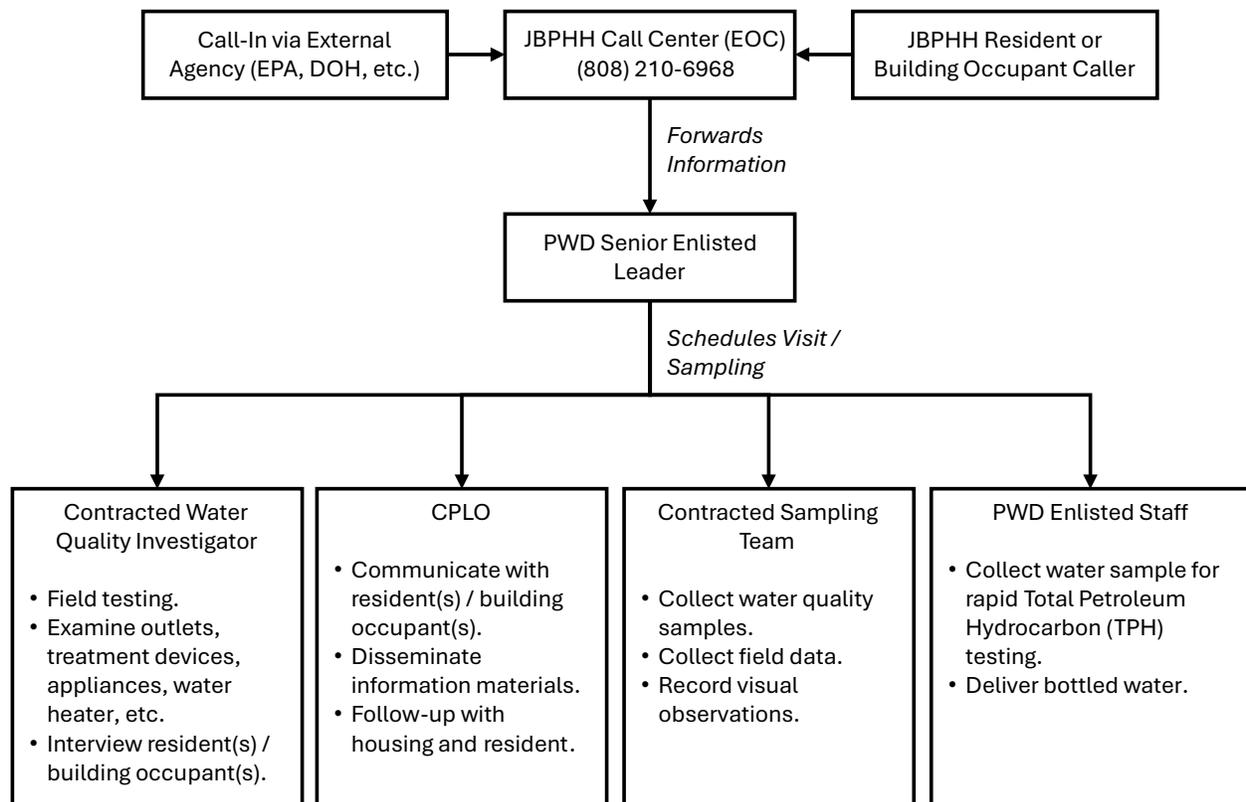


Figure 1. Overview of the Water Quality Concern Response Process (May 2024)

The visit serves to discuss the resident’s concerns, disseminate public outreach resources, provide bottled water (if requested), answer questions, inspect premise plumbing, and sample water for various chemical, physical, and microbiological parameters. The ultimate purpose is to determine if the water delivered to the tap is safe to consume and to alleviate the residents’ or building occupants’ concerns. AH staff performed over 50 home visits between February and May 2024. Each visit was documented and reported to NAVFAC Hawaii NCTF-RH. Section 4 summarizes these visits.

3. HISTORICAL CALL LOG ANALYSIS

This section details the data analysis and provides a corresponding discussion based on information in the call logs.

3.1 Data Analysis Methods

Call center log data was obtained on 15 July 2024 from the JBPHH Drinking Water Long Term Monitoring Database hosted by the (b) (4) Environmental Data Management System (EDMS).

EDMS was implemented as a repository for all environmental sampling data collected in response to the 2021 Red Hill fuel spill. It also contains location data to which the complaint calls can be linked for spatial visualization. The data were processed as follows:

- The call center log file contained information on distribution system zone, location, address, dates and times of the call and scheduled visit, and notes taken during the call and on-site.
- Rows not pertaining to customer calls or residential sampling requests were removed (e.g., log entries for tests performed on hydrants).
- AH staff read the notes pertaining to each log entry to classify each call for the following (where noted):
 - Duration of residence (i.e., how long the resident has lived at this location with start and end dates)
 - Number of people and pets at residence
 - Water use (bottled versus tap water for drinking, cooking, etc.)
 - Presence of point of use (POU) devices
 - Water quality concerns, including types and locations.
 - Health concerns
- Each call log entry was then annotated by adding columns with a list of possible values meeting the listed criteria. Where no information for the listed criteria was available, “Unknown” or “N/A” was entered.
- The data were then read into a data analysis computer program for tallying and graphing. Detailed methods are described in the appropriate sections.

3.2 Overview of Call Log Data

Figure 2 summarizes monthly calls received during various phases of the spill response between February 2022 and July 2024.

Between 17 February 2022 and 15 July 2024, 520 calls were recorded, ranging from zero to 184 calls per month. The calls originated from 440 unique locations, with 374 locations reporting once, 57 locations calling in twice, and 9 locations with three to five calls.

Following the spill event at the end of 2021, the call volume tapered off from the initial high of 184 in March 2022 to fewer than 5 per month between November 2022 and July 2023. An uptick in the monthly calls is evident afterwards, peaking at 39 calls in February 2024. Excluding log entries without specific water-quality related concerns shows that calls decreased from 89 to 3 or less by November 2022. In 2024, water-quality related calls increased again, peaking at 20 in February.

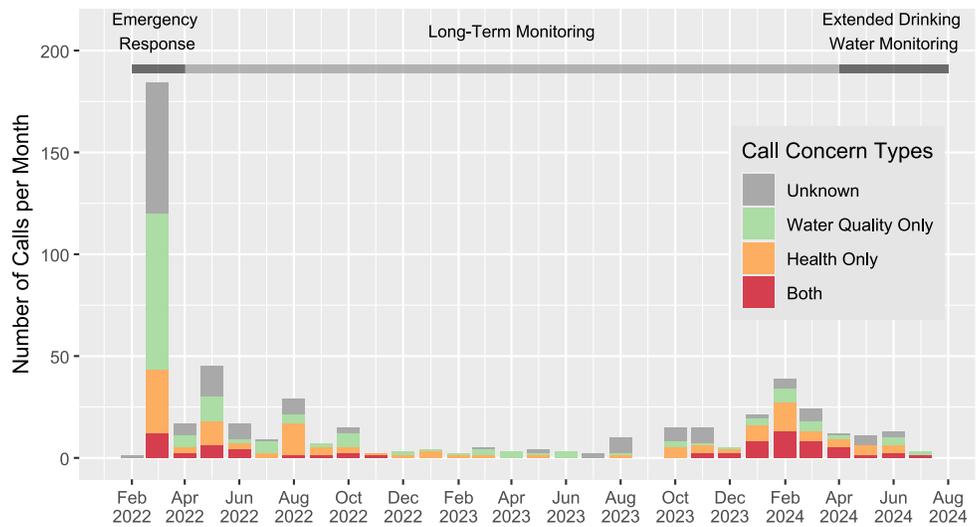


Figure 2. Call Log History

The relative volume of call types varied widely from month to month. Both water-quality related calls (Type “Water Quality Only” and “Both” in Figure 2) and health-related calls (Type “Health Only” and “Both” in Figure 2) comprised roughly half of the calls.

3.3 Comparison to Published Water Quality Complaint Benchmarks

To gauge whether the call volume at JBPHH is within acceptable limits, which refer to the threshold levels of call volume that indicate normal operational conditions and operational efficiency, we compared JPBHH customer calls to benchmarks developed by the American Water Works Association (AWWA)², which is a national, non-profit organization that sets standards and provides guidance for water utilities to ensure the safety and reliability of water services. Based on a survey of 22 utilities in 2023, the median service complaints-to-population ratio for water utilities was 0.5 per 1,000 customers. Half of the surveyed utilities reported between 0.2 and 1.3 complaints per 1,000³. The JBPHH data were tallied quarterly and adjusted to annual average values by dividing the number of water quality-related calls⁴ by the days in each quarter, considering the truncated first and last quarter, and multiplied by 365. The resulting values were then divided by the number

² AWWA (2024). 2023 AWWA Utility Benchmarking: Performance Management for Water and Wastewater. American Water Works Association, Denver, Colorado.

³ Half of the utilities with combined water and sewer operations reported 0.0 to 1.6 service complaints per 1,000 customers (median = 0.3).

⁴ Calls without specific water quality concerns (i.e., mentioning no or only health issues), were excluded from the analysis.

of customers served by the system. The service population of 71,636, including JBPHH and Ali-amanu, was obtained from the Safe Drinking Water Information System (SDWIS)⁵. This number is lower than a widely cited estimate of 93,000, but it will result in a more conservative estimate of the customer complaint rates. Figure 3 depicts the results of the comparison (comparison is based solely on reported water quality concerns, as AWWA benchmarks are based on water quality-related complaints). The green ribbon represents the middle range of customer complaint rates reported by the AWWA in 2023.

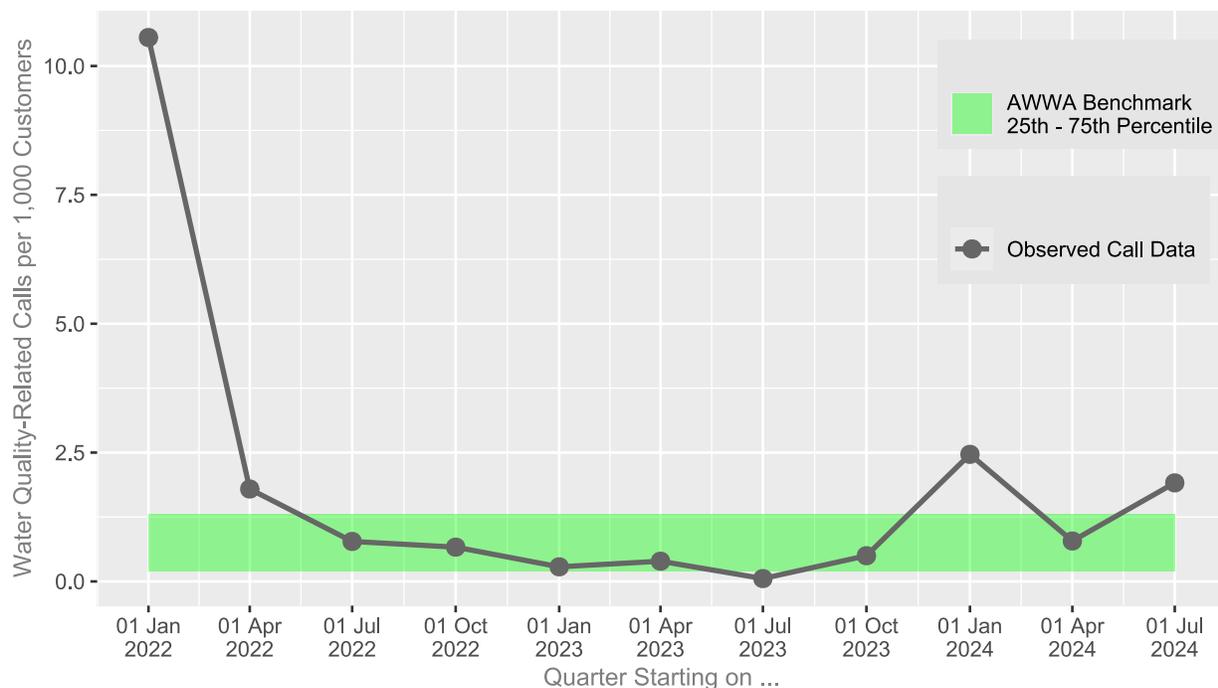


Figure 3. Comparison of Water Quality Related Calls to AWWA Benchmarks

The graphical representation highlights that shortly after the spill event in November 2021, JBPHH had a much higher complaints-to-population ratio compared to the AWWA benchmarks. However, significant improvements were observed in the second quarter of 2022, and a below-industry average call volume was maintained throughout the year 2023. An upward trend in complaint rates is discernible in the last quarter of 2023, and calls peaked in the first quarter of 2024 at above-average rates before declining back to acceptable levels in the second quarter. The third-quarter complaint rate value is not reliable because the available time span of the data extended only to 8 July 2024.

⁵ SDWIS is a data management system developed and maintained by the United States Environmental Protection Agency (EPA).

3.4 Analysis of Reported Water Quality Issues

Figure 4 illustrates the frequency of water quality concerns mentioned in the call log entries. Note that multiple issues may have been mentioned in each call. The most reported issue was related to taste or odor. The second most frequent concern was “Sheen/Film,” i.e., visible residues on the water surface. Other concern types, including discoloration, floating particles, cloudiness, scale deposits, and others received considerably fewer mentions, and together they totaled approximately the same number as either taste and odor or sheen/film concerns.

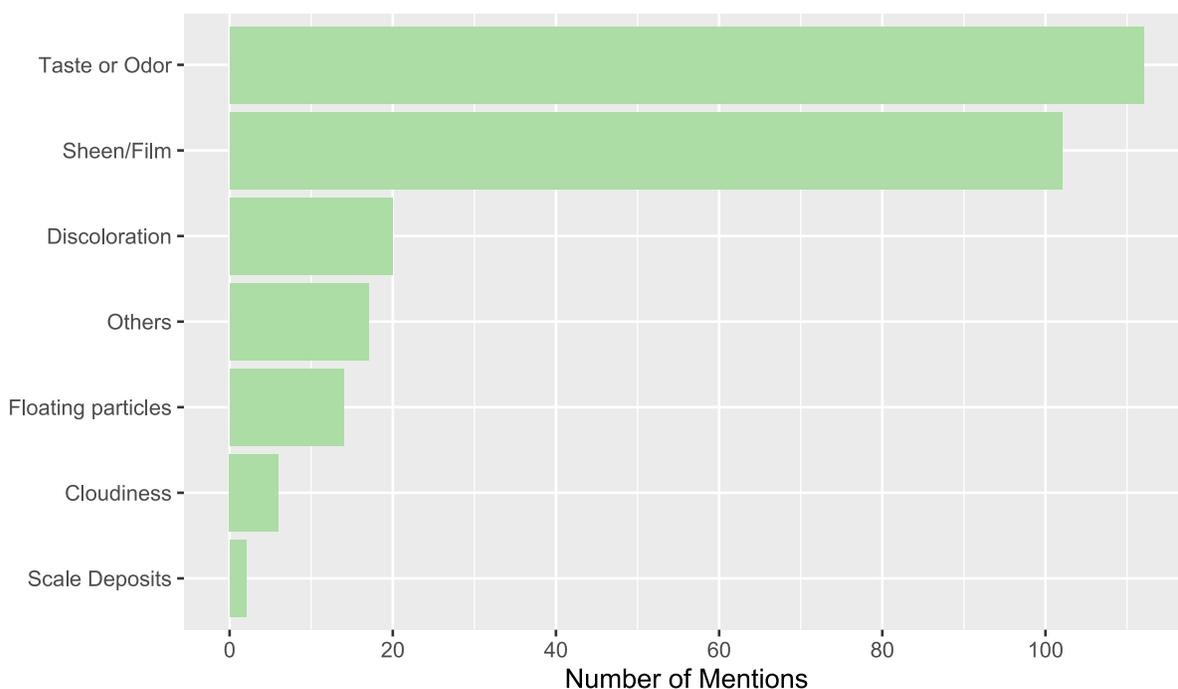


Figure 4. Water Quality Concern Types

Breaking out the monthly data shows that there was little variation in the relative proportion of water quality concern types over time (Figure 5). Taste and odor, sheen or film, and other concerns each comprised consistently one third of mentions in the caller notes. As with the total number of calls per month, the number of specific water quality concerns declined in the months following immediately after the fuel spill and remained low through the fall of 2023 before the 2024 uptick.

Figure 6 categorizes the types of taste or odor complaints reported by residents concerning their tap water. The categories were taken from the Flavor Profile Wheel published in Standard Method

2170B⁶. Taste and odor description in the callers’ logs were assigned the most similar segment of the flavor profile (e.g., “garlic smell” was assigned to “sulfurous”). The largest segment of the chart is dedicated to “Others,” indicating that most taste and odor complaints could not be assigned to any of the flavor profile wheel categories because they were not specified in the log entries (e.g., “bad smell”). The other significant portions include “chemical,” “sulfurous,” and “chlorinous.” Only a small fraction of the complaints referred to “metallic,” “earthy-musty,” “fragrant,” or “sweet” tastes and odors.

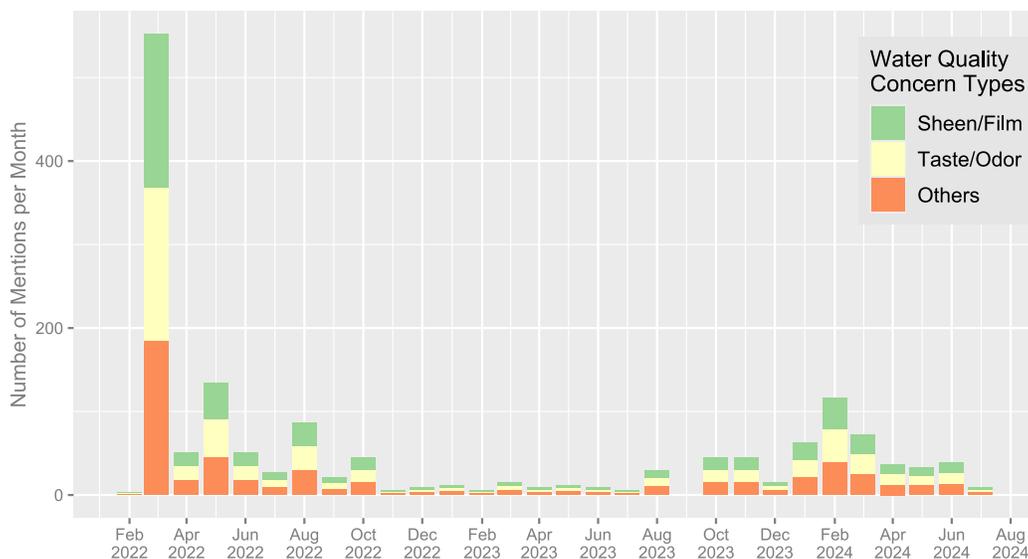


Figure 5. Monthly Mentions of Water Quality Concern Types

⁶ Baird, R., & Bridgewater, L. (2017). *Standard methods for the examination of water and wastewater*. 23rd edition. Washington, D.C.: American Public Health Association.

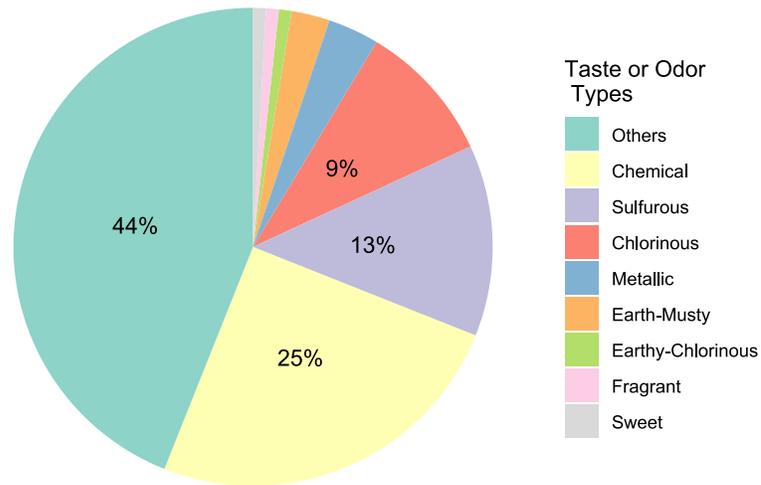


Figure 6. Proportion of Detected Taste and Odor Types

3.5 Spatial Water Quality Concern Trends

Figure 7 provides a map displaying the number of customer calls and proportion of complaint types in each distribution system zone. While the number of calls received since February 2022 spans a wide range among the zones, there is little variation in the proportions of call types throughout JBPHH, except in zones where few, if any, customer calls originated.

