FINAL

Supplement A Tier 2 Analysis of Total Petroleum Hydrocarbons (TPH) and Fuel Indicator Compounds

Joint Base Pearl Harbor-Hickam Public Water System
#HI0000360 and Aliamanu Military Reservation PWS
#HI0000337
O‘ahu, Hawai‘i

October 2024

Supplement A: Tier 2 Analysis of Total Petroleum Hydrocarbons (TPH) and Fuel Indicator Compounds

Introduction

The U.S. Navy has developed a detailed program (i.e., Tier 2 Analysis) that is described in this Supplement for evaluating petroleum indicator compounds that are not regulated under the Safe Drinking Water Act (i.e. those petroleum indicator compounds evaluated under Course of Action #3 in the Navy's Extended Drinking Water Program (EDWM) for Joint Base Pearl Harbor-Hickam (JBPHH)). This Supplement and the associated attachment (i.e., Attachment 1) are not included within the EDWM Plan, which has been incorporated into the 2023 Administrate Consent Order between the Navy and the U.S. Environmental Protection Agency (EPA)). Tier 2 Analysis is voluntary and may be followed to perform additional, detailed analyses of TPH and/or JP-5 indicator compounds detections. The complexity and analytical resolution increases in each tier. Not all locations will proceed to Tier 2.

Tier 2

Tier 2 is summarized below, followed by a detailed description of the Standard Operating Procedures (SOPs):

- **Tier 2**: Includes a quantitative evaluation of petroleum hydrocarbons and other Fuel Indicator Compounds using advanced analytical methods. Drinking water samples will be analyzed using detailed, forensic methods (see Table 1- 1):
    - EPA Method 8260D – Paraffins, Isoparaffins, Aromatics, Napthenes and Olefins (PIANO)
    - EPA 8270E-SIM – PAHs and alkylated-PAHs
    - EPA 8015D – Saturated Hydrocarbons

  A quantitative evaluation of the human health risks associated with potential exposure to these constituents in drinking water will be performed.

Table 1-2 presents the criteria for determining when the Tier 2 analysis will be performed. The detailed

SOP for Tier 2 is summarized below:

1. Follow Steps presented in COA #3 in the EDWM.

Tier 2 Analysis: Perform Quantitative Evaluation of Petroleum Hydrocarbons or Fuel Indicator Compounds [1]

1. Perform a detailed quantitative analysis by a forensic laboratory using the additional sample volume.[2] The target analyte list for PIANO, PAHs/Alkylated PAHs, and Saturated Hydrocarbon analyses is presented in Table 1-3. This list is based on the analytes that were detected in 16 samples that were collected on 03 July 2023 from seven tanks at the Navy's Red Hill Bulk Fuel Storage Facility (RHBFSF) that stored JP-5 jet fuel (i.e. Tank 07, Tank 08, Tank 09, Tank 10, Tank 11, Tank 12, and Tank 20). Only a subset of the analytes detected are soluble in water.
   Process: The human health risk evaluation will be performed using the results of the PIANO, PAHs/Alkylated PAHs, and Saturated Hydrocarbon analyses. The purpose of this evaluation is to estimate the risk to human health associated with petroleum hydrocarbons at locations where JP-5/other fuel-related analytes have been detected and were not conclusively identified as "naturally occurring" hydrocarbons under Tier 1. The SOP for conducting the risk evaluation, including the assumptions made for developing the risk model and decision criteria are presented in Attachment 1.

❖ **Decision Rule**: Multiple lines of evidence will be evaluated, and the results will be documented in a Technical Memorandum (Tech Memo). Additional lines of evidence include evaluating drinking water results spatially. For example, if TPH were detected at a residence location, the evaluation would include reviewing the TPH results from drinking water samples at neighboring houses (if available) collected during that sampling period.

[1] This step will only be reached if the Total TPH detected is 1) potentially petrogenic and 2) is not TPH-O (i.e., the Total TPH is potentially JP-5/other fuel-related analytes) based on Tier 1.

[2] If the extra sample volume is not within the required holding time, resampling may be required.

If TPH was detected at a hydrant, then drinking water results from an upgradient and downgradient hydrant will be evaluated to determine if this is a location-specific issue or a distribution system issue. Additional sampling (e.g., bracketed residential sampling, bracketed sampling of hydrants) may be required. If the results of the human health risk evaluation of the PIANO, PAHs/Alkylated PAHs, and Saturated Hydrocarbon analyses are within acceptable limits presented in Attachment 1 no further analysis/documentation is needed. Otherwise, the Navy will consult with EPA/DOH for next steps (e.g., flushing/resampling, appliance replacement, water heater replacement, et cetera).

TABLE 1-1: SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Analytical Method	Container	Preservative	Holding Times (Extraction/ Analysis)
PIANO VOCs	5030C/8260D	2 x 40 mL Glass VOA	25 mg Ascorbic / 3 drops HCl	14 days
PAHs/Alkylated PAHs	3510C (Methylene chloride)/8270E -SIM	2 x 1 L Amber Glass	Quench with Sodium Thiosulfate (added to sample container prior to sample collection).	7 days to extraction/ 40 days extraction to analysis
Saturated Hydrocarbons	3510C (Methylene chloride)/8015 D	2 x 1 L Amber Glass	Quench with Sodium Thiosulfate (added to sample container prior to sample collection).	7 days to extraction/ 40 days extraction to analysis

Note: All samples will be chilled to < 6°C, unless otherwise noted.

EPA Method 8015 is not a drinking water method and is typically run on unchlorinated water samples. However, the JBPHH drinking water samples are chlorinated. Therefore, EDWM samples will be quenched with sodium thiosulfate prior to sample collection to stop reactions from occurring between chlorine, potential analytes, and reagents added to the sample by the laboratory.

TABLE 1-2: SUMMARY OF NUMBER OF TIER 1/TIER 2 EVALUATIONS FORECASTED FOR EDWM

Tier Trigger	Required Number of Locations	Maximum Number of Tiered Analyses Performed
Tier 2: EDWM locations with 8015 MEQ TPH results and/or 8260 TPH-G results > MRL and Triggered by Tier 1	None required unless triggered by Tier 1	200 locations
Tier 2: Locations with a previous 8015/ 8260 TPH detection (using non- quenched/separatory funnel preparatory method) result > 50 µg/L during LTM	50 Required regardless of the outcome of Tier 1. These locations will be spatially and temporarily (i.e., locations will be sampled over the duration of EDWM) distributed throughout the JBPHH System and representative of the range of TPH concentrations detected during LTM	50 locations

TABLE 1-3: MRLS/MDLS FOR PIANO, PAH/ALKYL PAH, AND SATURATED HYDROCARBONS ANALYSES

Method	CAS_NO	ANALYTE	Surrogate Analyte for Target Reporting Level (Noted, if used)	Detected in 03 July 2023 JP-5 Product Samples from Red Hill Tanks?[3]	Maximum Target Reporting Level (µg/L)[4]	MRL (µg/L)	MDL (µg/L)
APAH	83-32-9	Acenaphthene		TRUE	53	0.01	0.00128
APAH	208-96-8	Acenaphthylene	TPHs (Aromatic High)	TRUE	0.60	0.01	0.002
APAH	120-12-7	Anthracene		TRUE	180	0.01	0.00181
APAH	92-52-4	Biphenyl		TRUE	0.083	0.01	0.00233
APAH	132-65-0-C1	C1-Dibenzothiophenes BS	TPHs (Aromatic High)	TRUE	0.60	0.01	0.00146
APAH	86-73-7-C1	C1-Fluorenes	Fluorene	TRUE	29	0.01	0.00177
APAH	91-20-3-C1	C1-Naphthalenes	Naphthalene	TRUE	0.012	0.01	0.00197
APAH	132-65-0-C2	C2-Dibenzothiophenes	TPHs (Aromatic High)	TRUE	0.60	0.01	0.00146
APAH	86-73-7-C2	C2-Fluorenes	Fluorene	TRUE	29	0.01	0.00177
APAH	91-20-3-C2	C2-Naphthalenes	Naphthalene	TRUE	0.012	0.01	0.00197
APAH	132-65-0-C3	C3-Dibenzothiophenes	TPHs (Aromatic High)	TRUE	0.60	0.01	0.00146
APAH	86-73-7-C3	C3-Fluorenes	Fluorene	TRUE	29	0.01	0.00177
APAH	91-20-3-C3	C3-Naphthalenes	Naphthalene	TRUE	0.012	0.01	0.00197
APAH	91-20-3-C4	C4-Naphthalenes	Naphthalene	TRUE	0.012	0.01	0.00197
APAH	132-65-0	Dibenzothiophene	TPHs (Aromatic High)	TRUE	0.60	0.01	0.00146
APAH	86-73-7	Fluorene		TRUE	29	0.01	0.00177
APAH	91-20-3	Naphthalene		TRUE	0.012	0.01	0.00197
APAH	85-01-8	Phenanthrene	TPHs (Aromatic High)	TRUE	0.60	0.01	0.0012
PIANO	488-23-3	1,2,3,4-Tetramethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.214
PIANO	527-53-7	1,2,3,5-Tetramethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.152
PIANO	526-73-8	1,2,3-Trimethylbenzene		TRUE	5.5	2	0.223
PIANO	95-93-2	1,2,4,5-Tetramethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.155
PIANO	95-63-6	1,2,4-Trimethylbenzene		TRUE	5.6	2	0.207
PIANO	135-01-3	1,2-Diethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.296
PIANO	933-98-2	1,2-Dimethyl-3-Ethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.127
PIANO	934-80-5	1,2-Dimethyl-4-Ethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.245
PIANO	6876-23-9	1,2-Dimethylcyclohexane (trans)	TPHs (Aliphatic Low)	TRUE	2.80	2	0.294
PIANO	108-67-8	1,3,5-Trimethylbenzene		TRUE	6.0	2	0.23
PIANO	141-93-5	1,3-Diethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.249
PIANO	2870-04-4	1,3-Dimethyl-2-Ethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.149
PIANO	874-41-9	1,3-Dimethyl-4-Ethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.194
PIANO	934-74-7	1,3-Dimethyl-5-Ethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.236
PIANO	2532-58-3	1,3-Dimethylcyclopentane (cis)	TPHs (Aliphatic Low)	TRUE	2.8	2	0.301
PIANO	1758-88-9	1,4-Dimethyl-2-Ethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.187
PIANO	2207-04-7	1,4-Dimethylcyclohexane (trans)	TPHs (Aliphatic Low)	TRUE	2.8	2	0.26
PIANO	611-14-3	1-Methyl-2-Ethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.17
PIANO	527-84-4	1-Methyl-2-Isopropylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.217
PIANO	1074-17-5	1-Methyl-2-N-Propylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.249

Method	CAS_NO	ANALYTE	Surrogate Analyte for Target Reporting Level (Noted, if used)	Detected in 03 July 2023 JP-5 Product Samples from Red Hill Tanks?[3]	Maximum Target Reporting Level (µg/L)[4]	MRL (µg/L)	MDL (µg/L)
PIANO	620-14-4	1-Methyl-3-Ethylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.316
PIANO	535-77-3	1-Methyl-3-Isopropylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.258
PIANO	1074-43-7	1-Methyl-3-N-Propylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.202
PIANO	99-87-6	1-Methyl-4-Isopropylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.212
PIANO	1074-55-1	1-Methyl-4-N-Propylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.25
PIANO	90-12-0	1-Methylnaphthalene		TRUE	0.11	**5**	**1.47**
PIANO	3074-71-3	2,3-Dimethylheptane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.228
PIANO	589-43-5	2,4-Dimethylhexane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.243
PIANO	2216-30-0	2,5-Dimethylheptane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.335
PIANO	91-57-6	2-Methylnaphthalene		TRUE	3.6	**5**	1.32
PIANO	871-83-0	2-Methylnonane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.283
PIANO	3221-61-2	2-Methyloctane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.512
PIANO	4032-86-4	3,3-Dimethylheptane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.242
PIANO	4110-44-5	3,3-Dimethyloctane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.202
PIANO	922-28-1	3,4-Dimethylheptane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.34
PIANO	926-82-9	3,5-Dimethylheptane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.282
PIANO	589-81-1	3-Methylheptane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.385
PIANO	589-34-4	3-Methylhexane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.32
PIANO	5911-04-6	3-Methylnonane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.279
PIANO	2216-33-3	3-Methyloctane	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.224
PIANO	589-53-7	4-Methylheptane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.344
PIANO	2216-34-4	4-Methyloctane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.334
PIANO	110-82-7	Cyclohexane		TRUE	1,300	2	0.247
PIANO	124-18-5	Decane (C10)	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.271
PIANO	112-40-3	Dodecane (C12)	TPHs (Aliphatic High)	TRUE	6000	5	0.657
PIANO	100-41-4	Ethylbenzene		TRUE	0.15	**2**	**0.216**
PIANO	1640-89-7	Ethylcyclopentane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.265
PIANO	142-82-5	Heptane		TRUE	0.60	**2**	0.348
PIANO	1077-16-3	Hexylbenzene	TPHs (Aromatic High)	TRUE	0.60	**2**	0.385
PIANO	95-13-6	Indene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.116
PIANO	538-93-2	Isobutylbenzene	TPHs (Aromatic Medium)	TRUE	5.7	2	0.27
PIANO	98-82-8	Isopropylbenzene		TRUE	45	2	0.187
PIANO	3875-51-2	Isopropylcyclopentane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.293
PIANO	108-87-2	Methylcyclohexane		TRUE	20.00	2	0.27
PIANO	96-37-7	Methylcyclopentane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.268
PIANO	104-51-8	n-Butylbenzene		TRUE	100	2	0.197
PIANO	110-54-3	n-Hexane		TRUE	150	2	0.329
PIANO	111-84-2	Nonane (C9)		TRUE	0.53	**2**	0.311
PIANO	103-65-1	n-Propylbenzene		TRUE	66	2	0.177
PIANO	111-65-9	Octane	TPHs (Aliphatic Low)	TRUE	2.8	2	0.235
PIANO	629-62-9	Pentadecane	TPHs (Aliphatic High)	TRUE	6000	5	1.12

