Field Study of Per- and Polyfluoroalkyl Substances Associated with Wastewater Treatment Plants, Landfills and AFFF-Release Sites in Hawai‘i

Hawai‘i Department of Health
Hazard Evaluation and Emergency Response

Prepared by: Roger Brewer, PhD,
Senior Environmental Scientist

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Summary of Updates

November 15, 2024:

- Figure 15a corrected.

Foreword

This report summarizes per- and polyfluoroalkyl substance (PFAS) data for Hawaii-specific environmental samples collected at six municipal wastewater treatment plants (influent, effluent and biosolids), five municipal landfills (leachate), a site with an accidental release of PFAS-containing Aqueous Film Forming Foam (AFFF) and an active fire training area where PFAS-containing AFFF is known to have been released (impacted soil and groundwater). Soil samples were collected in remote areas of Hawai′i in order to assess anthropogenic, background PFASs in the environment associated with atmospheric deposition. Samples were collected by Hawai'i Department of Health (HIDOH) staff or by staff of the subject facility or their consultant.

The study is intended to provide preliminary information on the nature and relative concentrations of PFASs at the types of facilities and release scenarios noted in general. The data represent a one-time snapshot of site conditions at the facilities included in the study and might not be reflective longer-term trends. An in-depth review of published data from similar studies has not been carried out. research Based on discussions with outside PFAS experts, however, the data are reflective of similar types of facilities (Lang et al. 2014; Vo et al. 2020, Kim et al. 2022). Additional sample data are also needed to confirm this conclusions presented in this study, particularly with respect to municipal wastewater treatment plants.

Calculations of health risk based on the sample data are used to characterize relative PFAS source strengths between the different types of facilities and operations. "Source strength" as used in this study refers to the general concentration and weighted toxicity of PFASs present in the media tested. Noncancer Hazard Indices calculated and are purely hypothetical in nature and are not intended to be reflective of actual exposure or health risks posed to facility workers or others who might temporarily come in contact with the media tested. Workers at wastewater treatment plants, landfills and fire training areas are trained in potential health hazards posed by hazardous substances and contaminated media that could be present at the facilities and methods to minimize exposure. Access to the facilities included in the study is strictly controlled. None of the facilities are known to pose a direct risk to drinking water resources.

The collection of additional samples from some or all of the facilities noted in this interim report is anticipated for early 2025. The report will be updated to incorporate additional data as well as insight gained from reviews of similar research published elsewhere. Comments and suggestions for future studies are welcome and should be provided to the below contacts.

Reference: *Field Study of Per- and Polyfluoroalkyl Substances Associated with Wastewater Treatment Plants, Landfills and AFFF-Release Sites in Hawai'i*: Hawai'i Department of Health, Hazard Evaluation and Emergency response Office, November 2024.

Contacts: Roger Brewer(roger.brewer@doh.hawaii.gov), John Jacob (john.jacob@doh.hawaii.gov)

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Study Design

This report presents a snapshot of per- and polyfluoroalkyl substances (PFASs) in: 1) Municipal wastewater treatment plant (WWTP) influent, effluent and biosolids; 2) Landfill leachate and 3) Soil and groundwater impacted by releases of Aqueous Film Forming Foam (AFFF). The study included the collection and analysis of samples from six municipal WWTPs, five landfills and two AFFF-release sites. Additional soil samples were collected from nine remote areas of the islands in order to evaluate potential widespread atmospheric deposition of PFASs from sources outside of Hawaii.

Three groupings of PFASs were utilized for assessment of cumulative risk posed by complex mixtures of PFASs to human health and the environment: 1) Primary Terminal PFASs such as $PFOS^-$, $PFHxS^-$ and $PFOA^-$ originally present in a sample, 2) Secondary Terminal PFASs generated by Total Oxidizable Precursors (TOPs) oxidation and breakdown of precursor compounds present in the sample and 3) Excess Fluorine PFASs identified by comparison of predicted versus measured total Organic Fluorine (TOF) in the sample. Consideration of the full suite of analytical methods necessary to identify and evaluate each group of PFASs is recommended during the initial stages of a PFAS investigation. More focused testing can be carried out during later states of an investigation as key PFASs anticipated to drive health risk and remedial actions are identified.

Calculations of Total PFAS Risk presented in this study are purely hypothetical and do not reflect actual risk to human health posed by exposure to PFASs at the facilities noted. The results are intended to help assess the general, relative source strength of PFAS between the different scenarios investigated and assist in development of future HIDOH guidance and regulations. “Source strength” as used in this study refers only to the concentration and weighted toxicity of PFASs present in the media tested.

Wastewater Treatment Plants

In short, WWTP influent, effluent and biosolids were characterized by relatively low concentrations of less toxic, short-chain PFAS compounds. Health risk posed by largely hypothetical, regular exposure to PFASs in these media is estimated to likewise be relatively low. Biosolids at most facilities are disposed of in municipal landfills. Past use of biosolids in composting operations has largely ceased.

Effluent is directly discharged to the ocean, injected into coastal groundwater which ultimately drains to the ocean or used for irrigation of landscaped areas and golf courses. The use of effluent for irrigation of agricultural fields where food crops are grown requires additional research. Concentrations of PFASs in effluent are well below published levels that could pose acute or chronic toxicity to aquatic organisms. Uptake of PFASs and biomagnification in the food chain could be a concern in areas where effluent is discharged into bodies of water with limited circulation, particularly freshwater lakes or streams. Although the data are limited, levels of PFASs that could pose potential human health concerns have not been reported in fish caught in the vicinity of the Hawaiian islands (HIDOH 2024a).

Although the types and concentrations of PFASs in WWTP effluent appear to pose a relatively low health risk, additional research on the potential uptake of PFASs into food crops is warranted. This is particularly important given calls in water-limited areas of the islands for an increased used of WWTP effluent for irrigation.

The types, concentrations and toxicities of PFASs present in influent, effluent and biosolids at WWTPs that receive a greater proportion of wastewater from industrial facilities could differ significantly from those described for municipal facilities. This includes operations that receive wastewater from activities that involve regular use of AFFF. Potential risks to human health and the environment posed by PFASs could be higher for these facilities than estimated in this study and require separate investigation.

Landfills

Concentrations of PFASs in samples of leachate collected from municipal landfills were significantly higher than those reported for WWTPs and included a greater proportion of more toxic, longer-chain compounds. The landfills evaluated are located in coastal areas and do not threaten sources of drinking water. Existing engineering and operational controls, including liners, maintenance of cover and measures to manage stormwater runoff, further minimize the risk of adverse environmental impacts. The majority of PFASs detected in the leachate are likely related to the disposal of treated textiles, carpet and other manufactured materials at the landfills.

Disposal of WWTP biosolids at landfills is unlikely to affect the nature and concentration of PFASs in leachate given the large volume of municipal waste disposed of at the landfills on a daily basis and PFASs present inherently present in this material. Leachate periodically removed from landfills is in some cases disposed of at WWTPs. Strict controls on the volume of leachate that can be disposed of at a WWTP in comparison to the large volume of daily influent negates significant changes in the concentration and type of PFASs that ultimately end up in the facility biosolids and effluent.

AFFF-Release Sites

Soil and groundwater impacted by releases of AFFF were characterized by much higher concentrations of PFASs and a greater proportion of longer-chain, more toxic compounds. The sample data indicate PFAS-containing AFFF could pose a significant threat to groundwater that is a source of drinking water. This includes the potential long-term leaching of residual PFASs from impacted soil.

The majority of fire training areas across the islands, including the site included in this study, are fortunately located in coastal areas that do not threaten a drinking water source. Concentrations of PFASs in groundwater at the study site were well above published criteria for potential acute and chronic toxicity to aquatic organisms. Although concentrations quickly decrease away from the immediate release area, additional investigation of potential impacts to aquatic habitats are warranted at such facilities.

Atmosphere Deposition of PFASs

PFASs were not identified in 8 of 9 soil samples collected in remote areas of the Hawaiian Islands. A trace level of the compound perfluorobutanoate was reported for a single sample collected downwind of an urban area. Overall, however, the sample data suggest minimal, large-scale, atmospheric deposition of PFASs across Hawaii from global sources.

1.0 Introduction

1.1 Study Objectives

This report summarizes Hawaii-specific data for per- and poly-fluoroalkyl substances (PFASs) associated with samples collected from municipal wastewater treatment plants (influent, effluent and biosolids), landfills (leachate) and sites where PFAS-containing Aqueous Film Forming Foam (AFFF) has been inadvertently or intentionally released (soil and groundwater). Samples of influent, effluent and biosolids were collected from six municipal WWTPs, including one each on the islands of Kauai, Maui and the Big Island (Island of Hawaiʻi) and three WWTPs on the island of Oʻahu. Leachate samples were collected from five landfills on the same islands. Soil samples were collected from an AFFF-release site on O'ahu. A sample of the AFFF concentrate released was also collected and tested. Both soil and groundwater samples were collected at an active fire training facility on the island of Maui. Background soil samples were collected from nine remote areas of the islands with no known, nearby sources of PFASs.

Staff with the Hawaiʻi Department of Health (HIDOH), Hazard Evaluation and Emergency Response (HEER) Office collected samples of biosolids from each of the WWTPs and samples of soil from the AFFF-release sites. All other samples were collected by staff of the subject facility or their consultant.

The study was carried out in two phases. In Phase 1, testing of samples was limited to standard laboratory methods for PFASs. The types of laboratory methods employed was expanded in Phase 2 of the study to include processing of samples using Total Oxidizable Precursors (TOPs) methods, testing for Total Organic Fluorine (TOF) and allowing optional Non-Targeted Analysis of samples. The added tests allowed identification of additional PFASs in samples that could be overlooked using standard methods.

Investigation Questions used to assist in design of the study included:

1. What is the relative makeup of PFASs in environmental media associated with WWTPs, landfills and AFFF-release sites?

2. What is the relative source strength of each scenario in terms of the total concentration of PFAS present and the corresponding hypothetical risk to human health and the environment?

"Source strength" in this context refers to the overall concentration and average toxicity of PFAS mixtures under the different, study site scenarios. Data based on different sampling methods are not necessarily comparable, for example 24-hour composite samples of wastewater versus one-time grab samples of groundwater, but still useful for ranking the hypothetical risks posed by PFASs under the different scenarios investigated.

Additional PFAS studies specific to Hawaiʻi are posted to the HEER Office PFAS webpage (https://health.hawaii.gov/heer/environmental-health/highlighted-projects/pfas/). Environmental Action Levels (EALs) and guidance for assessment of the environmental risk posed by PFASs in soil, water, air and other media are published separately in the document *Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances* (HIDOH 2024b). A copy of this document is provided in Appendix 1. Physiochemical constants and toxicity factors compiled for individual PFASs are included in the guidance. The PFAS EAL guidance represents an extension of the HEER Office document *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* (HIDOH 2024c).

1.2 Terminology

The compound naming convention for perfluoroalkyl and polyfluoroalkyl substances (PFASs) recommended by Buck et al. (2011) is generally adhered to for the purposes of this memorandum. Both the singular and plural acronyms "PFAS" and "PFASs" are used. A singular term and acronym is appropriate in cases when the term is used as an adjective, such as "PFAS Environmental Action Levels" and "PFAS manufacturing facilities." Other examples include use of the singular form as the subject noun in statements such as "The specific, precursor PFAS associated with the presence of 5:3 fluorotelomer carboxylate (5:3 FTCA) in biosolids is unknown." The plural form is appropriate when the group of compounds in general is the subject noun, for example "Environmental Action Levels for PFASs" or "Manufacture of PFASs."

The text and tables in this report utilize the dissociated, anion terms for the compounds rather than acid forms of the compounds due to the anticipated dominance of the former in both water and biosolid samples (HIDOH 2024b). A superscript "-" is added to the abbreviations used in this report to denote reference to the anion.

2.0 Study Sites

2.1 Wastewater Treatment Plants

Selected Facilities

Table 1 provides a summary of the nature and operation of WWTPs included in the study. Samples of influent, effluent and biosolids were collected from six WWTPs, on the islands of Kauai, O'ahu, Maui and Hawai'i (Big Island). An Identification Number assigned to each site is noted in the table and in most cases used throughout the report, rather than the name of the specific facility.

The Kihei WWTP (WWTP #3), Hilo WWTP (WWTP #4), Lihu'e WWTP (WWTP #5) and La'ie WWTP (WWTP #6) receive wastewater from primarily residential and commercial areas. The Sand Island WWTP (WWTP #1) and Hono'uli'uli WWTP (WWTP #2) additionally receive water from light industrial operations. The Sand Island and Hono'uli'uli WWTPs receive an average of 30-40,000 gallons per month of leachate and condensate from landfills and are restricted to receipt of no more than 12,000 gallons of leachate and condensate on a given day, up to three times per week. This is dwarfed by the 25 to 150 million gallons of influent flowing into the WWTP on a daily basis (refer to Table 1). Assuming a worst-case disposal of the leachate over a single day, for example, implies a minimum two-thousand-fold dilution of PFASs following mixing with influent water.

The remaining four WWTPs do not routinely receive leachate from a landfill. None of the WWTPs receive wastewater from industries that manufacture PFASs or use significant amounts of PFASs in their operations.

Wastewater Flow Rates

Average daily influent flow rates ranged from a high of 50 to 150 million gallons per day (MGD) at the largest WWTP (Sand Island) to 0.5 MGD at the smallest facility (La'ie). Two of the WWTPs had primary, secondary and at least partial tertiary treatment (Hono'uli'uli and La'ie). Four of the WWTPs had primary and secondary treatment (Kihei, Hilo and Lihu'e). The largest facility had only primary treatment at the time of sample collection but is currently undergoing expansion to add secondary treatment.

Effluent is discharged to the ocean at two of the six WWTPs and not used for other purposes (Sand Island, Hilo). Effluent (R1) is used for irrigation of landscaping, golf courses and agricultural fields at the Kihei WWTP and for partial irrigation of landscaping and agricultural fields at an additional three facilities (Hono'uli'uli, Lihu'e and La'ie). Effluent not used for irrigation is discharged into an injection well at the Lihu'e WWTP, into a leach field at the La'ie WWTP and into the ocean at the Hono'uli'uli WWTP.

Leachate from the Waimanalo Gulch landfill as well as the Kapa'a and Kalaheo landfills (not included in the study) is disposed of at the Hono'uli'uli WWTP and/or the Sand Island WWTP. A discharge limit of 12,000 gallons of leachate per day and 3,000 gallons of condensate per day up to three times per week is imposed on the WWTPs. This represents well under 1% of the volume of influent received by the WWTPs on a given day.

Biosolids Generation

Biosolids are dried and pelletized at the Sand Island WWTP. The facility generates a dry-weight average of approximately 35 tons of pellets per week, reflecting 66% of the total biosolids generated at the facility (2023 data). The majority of the remaining biosolids is disposed of at a municipal landfill (28%), with a small fraction (6%) disposed of at a waste-to-energy facility on the island. Biosolids remain in wet form

at the remaining WWTPs and consist of 80-90% water. The wet-weight mass of biosolids generated at these facilities ranges from 140 tons per week at the Hono'uli'uli WWTP to less than 10 tons per week at the La'ie WWTP.

Biosolids from the Hono'uli'uli WWTP were formerly used in the preparation of compost but are now disposed of at a municipal waste-to-energy incinerator and a municipal landfill. Ash from the incinerator is disposed of at the Waimanalo Gulch municipal landfill. Biosolids are used to prepare compost for onsite reuse at the La'ie WWTP. The remaining WWTPs have historically lacked composting operations due to the relatively small amount of biosolids generated and economic considerations. Biosolids are instead disposed of at a municipal landfill.

2.2 Landfills

Table 2 provides a summary of the nature and operation of landfills included in the study. Number assigned to each site is noted in the table and in most cases again used throughout the report, rather than the name of the specific facility. Leachate samples were collected from the Waimanalo Gulch Landfill (LF #1) and PVT landfill (LF #2) on the island of O'ahu (LF #1 and LF #2), the Central Maui landfill on the island of Maui, the West Hawai'i landfill on the Big Island (LF #4) and the Kekaha landfill on the island Kauai (LF #5). The landfills are operated under permits granted by HIDOH. Study of these areas focused on testing of landfill leachate for PFASs.

The depth to groundwater beneath the landfills varies from a few tens of feet to several hundred feet. All active landfills in Hawai'i are located oceanward of the Underground Injection Control Line and do not overlie or directly threaten groundwater that is a current or potential source of drinking water.

There are no permitted, hazardous waste landfills in Hawai'i. Four of the five landfills only receive municipal waste. The PVT landfill primarily receives construction debris related to building demolition or renovation. Contaminated soil generated during property redevelopment (construction) and not classifiable as hazardous waste may be disposed of at the landfill. Contaminated soil not classifiable as hazardous waste may also be disposed of at the other landfills. The volume and mass of soil disposed of at the facilities is relatively small in comparison to the volume and mass of disposed, municipal waste. Large amounts of soil associated with the targeted cleanup of PFAS-contaminated sites are not known to have been disposed of at any of the landfills.

The volume of waste disposed of at the landfills varies from a peak of 4,700 tons per day at the Waimanalo Gulch landfill to a low of 200 tons per day at the Kekaha landfill (refer to Table 2). The Waimanalo Gulch landfill receives an average of 1,200 tons of ash per day from a municipal waste-to-energy incinerator and up to 1,400 to 3,500 tons of unincinerated, municipal waste. Ash is disposed of in separate cells of the landfill.

2.3 AFFF Release Sites

Two sites with known releases of AFFF were selected for sample collection. Study of AFFF Release Site #1 focused on testing of soil for PFASs. Study of AFFF Release Site #2 focused on testing of both soil and groundwater.

Release Site #1 is associated with soil impacted by a release of concentrated AFFF at the US Navy Red Hill Fuel Storage Facility on the island of O'ahu. The main mass of impacted soil was excavated within a few days of the release. The area was immediately paved after excavation in order to prevent potential direct

exposure and leaching concerns from any remaining contamination. Data for confirmation soil samples collected by HIDOH staff prior to the completion of soil removal activities are referenced in this report and might not be reflective of final site conditions.

Release Site #2 is an active fire training area at a the Kahului municipal airport on the island of Maui. The training area has been in use since 1977. The fire pit was lined in 1997 and the surrounding area paved. Groundwater is situated 10 to 15 feet beneath the ground surface. The vadose zone is primarily characterized by a highly permeable, unconsolidated, carbonate sand with a variety of fill material in the immediate training pit area. Data for soil and groundwater samples collected by HIDOH and airport consultants are referred to for use in this report. The groundwater is not a current or potential source of drinking water.

3.0 Decision Unit Designation and Investigation Questions

3.1 Wastewater Treatment Plants

Wastewater

The volume of influent and effluent passing through a WWTP over a 24-hour period was designated as the Decision Unit (DU) for sample collection (Figure 1). A time period of 24 hours was selected in order to capture any temporally heterogeneity during a day and to accommodate the sample collection system already available at most of the WWTPs.

Assessment of toxicity-related risk associated with theoretical impacts to drinking water aquifers and aquatic habitats focuses on dissolved-phase concentrations of contaminants in water (HIDOH 2024c). As such, the designation of wastewater DUs excludes suspended sediment in the water. This required removal of suspended sediment from the samples (see Section 5.1). Both unfiltered and filtered samples of wastewater were, however, analyzed during Phase 1 of the study in order to assess the relative proportion of PFASs bound to suspended sediment versus dissolved or in colloidal form. Testing of unfiltered samples was omitted in Phase 2 of the study due to the lack of significant differences with filtered sample data in Phase 1.

Biosolids

The DU volume of biosolids was designated to approximate the volume of biosolids generated during a single day at a WWTP, matching the influent and effluent DU volumes. A corresponding particle size of <2mm was also designated. This reflects the particle size targeted for assessment of health risk associated with direct exposure to contaminants in soil or other particulate matter (HIDOH 2024c,d).

Clarifiers are used to allow solids to settle from wastewater and be collected (Figure 2). Daily DU masses of biosolids associated with five of the six WWTPs that generate wet biosolids ranged from 1 to 20 tons (refer to Table 2; average 80-90% moisture). The Sand Island WWTP generates approximately 10 tons of dried biosolid pellets per day. This equates to a production of approximately 65 tons of wet biosolids per day, assuming an original moisture content of 85% typical of the other facilities.

Biosolids at the facilities were in most cases stored in roll-off bins capable of holding 20 to 30 cubic yards (15 to 30 cubic meters) of material (Figure 3). The thickness of biosolids in the bins at the time of sample collection ranged from 1 to 1.5 meters. The mass of biosolids present in the bins at the time of sample collection was estimated by WWTP workers to range from 10 to 20 metric tons. This roughly approximated the daily volume of biosolids generated at the Hono'uli'uli WWTP but exceeds the daily mass of biosolids generated at the smaller WWTPs (refer to Table 2).

Biosolids from the Kihei WWTP at the time of Phase 2 of the study were used as an amendment at a green-waste compost facility. An approximately 20-ton stockpile of biosolids to be used in compost was present at the facility and designated as a hypothetical Exposure Area DU for sample collection. Use of the biosolids in compost has since been discontinued, with biosolids now disposed of at a municipal landfill.

An approximately 100 cubic yard stockpile of compost was available for sample collection at the La'ie WWTP (Figure 4). The compost was made with a 3:1 mixture of green waste to compost. The stockpile was designated as a hypothetical Exposure Area DU for sample collection for the purposes of this study.

3.2 Landfills

The volume of fluids in leachate collection systems in individual cells of the five, lined landfills included in the study was designated as the DU for sample collection and characterization. The actual volume present was unable to be estimated, however. As noted in Section 4.2, collection of leachate that could reliably be assumed to be representative of the volume of leachate present in an individual cell of the landfill as a whole was not practical.

As noted for testing of wastewater, assessment of hypothetical risk and comparison of the resulting data to risk-based action levels for drinking water focuses on dissolved-phase PFASs in the water. Both unfiltered and filtered samples of leachate were, however, analyzed as part of Phase 1 of the study. Testing of unfiltered samples was again excluded in Phase 2 of the Study due to the lack of significant difference of filtered versus unfiltered sample data in Phase 1.

3.3 AFFF Release Sites

The upper based of a shallow, 600 square foot trench excavated to remove AFFF-impacted soil was designated as a hypothetical Source Area Decision Unit at Red Hill Fuel Storage Facility (Release Site #1; Figure 5). The upper two to four inches of soil was targeted for sample collection. As noted in Section 2.3, the trench was subsequently backfilled and paved over. Comparison of sample data to risk-based action levels in Section 8 of this report is therefore purely hypothetical and intended only to assess the potential overall source strength of these types of releases.

A 3,200 square foot grassy area located beside asphalt pavement surrounding the fire training pit at the Kahului Airport Fire Training Area (Release Site #2) was designated as a hypothetical Exposure Area Decision Unit for characterization (Figure 6). The upper two to four inches of soil was targeted for sample collection. Access to the area within the airport is restricted by fencing and strictly controlled. Comparison of sample data to risk-based action levels in Section 8 of this report is again purely hypothetical.

The <2mm particle size fraction of soil was specified for testing. This reflects the particle size targeted for assessment of health risk associated with direct exposure to contaminants in soil or other particulate matter (HIDOH 2024c,d).

3.4 Background Soil

The Investigation Question developed to assess potential widespread, anthropogenic background concentrations of PFASs in soil is "Has atmospheric dispersion from distant sources led to widespread, detectable levels of PFASs in soil in remote areas of the Hawaiian Islands?" A total of nine remote areas on Kauai, O'ahu, Maui and the Big Island were selected for investigation collection. Site locations are summarized below and depicted in Figure 7.

Sample ID	Location
KOKEE-BCKG	Koke'e State Park, Kauai
KP-BCKG	Ka'ena Point, O'ahu
NPALI-BCKG	Nu'uanu Pali, O'ahi
MP-BCKG	Makapu'u, O'ahu
POLI-PFAS-BCKG	Polipoli State Recreation Area, Maui

MAK-PFHI-BCKG	Pu'u One'uli
ML#1-PFAS-BCKG	Mauna Loa, Big Island
KUD-PFAS-BCKG	Ka'u Desert, Big Island
MAK-PFHI-BCKG	Kaloli Point, Big Island

A single DU ranging from 5,000 to 10,000 square feet in size was designated at each location for the collection of a soil sample. The upper two to four inches of soil was targeted for sample collection. The <2mm particle size fraction of soil was again specified for testing and comparison of data to risk-based action levels.

The study areas included native forests, scrub growth coastal areas, rocky points overlooking the ocean, arid deserts and a forest abutting 2,000-foot-high cliffs over an urban area. Study sites were selected in collaboration with Element Environmental in Honolulu. None the sites had been disturbed by development or other land altering activities in recent history. An effort was made to stay well away from hiking trails and focus on areas where few, if any, people are anticipated to have regularly entered.

4.0 Sample Collection

Sample collection and data summaries are discussed in terms of the identification code assigned to each facility:

Facility Type	Report Code	Facility
Wastewater Treatment Plants	WWTP #1	Sand Island WWTP
	WWTP #2	Hono'uli'uli WWTP
	WWTP #3	Kihei
	WWTP #4	Hilo
	WWTP #5	Lihu'e
	WWTP #6	La'ie
Landfills	LF #1	Waimanalo Gulch Landfill
	LF #2	PVT
	LF #3	Central Maui
	LF #4	West Hawaii
	LF #5	Kekaha
AFFF Release Sites	AFFF #1	Navy Red Hill Fuel Storage Facility
	AFFF #2	Maui Airport Fire Training Area

The sample collection reflects a one-time snapshot of PFASs at the facilities and might not be reflective of longer-term trends.

Samples were collected in two phases of field work from 2021 to 2023 depending on field access and logistics and review of initial data for potential modification of analytical methods. Samples of influent, effluent and biosolids were collected from WWTP #3, WWTP #4 and WWTP #5 in September and October of 2021. A second phase of sample collection was carried out at WWTP #1, WWTP #2 and WWTP #6 in September of 2023. Samples of leachate were collected from Landfill #2, Landfill #3, Landfill #4 and Landfill #5 in September and October 2021. Samples were collected from Landfill #1 in December 2023. Samples of soil were collected from AFFF Release Site #1 in December 2022. A sample of the AFFF concentrate released from the site was obtained in May 2023. Samples of soil and groundwater were collected from AFFF Release Site #2 in September 2022. Background soil samples were collected from various locations in the islands during August and September 2023.

All samples of liquids and solids were collected, processed and tested in accordance with the HIDOH *Technical Guidance Manual* (HIDOH 2024d). An effort was made to collect Multi Increment® samples of solids whenever possible. (Multi Increment® is a trademark of Envirostat, Inc.)

4.1 WWTPs

Samples of influent, effluent and biosolids were collected from each the six WWTPs. The sample collection method was intended to approximate the nature and concentration of PFASs in the influent, effluent and biosolids generated during a random, 24-hour time period. Facility operators estimated that the biosolids being collected and disposed of at the time the samples were collected were associated with wastewater that had entered the plant approximately two weeks earlier.

Influent and Effluent

Single, twenty-four hour samples of the influent and effluent were collected by WWTP staff using a composite sampler and provided to HDOH for shipping and analysis (Figure 8). Samples were collected

on the same day and during the same approximate time period. All samples were collected on a weekday. Tubing on sample composite sampler pumps was replaced with new, Tygon tubing immediately before sample collection. An exception was the collection of grab sample of influent at WWTP #5 due to problems with the composite sampler equipment. Equipment blanks were collected and tested from both the influent and effluent samplers by running tapwater anticipated to be free of PFASs through the pump.

New, HDPE bottles shipped to HIDOH by the laboratory were provided to the WWTP facility for collection of samples. Samples were then delivered to HIDOH and, per recommendations by the laboratory, frozen prior to shipment for analysis.

Biosolids, Compost and Compost-Amended Soil

A roll-off bin containing an estimated 10 to 20 tons of biosolids was available for sampling at four of the six WWTPs (see Figure 3). Access to deeper area of the bins was not practical due to the heavy nature of the material, the inability to spread the material out into a thin layer and tools available for sample collection. A 2-3 kg, 30- to 40-increment sample was instead collected from the upper 10cm of exposed biosolids, representing an estimated 2 to 3 tons of material using a new, disposal, plastic scoop or pre-cleaned, stainless-steel scoop. Samples were placed in a new, heavy-duty, LDPE freezer bags. Triplicate samples were collected at WWTP #3. A single sample was collected at each of the remaining four WWTPs.

The collection of grab samples was required at WWTP #1 and WWTP #6. Separation of a ten-ton DU of dried pellets of biosolids at WWTP #1 for the collection of a Multi Increment sample was not practicable due to the nature of the facilities operations. A 3-4 kg grab sample of the pellets being extruded from the pelletizer equipment was instead provided to HIDOH by the facility operators and placed in a new, heavy-duty, LDPE freezer bag (Figure 9).

A single grab sample was collected from the WWTP #6 due to the lack of stored biosolids when the facility was visited. A second grab sample of dried, biosolid pellets was collected from the Sand Island WWTP during Phase 2 of the study in order to run additional analyses on the material. Data from this sample are carried forward for reference in this report.

A single, 30-increment, 3-4 kg sample of cured compost made of an approximately 100 cubic yard, 3:1 mixture of green waste and biosolids was also collected from the WWTP #6 (see Figure 4). Sample increments were collected from the surface and shallow pits dug into the compost due to lack of time and heavy equipment to spread the material out into a flatter and more accessible pile. The sample was placed in a new, heavy-duty, LDPE freezer bag.

4.2 Landfills

Samples of leachate were collected by landfill operator staff or their consultant from existing wells installed in individual cells of the landfills. Three samples of leachate were collected from the LF #1, two from cells that receive municipal waste and one from a cell that receives ash from a municipal waste-to-energy incinerator. One sample of leachate was collected from LF #2, a construction debris landfill. Three samples of leachate were collected from separate cells of LF #3. Four samples of leachate each were collected from separate cells of LF #4 and LF #5 landfill.

A bailer was used to collect sample at each of the facilities. Sample were placed in HDPE bottles originally shipped to HIDOH by the laboratory and forwarded to the facility. The samples were then delivered to

HIDOH and frozen prior to shipment to the laboratory for analysis. Equipment blanks were also collected and provided to HIDOH for shipping and testing.

Access to the full volume of leachate in targeted cells of the landfills was limited to a single monitoring well. The representativeness of the sample for the full, DU volume of leachate present within a given cell of the landfill is uncertain. Resulting data are, however, considered useful for identification of the general makeup and relative magnitude of PFAS contamination in the leachate.

4.3 AFFF Release Sites

Release Site #1

Four Source Area Decision Unit (DU) areas of soil impacted by a 2022 release of concentrated AFFF were designated for the collection of Multi Increment samples (refer to HIDOH 2024d). The areas ranged from a few hundred square feet to less than ten square feet in size. Decision Units DU2 and DU3 were in closest proximity to the original release area. Decision Units 4a and 4b were located at the furthest extent of anticipated contamination. Samples were collected after initial excavation of each area had already occurred.

A trowel was used to collect single, approximately 2 kg, 40-increment of gravelly, clayey soil from the upper two to four inches of the base of the four Source Area DUs designated (see Figure 5). Increments were collected in a systematic random manner along the entire length of the excavation. The samples were placed in new, heavy-duty freezer bags and frozen prior to shipment to the laboratory for analysis.

Release Site #2

A single, Exposure Area DU (HIDOH 2024d) was designated for a grassy area adjacent to a fire training pit where workers might gather on occasion. A trowel was used to collect triplicate 2 kg, 45-increment samples from the upper two to four inches of gravelly, sandy soil of the DU (see Figure 6). Triplicate samples (primary and two replicates) were collected from independent increment locations within the (Samples "DU5D", " DU5E" and " DU5F"). Samples were placed in heavy-duty, LDPE freezer bags and frozen prior to shipment to the laboratory for analysis.

A HydraSleeve was used to collect samples of groundwater from eight, existing monitoring wells around and downgradient of the fire training pit area. Wells were purged prior to sample collection. Samples were placed in bottles provided by the laboratory and frozen prior to shipment for analysis. A single equipment (HydraSleeve) blank was collected during collection of the groundwater samples.

4.4 Background Soil

Background soil samples were collected from targeted locations on the islands in September and October 2023 (see Figure 7). A clean trowel was used to collect a single, 30- to 40-increment, 2 to 3 kg Multi Increment sample at each locations. Increments were collected from the upper two to four inches of soil. An effort was made to ensure that the increments were evenly collected across the full interval and not wedge shaped. Samples were placed in heavy-duty, LDPE heavy duty freezer bags and frozen prior to shipment to the laboratory for analysis.

Samples from Kauai and Maui were collected by Element Environmental, as was the sample from Kaloli Point on the Big Island (see Figure 7). The remaining two samples on the Big Island were collected by HIDOH staff. Staff from HIDOH and Element Environmental jointly collected samples on the Island of O'ahu.

5.0 Sample Processing and Analysis

Table 3 summarizes analytical methods used to test samples collected during the study. An overview of laboratory analyses for each suite of compounds is provided below. Analysis of WWTP influent, effluent and biosolids, landfill leachate and soil samples from the AFFF release sites was carried out by SGS-AXYS laboratory using SGS Methods MLA110, MLA111, MLA119 and MLA120. Method MLA110 is an isotope dilution LC-MS/MS analysis equivalent to USEPA Method 1633. Method MLA120 is specific to a short list of ultrashort PFAS compounds. Method MLA 111 incorporates Total Oxidizable Precursors (TOPs) processing of the sample prior to analysis. An option for the use of Non-Targeted Analysis (NTA) was retained for identification of additional PFASs in samples (proprietary method offered by Eurofins).

Method MLA119 is used to determine total Absorbable Organic Fluorine (AOF) for liquids and total Extractable Organic Fluorine (EOF) for solids. Samples of groundwater from AFFF Release Site #2 were analyzed by Eurofins Laboratory using pre- and post-TOPs USEPA Method 537M. Testing of all biosolids as well as soil samples from AFFF Release Site #2 using the Synthetic Precipitation Leaching Procedure (SPLP; USEPA Method 1312) was carried out by SGS. The SPLP test is used to estimate a sorption coefficient "Kd" that describes how tightly bound a specific chemical is to the matrix tested by comparison of the concentration of the chemical in the leachate solution to the original concentration of chemical in the soil (Kd = Concentration in Soil/Concentration in SPLP Solution; HIDOH 2017). A Leachate solution was tested using MLA110 and MLA111. Eurofins carried out additional Absorbable Organic Fluorine (AOF; USEPA Method 1621) analysis of samples of WWTP effluent, groundwater from AFFF Release Site #2 and SPLP leachate for biosolid samples collected during the second phase of the study.

Anionic forms of the PFAS compounds are initially measured by the laboratory. Protocols in the USEPA analytical protocols referenced, however, recommend that the data be converted to the acid form of the compound for presentation in the final laboratory report. The rational for conversion of the anion data to the equivalent acid form of the compound is uncertain but presumably is related to initial preparation of the lab methods for testing of original, acid forms used in manufactured PFAS-based products. Anion forms of the compounds are predicted to dominate in environmental samples, however, due to removal of the hydrogen atom from the original hydroxyl radical in the presence of water (see HIDOH 2024b). The resulting increase in the reported concentration due to conversion of the original anion data to an acid form is insignificant but could cause confusion regarding the true nature of contamination present and the fate and transport of the PFAS compounds in the environment. Anion forms of the compounds are therefore utilized in the data summary tables. The anion forms are also referenced in the HIDOH EALs (HIDOH 2024b).

5.1 WWTP Samples

Both filtered and unfiltered samples of wastewater influent and effluent liquids were tested during Phase 1 of the study project (WWTP #3, WWTP #4, WWTP #5). Removal of suspended sediment from the samples was carried out at the laboratory using a fluorine-free, 0.45 µm filter. Samples of soil, biosolids and compost were air dried to a moisture content of <10% and sieved to <2mm. Manual methods were used to collect systematic random, 30-increment, 10-gram subsamples of soil and compost for analysis. A similar method was used to collect subsamples of biosolids. The mass of the subsample that could be tested was limited to 5 grams, however, due to the high organic content of the biosolids.