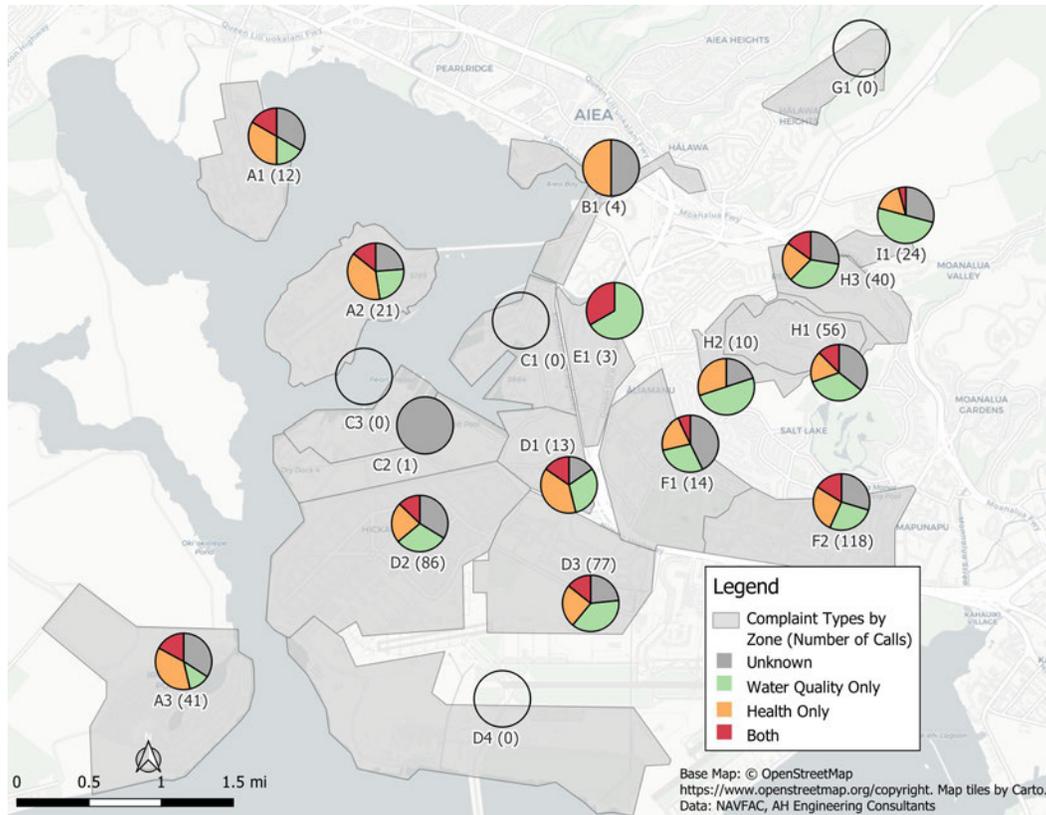


Figure 7. Spatial Distribution of Calls by Complaint Type

For an unbiased comparison among the zones, the number of water quality-related calls (Type “Water Quality Only” and “Both”) were divided by the number of residences⁷ in each zone and scaled to a one-year period. Figure 8 shows the resulting water quality complaint rates per 1,000 residences per year. Because the high call volume during the first quarter of 2022 had likely skewed the results (shown in blue font in Figure 8), the complaint rates were re-computed excluding this time period (shown in red font).

⁷ Complaint rates per zone were computed on a “per-residence” basis, because the service population in each zone is not known.

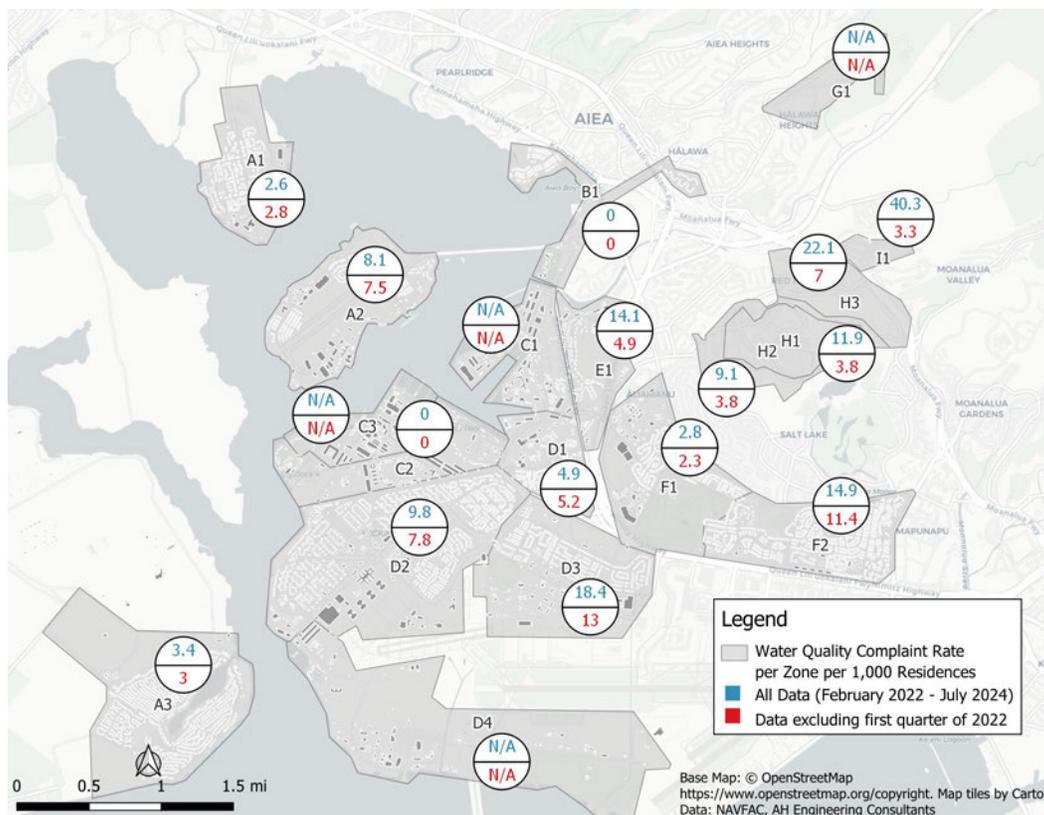


Figure 8. Water Quality Complaint Rates per Zone

The median AWWA Benchmark for customer service complaints is 1.5 calls per 1,000 accounts. Half of the surveyed water utilities reported between 0.1 and 10.5 calls per 1,000 accounts⁸. Assuming each JBPHH residence represents a customer account, the call volume has been unacceptably high in most zones. When excluding the first quarter of 2022 data however, the complaint rates drop to levels below the AWWA benchmark (less than 10 per 1,000 per year) in most zones, except D3 and F2.

Figure 9 breaks out the data by zone and water quality-related complaint type. The map shows that sheen or film and taste or odor were observed in all zones to varying degrees, but without any particular spatial pattern. Empty circles indicate that no water-quality-related concerns were reported in that zone.

⁸ In utilities with combined water and sewer operations, the number of water-system related service calls ranged from 0.1 to 10.5 calls per 1,000 accounts. Utilities operating only water systems reported a range from 0.5 to 5.1 calls per 1,000 accounts.

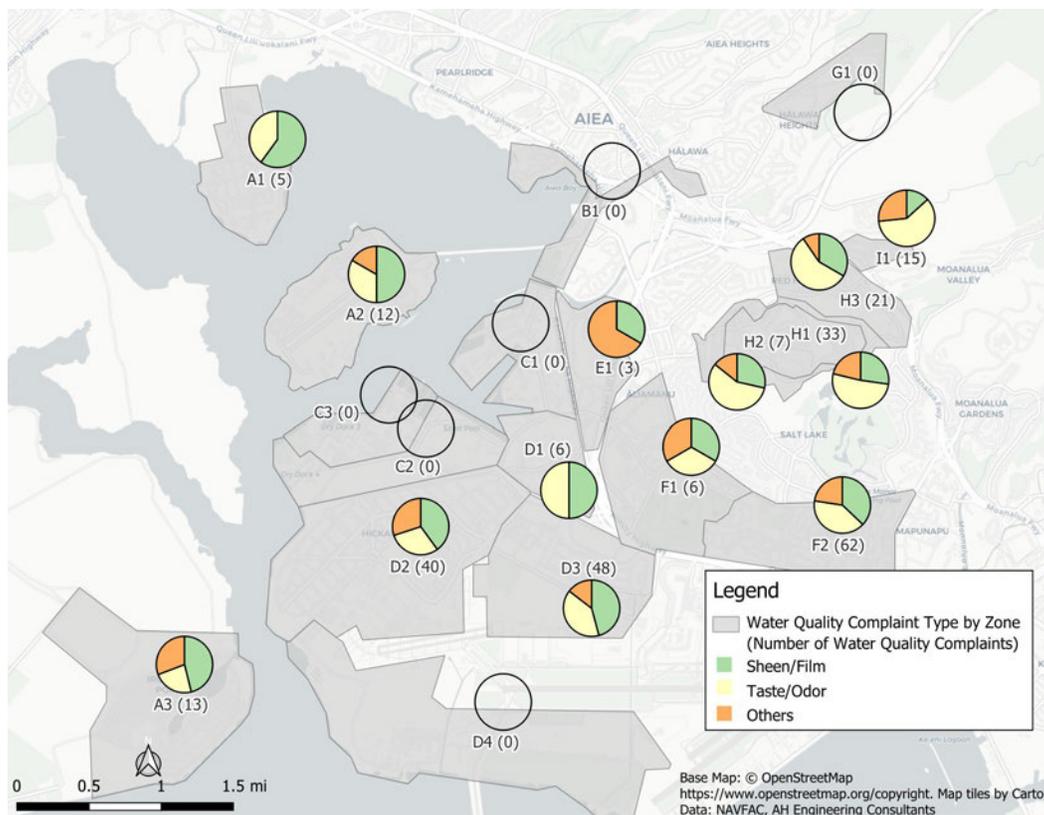


Figure 9. Spatial Distribution of Water Quality-Related Complaints.

3.6 Health Complaint Analysis

As the previous analyses have shown, the call center logs include a substantial number of health-related complaints. While a water utility is not a competent agency to address health concerns, trends in reported symptoms that are associated with discrete events or locations may point to water quality issues. It should be noted that such an analysis may be limited by the fact that health concerns are not always voiced by residents.

Figure 10 provides a tally of health concerns mentioned in the call log entries. Note that multiple issues may have been mentioned in each call. The most reported health concern was skin issues. The second most frequent concern related to GI illness, followed by headaches or dizziness. Other unspecified concerns, as well as health symptoms relating to vision, hair, nose, respiratory system, and hearing received considerably fewer mentions.

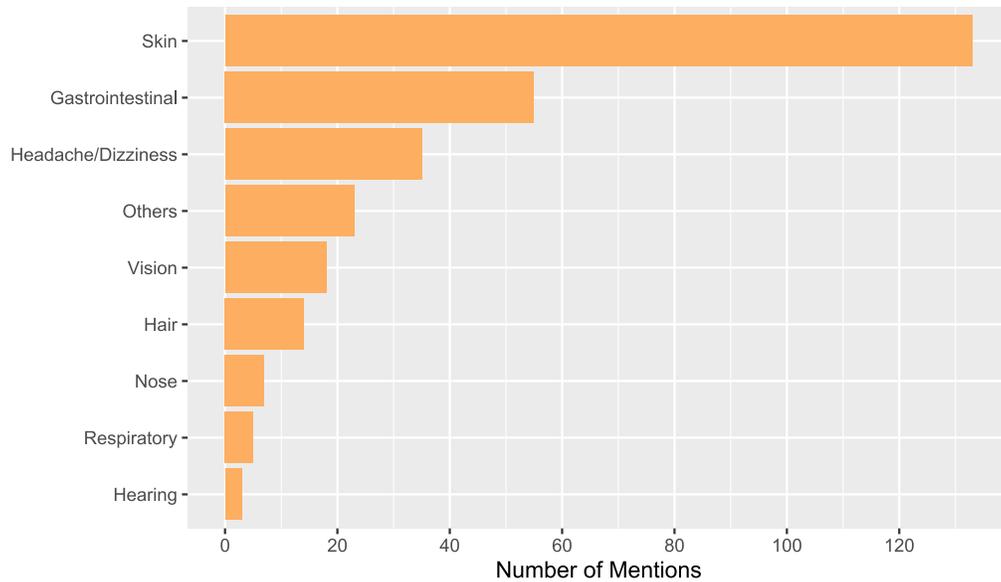


Figure 10. Number of Mentions of Health Concerns from February 2022 to July 2024

Figure 11 shows the number of mentions per month for different types of health concerns reported by residents, categorized by the two primary concerns (skin- and GI-related issues) and other health issues. As expected, the data follow the same trend as water quality-related concerns, with an initial peak following the Red Hill spill and declining to rare mentions of health-related concerns. In the fall of 2023, health-related customer calls increased again and peaked in February 2024. The numbers are currently declining again.

Figure 12 provides a map breaking out the data by zone and health-related complaint type. The map shows that skin, GI, and other issues were mentioned in all zones to varying degrees, but without any particular spatial pattern. Empty circles indicate that no health-related concerns were reported in that zone.

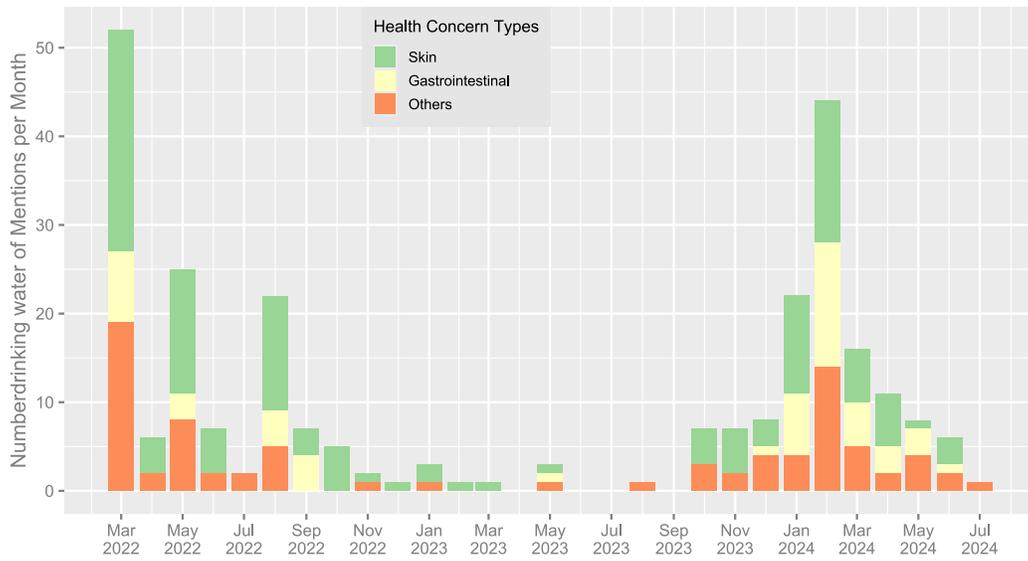


Figure 11. Monthly Mentions of Health Concern Types

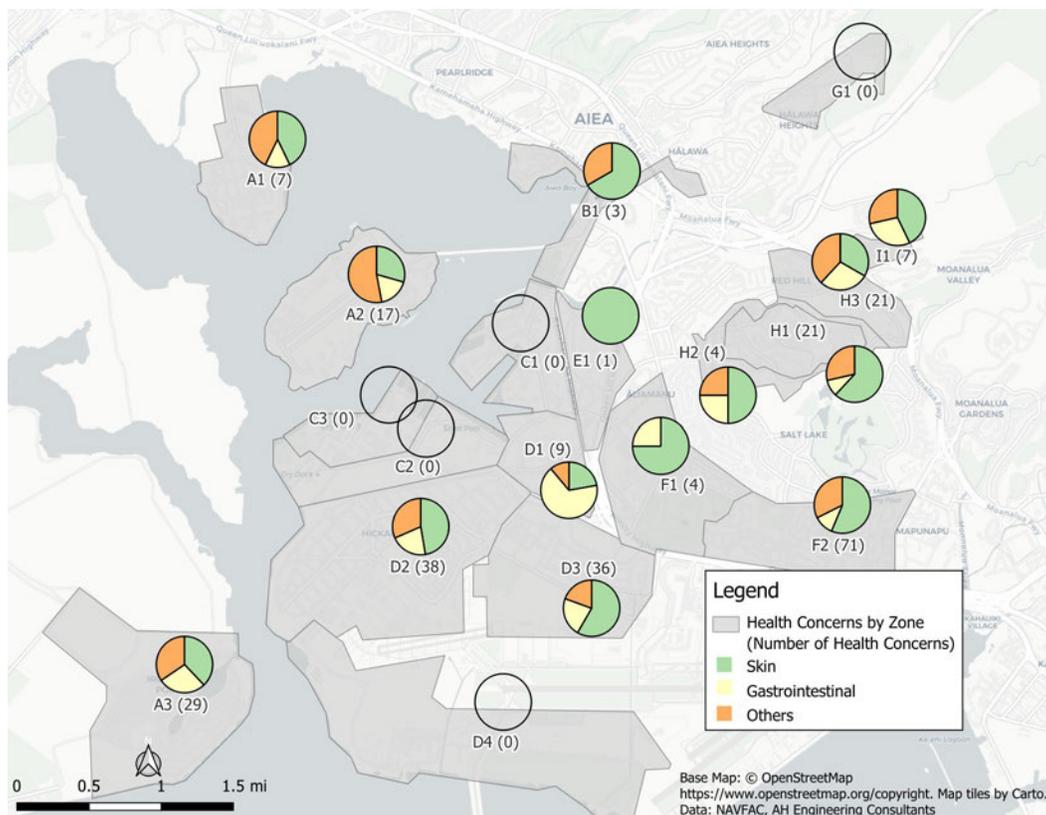


Figure 12. Spatial Distribution of Health Concern Types

3.7 Discussion

Some members of the public perceive that the water quality at JBPHH continues to be impacted by the November 2021 fuel spill at the Red Hill Bulk Storage Facility. However, the temporal and spatial distribution of call volume and nature of customer concerns cannot be due to residual fuel contamination in the system because of the following:

- Hydraulic modeling of the water distribution system indicated that actual impacts of the fuel spill were limited to the southern and eastern portions of the system⁹. The customer call volume and characteristics in areas of the system that were not impacted by the spill (i.e., Ford Island and Pearl City Peninsula) are no different than in areas that potentially received fuel-contaminated water.
- The Navy has collected nearly 10,000 distribution system samples during the Long-Term Monitoring (LTM) and Extended Drinking Water Monitoring (EDWM) programs. Fuel-related chemicals were detected at trace levels in only 0.2% of the samples collected in the JBPHH water system.
- According to the Defense Health Agency, soon after the fuel release, there was an increase in diagnoses that could be related to JP-5 exposure, but these diagnoses have returned to historic patterns.

The high call volumes in early 2022 are likely remnants of public concern due to the recent spill event, which may have been amplified by media coverage. It is also conceivable that the switch in water sources affected some customers' perception of the water quality in areas that were previously supplied by the Red Hill Shaft. The Waiawa Shaft produces much softer water than both the Navy's Aiea/Halawa and Red Hill Shafts, and some customers may be able to detect a difference in taste or skin sensation. Other potential water quality-related causes for the variation in customer call volume may be related to water chlorination. Samples collected over two years from thousands of JBPHH residences suggested a slight, but significant increase in residual chlorine delivered to the homes during the second half of 2023⁹. Flavor thresholds of chlorine have been reported between 0.2 and 0.6 mg/L¹⁰. Thus, given the large service population at JBPHH, a 0.1 mg/L increase, as observed last year, may have affected at least some customers. Furthermore, the US Army-operated consecutive water system at Aliamanu performs re-chlorination at its three interconnects with the Navy system. Chlorine residuals at Aliamanu have been slightly higher than in the purveyor's system (Figure 13). Interestingly, taste and odor-related concerns

⁹ Navy Closure Task Force – Red Hill (2024) Summary of Technical Memorandum Regarding Low-Level Hydrocarbon Detections Observed During Long-Term Monitoring https://jbphh-safewaters.org/public/Tech_Memo_JBPHH_LOE's_LTM_TPH_Detects_Redacted_Rev.pdf. Accessed May 2024.

¹⁰ Piriou, *et al* (2015) Evidence of regional differences in chlorine perception by consumers: sensitivity differences or habituation? *Journal of Water Supply: Research and Technology—AQUA* 64(7). DOI: 10.2166/aqua.2014.097

were also voiced more frequently at Aliamanu (zones H1, H2, H3, and I1) than in the Navy system relative to sheen or other complaints (refer to Figure 9).