Method	CAS_NO	ANALYTE	Surrogate Analyte for Target Reporting Level (Noted, if used)	Detected in 03 July 2023 JP-5 Product Samples from Red Hill Tanks?[3]	Maximum Target Reporting Level (µg/L)[4]	MRL (µg/L)	MDL (µg/L)
PIANO	135-98-8	sec-Butylbenzene		TRUE	200	2	0.259
PIANO	98-06-6	tert-Butylbenzene		TRUE	69	2	0.211
PIANO	629-59-4	Tetradecane (C14)	TPHs (Aliphatic High)	TRUE	6000	5	0.612
PIANO	108-88-3	Toluene		TRUE	110	2	0.271
PIANO	629-50-5	Tridecane	TPHs (Aliphatic High)	TRUE	6000	5	1.39
PIANO	1120-21-4	Undecane	TPHs (Aliphatic High)	TRUE	6000	2	0.222
PIANO	1330-20-7	Xylene (Total)1		TRUE	19	2	0.209
SHC	3891-98-3	2,6,10-Trimethyldodecane (1380)	TPHs (Aliphatic High)	TRUE	6000	1	0.098
SHC	3891-99-4	2,6,10-Trimethyltridecane (1470)	TPHs (Aliphatic High)	TRUE	6000	1	0.144
SHC	124-18-5	n-Decane (C10)	TPHs (Aliphatic Medium)	TRUE	10.0	2	0.271
SHC	112-40-3	n-Dodecane (C12)	TPHs (Aliphatic High)	TRUE	6000	5	0.657
SHC	629-78-7	n-Heptadecane (C17)	TPHs (Aliphatic High)	TRUE	6000	1	0.136
SHC	544-76-3	n-Hexadecane (C16)	TPHs (Aliphatic High)	TRUE	6000	1	0.149
SHC	111-84-2	n-Nonane (C9)		TRUE	0.53	**2**	0.311
SHC	593-45-3	n-Octadecane (C18)	TPHs (Aliphatic High)	TRUE	6000	1	0.08
SHC	3892-00-0	Norpristane (1650)	TPHs (Aliphatic High)	TRUE	6000	1	0.136
SHC	629-62-9	n-Pentadecane (C15)	TPHs (Aliphatic High)	TRUE	6000	5	1.12
SHC	629-59-4	n-Tetradecane (C14)	TPHs (Aliphatic High)	TRUE	6000	5	0.612
SHC	629-50-5	n-Tridecane (C13)	TPHs (Aliphatic High)	TRUE	6000	5	1.39
SHC	1120-21-4	n-Undecane (C11)	TPHs (Aliphatic High)	TRUE	6000	2	0.222
SHC	1921-70-6	Pristane	TPHs (Aliphatic High)	TRUE	6000	1	0.175

Notes:

[3] These analytes were detected in 16 samples that were collected on 03 July 2023 from seven tanks at Red Hill that stored JP-5 (i.e., Tank 07, Tank 08, Tank 09, Tank 10, Tank 11, Tank 12, and Tank 20).

[4] Target Reporting Level based on November 2023 Residential Tap Water Regional Screening Levels based on a cancer risk of 1E-07 and/or a hazard quotient of 0.1. Surrogate analytes identified, where used.

Bold and Blue Shaded Values exceed the Maximum Target Reporting Limit.

Supplement A: SOPs

Drinking Water Sample Collection SOP, Part A - Headspace, Sheen Observation and Free Chlorine

Scope – The purpose of this SOP is to ensure the sample collection and observation process is performed in a manner consistent with requests made by both EPA and Hawaii State Department of Health.

- **Procedure** – Prior to the collection of drinking water samples, a headspace, sheen observation, free chlorine test, and water quality parameters test (that includes temperature, pH, conductivity, and turbidity) must be taken.
    - Sink choice –
        - Choose the sink that is highest and farthest from the water distribution source (ex: an upstairs sink). If that sink is too shallow, check for other sinks that are far and high from the source. If those are also too shallow, use a lower-level sink (such as the kitchen sink). If all sinks in the house/building are too shallow, go back to the highest and farthest sink and use a 250 mL unpreserved bottle to transfer water from the sink to the large bottles. The 250 mL unpreserved should have never been used for any other sample and should not be used after for any other sample. If the house/building is single story, use any kitchen or bathroom sink. Document the reason behind deviation from the highest and farthest sink in your logbook if applicable.

    - Check for fixture filters as well as inline filters and water heaters –
        - First, check the sample point water fixture for any filters and remove if present.
        - Then, trace the water lines below the sink to ensure the cold-water source is directly connected to the tap, i.e., there is no inline filter or water heater.
        - If filter cannot be removed or bypassed, choose another sink

    - Isolate cold water –
        - Isolate the cold-water source by closing off the hot water valve. If the sink is not a mixer, the cold-water is already isolated.
        - If unable to isolate the cold-water source, move to a new sample location.
        - If no other sample location is viable, monitor water temperature while taking the sample. Note this in the logbook as “cold water monitored”. If water is not cold and cannot be isolated, contact team support for next steps.

    - If sampling from a kitchen sink, check that the dishwasher is not running. If it is running, ask the resident to turn it off for the sample collection.

- Pre-sampling preparation –
    - Clear sampling area of any potential volatile sources (hand soaps, dishwashing soap, air fresheners, etc.) within the immediate vicinity of the tap/spigot and sample bottle staging area. Don a new pair of gloves if they become contaminated.
    - Place several sheets of paper towels or an absorbent pad on a suitable flat surface such as a counter-top or the floor.
    - Place the sample containers on the paper towels/absorbent pad.

- Remove aerator and achieve laminar flow –
- Remove any aerator, spray nozzle, or detachable parts from the sample faucet.
    - To remove simple screen aerators from faucets, begin by twisting off by hand. If the aerator is lodged, protect the aerator from damage by covering it with a paper towel or glove, and use the sample kit pipe wrench to twist off aerator.
    - If a key is required, use the removal tool in the sampling kit. Invert the tool to face the aerator, align the notches, and twist while applying upwards pressure.
    - If the faucet has a sprayer or removable head, pull the hose from the sink and tie a glove around the hose or use a clamp to prevent it from retracting back into the sink. Twist off the head or sprayer.
- Ensure there are no rubber gaskets or pieces left behind. **Note**: The rubber gasket will sometimes stick to the faucet. Remove this before turning water on to prevent it falling down the drain. ‘
- Adjust the flow rate to approximately 500 mL/minute (approximately 0.5 cm diameter stream or the width of a BIC pen). Adjust the faucet stream until the flow is smooth and uniform, with a glassy appearance. The flow should be laminar and should not appear agitated or white with air bubbles.

- Headspace observation –
- Using a calibrated PID, take a PID reading in the vicinity of the drinking water sampling point (within 2 feet) and record the results in the logbook. Record any presence of odor and note any potential sources of the odor. **Consult with a project manager prior to sampling if ambient room reading is ≥ 2.0 ppm.**
- Proceed to Sheen observation.
- Sheen observation –
    - Rinse unpreserved 40-milliliter (mL) VOA vial with water from the drinking water sampling point 3 times.
- After rinsing, fill the VOA vial half-way, avoiding agitating the water inside the vial, and close the vial tightly.
- Lay the VOA vial horizontally on a paper towel and observe the surface of the water. Record sheen and odor observations under “I*nitial Observations*” in the logbook—photograph the vial if sheen is present.

- Let the VOA vial rest undisturbed for at least 1 minute before re-observing. Observe the surface of the water, noting sheen or discoloration and record your observations in the logbook under "*Final Observations*". If a sheen or film is observed, photograph observations and notify the project manager and field manager. Also, in the *"Final Observations"* section, note whether there was an odor or not after letting the vial rest.
- Once the analysis is concluded, the water can be discarded into the sink. If no sheen is observed, the empty VOA vial can be reused at the next location. If a sheen is observed, dispose of the VOA vial with the discarded PPE.
- Headspace observation –
- Quality control for Headspace and Sheen – In order to have consistency in the headspace and sheen analysis, it is critical to let the sheen VOA vial rest for a minimum of 1 minute. This gives time for any chemicals dissolved in the water to migrate out and float to the surface.

    - Free Chlorine Analysis –
        - Review the Safety Data Sheet for the DPD Free Chlorine Reagent Powder Pillows and ensure the proper PPE is in use. Review the colorimeter operator's manual.
        - Power on the colorimeter.
        - Set the instrument to low range by pressing the up arrow (triangle) button so the triangle is under **LR** on the instrument screen (Low Range).
        - Zero the colorimeter
            - Prior to collecting the Free Chlorine sample, rinse the sample cell and cap 3 times with water from the drinking water sampling point. Discard water into sink each time.
            - Fill the cell to the 10 mL mark and cap the sample cell. Clean and dry the outside of the sample cell with a lint free cloth.
            - Insert the sample into the cell holder ensuring the diamond mark on the cell is lined up with the triangle mark on the meter (facing the meter).
            - Insert the instrument cap over the cell holder.
            - Push **ZERO** (Blue button on the left of the meter), the display should show 0.00.
        - Take the chlorine measurement
            - Remove the sample cell from the meter and place on a flat surface. Remove the cap. Carefully open the DPD Free Chlorine Reagent Powder Pillow and add the entire contents to the sample and close the sample cell with the cap.
            - Invert the sample cell several times for 20 seconds to mix, a pink color will develop if chlorine is present.
            - Take a reading within 1 minute.
            - While timing the mixture, clean the cell with a lint free cloth and place the cell in the meter making sure the diamond on the cell is lined up with the triangle on the meter.

        - Press the green button with the check mark on the righthand side of the meter and record the results in the logbook in mg/L.
    - If the chlorine measurement is less than 0.02 mg/L, repeat free chlorine analysis after the 5-minute flush required prior to bacterial (total coliform/heterotrophic plate count) sample collection (see field SOP part B). If it is still less than 0.02 mg/L after a 5-minute flush, record that the free chlorine value is lower than the expected value in your logbook and proceed with sampling.
    - If the screen on the meter is blinking, that is an indication the Free Chlorine concentration is greater than 2.0 mg/L and a dilution of the sample is required.
        - Immediately decant the contents of the sample cell and rinse the sample cell and cap 3 times with the water to be analyzed and 2 times with deionized water.
        - Prepare a 1:1 dilution of the sample by decanting 50 mL of sample into a 100 mL beaker and add 50 mL of distilled water, swirl the mixture and decant into the 10 mL cell to the 10 mL mark and repeat the analysis.
        - Take the reading from the meter and multiply the result by 2 and record on the field form.
        - If the analysis is still over range, prepare a 1:4 dilution by adding 25 mL of sample to the beaker and 75 mL of distilled water. Multiply the results by 4 and record on the field form.

    - After taking the Free Chlorine Analysis, dispose of solution in sink. Be sure to rinse the bottom of the sink to avoid pink staining. Rinse the sample cell 3 times before stowing as residue can discolor the sample cells.