Samples of wastewater and biosolids collected during Phase 1 of the study were tested for 39 PFASs by SGS laboratory using Method MLA110 (Table 4; WWTP #3, WWTP #4, WWTP #5). An additional compound, perfluoro-3,6-dioxaheptanoic acid, was reported in Phase 2. Testing of samples using TOPs methods was limited to samples of biosolids using SGS Method MLA111. All samples of influent, effluent and biosolids were tested using TOP in Phase 2 of the study (WWTP #1, WWTP #2, WWTP #6). Samples of wastewater were additionally tested for Absorbable Organic Fluorine (AOF) by Eurofins using Method USEPA Method 1621. Samples of biosolids collected during Phase 2 were additionally tested for Extractable Organic Fluorine (EOF) using SGS Method MLA119.

Synthetic Precipitation Leaching Procedure (SPLP) analysis (Method 1312) was carried out on samples of biosolids. The SPLP leachate solution was tested for Pre-TOPs and Post-TOPs PFASs using SGS Methods MLA110 and MLA111. Leachate samples from the Phase 2 WWTPs were tested for Absorbable Organic Fluorine (AOF) by Eurofins using USEPA Method 1621. A sample of biosolid pellets from the Sand Island WWTP was submitted for Method 1314 Soil Column Leaching test. The results of the test were inconclusive, however, due to near complete dissolution of the pellets in the soil column.

Analysis of the influent, effluent and SPLP leachate for ultrashort PFASs for Phase 2 facilities was subsequently requested when this became available later in the study. Data for ultrashort PFAS in SPLP leachate are pending as of the date of this report and will be added in future updates.

An option for the use of Non-Targeted Analysis was included for all samples. Although not quantitative, the analysis allows identification of PFASs in a sample that are not otherwise reported by standard laboratory methods. A decision to carry out Non-Targeted Analysis of a sample was to be made based on a review of the sample chromatogram and comparison of measured TOF data to the concentration of TOFs predicted based on Primary and Secondary PFASs.

5.2 Landfill Leachate Samples

Samples of landfill leachate collected during Phase 1 of the study (LF #3, LF #3, LF #4, LF #5) were submitted to SGS laboratory for analysis of the same suite of Pre-TOPs and Post-TOPs compounds as noted for WWTP influent and effluent samples (refer to Table 3 and Table 4). Testing of both filtered and unfiltered samples was requested. Removal of suspended sediment from the samples was carried out at the laboratory using a fluorine-free, 0.45 µm filter.

Only filtered samples of landfill leachate were tested during Phase 2 of the study (WWTP #1). Absorbable Organic Fluorine analysis of the samples was also carried out. Optional testing using Non-Targeted Analysis was included for each sample.

5.3 AFFF Release Site Samples

Samples of soil collected at AFFF Release Site #1 and AFFF Release Site #2 were air dried to a moisture content of <10% and sieved to <2mm. Manual methods were used to collect systematic random, 30-increment, 10-gram subsamples of soil for analysis. Sample were tested using SGS Method MLA110 and TOPs metho MLA111. Non-Target Analysis was carried out for a sample of AFFF concentrate collected from Release Site #1 (3% Ansul concentrate).

Soil samples collected at AFFF Release Site #2 were processed and analyzed in the same manner as described for Release Site #1. Samples were additionally tested for Extractable Organic Fluorine (EOF) using SGS Method MLA119. Each of the triplicate soil samples was tested using SPLP methods. Leachate

was tested for both Pre-TOPs and Post-TOPs PFASs as well as Absorbable Organic Fluorine. One of the three triplicate samples was submitted for leaching analysis using Soil Column Method 1314. Optional testing using Non Targeted Analysis was included for each sample, including SPLP leachate. Analysis of the samples for ultrashort PFAS was not available prior to disposal of the samples by the laboratory.

The laboratory removed any suspended sediment in groundwater samples collected from AFFF Release Site #2 using a fluorine-free, 0.45 µm filter. Samples were analyzed for Pre-TOPs and Post-TOPs PFASs using MLA110 and MLA111. Samples were also analyzed for Absorbable Organic Fluorine using MLA119 and for ultrashort compounds using MLA120.

5.4 Soil Background Samples

Samples of soil were air dried to a moisture content of <10% and sieved to <2mm. Manual methods were used to collect systematic random, 30-increment, 10-gram subsamples of soil for analysis.

Samples were tested for Pre-TOPs and Post-TOPs PFASs using USEPA Method 537M. Samples were additionally tested for Extractable Organic Fluorine using Method 1621. Optional Non-Targeted Analysis was requested for each sample.

6.0 Results

Laboratory reports for samples associated with each study group are provided in Appendix 2 (WWTPs), Appendix 3 (Landfills), Appendix 4 (AFFF-Release Sites) and Appendix 5 (Background Soil). A summary of the concentration of Total PFASs in samples collected from WWTPs, landfills and AFFF-release sites as well as data for background soil samples is provided in the below sections. A discussion of the dominant suite of PFASs identified for each group of facilities is included in Section 8 of this report. Detailed summaries of data for individual PFASs are provided in Appendices 1 through 5.

Data for filtered samples of water are considered in the summary tables. Data for both filtered and non-filtered samples of WWTP wastewater and landfill leachate did not differ significantly and are summarized in the respective appendices (refer to laboratory reports in Appendices 2 and 3).

Non-Target Analysis was carried out on a sample of AFFF collected from AFFF Release Site #2, on a soil sample collected from AFFF Release Site #2 and on groundwater samples collected from five monitoring wells (Monitoring Wells #2, #3, #4, #7, #9). Analysis of influent and effluent samples was declined for samples of influent and effluent collected from WWTP #1, WWTP #2 and WWTP #6 based on recommendations by the laboratory and the lack of significant peaks for unidentified compounds in chromatograms. A Non-Targeted Analysis report and data for ultrashorts are still pending for samples of leachate collected from Landfill #1 as of publication of this preliminary report.

SPLP analysis was requested for all samples of biosolids and compost collected from WWTPs and samples of soil collected from AFFF Release Site #2. Additional Method 1314 soil column leaching analysis of a sample of compost collected from WWTP #6 and a sample of soil collected from AFFF Release Site #2 was also requested. Results of the soil column leaching tests are still pending as of publication of this report due to plugging of the column with fine biosolids during initial tests.

6.1 WWTPs

The primary PFAS components of influent, effluent and biosolids from the six WWTPs included in the study are summarized in Figures 10-15. Figures for WWTP #1, WWTP #2 and WWTP #6 influent and effluent are provided for both exclusion and inclusion of $PFEtA^-$ data in order to allow comparison to WWTPs where this compound was not reported in the laboratory analyses.

Table 5a presents a summary of the total concentration of PFASs reported for samples of WWTP influent, effluent and biosolids before and after TOPs processing. Influent and effluent data for $PFEtA^-$ are noted for WWTPs where this compound was included in the laboratory analyses. Data for AOF are similarly noted for facilities where this parameter was included in analysis of samples. Post-TOPs and TOF data were only obtained for samples collected from WWTP #1, WWTP #2 and WWTP #6. A summary of data for individual PFASs is provided in Appendix 6.

A significant increase in the concentration of post-TOPs data over pre-TOPs data is only recognized for the sample of influent collected WWTP #6. The concentration of AOF in both the influent and effluent samples is significantly higher than the total concentration of PFASs reported for both the pre-TOPs and post-TOPs analyses.

The reported total concentration of post-TOPs PFASs in samples of biosolids from each WWTP as well as the sample of compost from WWTP #6 is consistently higher than the total concentration of PFASs

reported for by pre-TOPs analyses. The concentration of EOF reported for the three samples of WWTPs biosolids tested is consistently higher than the total concentration of post-TOPs PFASs.

Data for five ultrashort compounds in samples of influent and effluent from WWTP #1, WWTP #2 and WWTP #6 are presented in Table 5b. The compound trifluoroethanoate ($PFEtA^-$, trifluoroacetate), more commonly referred to in literature as "trifluoroacetate (TFA)," was identified in the influent and effluent of each of the WWTPs at concentrations ranging from 287 ng/L to 328 ng/L in the influent and 308 ng/L to 484 ng/L in the effluent. Concentrations were consistently higher in the effluent than the influent. Reported concentrations in both cases, however, were well below the risk-based drinking water action level of 18,000 ng/L (rounded; refer to Table 12). Optional Non-Targeted Analysis of samples of influent and effluent from WWTP #1, WWTP #2 and WWTP #6 was declined based on recommendations by the laboratory that the analysis was unlikely to identify additional PFASs in the samples (see Table 3).

$PFEtA^-$ was reported for WWTP #1 Effluent equipment blank (115 ng/kg) but not in the Influent equipment blank (refer to lab report in Appendix 2). Ultrashort compounds were not identified in equipment blanks for WWTP #2 and WWTP #6.

Perfluoroethanoate (TFA) was reported at 133 ng/L for the SPLP solution of biosolids from WWTP #2 and 401 ng/L for the SPLP solution of biosolids from WWTP #6 (Table 5c). Trifluoromethane sulfonate ($PFMeS^-$) and $PFEtA^-$ were detected in the SPLP leachate of the compost sample collected from WWTP #6. The concentration of 5,410 ng/L $PFEtA^-$ reported for the compost leachate is considerably higher than reported for influent and effluent samples.

Data for ultrashort PFASs in samples of biosolids collected from the three facilities and the sample of compost collected from WWTP #6 are also pending. These data will be incorporated into future updates of this report. Method 1314 Soil column leaching data are pending for the sample of compost collected from WWTP #6. The resulting data will similarly be incorporated into future updates of this report.

6.2 Landfills

The primary PFAS components of leachate from the five landfills included in the study are summarized in Figures 16-20. Table 6 presents a summary of the total concentration of pre- and post-TOPs PFASs data as well as AOF data for samples of leachate collected from the five landfills included in the study. A summary of data for individual PFASs is provided in Appendix 7.

Reported concentrations of total Pre-TOPs PFASs in landfill leachate are significantly higher than reported for WWTP influent and effluent samples. The concentration of total, post-TOPs PFASs in samples of leachate from Landfill #1, Landfill #2 and Landfill #3 are marginally lower than the total concentration of Pre-TOPs PFASs reported for the same samples (refer to Appendix 7). This is attributed to the breakdown of precursor compounds identified in the pre-TOPs analysis and included in the sum of total PFASs. Concentrations of AOF reported for leachate samples from Landfill #1 cells used for disposal of non-incinerated municipal waste are notably higher than the sum of either Pre-TOPs or Post-TOPs PFASs.

6.3 AFFF Release Sites

AFFF Release Site #1

The primary PFAS components of in the sample of AFFF concentrate and soil impacted by AFFF at Release Site #1 are summarized in Figure 21 and Figure 22. The pre-TOPs and post-TOPs concentration

of total PFASs in the sample of AFFF concentrate collected from Release Site #1 are noted in Table 7. A summary of data for individual PFASs is provided in Appendix 8. The reported concentration of post-TOPs PFASs is significantly higher that the reported concentration of pre-TOPs PFASs.

The Non-Targeted Analysis report for the sample states (refer to lab report in Appendix 4):

> "There were several non-target analytes that were identified as potential PFAS parameters in this sample; 6:2 fluorotelomer thia propanoamido dimethyl ethyl sulfonate (6:2 Fluorotelomer thioether amido sulfonic acid) and 6:2 fluorotelomer thia hydroxy propyl trimethyl ammonium were present in greatest apparent abundance."

The compound 6:2 Fluorotelomer thioether amido sulfonic acid (6:2 FtTAoS) is known to one of the primary PFASs used in AFFF since 2005 (SEDRP 2017).

The concentration of AOF in the sample of AFFF concentration (12,000 mg/L) noted in Table 7 is unrealistically low in comparison to the reported concentration of post-TOPs PFASs (191,500 mg/L). This was interpreted by the laboratory to reflect interference with the AOF analytical method due to the exceptionally high concentration of PFASs in the sample.

Table 8 compares pre-TOPs and post-TOPs concentrations of Total PFASs in the four soil samples collected from the AFFF-release site. The reported concentrations of post-TOPs PFASs for Sample A and Sample B are approximately two orders of magnitude higher than the reported concentration of pre-TOPs PFASs (collected closest to the source of the original release). The reported concentration of post-TOPs PFASs in the two remaining samples are higher than the sum of the pre-TOPs data by a factor of 7 for the first sample and a factor of 50 for the second sample.

AFFF Release Site #2

A summary of pre-TOPs, post-TOPs and EOF data reported for triplicate soil samples collected from AFFF Release Site #2 are noted in Table 9 and Figure 23. Data for individual PFASs are provided in Appendix 9. Both Pre-TOPs and Post-TOPs PFASs are dominated by $PFOS^-$. Post-TOPs data reflect a marginal, average 39% increase in the total concentration of PFASs reported. The increase in PFASs is mainly contributable to the generation of $PFBA^-$, $PFPeA^-$ and $PFHxA^-$ following TOPs processing.

Table 10 and Figure 24 provides a summary of pre-TOPs, post-TOPs and AOF data for groundwater samples collected from AFFF Release Site #2. Contamination in samples collected from four of the five monitoring wells immediately surrounding the active, fire training pit area is characterized by a high proportion of 6:2 FTS^-(Monitoring Wells #1, #3, #4 and #5). As depicted in Figure 25, PFASs in downgradient MW #7 of the fire training pit are dominated by $PFOS^-$ and $PFHxS^-$. The makeup of PFASs is cross-gradient well MW #9 is, in contrast, dominated by $PFHxA^-$, $PFHxS^-$ and $PFBS^-$.

The reported total concentration of post-TOPs PFASs in most cases is marginally lower than the reported concentration of pre-TOPs PFAS. This is interpreted to be due to the breakdown of precursor compounds included in the summation of pre-TOPs PFAS and the corresponding decrease mass of the Secondary Terminal PFASs generated. The mass and concentration of compounds associated with the functional groups removed from the precursor compounds is not included in the reported concentration of post-TOPs PFASs.

The reported concentration of AOF in the samples is consistently higher than the sum of Total PFASs reported for either the pre-TOPs or post-TOPs data, indicating additional PFAS compounds in the

samples. The Non-Targeted Analysis (NTA) report for the groundwater sample from the site states (refer to lab report in Appendix 4):

> "There were several non-target analytes that were identified as potential PFAS parameters in these samples; Perfluorobutanesulfonamide (FBSA), Perfluorohexanesulfonamide (FHxSA) and Perfluoropropanesulfonic acid (PFPrS) were present in greatest apparent abundance. Perfluoropropanoic acid (PFPrA) was potentially present in several samples but has relatively poor response under the conditions of the NTA acquisition and its identification is less reliable."

Findings for Non-Targeted Analysis of a soil sample collected from the fire training area as well as analysis of an SPLP leachate sample of the soil identified a similar suite of compounds as reported for the groundwater samples, although at different proportions.

The sum of PFASs represented by post-TOPs PFASs is marginally higher than the sum of pre-TOPs PFASs for each of the soil samples collected at the site, indicating the presence of additional precursor compounds in the samples. Extractable Organic Fluorine was identified above the Method Reporting Limit in two of the three samples at concentrations below the sum of post-TOPs data.

Method 1314 Soil column leaching data are pending for one of the triplicate soil samples collected at the AFFF release site. The resulting data will be incorporated into future updates of this report.

6.4 Background Soil

Pre-TOPs and post-TOPs data for background samples of soil collected in remote areas of the islands are noted in Table 11. PFASs were not identified in 7 of the 8 samples above a laboratory Method Reporting Level of 0.96 µg/Kg to 0.99 µg/Kg. Extractable Organic Fluorine was reported at concentrations marginally above the Method Reporting Level in two of the 8 samples. The laboratory cautioned that confidence in the EOF was low due to the proximity the detection limit. Retesting of the samples for EOF as well as Non-Targeted Analysis has been requested. The resulting data will be incorporated into the future updates of this report.

7.0 Data Quality Review

Data quality and usability of samples collected during the study is evaluated with respect to methods presented in Section 3 of the HIDOH *Technical Guidance Manual* (HIDOH 2024d). This includes an initial review of the final methods employed to collect samples in the field and process the samples for testing at the laboratory. A review of analytical precision is the final step in the data quality review process. Refer to laboratory reports provided in Appendices 2-5 for discussions of data quality for specific samples.

7.1 Sample Holding Times

The recommended holding time of 14 days for water samples and 90 days for soil samples in the referenced analytical methods was marginally exceeded for several samples due to delays at the laboratories (refer to Section 2-5). Confidence in the significance of this holding time in terms of alteration or loss of PFASs in samples is low, given the known recalcitrant nature of the targeted compounds.

Wastewater treatment plant biosolids and effluent are subjected to conditions specifically intended to promote degradation of organic compounds, including oxidation and microbial degradation. Treatment plant influent is less strongly affected, as indicated by the common presence of 5:3 $FTCA^-$ in the samples. Additional degradation following collection and chilling or freezing of samples, including precursor compounds, is anticipated to be minimal. Assessment of risk as described in HIDOH (2024b) guidance likewise focuses on highly recalcitrant "Terminal PFAS" compounds (Section 8). This includes intentional oxidation of samples using TOP methods to further degrade any precursor compounds still present in the sample (refer to Section 5). Additional degradation of precursor compounds in the sample prior to analysis would not affect calculations of Total PFAS Risk. The same logic applies to samples of groundwater collected at AFFF Release Site #2.

The near five-month time between the collection of soil samples from AFFF Release Site #2 and analysis of the samples is irrelevant. The samples were collected from the exposed, surface of the targeted area. Releases attributed to the identified PFAS contamination likely occurred years if not decades in the past, leaving ample time for sample degradation to occur. Any degradation of PFASs in the samples following collections and storage prior to analysis can reasonably be assumed to be negligible. The same rational applies to samples of surface soil collected for assessment of background concentrations of PFASs.

7.2 Laboratory Quality Control

Laboratory Quality Control (QC) measures included matrix spikes, method blanks, Isotope Dilution Analyte recovery, the use of introduced surrogate compounds in lab control samples to assess the completeness of TOPs processing and testing of replicate subsamples (solids). Summaries of QC methods and results are included in the laboratory reports provided in Appendices 2-5. Overall sample data quality was considered acceptable for the purposes of the study.

7.3 Wastewater and Groundwater Sample Data

Field Sample Collection Methods

Wastewater samples were collected using a 24-hour, composite sampler at five of the six WWTPs. A 24-hour sample of influent was collected at WWTP #5. Collection of a grab sample of effluent was required, however, due to mechanical problems with the sampler. The general agreement and low concentration

of total PFASs reported for the grab sample of effluent versus 24-hour sample of influent suggests that potential error in the sample data is not significantly high, however (64 ng/L vs 36 ng/L; refer to Table 5a).

The representativeness of the relative makeup of PFASs in the influent and effluent sample data with respect to long-term trends is considered to be moderate, given the potential for varying discharges of wastewater from resorts and other commercial operations serviced over time. The influent and effluent sample data likewise do not represent the same volume of water. The average residence time of water passing through a WWTP is two weeks. Additional studies are required to more fully document long-term trends in PFASs entering and exiting the facilities.

Equipment Blanks

Targeted PFASs were not identified in influent and effluent equipment blanks collected at each of the WWTPs. PFASs were detected in a single equipment blank collected at AFFF Release Site #2.

Laboratory Analytical Precision

The precision of duplicate analyses of samples by the laboratory was consistently high. Laboratory analytical error is considered to contribute the least degree of error to the overall representativeness and quality of the sample data (refer to HIDOH 2024d).

7.4 Biosolids and Soil Sample Data

Field Sample Collection Methods

Acceptable, Multi Increment samples of biosolids were collected at four of the six WWTPs. Samples of biosolids at four of the six WWTPs (WWTPs # 2, #3, #4, #5) were collected from the surface of roll-off bins used to store the material prior to disposal. Access to deeper area of the bins was not practical due to the heavy nature of the material. Sample collection error in terms of the representativeness of the sample due to potential vertical layering of the material is assumed to be minimal. Thorough blending of biosolids in WWTP clarifiers and the wet nature of the material is anticipated to have minimized distributional heterogeneity of biosolids placed in the storage bin. The wet nature of the material would have further prevented finer and potentially more contaminated particles from separating and settling to the bottom of the bin.

The same rational is used to conclude that the grab sample of biosolid pellets collected from WWTP #1 is reasonably representative of biosolids being treated at the facility on that day. Pre-TOPs data for a grab samples collected during Phase 1 of the study and Phase 2 of the study were also very similar, suggesting a relative uniformity of biosolids generated at the facility over time.

Collection of a grab sample of biosolids was necessary at WWTP #6. Temporal, distributional heterogeneity within biosolids generated from the facility is predicted to be relatively low, however, and the sample provided is assumed to be reasonably representative of biosolids still being treated (dewatered) at the facility on the day the grab sample was collected.

A Multi Increment sample of compost was collected from the surface of a stockpile at WWTP #6. The interior of the stockpile could not be accessed. The representativeness of the relative makeup of PFASs in the sample is considered to be adequate, primarily given the low, anticipated heterogeneity of the biosolids used to prepare the compost. Confidence in the reliability of the data to reflect the mean

concentration of PFASs in the stockpile as a whole is low to moderate, since the relative proportion of biosolids in exposed compost might not be reflective of the interior of the pile.

Sample Processing and Subsample Collection Methods

Samples of biosolids and soil were air dried and sieved to isolate the targeted, <2mm-size particles for testing. Subsamples were collected using manual, Multi Increment sampling methods as recommended in the workplan (given the lack of a sectoral splitter at the laboratory). Ten-gram subsamples of soil and compost were tested, as recommended, as were five-gram subsamples of biosolids

Field and Laboratory Replicate Samples

Field replicate samples were collected for biosolids at WWTP #3 and soil at AFFF Release Site #2 (Kahului Fire Training Area). Replicate samples in both cases meet a target Relative Standard Deviation of 35%, indicating good overall precision of the sample collection and subsampling methods (refer to Appendix 2 and Appendix 4).

Laboratory Analytical Precision

The precision of duplicate analyses of samples by the laboratory was consistently high. Laboratory analytical error is considered to contribute the least degree of error to the overall representativeness and quality of the sample data (refer to HIDOH 2024d).

7.5 Potential Water Sample AOF Bias

Water samples were filtered using fluorine-free filters prior to analysis (refer to Appendix 2). This was done in order to meet the objectives of the study to focus on dissolved-phase PFASs only. Organic fluorine was not identified in influent and effluent equipment blanks collected at WWTPs #1, #2 and #6 (refer to Appendix 6). This supports the conclusion that excess organic fluorine identified in the wastewater samples is attributable to PFAS compounds, rather than from the equipment used to collect the samples or processing and analysis of the samples at the laboratory.

Note that some laboratories have reported that some filters can contribute significant organic fluorine to samples and bias the reported AOF data high. This should be discussed with the laboratory and confirmed by testing of filter blanks by the laboratory (i.e., fluorine-free water poured through a new filter and tested for AOF). Documentation for filter blanks should be provided with laboratory reports for water samples that were filtered prior to analysis.

8.0 Assessment of Total PFAS Risk

8.1 Interpretation of Total PFAS Risk Calculations

Calculations of Total PFAS Risk presented in this section are purely hypothetical and do not reflect actual risk to human health posed by exposure to PFASs at the facilities included in the study. The results are instead intended to help assess the general, relative source strength of the PFAS scenarios included in the study and assist in development of future HIDOH guidance and regulations.

Discharges of effluent from WWTPs included in the study do not threaten a source of drinking water. Environmental and engineering controls at regulated, municipal landfills serve to minimize the risk to underlying groundwater. Groundwater beneath the fire training area sampled during the study (AFFF Release Site #2) is brackish and not usable as a source of drinking water. Estimates of health risk posed by direct exposure to biosolids are similarly hypothetical. Biosolids generated at three of the six WWTPs are disposed of in municipal landfills or at a municipal waste-to-energy incinerator (refer to Table 1). Biosolid-amended compost prepared in the past at WWTPs #2 and #6 and pelletized biosolids still being produced at WWTP #1 not known to have been used in residential areas. Sample data and assessment of hypothetical risk associated with biosolids also does not consider the inherent reduction in PFAS concentrations following mixing with green waste and subsequent curing of the compost and spreading and mixing of compost with soil.

8.2 Methodology

PFAS Groupings

Sample data for WWTPs, landfills and AFFF-release sites are used to identify key PFAS compound risk drivers under each of the three PFAS-release scenarios and draw general conclusions regarding source strength and hypothetical risk to human health and the environment. Total PFAS Risk is assessed in terms of three groups of compounds: 1)"Primary Terminal PFASs" originally present in a sample, 2) Additional, "Secondary Terminal PFASs" generated by TOPs processing of the sample and 3) Excess Fluorine PFASs associated with a reported concentration TOF greater than that predicted by concentrations of Primary and Secondary Terminal PFASs.

Terminal PFASs are defined for use in this study as perfluoroalkyl compounds that will not further degrade under normal environmental conditions (refer to ITRC 2020). Targeted Terminal PFASs used to assess risk under HIDOH (2024b) guidance are noted in Table 12. "Primary Terminal PFASs" are represented by Terminal PFASs present in the sample prior to TOP processing. "Secondary Terminal PFASs" represent an additional Terminal PFASs generated by TOPs processing of a sample and the breakdown of precursor compounds originally present in the sample.

"Excess Fluorine PFASs" represent a third category of additional PFAS compounds potentially present in a sample. The concentration of total Excess Fluorine PFASs in a sample cannot be directly measured. An estimate is instead made based on comparison of the concentration of Total Organic Fluorine (TOF) predicted by reported concentrations of Primary and Secondary Terminal PFAFs to the concentration of TOF actually measured in the sample. Inorganic fluorine and fluorine ions are not included in quantification of TOF. This is used to identify excess organic fluorine in the sample assumed to be attributed to other PFAS compounds in the sample:

$$Excess\ Organic\ Fluorine\ = Measured\ TOF - Predicted\ TOF \quad \text{Eq.1}$$

$$Predicted\ TOF\ = (Predicted\ Primary\ Terminal\ PFASs\ TOF + Predicted\ Secondary\ Terminal\ PFASs\ TOF)$$ Eq.2

The predicted concentration of Total Organic Fluorine associated with sample data for Primary Terminal PFASs and calculated concentrations of precursor-related, Secondary Terminal PFASs is calculated as (see worksheets in Appendix 11):

$$Predicted\ TOF = (Conc._{PFAS\#1} \times \frac{(AM_{Fluorine} \times \#Fluorine\ Atoms)}{MW_{PFAS\#1}} + (Conc._{PFAS\#2} \times \frac{(AM_{Fluorine} \times \#Fluorine\ Atoms)}{MW_{PFAS\#2}} + (Conc._{PFAS\#3} \times \frac{(AM_{Fluorine} \times \#Fluorine\ Atoms)}{MW_{PFAS\#3}} + etc.$$ Eq.3

where "$AM_{Fluorine}$" is the atomic mass of fluorine (18.998) and "MW_{PFAS}" is the molecular weight (mass) of the specific PFAS compound.

TOPs processing is assumed to not affect Terminal PFASs originally present in a sample. A reported post-TOPs concentration of a Terminal PFAS lower than the original, pre-TOPs concentration is assumed to be attributable to laboratory analytical error. No excess organic fluorine is attributed to that specific compound (refer to examples in Total PFAS Risk worksheets in Appendix 11).

Excess organic fluorine in a sample is, for the purposes of initial assessment of risk, assumed to be primarily attributable to additional, ultrashort compounds in the sample. Calculation of a corresponding concentration of Excess Fluorine PFASs for assessment of risk is carried out by conversion of the concentration of excess organic fluorine to an equivalent concentration of $PFPrA^-$ using similar stoichiometry as described above, except in reverse (refer to worksheets in Appendix 11:

$$Conc.EFPs = Conc.Excess\ Organic\ Fluorine \times \frac{MW\ \mathrm{PFPrA^-}}{\#F \times AM_{Fluorine}}$$ Eq. 4

where "Conc. EFPs" is the concentration of "Excess Fluorine PFASs", "MWPFAS" is the molecular weight (mass) of $PFPrA^-$ (164), "#F" is the number of fluorine atoms in $PFPrA^-$ (5) and "$AM_{Fluorine}$" is the atomic mass of fluorine (18.998). This simplifies to:

Conc. EFPs = Concentration of Excess Fluorine x 1.73. Eq. 5.

Note that some excess organic fluorine could also be attributable to incompletely oxidized, short- and long-chain precursor compounds in the sample. The toxicity of these compounds is currently not well known. While imperfect, the approach described above allows for initial inclusion of this likely complex group of compounds for initial assessment of risk.

Estimation of predicted TOF was carried out based on post-TOPs data alone in past versions of the HIDOH PFAS EAL guidance (refer to HIDOH 2024b). Both approaches yield approximately the same results. Post-TOPs data in theory will capture all organic fluorine-containing compounds in the sample, including precursor compounds. A small amount of variability will arise due to analytical error. The updated approach allows input of data for compounds that are not reported in TOPs data and more directly relates to the three groups of PFASs defined for use in estimation of Total PFAS Risk.

HIDOH (2024b) Action Levels

Noncancer hazard is calculated by comparison of data for Primary and Secondary Terminal PFASs to risk-based action levels presented in the HIDOH (2024b) guidance document (see Table 12). Added risk posed by Excess Fluorine PFASs is estimated by comparison of the corresponding data to action levels for $PFEtA^-$. Action levels for drinking water toxicity are based on models and exposure assumptions used to derive Regional Screening Levels (RLSs) for tapwater published by the United States Environmental Protection Agency (USEPA 2024). Action levels for direct exposure to soil are based on models and exposure assumptions used to derive USEPA RSLs under a residential land-use scenario. A detailed discussion of the USEPA models is provided in HIDOH (2024b). A summary of exposure assumptions used in the models is provided in Table 13. A summary of physiochemical constants and toxicity factors utilized in the models is provided in Table 14.

Excess organic fluorine in a sample is assumed for the purposes of HIDOH (2024b) guidance to be attributable to ultrashort PFAS compounds. This is supported in part by Non-targeted Analysis identification of ultrashorts in study samples and an assumption that TOPs processing would have been broken down the majority of precursor compounds to terminal PFAS compounds (refer to Section 8). Toxicity factors and risk-based action levels are currently only available for the ultrashort compounds perfluoroethanoate ($PFEtA^-$; aka trifluoroacetate) and perfluoropropanoate ($PFPrA^-$) (see Table 12). The more conservative toxicity factors and corresponding action levels for $PFPrA^-$ are utilized as a default toxicity surrogate for the mixture of compounds associated with excess organic fluorine in a sample, assumed to be dominated by non-specific ultrashort (HIDOH 2024b).

Calculation of Hazard Quotients and Hazard Indices

The HIDOH Terminal PFAS action levels were calculated using a target Hazard Quotient of "1." Toxicity studies suggest that long-term exposure to the individual PFAS at the corresponding action level will not result in adverse health effects. Exposure to a mixture of multiple PFASs in water, soil or biosolids could, however, pose a potential cumulative health risk even though action levels for individual compounds are not exceeded. (This is similar in concept to counting dietary calories. The calories in multiple food items consumed over a day can, in combination, exceed a total daily limit, even though the total daily limit is not exceeded for any given, individual food item.) As discussed below and in HIDOH (2024b), this requires calculation of a "Hazard Index" in order to assess the combined risk posed by exposure to PFASs with similar health effects.

A Hazard Index (HI) is calculated by summing the ratios of the reported concentration of a PFAS in a sample by the corresponding action level:

$$Hazard\ Index\ = \frac{Concentration\ PFAS\ \#1}{Action\ Level\ PFAS\ \#1} += \frac{Concentration\ PFAS\ \#2}{Action\ Level\ PFAS\ \#2} + etc.$$

The ratio of an individual contaminant to its corresponding action level is referred to as a "Hazard Quotient (HQ)". Calculation of a Hazard Quotient for Excess Fluorine PFASs was made by comparison of the generated concentration by action levels for $PFEtA^-$. The result could conceivably be referred to as a "Hazard Index," since the value most likely reflects an unknown mixture of PFAS ultrashort compounds in the sample.

Hazard Indices and Hazard Quotients are both unitless. Hazard Indices are normally rounded to a single, significant digit (HIDOH 2024c). For example, a Hazard Index of "1.4" rounds to a value of "1." A Hazard

Index of "1.51" rounds to a value of "2." A Hazard Value of 1.5 can be rounded to "1." The Total PFAS Risk calculator accompanying the HIDOH (2024b) guidance was used to calculate hypothetical, noncancer Hazard Quotients and Hazard Indices for samples collected as part of the study described in this report.

Assessment of cancer risk is not included in this exercise. Action levels for noncancer risk hazard fall within the range of action levels based on an acceptable Excess Cancer Risk range of 10^{-4} to 10^{-6} for compounds such as $PFOS^-$ and $PFOA^-$ (refer to HIDOH 2024b). Protection of young children and young mothers against noncancer-related health risks and comparison of sample data to corresponding action levels is therefore anticipated to protect against longer-term cancer risk in adults.

Calculation of Total PFAS Risk

Total PFAS Risk for a sample is calculated as the sum of the Hazard Indices calculated for the pre-TOPs and post-TOPs groups of PFAS and the Hazard Quotient calculated for the group of unidentified ultrashorts collectively assessed as Excess Fluorine PFASs:

$$\textit{Total PFAS Risk} = \textit{Pre-TOPs PFASs HI} + \textit{Post-TOPs PFAS HI} + \textit{Excess Fluorine HQ.} \quad \text{Eq. 6}$$

Calculations of Total PFAS Risk were carried out using the Excel-based spreadsheet included with the HIDOH PFAS EAL guidance (HIDOH 2024b). Summaries of Total PFAS Risk calculated for individual PFAS groups are provided in Appendix 12. Corresponding worksheets generated from the HIDOH Total PFAS Risk calculator are included in Appendix 11.

A cumulative Hazard Index of ≤ 1 implies negligible health risk. A more detailed assessment of potential health risk in consultation with a toxicologist is recommended when a Hazard Index exceeds "1." This typically includes grouping of contaminants with respect to toxicological similarity and potential health effects (USEPA 1989, 2002, 2005). For example, contaminants can be grouped with respect to the specific organs that they are known to affect.

Toxicity factors and exposure assumptions used to derive risk-based action levels for chronic, long-term exposure typically incorporate an order of magnitude or more safety factor (refer to referenced toxicity studies). Noncancer toxicity factors only reflect the level of exposure below which no adverse health effects expected (USEPA 1989, 2002, 2005). Health risk (hazard) does not necessarily increase linearly with an increasing Hazard Index. In a very general sense, a Hazard Index between 1 and 3 typically implies a relatively low health risk but a need to more closely assess exposure conditions and ensure that all pathways of exposure have been accounted for. A Hazard Index between 5 and 10 causes increased concern that the safety margin is being approached and a potential need to reduce or eliminate exposure. A Hazard Index >10 typically warrants remedial actions to remove contamination or implement long-term management controls to eliminate exposure. These ranges are intended for general guidance only. Consultation with a risk assessor and/or toxicologists experienced in PFAS toxicity is required as increasing levels of potential health risk are identified.

Acute toxicity factors associated with short-term (e.g., < 14 days) exposure to very high concentrations are not currently available for PFASs. Were such factors to be developed, they would likely result in action levels several orders of magnitude above risk-based action levels for long-term, chronic exposure presented in Table 12.

8.3 Comparison of Secondary Terminal PFASs and Excess Organic Fluorine

A comparison of Pre-TOPs versus Post-TOPs data for study samples is provided in Table 15. Significant increases in Terminal PFASs were noted in all samples of soil and biosolids, reflecting the presence of equally significant concentrations of precursor compounds. The increase in Terminal PFASs was, in contrast, muted for all water samples. The reported total concentration of PFASs in samples inclusive of initially identified precursor compounds in many cases fell following TOPs processing. This is interpreted to reflect exclusion of the mass associated the original functional group attached to Terminal PFAS and the lack of additional, previously unidentified precursor compounds in the samples.