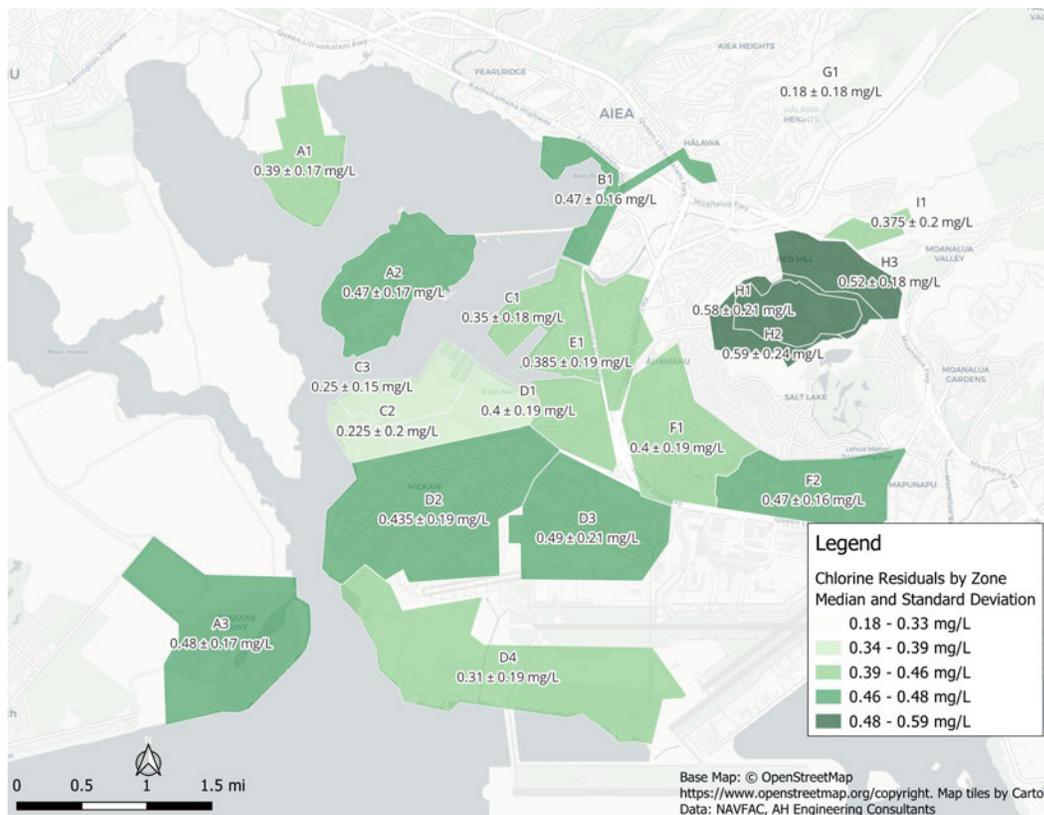


Figure 13. Chlorine Residual Data at JBPHH

The historical call volume data suggests that the water contamination event became “forgotten” until the increase in concerns in the fall of 2023. Several events could have led to the increase in public attention:

- In June 2023, the EPA finalized the Administrative Consent Order (ACO) for the closure and remediation of the Red Hill Bulk Storage Facility. As required by the ACO, a community representation initiative (CRI) was formed that started meeting monthly in the fall of 2023. The CRI members are very active on social media.
- In June 2023, the HDOH published its assessment of human exposure to JP-5 fuel following the Red Hill spill, which received considerable news coverage.
- In November 2023, the Navy completed defueling the Red Hill tanks, while at the same time the Honolulu Board of Water Supply filed claims against the Navy to cover costs incurred due to the Red Hill crisis.
- In the same month, a lawsuit brought against the US government in response to the fuel spill gained media attention as nearly 1,000 additional plaintiffs filed claims.

- In January 2024, news reports surfaced about low-level TPH detections in homes. The primary cause was identified as false positives due to the interaction between residual chlorine and the laboratory-added surrogate required to analyze the samples (refer to Footnote 9).
- In the same month, the Navy did not attend the monthly CRI meeting due to controversy and lack of civility during the December 2023 meeting.

Collectively, events such as those enumerated above, and the associated media coverage, may have raised public awareness and artificially amplified concerns about the safety of their drinking water. Figure 14 displays trends in weekly internet searches, web page hits, and number of news articles¹¹. Two of the three indicators show a discernible association with the initially high call volume and the decreasing trend in calls through 2023. However, no correlation between call volume and recent media coverage is obvious (compare to Figure 2).

¹¹ The web page access data for the Navy's JBPHH Safe Waters web page was provided by the NCTF-RH Public Affairs Office. Media coverage data was obtained by searching a commercial archival service (Newsbank, Inc., Naples, FL) for Hawaii-based news reports published between 2000 and present mentioning the terms "Red Hill" and "Fuel."

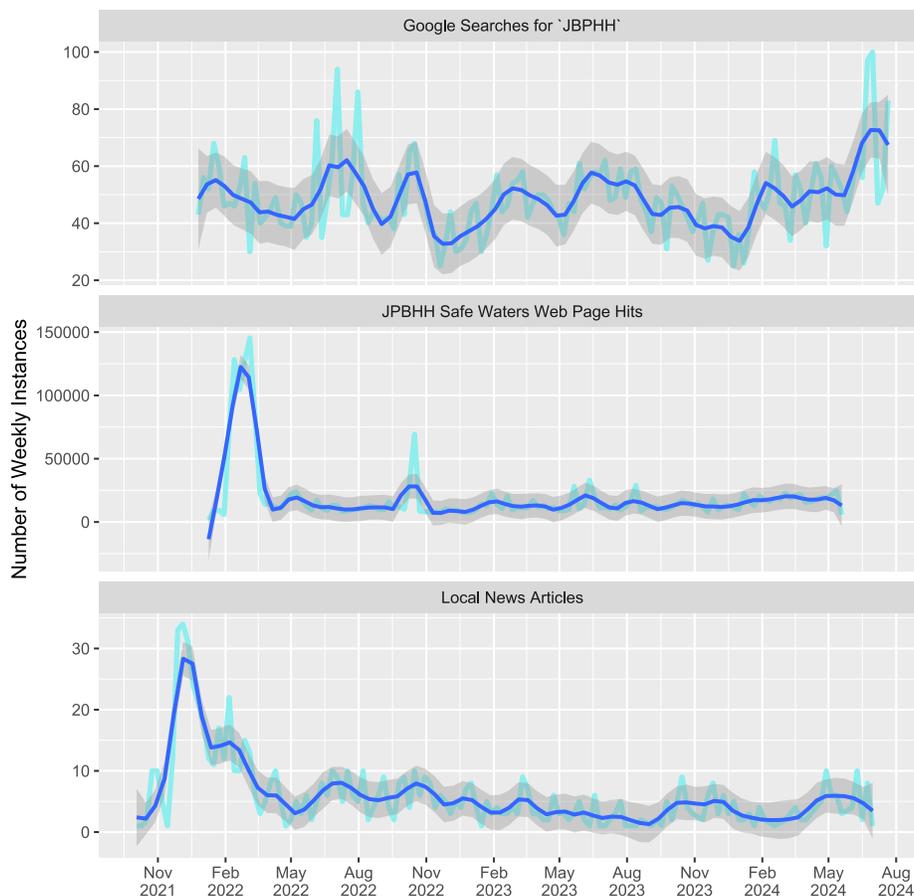


Figure 14. News Coverage and Internet Activity Related to JBPHH

The weak association, however, does not prove any causal relationships, and there are likely numerous confounding factors, such as misclassification of the search results and other activities (e.g., social media activities) by marketing interests¹² or foreign entities¹³.

4. HOME VISITS RESULTS

Table 1, which is appended to this section, presents a summary of over 50 home visits conducted between 20 February 2024 and 17 May 2024. Individual home visit briefs are provided as an attachment to this memorandum. In summary, AH found the following:

¹² Home water testing and treatment companies may exploit the public concern over the safety of the drinking water for commercial gain.

¹³ For example, in their report on “Chinese Disinformation Efforts on Social Media,” the Rand Corporation stated that “efforts to disrupt or degrade U.S. military operations ... seek to sow rumors and disinformation in ... Hawaii ... by generating popular opposition; create an impression that the military is engaged in covering up accidents, ...” (https://www.rand.org/pubs/research_reports/RR4373z3.html accessed May 2024).

- No fuel-related sheens or odors were found at any location. There were no other unusual observations regarding water taste, odor, or appearance. These findings support the field observations by the RRT as well as by the sampling teams that have visited approximately 8,000 homes during the LTM.
- Analytical results from sampling during the home visits did not reveal the presence of contaminants at elevated levels. The data frequently indicated trace levels of heavy metals that are used plumbing materials or that may occur naturally, as well as low-level detections of disinfection byproducts. These findings agree with results from approximately 8,000 samples collected during the LTM.

Additional investigations by AH, that were not included during prior RRT inspections, found the following:

- The inspectors frequently found particulate matter retained by faucet aerator screens. The material may originate from deterioration of water heater components and shell, material shavings from service line and premise plumbing repairs, debris entering the network during distribution system repairs, or dislodging of mineral scale built up in the hot water piping.
- Chlorine residuals in both hot and cold water were generally adequate. The few exceptions included buildings in areas served by aging cast-iron mains, vacant residences, buildings with excessive water stagnation due to low use, and some locations with excessively high hot water temperatures.
- Hot water temperatures were not always adequate, and hot water pipes were not always insulated. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) recommends a minimum water heater temperature of 120 °F. Allowing for some cooling in the premise plumbing, hot water temperatures above 115 °F should be attainable at distal outlets. Hot water temperatures were excessively high at a few locations, potentially creating scalding hazards.
- The dates of water heater installation and maintenance actions were not usually recorded on the appliances. Based on manufacturing dates, numerous units were past their useful lifetime.
- At several residences, the inspectors found home water treatment devices that are not NSF-certified or not appropriately maintained.

Table 1. Home Visits Record

Date Time	Zone	Address	Resident Concerns	Chlorine Residual	Hot Water Temperature	Visual Observation	Conclusion
20 Feb 2024 0900	F2	2770 Schmitt Pkwy	Health concern	Adequate	Inadequate	-	Recommend water heater replacement ¹⁴
21 Feb 2024 0900	H1	6343 Papaya Ln	In response to a list of complaints received from the EPA	Adequate	Inadequate	-	Adjust water heater temperature
22 Feb 2024 0800	A3	5174 Iroquois Ave	-	-	-	-	No further action required
22 Feb 2024 0900	D2	207 Beard Ave	-	Adequate	Adequate	-	No further action required
26 Feb 2024 0930	F2	2879 Arizona Rd	-	Adequate	Adequate	Sand on aerator screen	No further action required
27 Feb 2024 0900	F2	2851 Anderson Ave	-	Adequate	Adequate	Black particles on aerator screen	Recommend water heater replacement
28 Feb 2024 0800	F1	5202 Fuqua Ln	GI issues	-	Inadequate	Black particles on aerator screen	Adjust water heater temperature
28 Feb 2024 1000	D2	1824 Porter Ave	Severe dry skin	Adequate	Inadequate	Black particles on aerator screen	Recommend water heater replacement
28 Feb 2024 1030	D1	926 Huttenberg Ct	(b) (6) after drinking the tap water	Adequate	Inadequate	Sand and Black particles on aerator screen	Recommend water heater replacement
29 Feb 2024 1600	D2	123 2nd St	-	-	-	-	Re-scheduled from 1 Mar

¹⁴ Replacement of the water heater should be considered if it is older than 10 years, and if particulate matter (i.e., corrosion product) is observed in faucet aerators.

Date Time	Zone	Address	Resident Concerns	Chlorine Residual	Hot Water Temperature	Visual Observation	Conclusion
1 Mar 2024 1000	D3	628 Ohana Nui	Recurring rashes	Adequate	Inadequate	-	Recommend water heater replacement
1 Mar 2024 1300	D3	1057 Ohana Nui	Serious health concerns including severe hives; (b) (6) the fuel spill time	Adequate	Excessive	Black particles on aerator screen	Recommend water heater replacement
11 Mar 2024 0930	A2	NOAA Pier F9	White sheen in aquarium	Adequate	-	-	No further action required
11 Mar 2024 1020	A2	NOAA Pier F10	Health concern of headaches	Adequate	-	-	No further action required
11 Mar 2024 1120	A2	NOAA Building 176	Drinking water taste and odor	Adequate	-	-	No further action required
12 Mar 2024 0800	F2	5404 Benfold Ln	Hair loss	Adequate	Adequate	Sand like particle on aerator screen	Ensure aerator screens are cleaned periodically
12 Mar 2024 1000	A2	4702 Maryland St	Health concerns of sinus condition and (b) (6); white particles in water	Adequate	-	Black particles on aerator screen	Ensure aerator screens are cleaned periodically; Seal the leading edge of the new copper service line and flush completed installation prior to restoring service
12 Mar 2024 1100	F2	3110 Hailey Ct	Water quality concern: hot water temperature varies greatly	Adequate	Adequate	Black particles on aerator screen	No further action required

Date Time	Zone	Address	Resident Concerns	Chlorine Residual	Hot Water Temperature	Visual Observation	Conclusion
12 Mar 2024 1300	H1	4445 Kobashigawa St	Perform a full scale LTM and RRT sampling	-	-	-	Ensure aerator screens are cleaned periodically
13 Mar 2024 0900	D2	214 16th St	Water test for TPH; want water heater drained and flushed	-	Inadequate	Few particles on aerator screen	Recommend water heater replacement; ensure aerator screens are cleaned periodically
13 Mar 2024 1000	A2	NOAA Pier F9	-	-	-	-	No further action required
14 Mar 2024 1100	D2	214 16th St	Drain and flush hot water heater	-	-	-	No further action required
15 Mar 2024 0800	A3	5856A Fulmar Ave	White film at kitchen sink	Adequate	Adequate	-	Install insulation to avoid heat loss from hot water piping
15 Mar 2024 1000	D2	1937 Fox Blvd	Health concerns of hair loss; water quality concerns of odor	Adequate	Inadequate	-	Inadequate hot water temperature may contribute to odors in hot water
18 Mar 2024 0900	A3	6016 Gannett Ave	White floating sheen in cold water	Adequate	Excessive	-	Adjust water heater temperature
18 Mar 2024 1100	D2	1935 Fox Blvd	Health issues and maintenance issues	Adequate	Inadequate	-	Adjust water heater temperature
19 Mar 2024 0900	D2	1002 Signer Blvd	White sheen on cold water	Adequate	Inadequate	-	Adjust water heater temperature
19 Mar 2024 1100	A3	5292B Iroquois Ave	Hot water odor	Adequate	Excessive	-	Hot water odor likely related to extreme temperature; adjust water heater temperature

Date Time	Zone	Address	Resident Concerns	Chlorine Residual	Hot Water Temperature	Visual Observation	Conclusion
21 Mar 2024 0000	H3	7012 Point Welcome Pl	(b) (6)	Adequate	Inadequate	-	Adjust water heater temperature
22 Mar 2024 0800	H3	2009 Point Welcome Pl	(b) (6)	Adequate	Inadequate	-	Likely cause of infection not from drinking water; adjust water heater temperature
22 Mar 2024 0000	D2	1502 Kaufman Ct	Odor observed in hot water	Adequate	Inadequate	-	Adjust water heater temperature
25 Mar 2024 0800	D2	500 Graham Ct	Sulfur odors in hot water	Adequate	Inadequate	-	Sulfur odor in hot water is likely a result of hot water, sulfur reducing bacteria, and anode rod; adjust water heater temperature
27 Mar 2024 1100	A3	5229A Iroquois Ave	About TPH in hot water; health concerns of rashes and (b) (6)	Adequate	Inadequate	-	Adjust water heater temperature
29 Mar 2024 1430	F3	3004 Anderson Ave	Health concerns of rashes during or after showering; chemical or chlorinous smell during bathing	Adequate	Adequate	White specks and calcite on aerator screen	No further action required
10 Apr 2024 0800	A3	5720 Erne Ave	Last month, residents noticed a petroleum or chemical odor in the water.	Adequate	Adequate	-	Recommend water heater replacement

Date Time	Zone	Address	Resident Concerns	Chlorine Residual	Hot Water Temperature	Visual Observation	Conclusion
11 Apr 2024 0000	D2	212E 13th St	Pink residue on kitchen faucet sprayer and bathroom sink	Adequate	Inadequate	Pink, green substance on aerator screen	Recommend water heater replacement
11 Apr 2024 1330	F2	4115 Lounsbury St	Worsened eczema since arriving on the island	Adequate	Adequate	Black and brown particles on aerator screen	Recommend water heater replacement
12 Apr 2024 0800	H1	4645 Ke St	Dry skin after showering	Adequate	Adequate	Mineral scale on aerator screen	Recommend water heater replacement
16 Apr 2024 0800	A3	5891 Gannet Ave	-	Adequate	Adequate	Black particles on aerator screen	Recommend water heater replacement
17 Apr 2024 0800	D2	15 Julian Ave	Rash after showering	Adequate	Adequate	Black particles on aerator screen	Recommend water heater replacement
17 Apr 2024 0900	F1	Building 62, Radford Dr	-	-	-	Mineral particles on aerator screen	No further action required
17 Apr 2024 1000	C1	Building 683, Waterfront St	-	Adequate	Adequate	Rust and mineral particles on aerator screen	Recommend water heater replacement; potential for water stagnation in the system
18 Apr 2024 0900	F2	3072 Arizona Rd	-	Adequate	Adequate	Black and white particles on aerator screen	No further action required

Date Time	Zone	Address	Resident Concerns	Chlorine Residual	Hot Water Temperature	Visual Observation	Conclusion
19 Apr 2024 0800	D2	641 Apollo Ave	Recent occurrence of GI issues	Adequate	Adequate	Mineral particles on aerator screen	No further action required
22 Apr 2024 0900	H3	1805 Blackthorn Ln	Health concerns of headaches and skin irritations	Adequate	Inadequate	-	Recommend water heater replacement
1 May 2024 0900	D2	137 3rd St	Health concern of headaches	Adequate	Adequate	Mineral particles on aerator screen	Recommend water heater replacement
6 May 2024 1000	A3	5223 Iroquois Ave	Health concern of fever, coughing and congestions	Adequate	Inadequate	-	Recommend water heater replacement
8 May 2024 0800	F1	Building X29	Metallic taste in kitchen water dispenser and sink faucet	Adequate	Inadequate	-	Extended stagnation resulted in chlorine loss and biofilm growth
8 May 2024 1100	A3	5778 B Erne Ave	Body rashes (b) (6)	Adequate	Inadequate	-	No further action required
13 May 2024 0800	D2	1809 19th Way	-	Adequate	Excessive	-	Adjust water heater temperature
13 May 2024 1000	A3	5644A Dovekie Ave	Recent sewer repair due to backups	Adequate	Adequate	-	Recommend water heater replacement
13 May 2024 1100	A3	5651 Dovekie Ave	-	Adequate	Adequate	-	No further action required
17 May 2024 0830	A3	6632B 105th St	Health concerns of skins and GI	Adequate	Excessive	-	Adjust water heater temperature
17 May 2024 1015	WL	Building 432, W Loch Fire Station	Recent discolored water due to service line repair	Adequate	Adequate	Dirt and rust on aerator screen	Recommend water heater replacement

5. SUMMARY AND RECOMMENDATIONS

To inform future efforts to resolve customer complaints, AH assessed existing complaint response procedures, compiled and reviewed more than 2 years of water quality complaints, and queried water quality testing results. Water quality complaint descriptions were categorized, geocoded, aggregated and tallied before analyses (e.g., temporal and spatial). Additionally, during a 9-week period between February and May 2024, AH conducted over 50 field investigations in response to customer requests. The field investigations involved home visits for site characterization, including field testing of various indicator parameters, review of past and current chemical test results, and inspection of premise plumbing and appurtenances.

AH found the following:

- The current complaint response procedures do not include all elements of a comprehensive customer complaint surveillance and response system. The existing response procedures lack a standardized complaint recording process and may not be capable of timely detection of anomalies. At the same time, if requested, the Navy responds to customer calls by performing home visits, comprehensive sampling, and delivery of bottled water, utilizing resources that could be employed more effectively elsewhere.
- After conclusion of the emergency response following the spill, the customer reports of water quality issues could not be substantiated based on sampling data. Customer call volume and characteristics do not follow clearly discernible spatial patterns, and the recent increase in concerns may be related to non-water quality related events and news coverage.
- A comparison to published benchmarks shows that the volume of water-quality concerns at JBPHH is low and normal for typical water systems.

AH recommends the following:

- Enhance the customer complaint surveillance and response system in accordance with EPA guidance¹⁵, including data recording, visualization, and threshold detection. Create monthly reports on customer call volume and water quality complaints.
- Focus the response on reported water quality issues:
 - Record symptoms and advise customers with health concerns to seek medical care.
 - Home visits and sampling should be performed following reported, ongoing water quality issues, not generalized concerns about the safety of the drinking water.
- Continue the review of water quality data collected during EDWM program for fluctuations in disinfectant residuals and any associations with taste and odor complaint calls.

¹⁵ EPA (2017) Designing Customer Complaint Surveillance For Water Quality Surveillance and Response Systems. Office of Water (MC 140) EPA 817-B-15-002C. Internet: https://www.epa.gov/sites/default/files/2018-02/documents/customer_complaint_surveillance_design_guidance.pdf (Accessed May 2024).