- Water Quality Parameters Test -
    - Ensure the proper PPE is in use and review the Aqua TROLL 600 Multiparameter Sonde operator's manual.
    - Decontamination
        - Prior to collecting Water Quality Parameters, rinse a 250 ml amber transfer bottle 3 times using tap water from the sample point
        - Unscrew the black cap from the AT600 and remove the sponge, or dump out left over calibration water, from sample cell.
        - Rinse the sample cell 3 times using the 250 ml bottle that was decontaminated in the first step discarding water from cell into the sink after each rinse.
        - After rinsing, double check no debris is present (ex. sponge particles).
    - Power on and Pair the AT600

        - Power on the AT600 either by slightly unscrewing the black portion of the body from the center or by turning it upside down with metal hanger facing up.
        - The screen will turn blue when the device is on, and it is ready to be paired to a smart phone via Bluetooth using the Vu-Situ App.
        - Select the appropriate AT600 serial number prompted in the Vu-Situ App for pairing.
    - Take the Water Quality Parameters Measurement
        - In the Vu-Situ app select the "*Live Readings*" option.
        - Once on the *"Live Readings"* page, change the recording mode by selecting the camera image in the bottom left corner—the yellow toggle button on the bottom right corner should read *"Save Single Reading"*.
        - Above the parameters, click on "*Change Location"* and input the sample ID as the name.
        - Set "*Refresh Rate"* to 1 second
- On the parameter screen, check the following measurements and adjust units as needed such that parameters reflect the following:
- PH
- Range: 6.5-8.5
- Specific Conductivity (µS/cm)
- Range: 50-50,000 µS/cm
- Turbidity (NTU)
- Range: <5NTU
- Temperature (°C)
- Fill the sample cell until the brush is fully submerged.
- After filling the sample cell, let 30 seconds elapse before collecting "stabilized parameters"
- If parameters fall outside of the range listed above, rinse your sample cell three times and let the Aquatroll parameters restabilize.
    - If restabilized parameters remain outside of the range listed above, recalibrate Aquatroll sensors as needed. Note in logbooks that the Aquatroll was recalibrated and record new stabilized parameters.
- Once parameters have stabilized, click on the "S*ave Single Reading"* button on the bottom right corner. If measurements are outside of the expected range, note this in your logbook.
- Double check parameters have been recorded by clicking on the upper left 3 bars and selecting data files. Parameters should be saved in the Snapshot file associate with the sample date (ex. TeamA_Snapshot – 04/12/2024)

- At the end of the day, you will save this file and send it to the QC/Intake team. The title will include your team name and date (ex. Team A_20240412)

You are now prepared for sample collection. Refer to Drinking Water Sample Collection SOP, Part B – Sample Collection

Drinking Water Sample Collection SOP, Part B – Sample Collection

Scope – The purpose of this SOP is to ensure the sample collection process is performed in a manner consistent with requests made by both EPA and Hawaii State Department of Health.

Procedure – Once the headspace/sheen observations and free chlorine tests have been performed and recorded according to Part A, samples can be collected for shipment to the designated analytical laboratory. Samples should be collected in the order listed below referencing the required bottleware chart on the last page.

Pre-sampling preparation – Place the sample containers to be filled on the towel used in Part A. Check to ensure all required sample preservatives are available for each container. See Bottle Container Checklist (Part B). Do not rinse any of the bottles. No bottleware should be reopened after filling.

- Collect the samples for EPA Methods **8260 PIANO VOCs + TICs**
  - Remove cap and tilt the vial so the flow falls on the interior surface of the vial, do not shake or agitate. Fill to the neck of the vial (about 75% full).
  - Add 3 drops of HCl to the vial, then add more sample until a convex meniscus is formed, but do not overfill. Cap the vial.
  - Once the vial has been sealed, turn the vial upside down and look for the presence of bubbles. If any bubbles are present greater than half the size on a pea, re-collect the sample. DO NOT add additional sample. If there are no bubbles, repeat the process until all the vials have been filled.

- Collect the sample for EPA Method **8270SIM Parent and Alkylated PAHs + TICs and 8015 Saturated Hydrocarbons**
  - Remove cap and tilt the bottle so the flow falls on the interior surface of the bottle, do not shake or agitate.
  - Fill the bottle to the neck of the bottle. Replace the cap.

Take note of any color or odor associated with the sample and document. Complete the COC. Record the date as MM/DD/YYYY and time using universal (military) time. Affix the sample label to the bottles/vials, affix the custody seal to the bottles/vials, place the bottles/vials in the laboratory provided bubble wrap or equivalent and then place in a zip lock bag. Place the samples into a cooler with ice.

Analysis	Bottle Type and Number	Preservative in Bottle	Preservative Added in Field	RE/Priority Buildings	Resident Requests	Hydrants	Waiawa Shaft pre and post chlorination	NAH Shaft pre chlorination	Red Hill pre chlorination
PIANO VOCs + TICs (EPA 8260)	3 X 40 mL Clear Vial	Ascorbic Acid	HCl	x	x	x	x/x	x	x
Parent and Alkylated PAHs (EPA 8270 SIM) + TICs and Saturated Hydrocarbons (EPA 8015)	2 X 1L Amber Glass	Na2S2O3	None	x	x	x	x/x	x	x

Attachment 1 to Supplement A: Risk Evaluation Protocol

Risk Evaluation Protocol for Tier 2 Quantitative Evaluation of Petroleum Hydrocarbons

PREFACE: There are practical/technical challenges associated with collecting/performing Tier 2 analysis on drinking water samples. These challenges can be overcome but they are not insignificant. This is especially important because in order to perform a human health risk evaluation of the resulting data – we need to have representative, reproducible, and quality assured data (see Attachment 1 for more information). The Tier 2 analysis being proposed (i.e., Total Petroleum Hydrocarbon [TPH] Fingerprinting) is typically performed on pure product samples (i.e., fuel samples from refineries) or highly contaminated environmental samples (e.g., fuel-saturated soil, groundwater with free product) with very, very high (i.e., %) concentrations. Very few laboratories perform this type of fingerprinting analysis; laboratories that do perform this analysis are familiar with analyzing highly contaminated samples. This is a very important point because under Tier 2 we will be asking them to analyze drinking water samples with extremely low-levels (sub parts per billion) of soluble phase, TPH. This is like analyzing Apples and Oranges. In order to obtain the data quality required by the human health risk evaluation, the laboratory will need to provide reliable Tier 2 data in the sub-part per billion range to part per trillion range – not very high (% concentrations) they are accustomed to.

This will require the laboratory to:

1. Demonstrate accurate and precise identification/quantification of Tier 2 analytes.
2. Achieve low-level, risk-based Method Detection Limits (MDLs) and Method Reporting Limits (MRLs).
3. Ensure that blank (e.g., method blanks, field blanks, blind blanks) contamination is not present (i.e., is non- detect) or if it is present that concentrations are below risk-based goals.

Purpose

The purpose of this technical memorandum (memo) is to document the steps and assumptions that will be used to conduct a risk evaluation as part of Course of Action (COA) 3 – Detection of Total Petroleum Hydrocarbon (TPH) via Method 8015/8260 of the Extended Drinking Water Monitoring (EDWM) Program. The risk evaluation will be performed using the results of the following:

1. EPA Method 8260D: Paraffins, Isoparaffins, Aromatics, Naphthenes, and Olefin (PIANO)
2. EPA Method 8270E-SIM: Polycyclic Aromatic Hydrocarbons (PAHs)/Alkylated PAHs (Alkyl-PAHs), and
3. EPA Method 8015D: Saturated Hydrocarbons.

The purpose of this evaluation is to estimate the risk to human health to support the Tier 2 Quantitative Evaluation of Petroleum Hydrocarbons.

The steps described in this protocol are based on well-established, scientific methods recommend by the EPA to evaluate the potential for impacts to human health associated with exposure to constituents in contaminated media (e.g., tap water). Risk Assessment is a management decision tool; it does not evaluate nor does it provide information about actual health effects. Risk assessments focus on hypothetical (but realistic) upper-bound exposures to constituents and complete exposure pathways for a Site (in this case, the JBPHH Drinking Water System). Risk managers use the results of the risk evaluation to determine if further investigation or action is needed.

Human Health Risk Evaluation Process

The human health risk evaluation will be conducted in accordance with the United States Environmental Protection Agency (EPA) Risk Assessment Guidance for Superfund (RAGS)[1] and the United States Navy Human Health Navy Risk Assessment Guidance.[2] The primary steps of this risk evaluation include:

- Step 1: Hazard Identification and Data Evaluation and Reduction
- Step 2: Exposure Assessment
- Step 3: Toxicity Assessment
- Step 4: Risk Characterization and Uncertainty Analysis
- Step 5: Results, Decision Criteria, and Documentation

Step 1: Hazard Identification and Data Evaluation and Reduction

The purpose of the Hazard Identification and Data Evaluation and Reduction step is to identify the data that will be included in the risk evaluation and identify constituents of potential concern (COPCs) that will be retained for further evaluation in the risk assessment.

Key Decision Criteria in Step 1:

- This risk evaluation estimates the incremental risk (i.e., risk above background and potentially associated with the JP-5/Fuel release from Red Hill).
- Identification of chemicals to include in the risk evaluation. This protocol assumes the 225 chemicals tested for in the PIANO, PAH/Alkyl-PAH, and Saturated Hydrocarbon analyses will potentially be included in the risk evaluation.

[1] EPA, 1989. Risk Assessment Guidance for Superfund: (1) Part A: Human Health Evaluation Manual, Part B: Development of Risk-based Preliminary Remediation Goals, Part E: Supplemental Guidance for Dermal Risk Assessment, and Part F: Supplemental Guidance for Inhalation Risk Assessment. https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part.

[2] Navy, 2008. U.S. Navy Human Health Risk Assessment Guidance. Naval Facilities Engineering Command and Navy Marine Corps Public Health Center. December 2008. https://www.med.navy.mil/Navy-and-Marine-Corps-Force-Health-Protection-Command/Environmental-Health/Environmental-Programs/Risk-Assessment/.

Step 1 includes:

- Data Overview and Processing
  - The risk evaluation will be performed on a location-by-location basis using the results of the Tier 2 analyses. The risk evaluation will primarily focus on residence locations.
  - If the residence has one sample result:
    - Detected chemicals will be retained for further evaluation and the reported concentration will be used in the risk evaluation.
    - Non-detected chemicals will not be retained for further evaluation (i.e., the concentration for that chemical will be set to zero).
  - If the residence has two, or more, sample results:
    - Detected chemicals will be retained for further evaluation with the following modifications:
      - If multiple results are detected, the largest of the results will be used in the risk evaluation.
      - If only one result is detected and the other results are non-detect, the detected result will be used in the risk evaluation.
    - If all sample results are non-detect (i.e., chemicals are not detected in any sample), then the chemical will not be retained for further evaluation (i.e., the concentration for that chemical will be set to zero).

Step 2: Exposure Assessment

The purpose of the Exposure Assessment step is to identify potentially exposed populations (i.e., receptors), exposure scenarios, complete exposure pathways, and exposure factors/parameters.

Key Decision Criteria in Step 2:

- The risk evaluation focuses on child and adult residents that are provided tap water by the JBPHH System. Risk will be calculated for a 3-year and 6-year exposure duration (based on one or two tours with the Navy) and 26-years (EPA default for a resident).
- An exposure model will be developed using EPA-default parameters, except where otherwise noted. Complete exposure pathways included ingestion of tap water, inhalation of tap water while showering, and dermal contact with tap water while showering.

Step 2 includes:

- Developing a Conceptual Site Model and an Exposure Model
  - The conceptual site model (CSM) is provided in Figure 1. The CSM is a visual representative of how exposure to chemicals in tap water provided by the JBPHH System could occur.
  - Receptors Evaluated include: 3-Year Active-Duty Personnel (Child/Adult), 6-Year Active-Duty Personnel (Child/Adult), 26-Year Resident (Child/Adult)[3]
  - Complete Exposure Pathways include: Ingestion of Tap Water, Inhalation of Vapors in Tap Water while Showering, Dermal Contact with Tap Water
  - Exposure Factors/Parameters: Exposure Parameters were selected based on EPA's default parameters for child and adult resident exposure scenarios, except where noted.[4] Exposure Parameters are summarized in Table 1.

Step 3: Toxicity Assessment

The purpose of the Toxicity Assessment step is to obtain toxicity values for chemicals identified in Step 1.