Tables 16-19 provide a summary of excess organic fluorine identified in samples. High levels of excess organic fluorine were identified in all water samples and in particular in samples of WWTP influent and effluent. As discussed below, this is interpreted to reflect significant ultrashort PFAS compounds in the samples.

8.4 Estimates of WWTPs Influent, Effluent and Biosolids Total PFAS Risk

Table 20 summarizes hypothetical noncancer Hazard associated with PFASs identified in WWTP influent (Table 20a), effluent (Table 20b), biosolids (Table 20c) and biosolid-amended compost (Table 20d). A full suite of pre-TOPs, post-TOPs and TOF data for calculation of Total PFAS Risk is only available for WWTP #1, WWTP #2 and WWTP #6. Assessment of noncancer Hazard for WWTPs #3, #4 and #5 was limited to review of data for Primary Terminal PFASs.

Influent and Effluent

A Hazard Index of "1" is calculated for Primary Terminal PFASs in influent samples collected from four of the six WWTPs (WWTPS #2, #3, #4 and #6). A Hazard Index of 2 is calculated for influent samples collected from the remaining two WWTPs (WWTP #1 and WWTP #5). Hazard Indices for Primary Terminal PFASs in effluent samples were slightly higher than for influent samples but still relatively low, calculated to be 1 or less at four of the six WWTPs (WWTPs # 1, #4, #5 and #6) and 2 to 3 at the remaining two facilities (WWTP #1 and WWTP #3).

Hazard Indices associated with Secondary Terminal PFASs following TOPs processing of influent and effluent samples from WWTPs #1, #2 and #6 are consistently low, ranging from 0.1 to 0.6. This indicates minimal contribution to Total PFAS Risk from precursor PFASs present in the samples.

Hazard Indices calculated for Excess Fluorine PFASs both influent and effluent samples from WWTPs #1, #2 and #6 are notably higher than predicted for either Primary Terminal PFASs or Secondary Terminal PFASs. Calculated indices range from 4.6 to 5.6 for influent samples and 4.4 to 6.3 for effluent samples.

Total PFAS Risk for samples of influent and effluent collected from WWTP #1, WWTP #2 and WWTP #6 ranges from a combined Hazard Index of 6 to 7 for samples of influent and 6 to 8 for samples of effluent. Overall, hypothetical health risk is driven by Excess Fluorine PFAS interpreted to be associated with ultrashort compounds in the samples. Of secondary importance and making up at least 10% but less than 50% of the Total PFAS Risk were Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$ and $PFPeA^-$, in that general order of importance. This is true for both influent and effluent samples.

Biosolids and Compost

Hazard Indices calculated for Primary Terminal PFASs in samples of biosolids noted in Table 20c are low, ranging from just 0.5 (WWTP #4 and WWTP #6) to 1.9 (WWTP #1). Hazard Indices for Secondary PFASs

are notably higher for biosolids from five of the six WWTPs but still relatively low, ranging from 0.6 (WWTP #1) to 4.6 (WWTP #4). Hazard Indices associated with Excess Fluorine PFASs in samples of biosolids with data for Extractable Organic Fluorine are very low, ranging from just 0.1 to 0.2 (WWTP #1, WWTP #2 and WWTP #6).

Overall, Total PFAS Risk for samples of biosolids were relatively low, ranging from a value of 2 at WWTP #2 and WWTP #6 to a high of 5 for WWTP # 3, WWTP #4 and WWTP #5. Hypothetical noncancer hazard is driven by Primary $PFOS^-$ and $PFHxS^-$ for the sample of biosolids collected from WWTP #1. Noncancer hazard is driven by Secondary $PFOS^-$, $PFOA^-$, $PFNA^-$ and $PFDA^-$ in samples of biosolids collected from the remaining WWTPs.

A total noncancer Hazard Index of less than 1 is calculated for the sample of compost collected from WWTP #6 (Table 20d). The Hazard Index calculated for Primary Terminal PFASs (0.6) is notably higher than the Hazard Indices calculated for both Secondary Terminal PFASs and Excess Fluorine PFASs (both 0.1). Hypothetical noncancer hazard is driven by pre-TOPs $PFOS^-$, $PFDA^-$ and $PFOA^-$.

8.5 Estimates of Landfill Leachate Total PFAS Risk

Hazard Indices and Total PFAS Risk calculated for samples of leachate collected from landfills are summarized in Table 21. Hazard Indices for all categories of PFASs are significantly higher than those calculated for wastewater influent and effluent. Hazard Indices for Primary Terminal PFASs range from a low of 61 for a sample of leachate collected from a cell containing municipal waste incinerator ash at Landfill #1 to a high of over 7,000 for leachate collected from a cell containing construction debris at Landfill #2. Hazard Indices for samples of leachate collected from cells containing predominantly municipal waste at Landfills #3, #4 and #5 range from approximately 200 to 1,800. Hypothetical health risks posed by PFASs in the leachate is driven by a varying mix of pre-TOPs $PFOA^-$,$PFOS^-$ and $PFHxS^-$ (refer to Table 21).

Data for more broadly analyzed samples of leachate collected from Landfill #1 result in Hazard Indices for Secondary Terminal PFASs associated with precursor PFASs in the samples that range from a low of 6.8 for the cell containing ash to a high of 28 for one of the two cells containing unincinerated municipal waste. Hazard Indices for Excess Fluorine PFASs in the same samples are notably higher, ranging from a low of 16 for the ash cell to a high of 194 for a cell containing unincinerated municipal waste.

Total PFAS Risk calculated for the samples of leachate collected from Landfill #1 varies from a low of 84 for the ash containing cell to values of 623 and 1,041 for the two cells containing unincinerated municipal waste. Hypothetical health risks for PFASs in the leachate is driven by a varying mix of Primary $PFOA^-$, $PFHxS^-$ and $PFOS^-$ in the cells containing municipal waste, with moderate additional risk posed by ultrashort compounds (refer to Table 21). The latter are interpreted to be associated with excess organic fluorine identified in the samples. Total PFAS Risk for the sample of leachate collected from the cell of Landfill #1 that contains only incinerator ash is driven by Primary $PFOA^-$and $PFHpA^-$. Moderate additional risk is again posed by Excess Fluorine PFASs, again interpreted to be associated with ultrashort compounds in the sample.

8.6 Estimates of AFFF Release Site Total PFAS Risk

AFFF Release Site #1 (Soil)

Hazard Indices calculated for soil samples collected at AFFF Release Site #1 are presented in Table 22. Hazard Indices calculated for Primary Terminal PFASs are very low, ranging from 0.1 to 0.3. Hazard Indices calculated for Secondary Terminal PFASs in Samples DU-4a and DU-4b are similarly low. Hazard Indices for Secondary PFASs in Samples DU-2 and DU-3 are notably higher, however, at 5.9 and 5.7. Non-Targeted Analysis of the samples indicated that the secondary PFASs are associated with the precursor compound 6:2 FtTAoS, known to be the primary component of the AFFF released (refer to Section 6.3 and Appendix 8).

Extractable Organic Fluorine data were not available for assessment of and additional PFASs compounds in the samples. Total PFAS Risk based on Primary Terminal PFASs and Secondary Terminal PFASs identified in the samples ranges from a Hazard Index of 0.4 for both Sample DU-4a and Sample DU-4b to a Hazard Index of 6 for both Sample DU-2 and Sample DU-3. Hypothetical noncancer hazard for Samples DU-4a and DU-4b is driven by the Primary $PFHpA^-$, $PFPeA^-$, $PFHxA^-$ (refer to Table 22). Hypothetical noncancer hazard in the latter two samples is driven by the Secondary $PFHpA^-$, $PFPeA^-$ and $PFHxA^-$.

AFFF Release Site #2 (Soil)

Hazard Indices calculated for triplicate soil samples collected at AFFF Release Site #2 are presented in Table 23. An average Hazard Index of 32 is calculated for Primary Terminal PFASs in the sample. An average Hazard Index of 5 is calculated for Secondary Terminal PFASs in the sample. Hazard Indices could not be calculated for Excess Fluorine PFASs in two of the three samples. The reported concentration of Extractable Organic Fluorine in Sample DU5D was below that predicted by the reported concentrations of Primary and Secondary Terminal PFASs. Extractable Organic Fluorine was not detected above the Method Reporting Limit in Sample DU5E. A Hazard Quotient of 0 is calculated for the correspondingly low concentration of Extractable Organic Fluorine reported for Sample DU5F.

An average, Total PFAS Risk and combined Hazard Quotient of 37 is calculated for the triplicate soil samples (refer to Table 23). Hypothetical health risk is driven by the Primary $PFOS^-$ in each of the samples.

AFFF Release Site #2 (Groundwater)

Hazard Indices calculated for groundwater samples collected at AFFF Release Site #2 are presented in Table 24. Hazard Indices for Primary Terminal PFASs calculated for samples collected from monitoring wells in the immediate vicinity of the fire training area are exceptionally high, ranging from approximately 19,000 (MW-5) to over 120,000 (MW-2). Primary Terminal PFAS Hazard Indices for samples collected from downgradient wells range from approximately 18,000 for MW-7, located approximately 300 feet from the training pit, to 532 for MW-9, located approximately 800 feet and somewhat cross gradient from the training pit. A Hazard Index of 18 is calculated for Primary Terminal PFASs in the sample of groundwater collected from MW-8, situated approximately 200 feet upgradient of the training pit.

Hazard Indices calculated for Secondary Terminal PFASs in the groundwater samples are one to several orders of magnitude lower that indices calculated for Primary Terminal PFASs (refer to Table 24). A Hazard Index of just under 6,000 is calculated for the sample of groundwater collected from MW #1, situated immediately adjacent to and downgradient of the fire training pit. Hazard Indices calculated for Secondary Terminal PFASs in groundwater samples collected from Monitoring Wells MW-2, MW-3, MW-4 and MW-5 range from 55 to 347. Hazard Indices for Secondary Terminal PFASs identified in

downgradient monitoring wells range from 7.2 for the sample collected from MW-7 to 125 for the sample collected from MW-9. A Hazard Index for Secondary Terminal PFASs of 0.7 was calculated for upgradient Monitoring Well MW-8.

Hazard Indices for Excess Fluorine PFASs are moderately higher than those calculated for Secondary Terminal PFASs in the same samples but still more than an order of magnitude below Hazard Indices calculated for Primary Terminal PFASs (refer to Table 24). A total Hazard Index of over 4,000 is calculated for the sample collected from Monitoring Well MW #1. The Hazard Index ranges from approximately 1,000 to 3,500 for other monitoring wells located immediately adjacent to the fire training pit (MW #2, MW #3, MW #4 and MW #5). Hazard Indices of 188 and 23 are calculated for downgradient monitoring wells (MW-7 and MW-9, respectively). A Hazard Index of 2.7 is calculated for upgradient Monitoring Well MW-8.

Total PFASs Risk is driven by the Primary $PFOS^-$ and to a lesser degree $PFHxS^-$ in groundwater samples collected from monitoring wells immediately surrounding the fire training area as well as downgradient well MW-7 and upgradient well MW-8. Total PFASs Risk is driven by the Primary $PFHxS^-$ and to a lesser degree $PFOS^-$ in the groundwater sample collected from downgradient and cross gradient well MW-9.

Figure 26 depicts the relative PFAS group makeup for groundwater samples collected from select monitoring wells at AFFF Release Site #2. Excess Fluorine PFASs in the samples, preliminary assumed to be associated with ultrashort compounds, dominates samples collected from the source area monitoring wells (e.g., MW #1) and comprise only a marginally lesser proportion of total PFASs in samples collected from the downgradient well (MW #7) and cross-gradient well (MW #9).

Figure 27 compares the PFAS group makeup of samples in terms of relative risk. Compounds associated with Primary Terminal PFAS dominate hypothetical drinking water risk in each of the wells noted, as well as other wells within the plume. Compounds associated with Excess Fluorine PFASs only marginally contribute to the overall risk posed by PFASs in the groundwater. This is due to the significantly higher toxicity of $PFOS^-$ and $PFHxS^-$ in comparison to $PFPrA^-$.

9.0 Comparison of Relative Source Strengths

Table 25 through 38 compare and contrast the PFAS makeup of WWTP influent and effluent, landfill leachate and groundwater at AFFF release sites in terms of: 1) Primary Terminal PFAS associated with targeted Terminal PFASs originally present in the samples, 2) Secondary Terminal PFASs associated with targeted Terminal PFASs generated by TOPs processing of the samples and 3) Excess Fluorine PFASs identified by elevated levels of Total Organic Fluorine in the samples and interpreted to be associated with ultrashort compounds. The relative contribution to Total PFAS Risk from each group is then summarized and specific compounds driving overall risk noted.

Figures 28a and 28b compare the relative makeup and associated contribution to total risk by individual PFAS groups identified for samples of WWTP effluent, landfill leachate and AFFF-impacted groundwater. Figure 29 compares the relative source strength of the three types of liquid media. Figures 30a and 30b compare the relative makeup of PFASs and contribution to total risk by PFAS group identified for samples of WWTP biosolids and compost and AFFF-impacted soil. Figure 31 compares the relative source strength of the three types of solid media

As discussed in Section 8, calculations of risk and noncancer Hazard Indices are purely hypothetical and not reflective of actual exposure conditions at the facilities. Predicted risks are instead used to assess and compare the relative source strengths of the different types of potential PFAS-release scenarios included in the study.

9.1 PFAS-Impacted Wastewater Effluent, Landfill Leachate and Groundwater

Wastewater Effluent

Samples of wastewater influent and effluent collected from three WWTPs and including a full complement of PFAS data were dominated by Excess Fluorine PFASs (Table 25 and Table 26). The excess organic fluorine in the wastewater is interpreted to be associated with largely unidentified, ultrashort compounds, making up 77% to 85% of the total PFASs in the influent and 63% to 84% of the total PFASs present in the effluent. Short- and long-chain, Primary Terminal PFASs comprise the majority of the remaining mixture. Secondary Terminal PFASs associated with oxidized precursor compounds in the effluent composed less than 1% of the total PFASs present.

Total PFAS Risk, following the methodology described in Section 8.1, is driven by the ultrashort compounds, comprising 62% to 78% of the total Hazard Index for the influent and 60% to 81% of the total Hazard Index (see Figure 28b). Primary $PFHxS^-$, $PFOS^-$, $PFHxA^-$, $PFPeA^-$ and $PFOA^-$ in the samples contributed the majority of the remaining risk. Overall risk is relatively moderate, however, with predicted Hazard Indices ranging from 6 to 8.

Landfill Leachate

Samples of landfill leachate collected from cells containing municipal waste at Landfill #1 were dominated to a lesser extent by Excess Fluorine PFASs, making up 63% to 70% of the total PFAS present (Table 27 and Table 28). Primary Terminal PFAS comprise the majority of the remaining compounds, with Secondary Terminal PFASs again contributing only a minor part of the total mixture. Concentrations of Primary Terminal PFASs identified in leachate samples that lacked a full complement of PFAS data were similar to those reported for LF #1.

Total PFAS Risk for landfill leachate is notably higher than predicted for wastewater effluent, with final Hazard Indices ranging from 623 to 1,041 in the leachate cells containing municipal waste to a lower but still significant Hazard Index of 84 for a leachate sample collected from a cell dedicated to incinerator ash. The increased proportion of more toxic Primary $PFOA^-$, $PHxS^-$ and $PFOS^-$ in the leachate samples causes these compounds and Primary Terminal PFASs in general to drive overall risk, comprising 67% to 87% of the summed Hazard Indices (see Figure 28b). Excess Fluorine PFASs assumed to be associated with ultrashort compounds contribute 10% to 30% of the total risk, with Secondary Terminal PFASs contributing only 1.8% to 8.1% of the risk. Primary Terminal PFASs, in contrast, dominated the sample of leachate from the cell dedicated to ash derived from incinerated, municipal waste (see Figure 28a).

Data for the four remaining landfills were limited to pre-TOPs analysis for Primary PFASs. Calculated Hazard Indices for leachate samples collected from the three municipal-waste landfills varied between individual cells and ranged from 276 to 1,880 (refer to Table 21 and Appendix 12). A Hazard of 7,135 was calculated for the sample of leachate collected from a landfill dedicated to construction debris (LF #2). This was due to a higher concentration of Primary PFASs in the sample and in particular higher concentrations of $PFHxS^-$ and $PFOs^-$.

AFFF-Impacted Groundwater

Samples of groundwater collected from AFFF Release Site #2 were dominated by Excess Fluorine PFASs in the immediate area of the fire training pit, comprising 47% to 69% of the total PFASs present (Table 29 and Table 30; see also Figure 28a). The samples also exhibited moderately high proportions of Primary Terminal PFASs, ranging from 27% to 42% of the total PFASs concentration. Primary Terminal PFASs marginally dominate Excess Fluorine PFASs in downgradient wells, making up 56% of the total PFASs present in the sample collected from Monitoring Well MW-7 and 51% of the total PFASs in Monitoring Well MW-9.

Hypothetical Total PFAS Risk for groundwater samples collected in the immediate source area is significantly higher than the risk predicted for landfill leachate, with Hazard Indices ranging from over 20,316 to 124,456. Risk is again driven by Primary $PFOS^-$ and $PFHxS^-$, contributing to >90% of the Hazard Index calculated for 7 of the 8 groundwater samples (see Figure 28b). Primary $PFOS^-$ former drives risk for samples collected around the fire training pit source area and immediate downgradient areas (Monitoring Wells MW1 through MW5 and MW-7), while Primary $PFHxS^-$ begins to drive risk in areas further downgradient and cross gradient from the source area (Monitoring Well MW-9). Excess Fluorine PFASs in the samples contribute just 2% to 7% of the total risk. Secondary Terminal PFASs, associated with oxidation of precursor compounds initially present in the samples, contributes less than 1% to just over 5% to the total estimated noncancer hazard.

Comparison of Relative Source Strengths

Figure 29 compares the overall source strength of each PFAS-release scenario in terms of the final Hazard Index calculated for Total PFAS Risk. The source strength of effluent from the domestic WWTPs tested is one to three orders of magnitude lower than the source strength calculated for landfill leachate. The source strength of AFFF-impacted groundwater in the immediate release area is one to two orders of magnitude greater than calculated for landfill leachate and in some cases more than four orders of magnitude greater than Hazard Indices calculated for domestic wastewater effluent.

9.2 PFAS Impacted Biosolids, Compost and Soil

WWTP Biosolids and Compost

Samples of biosolids collected from three WWTPs where a full complement of PFAS data was obtained were dominated by Excess Fluorine PFASs, comprising an estimated 63% to 75% of the total makeup of PFASs in the samples (Table 31 and Table 32, Figure 30a). Secondary Terminal PFASs associated with precursor compounds comprised the second largest proportion of the samples, ranging from 17% to 33% of the total PFASs present. Primary Terminal PFASs made up only 1.9% to 7.3% of the total PFASs in the samples (see Figure 30a).

As noted in Figure 30b, hypothetical risk for the sample of biosolids collected from WWTP #1 is driven by Primary $PFOS^-$ and $PFHxS^-$ originally present in the sample (72% of total risk), with a lesser contribution from Secondary Terminal PFASs (23% of total). The predicted Hazard Index for the sample is relatively low, however, at just 3. Total PFAS Risk for samples of biosolids collected from WWTPs #2 and #6 is, in contrast, is driven by Secondary $PFOA^-$, $PFNA^-$ and $PFDA^-$, making up 58% and 66% of the predicted total risk (refer to Figure 30b). These long-chain, Terminal PFASs are interpreted to be associated with oxidation of long-chain precursor metabolites originally present in the samples (refer to Section 6 and Appendix 2). The overall Total PFAS Risk is again very low, with calculated Hazard Quotient of just 2 for both samples.

The single sample of compost collected from a WWTP was again dominated by Excess Fluorine PFASs, making up 84% of the total PFASs present (Table 33 and Table 34, Figure 30a). Hypothetical health risk, however, is driven by Primary $PFOS^-$, $PFDA^-$ and $PFOA^-$ identified in the sample. A final Hazard Index and Total PFAS Risk of 1 is calculated for the sample. Confidence in the representativeness of the compost sample data is low, however, due to difficulties in accessing the interior of the stockpile during collection of the sample (refer to Section 4.1).

AFFF-Impacted Soil

Data for samples of soil collected from the two AFFF-release sites reflect the release of two distinct types of AFFF. “Modern” (post 2005) AFFF released at Site #1 and identified in Samples DU-2 and DU-3 is dominated by Secondary Terminal PFASs, comprising near 100% of the total concentration of PFASs (Table 35 and Table 36, see Figure 30a). The compounds are largely attributed to the oxidation of 6:2 $FtTAoS^-$, the predominant PFAS present in the AFFF released (refer to Section 5.3). Overall risk is driven almost entirely by Secondary $PFHpA^-$, $PFPeA^-$and $PFHxA^-$ (see Figure 30b). A moderate Hazard Quotient of 6 was calculated for each sample.

Soil sample data from AFFF Release Site #1 contrast sharply with triplicate sample data from Release Site #2 (Table 37 and Table 38).). At Release Site #2, Primary Terminal PFASs make up an average 59% of total PFAS in Sample DU5F, the only sample for which a full complement of laboratory data was available (see Figure 30a). Ultrashort compounds associated with Excess Fluorine PFASs in the sample are estimated to comprise 15% of total PFASs, with Secondary Terminal PFASs making up the remainder.

Risk at Release Site #2 is driven almost entirely by Primary $PFOS^-$ (87% of total), with a relatively minor contribution from short-chain, Secondary Terminal PFASs (see Figure 30b). A final Hazard Index of 38 is calculated for the sample. The lack of significant Secondary Terminal PFASs in the sample suggest that the contamination is primarily associated with releases of pre-2005, PFOS-based AFFF.

Comparison of Relative Source Strengths

Figure 31 compares the overall source strength of each PFAS release scenario in terms of the final Hazard Index calculated for Total PFAS Risk. The source strength of PFASs associated with biosolids and compost from the domestic WWTPs included in the study is relatively low, with corresponding Hazard Indices of just 1 to 3. This compares with Hazard Indices of 6 for AFFF-samples of impacted soil from Release Site #1 and 38 for samples of soil collected from Release Site #2. The higher Hazard Index calculated for the sample collected from Release Site #2 contrasts with near twenty-fold lower concentration of total PFASs in the sample. This is due to the predominance of more toxic $PFOS^-$ at that site. Samples collected from Release Site #1 were collected following excavation of the most heavily contaminated soil. Samples from Release Site #2 were collected well away from the primary release areas. Concentrations of PFAS and associated Total PFAS Risk can be expected to be several orders of magnitude higher for AFFF-impacted soil in primary release areas.

10.0 Discussion

10.1 General Observations

An in-depth review of published research similar to the study described in this report has not been carried out. research Based on discussions with outside PFAS experts, however, the data are reflective of similar types of facilities (Lang et al. 2014; Vo et al. 2020, Kim et al. 2022). A summary of general observations of the methodologies developed and employed in the study and preliminary conclusions regarding the nature of PFASs at WWTPs, landfills and AFFF-release sites is presented below. These observations and conclusions will be updated and expanded following the collection of additional sample data and reviews of pertinent, available research.

Laboratory Analytical Methods

The study identified complex mixtures of PFASs in samples of WWTP influent, effluent and biosolids, landfill leachate and soil and groundwater impacted by AFFF not reported by conventional laboratory methods that focus on a short list of individually targeted compounds. Identification of a more complete suite of PFAS compounds was made possible through the use of three separate analytical methods to test each sample: 1) SGS Method MLA110 for a specified set of individual PFASs (Isotope dilution LC-MS/MS in the absence of initial sample processing, equivalent to USEPA Method 1633), 2) SGS Method MLA111 (processing of sample using Total Oxidizable Precursors (TOPs) methods and retesting using Isotope dilution LC-MS/MS) and 3) SGS Method 119 for Total Organic Fluorine (TOF). An Absorbable Organic Fluorine (AOF) method is used to test samples of liquids for TOF and an Extractable Organic Fluorine (EOF) is used for solids. Non-Targeted Analysis (NTA) was used to identify additional PFASs indicated by higher-than-predicted levels in TOF in samples that could not be directly reported and quantified by conventional laboratory methods.

TOPs processing of biosolid and soil proved critical for identification of precursor PFAS compounds in these media not fully captured and quantified by initial analysis. “Secondary Terminal PFASs” associated with precursor compounds omitted in pre-TOPs data were demonstrated to pose a significantly greater health risk than pre-TOPs, “Primary Terminal PFASs” such as PFOS or PFOA in the same samples.

TOPs processing of water samples did not identify significant, precursor compounds in wastewater, landfill leachate or AFFF-impacted groundwater beyond those reported by initial, pre-TOPs analysis. This suggests that partial to full removal of functional groups occurs relatively rapidly upon dissolution of precursor compounds in water. Additional variables that could affect sample data include adsorption to soil, availability of analytical methods to detect compounds accurately, sampling and preservation of samples and representativeness of the sampled collection method. Comparison of pre- vs post-TOPS data could, however, prove very useful for forensics assessment of PFAS sources in water as well as design of remedial options.

A comparison of the concentration of TOF predicted by reported concentrations of Primary and Secondary Terminal PFASs in water samples to the concentration of TOF measured in the same sample proved critical for identification of additional PFASs in samples that would have otherwise gone undetected. This group of “Excess Fluorine PFASs”, currently assumed to be largely associated with ultrashort compounds, dominated wastewater influent and effluent, landfill leachate and AFFF-impacted groundwater and, in the case of wastewater, is interpreted to drive potential health risk. Discussions with laboratories suggest that current AOF methods are not able to fully recover weakly sorptive, ultrashort

PFAS compounds in water samples. This implies that the concentration of Excess Fluorine PFASs could be underestimated, with a corresponding underestimation of associated health risk.

The results of the study suggest that initial testing of samples of suspect PFAS-contaminated soil, water and other media including food should be carried out using a full suite of pre-TOPs, post-TOPs and TOF analytical methods. Sample analysis could be revised as needed to focus on the PFAS group or groups interpreted to drive overall health risk during subsequent phases of the investigation.

Assessment of Cumulative (Total) PFAS Risk

Three groupings of PFASs reflective of the analytical methods noted above were used for quantitative assessment of Total PFAS Risk (HIDOH 2024b): 1) Primary Terminal PFASs such as $PFOS^-$, $PFHxS^-$ and $PFOA^-$ originally present in a sample, 2) Secondary Terminal PFASs generated by TOPs oxidation and breakdown of precursor compounds present in the sample and 3) Excess Fluorine PFASs identified by comparison of predicted versus measured TOF in the sample. Non-Targeted Analysis suggests that the majority of the latter category of PFASs is associated with non-specific, ultrashort compounds.

A cumulative, noncancer Hazard Index is calculated for each group of Primary and Secondary Terminal PFASs identified in a sample by comparison of sample data for individual compounds to corresponding HIDOH Environmental Action Levels (EALs). A Hazard Quotient is generated for Excess Fluorine PFASs in a sample by conversion of calculated excess organic fluorine in the sample to an equivalent concentration of $PFPrA^-$ and subsequent comparison to action levels for that compound $^-$. Total PFAS Risk in terms of cumulative, noncancer hazard, is then calculated as the sum of the calculated Hazard Indices for each of the three groups of compounds.

The Total PFAS Risk method allows for a much more comprehensive and robust assessment of potential health risk posed by exposure to complex mixtures of PFASs than a narrow focus on a short list of primary compounds identified in a sample. The need to assess potential health risk based on groupings of PFAS mixtures has been discussed in other publications (e.g., Bowles 2024) but to HIDOH's knowledge has not been developed to the degree utilized in this study and discussed in companion HIDOH guidance (HIDOH 2024b).

References for toxicity factors utilized to develop risk-based action levels for Terminal PFASs are provided in HIDOH PFAS EAL guidance document (HIDOH 2024b). The toxicity factors were developed based on both animal and epidemiological studies. Toxicity factors derived from the two types of studies can vary dramatically, with factors based on epidemiological studies oftentimes orders of magnitude lower (more conservative). Confidence in PFAS toxicity factors based on epidemiological studies versus animal studies is currently being debated, with preference in some cases being given to more controlled, animal studies (e.g., FSANZ 2021, Richardson and Martin 2024). Possible future options include the use of toxicity factors and associated action levels based on animal studies for regulatory, decision making and required, remedial actions. Toxicity factors derived from epidemiological studies could in turn be used to guide policies for longer-term reduction of PFAS exposure through minimization or elimination of the use of these compounds in a manner that could lead to exposure of the general population.

Ultrashort Compounds

A more detailed understanding of the nature and collective toxicity of the complex mixture of ultrashort PFAS compounds interpreted to be present in wastewater, landfill leachate and AFFF-impacted groundwater is needed. Laboratories are currently expanding the ability to identify and quantify these

compounds in environmental samples. The compounds could be associated with ultrashort PFASs originally in the source media or partial breakdown of short- and long-chain compounds following release to the environment. Error in the use of TOPs and TOF data to approximate the collective concentration of these compounds in a sample is also unknown.

The Total PFAS Risk approach outlined in HIDOH (2024b) and utilized in this report currently assigns a toxicity equal to the compound $PFPrA^-$ to the mixture of presumed ultrashort compounds identified in a sample by TOF data. This approach will overestimate hypothetical risk associated with ultrashort mixtures that include a significant proportion of lower-toxicity ultrashort compounds similar perfluoroethanoate (trifluoroacetate; refer to Table 12).

The presence of ultrashort compounds in water has important implications for both assessment of risk and design of remedial actions. Methods for removal or destruction of short- and long-chain PFASs in impacted water might not be effective for treatment of ultrashort compounds. Additional research is also required on the uptake of ultrashort compounds into food crops irrigated with PFAS-contaminated wastewater or groundwater. Apparent ultrashort compounds in the form of excess organic fluorine were also identified in biosolids. This has implications for uptake of these compounds into food crops grown in soil amended with biosolids.

Laboratories have noted that the sorption-based analytical method for AOF will likely under report compounds with very low sorption coefficients, such as $PFEtA^-$. This will bias the AOF data and estimate of excess organic fluorine in water samples low. The health risk associated with Excess Fluorine PFASs will in turn also be biased low. The result can be anticipated to be relatively insignificant if other PFASs are present in the sample, however, given the comparably low toxicity of $PFEtA^-$. Caution is also advised for filtering of water samples prior to analysis. Laboratories report that filters commonly used for water samples can contain relatively high levels of fluorine. The use of fluorine-free filters is required in order to avoid positive bias of AOF reported for water samples. The absence of fluorine contribution from filters to reported sample data can be verified by the inclusion of filter blanks in the laboratory QA/QC process.

Leaching of PFASs from Soil and Biosolids

Additional research on the fate and transport of PFASs in the environment is needed. Use of Synthetic Precipitation Leaching Procedure (SPLP) to derive sorption coefficients (Kd) for individual PFAS compounds yielded mixed results (HIDOH 2017). In some cases, the degree of desorption of a compound into the SPLP solution seemed clear, with associated Kd values indicating relatively limited mobility. This was especially the case for soil impacted by pre-2005 AFFF that lacked significant precursor compounds.

The utility of SPLP data to assess leaching of PFASs from soil and biosolids that contain a significant proportion of precursor is less clear, however. Breakdown of these compounds in the SPLP solution confounded comparison to concentrations of the same compounds originally present in the soil or biosolids. The generation of additional short-chain and ultrashort compounds in the SPLP solution similarly confounded calculation of sorption coefficients and assessment of leaching potential for these compounds as originally identified in the sample.

The use of Method 1314-type soil column leaching tests is anticipated to be more reliable for assessment of leaching of PFASs from impacted soil and other solids (USEPA 2017). Modification of the test method to utilize a larger column that can accommodate a 1-2 kg Multi Increment sample is required. Testing of leachate can be refined to focus on the concentration of PFASs in the “First Flush” of water pushed

through the sample (e.g., 10% of total water volume) and the "Long-Term" leaching of PFASs from the sample (final 90% of leachate generated). This reduces the number of samples to be tested from the method default of nine to just two. Modification of the method and additional testing of samples collected as part of this study is currently underway. The resulting data and experience gained for modified use of the approach will be included in future updates to this report.

Migration of PFAS in Groundwater

The compound $PFHxS^-$, when present, is predicted to increasingly drive potential health risk in downgradient areas of a release area due to the combined high toxicity and increased, relative mobility of the compound in comparison to longer-chain PFASs such as PFOS and PFOA. More mobile, ultrashort compounds associated with Excess Fluorine PFASs are predicted to drive potential health risks in the leading edge of expanding plumes of impacted groundwater. Identification of these compounds through direct reporting by the laboratory and comparison of predicted versus measured concentrations of Total Organic Fluorine in water samples will be important for reliable investigation and assessment of PFAS-contaminated groundwater and surface water.

Remediation of PFAS-Impacted Water

The apparent abundance of ultrashort PFASs in WWTP influent and effluent, landfill leachate and AFFF-impacted groundwater poses additional challenges for treatment of PFAS-contaminated water, particularly when a drinking water resource is threatened. Conventional methods for removal of PFASs from water using absorption (e.g., granulated activated carbon) or foam fractionation methods are less efficient for removal of ultrashort compounds (Bowles et al. 2024). Case-specific study of the physiochemical nature and toxicity of this group of compounds and optimal methods to reduce concentrations to acceptable levels will be necessary when potential significant exposure of human or ecological receptors is identified.

10.2 Wastewater Treatment Plant Influent and Effluent

PFAS Makeup

Refer to summary Figures 28 and 29 and summary Tables 25 and 26. The makeup of individually identified PFASs in influent and effluent varied widely between the six WWTPs included in the study. Individually identified compounds in the influent of three of the six WWTPs 5:3 $FTCA^-$ and $PFHxA^-$. None of these facilities receives leachate from landfills. The influent of the remaining three WWTPs was characterized by a varying mix of short-chain and long-chain carboxylates and sulfonates. Effluent samples from the WWTPs demonstrated a similar degree of variability but a notable lack of 5:3 $FTCA^-$. The latter was presumably oxidized and broken down into short-chain compounds as it passed through the WWTP.

Both WWTP influent and effluent were dominated by Excess Fluorine PFASs, comprising 60% to more than 80% of the total PFASs present in the samples. NTA analysis and published research on the metabolic breakdown of PFASs suggests that the excess organic fluorine is primarily attributable to non-specific, ultrashort compounds. Concentrations of $PFEtA^-$ (trifluoroacetate) in samples exceed the sum of other, individually identified PFASs. The compound accounted for less than 25% of the estimated concentration of Excess Fluorine PFASs estimated for the samples, however. This suggests a complex mixture of ultrashort compounds in the wastewater.

Primary Terminal PFASs, in most cases dominated by short-chain PFASs, made up the majority of the remaining suite of compounds in influent and effluent. Precursor compounds in many cases exemplified by relatively high levels of 5:3 $FTCA^-$ were identified in influent but not effluent samples.

Hypothetical Risk

Calculated noncancer Hazard Quotients for WWTP influent and effluent sample data with respect to hypothetical drinking water risk were relatively moderate, ranging from 6 to 8 at the three facilities where full suites of pre-TOPs, post-TOPs and TOF data were collected. Hypothetical risk was driven by the Excess Fluorine group of PFASs, making up 60% to 80% of the total calculated noncancer Hazard.

The sum of calculated noncancer Hazard Indices for Primary and Secondary Terminal PFASs in WWTP influent and effluent ranged from 1 to 3. Primary Terminal PFASs contribute 15% to 35% of the total risk for effluent. Risk was posed by Primary Terminal PFASs driven by $PFOS^-$, $PFHxS^-$, $PFOA^-$, with contributions in some cases from $PFPeA^-$ and $PFDA^-$. Risk posed by Secondary Terminal PFASs was spread over an assortment of both short and long-chain PFASs, including $PFHpA^-$, $PFOA^-$, $PFNA^-$ and $PFDA^-$.