ATTACHMENT

Tuesday 20 February 2024, 0900

Zone F2, 2110 Schmitt Parkway

A. Resident Concerns

- Resident has lived at the residence since August 2018.
- The resident had complaints about a rash from the bathtub and noticed a “weird” smell in April or May 2022. The resident has little contact with neighbors but recalled that they had similar issues at the same time. Ten days ago, the resident noticed a strong chlorine smell; visually the water seemed OK. The issues have subsided since then.

B. Observations

- The resident utilizes faucet filter systems for the kitchen sink (PUR PFM400H1, Figure 1) and bathroom faucets and shower heads (Tylola2, Figure 2). The resident stated that she replaces the kitchen filter faucet carbon filters when the unit’s indicator comes on.
- No particulate matter has accumulated on the aerator screen of the kitchen sink filter. However, there was a little mineral scale built-up.
- After ensuring that the dishwasher was not in operation, and after removing the attached carbon filter, the Seabee collected a sample in a 40-mL amber-glass vial from the kitchen faucet for total petroleum hydrocarbons (TPH) analysis at the PWD laboratory.
- The Seabee also filled a clear plastic cup with water to inspect for sheen. No sheen was visible on the sample.



Figure 1. Kitchen Sink Filter at 2110 Schmitt Parkway.

¹ Kaz USA, Inc. The unit is certified for the removal of aesthetic constituents under ANSI/NSF 42 and for the removal of specific contaminants under ANSI/NSF 53.

² The company was not found in NSF-certified product listings.



Figure 2. Bathroom Fixture Filters at 2110 Schmitt Parkway.

- The LTM team sampled the upstairs guest bathroom.
 - Analytes included free chlorine, TPH, volatile organic compounds (VOCs), and metals, in accordance with the LTM Plan.
 - As metals were sampled last, following the filling of several large bottles for other analytes, the lead and copper results are not necessarily representative of the premise plumbing.
 - Prior to sample collection, the LTM team turned off the hot water valve under the sink and removed the aerator from the faucet.
 - The cold-water lines were not flushed prior to sampling.
 - Because of the shallow bathroom sink, the taller bottles had to be tilted for filling, causing water to spill on the outside of the bottle. Without the aerator, the flow from the faucet was not always laminar, resulting in the entrainment of air into the sample.
 - The LTM team recorded a free chlorine reading of 0.53 mg/L.
 - The photoionization detector (PID), used to test for VOCs in the air, read 0.3 ppm.
- The 80-gallon water heater, located in a closet adjacent to the kitchen, was manufactured by the American Water Heater Company (Johnson City, Tennessee) in 2006. The heater is equipped with a pipe loop and pump to recirculate water through roof-mount solar panels. The cold-water supply and hot-water discharge piping transitioned from copper to chlorinated polyvinyl chloride (CPVC) where they entered the wall behind the heater.
- The tank had signs of external corrosion and mineral build-up on the cold-water connection. The top of the sacrificial anode tightening bolt was also corroded (Figure 3). It is not known if any maintenance has been performed on the appliance.
- The temperature gauge installed on the hot water discharge pipe indicated only 100°F.
- No other water quality measurements were taken during this visit.



Figure 3. Water Heater at 2110 Schmitt Parkway.

C. Recommendations

- Advise residents of certifications of point-of-use (POU) water treatment devices and the required maintenance.
- Review the water heater maintenance logs, ensure the tank is thoroughly flushed, and consider replacement of corroded fittings and the anode or, given its age, replace the entire appliance.
- Have the public-private venture (PPV) housing company adjust the temperature settings on the heater. To control growth of certain plumbing pathogens, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) recommends a minimum water heater temperature of 120°F³.
- Advise the LTM sampling teams to adjust faucets during sampling to ensure a steady, laminar flow, where possible. Unless requested otherwise by the resident, it is suggested that the kitchen faucet be sampled.

³ ASHRAE Guideline 12-2020. Managing the Risk of Legionellosis Associated with Building Water Systems.

Wednesday 21 February 2024, 0900

Zone H1, 6343 Papaya Ln

A. Resident Concerns

- The resident has lived at the location for 3.5 years.
- The resident has previously observed a sheen on water from the kitchen sink.
- The resident mentioned skin issues associated with the hot water, as well as miscellaneous health concerns with (b) (6).
- The resident stated that the upstairs bathroom water occasionally smells like “pond water.”

B. Observations

- The inspector checked the cold water in the upstairs bathroom and detected a metallic taste and odor, which might resemble “pond” water. The taste and odor disappeared after a few seconds of flushing.
- The hot water temperature at the kitchen sink was only 108°F.
- The water heater was made by AO Smith (Model Signature 100), and it appeared to be a newer model (year, serial was not noted). The heater is no longer connected to solar roof panels but has recently been plumbed to receive waste heat from the adjacent air conditioning unit. The pipe material is copper. A thermostatic mixing valve was installed between the cold supply and hot water line (Figure 4).
- The chlorine residual at the upstairs master bathroom sink was acceptable (0.28 mg/L). Iron was not detectable (< 0.10 mg/L).



Figure 4. Water Heater and AC Unit at 6343 Papaya Lane.

C. Recommendations

- Have the PPV housing company adjust the temperature settings on the thermostatic mixing valve and/or heater to ensure that the hot water is above 120°F in the tank and above 115°F at the kitchen sink.

Thursday 22 February 2024, 0800

Zone A3, 5174 Iroquois Ave

Due to time constraints, the water quality inspector did not accompany the CPLO, RRT, and LTM teams during the visit.

Thursday 22 February 2024, 0900

Zone D2, 207 Beard Avenue

A. Resident Concerns

- The resident has lived at the location since August 2023.
- The resident had no specific concerns with the water quality but was alerted about potential issues by a relative.

B. Observations

- There was a POU filter installed on the kitchen faucet (PUR FM-3333B4, Figure 5). The device has a light indicating when the filter element needs replacement.



Figure 5. Kitchen Faucet Filter at 207 Beard Avenue.

- The water quality parameter results measured at the kitchen sink are tabulated below. Both temperature and chlorine residual of the hot water were adequate.

Sample	Temperature	Conductivity, μS/cm	Chlorine Residual, mg/L	Iron, mg/L
Cold	Not measured	Not measured	Not measured	Not measured
Hot	115°F (46°C)	207 @ 45°C	0.18	< 0.10

- The water heater is a 50-gallon standard electric heater (Ruud Achiever) made by the Rheem Manufacturing Company in 2018 (Figure 6), and it connected with copper piping.

⁴ The device is made by Kaz USA, Inc. The unit is certified for the removal of aesthetic constituents under ANSI/NSF 42 and for the removal of specific contaminants under ANSI/NSF 53.



Figure 6. Water Heater at 207 Beard Avenue.

- The hot water discharge piping from the water heater was not insulated.
- C. Recommendations
- To avoid loss of heat from the hot water piping, it is recommended that appropriate insulation be installed.

Monday 26 February 2024, 0930

Zone F2, 2879 Arizona Road

A. Resident Concerns

The residence was vacant, and the visit served as a “dry run” for the water heater inspection at 2851 Anderson Ave on 27 February 2024. That inspection has been documented in a separate memorandum that was submitted on 1 March 2024. The Water Quality Inspector was accompanied by various NAVFAC HI PWD and Red Hill OIC personnel, a photographer from the Public Affairs Office (PAO), and PPV plumbers.

B. Observations

- The renovated residence has been vacant for several months.
- Sampling results from the hot and cold-water taps are tabulated below. Iron was not detected. The low chlorine residual in the hot water is probably due to lack of water use. The hot water temperature was adequate.

Sample	Temperature	Conductivity, $\mu\text{S}/\text{cm}$	Chlorine Residual, mg/L	pH
Cold	Not measured	240 @ 25°C	0.56	7.20
Hot	125°F (52°C)	270 @ 50°C	< 0.05	7.45

- Using a special key, the LTM team removed the aerator from the kitchen faucet. The aerator screen was clean. The inspector also removed the aerator from the faucet in the utility room adjacent to the kitchen. The aerator screen was partially clogged with sand grains (Figure 7).



Figure 7. Utility Sink Aerator Screen at 2879 Arizona Road.

- The 80-gallon water heater, located in the garage, was manufactured by the American Water Heater Company in 2022. The heater is equipped with a pipe loop and pump to recirculate water through roof-mount solar panels. The

cold-water supply and hot-water discharge piping transitioned from copper to CPVC where they entered the wall behind the heater (Figure 8).

- The PPV plumbers removed the cover from the heating element panel. The temperature setting of the heater was approximately 125°F (Figure 8).
- The inspector withdrew approximately 50 mL of water from the heater's drain valve. The initial aliquot had no chlorine residual, was turbid, and had a bluish hue. This was likely due to the water stagnating in the brass fittings and valve. The water cleared with the next aliquot.

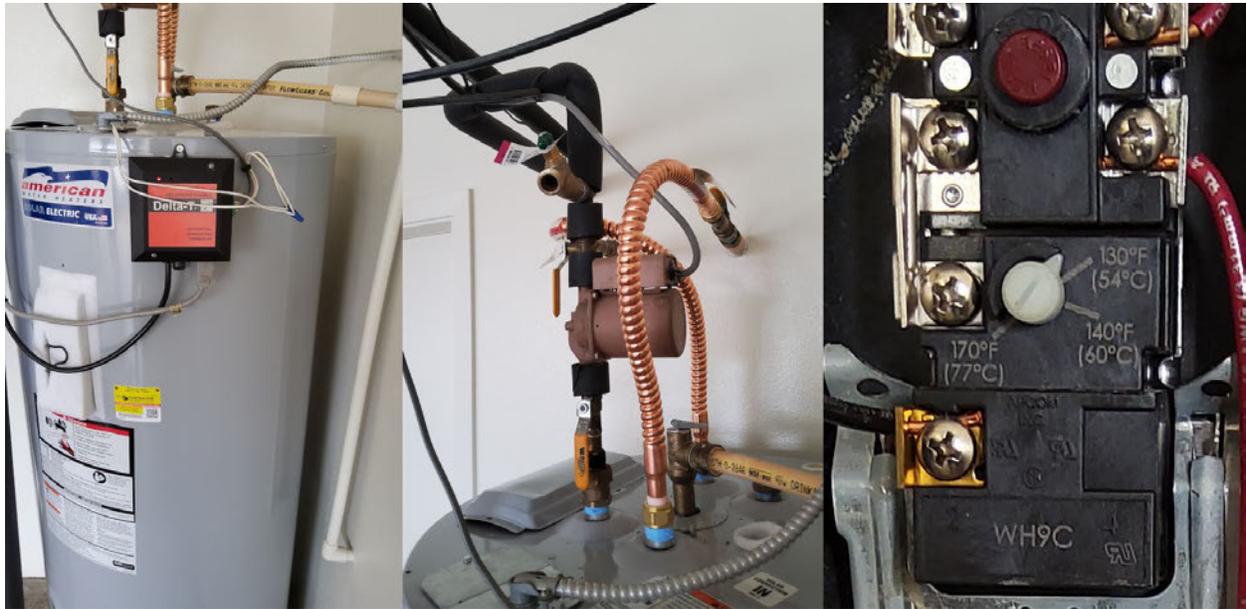


Figure 8. Water Heater at 2879 Arizona Road.

C. Recommendations

- Ensure that aerator screens are cleaned periodically. Accumulation of debris can inhibit flow. Additionally, in older plumbing systems, where lead solder was used, metal shavings from repairs may accumulate on the screen, potentially resulting in elevated first-draw lead concentrations during compliance sampling.

Wednesday 27 February 2024, 0900

Zone F2, 2851 Anderson Ave

On 27 February 2024, the Water Quality Assessment Team conducted an assessment at a residence in the Halsey Terrace housing area (2851 Anderson Avenue), which included a deliberate evaluation of the water heater. Prior to commencement of the water heater inspection, the inspector removed the aerator from the kitchen faucet and collected cold and hot water tap samples, which he analyzed for residual chlorine, conductivity, and iron. Iron and chlorine were measured colorimetrically using the HACH DR900. The results are shown below:

Sample	Temperature	Conductivity, $\mu\text{S}/\text{cm}$	Chlorine Residual, mg/L	Iron, mg/L
Cold	Not measured	240 @ 25°C	0.56	< 0.10
Hot	117°F (47°C)	205 @ 45°C	0.45	< 0.10

The results were in good agreement with values seen elsewhere in the system. Water temperature and disinfectant residual are two important measures to control the growth of microorganisms in hot water systems. The hot water temperature at the kitchen outlet was slightly below 120°F (49°C), which is acceptable at the point of service. The minimum water heater temperature recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) to control growth of certain pathogenic plumbing pathogens is 120°F. The residual chlorine levels were more than sufficient in both cold and hot water.

Neither the hot nor the cold water had any discernible taste or odor. There was no discoloration, turbidity, or bubbles. Multiple aliquots of both cold and hot water were inspected for any traces of sheen, but none was visible.

Close inspection of the aerator that was removed from the kitchen faucet revealed the presence of two sand grains as well as a few small, brittle, black particles (Figure 9). The origin of the materials is uncertain. However, replacement of water service lines made from polyethylene was ongoing in the area, which could have resulted in plastic debris entering the water system.



Figure 9. Particulate Matter on Kitchen Faucet Aerator.

It is recommended to periodically clean the aerators or have them replaced because flow could be obstructed as particulate matter accumulates. After the inspection of the kitchen faucet was completed, the Long-Term Monitoring (LTM) sampling team (AECOM) proceeded to collect cold and hot water samples for petroleum hydrocarbons, volatile organic chemicals, and metals. The validated results of these analyses showed no fuel-related chemicals. There were no detections of any contaminants other than expected traces of metals and disinfection byproducts.

The 80-gallon water heater was manufactured by the American Water Heater Company (Johnson City, Tennessee) in 2004 and installed in 2005⁵. It was located in a closet accessible from the exterior of the house. The heater was set to a temperature of 125°F, and it was equipped with a pipe loop recirculating water through roof-mount solar panels. A separate differential temperature thermostat actuated the recirculation pump. The tank had no signs of external corrosion. The label attached to water heater used to regular maintenance was blank, and therefore at the time, it was unknown whether any recent maintenance had been performed on the appliance.”

With the assistance of two plumbers, the inspector disconnected the electric power to the heater, relieved pressure, and closed the valves isolating the solar recirculation system. The inspector then opened the drain valve and performed a visual assessment of several aliquots of water drained from the bottom of the heater’s tank. The discharged water appeared clear, without any particulate material, discoloration, or unusual odor.

Using a hose attached to the drain valve, the team proceeded to drain the water, while observing the discharge, which remained clear. The team captured several gallons of the water in buckets for further examination and noted sand in the bottom of one bucket. After the water level in the tank was sufficiently low, the plumbers removed the heating element from the tank. There was considerable mineral scale on the heating element, which would

⁵The plumber claimed the heater was manufactured in 1999 and installed in 2008. However, the reference to “1999” on the tank’s label refers to the year ASHRAE Standard 90.1 was published. The installation date is noted on another label on the tank and was barely legible.

be expected even in soft to moderately hard water (Figure 10). The appearance and white/green coloration of the scale suggests precipitates of calcium carbonate, cupric salts, and potentially, magnesium hydroxides. The heating element was retained in a re-sealable bag filled with water drained from the tank.



Figure 10. Heating Element and Mineral Scales.

After the tank had drained completely, the plumbers laid the heater on its side to remove the anode rod. This required considerable force, resulting in the rod shearing off from the tightening nut and falling into the tank vessel. Through the two openings in the tank, the plastic dip tubes were visible and appeared intact, but further inspection required a larger opening. Public Works (PW) personnel transported the heater to a warehouse for later inspection. At the warehouse the personnel drained the remaining water from the tank and captured several aliquots, which appeared to contain appreciable amounts of sand and some gelatinous materials, likely hydroxides of magnesium and silica. The material was retained in amber 40-mL glass vials. The turbid supernatant was poured into a small plastic specimen container (Figure 11).



Figure 11. Solids and Liquid Removed from Bottom of Water Heater

On 29 February, PW personnel removed part of the heater's insulation and cut a 6-inch by 8-inch opening in the side of the steel vessel near the top. The protective glazing on the interior side of the cutout piece appeared intact. Inspection of the interior of the tank vessel showed a large accumulation of mineral scale, similar to that observed on the heating element. The largest pieces were removed from the tank and inspected visually. The pieces consisted of the nearly completely corroded steel cable to which the anode (presumably magnesium) was attached, as well as aggregates of the same mineral scale found on the heating element (Figure 12). The interior inspection of the pressure vessel showed that, while the glazing appeared intact, the onset of severe corrosion was evident adjacent to the openings for the dip tubes and anode rod (Figure 13).

In summary, the tank appeared to be in a condition commensurate with its age and the apparent lack of maintenance. There was a considerable accumulation of sand in the tank, suggesting that it has not been flushed annually. The accumulated sand has the potential to harbor microorganisms, particularly if adequate water temperatures and/or chlorine residuals are not maintained. The anode rod was completely corroded, which is likely the reason for the onset of corrosion of the steel shell. The recommended replacement interval for anode rods is 3 to 5 years.



Figure 12. Corroded Anode Rod Parts and Mineral Scale



Figure 13. Interior Tank Bottom (left) and Top (right).

A. Recommendations

Based on the findings of this water heater inspection, the following is recommended:

- Ensure that water heater temperatures are at least 120 °F so that a hot water temperature above 115 °F can be attained at distal outlets.
- Perform annual preventive maintenance on the water heaters:
 - Perform thorough flushing: Using a clean, white bucket, inspect the discharge from the heater for sand and other materials. Commence flushing until no more debris is visible in the discharge.
 - Once drained, inspect the heating elements of the water heater for build-up of minerals; clean or replace as necessary.
 - Inspect the faucet aerators to check for signs of debris that may indicate deterioration of the heater’s anode or corrosion of the steel shell.
- Replace the sacrificial anode every three to five years, or as conditions warrant. This action can extend the life of the water heater considerably.
- Ensure that the installation date, as well as maintenance actions are recorded on the heater. Detailed, digital inspection and maintenance records should be kept for the lifetime of the heater.
- The findings of the interior inspection of the aging water heater, including accumulation of sand, the deterioration of the anode, and the consequent onset of corrosion were expected given the lack of periodic maintenance. Additional water heater investigations will yield similar results and are therefore only warranted under exceptional conditions, such as abnormally high levels of particulate matter, metals or bacteria.

Because the water heater has been replaced and sampling results were satisfactory, there are no further actions required for the residence at 2851 Anderson Avenue.

Wednesday 28 February 2024, 0800

Zone F1, 5202 Fuqua Ln

A. Observations

- The resident utilizes an AquaEarth shower filter (Figure 14). The device is not NSF-certified for the claimed water treatment effects⁶.



Figure 14. Shower Filter at 5202 Fuqua Lane.

- The inspector removed the aerator from the kitchen faucet and found the screen covered with brittle, black granules (Figure 15).
- Both hot and cold water appeared clear, without bubbles, particulate matter, or sheen. The inspector noted no taste or odor. No other water quality parameters were recorded.
- The 80-gallon solar water heater is made by SunEarth, Inc. (Fontana, CA). The label was partially covered by solar loop thermostat and therefore, the manufacturing date was not legible. However, the unit appeared to be in good condition without signs of external corrosion (Figure 16).

⁶ The product web page at <https://www.aquaeearth.us/present/15-stage-shower-water-filters/> asserts that the device “helps fast remove chloramine fluoride and chlorine, heavy metals and other sediment and inhibits the growth of scale in the bathtub.”



Figure 15. Kitchen Faucet Aerator Screen at 5202 Fuqua Lane.

- The thermometer installed at the discharge piping from water heater, upstream of the thermostatic mixing valve, indicated 114°F, which is below the minimum value recommended by ASHRAE (Figure 16).



Figure 16. Solar Water Heater at 5202 Fuqua Lane.

B. Recommendations

- Ensure that aerator screens are cleaned periodically.
- Advise residents of certifications of POU water treatment devices and the required maintenance.
- Have the PPV housing company adjust the temperature settings on the thermostatic mixing valve and/or heater to ensure that the hot water is above 120°F in the tank and above 115°F at the kitchen sink.

Wednesday 28 February 2024, 1000

Zone D2, 1824 Porter Ave

A. Resident Concerns

- Resident has been in house for 8 months.
- The residents are experiencing severe dry skin.

B. Observations

- The inspector noted black, brittle granules and a small piece of white plastic on the kitchen faucet aerator screen. The edges of the aerator housing had some mineral scale buildup (Figure 17).



Figure 17. Kitchen Faucet Aerator Screen at 1824 Porter Avenue.