Key Decision Criteria in Step 3:

- This protocol assumes the 225 chemicals tested for in the PIANO, PAH/Alkyl-PAH, and Saturated Hydrocarbons analyses will potentially be included in the risk evaluation. However, toxicity values are only available (see the sources listed below) for 65 of the 225 chemicals. As a result, methodology will need to be developed to determine if/how surrogate toxicity values can/will be developed for the remaining 160 chemicals with acceptable confidence/uncertainty. Of those, 115 chemicals that were detected in the JP-5 product samples that were collected from the Red Hill Tanks in July 2023. The development of surrogate toxicity values will be prioritized by focusing on the subset of those 115 chemicals that are water soluble (see Table 2).
- Only noncarcinogenic, surrogate toxicity values will be developed, as appropriate.

Step 3 includes:

- Toxicity Values
  - Source: All Toxicity Values were obtained from the EPA's Regional Screening Levels (RSLs) tables and were selected by the EPA from the following sources (listed in order of priority):[5]
    1. EPA's Integrated Risk Information System (IRIS).
    2. The Provisional Peer Reviewed Toxicity Values (PPRTVs) derived by EPA's Superfund Health Risk Technical Support Center (STSC) for the EPA Superfund program. PPRTVs are archived (removed) when an IRIS profile is released, even if the IRIS profile indicates a toxicity value could not be derived. PPRTVs will retain subchronic values if IRIS releases a profile without subchronic values.
    3. EPA's Office of Pesticide Programs (OPP) Human Health Benchmarks for Pesticides (HHBPs). In 2016 IRIS archived 51 chemical assessments for pesticides. For these 51 pesticides IRIS has instead recommended

[3] The 3-year and 6-year exposure durations are based on one or two typical tour lengths for the Navy.
[4] EPA Default Exposure Parameters and Definitions are available at the following link: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.
[5] https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

the use of the toxicity values presented in the HHBP table. These include RfDs (also referred to as chronic PADs) and OSFs (referred to as cancer quantification values). In 2016, OPP listed 363 pesticides in the HHBP table. Only the 51 archived by IRIS are used in the RSL calculations.

4. The Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels (MRLs). An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure. These substance specific estimates, which are intended to serve as screening levels, are used by ATSDR health assessors and other responders to identify contaminants and potential health effects that may be of concern at hazardous waste sites. ATSDR provides both 'Final' and 'Draft' values, both of which are utilized in the RSLs. Typically, draft values are excluded from the RSL hierarchy. However, ATSDR's draft values have undergone external peer review and meet the criteria for inclusion in the RSL hierarchy. Final values take precedence over draft values in usage, and unique references are provided in the generic tables and calculator output.
5. The EPA Office of Water occasionally derives toxicity values presented in Human Health Toxicity Assessments for special case chemicals including PFOA, PFOS, and HFPO-DA.
6. The California Environmental Protection Agency Office of Environmental Health Hazard Assessment (OEHHA) provides toxicity values for the State of California. The OEHHA Toxicity Criteria Database website should be monitored for any updates to the toxicity values.
7. In the Fall 2009, this new source of toxicity values used was added: screening toxicity values in an appendix to certain PPRTV assessments. While we have less confidence in a screening toxicity value than in a PPRTV, we put these ahead of HEAST toxicity values because these appendix screening toxicity values are more recent and use current EPA methodologies in the derivation, and because the PPRTV appendix screening toxicity values also receive external peer review. To alert users when these values are used, the key presents an "X" (for Appendix) rather than a "P" (for PPRTV). The following is taken from a PPRTV appendix and states the intended usage of appendix screening levels.

   > "However, information is available for this chemical, which although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors. In such cases, the Superfund Health Risk Technical Support Center summarizes available information in an appendix and develops a "screening value." Appendices receive the same level of internal and external scientific peer review as the PPRTV documents to ensure their appropriateness within the limitations detailed in the document. Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of an appendix screening toxicity value than for a value presented in the body of the assessment. Questions or concerns about the appropriate use of screening values should be directed to the Superfund Health Risk Technical Support Center."

8. EPA's HERA program has posted the final Office of Research and Development (ORD) Human Health Toxicity Values for Perfluoropropanoic Acid (PFPrA), Lithium bis[(trifluoromethyl)sulfonyl]azanide (HQ-115), and Trifluoro-N-(trifluoromethanesulfonyl)methanesulfonamide, 1,1,1- (TFSI) . These toxicity assessments provide actionable science to inform EPA decision contexts and were developed in response to a request for site-specific technical support. Please see U.S. EPA. ORD Human Health Toxicity Value for Perfluoropropanoic Acid and U.S. EPA. ORD Human Health Toxicity Value for Lithium bis [(trifluoromethyl)sulfonyl]azanide for more information.

9. The 11th Cycle of Groundwater Standards Proposals from the State of Wisconsin Department of Health Services includes recommended standards for 4 PFAS chemicals (Perfluoroundecanoic acid (PFUDA), Perfluorododecanoic acid (PFDoDA), Perfluorotetradecanoic acid (PFTetDA), and Perfluorooctadecanoic (PFODA)) as well as other chemicals. The EPA Office of Land and Emergency Management's (OLEM) Human Health Regional Risk Assessment Forum's (OHHRRAF) Toxicity Workgroup recommends using these values because toxicity values from the other sources do not exist. While the recommended state (Wisconsin) reference values were derived by a state whose toxicity values have not been used before, the state's toxicity information was determined by the OHHRRAF's Toxicity Workgroup to be based on similar methods and procedures as those used for other Tier 3 values.
10. The EPA Superfund program's Health Effects Assessment Summary Table. Values in HEAST are archived (removed) when an IRIS profile or a PPRTV paper is released, even if the PPRTV paper indicates a toxicity value could not be derived.

- Table 2 presents the 225 that will potentially be included in the risk evaluation and also identifies (1) the Toxicity Values available in the November 2023 RSL table and (2) if the chemical was detected in the JP-5 product samples that were collected from the Red Hill Tanks in July 2023. Toxicity values are only available (see the sources listed below) for 65 of the 225 chemicals. As a result, the methodology will need to be developed to determine if/how surrogate toxicity values can/will be developed for the remaining 160 chemicals with acceptable confidence/uncertainty. Of those, 115 chemicals were detected in the JP-5 product samples that were collected from the Red Hill Tanks in July 2023. The development of surrogate toxicity values will be prioritized by focusing on the subset of those 115 chemicals that are water-soluble.
- Summary statistics for the chemicals detected in the JP-5 product samples collected from the Red Hill Tanks in July 2023 are provided in Attachment 2.

Step 4: Risk Characterization and Uncertainty Analysis

The purpose of the Risk Characterization step is to calculate the cancer risk and noncancer hazards associated with exposure to TPH-related chemicals using the information developed in Steps 1 through 3.

Key Decision Criteria in Step 4:

- Prior to calculating risk, a toxicity assessment will need to be conducted to identify the target endpoint/critical effect associated with each chemical. All chemicals will not be assumed to have the same target endpoint/critical effect.
- The EPA acceptable cancer risk range is 1.0E-04 to 1.0E-06 and he EPA noncancer hazard benchmark is 1 (grouped by target organ/critical effect) will be used, in conjunction with other information, to evaluate the results of the risk evaluation.

Step 4 includes:

- <u>Calculating Cancer Risk and Noncancer Hazards</u>
  - Cancer risks and noncancer hazards will be calculated for each receptor, pathway, and chemical – based on inputs from Steps 1 through 3.
- <u>Comparing Risks to Acceptable Cancer Risk Range and Noncancer Hazard Benchmarks</u>
  - Cancer risks will be compared to the EPA acceptable risk range of 1.0E-04 to 1.0E-06.

- Noncancer hazard indices will be compared to the EPA benchmark of 1 (grouped by target organ/critical effect). Note: Target-organ segregation/grouping for non-cancer impacts will only be performed if the total, cumulative, constituent-specific hazard quotients exceed 1.

Step 5: Results, Decision Criteria, and Documentation

The purpose of the Results, Decision Criteria, and Documentation step is to summarize the risk evaluation results, develop decision criteria for determining the next steps (if necessary), and outline how the results will be documented.

Key Questions/Decision Criteria in Step 5:

- The decision criteria for identifying if/when additional investigation or action is needed will depend on the location type (e.g., source water, hydrant, residence) to ensure proper action (e.g., flushing, re-sampling, bracket sampling, fixture replacement) and will include multiple factors. In general:
  - No further action is warranted if the total risk is within or below the EPA acceptable risk range of 1.0E-04 to 1.0E-06 and the noncancer hazard is below the EPA benchmark of 1 (grouped by target organ/critical effect). However, the Navy will consult with EPA/HDOH prior to making a final determination whether or not further action is necessary in instances where the cancer risk is within 1E-04 to 1E-06.
  - Additional action may be warranted if the total risk exceeds the EPA acceptable risk range of 1.0E-04 to 1.0E-06 and /or the noncancer hazard exceeds the EPA benchmark of 1 (grouped by target organ/critical effect).

Step 5 includes:

- Results
  - No further action is warranted if the total cancer risk is below or within the EPA acceptable risk range of 1.0E-04 to 1.0E-06 and total noncancer hazard index is below the EPA benchmark of 1 (grouped by target organ/critical effect). However, the Navy will consult with EPA/HDOH prior to making a final determination whether or not further action is necessary in instances where the cancer risk is within 1E-04 to 1E-06.
  - Additional action (e.g., flushing, re-sampling, fixture replacement, bracket sampling, spatial distribution evaluation) may be warranted if the total cancer risk exceeds the EPA acceptable risk range of 1.0E-04 to 1.0E-06 and /or the noncancer hazard exceeds the EPA benchmark of 1 (grouped by target organ/critical effect).
  - Results will be evaluated to determine if they are a localized impact (i.e., the risk is associated with conditions at that sample location and not associated with the JBPHH System) or a distribution impact (i.e., the risk is associated with conditions in the JBPHH distribution system). This will be achieved by evaluating nearby residences and results from nearby hydrants, reviewing source water data (i.e., Waiawa Shaft), and collecting additional data (if necessary).
- Documentation
  - Results of the risk evaluation will be documented in a tech memo. The tech memo will summarize the results of each step outlined in this protocol and identify next steps for that location.
  - The tech memo will be submitted to EPA and State of Hawaii Department of Health (DOH) for review.

Enclosures

Figure 1	Conceptual Site Model
Table 1	Exposure Parameters
Table 2	Toxicity Values for PIANO, PAH/Alkyl-PAH, and Saturated Hydrocarbons
Attachment 1	Email Regarding Practical, Technical Challenges for Collecting/Performing Tier 2 Data Analysis on Drinking Water Samples
Attachment 2	Summary Statistics for JP-5 Free Product Samples Collected from Red Hill Tanks (July 2023)