Potential Environmental Concerns

Leakage of sewage from municipal sewer lines could impact shallow, underlying groundwater. Relation of PFASs identified in shallow groundwater to leaking sewer lines can be investigated by testing for other markers of sewage, including (HIDOH 2024e):

- Optical brighteners (added to laundry detergent to enhance the colors of the laundered fabrics);
- Nutrients (primarily nitrogen and phosphorus);
- Oxygen and hydrogen Isotopes;
- Nitrate isotopes;
- Selected pharmaceuticals; and
- Targeted artificial sweeteners.

Discharge of WWTP effluent to a surface water body could in theory adversely impact aquatic habitats. Reported concentrations of PFASs in effluent are well below published action levels for acute or chronic toxicity to aquatic organisms, however (refer to Table 12; HIDOH 2024b). Uptake of PFASs into aquatic organisms at levels that could pose food chain and human health concerns is primarily associated with freshwater fish in water bodies that receive industrial WWTP effluent with high concentrations of long-chain compounds such as $PFOS^-$ (Barbo et al. 2023). Low concentrations of long-chain compounds in effluent of the municipal WWTPs included in the study discussed in this report combined with discharge to marine waters where significant mixing and dilution minimizes the risk of significant uptake of these compounds in fish around the islands. Barbo et al. (2023), however, highlight a significantly greater uptake of PFASs into clams, mussels and other types of aquatic organisms that feed primarily by filtering nutrients from the water. This warrants monitoring of PFASs in filter feeding organisms used for food.

Use of municipal WWTP effluent for irrigation in areas overlying groundwater that is a source of drinking water is unlikely to impact groundwater above drinking water standards or action levels or exceed a cumulative risk limit (e.g., noncancer Hazard >1), assuming a default dilution factor of 10 to 20 (USEPA 1996). Monitoring of such bodies of groundwater should, however, be carried out to confirm this prediction. Focused discharge of large volumes of effluent into groundwater that is a source of drinking water via an injection well could, however, lead to localized impacts above acceptable risk levels.

Risks associated with the potential uptake of PFASs into food crops from municipal WWTP effluent used for irrigation also requires additional research. An HIDOH-sponsored field study currently underway is anticipated to be completed by the end of 2025. The results of this study in combination with reviews of other studies and published research will be used for a more in-depth review of this issue and development of additional guidance as necessary.

10.3 Wastewater Treatment Plant Biosolids and Compost

PFAS Makeup

Refer to summary Figures 30 and 31 and summary Tables 31 through Table 34. Testing of individual compounds in biosolids revealed a complex mix of terminal carboxylates and sulfonates and precursor compounds. Processing of samples using TOPs resulting in an three- to ten-fold increase in the total concentration of PFASs reported for the sample, indicating a dominance of precursor compounds. The increase was less pronounced in the single sample of biosolids-amended compost tested. This is presumably related to oxidation and breakdown of precursors during curing of the compost.

The comparison of predicted versus measured TOF in samples suggests that Excess Fluorine PFASs make up 60-80% of the total concentration of PFASs present in biosolids from each of the six WWTPs included in the study. The PFASs are again interpreted to be dominated by ultrashort compounds. This is expected, given the dominance of this group of compounds in wastewater influent and the average 85% moisture content of the samples.

Precursor-related, Secondary Terminal PFASs comprised 15-30% of total PFASs present in the samples of biosolids. Relatively large amounts of long-chain Terminal PFASs were generated by TOPs processing, presumably related to long-chain precursor compounds originally present in the samples. Processing of the single, biosolids-amended compost sample included in the study did not generate additional Secondary Terminal PFASs. This is interpreted to reflect the breakdown of precursor compounds originally in the biosolids during curing of the compost.

Hypothetical Health Risk

Hypothetical noncancer hazard was driven by Primary Terminal PFASs in biosolids from one of the three WWTPs with a full complement of PFAS data and by precursor-related, Secondary Terminal PFASs in biosolids collected from the remaining two WWTPs. Risk was driven by Primary $PFOS^-$ and PFHxS in the first case and by Secondary $PFOA^-$, $PFNA^-$ and $PFDA^-$ in the latter two cases. Calculated Hazard Indices were in each case very low, however, ranging from 2 to 3.

Contribution to total risk from ultrashort compounds assumed to be associated with Excess Fluorine PFASs was relatively minor in all cases. This was in primarily due to relatively high concentrations of more toxic short and long-chain PFASs in the samples.

A noncancer Hazard Index of less than one was calculated for the single sample of compost collected. Risk was driven by Primary Terminal PFASs.

Potential Environmental Concerns

The majority of WWTPs in Hawaii dispose of biosolids at municipal landfills. This is due in part to the relatively small volume of biosolids generated and the cost of setting up and managing a composting facility. Use of biosolids as a soil amendment or disposal at a municipal landfill or waste-to-energy municipal incinerator could lead to exposure of residents or workers at municipal facilities. The relatively

low Hazard Indices calculated for biosolids and compost suggests minimal potential health risk from exposure to PFAS in compost or soil amended with municipal WWTP biosolids or from biosolids disposed of at municipal landfills and waste-to-energy facilities.

A study of the potential uptake of PFASs into food crops from agricultural soil amended with biosolids has not been carried out by HIDOH. The low risk posed by direct exposure to municipal biosolids and compost suggests, however, that the risk posed by potential uptake into food crops will likewise be minimal. Additional research on this issue is warranted, particularly for areas where biosolids have been applied to agricultural fields used for the production of food crops. Guidance based on Decision Unit and Multi Increment Sample investigation methods described in the HIDOH *Technical Guidance Manual* (HIDOH 2024d) should be expanded to included testing of both food crops and agricultural fields for potential contaminant uptake risks.

10.4 Landfill Leachate

PFAS Makeup

Refer to summary Figures 28 and 29 and summary Tables 27 and 28. The precursor compound 5:3 $FTCA^-$ dominated individually identified PFASs in samples of leachate collected from 12 of 14 cells from the five municipal landfills included in the study. The short-chain compounds $PFPeA^-$, $PFHxA^-$ and $PFHpA^-$ comprised the majority of the additional, individually identified compounds. Individually identified compounds in leachate dedicated to ash from a municipal waste-to-energy facility were dominated by the same short-chain compounds in the absence of 5:3 $FTCA^-$. Comparatively low concentration of more toxic $PFOA^-$, $PFHxS^-$ and $PFOS^-$ were also identified in most samples. Individually identified compounds Leachate from a landfill dedicated to construction debris were, in contrast, dominated by $PFHxS^-$ and a mixture of $PFBS^-$, $PFPeS^-$ and $PFOS^-$.

A full suite of data for calculation of Total PFAS Risk was only available for one of the municipal landfills. The total concentration of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs in leachate from two cells containing unincinerated, municipal waste was 500 or more times higher than the total concentration of PFASs in WWTP effluent.

Excess Fluorine PFASs assumed to be associated with a complex mixture of ultrashort compounds dominated PFASs present in the samples. Primary short- and long-chain terminal PFASs comprised a substantial proportion of the total PFASs (26% to 34%), however. Comparably high concentrations of Primary Terminal PFASs in samples collected from landfills that lack a full suite of data suggest that this is likely to be the case for these landfills as well.

Hypothetical Health Risk

Calculated Hazard Indices for landfill leachate were in most cases two orders of magnitude or higher than for WWTP effluent, even in the absence of TOPs and TOF data. This corresponds both to a higher concentration of total PFASs in the leachate as well as the presence of more toxic, longer-chain Primary Terminal PFASs in the leachate. Noncancer hazard for leachate samples collected from landfill cells that contained unincinerated, municipal waste was driven by Primary $PFOS^-$, $PFOA^-$ and $PFHxS^-$. Noncancer hazard was driven by Primary $PFHpA^-$ and $PFOA^-$ in the sample of leachate collected from a cell containing ash from incinerated municipal waste.

Leachate from the landfill dedicated to construction debris fill exhibited the highest noncancer Hazard Index. This was due to both a higher total concentration of PFASs in the sample and a dominance of more toxic, sulfonated compounds such as $PFHxS^-$.

Potential Environmental Concerns

Health and safety precautions and personal protective equipment requirements (PPE) already in place to protect landfill workers from adverse exposure to heavy metals, ammonia-nitrogen compounds and other organic compounds commonly found in leachate are anticipated to be adequately protective of potential exposure to PFASs.

Engineering controls required under permits for municipal landfills as well as the location of a majority of operating landfills in coastal areas reduces the risk of potential adverse impacts to groundwater that is a source of drinking water. Leachate extracted from four of the five landfills included in the study is used for dust control or discharged to evaporation ponds. Controls on the daily volume of leachate that can be disposed of at a WWTP at the remaining landfill represent less than 0.1% of the total volume of influent received by the landfill. This negates a significant increase in the concentration or toxicity of PFASs in the WWTP effluent.

Leaching of PFASs from older, unlined landfills could pose a potential risk to underlying groundwater that is used as a source of drinking water. Maintenance of engineering controls, such as the cover system, could minimize this risk. Long-term monitoring of PFASs in the groundwater is warranted in these types of scenarios. Although the risk of impacts to aquatic life or significant uptake into the food chain is low, short-term monitoring of PFASs in groundwater underlying and downgradient of unlined landfills in close proximity to an aquatic habitat could also be warranted on a case-by-case basis.

10.5 Fire Training Area Soils

PFAS Makeup

Refer to summary Figures 30 and 31 and summary Tables 35 through Table 38. Soil impacted by older, PFOS-based AFFF at the second release site included in the study was dominated by Primary $PFOS^-$. TOPs processing of the samples only marginally increased the concentration of total PFASs present, with small amounts of $PFBA^-$, $PFPeA^-$ and $PFHxA^-$ generated.

Individually identified compounds in soil impacted by modern (post-2005), precursor-based AFFF at the first release site were dominated by 6:2 FTS^-, with small amounts of also $PFBA^-$, $PFPeA^-$ and $PFHxA^-$ reported. TOPs processing of samples from the main release area generated a near three-order magnitude increase in total PFASs and significant amounts of Secondary $PFHpA^-$, $PFPeA^-$ and $PFHxA^-$. Non-Targeted Analysis data confirmed that these compounds were associated with the breakdown of 6:2 FtTAoS in the AFFF released at the site.

Hypothetical Health Risk

Hypothetical risk posed by soil impacted by precursor-based AFFF in the first AFFF-release site was driven by Secondary $PFPeA^-$, $PFHxA^-$ and $PFHpA^-$. Additional contribution to risk from Primary Terminal PFASs was negligible. Hypothetical risk posed by soil impacted by past releases of PFOS-based AFFF at the second release site was driven by Primary $PFOS^-$ and $PFHxS^-$. Additional contribution from Secondary Terminal PFASs ranged from 3% to 23% and included Secondary $PFOA^-$, $PFNA^-$ and $PFDA^-$.

Potential Environmental Concerns

Soil samples tested as part of the study described in this report were collected after initial remediation of the site (AFFF release Site #1) or in areas outside of the main release location (AFFF release Site #2). Calculated noncancer Hazard Indices were relatively moderate and ranged from 6 to 40, with the higher Hazard Index associated with a higher concentration of PFASs in the sample. Hazard Indices for AFFF-impacted soil in the immediate vicinity of the release can be anticipated to be significantly higher and require careful management of the soil.

Soil impacted with AFFF poses a potentially significant leaching risk to underlying groundwater and nearby surface water. Leaching of PFASs from soil poses an especially high concern in areas that overlie groundwater that is a potential source of drinking water. More mobile, short-chain compounds associated with more modern formulations of AFFF could be expected to migrate more quickly from initial release areas and form longer plumes in groundwater. Less mobile, long-chain compounds used in older formulations of AFFF could still generate extensive plumes, however, over several decades of releases.

10.6 Fire Training Area Groundwater

PFAS Makeup

Refer to summary Figures 28 and 29 and summary Tables 29 and 30. Groundwater impacted by long-term releases of AFFF at the fire training site included in the study was dominated by $PFOS^-$, 6:2 FTS^- and a lesser proportion of $PFBA^-$, $PFPeA^-$ and $PFHxA^-$ and in the immediate area of the training pit and $PFOS^-$- and $PFHxS^-$ in downgradient areas. The presence of $PFOS^-$ in the groundwater is interpreted to be related to the use of pre-2005, PFOS-based AFFF in the training area. The presence of 6:2 FTS^- and short-chain compounds in the groundwater is interpreted to be related to the use of 6:2 FtTAoS-based AFFF after 2005. TOPs processing of the groundwater samples stripped the functional group from 6:2 FTS- and resulted in an increased in the respective concentrations of short-chain compounds originally identified in the samples. The total concentration of PFASs in the samples generally decreased following TOPs processing. This is interpreted to be due to removal of the functional group from 6:2 FTS^- and associated, decreased, average molecular weight of the short-chain PFASs generated and the lack of additional and previously undetected PFASs in the groundwater.

The concentration of total PFASs in groundwater below the release area of AFFF is significantly higher than that reported for landfill leachate. The mixture of PFAS present in the groundwater is also significantly more toxic due to the abundance of both short- and long-chain Primary PFASs and a reduced proportion of less toxic, ultrashort compounds.

The presence of sulfonated PFASs such $PFBS^-$, $PFHxS^-$and $PFOS^-$ in groundwater well downgradient of the training area at AFFF Release Site #2 is likely indicative of past releases of PFOS-based, pre-2005 AFFF. Releases of post-2005, “modern” AFFF are, in contrast, characterized by breakdown products of 6:2 FtTAOS. This includes the presence of 6:2 FTS in the immediate release area and $PFHxA^-$ and $PFHpA^-$ throughout the plume area.

The dominance of $PFOS^-$and PFHxS- throughout the plume is likely indicative of releases of PFOS-based AFFF that occurred prior to lining of the fire training area in 1997. Short-chain compounds in groundwater samples collected within the immediate vicinity of the training pit are interpreted to be associated with more recent releases of 6:2 FtTAOS.

Significant, excess organic fluorine interpreted to be associated with ultrashort compounds was also identified in samples of groundwater collected from AFFF Release Site #2. Non-targeted analysis of one of the samples identified the presence of the ultrashort compound $PFPrA^-$. The makeup of ultrashort compounds in the water is likely to be highly complex, however. The apparent decrease in the proportion of Absorbable Organic Fluorine in downgradient wells is unexpected given the presumed greater mobility of these compounds. This could simply be an artifact of limited data, however.

Hypothetical Health Risk

Hypothetical noncancer Hazard Indices calculated for AFFF-contaminated groundwater at the study site exceeded 100,000 and remained well over 500 in downgradient areas. Risk was driven by Primary $PFOS^-$ and $PFHxS^-$ with comparatively minor contributions from ultrashorts assumed to associated with Excess Fluorine PFASs and Secondary $PFPeA^-$, $PFHpA^-$ and $PFHxA^-$.

Potential Environmental Concerns

Groundwater impacted by releases of AFFF can pose a significant, potential health risk is used as a source of drinking water. Unlike effluent from domestic WWTPs, hypothetical health risk is driven by the more toxic short- and long-chain PFASs. Methods to remove short- and long-chain PFASs from water, including granulated activated carbon and foam fractionation, are relatively well established. The adequacy of these methods to reduce concentration of ultrashort compounds to acceptable levels requires additional research, however.

The natural discharge of AFFF-impacted groundwater into surface water bodies via springs, construction-related, dewatering activities or seepage into storm sewers could pose a moderate to high but localized toxicity risk to aquatic habitats. This issue should be investigated on a case-by-case basis. The natural or intentional discharge of AFFF-contaminated groundwater into a body of surface water with restricted circulation could pose a localized risk of uptake into aquatic organisms and passage up the food chain. Additional research of this issue is also needed.

Testing for all three groups of PFASs is important during initial investigations to adequately characterize the degradation stage of a plume of impacted groundwater. Testing for ultrashort compounds using TOF and as needed NTA analysis is especially important in downgradient areas of the plume to ensure that extent of contamination is adequately identified.

10.7 Anthropogenic Background

PFASs were not identified in 7 of the 8 soil samples collected in remote areas of the Hawaiian Islands. A trace level of Primary $PFBA^-$ was reported in a sample collected in the Ko´olau mountains above and downwind of an urban area. The data a whole is suggests minimal broadscale, atmospheric deposition of PFASs in Hawaii from distant sources.

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Figure 1. Influent intake and effluent discharge culvert at a WWTP. Effluent discharges to ocean.

Figure 2. Wastewater treatment plant clarifier used for settling and collection of biosolids from wastewater influent.

Figure 3. Twenty cubic yard roll-off bins used to collect and transport biosolids at wastewater treatment plants.

Figure 4. Stockpile of compost prepared of a 3:1 mixture of green waste and biosolids at WWTP #6 (used for on-site landscaping).

Figure 5. Excavation trench designated as a Source Area Decision Unit for collection of a single, Multi Increment sample. Used to confirm cleanup of an AFFF release.

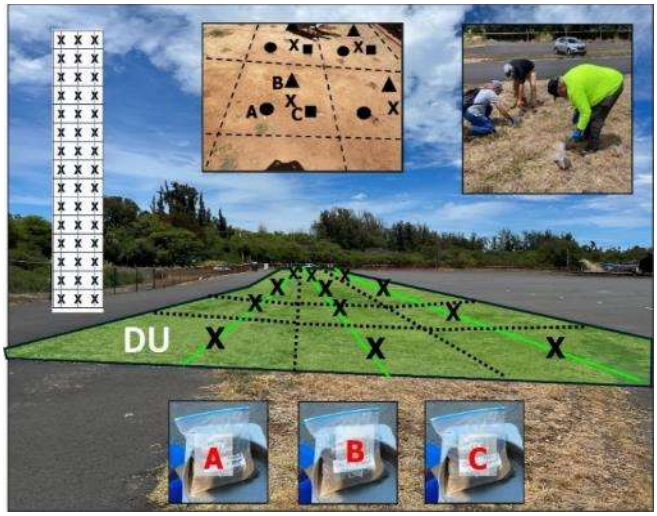


Figure 6. Collection of Multi Increment samples from suspected AFFF-impacted soil at a fire training area. Grassy area beside the training area where workers sometimes congregate designated as an Exposure Area Decision Unit. Triplicate samples A, B and C collected from independent locations within individual collection cells and used to test precision of overall sampling method.

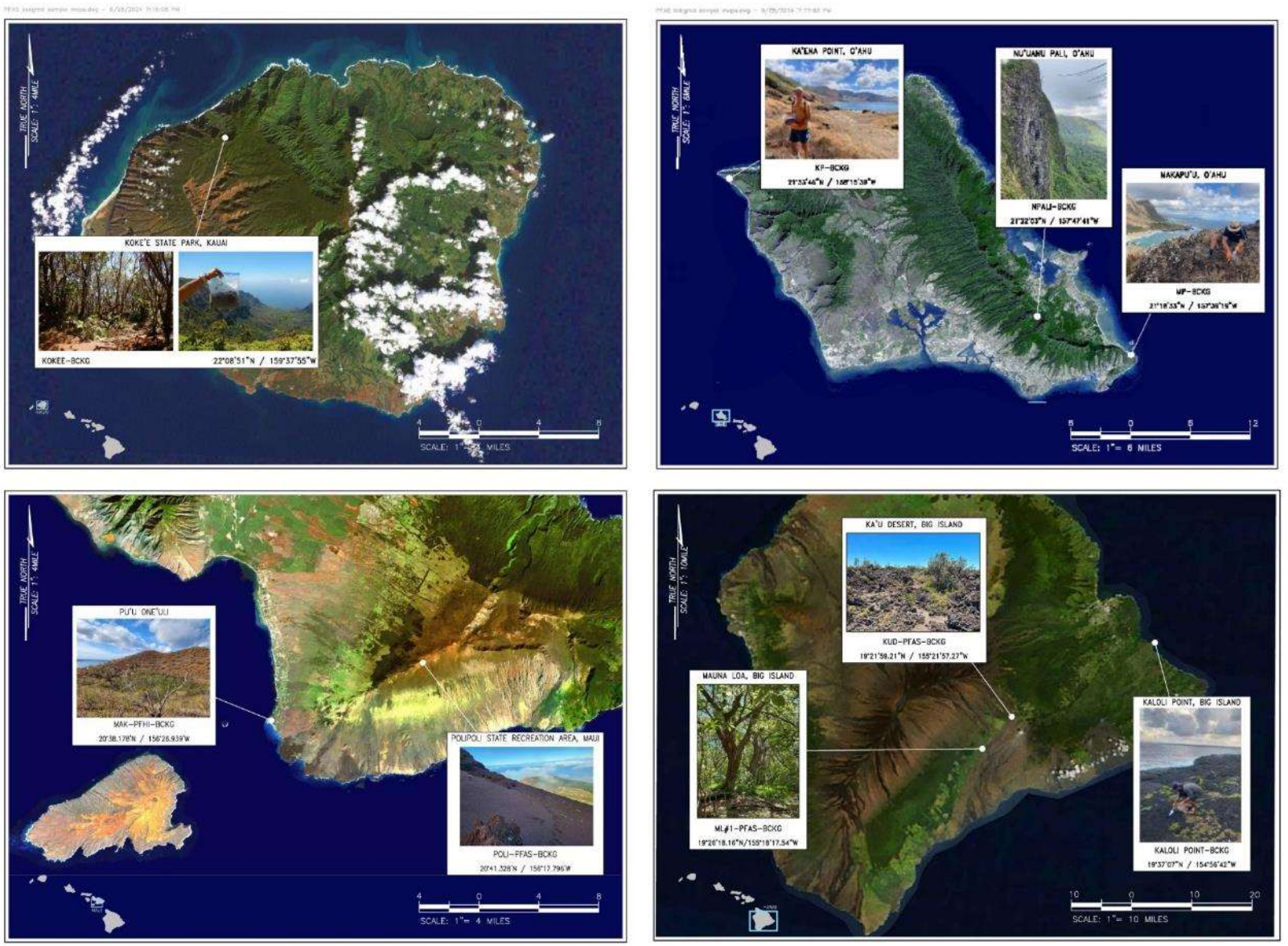


Figure 7. Location of PFAS soil background collection sites. Top Left: Kauai; Top Right: Oahu; Bottom Left: Maui; Bottom Right: Island of Hawai'i (Big Island).

Figure 8. Composite sampler equipment used to collect 24-hour samples of influent and effluent at wastewater treatment plants.

Figure 9. Pellets of dried biosolids used as fertilizer on golf courses and landscaped areas.

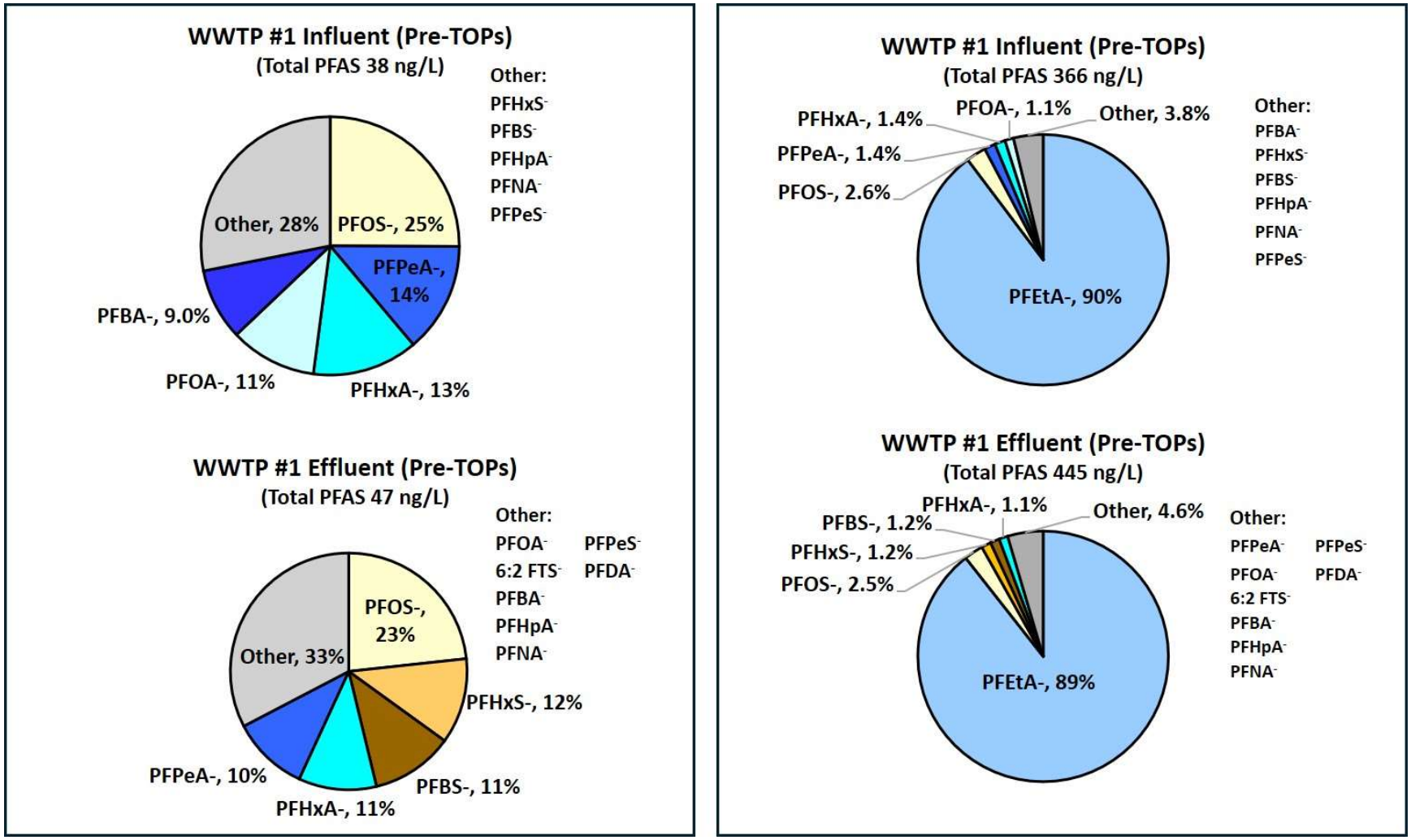


Figure 10a. PFAS makeup of WWTP #1 influent and effluent (Left: Excluding. Right: Including $PFEtA^-$).

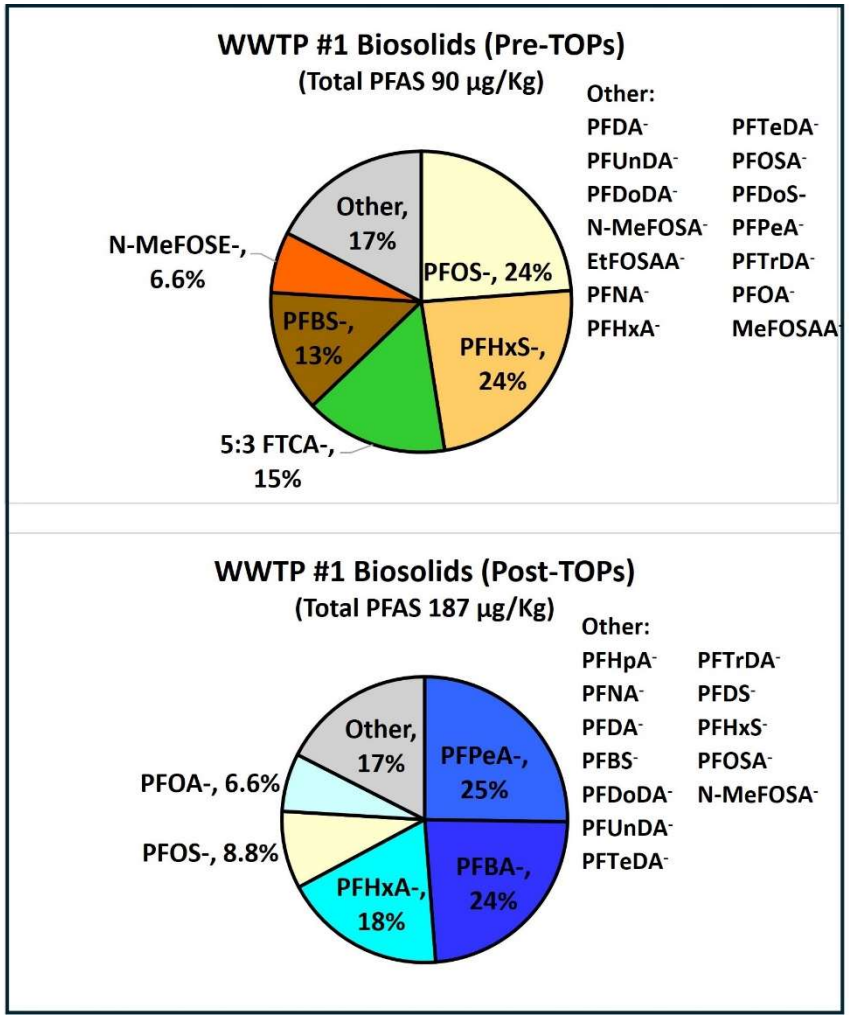


Figure 10b. PFAS makeup of WWTP #1 biosolids.

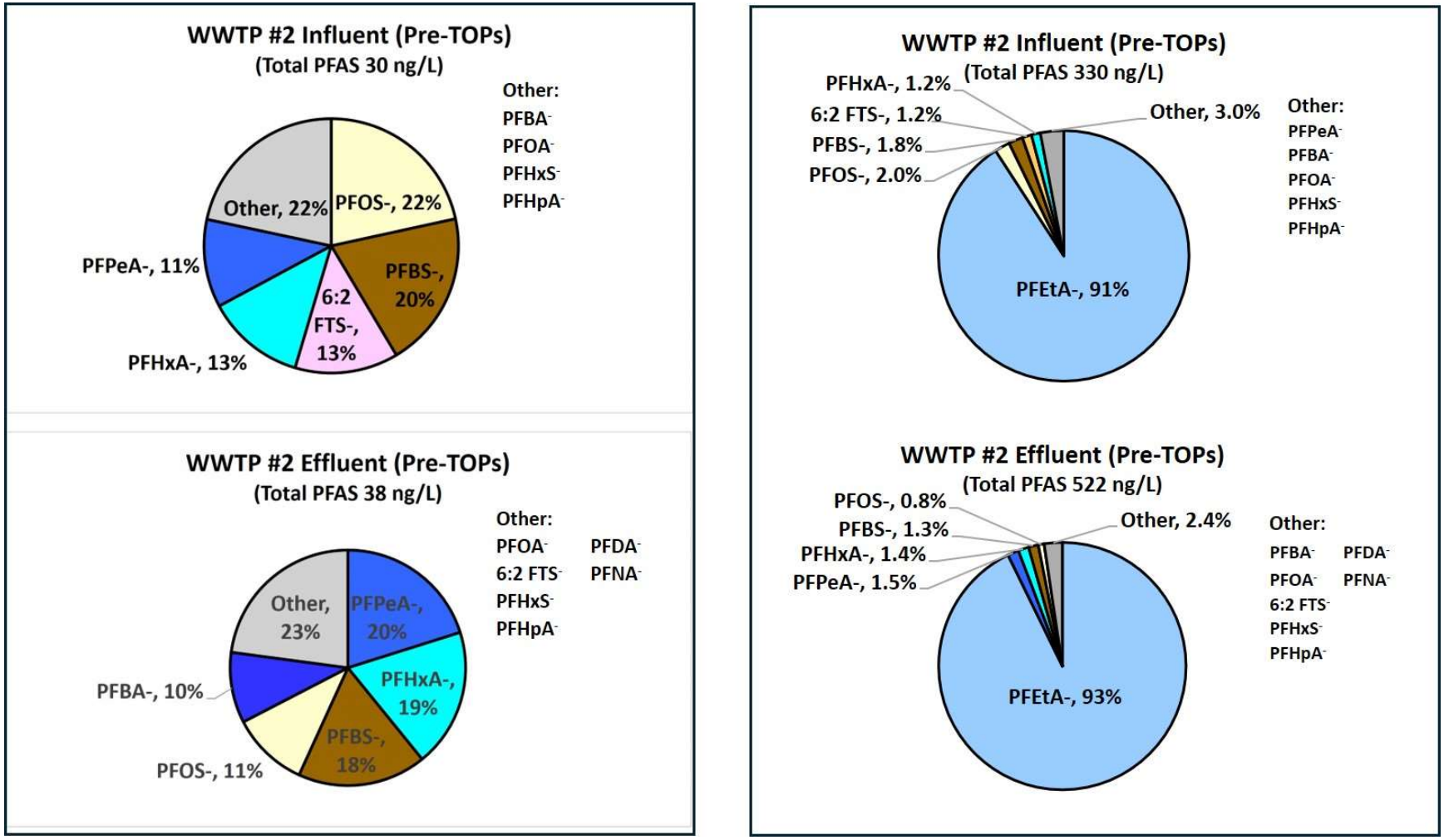


Figure 11a. PFAS makeup of WWTP #2 influent and effluent (Left: Excluding. Right: Including PFEtA-).

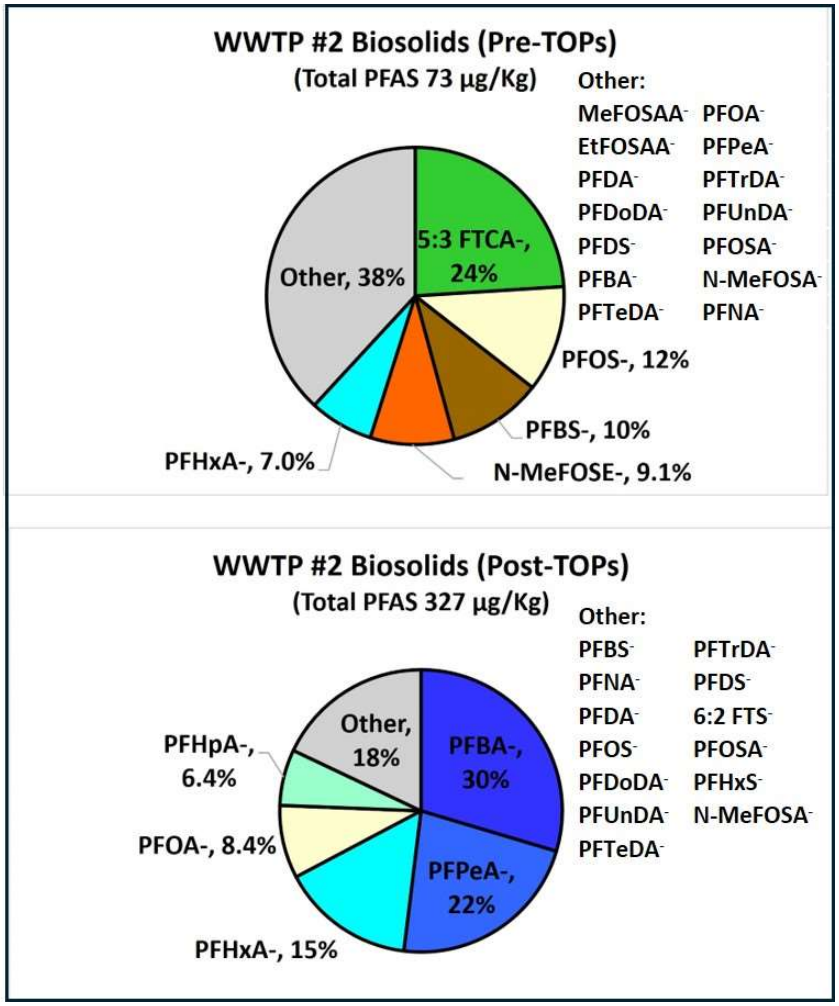


Figure 11b. PFAS makeup of WWTP #2 biosolids.