- The following water quality parameters were recorded:

Sample	Temperature	Conductivity, $\mu\text{S}/\text{cm}$	Chlorine Residual, mg/L	Iron, mg/L
Cold	75°F (24°C)	203 @ 24°C	0.54	< 0.10
Hot	107°F (42°C)	252 @ 42°C	0.46	< 0.10

- The chlorine residuals were adequate in both cold and hot water. The hot water temperature should be 115°F or higher.
- Neither the hot nor the cold water exhibited any bubbles, particulate matter, taste, odor, or sheen.
- The 80-gallon water heater was made by the Bradford White Corporation (Middleville, MI). The inspector could not discern the manufacturing date from the heater's label. The appliance used to be tied into solar panels, but the piping and recirculation pump had been disconnected and/or valved off. The cold-water supply copper tubing appeared new. There was some external

corrosion on the heater shell and the out-of-service recirculation pump. The temperature indicator showed approximately 107°F, which is significantly below the minimum temperature recommended by ASHRAE.



Figure 18. Water Heater at 1824 Porter Avenue.

C. Recommendations

- Ensure that aerator screens are cleaned periodically.
- Have the PPV housing company adjust the temperature settings on the thermostatic mixing valve and/or heater to ensure that the hot water is above 120°F in the tank and above 115°F at the kitchen sink.

Wednesday 28 February 2024, 1030

Zone D1, 926 Huttenberg Ct

A. Resident Concerns

- Residents reported [REDACTED] (b) (6) after drinking the tap water.

B. Observations

- There were no filters installed on the kitchen faucet or under the sink. The premise piping was made from copper.
- There were some small black particles and some sand grains on the kitchen faucet aerator screen (Figure 19).

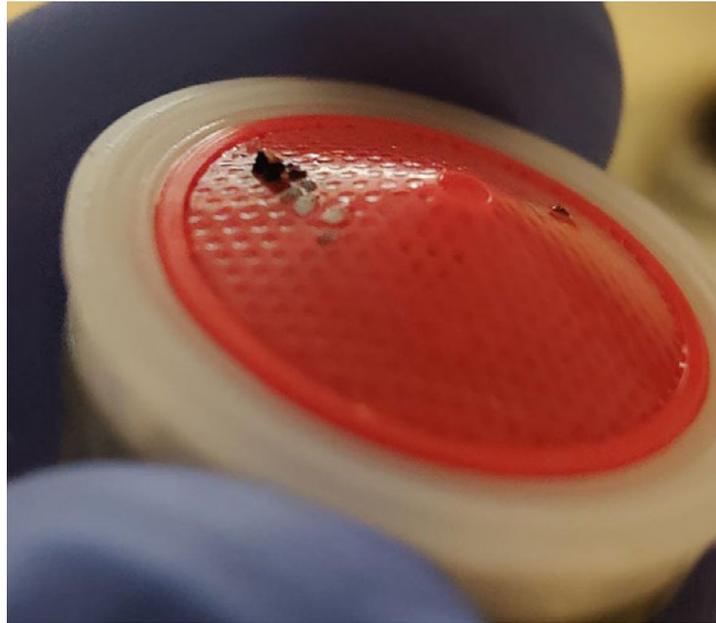


Figure 19. Kitchen Faucet Aerator Screen at 926 Huttenberg Court.

- The following water quality parameters were recorded:

Sample	Temperature	Conductivity, $\mu\text{S}/\text{cm}$	Chlorine Residual, mg/L	Iron, mg/L
Cold	75°F (24°C)	210 @ 24°C	0.74	< 0.10
Hot	111°F (44°C)	254 @ 40°C	0.53	< 0.10

- The chlorine residuals were adequate in both hot and cold water. The hot water temperature at the outlet was below 115°F.
- The 80-gallon solar water heater was manufactured by SunEarth, Inc. in 2014. The cold-water supply and hot water discharge tubing seemed new, and the heater appeared to be in good condition. The new hot water discharge tubing was not insulated. There was no temperature gauge installed.



Figure 20. Water Heater at 926 Huttenberg Court.

C. Recommendations

- Ensure that aerator screens are cleaned periodically.
- Have the PPV housing company adjust the temperature settings on the thermostatic mixing valve and/or heater to ensure that the hot water is above 120°F in the tank and above 115°F at the kitchen sink.
- To avoid loss of heat from the hot water piping, it is recommended that appropriate insulation be installed.

Thursday 29 February 2024, 1600

Zone D2, 123 2nd Street

A. Observations:

- The resident showed a stainless-steel saucepan with rainbow-like discoloration on the bottom and lower outside and asserted that this has started since plumbers made repairs on her water heater. She mentioned that someone told her it could be due to dishwasher pods.
- The resident stated that there is a whole-house filtration system installed and that the residents do not drink the water. The resident refused to respond when asked if the filtration system is professionally maintained.
- The resident showed some glass dishes with some white residue.
- Two PPV electricians were in the process of replacing the temperature regulators on the water heater. The electricians stated that the automatic timer for the heater was bypassed at some point in the past, causing both bottom and top regulators and elements to be powered continuously and then “burn” out.
- The heater operates only on electricity (i.e., there are no solar panels). The heating elements were just replaced.
- No temperature or chlorine residual measurements were made because the heater was out of service and there was a whole-house filtration system.
- The whole-house filtration system is installed outside, and it is only covered with a tarp held together by bungee cords.
- The CPLO went with the resident over the past LTM sampling results, noting non-detects on all organics. The resident voiced concerns about low levels of arsenic ($< 1 \mu\text{g/L}$).
- The inspector pointed out the potential effects of whole-house filtration systems, which cause the removal of the chlorine residual (i.e., biofilm growth and associated aesthetic effects, or the potential proliferation of opportunistic premise plumbing pathogens).
- The resident is asking to have the water heater replaced and to have the cold and hot water sampled.
- The resident went on to ask why the Navy is not looking at “everything.” The inspector suggested reviewing the chromatograms from her samples for any fuel signatures.

Friday 1 March 2024, 1000

Zone D3, 628 Ohana Nui Cir

A. Resident Concerns

- The residents have lived at the address for one year and one month.
- The family has (b) (6).
- The resident voiced concerns about recurring rashes on (b) (6) following baths that are taken in the bathroom or next to the kitchen sink.
- The resident has no concerns regarding the aesthetic water quality.

B. Observations

- Other than the presence of small bubbles in the hot water, the visual appearance of the water was very good in the kitchen. It was clear, there was no sheen, no turbidity, and no discoloration. The inspector checked the upstairs bathroom sink and detected no taste or odor in the cold water.
- The following water quality parameters were recorded:

Sample	Temperature	Conductivity, $\mu\text{S}/\text{cm}$	Chlorine Residual, mg/L	Iron, mg/L
Cold	75°F (24°C)	230 @ 24°C	1.06	< 0.10
Hot	104°F (40°C)	232 @ 39°C	0.40	< 0.10

- The cold-water chlorine residual was measured at the upstairs bathroom. While the chlorine residuals are good, the hot water temperature is too low. The resident stated that a ticket was submitted to PPV housing in December 2023 to get the issue resolved.
- There is a full-flow water filter installed on the cold-water line under the kitchen sink (GE Appliances GXULQ7, Figure 21).
- There is a full flow shower filter installed in the upstairs bathroom (Aqua Home Group, Figure 21). The resident stated that the filter is exchanged every 3 months. The product vendor was not found in the NSF database.
- The pressure appeared low at all outlets. No pressure regulator was found at the water supply line.

⁷ The vendor claims certification per NSF/ANSI Standard 42 and CSA B483.1, but the product was not found in the NSF certified product listings.



Figure 21. Kitchen and Shower Filters at 928 Ohana Nui Circle.

- There were outside deposits on the kitchen faucet aerator. The upstairs bathroom faucet aerator was clean, although there is some white residue on the gasket (Figure 22).



Figure 22. Kitchen Faucet Outlet and Bathroom Faucet Aerator at 928 Ohana Nui Circle.

- The 120-gallon capacity water heater was manufactured in 2007, and it did not show any signs of external corrosion. The water heater did not appear to be connected to the solar panels on the roof. There was no thermostat and no recirculation pump. There was a tempering valve installed between the cold and hot water lines (Figure 23).

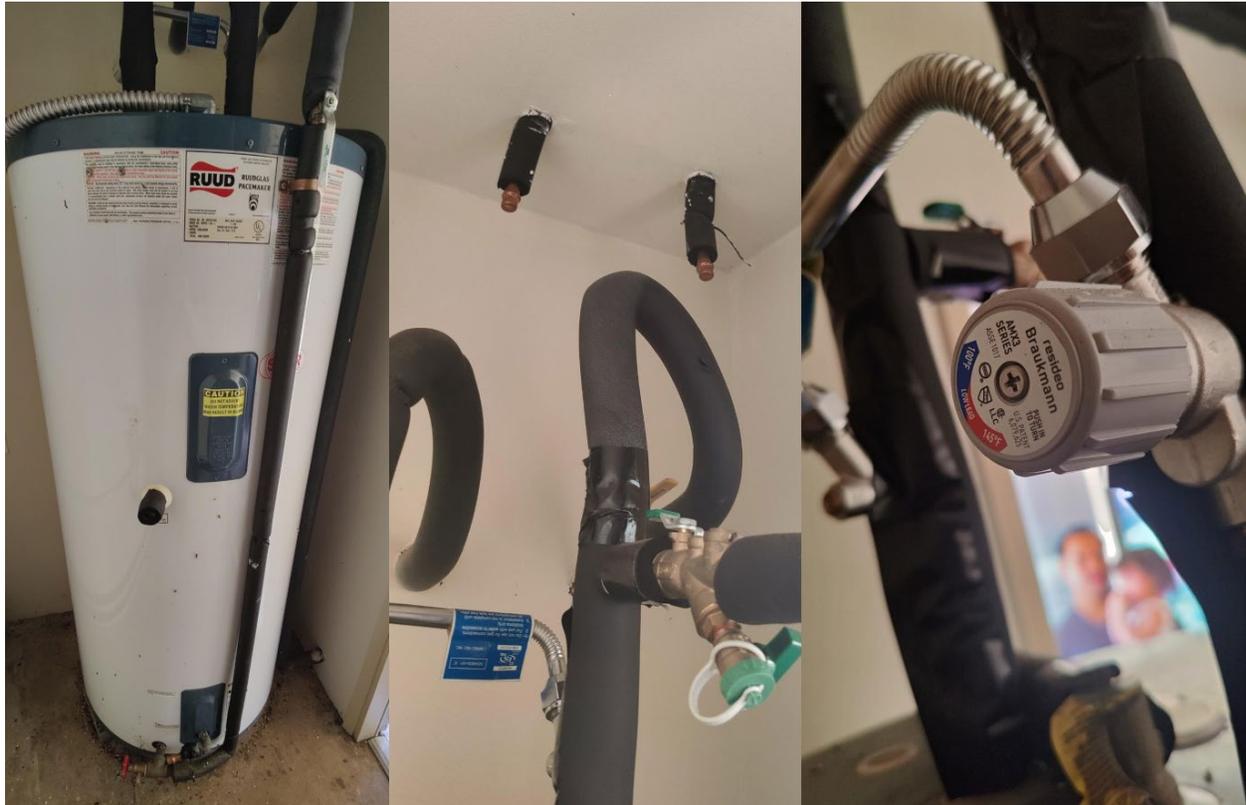


Figure 23. Water Heater at 928 Ohana Nui Circle.

Friday 1 March 2024, 1300

Zone D3, 1057 Ohana Nui Cir

A. Resident Concerns

- The residents have been living at the address since 2019.
- The residents claim serious health concerns, including acute effects after exposure to “fumes in the water,” such as developing severe hives in the shower.
- Resident stated that there was a [REDACTED] (b) (6) [REDACTED] around the time of the fuel spill.
- The resident showed a video of what appeared to be a [REDACTED] (b) (6) [REDACTED]. When the camera was held at a right angle, there appeared to be some iridescence.

B. Observations

- The resident showed the inspector several glass jars that were filled with water in December of 2021. The resident also presented an old aerator in a plastic bag. It had small black specks on the screen (Figure 24).



Figure 24. Collected Water and Old Kitchen Aerator Screen at 1057 Ohana Nui Circle.

- The resident also presented two plastic pans with an accumulation of white residue that appeared after the evaporation of water, which appeared to be calcium carbonate.
- The resident reported black residue in the toilet (Figure 25). The flush tank had recently been replaced.



Figure 25. Black Residue in the Toilet Bowl.

- The inspector took water samples from the kitchen faucet and measured the following parameter values:

Sample	Temperature	Conductivity, $\mu\text{S}/\text{cm}$	Chlorine Residual, mg/L
Cold	72°F (22°C)	232 @ 22°C	0.87
Hot	131°F (55°C)	260 @ 49°C	0.10

- The high hot water temperature may accelerate chlorine decay, explaining the low residual measured in the sample. The hot water had a milky appearance due to bubbles that dissipated within one minute. There was no discoloration, particles, or sheen.
- The 80-gallon water heater was made by SunEarth in 2010 (Figure 26). The heater appeared to be in fair condition. There was plant debris on top of the heater.

C. Recommendations

- PPV plumbing personnel should ensure that the water heater is properly maintained. Given its age, it may need replacement.
- PPV plumbing personnel should also investigate the black stains in the toilet bowl, which might originate from the disintegration of an old gasket.



Figure 26. Solar Water Heater at 1057 Ohana Nui Circle.

Monday 11 March 2024, 0930

Zone A2, NOAA Pier F9

A. Statements by NOAA Ship Oscar Elton Sette (R335)

- NOAA Ship R335 out for several weeks. Returned Sunday 10 March. Observed white sheen in aquarium filled with water from pier.
- The ship requested samples be taken from the pier by a NOAA Industrial Hygienist. Results came back with 1300 µg/L Total Petroleum Hydrocarbons (TPH).
- NOAA Ship R335 still had water in tanks made while underway. Nevertheless, would not take additional water from the pier pending results of LTM sampling. Bottled water was requested and provided as an interim measure.

B. Observations

- Flushed water from the standby backflow preventor on Pier F9 for 5 minutes. The following water quality parameters were recorded:

Sample	Temperature	Conductivity, µS/cm	Free Chlorine Residual, mg/L	pH
Cold	75°F (24°C)	252	0.49	7.2

- The LTM team and RRT team sampled water from the outlet of the standby backflow preventer in accordance with the approved sampling plans.

C. Recommendations

- Follow up on NOAA sample results. On 20 March, the water quality results from Pier F9 were validated Non-Detect (ND) for TPH. No additional action required for TPH.
- Investigate non-petroleum sources for white sheen on Ford Island.

Monday 11 March 2024, 1020

Zone A2, NOAA Pier F10

A. Statements by NOAA Ship Ranier (S221)

- NOAA Ship S221 has been in port since September 2023 and has been continuously connected with the JBPHH water system since that time.
- Received NOAA test results at the same time as her sister ship. Results were much lower.
- Some sailors have recently experienced headaches. Unclear if this was attributable to water from JBPHH system.
- Commanding Office (CO) saw information on the internet and was concerned.
- Taste & Odor, white sheen, and or particles were not concerns for this location.

B. Observations

- Flushed water from the standby backflow preventor on Pier F10 for 5 minutes. The following water quality parameters were recorded:

Sample	Temperature	Conductivity, µS/cm	Free Chlorine Residual, mg/L	pH
Cold	72°F (22°C)	252	0.39	7.3

- The principal concern at this location was the TPH measured in the NOAA sample. Hot water was not a concern at this location.
- The LTM team and RRT team sampled water from the outlet of the standby backflow preventer on the pier in accordance with the approved sampling plans.

C. Recommendations

- Follow up on NOAA test results. On 20 March, the water quality results from Pier F10 were validated ND for TPH. No additional action required.

Monday 11 March 2024, 1120

Zone A2, Main Building 176

A. Statements by NOAA Building Manager

- Complaint was centered around drinking water taste and odor.
- Building 176 has a gym with male/female showers. They have not experienced any complaints regarding the hot water in showers which are heavily used at this location.
- Building 176 is a LEED Green certified building.
- Other facilities under his control include Bldg. M, 130, and 184.

B. Observations

- The following water quality parameters were recorded from the hand wash sink in the kitchen.

Sample	Temperature	Conductivity, µS/cm	Free Chlorine Residual, mg/L	pH
Cold	72°F (22°C)	245	0.51	7.2

- The LTM team and RRT team sampled water in accordance with the approved sampling plans.

C. Recommendations

- Follow up with test results. On 20 March, the water quality results from Main Bldg. 176 were validated ND for TPH. Therefore, no additional actions for TPH testing in Bldgs. M, 130 or 184 are required.
- Follow up with Building Manager on taste and odor in three months. No unusual results were observed in LTM monitoring test results. Nonetheless, the water residence time in LEED certified buildings is greater than that for non-certified buildings, which can contribute to water quality degradation and taste and odor concerns.

Tuesday 12 March 2024, 0800

Zone F2, 5404 Benfold Ln

A. Statements by the Resident

- The resident wanted the water tested.
- Has another (b) (6), to which they travel periodically during the year. (b) (6) noticed her hair felt “fuller in (b) (6)”; hair texture felt different from exposure compared to water in Hawaii.

B. Observations

- Removed aerator and found sand like particle retained on screen.
- The residence receives solar heated hot water from a 120-gallon unit manufactured by RUUD Division of Rheem Manufacturing Company in Jan 2008.
- The cold-water feed too and hot water discharge from the water heater was insulated.
- The water quality parameter results measured at the kitchen sink are tabulated below.

Sample	Temperature	Conductivity, $\mu\text{S}/\text{cm}$	Free Chlorine Residual, mg/L	pH
Cold	73°F (23°C)	240	0.65	7.2
Hot	123°F (51°C)	Not measured	Not measured	Not measured

- The LTM team and RRT team sampled water in accordance with the approved sampling plans at the kitchen sink.
- The hot water temperature appeared adequate.
- Asked resident about mineral stains at water fixtures in their home in (b) (6). He indicated they had mineral stains (white/gray) on all faucets and fixtures, including the water line in toilet bowl. This is likely hardness (calcium and magnesium) which can be absorbed by hair, making it “feel fuller.” The source water at JBPHH is naturally low in mineral content, especially hardness.
- Hardness has no health-based standard or limit in drinking water. It is strictly an aesthetic concern.

C. Recommendations

- Ensure that aerator screens are cleaned periodically. Accumulation of debris can inhibit flow.
- Follow up with test results. On 20 March, the unvalidated water quality results were ND for TPH. No additional action required

Tuesday 12 March 2024, 1000

Zone A2, 4702 Maryland St

A. Resident Concerns

- Resident moved in November 2023. Prior residence supplied water from the Board of Water Supply (BWS). [REDACTED] (b) (6) [REDACTED]
- Health concerns include sinus condition and hearing loss. My [REDACTED] (b) (6) [REDACTED].
- For both partners, the principal concern was white particles observed in the cold water only at the kitchen sink and refrigerator chilled water dispenser. Nowhere else.
- Hot water is not a concern at this location.

B. Observations

- The kitchen faucet aerator had black particles retained on screen as noted below.



Figure 27. Kitchen Faucet Aerator

- Construction was observed on an adjacent road (Tennessee Road), where high-density polyethylene (HDPE) service lines were being replaced with copper piping. HDPE shavings have the same appearance as the particle retained on the screen.



Figure 28. Service line replacement on Tennessee Street.

- Private-Public Venture (PPV) housing contractor replaced refrigerator water filter with an NSF certified (42, 53, and 401) unit.



Figure 29. Refrigerator Water Filter

- Sampling results from kitchen sink are noted below.

Sample	Temperature	Conductivity, μS/cm	Free Chlorine Residual, mg/L	pH
Cold	73°F (23°C)	242 @ 23°C	0.59	7.1

- The LTM team and RRT team sampled water at the kitchen sink in accordance with the approved sampling plans.
- C. Recommendations
- Ensure that aerator screens are cleaned periodically. Accumulation of debris can inhibit flow.
 - Request the following from the service line contractor.
 - a. Seal the leading edge of the new copper service line before it is pushed down the trench to prevent dirt and impurities from entering the service line.
 - b. Flush completed installation prior to restoring service.
 - Follow up with test results. On 20 March, the unvalidated water quality results were ND for TPH. No additional action required for TPH.
 - Investigate non-petroleum sources for white sheen and particles on Ford Island.

Tuesday 12 March 2024, 1100

Zone F2, 3110 Hailey Ct

A. Resident Concerns

- Lived in (b) (6) during the Red Hill incident. Moved to Hailey Court after the situation had cleared up.
- Concerns regarding water are derived from Facebook.
- Moved to residence (b) (6). Has been drinking the water all along. Now has a (b) (6).
- Hot water temperature varies greatly.

B. Observations

- The kitchen faucet aerator had black particles retained on screen as noted below.



Figure 30. Kitchen Faucet Aerator

- The residence receives solar heated hot water from an 80-gallon unit manufactured by American Water Heaters.
- The hot water temperature measured at the outlet of the heater was 116°F.



Figure 31. Hot Water Heater

- The cold-water feed too and hot water discharge from the water heater were insulated.

- The water quality parameter results measured at the kitchen sink are tabulated below.