Figure 1. Conceptual Site Model

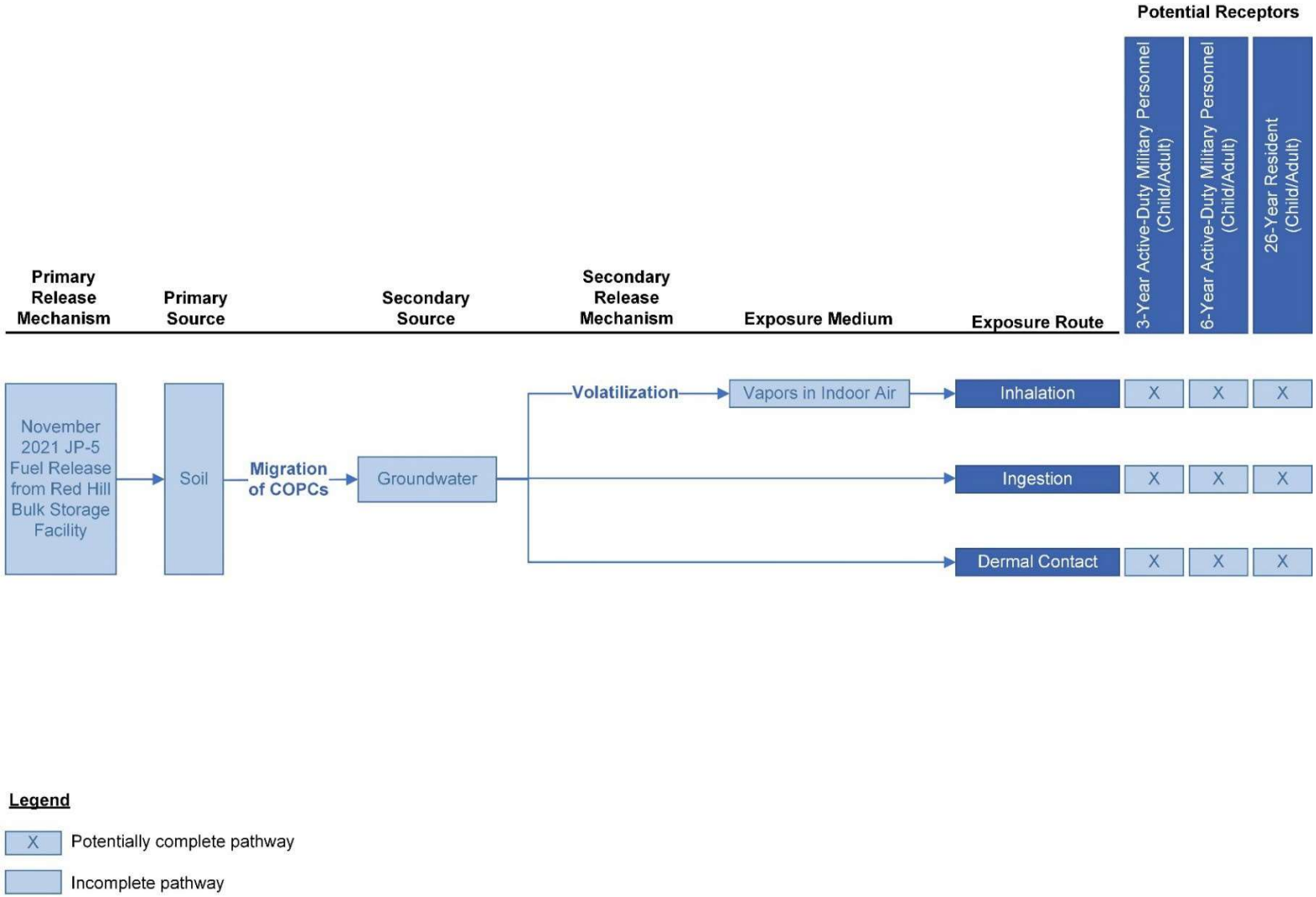

Table 1. Exposure Parameters

Ingestion of Drinking Water Exposure Parameters				
Exposure Parameter	for Non-carcinogens (Child 0 - 6)		for Carcinogens (Child + Adults)	
Average Body Weight	15	kg	80	kg
Unit Conversion Factor	0.001	mg/ug	0.001	mg/ug
Drinking Water Ingestion Rate	0.78	L/day	2.5	L/day
Drinking Water Fraction	1	unitless	1	unitless
Exposure Frequency	350	day/year	350	day/year
Exposure Duration	6	years	26	years
Averaging Time	2,190	days	25,550	days

Inhalation via Showering Exposure Parameters				
Exposure Parameter	for Non-carcinogens (Child 0 - 6)		for Carcinogens (Child + Adults)	
Exposure Time	1.08	hours/day	1.42	hours/day
Unit Conversion Factor	0.001	mg/ug	1	ug/ug
Exposure Frequency	200	days/year	350	days/year
Exposure Duration	6	years	26	years
Volatilization factor of Andelman (K)	0.5	L/m3	0.5	L/m3
Averaging Time	52,560	hours	613,200	hours

Dermal Contact with Water Exposure Parameters (Bathing/Showering)				
Exposure Parameter	Bathing for Non-carcinogens (Child 0 - 6)		Showering for Carcinogens (Adults)	
Average Body Weight	15	kg	80	kg
Unit Conversion Factor	0.001	mg/ug	0.001	mg/ug
Skin Surface Area	6,365	cm^2	4,193	cm^2
Event Frequency	1	event/day	1	event/day
Exposure Frequency	200	day/year	350	day/year
Exposure Duration	6	years	26	years
Averaging Time	2,190	days	25,550	days

Notes:

1.) All Exposure Parameters are from the USEPA Regional Screening Level Table (March 2, 2022), except as noted.

2.) Exposure Time for Inhalation via Showering was assumed to be 2 events/day: 1.08 hours/day (i.e., 2 * 0.54 hr/event) for the child and 1.42 hours/day (i.e., 2 * 0.71 hr/event) for the adult.

3.) The Exposure Frequency for Showering/Bathing for the child was assumed to be 4 day/week for 50 weeks (i.e., 200 days/year), assuming 2 weeks of vacation.

4.) Adults are assumed to Shower and not Bathe. Twenty-five (25%) of the Adult Skin Surface Area was assumed to be in contact with water during Showering (i.e., 19,652 cm^2 * 0.25 = 4,913 cm^2) during the showering event.

5.) EPA defaults to a 26-year exposure duration for a residential exposure scenario. In addition to the default scenario recommended by EPA, risk will be calculated for a 3- and 6-year residential exposure scenario. This is representative of one to two tours of active-duty personnel serving in the U.S. Navy who are stationed at JBPHH.

Notes: Other Dermal Factors Used to Calculate DAD-event for Child and DAD-Event for Adult

Event Time (Child)	0.54	hr/event
Event Time (Adult)	0.71	hr/event
Skin Thickness	0.001	cm

Table 2. Toxicity Values for PIANO, PAH/Alkyl-PAH, and Saturated Hydrocarbons

CASRN	Analyte	Detected in JP-5 Sample?	Oral Slope Factor mg/kg-day^{-1}	Inhalation Unit Risk ug/m$^{3(-1)}$	Oral Reference Dose mg/kg-day	Inhalation Reference Concentration mg/m^3
7094-27-1	1,1,4-Trimethylcyclohexane	No	--	--	--	--
1638-26-2	1,1-Dimethylcyclopentane	No	--	--	--	--
877-44-1	1,2,4-Triethylbenzene	No	--	--	--	--
106-93-4	1,2-Dibromoethane	No	2.0	0.00060	0.0090	0.0090
107-06-2	1,2-Dichloroethane	No	0.091	0.000026	0.0060	0.0070
102-25-0	1,3,5-Triethylbenzene	No	--	--	--	--
98-19-1	1,3-Dimethyl-5-tert-Butylbenzene	No	--	--	--	--
872-05-9	1-Decene	No	--	--	--	--
592-41-6	1-Hexene	No	--	--	--	--
124-11-8	1-Nonene	No	--	--	--	--
111-66-0	1-Octene	No	--	--	--	--
109-67-1	1-Pentene	No	--	--	--	--
464-06-2	2,2,3-Trimethylbutane	No	--	--	--	--
564-02-3	2,2,3-Trimethylpentane	No	--	--	--	--
75-83-2	2,2-Dimethylbutane	No	--	--	--	--
590-73-8	2,2-Dimethylhexane	No	--	--	--	--
590-35-2	2,2-Dimethylpentane	No	--	--	--	--
560-21-4	2,3,3-Trimethylpentane	No	--	--	--	--
565-75-3	2,3,4-Trimethylpentane	No	--	--	--	--
79-29-8	2,3-Dimethylbutane	No	--	--	--	--
584-94-1	2,3-Dimethylhexane	No	--	--	--	--
565-59-3	2,3-Dimethylpentane	No	--	--	--	--
108-08-7	2,4-Dimethylpentane	No	--	--	--	--
592-13-2	2,5-Dimethylhexane	No	--	--	--	--
872-55-9	2-Ethylthiophene	No	--	--	--	--
563-46-2	2-Methyl-1-Butene	No	--	--	--	--
625-27-4	2-Methyl-2-pentene	No	--	--	--	--
107-83-5	2-Methylpentane	No	--	--	--	--
554-14-3	2-Methylthiophene	No	--	--	--	--
2216-38-8	2-Nonene	No	--	--	--	--
1067-20-5	3,3-Diethylpentane	No	--	--	--	--
562-49-2	3,3-Dimethylpentane	No	--	--	--	--
619-99-8	3-Ethylhexane	No	--	--	--	--
617-78-7	3-Ethylpentane	No	--	--	--	--
563-45-1	3-Methyl-1-butene	No	--	--	--	--
96-14-0	3-Methylpentane	No	--	--	--	--
616-44-4	3-Methylthiophene	No	--	--	--	--
691-37-2	4-Methyl-1-pentene	No	--	--	--	--
56-55-3	Benz(a)anthracene	No	0.10	0.000060	--	--
71-43-2	Benzene	No	0.055	0.0000078	0.0040	0.030
50-32-8	Benzo(a)pyrene	No	1.0	0.00060	0.00030	0.0000020
205-99-2	Benzo(b)fluoranthene	No	0.10	0.000060	--	--
192-97-2	Benzo(e)pyrene	No	--	--	0.000090	0.0000020
191-24-2	Benzo(g,h,i)perylene	No	--	--	--	--
205-82-3, 207-08-9	Benzo(j)+(k)fluoranthene	No	--	--	--	--

Table 2. Toxicity Values for PIANO, PAH/Alkyl-PAH, and Saturated Hydrocarbons

CASRN	Analyte	Detected in JP-5 Sample?	Oral Slope Factor mg/kg-day^{-1}	Inhalation Unit Risk ug/m$^{3(-1)}$	Oral Reference Dose mg/kg-day	Inhalation Reference Concentration mg/m^3
95-15-8	Benzothiophene	No	--	--	--	--
218-01-9-C1	C1-Chrysenes	No	--	--	--	--
218-01-9-C2	C2-Chrysenes BS	No	--	--	--	--
206-44-0,129-00-0-C2	C2-Fluoranthenes/Pyrenes	No	--	--	--	--
218-01-9-C3	C3-Chrysenes	No	--	--	--	--
206-44-0,129-00-0-C3	C3-Fluoranthenes/Pyrenes	No	--	--	--	--
85-01-8,120-12-7-C3	C3-Phenanthrenes/Anthracenes	No	--	--	--	--
218-01-9-C4	C4-Chrysenes	No	--	--	--	--
132-65-0-C4	C4-Dibenzothiophenes	No	--	--	--	--
206-44-0,129-00-0-C4	C4-Fluoranthenes/Pyrenes	No	--	--	--	--
85-01-8,120-12-7-C4	C4-Phenanthrenes/Anthracenes	No	--	--	--	--
218-01-9,Triph	Chrysene/Triphenylene	No	--	--	--	--
6443-92-1	cis-2-Heptene	No	--	--	--	--
7688-21-3	cis-2-Hexene	No	--	--	--	--
7642-04-8	cis-2-Octene	No	--	--	--	--
627-20-3	cis-2-Pentene	No	--	--	--	--
20237-46-1	cis-3-Nonene	No	--	--	--	--
287-92-3	Cyclopentane	No	--	--	--	--
53-70-3 , 218-58-7	Dibenz(a,h)+(a,c)anthracene	No	--	--	--	--
637-92-3	Ethyl-Tert-Butyl-Ether	No	--	0.000000080	1.0	40
206-44-0	Fluoranthene	No	--	--	0.040	--
193-39-5	Indeno(1,2,3-cd)pyrene	No	0.10	0.000060	--	--
1678-98-4	Isobutylcyclohexane	No	--	--	--	--
540-84-1	Isooctane	No	--	--	--	--
78-78-4	Isopentane	No	--	--	--	--
78-79-5	Isoprene	No	--	--	--	--
108-20-3	Isopropyl Ether	No	--	--	--	0.70
696-29-7	Isopropylcyclohexane	No	--	--	--	--
1634-04-4	Methyl tert butyl ether	No	0.0018	0.00000026	--	3.0
12108-13-3	MMT	No	--	--	--	--
629-97-0	n-Docosane (C22)	No	--	--	--	--
544-85-4	n-Dotriacontane (C32)	No	--	--	--	--
112-95-8	n-Eicosane (C20)	No	--	--	--	--
629-94-7	n-Heneicosane (C21)	No	--	--	--	--
630-04-6	n-Hentriacontane (C31)	No	--	--	--	--
593-49-7	n-Heptacosane (C27)	No	--	--	--	--
7194-84-5	n-Heptatriacontane (C37)	No	--	--	--	--
630-01-3	n-Hexacosane (C26)	No	--	--	--	--
630-06-8	n-Hexatriacontane (C36)	No	--	--	--	--
630-03-5	n-Nonacosane (C29)	No	--	--	--	--
629-92-5	n-Nonadecane (C19)	No	--	--	--	--
7194-86-7	n-Nonatriacontane (C39)	No	--	--	--	--
7194-85-6	n-Octatriacontane (C38)	No	--	--	--	--
630-07-9	n-Pentatriacontane (C35)	No	--	--	--	--
4181-95-7	n-Tetracontane (C40)	No	--	--	--	--