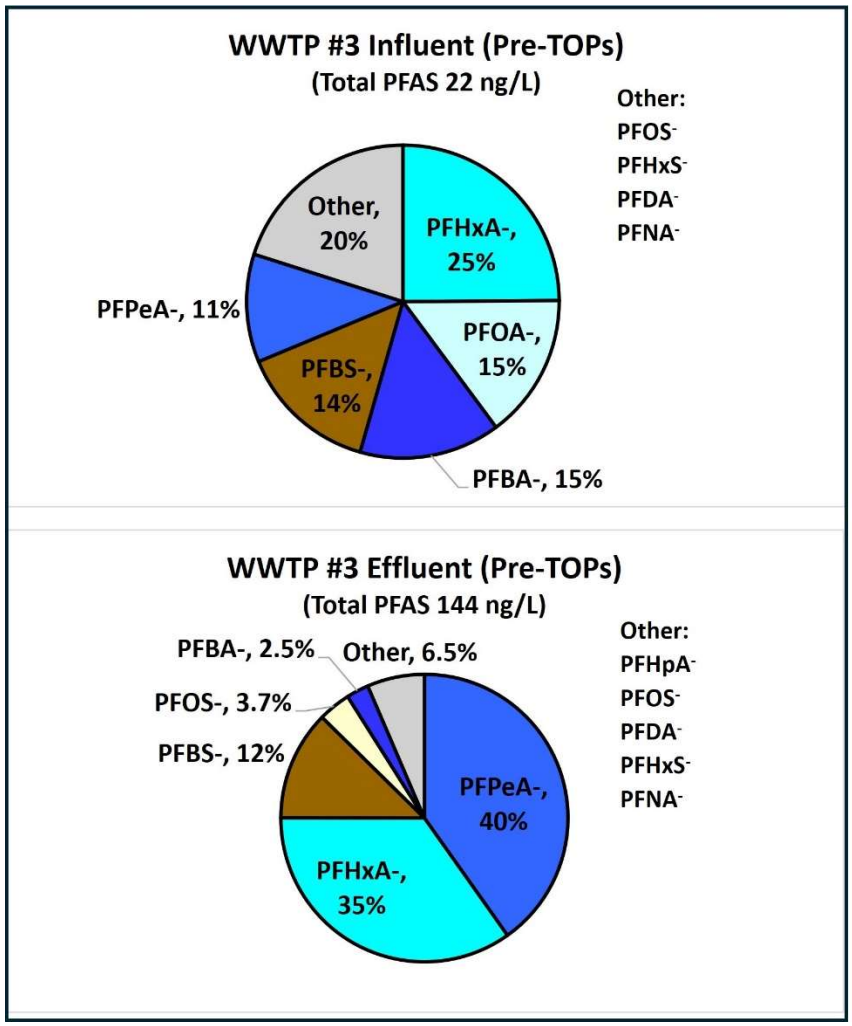


Figure 12. PFAS makeup of WWTP #3 influent, effluent and biosolids.

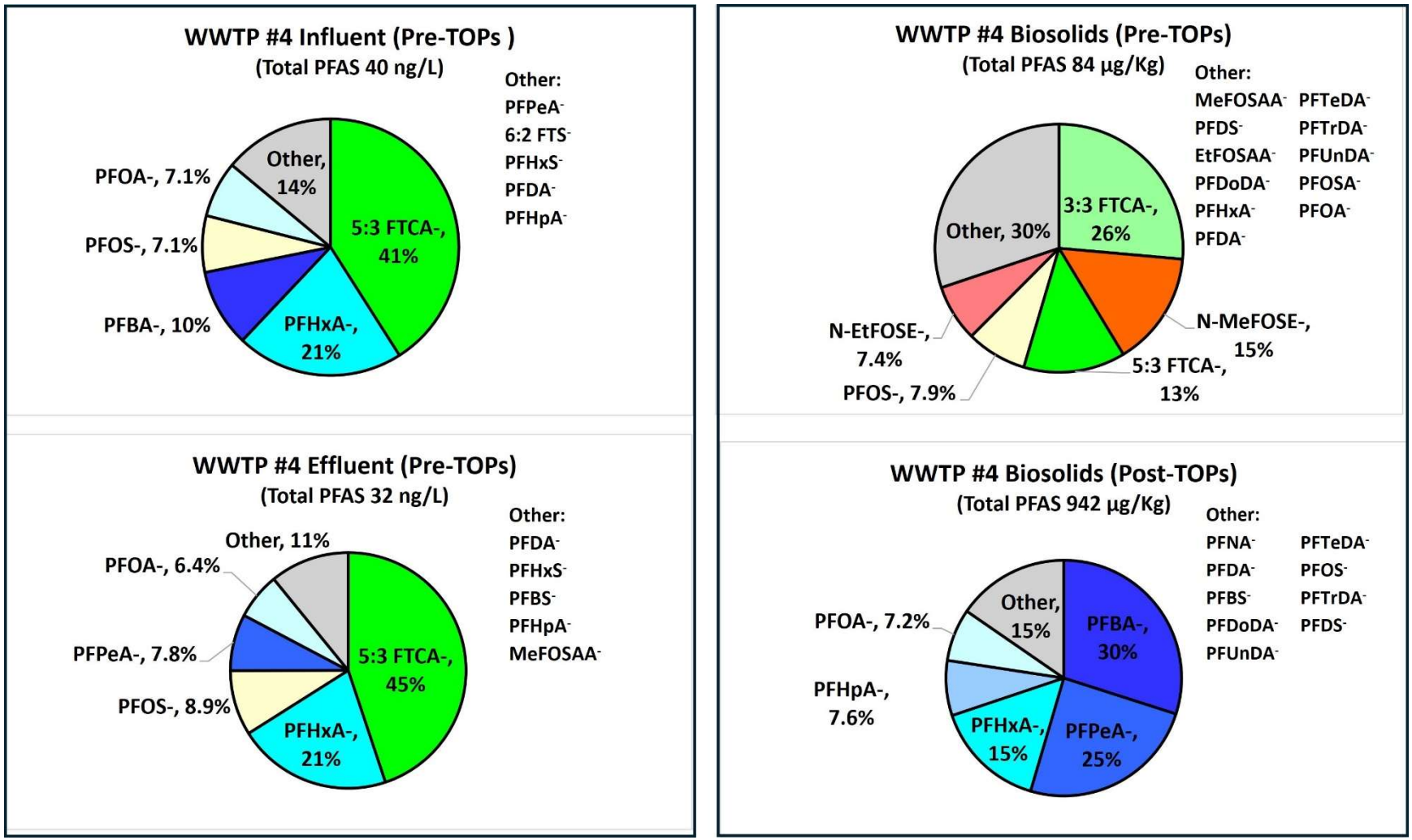


Figure 13. PFAS makeup of WWTP #4 influent, effluent and biosolids.

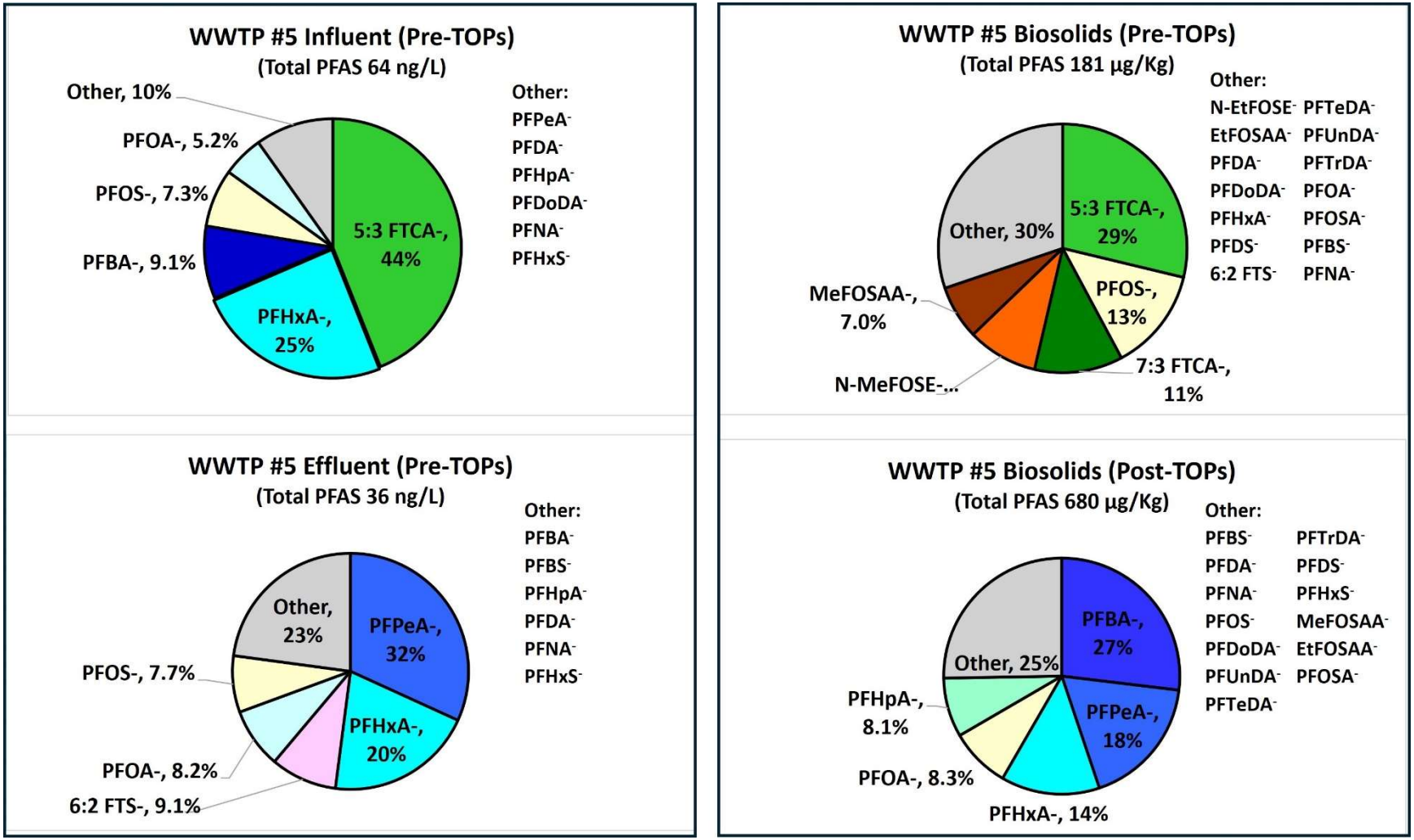


Figure 14. PFAS makeup of WWTP #5 influent, effluent and biosolids.

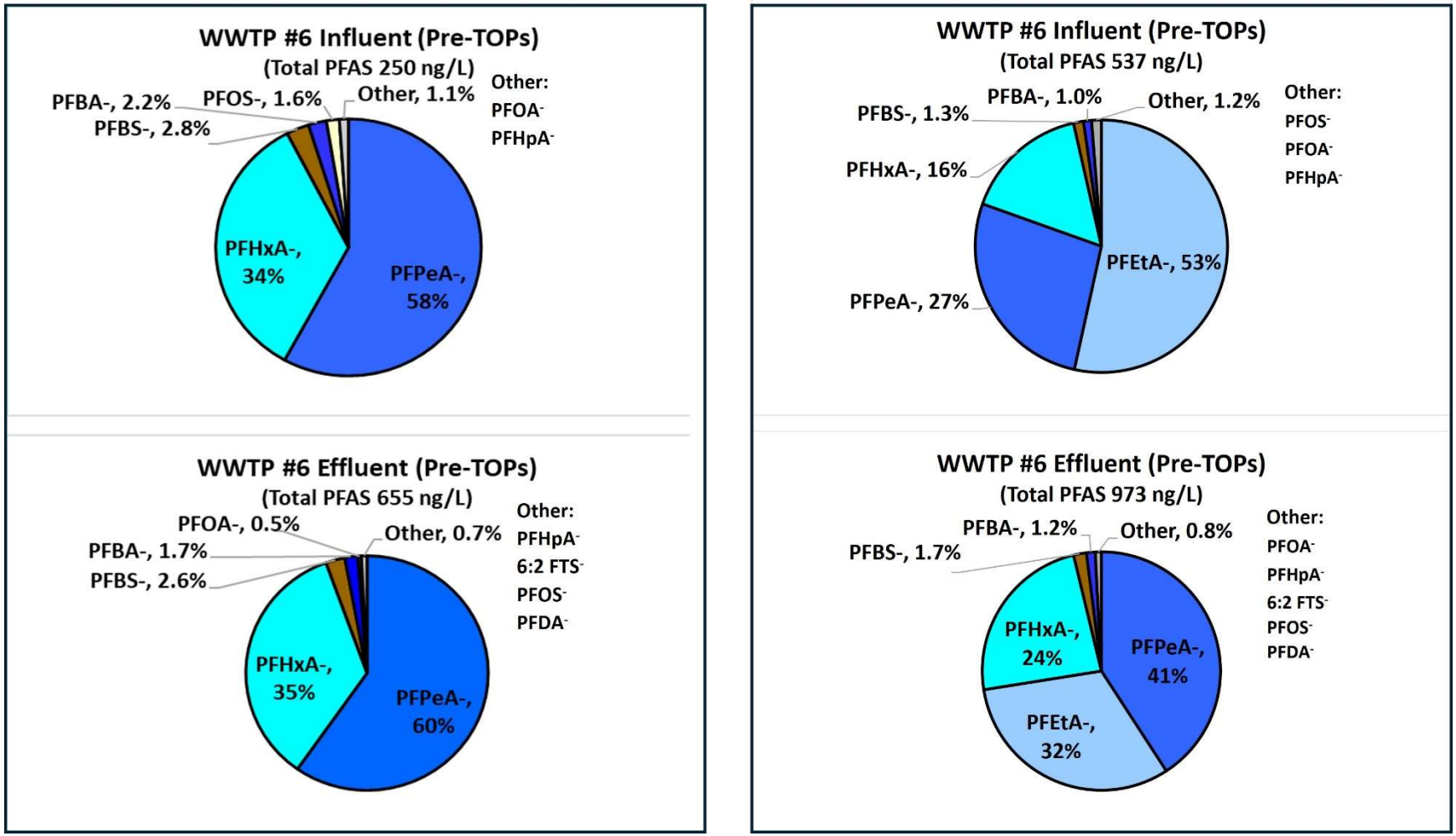


Figure 15a. PFAS makeup of WWTP #6 influent and effluent (Left: Excluding. Right: Including $PFEtA^-$).

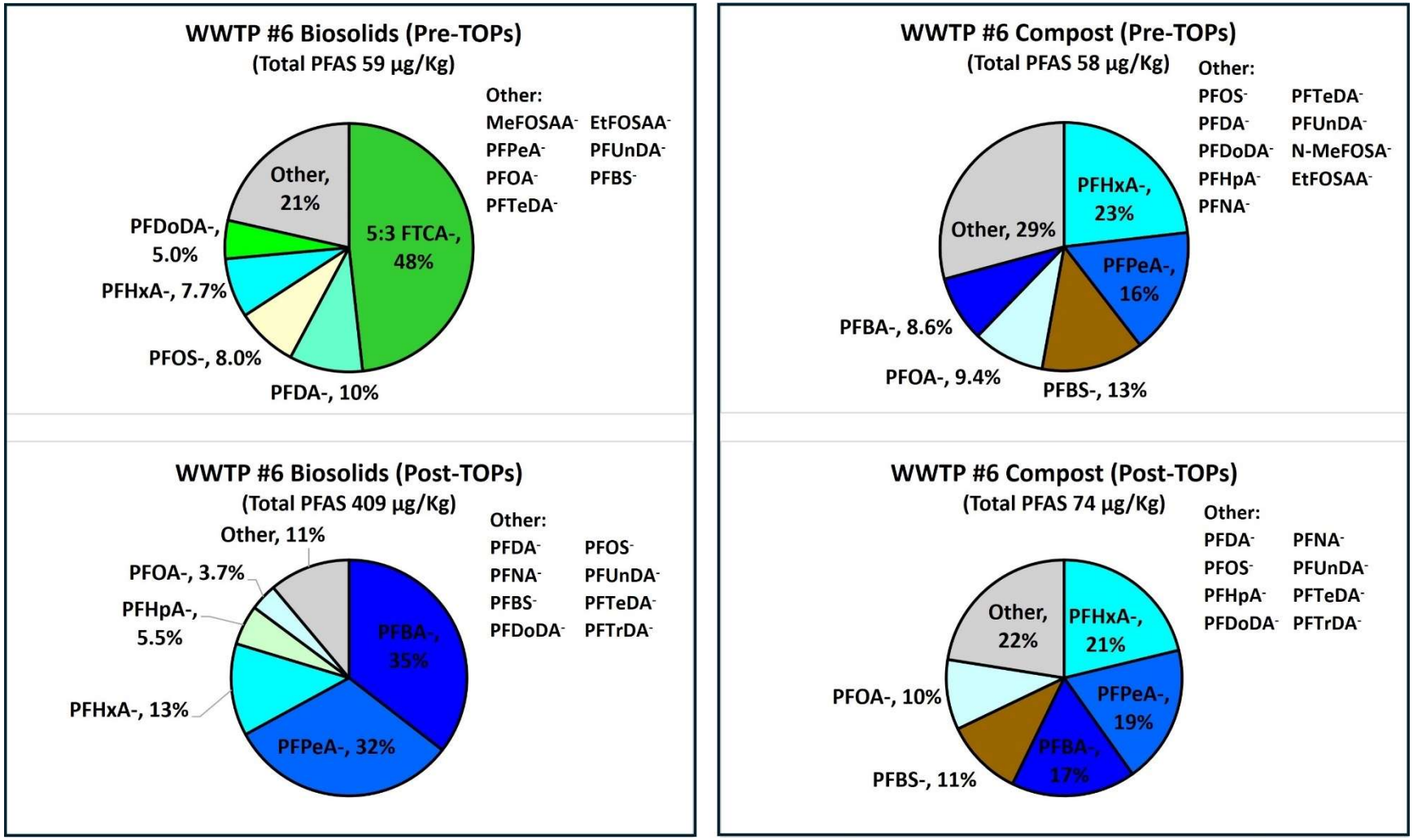
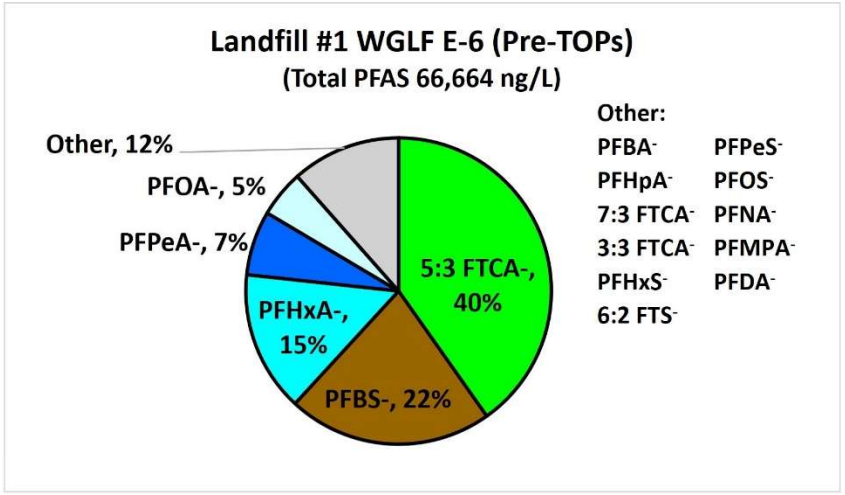
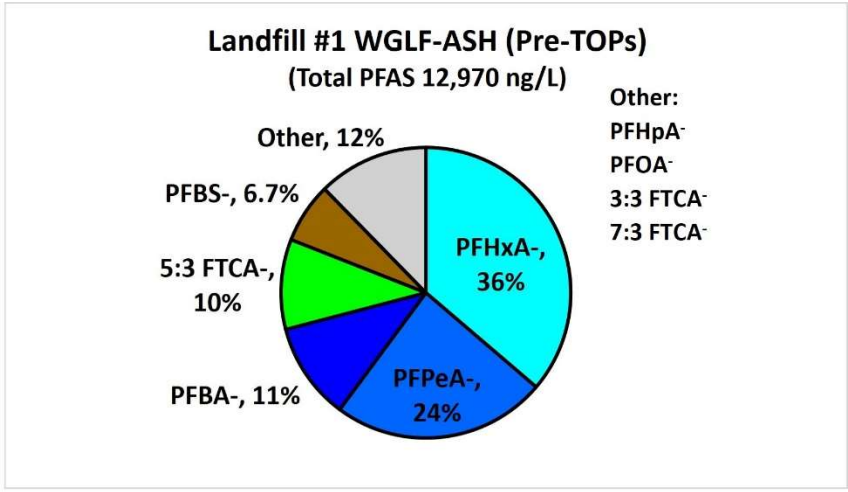


Figure 15b. PFAS makeup of WWTP #6 biosolids and compost.





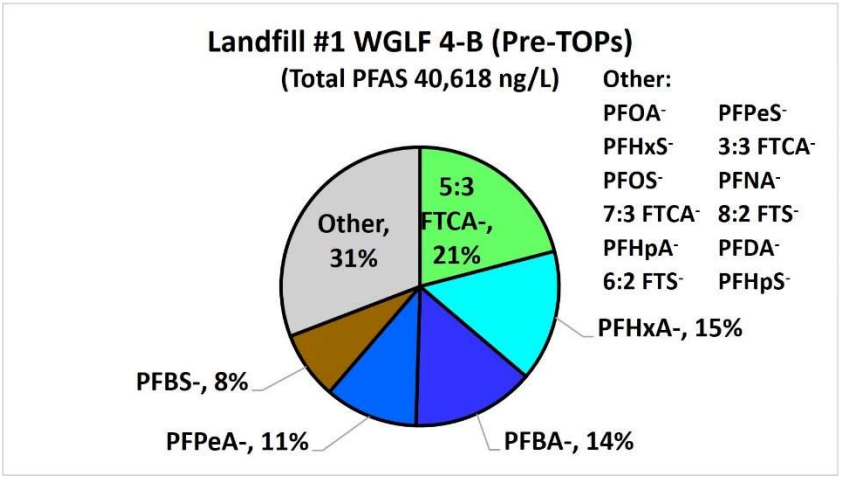


Figure 16. PFAS makeup of Landfill #1 leachate (data for individual wells).

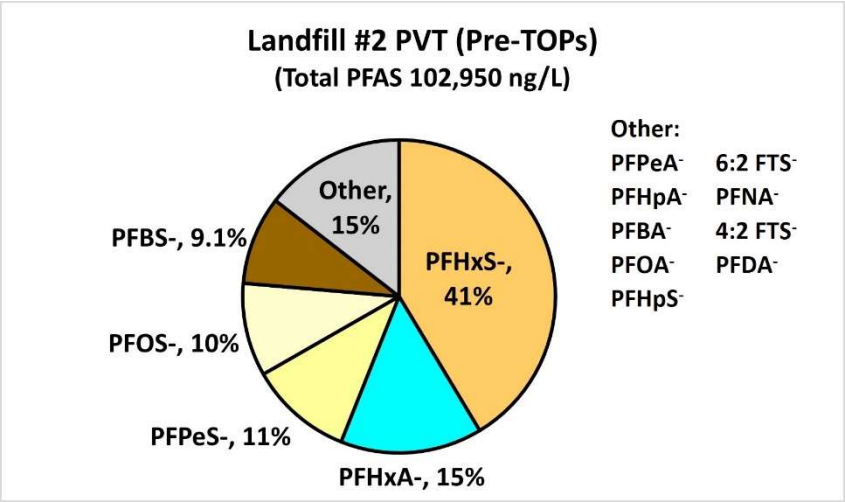
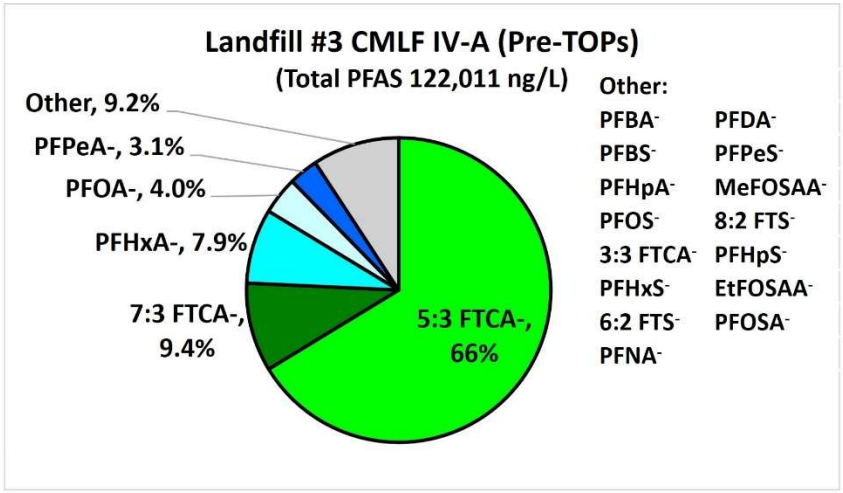
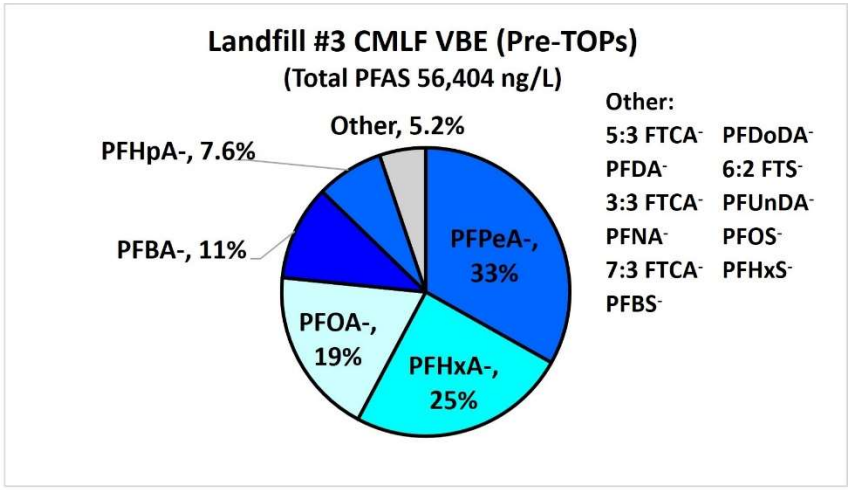


Figure 17. PFAS makeup of Landfill #2 leachate.





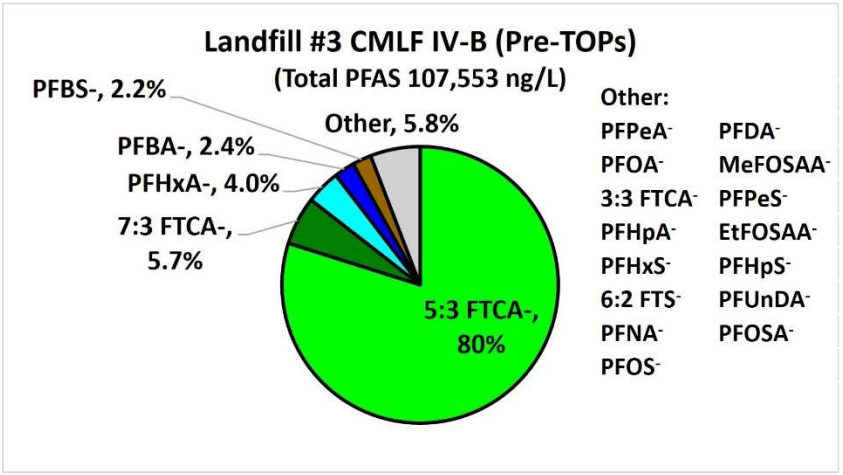
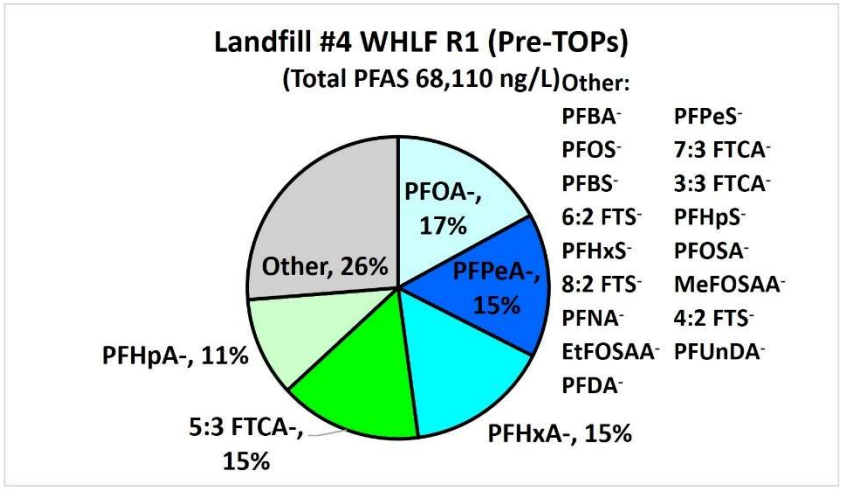
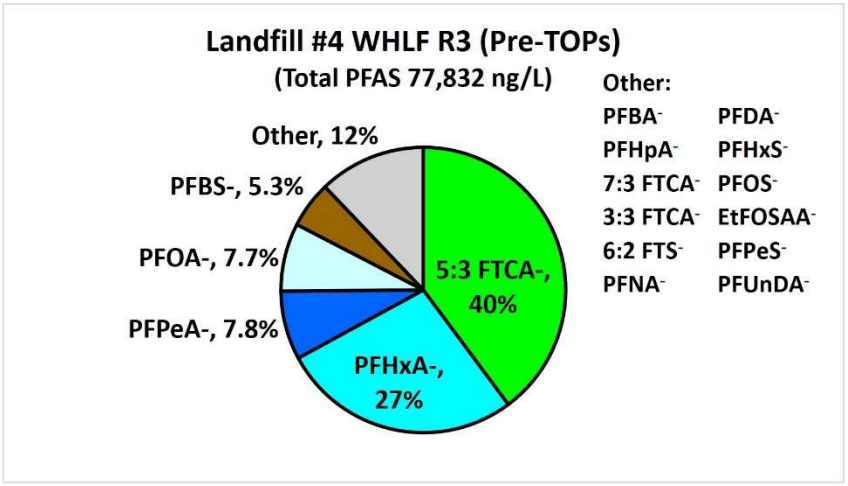
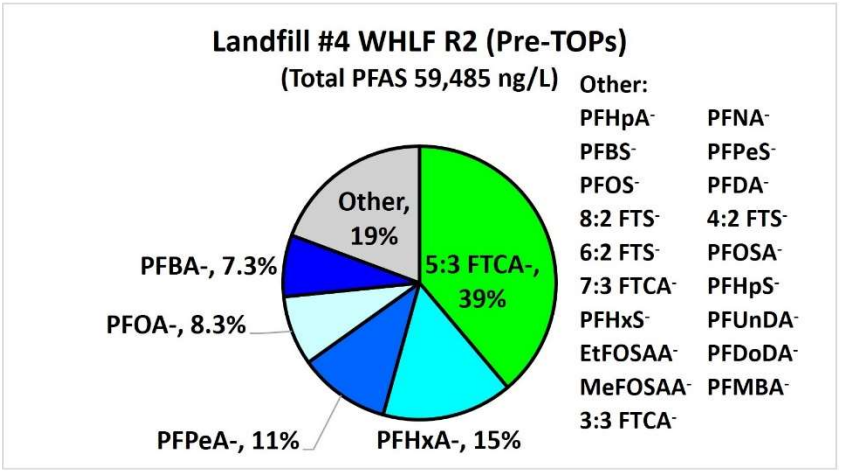


Figure 18. PFAS makeup of Landfill #3 leachate (data for individual wells).







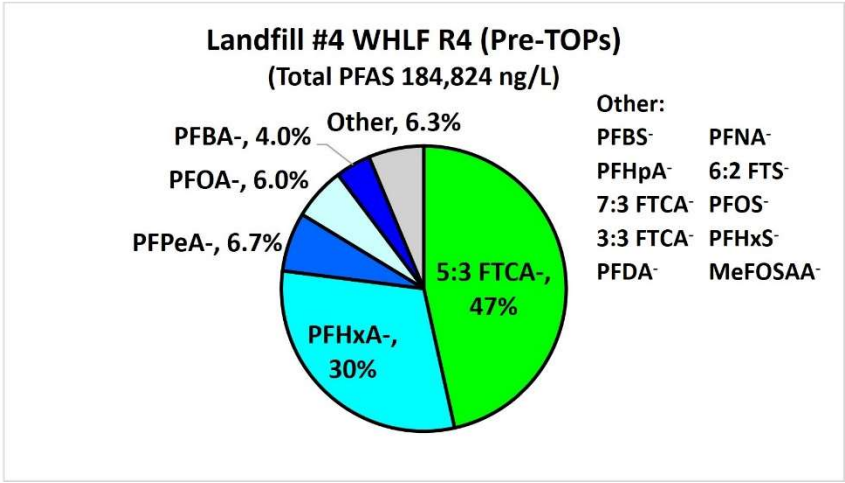
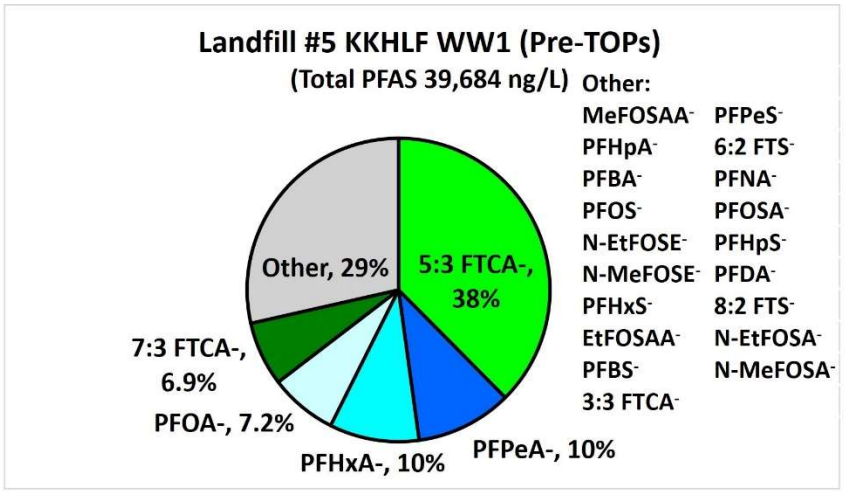
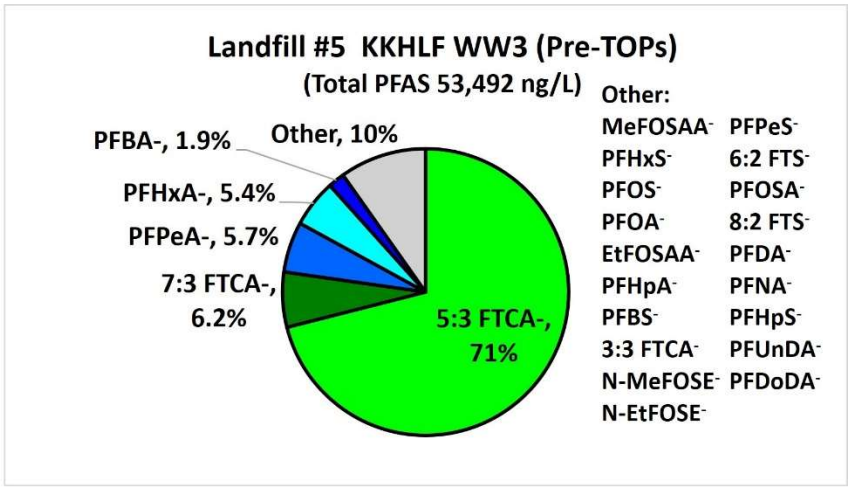
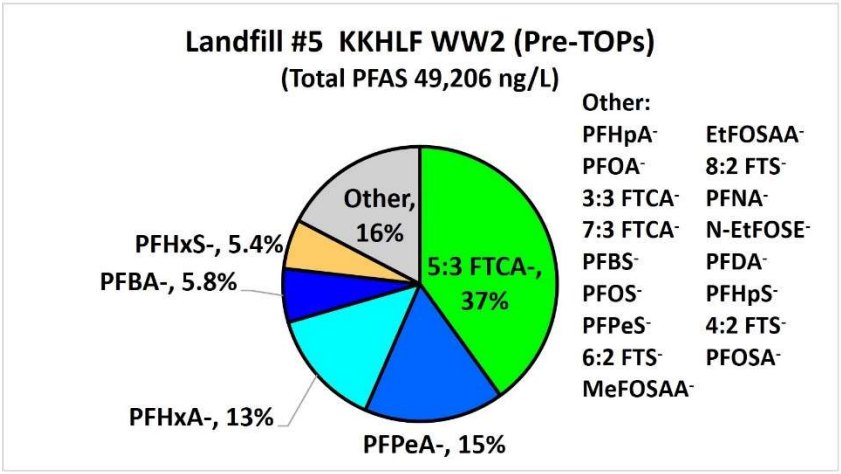


Figure 19. PFAS makeup of Landfill #4 leachate (data for individual wells).