Sample	Temperature	Conductivity, μS/cm	Free Chlorine Residual, mg/L	pH
Cold	73°F (23°C)	241	0.57	7.1
Hot	116°F (47°C)	Not measured	Not measured	Not measured

- The LTM team and RRT team sampled water in accordance with the approved sampling plans at the kitchen sink.

C. Recommendations

- Ensure that aerator screens are cleaned periodically.
- Have the PPV housing contractor service the solar heater to ensure that the hot water continuously remains at 120°F in the tank.
- Follow up with test results. On 20 March, the unvalidated water quality results were ND for TPH. No additional action required.

Tuesday 12 March 2024, 1300

Zone H1, 4445 Kobashigawa St

A. Resident Concerns

- Customer in residence before 20 November 2021 Red Hill event.
- The primary purpose for the visit was to perform a full scale LTM and RRT sampling. Limited testing was conducted on 29 February that focused on TPH utilizing chlorine quench and micro extraction.
- During this visit, test results from 29 February (ND) were hand delivered and the modified TPH testing protocol explained.
- Representative from US Army (b) (6) was on site during visit.

B. Observations

- The LTM team and RRT team sampled water in accordance with the approved sampling plans at all sinks within the residence.
- Hot water was not a concern at this location.
- Residence located downstream of US Army operated granular activated carbon (GAC) filters. Based on conversations with US Army personnel, GAC media may not have been replaced since it was installed approximately two years ago.

C. Recommendations

- Ensure that aerator screens are cleaned periodically.
- Follow up with test results, when available.

Tuesday 13 March, 0900

Zone D2, 214 16th St

A. Resident Concerns

- Family had been in residence since August 2019.
- Residents expressed no specific water quality concerns (e.g., white sheen or particles), other than they wanted the water tested for TPH. In addition, they clearly stated they wanted the hot water heater drained and flushed.

B. Observations

- Few particles found on the kitchen faucet aerator screen (Figure 32).



Figure 32. Kitchen Faucet Aerator Screen.

- The following water quality parameters were recorded at the kitchen sink:

Sample	Temperature
Hot	114°F (44°C)

- The residence had a conventional 80-gallon electric hot water heater.



Figure 33. Hot Water Heater

- No information was listed for the date of manufacturer. However, based on the overall appearance, the unit was installed approximately ten to fifteen years ago.
- Based on the temperature recorded in the kitchen sink, the hot water heater appeared to be set and operating normally. However, no insulation on the cold or hot water piping was observed.

-
- The LTM team and RRT team sampled water in accordance with the approved sampling plans.

C. Recommendations

- Ensure that aerator screens are cleaned periodically.
- Set up another appointment to flush the hot water heater on 14 March at 1100.
- To avoid loss of heat from the hot water piping, it is recommended that appropriate insulation be installed.
- Follow up with test results, when available.

Tuesday 13 March 2024, 1000

Zone A2, NOAA Pier 9

- The intent of the visit was to identify possible root causes for elevated TPH values reported in NOAA sample.
- Subsequent to this visit, it was determined from a review of the raw laboratory data (chromatograph) that the NOAA sample was run directly after a sample that contained 18,000 µg/L TPH, and this likely contaminated the test column, compromising the results.
- On 20 March, the unvalidated water quality results from the samples collected on 11 March were ND for TPH. No additional action required.

Tuesday 14 March 2024, 1100

Zone D2, 214 16th St

A. Resident Concerns

Prior to the visit, the resident turned the water heater off two hours prior to the visit.

During this drain/flush, aliquots of the discharge water were collected at the following intervals during the drain cycle:

- 1st Aliquot: Beginning
- 2nd Aliquot: Middle
- 3rd Aliquot: Prior to End

An additional aliquot was collected after the initial flush of water entering the heater.

Each aliquot was split and shared between the RRT and the resident.

B. Observations

- The first draw of water exiting the water heater was clear and remained so throughout the entire drain/flush exercise.
- The discharge hose from the water heater was directed into a 5-gallon opaque polyethylene cylindrical container. Some light solids did appear to settle on the bottom of the container up to and including the 2nd Aliquot as shown below.



Figure 34. Solids in Bottom of Container

- After the second aliquot, little, if any, solid deposition was observed.
- Solids were decanted from the container and observed to be silty sand.
- Solids were collected, transferred to a glass container, and sent to the RRT laboratory for TPH analysis.
- Resident was apprised of the results.

C. Recommendations

- No additional action is required for the hot water heater.

Tuesday 15 March 2024, 0800

Zone A3, 5856A Fulmar Avenue

A. Resident Concerns

- The resident had been living at that location for three years. Did not experience TPH from Red Hill incident.
- Went away for one week, approximately two weeks ago. Upon return to the residence, they experienced white film at kitchen sink in both hot and cold water.
- (b) (6) flushed all the water outlets for ten minutes.
- (b) (6) at 6016 Gannett Avenue, who observed the white sheen first.

B. Observations

- No particles observed in aerator screen, or in hot/cold water.
- Water sampled from the kitchen faucet and measured the following parameter values:

Sample	Temperature	Conductivity, $\mu\text{S/cm}$	Free Chlorine Residual, mg/L	pH
Cold	74°F (23°C)	245	0.60	7.4
Hot	121°F (49°C)	Not measured	Not measured	Not measured

- The LTM team and RRT team sampled water in accordance with the approved sampling plans.
- The 40-gallon water heater was manufactured by Bradford White Corporation and appeared in good condition.



Figure 35. Hot Water Heater

- No insulation was observed on the cold or hot water piping.
- C. Recommendations**
- Follow up with test results, when available.
 - To avoid loss of heat from the hot water piping, it is recommended that appropriate insulation be installed.

- Source for white sheen was not obvious. Investigate non-petroleum sources for white sheen on Iroquois Point.

Tuesday 15 March 2024, 1000

Zone D2, 1937 Fox Blvd

- Resident Concerns
 - The resident has been living at this location for over three years, lived through the Red Hill incident including TPH in premise plumbing.
 - Customer has many concerns with the water including odor in hot, and cold water. Initially detected odor approximately three months ago.
 - Customer has many health-related concerns including hair loss. (b) (c)
 - Hot water is also not very hot.
- Observations
 - No particles observed in aerator screen, or in hot/cold water.
 - Water samples from the bathroom sink (without treatment) measured the following parameter values:

Sample	Temperature	Conductivity, $\mu\text{S}/\text{cm}$	Free Chlorine Residual, mg/L	pH
Cold	72°F (23°C)	243	0.48	7.3

- The residence receives solar heated hot water from an 80-gallon unit manufactured by RUUD Division, Rheem Manufacturing Company in May 2006.
- The hot water temperature measured at the outlet of the heater was 96°F.



Figure 36. Hot Water Heater

- Hot water piping adjacent to the water heater was insulated, as shown in photograph above.

-
- Odors were detected in the bathroom sink. Faint in cold, pronounced in hot, (earthy musty), which resident articulates as a chemical odor.
 - Because of detecting odor events, customers installed GAC filters at the kitchen sink and at the master bath shower. They have been in place for no more than three months.



Figure 37. GAC Filters on Kitchen Sink and Shower

- Recommendations
 - The hot water heater temperature at the unit measured 96°F, which is well below the recommended level of 120°F. This may be contributing to odors in hot water.
 - Replace cartridge filters every six months.
 - Follow up with test results, when available.

Monday 18 March 2024, 0900

Zone A3, 6016 Gannett Ave

A. Resident Concerns

- Moved into residence on 30 Jan 2024
- (b) (6) at 5856A Fulmar Avenue
- Specific concern was white floating sheen in cold water, experience two weeks ago.
- According to resident, sheen passed through Brita filter in water pitcher.
- Hot water is not an issue. No odors reported.
- No rashes reported.

B. Water Quality Observations and Results

- Results of testing from kitchen sink:
 - pH 7.2
 - Conductivity 247
 - Free Chlorine 0.55
 - Cold Temp 75F
- RRT and LTM crew on site. LTM collected from kitchen sink.
- No particles observed in the kitchen sink.

C. Hot Water Heater

- Has gas fired hot water heater (40 gal.)
- The temperature of hot water at kitchen sink was 131F.

D. Overall Assessment

- The water quality results looked good. TPH results will confirm petroleum not present.

E. Recommendations

- PPV maintenance should reduce the temperature at hot water heater outlet to 120F. (b) (6).
- Follow up with TPH water quality results when available.
- Follow up on white sheen in Iroquois Point distribution system - A3.
- What was the occupancy history of this unit during and after Red Hill?
- How long was it vacant before current residents moved in?

Monday 18 March 2024, 1100

Zone D2, 1935 Fox Blvd

A. Resident Concerns

- Moved into residence on 3 Aug 2023
- The biggest concern was health issues of (b) (6) (brittle hair, rashes, thyroid, etc.)
- The beloved (b) (6).
- Maintenance issue include:
 - Solar hot water collector on roof leaked. The recirculation loop has been isolated but not repaired.
 - Sewer gas smell near toilet in bathroom. A toilet bowl seal likely leaks allowing gases to enter the house.
- Read information available on social media and heard from next door neighbor 1937 Fox Boulevard.
- Never had water tested.
- Has not observed white particles or sheen in hot or cold water.
- Hot water temperature or odor is not an issue, other than maintenance of unit.

B. Water Quality Observations and Results

- Results of testing from kitchen sink:
 - pH 7.3
 - Conductivity 243
 - Free Chlorine 0.48
 - Cold Temp 73F
- RRT and LTM crew on site. LTM collected from kitchen sink.
- Did not observe particles in the kitchen sink.

C. Hot Water Heater

- Has solar heated hot water heater (80 gals.)
- Temperature at outlet of unit 110F.

D. Overall Assessment

- The water quality results looked good. TPH results will confirm petroleum not present.

E. Recommendations

- PPV maintenance repair solar collector and restore temperature at hot water heater outlet to 120F.
- Follow up with TPH water quality results when available.

Tuesday 19 March 2024, 0900

Zone D2, 1002 Signer Blvd

A. Resident Concerns

- Moved into residence on 2 Jan 2024
- Biggest concern: 2nd week in residence observed white/silver sheen floating on top of cold water.
- Hot water is not a concern.
- Installed faucet mounted GAC filter at kitchen sink and shower head unit in master bath.
- Medical: reported hair loss in shower.

B. Water Quality Observations and Results

- (b) (6) from Hawaii DOH at home visit.
- Results of testing from kitchen sink:
 - pH 7.1
 - Conductivity 243
 - Free Chlorine 0.55
 - Cold Temp 73F
- RRT and LTM crew on site. LTM collected from kitchen sink.
- Did not observe particles in the kitchen sink.

C. Hot Water Heater

- Hot water is not an issue. The temperature at kitchen sinks measured 113F.

D. Overall Assessment

- The water quality results looked good. TPH results will confirm petroleum not present.

E. Recommendations

- Follow up with test results. On 20 March, the water quality results from Main Bldg. 176 were validated ND for TPH. Therefore, no additional actions for TPH testing in Bldgs. M, 130 or 184 are required.
- Follow up with Building Manager on taste and odor in three months. No unusual results were observed in LTM monitoring test results. Nonetheless, the water residence time in LEED certified buildings is greater than that for non-certified buildings, which can contribute to water quality degradation and taste and odor concerns.

Tuesday 19 March 2024, 1100

Zone A3, 5292B Iroquois Ave

A. Resident Concerns

- Moved into residence in Dec 2023
- Biggest concern: Hot water odor (“garlic”) observed in master bath.
- White sheen or particles not a concern.
- No medical concerns reported.

B. Water Quality Observations and Results

- Results of testing from kitchen sink:
 - pH 7.2
 - Conductivity 245
 - Free Chlorine 0.54
 - Cold Temp 74F
- RRT and LTM crew on site. LTM collected from kitchen sink.
- Did not observe particles in the kitchen sink.
- No odor detected in cold water at master bath sink.
- A faint smell of garlic observed in master bath sink with just hot water. Likely related to extreme temperature of hot water (e.g., heater, piping, pipe joining materials, etc.)

C. Hot Water Heater

- Gas fired hot water heater (40 gals).
- The hot water temperature measured at the kitchen sink was 150F.

D. Overall Assessment

- The water quality results looked good. TPH results will confirm petroleum not present.

E. Recommendations

- PPV maintenance should reduce the temperature at hot water heater outlet to 120F.
- Follow up with TPH water quality results when available.

Thursday 21 March 2024, 1200

Zone H3, 7012 Point Welcome Pl

A. Resident Concerns

- Biggest concern was for (b) (6).
- Army did not address her concern.
- Read information available on social media.
- White sheen, particles, or hot water were not concerns.

B. Water Quality Observations and Results

- Results of testing from kitchen sink:
 - pH 7.2
 - Conductivity 258
 - Free Chlorine 0.46
 - Cold Temp 76F
 - Hot Temp 114F
- RRT and LTM crew on site. LTM collected from kitchen sink.
- Did not observe particles in the kitchen sink.

C. Hot Water Heater

- Not a customer concern

D. Overall Assessment

- Informed resident about sources for (b) (6): soil, food, water, and (b) (6). Handed out fact sheet from CDC regarding (b) (6). Discussed water supply in Hawaii, and specifically here at Welcome Point Place.
- The water quality results looked good. TPH results will confirm petroleum not present.

E. Recommendations

- Follow up with TPH water quality results when available.
- No other actions required.

Friday 22 March 2024, 0800

Zone H3, 2009 Point Welcome Pl

A. Resident Concerns

- Moved into residence in Sept 2023
- Biggest concern was for (b) (6).
- Army did not address his concern. Informed him water was safe.
- Read information available on social media. Followed talking points from website. For example, asked about fuel (JP5) still present in distribution water mains.
- When first moved into the residence, he observed particles in the kitchen sink and refrigerator chilled water dispenser. Used bottled water for consumption ever since.
- Hot water is not a concern.

B. Water Quality Observations and Results

- Results of testing from kitchen sink:
 - pH 7.2
 - Conductivity 261
 - Free Chlorine 0.50
 - Cold Temp 75F
 - Hot Temp 110F
- RRT and LTM crew on site. LTM collected from kitchen sink.
- Did not observe particles in the kitchen sink.
- Residents not aware US Army had installed treatment for Army housing.

C. Hot Water Heater

- Not a customer concern

D. Overall Assessment

- Informed resident about sources for (b) (6): soil, food, water, and (b) (6). Handed out fact sheet from CDC regarding (b) (6). Discussed water supply in Hawaii, and specifically here at Welcome Point Place. Agreed likely cause of infection not from drinking water.
- The water quality results looked good. TPH results will confirm petroleum not present.

E. Recommendations

- Follow up with TPH water quality results when available.
- No other actions required.

Friday 22 March 2024, 1200

Zone D2, 1502 Kaufman Ct

A. Resident Concerns

- Moved into residence on 1 March 2024
- The biggest concern was odor observed in hot water, not cold, throughout residence.
- Read information available on social media.
- Has not observed white particles or sheen in hot or cold water.

B. Water Quality Observations and Results

- Results of testing from kitchen sink:
 - pH 7.2
 - Conductivity 243
 - Free Chlorine 0.69
 - Cold Temp 73F
- RRT and LTM crew on site. LTM collected from kitchen sink.
- Did not observe particles in the kitchen sink.
- Has solar heated hot water. Temperature at outlet of unit 100F.

C. Hot Water Heater

- The temperature of hot water in the bathroom sink was 108F.
- Detected faint earthy-musty odor in hot water only at bathroom sink,

D. Overall Assessment

- The water quality results looked good. TPH results will confirm petroleum not present.

E. Recommendations

- PPV maintenance restores temperature at hot water heater outlet to 120F.
- Follow up with TPH water quality results when available.

Monday 25 March 2024, 0800

Zone D2, 500 Graham Ct

A. Resident Concerns

- Moved into a residence one week ago.
- Unit vacant for over 30 days prior to arrival.
- Wanted water tested, in light of media.
- The biggest concern was sulfur odors in hot water/shower/dishwasher.
- White sheen/particles not a concern.

B. Water Quality Observations and Results

- Results of testing from kitchen sink:
 - pH 7.2
 - Conductivity 245
 - Free Chlorine 0.49
 - Cold Temp 75°F
 - Hot Temp 111°F
- RRT and LTM crew on site. LTM collected from 2nd floor hall bathroom sink.
- Sheen/particles do not present in the kitchen sink.

C. Hot Water Heater

- Solar heated hot water (80 gals).
- Temperature at unit: 110°F
- The recirculating pump timer was in OFF position.

D. Overall Assessment

- The water quality results looked good. TPH results will confirm petroleum not present.
- Sulfur odors in hot water likely a result of the following:
 - Hot water at heater 110°F.
 - Stagnant water in solar collector and recirculation line could promote the growth of sulfur reducing bacteria (SRB).
 - Anode rod in hot water.

E. Recommendations

- PPV maintenance should repair solar collector, turn ON recirculating pump, and restore temperature at hot water heater outlet to 120F.
- Replace anode rod on hot water heater with zinc-aluminum rod which has less tendency to catalyze sulfur odors to hot water.
- Flush hot water heater following replacement of anode rod.
- Follow up with TPH water quality results when available.

Wednesday 27 March 2024, 1100

Zone A3, 5229A Iroquois Ave

A. Resident Concerns

- Moved into residence approximately 3 ½ years.
- Experienced some TPH during Red Hill.
- White sheen observed long ago.
- Health concerns
 - Rashes
 - Hearing loss (b) (6)
- My biggest concern was TPH in hot water. Wanted a hot water heater sampled for TPH.
- White sheen/particles not a current concern.

B. Water Quality Observations and Results

- Results of testing from kitchen sink:
 - pH 7.2
 - Conductivity 249
 - Free Chlorine 0.60
 - Cold Temp 77°F
 - Hot Temp 114°F
- RRT and LTM crew on site. LTM collected from kitchen sink cold & hot.
- Sheen/particles do not present in the kitchen sink.
- Air bubbles observed in cold water. Dissipated in one minute.

C. Hot Water Heater

- Gas fired hot water heater (40 gals).
- Temperature at kitchen sink: 114°F

D. Overall Assessment

- The water quality results looked good. TPH results will confirm petroleum not present.

E. Recommendations

- Follow up with TPH water quality results when available.
- No additional actions required.

Friday 29 March 2024, 1430

Zone F3, 3004 Anderson Avenue

A. Resident Concerns

- Moved into a residence last fall.
- (b) (6) in home
- Have detected chemical or chlorinous smell during bathing.
- Health concerns
 - Both (b) (6) have experienced rashes during/after showering
 - Rashes were not noticed during travel away from JBPHH.
 - Both (b) (6) consulted a physician. They do not feel that the (b) (6) (b) (6) are effective.
- Residents also mentioned white residue on vehicles after washing.

B. Water Quality Observations and Results

- Unit was sampled during emergency response phase on 24 JAN 2024
 - TPH and VOCs were not detected.
 - TOC was 4.73 mg/L C, which appears abnormally high for this water.
- Results of testing from kitchen sink:
 - pH 7.3 (cold), 7.6 (hot)
 - Conductivity 238 µS/cm (cold water), 262 µS/cm (hot water)
 - Free Chlorine 0.47 mg/L (cold), 0.27 mg/L (hot) (bathroom)
 - Cold Temp 76 °F
 - Hot Temp 117 °F
- RRT and LTM crew on site. RRT and LTM collected cold and hot water from the upstairs bathroom sinks.
- No sheen, particles, discoloration, or cloudiness observed at kitchen sink in hot or cold water.
- Two small white specks, presumably calcite, were found on the kitchen sink aerator.

C. Hot Water Heater

- Electric solar hot water heater (80 gals). The manufacturing date was concealed by thermostat panel, but the appliance appeared fairly new.
- The unit was flushed recently by PPV plumbers. Resident presented picture of hot water from kitchen sink after conclusion of flushing – the water was initially beige/brown.

D. Point-of-Use Treatment

- The residents use water from refrigerator filter for cooking/boiling. The installed filter element (Whirlpool Corporation, EDR1RXD1) is certified under NSF/ANSI 42, 53, 401, and CSA Standard B483.1.
- For drinking, the residents use water from a steel gravity filter system (“Berkey,” New Millenium Concepts, Ltd.) to which they add a mineral supplement. The

filtered water had no chlorine; pH was 8.0 and conductivity 240 $\mu\text{S}/\text{cm}$. The filter makes or model was not found in the NSF database.

- The residents installed a shower filter (Sprite Showers, Perma Seal Model SR), which has been certified by the International Association of Plumbing and Mechanical Officials (IAPMO) Research & Testing Division against the NSF/ANSI 177 standard for the reduction of chlorine. However, the product was not found in the NSF database.

E. Overall Assessment

- The water quality results looked good. LTM results will confirm petroleum not present.

F. Recommendations

- Follow up with LTM water quality results when available.
- No additional actions required.