Table 2. Toxicity Values for PIANO, PAH/Alkyl-PAH, and Saturated Hydrocarbons

CASRN	Analyte	Detected in JP-5 Sample?	Oral Slope Factor mg/kg-day^{-1}	Inhalation Unit Risk ug/m$^{3(-1)}$	Oral Reference Dose mg/kg-day	Inhalation Reference Concentration mg/m^3
646-31-1	n-Tetracosane (C24)	No	--	--	--	--
14167-59-0	n-Tetratriacontane (C34)	No	--	--	--	--
638-68-6	n-Triacontane (C30)	No	--	--	--	--
638-67-5	n-Tricosane (C23)	No	--	--	--	--
630-05-7	n-Tritriacontane (C33)	No	--	--	--	--
109-66-0	Pentane	No	--	--	--	1.0
198-55-0	Perylene	No	--	--	0.000090	0.0000020
108-95-2	Phenol	No	--	--	0.30	0.20
638-36-8	Phytane	No	--	--	--	--
129-00-0	Pyrene	No	--	--	0.030	--
483-65-8	Retene	No	--	--	--	--
100-42-5	Styrene	No	--	--	0.20	1.0
75-65-0	Tertiary Butanol	No	0.00050	--	0.40	5.0
994-05-8	Tertiary-Amyl Methyl Ether	No	--	--	--	--
110-02-1	Thiophene	No	--	--	--	--
14686-13-6	trans-2-Heptene	No	--	--	--	--
4050-45-7	trans-2-Hexene	No	--	--	--	--
646-04-8	trans-2-Pentene	No	--	--	--	--
14686-14-7	trans-3-Heptene	No	--	--	--	--
20063-92-7	trans-3-Nonene	No	--	--	--	--
2532-58-3	1,3-Dimethylcyclopentane (cis)	Yes	--	--	--	--
120-12-7	Anthracene	Yes	--	--	0.30	--
132-65-0-C3	C3-Dibenzothiophenes	Yes	--	--	--	--
86-73-7-C3	C3-Fluorenes	Yes	--	--	--	--
630-02-4	n-Octacosane (C28)	No	--	--	--	--
1-Heptene/1,2-DMCP(trans)	1-Heptene/1,2-DMCP (trans)	No	--	--	--	--
591-76-4	2-Methylhexane	No	--	--	--	--
589-53-7	4-Methylheptane	Yes	--	--	--	--
3875-51-2	Isopropylcyclopentane	Yes	--	--	--	--
110-54-3	n-Hexane	Yes	--	--	--	0.70
98-06-6	tert-Butylbenzene	Yes	--	--	0.10	--
85-01-8,120-12-7-C2	C2-Phenanthrenes/Anthr BS	No	--	--	--	--
589-43-5	2,4-Dimethylhexane	Yes	--	--	--	--
4032-86-4	3,3-Dimethylheptane	Yes	--	--	--	--
589-34-4	3-Methylhexane	Yes	--	--	--	--
1640-89-7	Ethylcyclopentane	Yes	--	--	--	--
96-37-7	Methylcyclopentane	Yes	--	--	--	--
629-99-2	n-Pentacosane (C25)	No	--	--	--	--
110-82-7	Cyclohexane	Yes	--	--	--	6.0
3892-00-0	Norpristane (1650)	Yes	--	--	--	--
593-45-3	n-Octadecane (C18)	Yes	--	--	--	--
206-44-0,129-00-0-C1	C1-Fluoranthenes/Pyrenes	No	--	--	--	--
2207-01-4	1,2-Dimethylcyclohexane (cis)	No	--	--	--	--
926-82-9	3,5-Dimethylheptane	Yes	--	--	--	--

Table 2. Toxicity Values for PIANO, PAH/Alkyl-PAH, and Saturated Hydrocarbons

CASRN	Analyte	Detected in JP-5 Sample?	Oral Slope Factor mg/kg-day^{-1}	Inhalation Unit Risk ug/m$^{3(-1)}$	Oral Reference Dose mg/kg-day	Inhalation Reference Concentration mg/m^3
629-78-7	n-Heptadecane (C17)	Yes	--	--	--	--
1921-70-6	Pristane	Yes	--	--	--	--
85-01-8,120-12-7-C1	C1-Phenanthrenes/Anthracenes	No	--	--	--	--
488-23-3	1,2,3,4-Tetramethylbenzene	Yes	--	--	--	--
527-53-7	1,2,3,5-Tetramethylbenzene	Yes	--	--	--	--
526-73-8	1,2,3-Trimethylbenzene	Yes	--	--	0.010	0.060
95-93-2	1,2,4,5-Tetramethylbenzene	Yes	--	--	--	--
95-63-6	1,2,4-Trimethylbenzene	Yes	--	--	0.010	0.060
135-01-3	1,2-Diethylbenzene	Yes	--	--	--	--
933-98-2	1,2-Dimethyl-3-Ethylbenzene	Yes	--	--	--	--
934-80-5	1,2-Dimethyl-4-Ethylbenzene	Yes	--	--	--	--
6876-23-9	1,2-Dimethylcyclohexane (trans)	Yes	--	--	--	--
108-67-8	1,3,5-Trimethylbenzene	Yes	--	--	0.010	0.060
141-93-5	1,3-Diethylbenzene	Yes	--	--	--	--
2870-04-4	1,3-Dimethyl-2-Ethylbenzene	Yes	--	--	--	--
874-41-9	1,3-Dimethyl-4-Ethylbenzene	Yes	--	--	--	--
934-74-7	1,3-Dimethyl-5-Ethylbenzene	Yes	--	--	--	--
1758-88-9	1,4-Dimethyl-2-Ethylbenzene	Yes	--	--	--	--
2207-04-7	1,4-Dimethylcyclohexane (trans)	Yes	--	--	--	--
611-14-3	1-Methyl-2-Ethylbenzene	Yes	--	--	--	--
527-84-4	1-Methyl-2-Isopropylbenzene	Yes	--	--	--	--
1074-17-5	1-Methyl-2-N-Propylbenzene	Yes	--	--	--	--
620-14-4	1-Methyl-3-Ethylbenzene	Yes	--	--	--	--
535-77-3	1-Methyl-3-Isopropylbenzene	Yes	--	--	--	--
1074-43-7	1-Methyl-3-N-Propylbenzene	Yes	--	--	--	--
622-96-8	1-Methyl-4-Ethylbenzene	No	--	--	--	--
99-87-6	1-Methyl-4-Isopropylbenzene	Yes	--	--	--	--
1074-55-1	1-Methyl-4-N-Propylbenzene	Yes	--	--	--	--
90-12-0	1-Methylnaphthalene	Yes	0.029	--	0.070	--
2245-38-7	2,3,5-Trimethylnaphthalene	No	--	--	--	--
3074-71-3	2,3-Dimethylheptane	Yes	--	--	--	--
2216-30-0	2,5-Dimethylheptane	Yes	--	--	--	--
3891-98-3	2,6,10-Trimethyldodecane (1380)	Yes	--	--	--	--
3891-99-4	2,6,10-Trimethyltridecane (1470)	Yes	--	--	--	--
581-42-0	2,6-Dimethylnaphthalene	No	--	--	--	--
592-27-8	2-Methylheptane	No	--	--	--	--
91-57-6	2-Methylnaphthalene	Yes	--	--	0.0040	--
871-83-0	2-Methylnonane	Yes	--	--	--	--
3221-61-2	2-Methyloctane	Yes	--	--	--	--
4110-44-5	3,3-Dimethyloctane	Yes	--	--	--	--
922-28-1	3,4-Dimethylheptane	Yes	--	--	--	--
589-81-1	3-Methylheptane	Yes	--	--	--	--
5911-04-6	3-Methylnonane	Yes	--	--	--	--
2216-33-3	3-Methyloctane	Yes	--	--	--	--
2216-34-4	4-Methyloctane	Yes	--	--	--	--

Table 2. Toxicity Values for PIANO, PAH/Alkyl-PAH, and Saturated Hydrocarbons

CASRN	Analyte	Detected in JP-5 Sample?	Oral Slope Factor mg/kg-day^{-1}	Inhalation Unit Risk ug/m$^{3(-1)}$	Oral Reference Dose mg/kg-day	Inhalation Reference Concentration mg/m^3
83-32-9	Acenaphthene	Yes	--	--	0.060	--
208-96-8	Acenaphthylene	Yes	--	--	--	--
92-52-4	Biphenyl	Yes	0.0080	--	0.50	0.00040
132-65-0-C1	C1-Dibenzothiophenes BS	Yes	--	--	--	--
86-73-7-C1	C1-Fluorenes	Yes	--	--	--	--
91-20-3-C1	C1-Naphthalenes	Yes	--	--	--	--
132-65-0-C2	C2-Dibenzothiophenes	Yes	--	--	--	--
86-73-7-C2	C2-Fluorenes	Yes	--	--	--	--
91-20-3-C2	C2-Naphthalenes	Yes	--	--	--	--
91-20-3-C3	C3-Naphthalenes	Yes	--	--	--	--
91-20-3-C4	C4-Naphthalenes	Yes	--	--	--	--
124-18-5	Decane (C10)	Yes	--	--	--	--
132-64-9	Dibenzofuran	No	--	--	0.0010	--
132-65-0	Dibenzothiophene	Yes	--	--	--	--
112-40-3	Dodecane (C12)	Yes	--	--	--	--
100-41-4	Ethylbenzene	Yes	0.011	0.0000025	0.050	1.0
86-73-7	Fluorene	Yes	--	--	0.040	--
142-82-5	Heptane	Yes	--	--	0.00030	0.40
1077-16-3	Hexylbenzene	Yes	--	--	--	--
496-11-7	Indane	No	--	--	--	--
95-13-6	Indene	Yes	--	--	--	--
538-93-2	Isobutylbenzene	Yes	--	--	--	--
98-82-8	Isopropylbenzene	Yes	--	--	0.10	0.40
108-87-2	Methylcyclohexane	Yes	--	--	--	0.095
91-20-3	Naphthalene	Yes	0.12	0.000034	0.020	0.0030
104-51-8	n-Butylbenzene	Yes	--	--	0.050	--
124-18-5	n-Decane (C10)	Yes	--	--	--	--
112-40-3	n-Dodecane (C12)	Yes	--	--	--	--
544-76-3	n-Hexadecane (C16)	Yes	--	--	--	--
111-84-2	n-Nonane (C9)	Yes	--	--	0.00030	0.020
629-62-9	n-Pentadecane (C15)	Yes	--	--	--	--
538-68-1	N-Pentylbenzene	No	--	--	--	--
103-65-1	n-Propylbenzene	Yes	--	--	0.10	1.0
629-59-4	n-Tetradecane (C14)	Yes	--	--	--	--
629-50-5	n-Tridecane (C13)	Yes	--	--	--	--
1120-21-4	n-Undecane (C11)	Yes	--	--	--	--
111-65-9	Octane	Yes	--	--	--	--
629-62-9	Pentadecane	Yes	--	--	--	--
85-01-8	Phenanthrene	Yes	--	--	--	--
135-98-8	sec-Butylbenzene	Yes	--	--	0.10	--
629-59-4	Tetradecane (C14)	Yes	--	--	--	--
108-88-3	Toluene	Yes	--	--	0.080	5.0
629-50-5	Tridecane	Yes	--	--	--	--
1120-21-4	Undecane	Yes	--	--	--	--
1330-20-7	Xylene (Total)	Yes	--	--	0.20	0.10

Notes:

-- No toxicity value available in the November 2023 EPA RSL Table. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Chemical was detected in JP-5 product sample collected from Red Hill.

Chemical was not detected inJP-5 product sample collected from Red Hill.

Attachment 1 – Email Regarding Practical, Technical Challenges for Collecting/Performing Tier 2 Data Analysis on Drinking Water Samples

From: (b) (6)
Sent: Tuesday, March 26, 2024 11:04 AM
To: Corine Li (EPA)
Cc: Bob Hopeman (EPA)
Subject: JBPHH - PIANO/Alkyl PAH Lab Discussion

Hi Corine,

Are you and Bob Hopeman available today to discuss PIANO/Alkyl PAH Analysis and Labs/Lab protocols? It is feasible to collect Tier 2 data for use in a human health risk assessment. I want to discuss the idea of developing a protocol for Tier 2 that the Navy's Lab and the EPA's Lab will both follow to ensure that we have confidence in the data that are returned. If not, we (Navy and EPA) could be very different results from split samples which are due to laboratory issues and not due to the actual field samples.