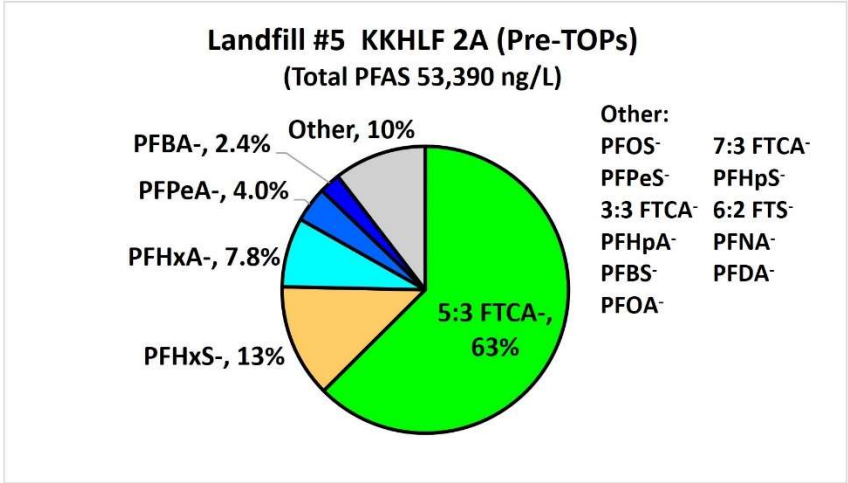


Figure 20. PFAS makeup of Landfill #5 leachate (data for individual wells).

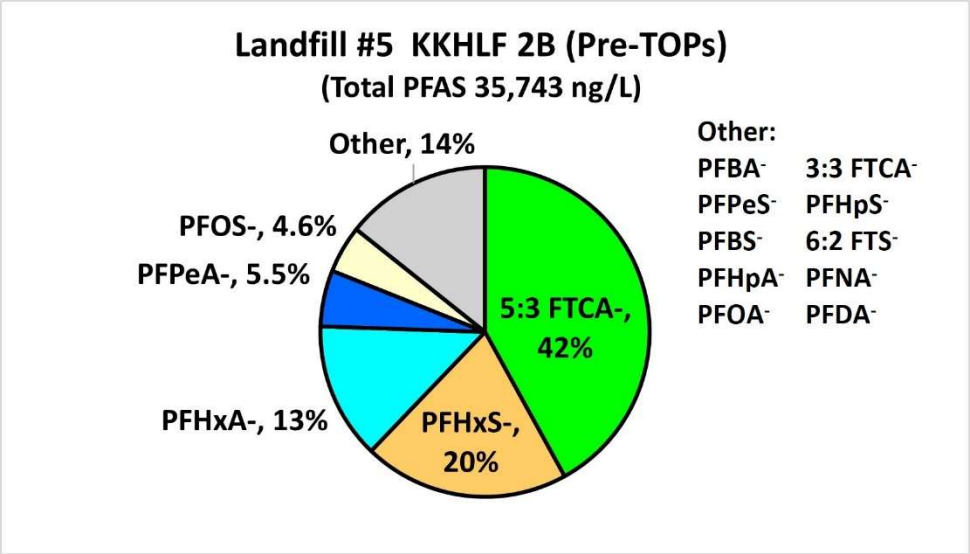
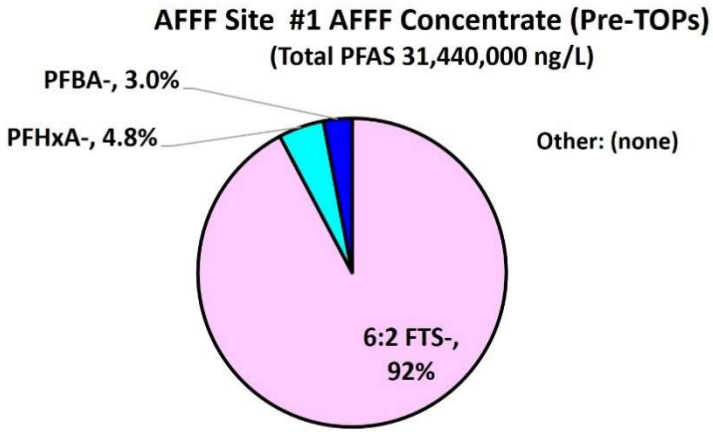


Figure 20 (cont.). PFAS makeup of Landfill #5 leachate.



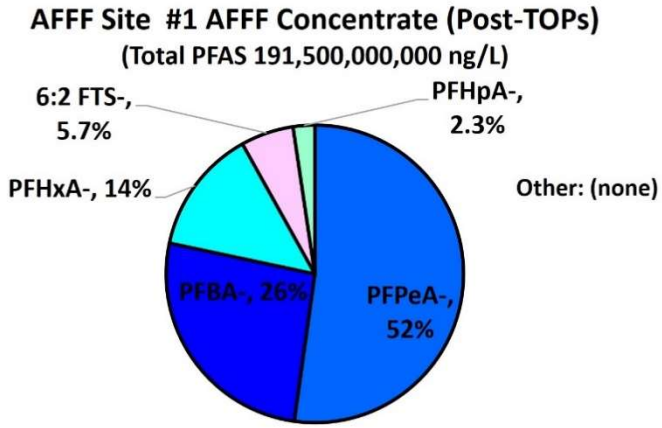
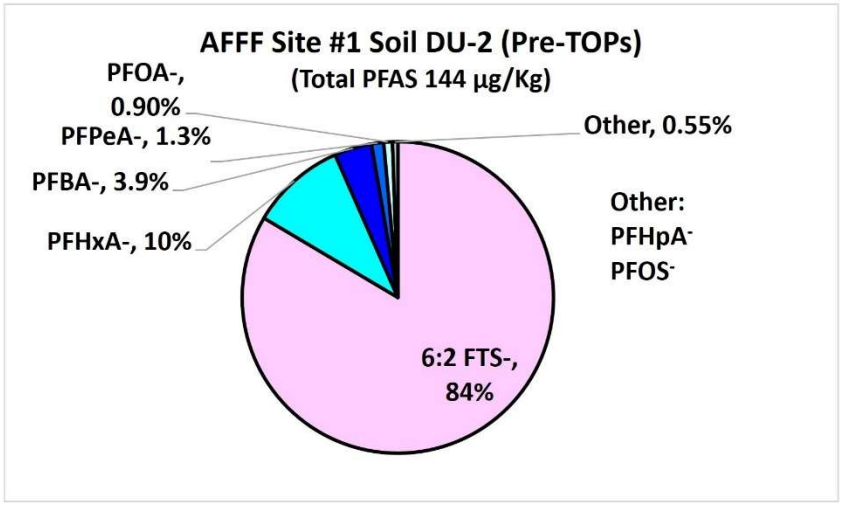
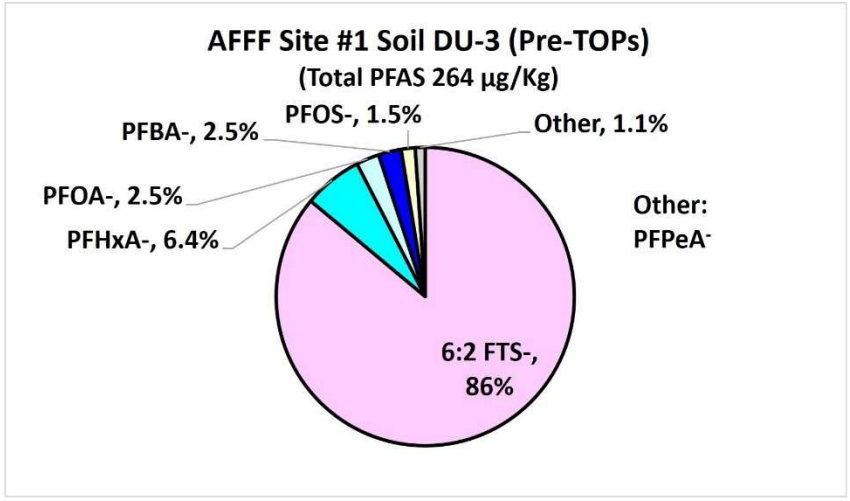
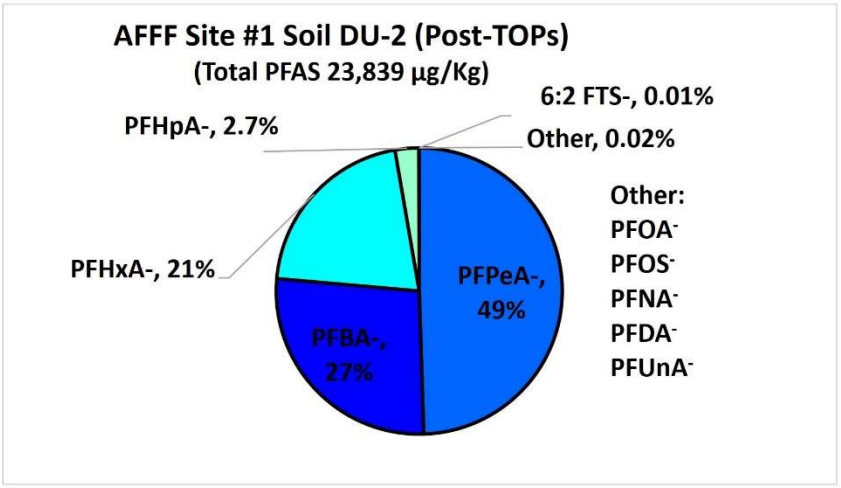


Figure 21. PFAS makeup of AFFF concentrate from AFFF Release Site #1.







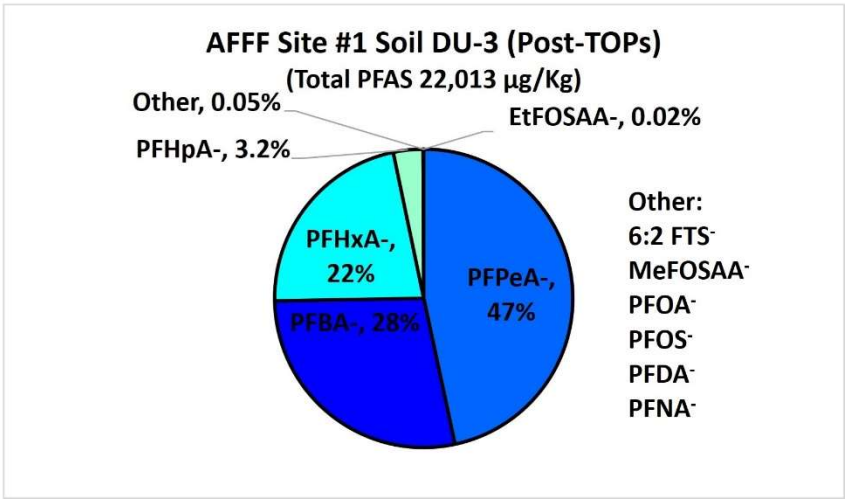


Figure 22a. PFAS makeup of AFFF-impacted soil at AFFF Release Site #1 (Samples DU-2 & DU-3; Multi Increment samples collected from separate Decision Units).

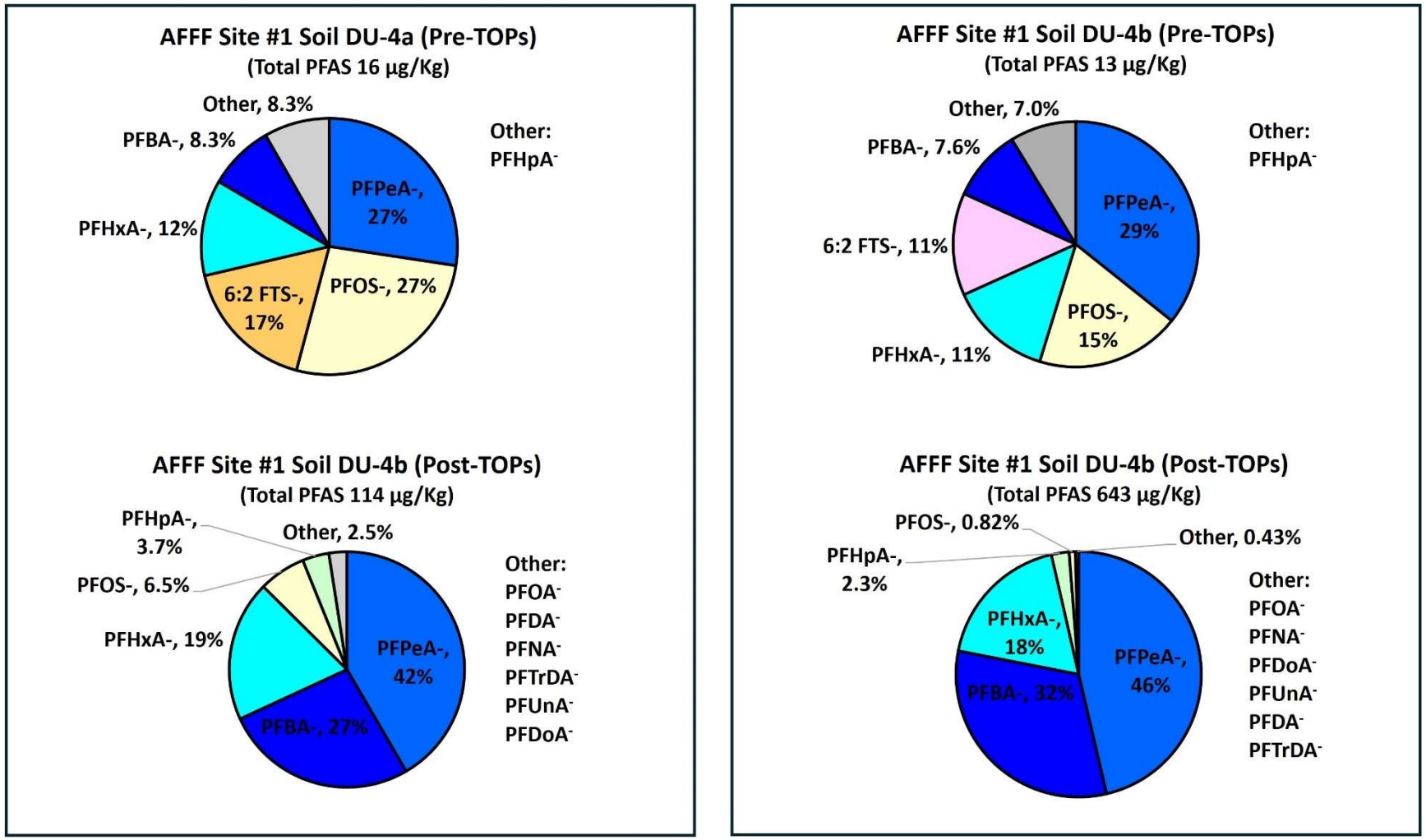


Figure 22b. PFAS makeup of AFFF-impacted soil at AFFF Release Site #1 (Samples DU-4a & DU-4b; Multi Increment samples collected from separate Decision Units).

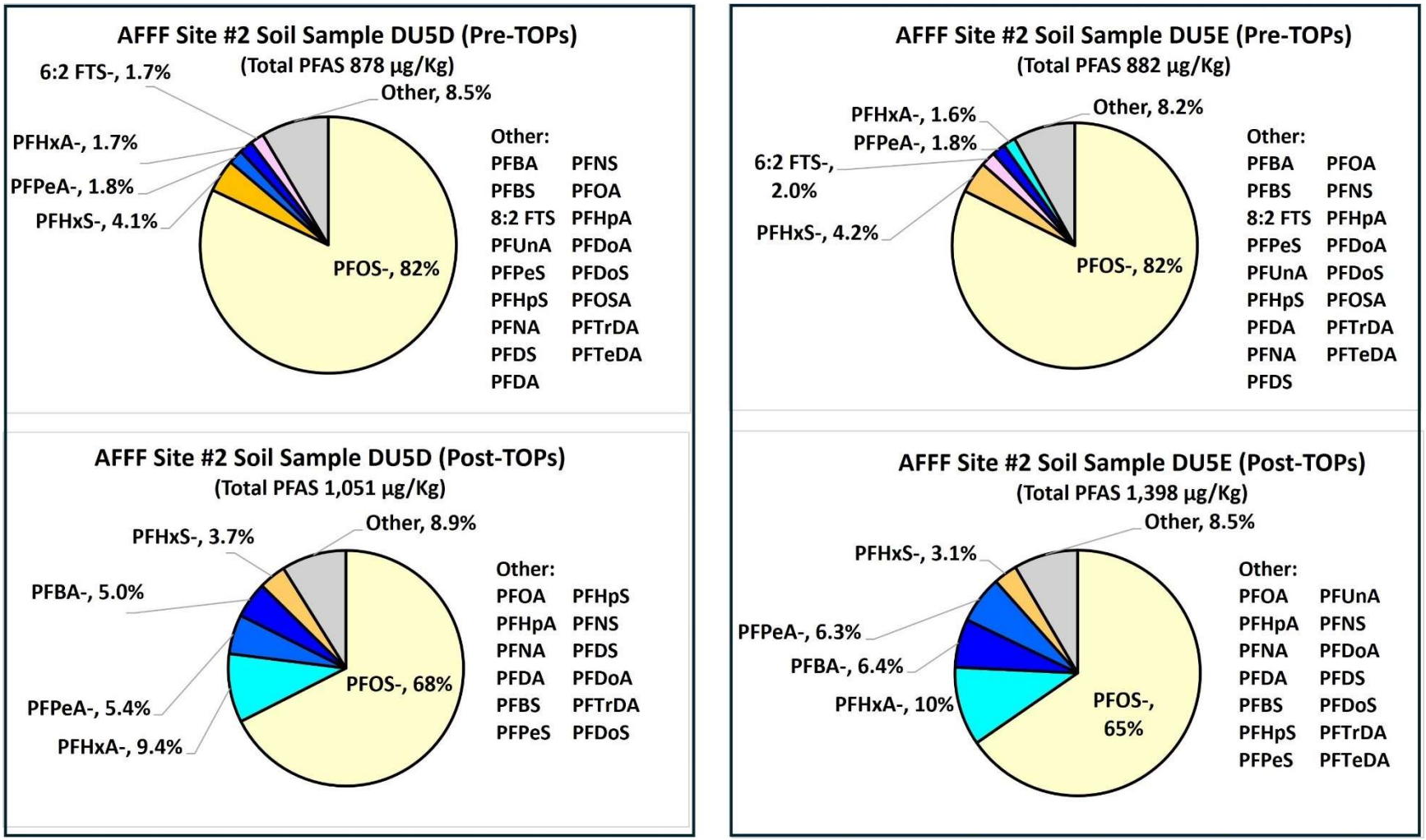


Figure 23a. PFAS makeup of AFFF-impacted soil at AFFF Release Site #2 (Samples DU5D and DU5E; Multi Increment triplicate samples collected from the same Decision Unit).

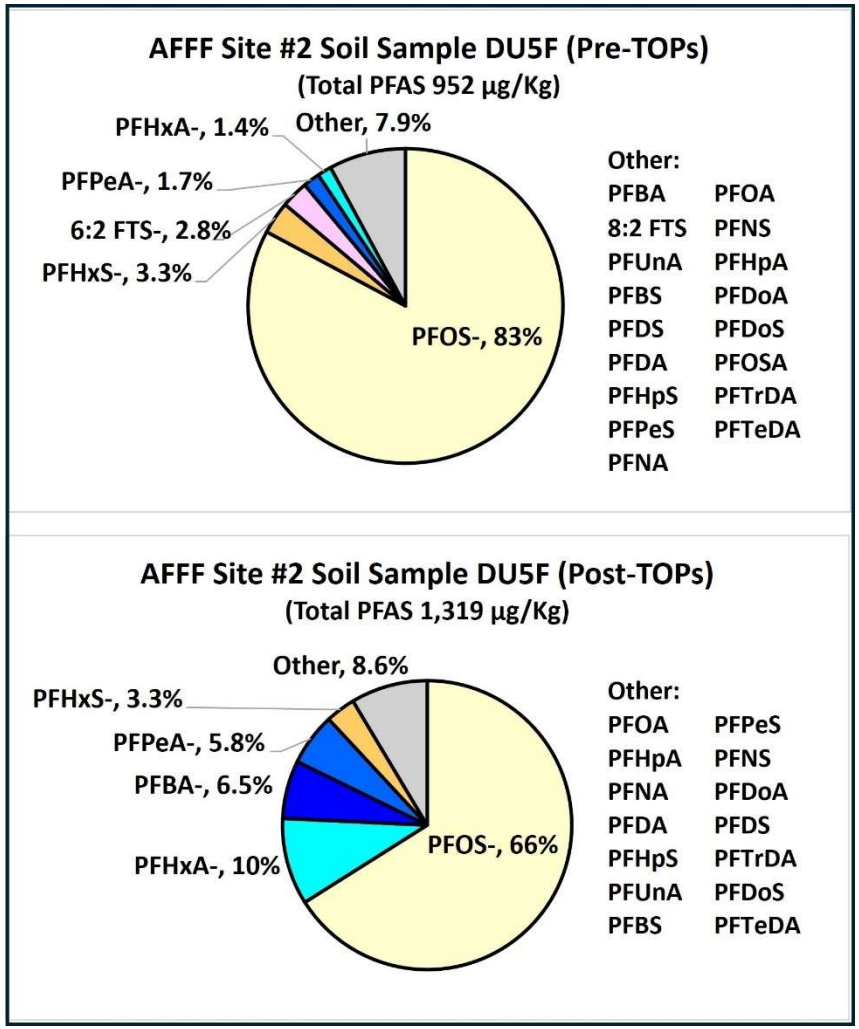


Figure 23b. PFAS makeup of AFFF-impacted soil at AFFF Release Site #2 (Sample DU5F; Multi Increment triplicate samples collected from the same Decision Unit).

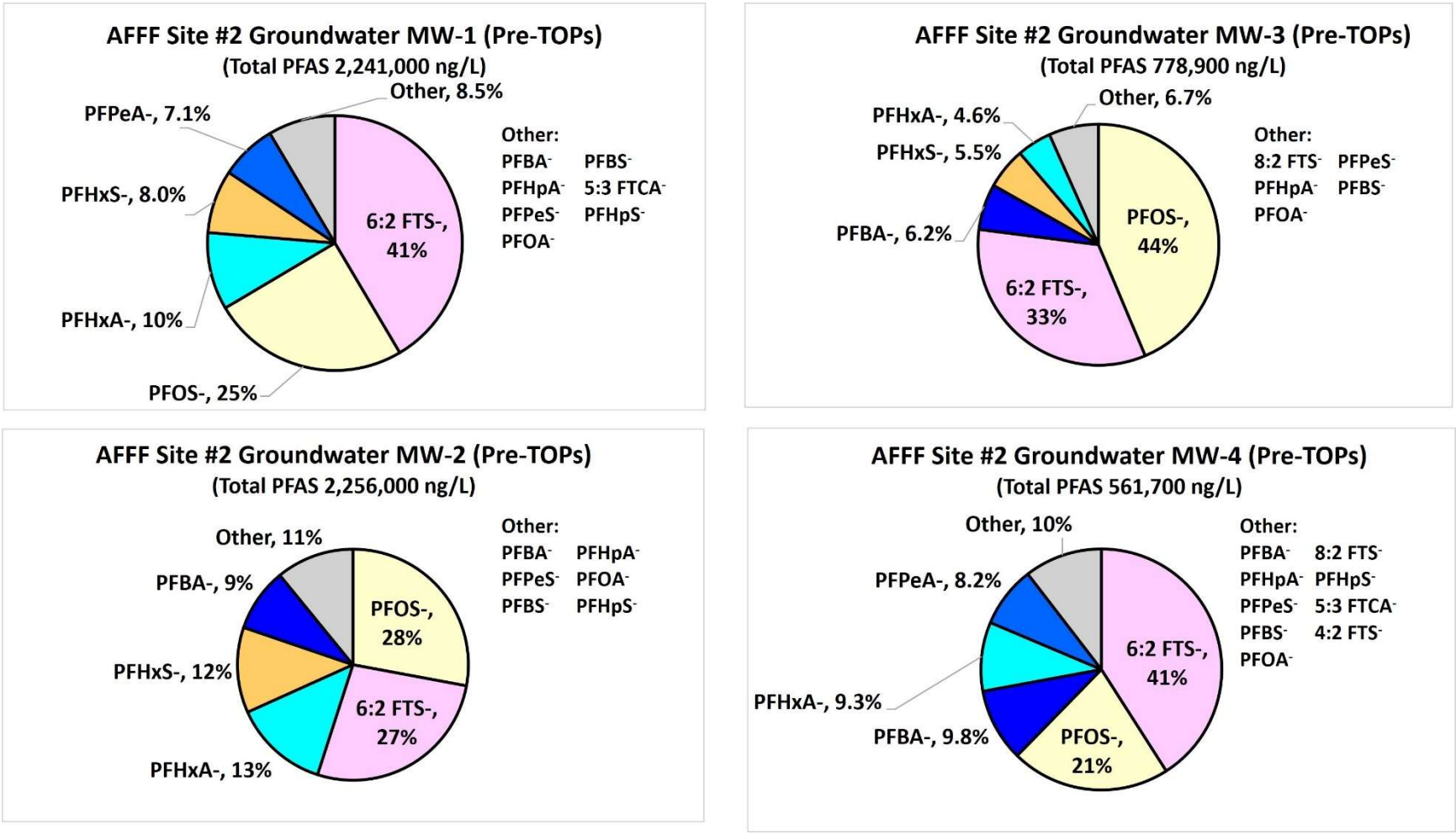


Figure 24a. PFAS makeup of AFFF-impacted groundwater at AFFF Release Site #2 (Monitoring wells 1, 2, 3 & 4).

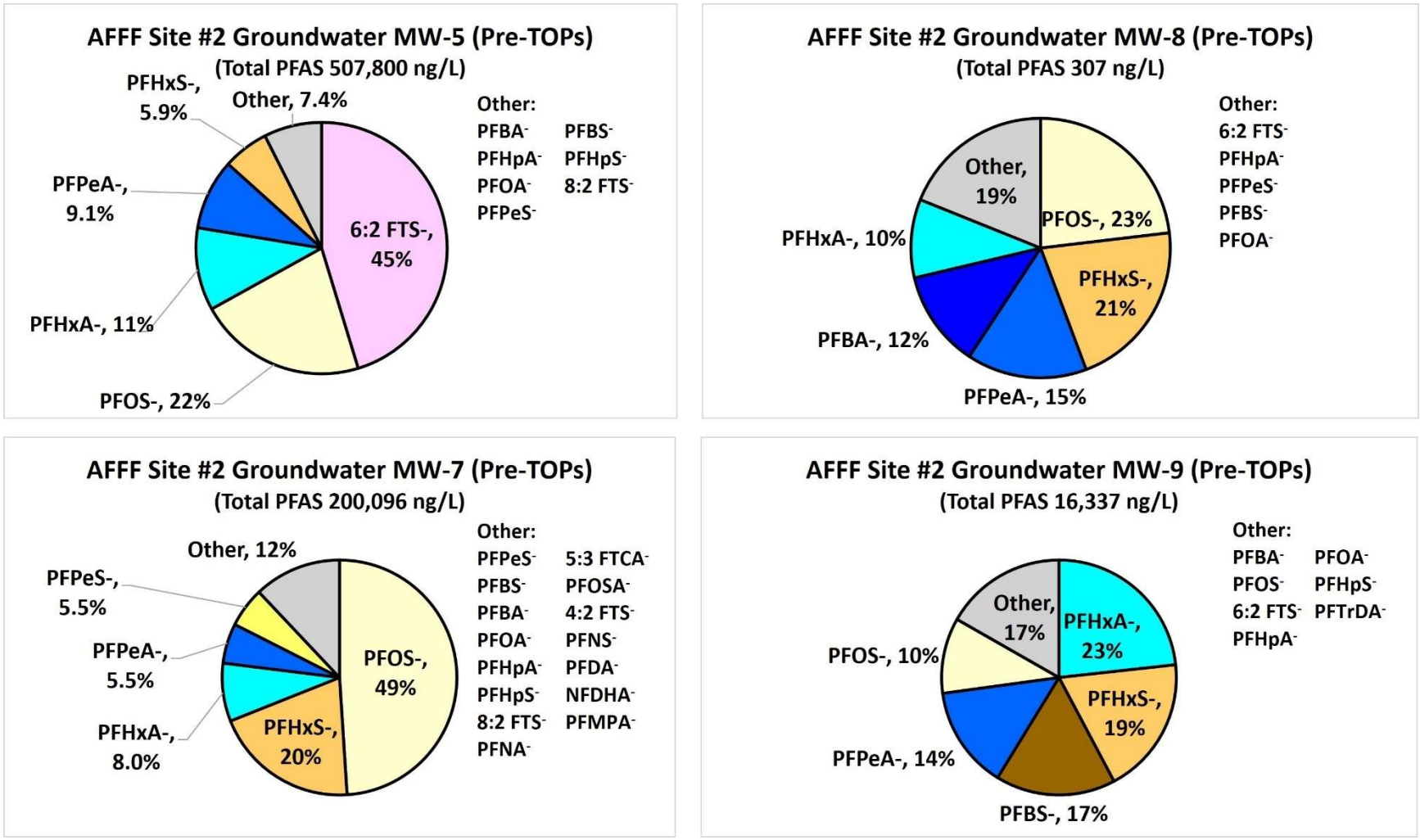


Figure 24b. PFAS makeup of AFFF-impacted groundwater at AFFF Release Site #2 (Monitoring wells 5, 7, 8, 9).

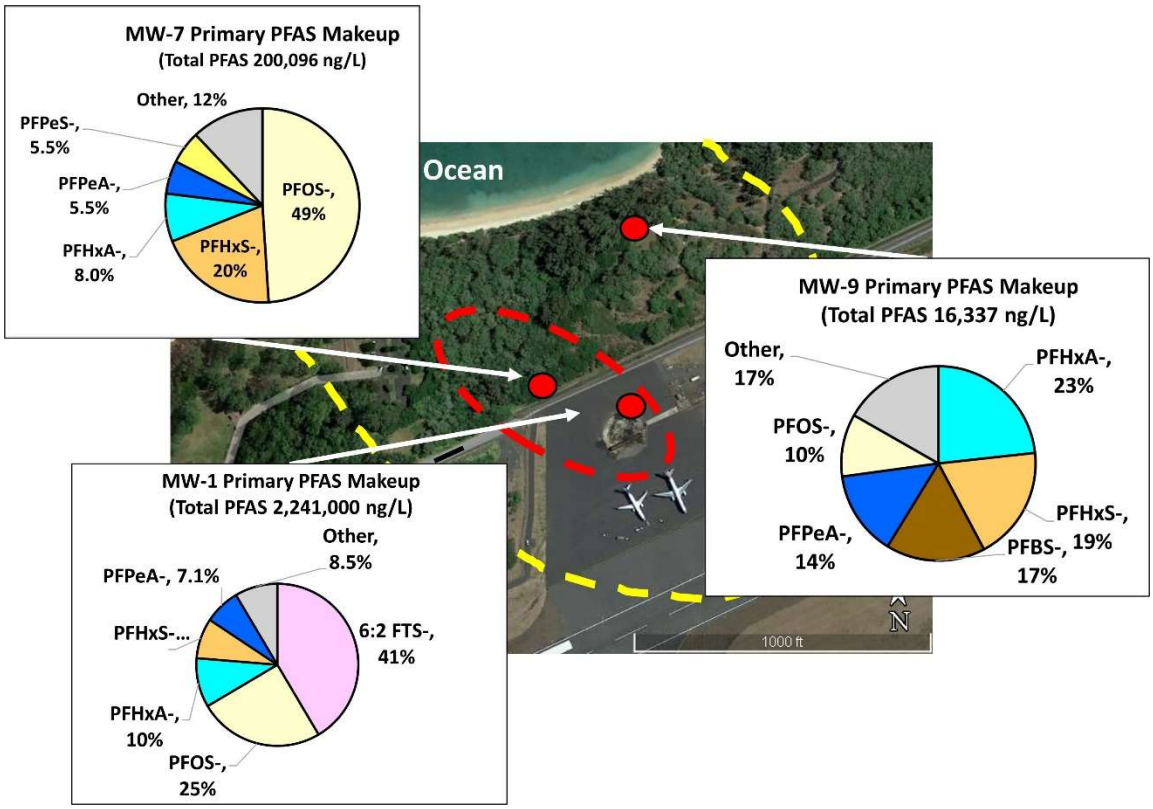


Figure 25. Relative PFAS Individual Makeup for select monitoring wells at AFFF Release Site #2.

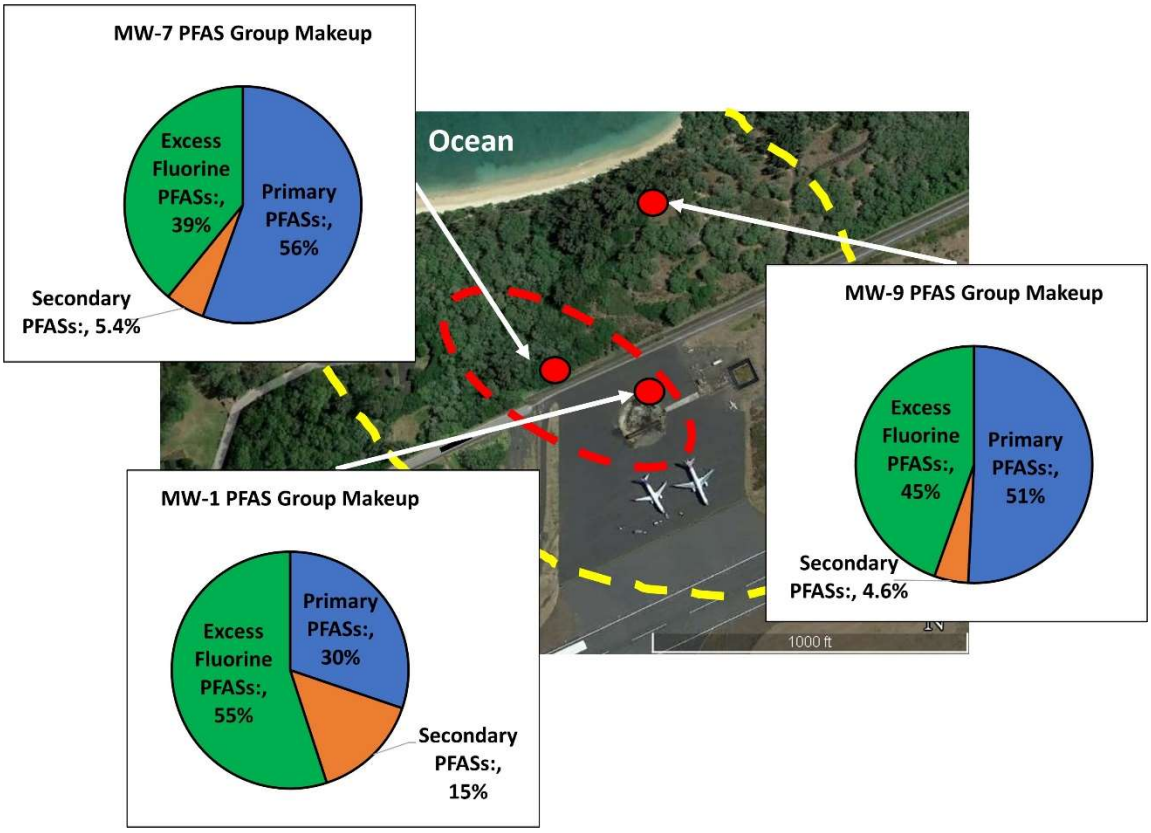


Figure 26. Relative PFAS Group Makeup for select monitoring wells at AFFF Release Site #2.