Wednesday 10 April 2024, 1430

Zone A3, 5720 Erne Ave

A. Resident Concerns

- Moved into the residence approximately 3 years ago.
- (b) (6) in home
- Last month, residents detected petroleum or chemical odor in water, stating that it was reminiscent of the time during the spill.
- Water is not used for drinking.
- Health concerns
 - None were mentioned during the visit upon inquiry.
 - Abdominal pain was mentioned in the original DOH call.

B. Water Quality Observations and Results

- Unit was sampled during LTM on 18 July 2022
 - No unusual detections.
 - Traces of disinfection byproducts.
 - Traces of barium, copper, selenium.
- RRT, LTM crew, and DOH representative on site.
- RRT collected cold water samples from the bathroom sink.
- LTM collected cold water samples from the kitchen but did not notice the installed water filter. Team will return to re-sample with filter removed.
- Results of testing from bathroom sink:
 - pH 7.2 (cold), 7.4 (hot)
 - Conductivity 235 μ S/cm (cold water), 260 μ S/cm (hot water)
 - Free Chlorine 0.46 mg/L (cold, outside hose bibb), 0.45 mg/L (hot) (bathroom)
 - Cold Temp 76 °F
 - Hot Temp 118 °F
- No sheen, particles, discoloration, or cloudiness observed at bathroom sink in hot or cold water.

C. Hot Water Heater

- Natural gas water heater (80 gals). No label with manufacturing or installation date found. (From serial #, we know manufacturing date is May 2006)
- Residents reported a recent gas smell in closet, which was resolved by maintenance personnel.
- Resident has no other recollection of premise plumbing maintenance.

D. Point-of-Use Treatment

- The residents use under-the-sink filters in the bathroom and kitchen sink. The installed filters (Hydroviv) are certified under NSF/ANSI 42 and 53.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- No additional actions required.

Thursday 11 April 2024, 1200

Zone D2, 212E 13th St

(Location Code: D2-13TH0212E)

A. Resident Concerns

- Moved into the residence less than 1 year ago.
- (b) (6) in home
- Resident is concerned about pink residue on kitchen faucet sprayer. Also mentioned that there was pink residue in the bathroom sink, which had been removed.
- Water is not used for drinking, but for all other purposes.
- Health concerns: None were mentioned relating to drinking water.

B. Water Quality Observations and Results

- Unit was previously sampled on 23 January 2023
 - No unusual observations.
 - No detection of organic chemicals.
 - Traces of barium, chromium, copper, and lead were found.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from bathroom sink for rapid TPH test.
 - The EDWM team collected cold water samples from the upstairs bathroom.
- Results of field testing from kitchen sink:
 - pH 7.2 (cold), 7.3 (hot)
 - Conductivity 230 μ S/cm (cold water), 239 μ S/cm (hot water)
 - Free Chlorine 0.52 mg/L (cold), 0.34 mg/L (hot)
 - Cold Temp 75 °F
 - Hot Temp 112 °F (Kitchen), 113 °F (Upstairs bath)
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- A small piece of white plastic or mineral scale was found on aerator for kitchen faucet sprayer.



- Pink residue on top of calcite scale found on kitchen faucet sprayer, where water appears to be dripping down after use. Material is likely the growth of air-borne bacteria (species Serratia) on damp surfaces. Advised residents to

keep areas around sinks dry; remove pink residue after 10 minutes of soaking in 50/50 vinegar/water solution, followed by disinfection with bleach-based cleaner.



- Green, gel-like substance found on aerator at upstairs bathroom faucet, possibly magnesium hydroxide, resulting from corrosion and disintegration of the water heater anode.



- Hot Water Heater
- The electric water heater is 12 years old. The kitchen faucet temperature should not be below 115 °F; heater temperature may require adjustment.
- Point-of-Use Treatment
- None
- Overall Assessment
- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.
- Recommendations
- Follow up with EDWM water quality results when available.
- The water heater anode may require replacement followed by thorough flushing. Alternatively, replace the entire appliance. Heater temperature may require adjustment.
- No additional actions required.

Thursday 11 April 2024, 1330

Zone F2, 4115 Lounsbury Street

(Location Code: F2-LOUN4115)

A. Resident Concerns

- Moved into the residence less than 1 year ago.
- (b) (6) observed in home.
- Water is not used for drinking, but for all other purposes.
- Health concerns:
 - (b) (6), which has worsened since arriving on the island. Wanted to ensure it skin rash is not related to the water.
 - Asked for testing up- and downstream of installed shower filter.
 - Asked about PFAS in drinking water relating to AFFF spill at Red Hill

B. Water Quality Observations and Results

- Unit was previously sampled on 24 March 2022 and 18 August 2023
 - No unusual observations.
 - No detections of organic chemicals, except traces of disinfection byproducts (THMs)
 - Traces of barium, chromium, copper, lead, and selenium were found.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from the kitchen sink for rapid TPH test.
 - The EDWM team collected cold water samples from the upstairs bathroom.
- Results of field testing from kitchen sink:
 - pH 7.3 (cold), 7.3 (hot)
 - Conductivity 235 $\mu\text{S}/\text{cm}$ (cold water), 260 $\mu\text{S}/\text{cm}$ (hot water)
 - Free Chlorine 0.55 mg/L (cold), 0.48 mg/L (hot)
 - Cold Temp 76 °F
 - Hot Temp 120 °F (Kitchen)
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Observed scale buildup on kitchen faucet spout. Should be cleaned after soaking in vinegar/water solution to avoid attachment of bacteria.



-
- Black and brown mineral particles found in kitchen faucet aerator. They may originate from debris entering the water pipes during repairs. Recommended occasional checking/cleaning to ensure faucet flow capacity is not impaired.



C. Hot Water Heater

- The electric – solar water heater was made in 2007.
- Observed plastic piping downstream of heater.

D. Point-of-Use Treatment

- Shower filter (WD-100, Wedell Water, Anaheim, CA). Unit is NSF 177 certified for chlorine removal only and has recently been installed. Advised resident to replace cartridges periodically as recommended by the manufacturer.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Review water heater maintenance records. Given the age, consider replacing the unit.
- No additional actions required.

Friday 12 April 2024, 0800

Zone H1, 4645 Ke Street

(Location Code: H1-KEST4645)

A. Resident Concerns

- Resident was not present. May have been at residence more than 2 years.
- Health concerns:
 - Residents experiencing dry skin after showering.
- Water Quality Concern:
 - Noticed a surge in the water and sediments on one day.
 - No smells or other issues.

B. Water Quality Observations and Results

- Unit was previously sampled on 25 September 2023
 - No unusual observations.
 - No detection of organic chemicals.
 - Traces of barium, chromium, copper, lead, and selenium were found.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from the kitchen sink for rapid TPH test.
 - EDWM team collected cold water samples from the kitchen sink. Due to the presence of fragrances and resulting high PID readings, the bathroom could not be sampled.
- Results of field testing from kitchen sink:
 - pH 7.0 (cold), 7.1 (hot)
 - Conductivity 237 μ S/cm (cold water), 254 μ S/cm (hot water)
 - Free Chlorine 0.68 mg/L (cold), 0.42 mg/L (hot), 0.52 mg/L (shower with filter)
 - Cold Temp 75 °F
 - Hot Temp 115 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Observed scale buildup on kitchen faucet spout. Should be cleaned after soaking in vinegar/water solution to avoid attachment of bacteria.



-
- Found mineral scale on one bathroom faucet aerator, and a small particle on another.



- Found mold on shower door track.



- The hose attached to the spout in the slop sink in the utility room presents a potential cross connection.



- A pipe, branching off from the supply to the heater, appears to be routed to the irrigation system without backflow prevention.



C. Hot Water Heater

- The electric water heater was made in 2009. The heater is no longer connected to solar roof panels but has recently been plumbed to receive waste heat from the adjacent air conditioning unit. The pipe material is copper. A thermostatic mixing valve is installed between the cold supply and hot water line.
- Hot water heater plastic piping in the wall

D. Point-of-Use Treatment

- Shower filter installed in the upstairs bathroom with no label indicating make or model. Unit looks similar Aqua Home Group product, which is not NSF-certified. Unit has likely never been replaced. Field test showed that it does not remove chlorine.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Review water heater maintenance records. Given the age, consider replacing the unit.
- Advise residents of questionable effectiveness of shower filter. Recommend removal or replacement with NSF-certified unit.
- No additional actions required.

Tuesday 16 April 2024, 0800

Zone A3, 5891 Gannet Ave

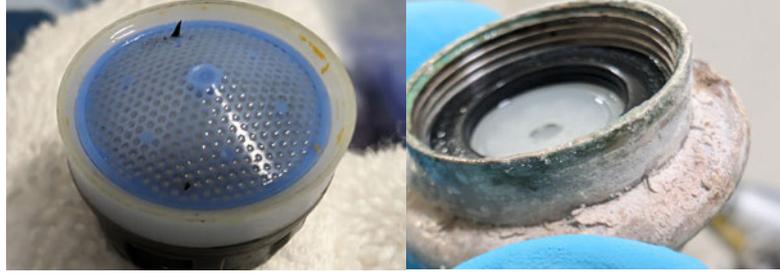
(Location Code: A3-GANN5891)

A. Resident Concerns

- [REDACTED] (b) (6) .
- Resident at address for 1 year and 4 months. Has [REDACTED] (b) (6) (pre-RH spill).
- Water is used for all purposes except drinking.
- Health concerns:
 - [REDACTED] (b) (6) experiences skin issues. Resident acknowledges that they may not be related to the water quality. [REDACTED] (b) (6) has no issues.
- Water Quality Concern: None
- Recent plumbing repairs: None

B. Water Quality Observations and Results

- Unit was previously sampled on 14 March 2023
 - No unusual observations.
 - No detection of organic chemicals.
 - Traces of antimony, bromoform, barium, chromium, copper, lead, selenium, thallium found, all well below regulatory limits.
 - Traces of bromoform, a disinfection byproduct, found.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from the kitchen sink for rapid TPH test.
 - EDWM team collected cold water samples from the kitchen sink.
- Results of field testing from bathroom sink:
 - pH 7.23 (cold), 7.48(hot)
 - Conductivity 233 μ S/cm (cold water), 284 μ S/cm (hot water)
 - Free Chlorine 0.61 mg/L (cold), 0.42 mg/L (hot)
 - Cold Temp 74 °F
 - Hot Temp 129 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Observed heavy calcite scale buildup on all outlets.
- Observed two small black particles on kitchen faucet aerator. The bathroom aerator was clean. Housing showed heavy external scale and minor brass corrosion.



C. Hot Water Heater

- The 40-gallon gas water heater was made in 2009.
- Hot water heater plastic piping in the wall

D. Point-of-Use Treatment

- No filters installed.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- No additional actions required.

Wednesday 17 April 2024, 0800

Zone D2, 15 Julian Avenue

(Location Code : D2-JULI0015)

A. Resident Concerns

- Resident for 4 years at address. [REDACTED] (b) (6).
- Health concerns:
 - Residents experiencing rashes after showering.
- Water Quality Concern:
 - White residue on drain board for dish rack.

B. Water Quality Observations and Results

- The unit was previously sampled on 29 March 2022, 20 October 2023, and 12 February 2024. Additionally, the water heater drain was sampled on 7 December 2023.
 - No unusual observations.
 - Traces of barium, bromoform, chromium, copper, dibromo acetic acid, dibromochloromethane, lead, petroleum hydrocarbons (as diesel), selenium, and thallium were found.
- Residence was also evaluated as part of the Fall 2023 premise plumbing assessment. No unusual observations were made.
- WQAT & EDWM crew on site. CPLO was not present.
 - WQAT did not collect rapid TPH test.
 - The EDWM team collected cold water samples from the master bathroom sink.
- Results of field testing from kitchen sink:

– pH	7.25 (cold), 7.55 (hot)
– Conductivity	236 µS/cm (cold water), 244 µS/cm (hot water)
– Free Chlorine	0.43 mg/L (cold), 0.24 mg/L (hot)
– Cold Temp	71 °F
– Hot Temp	125 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Observed white residue on black plastic drain board next to kitchen sink. It did not appear to be soap scum or mineral scale. It is possible that the plastic surface has degraded due to direct sunlight or the use of harsh, alcohol-based cleaners, leaving white marks.



- Observed calcite buildup on most outlets.



- There were several small black particles and a sand grain on the kitchen faucet aerator screen. A piece of rubber was found in the aerator of one of the upstairs guest bathroom faucets. The other aerators were clean.



C. Hot Water Heater

- The electric water heater was made by AO Smith. The manufacturing date is not known (2004 according to serial number). The heater is no longer connected to solar roof panels but has recently been plumbed to receive waste heat from the adjacent air conditioning unit. The pipe material is copper. A thermostatic mixing valve is installed between the cold supply and hot water line.
- Unit showed signs of past leaks and external corrosion at bottom of tank.



D. Point-of-Use Treatment

- No filters installed.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Review water heater installation record. Depending on age, consider replacing the unit.
- No additional actions required.

Wednesday 17 April 2024, 0900

Zone F1, Building 62, Radford Dr

(Location Code : F1-BLDG0062)

A. Tenant Concerns

- Visited NAVFAC portion of building; [REDACTED] (b) (6) [REDACTED] requested testing.
- Health concerns: None
- Water Quality Concern: None

B. Water Quality Observations and Results

- Location was previously sampled on 13 September 2022:
 - No detection of organic chemicals.
 - Traces of barium, chromium, and copper were found.
 - Sample was collected from breakroom kitchen sink and no chlorine was detected. The carbon filter observed during this visit may have already been present, causing the non-detection for chlorine. Prior results may not reflect water quality in the premise plumbing.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water sample from breakroom kitchen sink for rapid TPH test.
 - EDWM team collected cold water sample from women’s room sink. Due to the presence of a filter, the breakroom kitchen could not be sampled. EDWM team sampled hot water from kitchen sink (no filter) for HPCs.
- No field testing performed (other than by EDWM team).
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- There were some mineral particles on faucet aerator screen in the women’s rest room.



C. Hot Water Heater

- A 6-gallon electric water heater is located under the kitchen counter in the breakroom.
- The heater did not have a discharge pipe attached to the pressure relief valve.
- Piping is made from copper. There was evidence of excessive use of solder under the sink.

D. Point-of-Use Treatment

-
- There are filters installed for the water fountain and under the kitchen sink (Pentair Everpure BH2, NSF-certified under Standard 42, 53, and 401). Both filters were replaced in February 2024.
- E. Overall Assessment
- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.
- F. Recommendations
- Follow up with EDWM water quality results when available.
 - No additional actions required.

Wednesday 17 April 2024, 1000

Zone C1, Building 683, Waterfront St

(Location Code : C1-BLDG0683)

A. Resident Concerns

- No health or water quality concerns were communicated.

B. Water Quality Observations and Results

- Unit was previously sampled on 13 October 2022
 - No unusual observations.
 - There were trace detections of barium, chromium, copper and petroleum hydrocarbons (as diesel).
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from the downstairs sink for rapid TPH test.
 - EDWM team collected cold water sample from the upstairs rest room sink.
- Results of field testing from downstairs (basement) bathroom sink:
 - pH 7.52 (cold), 8.08 (hot)
 - Conductivity 238 $\mu\text{S}/\text{cm}$ (cold water), 259 $\mu\text{S}/\text{cm}$ (hot water)
 - Free Chlorine 0.04 mg/L (cold), 0.34 mg/L (hot, after flushing)
 - Cold Temp 74 °F
 - Hot Temp 117 °F

Noted low to no chlorine residuals and elevated pH in hot and cold water. This may be related to stagnant water in the distribution system.

- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Observed significant scale buildup at drinking fountain.



- There was a massive accumulation of rust and mineral particles on the bathroom faucet aerator. Advised tenant to have aerator replaced.



C. Hot Water Heater

- The 12-gallon electric water heater is located in the space above the bathroom, and it was manufactured in 2012. There was a kinked garden hose attached to the pressure relief valve, which pointed upwards, creating a considerable scalding hazard.



D. Point-of-Use Treatment

- There was a filter installed for the water fountain (Pentair Everpure BH2, NSF-certified under Standard 42, 53, and 401). It was last replaced on 16 Apr 2024.

E. Overall Assessment

- Potential for stagnant water in the system.
- The water quality is adequate. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Advise public works to test chlorine residuals in the mains adjacent to Building 683. Based on findings, perform hydrant flushing as needed. Re-test chlorine residuals in building.

-
- Recommend follow-up visit to test field parameters (pH, chlorine residual, etc.)
 - Advise facilities maintenance of code compliance for water heater pressure relief discharge pipe.
 - No additional actions required.

Thursday 18 April 2024, 0930

Zone F2, 3072 Arizona Rd

(Location Code : F2-ARIZ3072)

A. Resident Concerns

- [REDACTED] (b) (6); living at residence for 18 months.
- Residents are expecting visitors who are concerned about the water quality.
- Residents use the water for all purposes; they use filtered tap water for drinking.
- Health concerns: None related to water.
- Water Quality Concern: None. Residents mentioned occasional mold growth on caulk around wet areas. This is expected in a humid climate and not drinking water quality related.
- Recent plumbing repairs: None.

B. Water Quality Observations and Results

- Unit was previously sampled on 1 July 2022
 - No unusual observations.
 - No detections of organic chemicals, other than trace amounts of disinfection byproducts, dibromochloromethane and bromoform
 - Traces of barium, chromium, lead, and copper were found.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from kitchen and upstairs bathroom sinks for rapid TPH test.
 - The EDWM team collected cold water samples from the upstairs bathroom sink.
- Results of field testing from kitchen sink:
 - pH 7.27 (cold), 7.42 (hot)
 - Conductivity 227 $\mu\text{S}/\text{cm}$ (cold water), 270 $\mu\text{S}/\text{cm}$ (hot water)
 - Free Chlorine 0.44 mg/L (cold), 0.29 mg/L (hot)
 - Cold Temp 76 °F
 - Hot Temp 117 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Observed scale buildup on kitchen sink spray nozzles. There were small black and white mineral particles on the aerator screen. Some small particles were also observed on the aerator screen in one bathroom sink. Advised the resident to have aerators replaced.



C. Hot Water Heater

- The 80-gallon solar-electric water heater was made in 2019. There is a new flexible copper piping that transitions to plastic piping in the wall. Observed evidence of past leaks of the recirculation pump and advanced external corrosion on brass fittings.



- Resident stated that the automatic timer has been disabled to ensure availability of hot water throughout the day. The solar water recirculation loop is not isolated, and the thermostat and the pump were both plugged in.

D. Point-of-Use Treatment

- Residents consume water from the refrigerator dispenser. Resident replaces installed filter based on built-in indicator; replacement cartridges are provided by PPV housing. Filter element was not examined but is likely similar product observed elsewhere (Whirlpool Corporation, EDR1RXD1, certified under NSF/ANSI 42, 53, 401, and CSA Standard B483.1.).

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Follow-up with PPV housing to have corroded parts and recirculation pump replaced on hot water heater. Have the heater drained and flushed. Given its age, consider anode replacement.
- No additional actions required.

Friday 19 April 2024, 0800

Zone D2, 641 Apollo Ave

(Location Code : D2-APOL0641)

A. Resident Concerns

- (b) (6) residing at address since August 2023
- Health concerns:
 - Recent occurrence of GI issues; resident suspects it may have been due to food but requested testing to confirm it is not due to drinking water.
 - Water is used for all purposes except drinking.
 - Water quality concerns: None.

B. Water Quality Observations and Results

- Unit was previously sampled on 13 January 2022
 - No unusual observations.
 - No organic chemicals were detected.
 - Traces of arsenic, barium, chromium, copper, and lead were found.
- WQAT & EDWM crew on site, CPLO was not present.
 - WQAT collected cold water samples from the kitchen sink for rapid TPH test.
 - The EDWM team collected cold water samples from the upstairs bathroom sink.
- Results of field testing from kitchen sink:
 - pH 7.31 (cold), 7.5 (hot)
 - Conductivity 246 μ S/cm (cold water), 259 μ S/cm (hot water)
 - Free Chlorine 0.49 mg/L (cold), 0.04 mg/L (hot, trace amount)
 - Cold Temp 72 °F
 - Hot Temp 116 °F
- While the hot water temperature was adequate in the kitchen, it was below 115 °F at the bathroom outlets.
- Chlorine residual was barely detectable in hot water even after flushing. EDWM team confirmed observation in the upstairs bathroom. Chlorine was detected at trace concentrations in hot water sampled from the heater drain.
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water. No unusual taste or odor.
- Faucet aerator screens in kitchen and in downstairs bathroom had accumulated some mineral particles, which, based on appearance, could originate from water heater corrosion and anode deterioration.



C. Hot Water Heater

- The 80-gallon electric water heater was made in 2011. It used to be connected to solar roof panels but has recently been plumbed to receive waste heat from the adjacent air conditioning unit. The pipe material is copper. A thermostatic mixing valve is installed between the cold supply and hot water line.