This would just be the 3 of us, unless you need additional folks. The purpose to discuss some practical concerns that I have regarding the labs that perform PIANO/Alkyl PAH analysis and start the process for developing an approach to ensure consistency with how the Lab EPA selects to perform PIANO/Alkyl PAH analysis and the Navy's lab.

Here's a list of challenges (this is not a complete list) we'll need to overcome:

- Our field teams need to be uber meticulous when collecting samples. We should consider developing SOPs for sampling that are similar to those used when collecting PFAS samples.
- These labs typically analyze product samples (e.g., refinery samples) with very high concentrations – this may create very real, practical challenges to obtaining reliable data from these labs at the sub-part-per billion concentrations required by human health risk assessment.
- Lab contamination/cross contamination. This becomes a bigger issue as we push the lab to lower and lower detection limits. This will be even more significant if the lab routinely analyzes highly contaminated samples because they won't be experienced applying SOPs required, at all levels, to prevent low-level lab contamination in Method Blanks et cetera to the parts per trillion levels (or less).
- These labs do not routinely (and likely never have) run drinking water samples. So, they are not experienced with potential chlorine interactions that may occur during preparation/analysis. We will quench the samples prior to analysis, which should minimize the impact of residual chlorine, but we need to keep this in mind.
- Labs typically combine samples from multiple customers in Sample Delivery Groups of 20 samples and then run those as a batch. This could significantly impact our results if our batch includes samples with higher contamination – due to "Bleed Over" from the previous contaminated sample. THINK the NOAA Lab results.
- May need to consider requiring dedicated equipment (glassware, consumables, analytical equipment [GC/MS]) for performing this analysis.
- We will need to perform Level 4 Data Validation on all PIANO data.
- These specialty labs are typically small and routinely take a month (or more) to perform/report the results of PIANO Analysis. This does not include Data Validation. This will take time…

-Thank you,

-(b) (6)

Attachment 2 – Summary Statistics for JP-5 Free Product Samples Collected from Red Hill Tanks (July 2023)

The summary statistics presented in the following table are based on the results from 16 free product samples collected from Red Hill tanks in July 2023. The sample IDs are as follows:

- RHTK07-10TAP-POLN01
- RHTK07-135TAP-POLN01
- RHTK08-10TAP-POLN01
- RHTK08-75TAP-POLN01
- RHTK09-135TAP-POLN01
- RHTK09-75TAP-POLN01
- RHTK10-10TAP-POLN01
- RHTK10-75TAP-POLD01
- RHTK10-75TAP-POLN01
- RHTK11-10TAP-POLN01
- RHTK12-120TAP-POLN01
- RHTK12-60TAP-POLN01
- RHTK12-8TAP-POLN01
- RHTK20-120TAP-POLN01
- RHTK20-200TAP-POLN01
- RHTK20-60TAP-POLN01

CASRN	Analyte	# Samples	# of Detections	Frequency of Detection (%)	Minimum Nondetect (mg/kg)	Maximum Nondetect (mg/kg	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Mode (mg/kg)	Standard Deviation (mg/kg)
7094-27-1	1,1,4-Trimethylcyclohexane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
1638-26-2	1,1-Dimethylcyclopentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
877-44-1	1,2,4-Triethylbenzene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
106-93-4	1,2-Dibromoethane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
107-06-2	1,2-Dichloroethane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
102-25-0	1,3,5-Triethylbenzene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
98-19-1	1,3-Dimethyl-5-tert-Butylbenzene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
872-05-9	1-Decene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
592-41-6	1-Hexene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
124-11-8	1-Nonene	16	0	0.0	468	1,210	0.0	0.0	441	538	242	154
111-66-0	1-Octene	16	0	0.0	468	1,210	0.0	0.0	441	538	242	154
109-67-1	1-Pentene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
464-06-2	2,2,3-Trimethylbutane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
564-02-3	2,2,3-Trimethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
75-83-2	2,2-Dimethylbutane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
590-73-8	2,2-Dimethylhexane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
590-35-2	2,2-Dimethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
560-21-4	2,3,3-Trimethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
565-75-3	2,3,4-Trimethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
79-29-8	2,3-Dimethylbutane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
584-94-1	2,3-Dimethylhexane	16	0	0.0	187	484	0.0	0.0	176	216	97	62

CASRN	Analyte	# Samples	# of Detections	Frequency of Detection (%)	Minimum Nondetect (mg/kg)	Maximum Nondetect (mg/kg	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Mode (mg/kg)	Standard Deviation (mg/kg)
565-59-3	2,3-Dimethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
108-08-7	2,4-Dimethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
592-13-2	2,5-Dimethylhexane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
872-55-9	2-Ethylthiophene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
563-46-2	2-Methyl-1-Butene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
625-27-4	2-Methyl-2-pentene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
107-83-5	2-Methylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
554-14-3	2-Methylthiophene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
2216-38-8	2-Nonene	16	0	0.0	468	1,210	0.0	0.0	441	538	242	154
1067-20-5	3,3-Diethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
562-49-2	3,3-Dimethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
619-99-8	3-Ethylhexane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
617-78-7	3-Ethylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
563-45-1	3-Methyl-1-butene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
96-14-0	3-Methylpentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
616-44-4	3-Methylthiophene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
691-37-2	4-Methyl-1-pentene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
56-55-3	Benz(a)anthracene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
71-43-2	Benzene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
50-32-8	Benzo(a)pyrene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
205-99-2	Benzo(b)fluoranthene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
192-97-2	Benzo(e)pyrene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
191-24-2	Benzo(g,h,i)perylene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
205-82-3, 207-08-9	Benzo(j)+(k)fluoranthene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
95-15-8	Benzothiophene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
218-01-9-C1	C1-Chrysenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
218-01-9-C2	C2-Chrysenes BS	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
206-44-0,129-00-0-C2	C2-Fluoranthenes/Pyrenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
218-01-9-C3	C3-Chrysenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
206-44-0,129-00-0-C3	C3-Fluoranthenes/Pyrenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
85-01-8,120-12-7-C3	C3-Phenanthrenes/Anthracenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4

CASRN	Analyte	# Samples	# of Detections	Frequency of Detection (%)	Minimum Nondetect (mg/kg)	Maximum Nondetect (mg/kg	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Mode (mg/kg)	Standard Deviation (mg/kg)
218-01-9-C4	C4-Chrysenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
132-65-0-C4	C4-Dibenzothiophenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
206-44-0,129-00-0-C4	C4-Fluoranthenes/Pyrenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
85-01-8,120-12-7-C4	C4-Phenanthrenes/Anthracenes	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
218-01-9,Triph	Chrysene/Triphenylene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
6443-92-1	cis-2-Heptene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
7688-21-3	cis-2-Hexene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
7642-04-8	cis-2-Octene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
627-20-3	cis-2-Pentene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
20237-46-1	cis-3-Nonene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
287-92-3	Cyclopentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
53-70-3 , 218-58-7	Dibenz(a,h)+(a,c)anthracene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
637-92-3	Ethyl-Tert-Butyl-Ether	16	0	0.0	187	484	0.0	0.0	176	216	97	62
206-44-0	Fluoranthene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
193-39-5	Indeno(1,2,3-cd)pyrene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
1678-98-4	Isobutylcyclohexane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
540-84-1	Isooctane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
78-78-4	Isopentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
78-79-5	Isoprene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
108-20-3	Isopropyl Ether	16	0	0.0	187	484	0.0	0.0	176	216	97	62
696-29-7	Isopropylcyclohexane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
1634-04-4	Methyl tert butyl ether	16	0	0.0	187	484	0.0	0.0	176	216	97	62
12108-13-3	MMT	16	0	0.0	468	1,210	0.0	0.0	441	538	242	154
629-97-0	n-Docosane (C22)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
544-85-4	n-Dotriacontane (C32)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
112-95-8	n-Eicosane (C20)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
629-94-7	n-Heneicosane (C21)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
630-04-6	n-Hentriacontane (C31)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
593-49-7	n-Heptacosane (C27)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
7194-84-5	n-Heptatriacontane (C37)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
630-01-3	n-Hexacosane (C26)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
630-06-8	n-Hexatriacontane (C36)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73

CASRN	Analyte	# Samples	# of Detections	Frequency of Detection (%)	Minimum Nondetect (mg/kg)	Maximum Nondetect (mg/kg	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Mode (mg/kg)	Standard Deviation (mg/kg)
630-03-5	n-Nonacosane (C29)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
629-92-5	n-Nonadecane (C19)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
7194-86-7	n-Nonatriacontane (C39)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
7194-85-6	n-Octatriacontane (C38)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
630-07-9	n-Pentatriacontane (C35)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
4181-95-7	n-Tetracontane (C40)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
646-31-1	n-Tetracosane (C24)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
14167-59-0	n-Tetratriacontane (C34)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
638-68-6	n-Triacontane (C30)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
638-67-5	n-Tricosane (C23)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
630-05-7	n-Tritriacontane (C33)	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
109-66-0	Pentane	16	0	0.0	187	484	0.0	0.0	176	216	97	62
198-55-0	Perylene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
108-95-2	Phenol	16	0	0.0	427	496	0.0	0.0	233	232	244	9.6
638-36-8	Phytane	16	0	0.0	186	798	0.0	0.0	358	374	N/A	73
129-00-0	Pyrene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
483-65-8	Retene	16	0	0.0	2.6	11	0.0	0.0	3.3	3.0	N/A	1.4
100-42-5	Styrene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
75-65-0	Tertiary Butanol	16	0	0.0	2,340	6,050	0.0	0.0	2,203	2,695	1,210	771
994-05-8	Tertiary-Amyl Methyl Ether	16	0	0.0	187	484	0.0	0.0	176	216	97	62
110-02-1	Thiophene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
14686-13-6	trans-2-Heptene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
4050-45-7	trans-2-Hexene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
646-04-8	trans-2-Pentene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
14686-14-7	trans-3-Heptene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
20063-92-7	trans-3-Nonene	16	0	0.0	187	484	0.0	0.0	176	216	97	62
2532-58-3	1,3-Dimethylcyclopentane (cis)	16	1	6.3	193	484	39	39	173	216	97	68
120-12-7	Anthracene	16	1	6.3	2.6	11	1.3	1.3	3.2	2.9	N/A	1.5
132-65-0-C3	C3-Dibenzothiophenes	16	1	6.3	2.7	11	1.5	1.5	3.3	3.0	N/A	1.4
86-73-7-C3	C3-Fluorenes	16	1	6.3	2.7	11	3.3	3.3	3.5	3.0	N/A	1.3
630-02-4	n-Octacosane (C28)	16	1	6.3	675	798	47	47	355	374	N/A	85
1-Heptene/1,2-DMCP(trans)	1-Heptene/1,2-DMCP (trans)	16	2	13	387	968	55	59	336	431	454	152
591-76-4	2-Methylhexane	16	2	13	187	484	50	55	167	216	97	74