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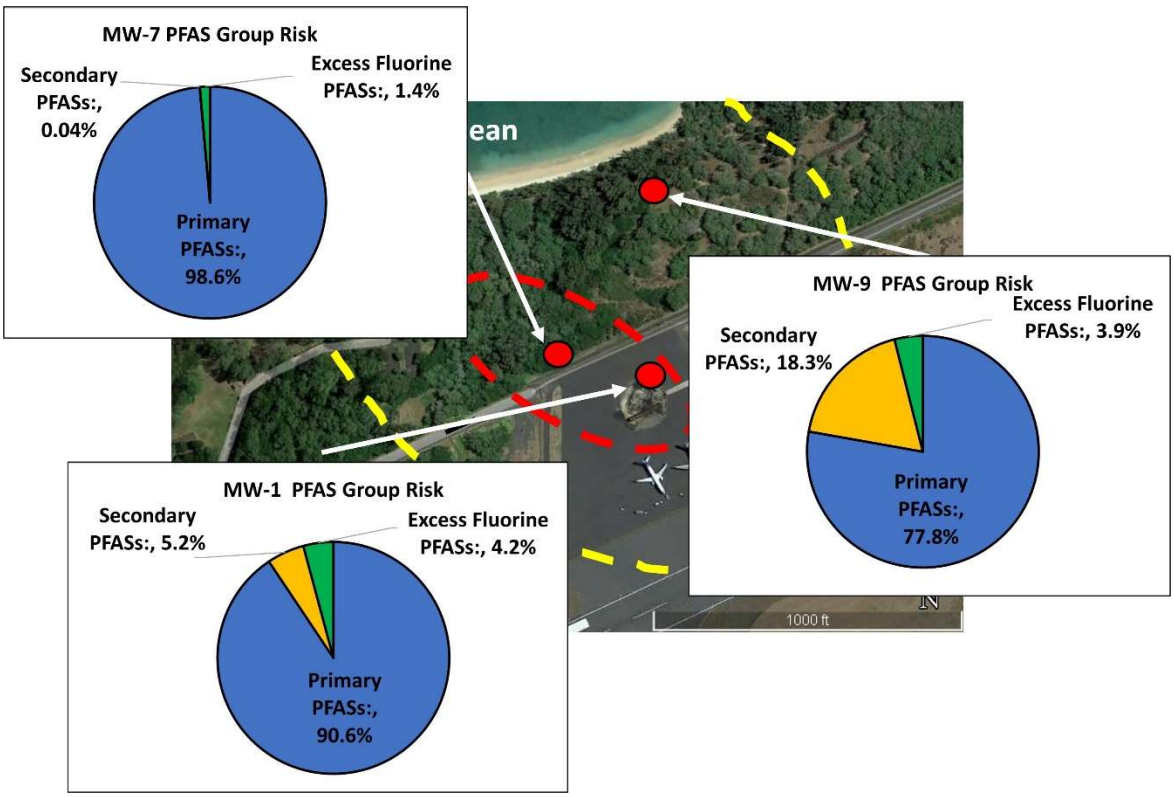

Figure 27. Relative PFAS Group Risk for select monitoring wells at AFFF Release Site #2.

.

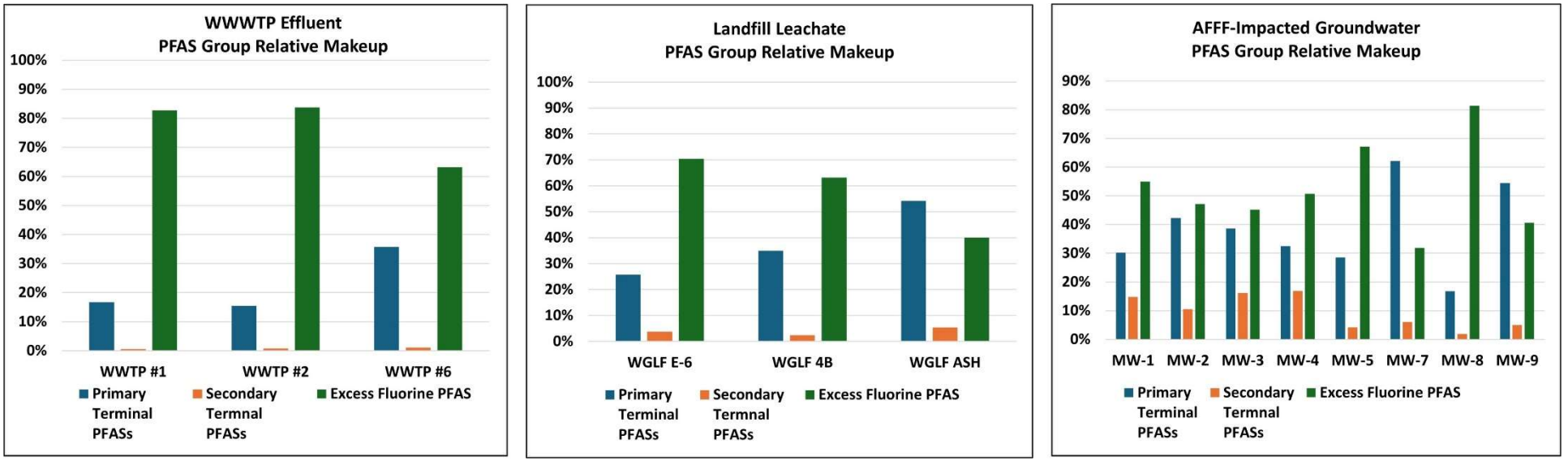

Figure 28a. Comparison of PFAS Group Relative Makeup of WWTP effluent, landfill leachate and AFFF-impacted groundwater.

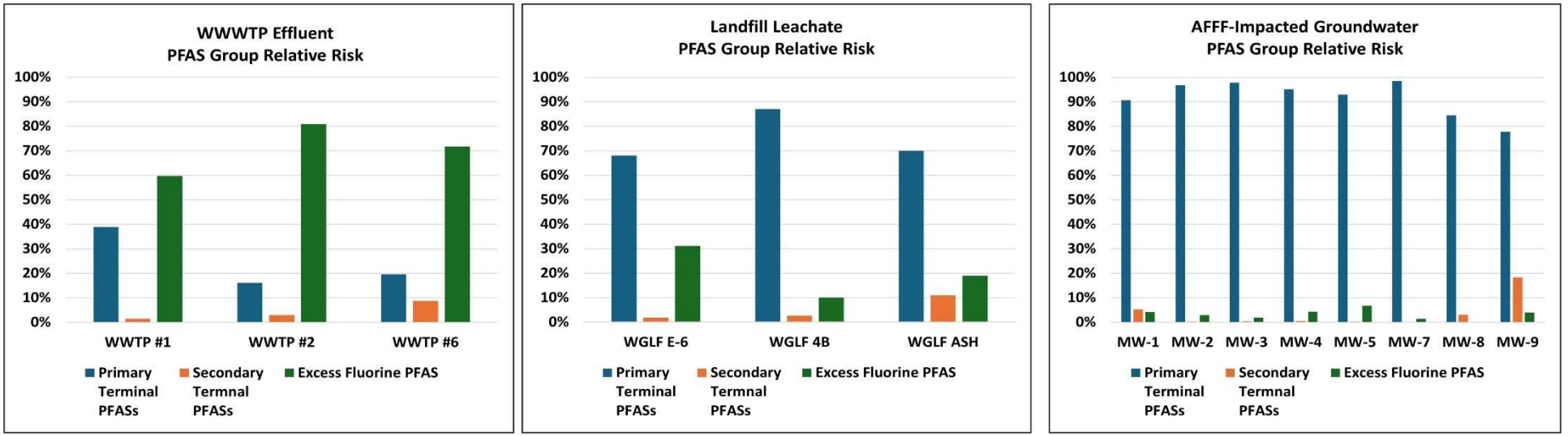

Figure 30b. Comparison of PFAS Group Relative Risk of WWTP effluent, landfill leachate and AFFF-impacted groundwater.

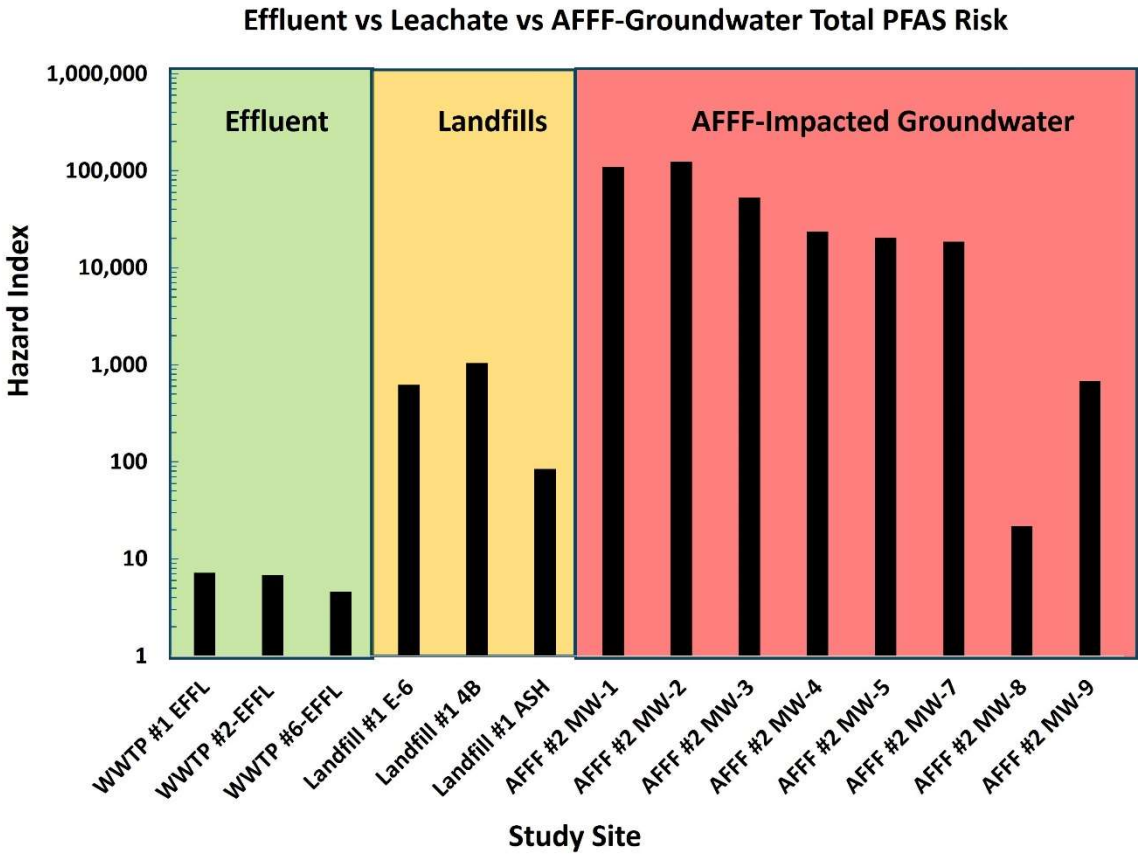

Figure 29. Relative Source Strength in terms of Total PFAS Risk posed by WWTP Effluent vs Landfill Leachate vs AFFF-Impacted Groundwater.

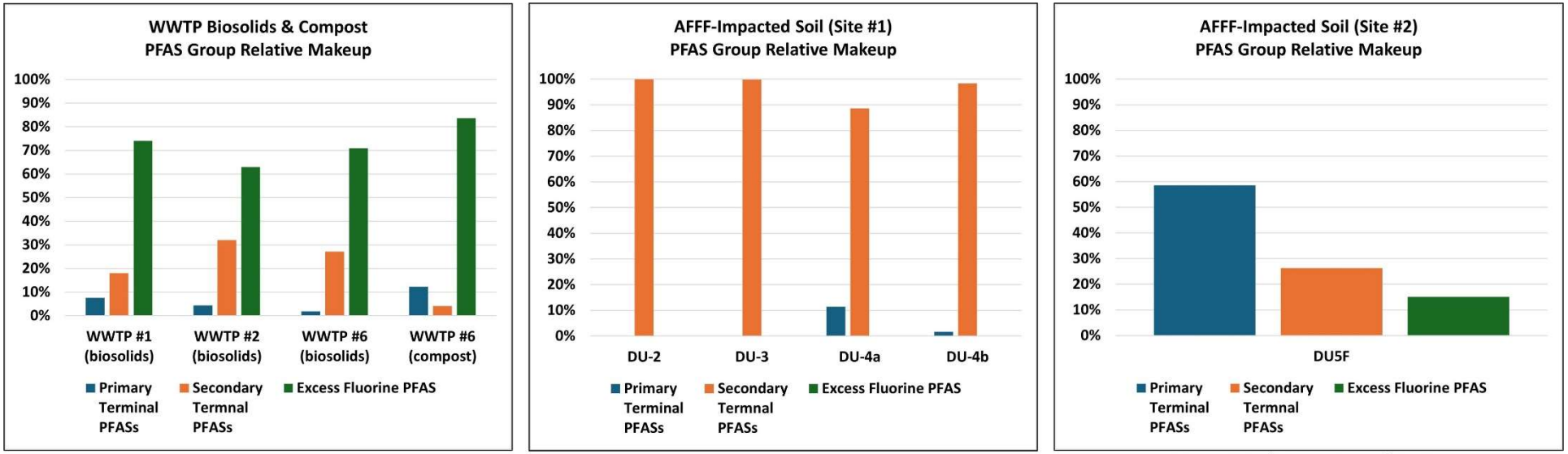

Figure 30a. Comparison of PFAS Group Relative Makeup of WWTP biosolids & compost and AFFF-impacted soil.

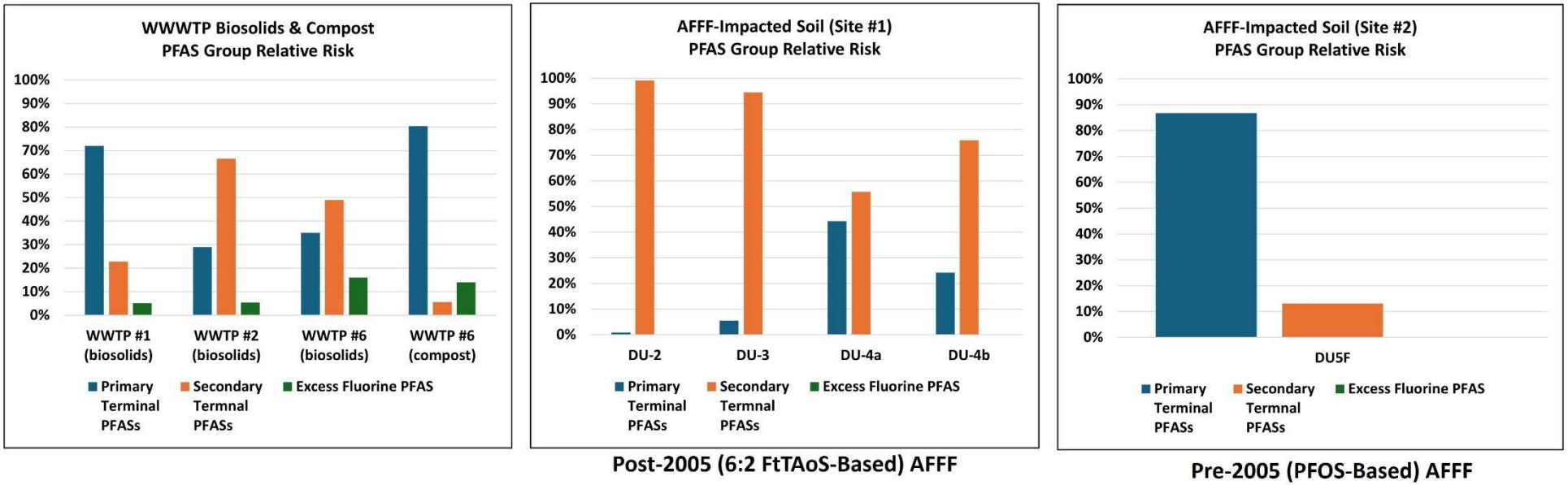

Figure 30b. Comparison of PFAS Group Relative Risk of WWTP biosolids & compost and AFFF-impacted soil.

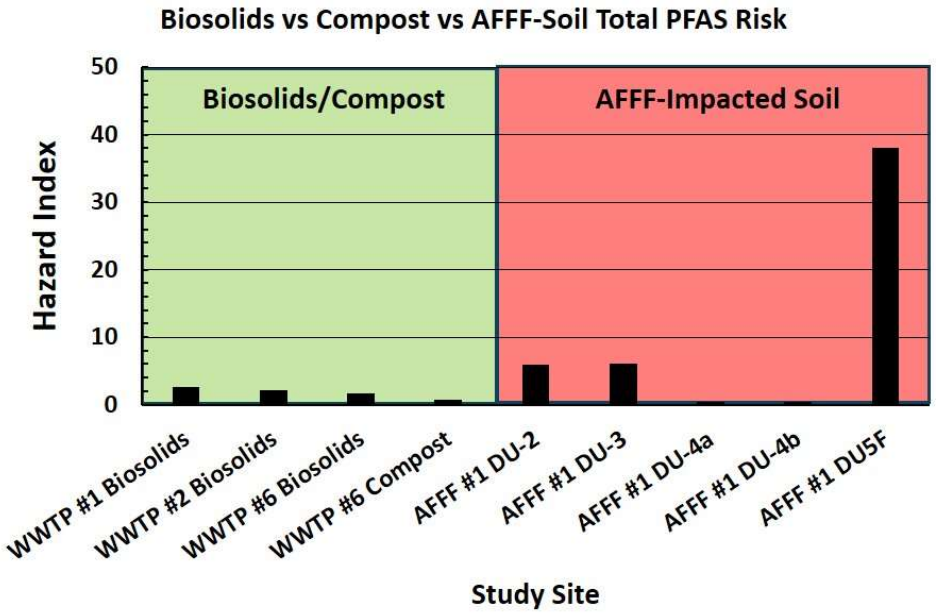

Figure 31. Relative Source Strength in terms of Total PFAS Risk posed by WWTP Biosolids, Biosolids-Amended Compost vs AFFF-Impacted Soil.

Table 1. Summary of wastewater treatment plant design and operation.

[1]Facility	Source	Treatment Level	[2]Average Influent Flow	Average Biosolids Generation (wet weight)	Notes
WWTP #1 (Sand Island)	Residential/Commercial + Cesspools, occasional	Primary (Secondary under development)	50-150 MGD	70 tons/week	Effluent: Outfall to ocean Biosolids: Dry weight noted. Pelletized and used as fertilizer (primarily landscaping, golf courses)
WWTP #2 (Hono'uli'uli)	Residential/Commercial + sludge from small WWTPs +Municipal landfill leachate (average 20-30,000 gallons/day)	Primary Partial Secondary Tertiary	25-50 MGD	140 tons/week	Effluent: • Partial R1 Reuse (<50%, Reverse Osmosis, irrigation: medians, commercial landscaping, golf courses) • Remaining discharged to ocean Biosolids**:** • Municipal Waste-to-Energy Incinerator
WWTP #3 (Kihei)	Mixed Residential/Commercial	Primary Secondary	3.7 MGD	25 tons/week	Effluent: • Partial R1 Reuse (<50%, irrigation of golf courses and seed corn crops) • Average 2 MGD discharge to ocean Biosolids: Landfill disposal
WWTP #4 (Hilo)	Mixed Residential/Commercial	Primary Secondary	2.8 MGD	36 tons/week	Effluent: Outfall to ocean Biosolids: Landfill disposal
WWTP #5 (Lihu'e)	Mixed Residential/Commercial	Primary Secondary	1.2 MGD	25 tons/week	Effluent: • Partial R1 Reuse (irrigation – golf course) • Injection well Biosolids: Landfill disposal
WWTP #6 (La'ie)	Mixed Residential & Commercial	Primary Secondary Tertiary	0.5 MGD	7 tons/week	Effluent: • 75% leach field; • 25% R1 crop irrigation Biosolids**:** Compost (used on-site)

Table 1 (cont.). Summary of wastewater treatment plant design and operation.

Notes:

1. Information provided by facility operators. Sample data presented in this report are intended for qualitative comparison only and are not intended to be representative of long-term trends.
2. MGD: Million Gallons per Day.

Table 2. Summary of landfill design and operation.

[1]Facility	Waste Source	Permitted Disposal (tons/day)	FY23 Disposal (tons per year)*	Annual Leachate Disposal (Gallons FY23)*
LF #1 (Waimanalo Gulch)	Commercial/ Residential	3,500 MSW (peak) 1,400 MSW (nominal) 1,200 Ash	237,520	Volume: 5,047,480 gallons Disposal: WWTP #2
LF #2 (PVT, O'ahu)	Construction Debris	3,000 C&D 500 Asbestos	229,214	Volume: 139,000 gallons Disposal: Dust control at the working face
LF #3 (Central Maui)	Commercial/ Residential	1600 (peak) 800 (nominal)	277,140	Volume: 2,518,400 gallons Disposal: WWTP, dust control at working face, landfill recirculation
LF #4 (West Hawai'i)	Commercial/ Residential	720 (peak) 300 (nominal)	205,281	Volume: 2,184,000 gallons Disposal: Sprayed on lined, active areas and allowed to evaporate
LF #5 (Kekaha)	Commercial/ Residential	600 (peak) 200 (nominal)	88,208	Volume: 1,092,016 gallons Disposal: On-site evaporation pond

Notes:

1. Information provided by facility operators. Sample data presented in this report are intended for qualitative comparison only and are not intended to be representative of long-term trends.

Table 3. Summary of laboratory analyses.

Facility Type	Study Site ID	Media	[1,7]Pre-TOP	[2,7]TOP	[3]TOF	[4]NTA	Ultrashorts	[5,7]SPLP	[6,7]Method 1314
Wastewater Treatment Plants	[8]WWTP #1	Influent	X	X	X	(declined)	X		
		Effluent	X	X	X	(declined)	X		
		Biosolids	X	X	X			X	X
	[8]WWTP #2	Influent	X	X	X	(declined)	X		
		Effluent	X	X	X	(declined)	X		
		Biosolids	X	X	X			X	
	WWTP #3	Influent	X						
		Effluent	X						
		Biosolids	X	X				X	
	WWTP #4	Influent	X						
		Effluent	X						
		Biosolids	X	X				X	
	WWTP #5	Influent	X						
		Effluent	X						
		Biosolids	X	X				X	
	[8]WWTP #6	Influent	X	X	X	(declined)	X		
		Effluent	X	X	X	(declined)	X		
		Biosolids	X	X	X			X)	
		Compost	X	X	X			X	(pending)
Landfills	LF #1	Leachate	X	X	X	(pending)	(pending)		
	LF #2	Leachate	X	X					
	LF #3	Leachate	X	X					
	LF #4	Leachate	X						
	LF #5	Leachate	X						
AFFF Release Sites	AFFF Site #1	AFFF	X	X		X			
		Soil	X	X					
	AFFF Site #2	Soil	X	X	X	X		X	(pending)
		Groundwater	X	X	X	X			
Background Soil	(multiple sites)	Soil	X	X	X	(pending)			

Table 3 (cont.). Summary of laboratory analyses.

Notes:
Study Phase 1: Green highlight. **Study Phase 2:** Orange highlight.

1. Pre-TOPs Analysis: WWTP liquid and biosolid samples, landfill leachate samples and soil samples from AFFF release sites tested by SGS Laboratory using MLA110 (USEPA Method 1633). Groundwater samples from AFFF Release Site #2 tested by Eurofins using USEPA Method 537M in the absence of TOP processing and include reporting of a limited number of ultrashort PFASs.
2. Post-TOPs Analysis: WWTP liquid and biosolid samples, landfill leachate samples and soil samples from AFFF release sites tested by SGS Laboratory using Total Oxidizable Precursors (TOPs) Method MLA111. Groundwater samples from AFFF Release Site #2 tested by Eurofins using Method 537M post TOPs processing and including reporting of a limited number of ultrashort PFASs.
3. Total Organic Fluorine (TOF) analysis added for Phase 2 liquid and solid samples. Samples of liquid were tested for Absorbable Organic Fluorine by Eurofins using Method 1621. Samples of solids were tested for Extractable Organic Fluorine by SGS using Method MLA119.
4. Non-Target Analysis (NTA) used in Phase 2 of the study to assess nature of PFAS compounds associated with apparent excess fluorine in samples based on TOF data. Test omitted if no or limited excess fluorine identified or as otherwise recommended by laboratory based on reviews of chromatograms for pre- and post-TOPs data. NTA analysis was ultimately declined for WWTP influent and effluent samples based on review of chromatograms and recommendations by laboratory.
5. Synthetic Precipitation Leaching Procedure (SPLP) used to estimate desorption coefficients for PFASs in solids. Both filtered and unfiltered samples of biosolid SPLP solutions were tested during Phase 1 of the study (WWTPs #1, #3, #4, #5). Only filtered samples were tested for samples of biosolids and soil collected during Phase 2 of the study. Phase 2 SPLP solution samples were tested using both pre- and post-TOPs methods. Phase 2 samples also tested for AOF, TOPs and ultrashorts. Testing of SPLP solution using NTA was made optional pending recommendations by laboratory.
6. Soil Column Leaching Method 1314 used to assess leaching of PFASs from solids.
7. Both filtered and unfiltered samples of liquids tested collected during Phase 1 of the Study (WWTPs #3, #4, #5; Landfills #2, #3, #4, #5). Testing of unfiltered samples discontinued for Phase 2 of the study (WWTPs #1, #2, #6).
8. Effluent samples from WWTPs #1, #2 and #6 tested by both SGS and Eurofins. Eurofins data includes additional reporting of a limited number of ultrashort PFAS compounds.

Table 4. [1]PFAS compounds reported by laboratory for WWTP influent, effluent and biosolids.

Terminal Compounds	Precursor Compounds
• Perfluoroethanoic acid (PFEtA/trifluoroacetate)	• 3-Perfluoroheptylpropanoic acid (7:3 FTCA)
• Perfluoropropanoic acid (PFPrA)	• 3-Perfluoropentylpropanoic acid (5:3 FTCA)
• Perfluorobutanoic acid (PFBA)	• 3-Perfluoropropylpropanoic acid (3:3 FTCA)
• Perfluoropentanoic acid (PFPeA)	• 4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
• Perfluorohexanoic acid (PFHxA)	• 6:2 Fluorotelomer unsaturated carboxylic acid (6:2 FTUCA)
• Perfluoroheptanoic acid (PFHpA)	• Hexafluoropropylene Oxide Dimer Acid (HFPO-DA/GenX)
• Perfluorooctanoic acid (PFOA)	• Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
• Perfluorononanoic acid (PFNA)	• 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
• Perfluorodecanoic acid (PFDA)	• 1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)
• Perfluoroundecanoic acid (PFUnA)	• 1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS)
• Perfluorododecanoic acid (PFDoA)	• 1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)
• Perfluorotridecanoic acid (PFTrDA)	• 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
• Perfluorotetradecanoic acid (PFTeA)	• Perfluorooctanesulfonamide (FOSA)
• Perfluorobutanesulfonic acid (PFBS)	• N-ethylperfluorooctane sulfonamide (NEtFOSA)
• Perfluoropentanesulfonic acid (PFPeS)	• N-methylperfluorooctane sulfonamide (NMeFOSA)
• Perfluorohexanesulfonic acid (PFHxS)	• N-Ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
• Perfluoroheptanesulfonic acid (PFHpS)	• N-Methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
• Perfluorooctanesulfonic acid (PFOS)	• N-ethylperfluorooctane sulfonamidoethanol (NEtFOSE)
• Perfluorononanesulfonic acid (PFNS)	• N-methylperfluorooctane sulfonamidoethanol (NMeFOSE)
• Perfluorodecanesulfonic acid (PFDS)	• Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
• Perfluorododecanesulfonic acid (PFDoS)	• Perfluoro-3,6-dioxaheptanoic acid (PFDoHpA)

Notes:

1. Original concentration of anion forms of compounds converted to acid forms in laboratory reports, based on laboratory Standard Operating Procedures. Term for anion form of compounds used in summary tables. True concentration of anion form not significantly different from acid-reported concentration.
2. PFEtA (perfluoroacetatic acid), PFPrA and PFDoHpA (nonafluoro-3,6-dioxaheptanoic acid) added to list of reported PFASs in Phase 2.

Table 5a. [1]Total PFASs in WWTP influent, effluent and biosolids.

	Influent			Effluent			Biosolids			Compost		
WWTP ID	[2]Pre-TOPs (ng/L)	Post-TOPs (ng/L)	AOF (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	AOF (ng/L)	Pre-TOPs (µg/kg)	Post-TOPs (µg/kg)	EOF (µg/kg)	Pre-TOPs (µg/kg)	Post-TOPs (µg/kg)	EOF (µg/kg)
WWTP #1	38 (366)	43	1,400	47 (444)	48	1,500	90	187	509	-	-	-
WWTP #2	30 (330)	21	1,500	38 (522)	47	1,900	73	327	532	-	-	-
WWTP #3	22	-	-	144	-	-	123	785	-	-	-	-
WWTP #4	40	-	-	32	-	-	84	942	-	-	-	-
WWTP #5	64	-	-	36	-	-	181	680	-	-	-	-
WWTP #6	250 (537)	514	2,000	665 (933)	455	1,600	59	409	842	58	74	271

Notes:

"-": Not tested

AOF: Absorbable Organic Fluorine

EOF: Extractable Organic Fluorine

AOF tested on Pre-TOPs sample.

EOF: In blanks at 86 µg/kg and 109 ng/kg.

1. Refer to Appendix 6 for detailed summary of sample data; includes reported precursor compounds.

2. Concentration in parentheses includes Pre-TOPs ultrashort compounds (primarily $PFEtA^-$). Ultrashorts not reported for Post-TOPs analyses.

Table 5b. Pre-TOPs Ultrashort PFAS data for WWTP influent and effluent.

[1]Compound	WWTP #1 (Sand Island)		WWTP #2 (Hono'uli'uli)		WWTP #6 (La'ie)	
	Influent (ng/L)	[3]Effluent (ng/L)	Influent (ng/L)	[3]Effluent (ng/L)	Influent (ng/L)	[2]Effluent (ng/L)
Perfluoromethane sulfonate (PFMeS$^-$)	ND (<9.92)	ND (<9.86)	ND (<9.91)	ND (<9.57)	ND (<9.55)	ND (<9.57)
Perfluoroethane sulfonate (PFEtS-)	ND (<5.11)	ND (<5.07)	ND (<5.1)	ND (<4.93)	ND (<4.91)	ND (<4.93)
Perfluoropropane sulfonate (PFPrS$^-$)	ND (<5.05)	ND (<5.02)	ND (<5.05)	ND (<4.88)	ND (<4.86)	ND (<4.88)
[2]Perfluoroethanoate (trifluoroacetate) (PFEtA$^-$)	328	397	300	484	287	308
Perfluoropropanoate (PFPrA$^-$)	ND (<19.9)	ND (<19.7)	ND (<19.8)	ND (<19.2)	ND (<19.1)	ND (<19.2)

Notes:

1. Referred to as “Tri-“ rather than “Per-“ compounds in laboratory report.
2. Data for reported detections of PFEtA$^-$ flagged "R" by laboratory: "Peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration."
3. SGS noted in table. Eurofins analyses of effluent sample splits reported PFPrA- concentrations of 11 ng/L, 23 ng/L, 12 ng/L and in effluent samples from WWTP #1, WWTP #2 and WWTP #3, respectively (refer to Eurofins lab reports in Appendix 2).

Table 5c. Pre-TOPs ultrashort PFAS data for WWTP biosolids SPLP leachate.

[1]Compound	Sand Island WWTP #1	Hono'uli'uli WWTP #2	La'ie WWTP #6	
	Biosolids SPLP (ng/L)	Biosolids SPLP (ng/L)	Biosolids SPLP (ng/L)	Compost SPLP (ng/L)
Perfluoromethane sulfonate (PFMeS$^-$)	ND (<9.83)	ND (<9.92)	ND (<9.77)	509
Perfluoroethane sulfonate (PFEtS-)	ND (<13.1)	ND (<6.75)	ND (<5.03)	ND (<11.1)
Perfluoropropane sulfonate (PFPrS$^-$)	ND (<5.01)	ND (<5.06)	ND (<4.98)	ND (<4.98)
[2]Perfluoroethanoate (trifluoroacetate) (PFEtA$^-$)	ND (<718)	ND (<134)	ND (<176)	4,980
Perfluoropropanoate (PFPrA$^-$)	ND (<102)	ND (<19.9)	ND (<19.6)	ND (<45)

Notes:

1. Referred to as “Tri-“ rather than “Per-“ compounds in laboratory report.
2. Filtered samples. Data for reported detections of PFEtA$^-$ flagged "R" by laboratory: "Peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration." PFEtA$^-$ was reported in unfiltered samples of SPLP leachate from WWTP #2 (133 ng/L) and WWTP #6 (401 ng/L) (Appendix 2).

Table 6. [1]Total PFASs in landfill leachate.

Landfill	Sample ID	[2]Pre-TOPs (ng/L)	[2]Post-TOPs (ng/L)	[3]AOF (ng/L)
LF #1	WGLF E-6	64,664	40,771	83,000
	WGLF 4B	40,618	36,835	51,000
	WGLF ASH	12,970	12,455	13,000
LF #2	PVTLF	102,950	-	-
LF #3	CMLF IV-A	122,011	-	-
	CMLF IV-B	107,553	-	-
	CMLF VBE	56,404	-	-
LF #4	WHLF-LECH-R1	68,110	-	-
	WHLF-LECH-R2	59,485	-	-
	WHLF-LECH-R3	77,832	-	-
	WHLF-LECH-R4	184,824	-	-
LF #5	KKLF-WW1	39,684	-	-
	KKLF-WW2	49,206	-	-
	KKLF-WW3	53,492	-	-
	KKLF-WW2A	53,390	-	-
	KKLF-WW2B	35,743	-	-

Notes:

"-": Not tested

AOF: Absorbable Organic Fluorine

1. Refer to Appendix 7 for detailed summary of sample data.
2. Data presented are for filtered samples.
3. AOF tested on Pre-TOPs sample.

Table 7: [1]Pre-TOPs versus Post-TOPs analysis of concentrated AFFF spilled at Release Site #1.

Sample ID	Pre-TOPs (mg/L)	Post-TOPs (mg/L)	[2]AOF (mg/L)
AFFF Concentrate	31	191,500	12,000

Notes:
AOF: Absorbable Organic Fluorine
1. Refer to Appendix 8 for detailed summary of sample data.
2. AOF biased low due to interference of test with high concentration of PFASs in sample.

Table 8. [1]Total Pre-TOPs versus Post-TOPs in soil at AFFF Release Site #1.

Sample ID	Pre-TOPs (µg/kg)	Post-TOPs (µg/kg)	EOF (µg/kg)
DU-2	144	23,839	-
DU-3	264	22,013	-
DU-4a	16	114	-
DU-4b	13	643	-

Notes:
"-": Not tested
EOF: Extractable Organic Fluorine
1. Refer to Appendix 8 for detailed summary of sample data.