D. Point-of-Use Treatment

- None

E. Overall Assessment

- Other than low chlorine residuals in hot water, water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Review water heater maintenance records. Given the age, consider replacing the unit. At a minimum, the appliance needs to be drained and flushed thoroughly. It is suggested to schedule flushing ASAP, and retest hot water chlorine residuals.
- Adjust the thermostatic mixing valve at the water heater to ensure hot water temperatures above 115 °F at all outlets.
- No additional actions required.

Monday 22 April 2024, 0900

Zone H3, 1805 Blackthorn Lp

(Location Code : H3-BLAC1805. Sample ID = H3-TW-0013888-24092-A-WQI)

A. Resident Concerns:

- Health concerns:
 - Residents have had headaches and skin irritations since the fuel incident.
 - Residents also notice very high-water pressure in recent months after noticing workers on the street.

2. Water Quality Observations and Results

- The unit was previously sampled on January 5, 2024.
 - No unusual observations.
 - No organic chemicals were detected.
 - Traces of arsenic, barium, chromium, copper, and lead were found.
- WQAT & EDWM crew on site, CPLO was not present.
 - WQAT collected cold water samples from the kitchen sink for rapid TPH test.
 - The EDWM team collected cold water samples from the upstairs bathroom sink.
- Results of field testing from kitchen sink:
 - pH 7.0 (cold), 7.0 (hot)
 - Conductivity 272 μ S/cm (cold water), 274 μ S/cm (hot water)
 - Free Chlorine 0.52 mg/L (cold), 0.52 mg/L (hot)
 - Cold Temp 76 °F
 - Hot Temp 108 °F
- While the hot water temperature was adequate in the kitchen, it was below 115 °F at the bathroom outlets.
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water. No unusual taste or odor.
- Faucet aerator screens in kitchen and restrooms were free of any mineral particles.



3. Hot Water Heater

- The 119-gallon electric water heater was made in 2013. It used to be connected to solar roof panels. The pipe material is copper with a thermostatic mixing valve installed between the cold supply and hot water line.

4. Point-of-Use Treatment

- None

5. Overall Assessment

- Other than low hot water temperature, water quality is good. EDWM results will confirm petroleum not present.

6. Recommendations

- Follow up with EDWM water quality results when available.
- Review water heater maintenance records. Given the age, consider replacing the unit. At a minimum, the appliance needs to be drained and flushed thoroughly.
- Adjust the thermostatic mixing valve at the water heater to ensure hot water temperatures above 115 °F at all outlets.
- No additional actions required.

Wednesday 1 May 2024, 0900

Zone D2, 137 3rd St

(Location Code : D2-3RD0137)

A. Resident Concerns

- [REDACTED] (b) (6)
- Resident at location since March 2023. Lived on base [REDACTED] (b) (6) for two years before.
- Health concerns:
 - [REDACTED] (b) (6) is experiencing headaches since moving in and, recently, rashes. Resident seems to correlate issues to water use but did not imply causation. Suggested improvement of migraine with use of reverse osmosis (RO) treated water.
 - Nobody else in the household experiences health issues.
- Water Quality Concerns:
 - None. Asked for water heater sampling. Declined and explained that hot water sample from upstairs bathroom will be representative.

B. Water Quality Observations and Results

- The unit was previously sampled on 29 March 2022.
 - No unusual observations.
 - No detection of organic chemicals.
 - Traces of barium, chromium, copper, and lead were found.
- WQAT & EDWM crew on site, shadowed one trainee. CPLO was represented by a contractor.
 - WQAT collected a water sample from the bathtub faucet for rapid TPH test.
 - The EDWM team collected water samples from the downstairs bathroom sink after removing the GAC filter.
- Results of field testing from kitchen sink:
 - pH not tested (GAC filter upstream)
 - Conductivity 255 μ S/cm (GAC filtered cold water), 71 μ S/cm (RO treated)
 - Free Chlorine 0.20 mg/L (at water heater drain), non-detect in filtered water.
 - Cold Temp 74 °F
 - Hot Temp 126 °F (Kitchen sink)
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Faucet aerators in kitchen and upstairs bathrooms each showed one or two small mineral particles with a light green to dark blue hue, presumed to be copper minerals.



C. Water Heater

- The electric water heater was made in 2003. Resident indicated heater was flushed in the past year. Anode has likely never been replaced.

D. Point-of-Use Treatment

- Under-the-sink GAC filters installed on cold and hot water supplies in kitchens and bathrooms (Pono Revival Kitchen Essential). Product bears NSF logo and vendor claims NSF 42 certification for the removal of taste, odor, and chlorine. Website also claims “maximum reduction” of benzene, haloacetic acids, herbicides, volatile organic chemicals (VOCs), pesticides, and others. Product or vendor was not found in NSF or WQA listings of certified/tested products⁸. Field tests indicated chlorine removal, but effectiveness for reduction of health-related contaminants is questionable.
- Under-the-sink RO system
 - Pono Revival Natural Alkaline Hydrogen-Rich Drinking Water System
 - System installed downstream of GAC filters; utilizes pre-carbon filter, RO cartridge, remineralization cartridge, and post-carbon filter.
 - Field tests showed that the system removes over 70% of dissolved solids and is thus likely effective for removing health-related contaminants.
 - Product or vendor was not found in NSF or WQA listings of certified/tested products.
 - Direct connection of reject water line to sewer drain downstream of trap presents a cross-connection. Advised resident to have installer provide connection with air gap.
- Shower filters installed (Pono Revival High-Capacity Shower Filter). The website claims that the system removes chlorine, chloramine, fluoride, heavy metals, 300+ other contaminants and controls scale, bacteria, and algae. The product is not NSF-certified and effectiveness for removal of health-related contaminants is questionable.
- Residents consume water from water cooler (BRIO Model CLPOU720UVF3) installed downstream of under-the-sink GAC filter. The product is UL-listed, and the installed GAC and sediment filters are NSF 42-certified for chlorine, taste/odor, and nominal particulate reduction.

E. Other Observations

- No hose bib vacuum breakers on outside hose bibs

⁸ System may be a re-branded, certified product.

-
- Could not identify connection or verify backflow protection between potable water and the home irrigation system.

F. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm that fuel-related chemicals are not present.

G. Recommendations

- Follow up with EDWM water quality results when available.
- Review water heater maintenance records, if available. Given the age, strongly recommend replacing the unit.
- No additional actions required.

Monday 6 May 2024, 1000

Zone A3, 5223 Iroquois Ave

(Location Code : A3-IROQ5223)

A. Resident Concerns

- (b) (6) observed)
- Resident for 9 years.
- Health concerns:
 - Residents reported experiencing low grade fever, coughing and congestion, they specifically requested to have the water heater tested. It has been clarified Navy will only sample the hot water from the sink.
- Water Quality Concern:
 - Resident mentioned rare chemical smell.

B. Water Quality Observations and Results

- The unit was previously sampled on 20 October 2023.
 - No unusual observations.
 - No detection of organic chemicals.
 - Traces of barium, copper, lead, and selenium were found.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from bathroom sink for rapid TPH test.
 - EDWM team collected cold water samples from the kitchen sink.
- Results of field testing from kitchen sink:
 - pH 7.38 (cold), 7.49 (hot)
 - Conductivity 260 μ S/cm (cold water), 249 μ S/cm (hot water)
 - Free Chlorine 0.65 mg/L (cold), 0.45 mg/L (hot)
 - Cold Temp 79 °F
 - Hot Temp 114 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Observed scale buildup on faucets and appurtenances. The kitchen faucet aerator was clean – there were a few small mineral particles visible, which appeared to be sand grains. Aerators in bathrooms could not be easily removed due to scale built-up. Advised residents to have them replaced.



C. Hot Water Heater

-
- The gas water heater was made in 2007 according to the serial number. A note on the appliance suggested that it was flushed in 2010 and therefore, it is probably more than 15 years old. The pipe material is copper.

D. Point-of-Use Treatment

- There was a shower filter (“Aquabliss”) installed. The product is not NSF-certified. Resident states that they notice improvements with hair and skin care after showering with filter.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Review water heater maintenance records. While there are no discrete concerns with the appliance affecting aesthetic water quality, given the age, consider replacing the unit.
- No additional actions required.

Wednesday 8 May 2024, 0800

Zone F1, Building X29 ((b) (3))

(Location Code : F1-BLDG0X29)

A. Resident Concerns

- Over 100 people are employed in the building. With personnel in the field, the building may be occupied by only 20+ people during the daytime.
- Health concerns:
 - No specific health concerns.
- Water Quality Concern:
 - Contact person, who has worked onsite for ten years, reported “funny” or metallic taste in breakroom kitchen water dispenser and sink faucet. Stated tingling sensation on tip of tongue, which started Monday morning, and that water has “changed.”

B. Water Quality Observations and Results

- Unit was previously sampled on 22 May 2022
 - No unusual observations.
 - No detections of organic chemicals, except a trace of bromoform, a disinfection byproduct.
 - Traces of barium, chromium, copper, and lead were found.
- WQAT & EDWM crew on site, shadowed by one trainee.
 - WQAT collected cold water samples from bathroom sink for rapid TPH test.
 - EDWM team collected cold water samples from the kitchen sink.
- Results of field testing from kitchen sink:
 - pH 7.34 (cold), 7.44 (hot)
 - Conductivity 250 $\mu\text{S}/\text{cm}$ (cold water), 261 $\mu\text{S}/\text{cm}$ (hot water)
 - Free Chlorine 0.08 mg/L (cold), not detected (hot)
 - Cold Temp 78 °F
 - Hot Temp 111 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water or from water dispenser. No unusual taste or odor detected in dispensed water or ice.
- Observed scale buildup on water/ice dispenser and around kitchen sink.
- The faucet aerator equipped with orifice flow restrictor did not show any buildup of debris.

C. Water Heater

- The electric water heater was not located or examined.

D. Point-of-Use Treatment

- No filters installed on outlets.
- There is a filter installed upstream of the water/ice dispenser (Hoshizaki Ice Maker, Model DCM-270BAH). The water/ice dispenser is 4 to 6 years old. It is

not certain that the appliance has been appropriately maintained. The manufacturer's instructions require periodic maintenance, including frequent cleaning and sanitizing of the appliance.



- The filter (Pentair Everpure i20002, EV9612-22) is installed on the outside wall of the building, exposed to the elements. The filter has last been replaced in May of 2023.

E. Overall Assessment

- The breakroom is located on the side of the large building opposite the service connection. Extended stagnation in the premise plumbing will result in loss of chlorine residual and potential of biofilm growth, which could impact aesthetic water quality.
- Water quality is good, except disinfectant residuals are low. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Advise PWD that the filter should be moved to an air-conditioned space inside the building and that periodic maintenance must be performed on the water/ice dispenser.
- Advised staff to flush faucet and water dispenser Monday mornings.
- No additional actions required.

Wednesday 8 May 2024, 1100

Zone A3, 5778 B Erne Ave

(Location Code: A3-ERNE5778B)

A. Resident Concerns

- [REDACTED] (b) (6)
- Resident for 7 years.
- Health concerns:
 - Resident reported experiencing in 2018 body rashes after showering and has been treated by her physician.
 - Residents use drinking water for cooking and showering only.
- Water Quality Concern:
 - Residents mentioned that the neighborhood sewer continues to back up, and their toilet then overflows, and are concerned that the sewage could be getting into their drinking water.

B. Water Quality Observations and Results

- The unit was previously sampled on 14 August 2023.
 - No unusual observations.
 - No detection of organic chemicals.
 - Traces of barium, copper, lead, and selenium were found.
- Crews on site,
 - WQAT - collected cold water sample from bathroom sinks, shower, and kitchen for rapid TPH test.
 - CPLO - (b) (6)
 - WQIWM - collected hot/cold water samples from kitchen sink.
 - SDWB – n/a
- Results of field testing from kitchen sink:
 - pH
 - 7.5 (cold),
 - 7.6 (hot)
 - Conductivity -
 - 236.821 μ S/cm (cold water),
 - 255.429 μ S/cm (hot water)
 - Free Chlorine -
 - 0.65 mg/L (cold),
 - 0.64 mg/L (hot)
 - Cold Temp 79 °F
 - Hot Temp 114 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.

-
- Observed little scale buildup on faucets. The kitchen faucet aerator was not able to be removed. The master bedroom aerator was clean with scale deposits on the exterior of the faucet.



C. Hot Water Heater

- A 40-gallon gas water heater could not be ascertained. The pipe material is copper.
- Point-of-Use Treatment
- There was a shower filter (Nortex) installed. Was not able to determine if the product was NSF-certified.

D. Overall Assessment

- No unusual observations. Water quality is good. WQIWM results will confirm petroleum not present.

E. Recommendations

- Follow up with WQIWM water quality results when available.
- No additional actions are required.

Monday 13 May 2024, 0800

Zone D2, 1809 19th Way

(Location Code : D2-19TH1809)

A. Resident Concerns

- (b) (6) in the house.
- Resident for 1 year.
- No discrete health concerns. Wanted peace of mind after a recent health issue and could not find pre-LTM water quality sampling results online.
- No water quality concerns. Residents stated that they can smell or taste chlorine.

B. Water Quality Observations and Results

- Unit was previously sampled on 11 January 2022
 - No unusual observations.
 - No detection of organic chemicals.
 - Traces of lead, chromium, barium, copper, selenium found.
- WQAT & EDWM crew on site, shadowed by one trainee.
 - WQAT collected cold water samples from bathroom sink for rapid TPH test.
 - The EDWM team collected water samples from the kitchen sink.
- Results of field testing from kitchen sink:
 - pH 7.21 (cold), 7.61 (hot)
 - Conductivity 251 μ S/cm (cold water), 270 μ S/cm (hot water)
 - Free Chlorine 0.65 mg/L (cold), 0.59 mg/L (hot)
 - Cold Temp 72 °F
 - Hot Temp 132 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- Faucet aerators were clean.

C. Water Heater

- The solar electric water heater was made in 2022. A thermostatic mixing valve is installed between the cold supply and hot water line.

D. Point-of-Use Treatment

- Resident stated kitchen faucet filter installed (PUR, NSF 53 certified) was installed to remove chlorine taste and odor.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- No additional actions required.

Monday 13 May 2024, 1000

Zone A3, 5644A Dovekie Ave

(Location Code : A3-DOVE5644A)

A. Resident Concerns

- Resident for 4 years.
- (b) (6) in the house
- No discrete health concerns. Residents spoke about gastrointestinal issues and past lead poisoning.
- No water quality concerns. Residents do not drink tap water. Resident mentioned recent sewer repair due to backups.

B. Water Quality Observations and Results

- Unit was previously sampled on 11 September 2023
 - No unusual observations.
 - No detections of organic chemicals, other than bis(2-ethylhexyl) phthalate, a plasticizer. The concentration was 2 µg/L, significantly below applicable limits. Source unknown.
 - Traces of chromium, copper, barium, selenium, and lead were found.
- WQAT & EDWM crew on site, shadowed by one trainee.
 - WQAT took bathroom sink cold water samples for rapid TPH test.
 - The EDWM team collected water samples from the kitchen sink.
- Results of field testing from bathroom sink:
 - pH 7.29 (cold), 7.57 (hot)
 - Conductivity 257 µS/cm (cold water), 264 µS/cm (hot water)
 - Free Chlorine 0.65 mg/L (cold), 0.57 mg/L (hot)
 - Temperature 78 °F (cold), 120 °F (hot)
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- No unusual taste or odor detected.
- Faucet aerators were clean.

C. Water Heater

- The gas water heater was made in 2010. Resident does not recall any heater maintenance, other than flushing during emergency phase in early 2022.

D. Point-of-Use Treatment

- None.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- Aging gas water heaters do not yet show signs of leaks or impacts on water quality, but given the age, it should be considered for replacement.
- No additional actions required.

Monday 13 May 2024, 1100

Zone A3, 5651 Dovekie Ave

(Location Code : A3- DOVE5651)

A. Resident Concerns

- (b) (6) in the house.
- Resident for 3 years. No discrete health concerns.
- No water quality concerns since November 2021 when water appeared cloudy.
- Uses bottled water for drinking.

B. Water Quality Observations and Results

- Unit was previously sampled on 14 August 2023
 - No unusual observations.
 - No detections of organic chemicals, other than a trace of bromoform, a disinfection byproduct.
 - Traces of lead, copper, selenium, barium found.
- WQAT & EDWM crew on site, shadowed by one trainee.
 - WQAT collected cold water samples from bathroom sink for rapid TPH test.
 - The EDWM team collected water samples from the kitchen sink.
- Results of field testing from bathroom sink:
- Cold: PH 7.36, 254, 0.65, 78
- Hot 127, 0.34, 270, 7.89
 - pH 7.36 (cold), 7.89 (hot)
 - Conductivity 254 μ S/cm (cold), 270 μ S/cm (hot)
 - Free Chlorine 0.65 mg/L (cold), 0.34 mg/L (hot)
 - Cold Temp 78 °F
 - Hot Temp 127 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water.
- No taste or odor detected in hot or cold water.
- Faucet aerators were clean. Calcite built-up was observed at all outlets.



C. Water Heater

- The gas water heater was made in 2023 and installed less than 6 months ago.

D. Point-of-Use Treatment

- None.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- No additional actions required.

Friday 17 May 2024, 0830

Zone A3, 6632B 105th St

(Location Code: A3-105S6632B)

A. Resident Concerns

- (b) (6) at home for two years. Previously lived on the (b) (6).
- Health concerns: Residents experiencing burning sensation during shower, dry, itchy scalp, GI issues since moving in. Residents have not sought medical care.
- Water Quality Concern:
 - Occasional chemical smell when turning on shower.

B. Water Quality Observations and Results

- Unit has not been sampled before.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from the hall bathroom and kitchen for rapid TPH test.
 - The EDWM team collected water samples from the kitchen sink.
- Results of WQAT field testing from hall bathroom sink:
 - pH 7.22 (cold), 7.60 (hot)
 - Conductivity 258 μ S/cm (cold), 260 μ S/cm (hot)
 - Free Chlorine 0.76 mg/L (cold), 0.25 mg/L (hot)
 - Cold Temp 76.4 °F
 - Hot Temp 140 °F (!)
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water. There was metallic taste initially after turning on the cold water. After brief flushing no unusual taste or odor was detected.
- Observed some calcite scale buildup on faucets. The aerators were clean.

C. Water Heater

- The electric water heater was made in 2021.

D. Point-of-Use Treatment

- No filters installed.

E. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

F. Recommendations

- Follow up with EDWM water quality results when available.
- No additional actions required.

Friday 17 May 2024, 1015

Zone WL, Building 432 ((b) (3))

(Location Code: WL-BLDG0432)

A. Resident Concerns

- (b) (3) is occupied 24/7.
- Health concerns: None
- Water Quality Concerns: Recent discolored water due to service line repair

B. Water Quality Observations and Results

- The building has not been sampled before.
- WQAT & EDWM crew on site, shadowed by two trainees.
 - WQAT collected cold water samples from the kitchen sink for rapid TPH test.
 - The EDWM team collected water samples from the kitchen sink.
- Results of WQAT field testing from bathroom sink:
 - pH 7.35 (cold), 7.35 (hot)
 - Conductivity 249 $\mu\text{S}/\text{cm}$ (cold), 267 $\mu\text{S}/\text{cm}$ (hot)
 - Free Chlorine 0.45 mg/L (cold), 0.26 mg/L (hot)
 - Cold Temp 79.8 °F
 - Hot Temp 128 °F
- No sheen, particles, discoloration, or cloudiness observed in hot or cold water. No unusual taste or odor detected.
- Observed calcite scale buildup on all appurtenances, sinks, toilets, urinals as well as green-brown staining, presumably arising due to growth of airborne microorganisms.



- The faucet aerator in kitchen was clean, but aerators on four faucets in the bathroom presented significant buildup of debris resembling dirt and rust. The particulate matter may be a result of the recent service line repair or could be due to interior corrosion of the water heater.



C. Water Heater

- The electric water heater was made by A.O. Smith. No manufacturing date was indicated on the label. WQI noted the serial number to determine the age of the appliance. There were rust spots at the bottom of the heater, suggesting past leakage.



D. Point-of-Use Treatment

- Point-of-use filters are installed at the ice machine and the water fountain. The ice machine and filter (Arctic Pure Plus AR-10000P) was recently installed and is maintained by NAVFAC. The product or replacement cartridge was not found in the NSF database. The water fountain filter (Everpure QC4 with EV9615-50 cartridge) was installed by the building occupants, and the product is NSF-certified under Standard 42, 53, and 401. The cartridge has not been replaced since December 2023. Another filter was installed in the corner of the fire truck bays but is no longer used.

E. Other observations

- Only one of the four exterior hose bibbs had a vacuum breaker installed. The spouts of the two faucets at the outdoor utility sink are installed too low, presenting potential cross connections.



F. Overall Assessment

- No unusual observations. Water quality is good. EDWM results will confirm petroleum not present.

G. Recommendations

- Follow up with EDWM water quality results when available.
- Determine the water heater age and consider replacing the unit.
- Address cross connection concerns.
- No additional actions required.