CASRN	Analyte	# Samples	# of Detections	Frequency of Detection (%)	Minimum Nondetect (mg/kg)	Maximum Nondetect (mg/kg	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Mode (mg/kg)	Standard Deviation (mg/kg)
589-53-7	4-Methylheptane	16	2	13	187	484	60	117	173	216	227	66
3875-51-2	Isopropylcyclopentane	16	2	13	193	484	42	43	170	216	227	72
110-54-3	n-Hexane	16	2	13	187	484	44	45	166	216	97	75
98-06-6	tert-Butylbenzene	16	2	13	187	484	27	32	166	216	227	77
85-01-8,120-12-7-C2	C2-Phenanthrenes/Anthr BS	16	3	19	5.1	11	0.90	2.5	3.3	2.9	N/A	1.5
589-43-5	2,4-Dimethylhexane	16	4	25	193	484	25	39	157	216	227	87
4032-86-4	3,3-Dimethylheptane	16	4	25	193	484	24	37	157	216	227	88
589-34-4	3-Methylhexane	16	4	25	193	484	51	81	165	216	227	76
1640-89-7	Ethylcyclopentane	16	4	25	193	484	39	48	160	216	227	84
96-37-7	Methylcyclopentane	16	4	25	193	484	29	43	158	216	227	86
629-99-2	n-Pentacosane (C25)	16	4	25	186	798	390	429	365	390	390	77
110-82-7	Cyclohexane	16	5	31	222	484	25	64	156	216	227	88
3892-00-0	Norpristane (1650)	16	5	31	700	798	224	321	351	364	N/A	51
593-45-3	n-Octadecane (C18)	16	6	38	700	795	74	205	294	359	N/A	108
206-44-0,129-00-0-C1	C1-Fluoranthenes/Pyrenes	16	7	44	2.6	11	1.6	3.8	3.1	2.7	N/A	1.6
2207-01-4	1,2-Dimethylcyclohexane (cis)	16	10	63	430	473	113	224	193	215	160	40
926-82-9	3,5-Dimethylheptane	16	11	69	243	473	35	100	117	86	N/A	69
629-78-7	n-Heptadecane (C17)	16	13	81	700	728	229	494	366	360	404	87
1921-70-6	Pristane	16	14	88	773	795	151	254	228	208	206	70
85-01-8,120-12-7-C1	C1-Phenanthrenes/Anthracenes	16	15	94	11	11	1.7	5.9	3.7	3.6	N/A	1.2
488-23-3	1,2,3,4-Tetramethylbenzene	16	16	100	0.0	0.0	1,880	3,500	2,715	2,795	3,060	460
527-53-7	1,2,3,5-Tetramethylbenzene	16	16	100	0.0	0.0	2,060	3,820	2,918	2,850	N/A	510
526-73-8	1,2,3-Trimethylbenzene	16	16	100	0.0	0.0	1,790	3,230	2,702	2,785	2,950	366
95-93-2	1,2,4,5-Tetramethylbenzene	16	16	100	0.0	0.0	1,090	2,000	1,555	1,575	1,430	236
95-63-6	1,2,4-Trimethylbenzene	16	16	100	0.0	0.0	3,510	6,370	5,210	5,420	5,690	711
135-01-3	1,2-Diethylbenzene	16	16	100	0.0	0.0	410	735	557	516	N/A	108
933-98-2	1,2-Dimethyl-3-Ethylbenzene	16	16	100	0.0	0.0	1,000	1,830	1,439	1,380	1,240	264
934-80-5	1,2-Dimethyl-4-Ethylbenzene	16	16	100	0.0	0.0	1,450	2,610	2,074	2,110	N/A	337
6876-23-9	1,2-Dimethylcyclohexane (trans)	16	16	100	0.0	0.0	173	348	266	268	268	53
108-67-8	1,3,5-Trimethylbenzene	16	16	100	0.0	0.0	1,020	1,860	1,502	1,570	1,580	205
141-93-5	1,3-Diethylbenzene	16	16	100	0.0	0.0	564	1,050	841	839	N/A	132
2870-04-4	1,3-Dimethyl-2-Ethylbenzene	16	16	100	0.0	0.0	306	687	481	477	584	90

CASRN	Analyte	# Samples	# of Detections	Frequency of Detection (%)	Minimum Nondetect (mg/kg)	Maximum Nondetect (mg/kg	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Mode (mg/kg)	Standard Deviation (mg/kg)
874-41-9	1,3-Dimethyl-4-Ethylbenzene	16	16	100	0.0	0.0	1,820	3,330	2,608	2,510	N/A	476
934-74-7	1,3-Dimethyl-5-Ethylbenzene	16	16	100	0.0	0.0	1,900	3,510	2,762	2,710	N/A	500
1758-88-9	1,4-Dimethyl-2-Ethylbenzene	16	16	100	0.0	0.0	1,510	2,820	2,133	1,990	1,990	439
2207-04-7	1,4-Dimethylcyclohexane (trans)	16	16	100	0.0	0.0	68	165	133	138	126	24
611-14-3	1-Methyl-2-Ethylbenzene	16	16	100	0.0	0.0	961	1,730	1,405	1,375	1,320	228
527-84-4	1-Methyl-2-Isopropylbenzene	16	16	100	0.0	0.0	123	225	188	194	153	27
1074-17-5	1-Methyl-2-N-Propylbenzene	16	16	100	0.0	0.0	1,630	2,990	2,333	2,260	N/A	444
620-14-4	1-Methyl-3-Ethylbenzene	16	16	100	0.0	0.0	1,290	2,360	1,950	1,985	N/A	287
535-77-3	1-Methyl-3-Isopropylbenzene	16	16	100	0.0	0.0	556	982	826	861	N/A	110
1074-43-7	1-Methyl-3-N-Propylbenzene	16	16	100	0.0	0.0	1,660	2,980	2,511	2,650	2,790	369
622-96-8	1-Methyl-4-Ethylbenzene	16	16	100	0.0	0.0	732	1,280	1,053	1,050	1,060	163
99-87-6	1-Methyl-4-Isopropylbenzene	16	16	100	0.0	0.0	447	809	685	722	N/A	93
1074-55-1	1-Methyl-4-N-Propylbenzene	16	16	100	0.0	0.0	884	1,580	1,292	1,315	1,470	197
90-12-0	1-Methylnaphthalene	16	16	100	0.0	0.0	2,140	4,480	3,646	3,735	3,660	709
2245-38-7	2,3,5-Trimethylnaphthalene	16	16	100	0.0	0.0	83	163	105	95	N/A	24
3074-71-3	2,3-Dimethylheptane	16	16	100	0.0	0.0	281	530	424	424	N/A	75
2216-30-0	2,5-Dimethylheptane	16	16	100	0.0	0.0	164	320	244	241	296	49
3891-98-3	2,6,10-Trimethyldodecane (1380)	16	16	100	0.0	0.0	4,340	6,240	5,111	4,845	N/A	651
3891-99-4	2,6,10-Trimethyltridecane (1470)	16	16	100	0.0	0.0	3,260	6,580	4,171	3,825	N/A	960
581-42-0	2,6-Dimethylnaphthalene	16	16	100	0.0	0.0	1,350	2,920	1,860	1,655	1,350	485
592-27-8	2-Methylheptane	16	16	100	0.0	0.0	140	395	255	242	213	76
91-57-6	2-Methylnaphthalene	16	16	100	0.0	0.0	3,150	6,500	5,223	5,400	N/A	1,042
871-83-0	2-Methylnonane	16	16	100	0.0	0.0	2,060	3,670	2,826	2,745	3,340	556
3221-61-2	2-Methyloctane	16	16	100	0.0	0.0	465	982	736	713	N/A	160
4110-44-5	3,3-Dimethyloctane	16	16	100	0.0	0.0	148	238	189	195	209	30
922-28-1	3,4-Dimethylheptane	16	16	100	0.0	0.0	128	244	195	196	N/A	35
589-81-1	3-Methylheptane	16	16	100	0.0	0.0	184	387	299	316	316	66
5911-04-6	3-Methylnonane	16	16	100	0.0	0.0	1,930	3,450	2,656	2,560	N/A	525
2216-33-3	3-Methyloctane	16	16	100	0.0	0.0	627	1,220	937	893	862	189
2216-34-4	4-Methyloctane	16	16	100	0.0	0.0	380	692	544	527	N/A	107
83-32-9	Acenaphthene	16	16	100	0.0	0.0	27	66	40	37	39	13
208-96-8	Acenaphthylene	16	16	100	0.0	0.0	10	29	16	14	N/A	4.9
92-52-4	Biphenyl	16	16	100	0.0	0.0	322	704	460	437	N/A	124

CASRN	Analyte	# Samples	# of Detections	Frequency of Detection (%)	Minimum Nondetect (mg/kg)	Maximum Nondetect (mg/kg	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Mode (mg/kg)	Standard Deviation (mg/kg)
132-65-0-C1	C1-Dibenzothiophenes BS	16	16	100	0.0	0.0	2.5	7.0	4.9	5.3	N/A	1.4
86-73-7-C1	C1-Fluorenes	16	16	100	0.0	0.0	9.9	19	14	14	14	2.7
91-20-3-C1	C1-Naphthalenes	16	16	100	0.0	0.0	3,920	8,270	5,196	5,130	4,050	1,264
132-65-0-C2	C2-Dibenzothiophenes	16	16	100	0.0	0.0	1.8	6.0	4.3	4.6	3.0	1.2
86-73-7-C2	C2-Fluorenes	16	16	100	0.0	0.0	4.8	11	7.7	7.8	N/A	1.6
91-20-3-C2	C2-Naphthalenes	16	16	100	0.0	0.0	2,880	6,640	4,081	3,885	N/A	1,208
91-20-3-C3	C3-Naphthalenes	16	16	100	0.0	0.0	897	1,890	1,156	1,040	N/A	304
91-20-3-C4	C4-Naphthalenes	16	16	100	0.0	0.0	139	264	173	166	N/A	34
124-18-5	Decane (C10)	16	16	100	0.0	0.0	15,100	26,800	21,106	22,200	N/A	3,961
132-64-9	Dibenzofuran	16	16	100	0.0	0.0	44	125	68	62	N/A	24
132-65-0	Dibenzothiophene	16	16	100	0.0	0.0	4.7	9.4	7.0	7.3	N/A	1.7
112-40-3	Dodecane (C12)	16	16	100	0.0	0.0	24,400	53,100	38,081	38,500	38,600	7,912
100-41-4	Ethylbenzene	16	16	100	0.0	0.0	281	552	426	426	N/A	78
86-73-7	Fluorene	16	16	100	0.0	0.0	31	81	43	36	N/A	15
142-82-5	Heptane	16	16	100	0.0	0.0	69	261	141	128	N/A	57
1077-16-3	Hexylbenzene	16	16	100	0.0	0.0	581	1,330	928	916	906	189
496-11-7	Indane	16	16	100	0.0	0.0	332	605	476	481	N/A	67
95-13-6	Indene	16	16	100	0.0	0.0	89	150	123	125	114	18
538-93-2	Isobutylbenzene	16	16	100	0.0	0.0	171	334	271	282	N/A	43
98-82-8	Isopropylbenzene	16	16	100	0.0	0.0	183	346	282	289	N/A	44
108-87-2	Methylcyclohexane	16	16	100	0.0	0.0	153	398	270	264	N/A	70
91-20-3	Naphthalene	16	16	100	0.0	0.0	1,830	3,470	2,965	3,075	N/A	482
104-51-8	n-Butylbenzene	16	16	100	0.0	0.0	873	1,580	1,300	1,310	N/A	213
124-18-5	n-Decane (C10)	16	16	100	0.0	0.0	15,600	25,500	21,869	22,500	N/A	3,071
112-40-3	n-Dodecane (C12)	16	16	100	0.0	0.0	36,500	55,700	48,188	48,900	47,000	5,629
544-76-3	n-Hexadecane (C16)	16	16	100	0.0	0.0	1,220	1,980	1,641	1,645	N/A	245
111-84-2	n-Nonane (C9)	16	16	100	0.0	0.0	4,900	7,180	6,100	6,025	N/A	672
111-84-2	Nonane (C9)	16	16	100	0.0	0.0	3,640	6,820	5,472	5,335	6,680	1,029
629-62-9	n-Pentadecane (C15)	16	16	100	0.0	0.0	5,960	10,000	7,591	7,545	N/A	1,091
538-68-1	N-Pentylbenzene	16	16	100	0.0	0.0	579	1,140	854	787	N/A	189
103-65-1	n-Propylbenzene	16	16	100	0.0	0.0	513	927	779	792	N/A	116
629-59-4	n-Tetradecane (C14)	16	16	100	0.0	0.0	16,200	22,500	18,556	18,450	16,200	1,988
629-50-5	n-Tridecane (C13)	16	16	100	0.0	0.0	29,700	44,300	35,275	33,650	32,000	4,312

CASRN	Analyte	# Samples	# of Detections	Frequency of Detection (%)	Minimum Nondetect (mg/kg)	Maximum Nondetect (mg/kg	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Mode (mg/kg)	Standard Deviation (mg/kg)
1120-21-4	n-Undecane (C11)	16	16	100	0.0	0.0	34,100	65,200	52,350	54,350	46,000	8,973
111-65-9	Octane	16	16	100	0.0	0.0	610	1,490	1,003	915	N/A	270
629-62-9	Pentadecane	16	16	100	0.0	0.0	5,140	8,180	6,559	6,355	N/A	903
85-01-8	Phenanthrene	16	16	100	0.0	0.0	4.3	9.0	6.7	6.6	6.6	1.1
135-98-8	sec-Butylbenzene	16	16	100	0.0	0.0	397	736	613	623	610	98
629-59-4	Tetradecane (C14)	16	16	100	0.0	0.0	10,100	19,100	15,338	15,300	14,600	2,556
108-88-3	Toluene	16	16	100	0.0	0.0	164	375	255	247	227	60
629-50-5	Tridecane	16	16	100	0.0	0.0	17,000	35,100	24,794	26,600	27,500	4,802
1120-21-4	Undecane	16	16	100	0.0	0.0	6,300	61,400	41,794	43,000	43,000	13,899
1330-20-7	Xylene (Total)	16	16	100	0.0	0.0	1,850	3,420	2,863	2,915	N/A	456