Table 9 [1]Total Pre-TOPs versus Post-TOPs in soil at AFFF Release Site #2.

[2]Sample ID	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	EOF (µg/Kg)
DU5D	878	1,051	650
DU5E	882	1,398	ND (<500)
DU5F	952	1,319	990

Notes:
1. Refer to Appendix 9 for detailed summary of sample data.
2. Triplicate samples collected from the same Decision Unit.

Table 10. [1]Total Pre-TOPs versus Post-TOPs PFASs in groundwater at AFFF Release Site #2.

Sample ID	[1]Pre-TOPs (ng/L)	[1]Post-TOPs (ng/L)	[2]AOF (ng/L)
MW-1	2,241,000	1,947,310	2,600,000
MW-2	2,256,000	2,053,880	2,400,000
MW-3	778,900	657,350	790,000
MW-4	561,700	484,460	610,000
MW-5	507,800	426,536	580,000
MW-7	200,096	174,715	190,000
MW-8	307	310	ND (<2,000)
MW-9	16,337	15,400	18,000

Notes

AOF: Absorbable Organic Fluorine

1. Refer to Appendix 9 for detailed summary of sample data.
2. Data for filtered samples.

Table 11. [1]Background soil PFAS data

Sample ID	[2]Pre-TOPs (µg/Kg)	[2]Post-TOPs(µg/Kg)	[3]EOF (µg/Kg)
KOKEE-BCKG	ND	ND	620
KP-BCKG	ND	ND	ND (<500)
NPALI-BCKG	ND	1.1	ND (<500)
MP-BCKG	ND	ND	ND (<500)
POLI-PFAS-BCKG	ND	ND	ND (<500)
MAK-PFHI-BCKG	ND	ND	ND (<500)
ML#1-PFAS-BCKG	ND	ND	ND (<500)
KUD-PFAS-BCKG	ND	ND	ND (<500)
KALOLI POINT-BCKG	ND	ND	670

Notes

1. Refer to Appendix 10 for detailed summary of sample data.
2. ND: Range of Method Reporting Levels for individual compounds 0.96 µg/kg to 0.99 µg/kg (see Appendix 10).
3. Laboratory stated low confidence in EOF data and actual presence of PFASs in samples due to estimated concentration marginally above Method Reporting Limit. Samples being retested for EOF as well as Non-Targeted Analysis for PFASs (pending as of November 2024).

Table 12. Targeted Terminal PFASs and corresponding action levels used assess Total PFAS Risk (HIDOH 2024b).

CAS #	Chemical	Water Action Levels		[3]Soil Action Levels		
		[1]Drinking Water (ng/L)	[2]Aquatic Toxicity (ng/L)	Unrestricted/ Residential (µg/Kg)	Commercial/ Industrial (µg/Kg)	Construction/ Trench Worker (µg/Kg)
45187-15-3	**Perfluorobutane sulfonate (PFBS$^-$)**	7,345	127,000,000	16,435	146,680	288,600
146689-46-5	**[7]Perfluoropentanesulfonate (PFPeS-)**	2,538	581	8,344	74,475	150,221
108427-53-8	**Perfluorohexane sulfonate (PFHxS$^-$)**	7.7	10,000	25	226	453
146689-46-5	**Perfluoroheptane sulfonate (PFHpS$^-$)**	38	38	126	1,128	2,276
45298-90-6	**Perfluorooctane sulfonate (PFOS$^-$)**	7.7	1,100	25	226	455
126105-34-8	**Perfluorodecane sulfonate (PFDS$^-$)**	38	38	126	1,128	2,276
14477-72-6	**[4]Perfluoro ethanoate (PFEtA$^-$)**	18,000	100,000	29,000	130,000	200,000
44864-55-3	**Perfluoro propanoate (PFPrA$^-$)**	513	513	5,038	36,601	112,988
45048-62-2	**Perfluoro butanoate (PFBA$^-$)**	14,615	830,000	48,042	428,781	856,686
45167-47-3	**Perfluoro pentanoate (PFPeA$^-$)**	1,538	1,538	5,057	45,135	90,391
92612-52-7	**Perfluoro hexanoate (PFHxA$^-$)**	1,923	6,300,000	6,321	56,419	112,988
120885-29-2	**Perfluoro heptanoate (PFHpA$^-$)**	77	77	253	2,257	4,552
45285-51-6	**Perfluoro octanoate (PFOA$^-$)**	12	8,300	38	338	670
72007-68-2	**Perfluoro nonanoate (PFNA$^-$)**	12	8,000	38	339	681
73829-36-4	**Perfluoro decanoate (PFDA$^-$)**	7.7	10,000	25	226	455
196859-54-8	**Perfluoro undecanoate (PFUnDA$^-$)**	19	10,000	63	564	1,138
171978-95-3	**Perfluoro dodecanoate (PFDoDA$^-$)**	26	20,000	85	756	1,519
862374-87-6	**Perfluoro tridecanoate (PFTrDA$^-$)**	26	26	85	756	1,525
365971-87-5	**Perfluoro tetradecanoate (PFTeDA$^-$)**	258	258	847	7,560	15,250

Notes

1. Refer to Attachment 3, Table D-3a of HIDOH (2024b). Target Hazard Quotient = 1. "Unrestricted" land use includes residential.
2. Refer to Attachment 3, Table D-4a of HIDOH (2024b). Chronic aquatic toxicity action levels noted. Aquatic toxicity action level set equal to drinking water action level for PFHpS$^-$, PFDS$^-$, PFPrA$^-$, PFHpA$^-$, PFTrDA$^-$ and PFTeDA$^-$ due to lack of action levels specific to aquatic toxicity.
3. Refer to Attachment 3, Tables I-1, I-2 and I-3 of referenced document of HIDOH (2024b).Target Hazard Quotient = 1.
4. Also referred to as “Trifluoroacetate.”

Table 13. Default exposure parameter values used to generate toxicity-based action levels for drinking water and direct- exposure action levels for soil (HIDOH 2024b).

Symbol	Definition (units)	Default	References
CSFo	Cancer slope factor oral $(mg/kg\text{-}d)^{-1}$	--	Chemical specific
CSFi	Cancer slope factor inhaled $(mg/kg\text{-}d)^{-1}$	--	Chemical specific
RfDo	Reference dose oral (mg/kg-d)	--	Chemical specific
RfDi	Reference dose inhaled (mg/kg-d)	--	Chemical specific
^{2}THQs	Target hazard quotient (soil)	1.0	(refer to memorandum text)
^{2}THQdw	Target hazard quotient (drinking water)	1.0	(refer to memorandum text)
RSCdw	Relative Source Contribution (drinking water)	0.2	(refer to memorandum text)
BWa	Body weight, adult (kg) (soil exposure)	55	HIDOH
BWc	Body weight, child (kg)	15	USEPA 2023
ATc	Average time – carcinogens (days)	25,550	USEPA 2023
ATn	Average time – noncarcinogens (days)	EDx365	USEPA 2023
SAar	Exposed surface area, adult res. (cm^2/day)	6,032	USEPA 2023
SAaw	Exposed surface area, adult occ. (cm^2/day)	2,373	USEPA 2023
SAc	Exposed surface area, child (cm^2/day)	3,527	USEPA 2023
AFar	Adherence factor, adult res. (mg/cm^2)	0.07	USEPA 2023
AFaw	Adherence factor, occupational (mg/cm^2)	0.12	USEPA 2023
AFctw	Adherence factor, construction/trench worker (mg/cm^2)	0.30	USEPA 2023
AFc	Adherence factor, child (mg/cm^2)	0.20	USEPA 2023
ABS	Skin absorption (unitless): chemical specific	--	USEPA 2023
IRAa	Inhalation rate – adult (m^3/day)	20	USEPA 2023
IRAc	Inhalation rate – child (m^3/day)	10	USEPA 2023
IRActw	Inhalation rate – construction/trench worker (m^3/day)	20	USEPA 2011b
IRWa	Drinking water ingestion – adult (L/day)	-	Chemical specific
IRWc	Drinking water ingestion – child (L/day)	-	Chemical specific
IRSa	Soil ingestion – adult (mg/day)	100	USEPA 2023
IRSc	Soil ingestion – child (mg/day)	200	USEPA 2023
IRSo	Soil ingestion – occupational (mg/day)	100	USEPA 2023
IRSctw	Soil ingestion–construction/trench worker (mg/day)	330	USEPA 2002
EFr_{DW}	Exposure frequency (Drinking Water; d/y)	365	USEPA 2023
EFr_{soil}	Exposure frequency (Soil, Residential; d/y)	350	USEPA 2023
EFo	Exposure frequency (Soil, Occupational; d/y)	250	USEPA 2023
EFctw	Exposure frequency – construction/trench worker (d/y)	20	Massachusetts DEP (1994)
EDr	Exposure duration – residential (years)	26	USEPA 2023
EDc	Exposure duration – child (years)	6	USEPA 2023
EDo	Exposure duration – occupational (years)	25	USEPA 2023
EDctw	Exposure duration – construction/trench worker (years)	7	modified from Massachusetts DEP (1994)

Table 14. Physiochemical constants and toxicity factors used to derive risk-based action levels for drinking water and soil (HIDOH 2024b).

[1]PFAS	[1]CAS #	[2]Physical State		Molecular Weight	Organic Carbon Partition coefficient,	Diffusivity in Air	Diffusivity in Water	Pure Component Solubility in Water	[4]Vapor Pressure	Henry's Law Constant	Henry's Law Constant	GI Tract Absorption Factor	Skin Absorption Factor
					K_{oc}	D_a	D_w	S	VP	H	H'	GIABS	ABS
				MW	(cm^3/g)	(cm^2/s)	(cm^2/s)	(mg/L)	(mm Hg)	(atm-m^3/mol)	(unitless)	(unitless)	(unitless)
PFBS⁻	45187-15-3	NV	S	299	3.10E+01	2.70E-02	7.17E-06	2.17E+03	1.15E-08	2.95E-10	1.21E-08	1.00E+00	1.00E-01
PFPeS⁻	175905-36-9	NV	S	349	1.05E+03			1.31E+05	2.82E-07	2.14E-10	8.75E-09	1.00E+00	1.00E-01
PFHxS⁻	108427-53-8	NV	S	399	5.62E+02	3.50E-02	4.09E-06	1.70E+05	8.13E-09	1.94E-10	7.93E-09	1.00E+00	1.00E-01
PFHpS⁻	146689-46-5	NV	S	449	1.23E+03			3.53E+05	3.31E-07	1.79E-10	7.32E-09	1.00E+00	1.00E-01
PFOS⁻	45298-90-6	NV	S	499	1.12E+03	2.07E-02	5.26E-06	5.64E+05	2.45E-06	1.80E-11	7.36E-10	1.00E+00	1.00E-01
PFDS⁻	126105-34-8	NV	S	599	3.94E+03			1.08E+06	8.13E-06	3.31E-10	1.35E-08	1.00E+00	1.00E-01
PFEtA⁻	14477-72-6	V	L	114	4.07E+00	5.07E-02	9.30E-06	9.93E+05	1.08E+02	3.31E-03	1.35E-01	1.00E+00	1.00E-01
PFPrA⁻	44864-55-3	V	L	164	5.89E+00			2.44E+04	2.30E+01	3.63E-06	1.48E-04	1.00E+00	1.00E-01
PFBA⁻	45048-62-2	SV	L	213	7.60E+01			1.46E+05	2.18E+01	5.01E-05	2.05E-03	1.00E+00	1.00E-01
PFPeA⁻	45167-47-3	NV	L	263	2.30E+01			2.43E+05	7.27E+00	2.97E-10	1.21E-08	1.00E+00	1.00E-01
PFHxA⁻	92612-52-7	NV	L	313	2.00E+01			3.44E+05	2.00E+00	2.35E-10	9.61E-09	1.00E+00	1.00E-01
PFHpA⁻	120885-29-2	NV	S	363	4.30E+01			5.30E+05	3.03E-01	2.09E-10	8.54E-09	1.00E+00	1.00E-01
PFOA⁻	45285-51-6	NV	S	413	1.82E+02			6.24E+05	1.92E-01	1.92E-10	7.85E-09	1.00E+00	1.00E-01
PFNA⁻	72007-68-2	NV	S	463	1.06E+03			7.78E+05	8.98E-02	1.18E-09	4.82E-08	1.00E+00	1.00E-01
PFDA⁻	73829-36-4	NV	S	513	7.24E+02			9.54E+05	2.39E-02	1.50E-10	6.13E-09	1.00E+00	1.00E-01
PFUnDA⁻	196859-54-8	NV	S	563	2.69E+03			1.16E+06	1.27E-02	3.34E-10	1.37E-08	1.00E+00	1.00E-01
PFDoDA⁻	171978-95-3	NV	S	613	8.54E+04			1.40E+06	4.72E-03	3.40E-10	1.39E-08	1.00E+00	1.00E-01
PFTrDA⁻	862374-87-6	NV	S	663	1.84E+05			1.69E+06	2.13E-03	3.48E-10	1.42E-08	1.00E+00	1.00E-01
PFTeDA⁻	365971-87-5	NV	S	713	2.33E+05			2.03E+06	1.20E-03	3.55E-10	1.45E-08	1.00E+00	1.00E-01
PFOSA	754-91-6	NV	S	499	1.26E+04	3.02E-02	3.53E-06	6.64E-01	2.48E-01	1.26E-09	5.15E-08	1.00E+00	1.00E-01
HFPO-DA⁻	122499-17-6	NV	S	329	1.20E+01			1.00E+06	2.40E-01	4.06E-06	1.66E-04	1.00E+00	1.00E-01
6:2 FTS⁻	425670-75-3	NV	S	427	9.47E+02			5.72E+05	8.24E-07	1.83E-10	7.48E-09	1.00E+00	1.00E-01
ADONA⁻	958445-44-8	NV	S	395	9.67E+02			2.17E+05	1.32E-02	1.80E-10	7.36E-09	1.00E+00	1.00E-01
6:2 FTOH⁻	647-42-7	SV	L	364	3.16E+03			1.76E+01	1.70E+00	2.60E-10	1.06E-08	1.00E+00	1.00E-01
8:2 FTOH⁻	678-39-7	NV	S	464	2.24E+03			1.98E-01	2.09E-01	2.09E-10	8.54E-09	1.00E+00	1.00E-01
6:2 FtTAoS⁻	88992-47-6	NV	S	586	6.76E+04			1.92E+02	2.57E-09	8.91E-10	3.64E-08	1.00E+00	1.00E-01

Table 15. Change in reported total concentration of PFASs based on Pre-TOPs versus Post-TOPs sample data.

Study Site	Media	[1]Post-TOPs % Change
WWTP #1	Influent	+13
	Effluent	+1.5%
	Biosolids	+108%
WWTP #2	Influent	-30%
	Effluent	+24%
	Biosolids	+351%
WWTP #3	Influent	-
	Effluent	-
	Biosolids	+540%
WWTP #4	Influent	-
	Effluent	-
	Biosolids	+1,016%
WWTP #5	Influent	-
	Effluent	-
	Biosolids	+192%
WWTP #6	Influent	+105%
	Effluent	-32%
	Biosolids	+592%
	Compost	+28%
[2]Landfill #1	Leachate (WGLF E-6)	-37%
	Leachate (WGLF 4B)	-9.3%
	Leachate (WGLF ASH)	-4.0%
AFFF Release Site #1	3% AFFF Concentrate	+1,472,977%
[3]AFFF Release Site #1	Soil (DU-2)	+16,491%
	Soil (DU-3)	+8,234%
	Soil (DU-4a)	+626%
	Soil (DU-4b)	+5,003%
AFFF Release Site #2	Groundwater (MW-1)	-16%
	Groundwater (MW-2)	-20%
	Groundwater (MW-3)	-26^
	Groundwater (MW-4)	-23%
	Groundwater (MW-5)	-7.2%
	Groundwater (MW-7)	-6.2%
	Groundwater (MW-8)	-8.4%
	Groundwater (MW-9)	-7.9%
[4]AFFF Release Site #2	Soil (DU5F)	+39%

Table 15 (cont.). Change in reported total concentration of PFASs based on Pre-TOPs versus Post-TOPs sample data.

Notes:

1. Total Post-TOPs PFAS divided by (Total Post-TOPs PFASs – Total Pre-TOPs PFASs).
2. Leachate Samples WGLF E-6 & WGLF 4B collected from cells containing municipal garbage diverted from municipal waste-to-energy incinerator. Leachate Sample WGLF ASH collected from cell containing ash from municipal waste-to-energy incinerator.
3. Single Multi Increment soil sample collected from each of four separate Decision Units.
4. Average of triplicate Multi Increment samples collected from the same Decision Unit.
5. Comparatively small increase in post-TOPs Total PFAS concentration attributed to pre-2005 releases of AFFF that lacked the precursor compound 6:2 FtTAoS used in post-2005 AFFF.

Table 16. Excess Organic Fluorine in WWTP samples.

	Influent			Effluent			Biosolids			Compost		
WWTP ID	[1]Predicted AOF (ng/L)	[2]Measured AOF (ng/L)	[3]Excess Organic Fluorine (ng/L)	[1]Predicted AOF (ng/L)	[2]Measured AOF (ng/L)	[3]Excess Organic Fluorine (ng/L)	[1]Predicted EOF (µg/Kg)	[2]Measured EOF (µg/Kg)	[3]Excess Organic Fluorine (µg/Kg)	[1]Predicted EOF (µg/Kg)	[2]Measured EOF (µg/Kg)	[3]Excess Organic Fluorine (µg/Kg)
WWTP #1	199	1,400	1,201	236	1,500	1,264	143	509	366	-	-	-
WWTP #2	173	1,500	1,327	281	1,900	1,619	212	532	320	-	-	-
WWTP #3	-	-	-	-	-	-	-	-	-	-	-	-
WWTP #4	-	-	-	-	-	-	-	-	-	-	-	-
WWTP #5	-	-	-	-	-	-	-	-	-	-	-	-
WWTP #6	480	2,000	1,520	607	1,600	993	254	842	588	48	271	223

Notes:

"-": Not tested

Notes:

1. Predicted concentration of Absorbable Organic Fluorine based on reported concentrations and molecular formulas of Primary Pre-TOPs PFASs and Secondary, precursor-related Post-TOPs PFAS.

2. Measured concentration of Absorbable Organic Fluorine for sample.

3. Measured Total Organic Fluorine minus Predicted Organic Fluorine (refer to Appendix 6 and Appendix 11).

Table 17. Excess Organic Fluorine in landfill leachate samples.

LF #1 Sample ID	[1]Predicted AOF (ng/L)	[2]Measured AOF (ng/L)	[3]Excess Organic Fluorine (ng/L)
WGLF E-6	26,217	83,000	56,783
WGLF 4B	20,241	51,000	30,759
WGLF ASH	8,128	13,000	4,872

Notes:

1. Predicted concentration of Absorbable Organic Fluorine based on reported concentrations and molecular formulas of Primary Pre-TOPs PFASs and Secondary, precursor-related Post-TOPs PFAS.
2. Measured concentration of Absorbable Organic Fluorine for sample.
3. Measured Total Organic Fluorine minus Predicted Organic Fluorine (refer to Appendix 7 and Appendix 11).

Table 18. Excess Organic Fluorine in AFFF Release Site #2 soil samples.

AFFF Site #2 Sample ID	[1]Predicted EOF (µg/Kg)	[2]Measured EOF (µg/Kg)	[3]Excess Organic Fluorine (µg/Kg)
DU5D	690	650	(error)
DU5E	908	ND (<500)	-
DU5F	857	990	133

Notes:

1. Predicted concentration of Absorbable Organic Fluorine based on reported concentrations and molecular formulas of Primary Pre-TOPs PFASs and Secondary, precursor-related Post-TOPs PFAS.
2. Measured concentration of Absorbable Organic Fluorine for sample.
3. Measured Total Organic Fluorine minus Predicted Organic Fluorine (refer to Appendix 9 and Appendix 11).

Table 19. Excess Organic Fluorine in AFFF Release Site #2 groundwater samples.

AFFF Site #2 Sample ID	[1]Predicted AOF (ng/L)	[2]Measured AOF (ng/L)	[3]Excess Organic Fluorine (ng/L)
MW 1	1,247,510	2,600,000	1,352,490
MW 2	1,336,302	2,400,000	1,063,698
MW 3	455,784	790,000	334,216
MW 4	318,812	610,000	291,188
MW 5	205,690	580,000	374,310
MW 7	134,102	190,000	55,898
[4]MW 8	204	ND (<2,000)	796
MW 9	11,201	18,000	6,799

Notes:

1. Predicted concentration of Absorbable Organic Fluorine based on reported concentrations and molecular formulas of Primary Pre-TOPs PFASs and Secondary, precursor-related, Post-TOPs PFAS.
2. Measured concentration of Absorbable Organic Fluorine for sample.
3. Measured Total Organic Fluorine minus Predicted Organic Fluorine (refer to Appendix 9 and Appendix 11).
4. ½ of AOF MRL assumed for calculation of Excess Organic Fluorine.

Table 20a. [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for WWTP influent.

	Influent				
WWTP ID	[2]Primary PFASs Hazard Index	[3]Secondary PFASs Hazard Index	[4]Excess Fluorine PFASs Hazard Index	[5]Hypothetical Total PFAS Risk	[6]Primary Risk Drivers
WWTP #1	2.2	0.3	4.0	7	Ultrashorts; Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
WWTP #2	1.2	0.1	4.5	6	Ultrashorts; Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
WWTP #3	0.8	NA	NA	1	[7]Primary $PFOS^-$, $PFOA^-$
WWTP #4	0.8	NA	NA	1	[7]Primary $PFOS^-$, $PFOA^-$, $PFDA^-$
WWTP #5	1.5	NA	NA	2	[7]Primary $PFOS^-$, $PFOA^-$, $PFDA^-$
WWTP #6	0.6	0.3	5.7	7	Ultrashorts; Primary $PFOS^-$, $PFOA^-$, $PFPeA^-$

Table 20b. [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for WWTP effluent.

	Effluent				
WWTP ID	[2]Primary PFASs Hazard Index	[3]Secondary PFASs Hazard Index	[4]Excess Fluorine PFASs Hazard Index	[5]Hypothetical Total PFAS Risk	[6]Primary Risk Drivers
WWTP #1	2.8	0.1	4.3	7	Ultrashorts; Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
WWTP #2	1.1	0.2	5.5	7	Ultrashorts; Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
WWTP #3	2.4	NA	NA	2	Primary $PFOS^-$, $PFOA^-$, $PFDA^-$
WWTP #4	0.8	NA	NA	1	Primary $PFOS^-$, $PFOA^-$, $PFDA^-$
WWTP #5	0.9	NA	NA	1	Primary $PFOS^-$, $PFOA^-$, $PFDA^-$
WWTP #6	0.4	0.1	3.9	4	Ultrashorts; Primary $PFOA^-$, $PFPeA^-$, $PFOS^-$, $PFHxA^-$

Table 20c. [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for WWTP biosolids.

	Biosolids				
WWTP ID	[2]Primary PFASs Hazard Index	[3]Secondary PFASs Hazard Index	[4]Excess Fluorine PFASs Hazard Index	[5]Hypothetical Total PFAS Risk	[6]Primary Risk Drivers
WWTP #1	1.9	0.6	0.1	3	Primary $PFOS^-$, $PFHxS^-$
WWTP #2	0.6	1.4	0.1	2	Secondary $PFOA^-$, $PFNA^-$, $PFDA^-$
WWTP #3	1.6	3.6	NA	5	Secondary $PFOA^-$, $PFNA^-$, $PFDA^-$
WWTP #4	0.5	4.6	NA	5	Secondary $PFOS^-$, $PFDA^-$, $PFNA^-$
WWTP #5	1.5	3.8	NA	5	Secondary $PFOS^-$, $PFDA^-$, $PFNA^-$
WWTP #6	0.5	0.6	0.2	1	Secondary $PFOA^-$, $PFNA^-$, $PFDA^-$

Table 20d. [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for WWTP compost.

	Compost				
WWTP ID	[2]Primary PFASs Hazard Index	[3]Secondary PFASs Hazard Index	[4]Excess Fluorine PFASs Hazard Index	[5]Hypothetical Total PFAS Risk	[6]Primary Risk Drivers
WWTP #1	-	-	-	-	(no compost)
WWTP #2	-	-	-	-	(no compost)
WWTP #3	-	-	-	-	(no compost)
WWTP #4	-	-	-	-	(no compost)
WWTP #5	-	-	-	-	(no compost)
WWTP #6	0.4	0.0	0.1	1	Primary $PFOS^-$, $PFDA^-$, $PFOA^-$

Table 20 (cont.). [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for WWTP influent, effluent, biosolids and compost.

Notes:

NA: Not Available. PFAS Group not included in estimation of Total PFAS Risk or identification of primary risk drivers.

1. Refer to Total PFAS Risk calculator worksheets in Appendix 11 for detailed summary of Hazard Index calculations.
2. Noncancer Hazard Index calculated for Primary Terminal PFASs originally present in the sample.
3. Noncancer Hazard Index calculated for Secondary Terminal PFASs generated following TOPs processing of sample.
4. Noncancer Hazard Index calculated for unreported PFASs compounds assumed to associated with excess fluorine in the sample.
5. Hypothetical noncancer Hazard Index based on comparison of influent and effluent data to drinking water action levels and soil data to risk-based action levels for residential (unrestricted) direct exposure. For assessment of relative source strength only. Effluent not used for drinking water and does not directly threaten a drinking water resource. Biosolids disposed of at municipal landfills at four of the six WWTPs. Use of unadjusted biosolids data at the remaining two WWTPs (WWTP #1 and WWTP #6) does not consider an inherent reduction in mean PFAS concentrations in soil following incorporation into compost or spreading and mixing of biosolid pellets into soil. Compost and pelletized biosolids not known to have been used at residential homes.
6. PFAS Group and type with highest Hazard Index and individual Hazard Quotients (refer to Appendix 12). Ultrashorts dominate hypothetical health risk in wastewater influent and effluent. These compounds and $PFHxS^-$, $PFPeA^-$ and $PFHxA^-$, when present, are predicted to form the leading edge of groundwater plumes due to reduced sorption capacity and increased, relative mobility.
7. TOP and AOF/EOF data not available for WWTPs #2, #3 and #4. Not included in calculation of hypothetical Total PFAS Risk.

Table 21. [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for landfill leachate.

[1]Landfill	Sample ID	[2]Primary PFASs Hazard Index	[3]Secondary PFASs Hazard Index	[4]Excess Fluorine PFASs Hazard Index	[5]Hypothetical Total PFAS Risk	[6]Primary Risk Drivers
LF #1	WGLF E-6	424	11	191	626	Primary $PFOA^-$, $PFHxS^-$; ultrashorts
	WGLF 4B	910	28	104	1,042	Primary $PFHxS^-$, PFOA-, $PFOS^-$; ultrashorts
	WGLF ASH	61	6.8	16	84	Primary PFOA-, $PFHpA^-$; ultrashorts
LF #2	PVTLF	7,135	NA	NA	7,135	Primary $PFHxS^-$, $PFOS^-$
LF #3	CMLF IV-A	735	NA	NA	735	Primary $PFOA^-$, $PFOS^-$, $PFHxS^-$
	CMLF IV-B	266	NA	NA	266	Primary $PFOA^-$, $PFHxS^-$, $PFOS^-$
	CMLF VBE	1,082	NA	NA	1,082	Primary $PFOA^-$
LF #4	WHLF-LECH-R1	1,830	NA	NA	1,830	Primary $PFOA^-$, $PFHxS^-$, $PFOS^-$
	WHLF-LECH-R2	749	NA	NA	749	Primary $PFOA^-$, $PFOS^-$, $PFHxS^-$
	WHLF-LECH-R3	623	NA	NA	623	Primary $PFOA^-$
	WHLF-LECH-R4	1,143	NA	NA	1,143	Primary $PFOA^-$
LF #5	KKLF-WW1	577	NA	NA	577	Primary $PFOA^-$, $PFOS^-$, $PFHxS^-$
	KKLF-WW2	660	NA	NA	660	Primary $PFHxS^-$, $PFOA^-$, $PFOS^-$
	KKLF-WW3	243	NA	NA	243	Primary $PFHxS^-$, $PFOS^-$, $PFOA^-$
	KKLF-WW2A	1,115	NA	NA	1,115	Primary $PFHxS^-$, $PFOS^-$
	KKLF-WW2B	1,232	NA	NA	1,232	Primary $PFHxS^-$, $PFOS^-$

Notes:

NA: Not Available. TOPs and AOF analysis not carried out on leachate samples collected from LF #2, LF #3, LF #4 and LF #5.

1. Refer to Total PFAS Risk calculator worksheets in Appendix 11 for detailed summary of Hazard Index calculations.
2. Noncancer Hazard Index calculated for Primary Terminal PFASs originally present in the sample.
3. Noncancer Hazard Index calculated for Secondary Terminal PFASs generated following TOPs processing of sample.
4. Noncancer Hazard Index calculated for unreported PFASs compounds assumed to associated with excess fluorine in the sample.
5. Hypothetical noncancer Hazard Index based on comparison of leachate data to risk-based drinking water action levels. For assessment of relative source strength only. Leachate not used as a source of drinking water.
6. PFAS Group and type with highest Hazard Index and individual Hazard Quotients (refer to Appendix 12).

Table 22. [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for soil at AFFF Release Site #1.

	AFFF Release Site #1 Soil				
Sample ID	[2]Primary PFASs Hazard Index	[3]Secondary PFASs Hazard Index	[4]Excess Fluorine PFASs Hazard Index	[5]Hypothetical Total PFAS Risk	[6]Primary Risk Drivers
DU-2	0.1	5.9	NA	6	Secondary $PFHpA^-$, $PFPeA^-$, $PFHxA^-$
DU-3	0.3	5.7	NA	6	Secondary $PFHpA^-$, $PFPeA^-$, $PFHxA^-$
DU-4a	0.2	0.2	NA	0	Primary and Secondary $PFOS^-$, $PFOA^-$
DU-4b	0.1	0.3	NA	0	Secondary $PFOS^-$, $PFPeA^-$, $PFHxA^-$

Notes

NA: Not Available. PFAS Group not included in estimation of Total PFAS Risk or identification of primary risk drivers.

1. Refer to Total PFAS Risk calculator worksheets in Appendix 11 for detailed summary of Hazard Index calculations.
2. Noncancer Hazard Index calculated for Primary Terminal PFASs originally present in the sample.
3. Noncancer Hazard Index calculated for Secondary Terminal PFASs generated following TOPs processing of sample.
4. Noncancer Hazard Index calculated for unreported PFASs compounds assumed to associated with excess fluorine in the sample.
5. Hypothetical noncancer Hazard Index based on comparison of soil data to risk-based action levels for residential (unrestricted) direct exposure. For assessment of relative source strength only. Soil is not located in a residential area.
6. PFAS Group and type with highest Hazard Index and individual Hazard Quotients (refer to Appendix 12).

Table 23. [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for soil at AFFF Release Site #2.

	AFFF Release Site #1 Soil				
Sample ID	[2]Primary PFASs Hazard Index	[3]Secondary PFASs Hazard Index	[4]Excess Fluorine PFASs Hazard Index	[5]Hypothetical Total PFAS Risk	[6]Primary Risk Drivers
DU5D	31	1	(error)	32	Primary $PFOS^-$
DU5E	31	9	0	40	Primary $PFOS^-$
DU5F	33	5	0	38	Primary $PFOS^-$

Notes

Error: Reported concentration of EOF less than Predicted EOF concentration.

1. Refer to Total PFAS Risk calculator worksheets in Appendix 11 for detailed summary of Hazard Index calculations.
2. Noncancer Hazard Index calculated for Primary Terminal PFASs originally present in the sample.
3. Noncancer Hazard Index calculated for Secondary Terminal PFASs generated following TOPs processing of sample.
4. Noncancer Hazard Index calculated for unreported PFASs compounds assumed to associated with excess fluorine in the sample.
5. Hypothetical noncancer Hazard Index based on comparison of soil data to risk-based action levels for residential (unrestricted) direct exposure. For assessment of relative source strength only. Soil is not located in a residential area.
6. PFAS Group and type with highest Hazard Index and individual Hazard Quotients (refer to Appendix 12).

Table 24. [1]Summary of Primary Terminal PFASs, Secondary Terminal PFASs and Excess Fluorine PFASs hypothetical noncancer hazard and Total PFAS Risk for groundwater at AFFF Release Site #2.

Sample ID	[2]Primary PFASs Hazard Index	[3]Secondary PFASs Hazard Index	[4]Excess Fluorine PFASs Hazard Index	[5]Hypothetical Total PFAS Risk	[6]Primary Risk Drivers
MW-1	99,242	5,700	4,559	109,502	Primary $PFOS^-$, $PFHxS^-$
MW-2	120,524	358	3,586	124,468	Primary $PFOS^-$, $PFHxS^-$
MW-3	51,243	185	982	52,410	Primary $PFOS^-$, $PFHxS^-$
MW-4	22,445	121	1,018	23,584	Primary $PFOS^-$, $PFHxS^-$
MW-5	18,892	56	1,262	20,210	Primary $PFOS^-$, $PFHxS^-$
MW-7	18,395	8.1	188	18,591	Primary $PFOS^-$, $PFHxS^-$
MW-8	18	0.7	2.7	22	Primary $PFOS^-$, $PFHxS^-$
MW-9	532	125	23	679	Primary $PFHxS^-$, $PFOS^-$

Notes:

NA: Not Available. PFAS Group not included in estimation of Total PFAS Risk or identification of primary risk drivers.

1. Refer to Total PFAS Risk calculator worksheets in Appendix 11 for detailed summary of Hazard Index calculations.
2. Noncancer Hazard Index calculated for Primary Terminal PFASs originally present in the sample.
3. Noncancer Hazard Index calculated for Secondary Terminal PFASs generated following TOPs processing of sample.
4. Noncancer Hazard Index calculated for unreported PFASs compounds assumed to associated with excess fluorine in the sample.
5. Hypothetical noncancer Hazard Index based on comparison of groundwater data to risk-based action levels for residential (unrestricted) direct exposure. For assessment of relative source strength only. Biosolids are not used residential areas.
6. PFAS Group and type with highest Hazard Index and individual Hazard Quotients (refer to Appendix 12). $PFHxS^-$ makes up increasing proportion of Total PFAS Risk with increasing distance from fire training pit, suggesting increased, relative mobility with respect to $PFOS^-$.

Table 25a. PFAS Group Total Concentration and Hazard Index associated with WWTP influent and primary risk drivers.

WWTP ID	Parameter	Influent			Total	[5]Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFAS		
WWTP #1	Total Concentration (ng/L):	366	15	2,078	2,459	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
	Hazard Index:	2.2	0.3	4	7	
WWTP #2	Total Concentration (ng/L):	326	9.2	2,296	2,631	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
	Hazard Index:	1.2	0.1	4.5	6	
WWTP #6	Total Concentration (ng/L):	537	268	2,630	3,435	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFOA^-$, $PFPeA^-$
	Hazard Index:	0.8	0.6	5.1	7	

Table 25b. PFAS Group Total Concentration and Hazard Index associated with WWTP effluent and primary risk drivers.

WWTP ID	Parameter	Effluent			Total	[5]Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
WWTP #1	Total Concentration (ng/L):	44	14	2,541	2,598	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
	Hazard Index:	2.7	0.1	5.0	8	
WWTP #2	Total Concentration (ng/L):	35	26	3,234	3,295	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
	Hazard Index:	1.1	0.2	6.3	8	
WWTP #6	Total Concentration (ng/L):	663	30	2,254	2,947	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOA^-$, $PFPeA^-$, $PFOS^-$, $PFHxA^-$
	Hazard Index:	0.9	0.4	4.4	6	

Table 26a. Relative PFAS Group Total Concentration and Hazard Index associated with WWTP influent and primary risk drivers.

WWTP ID	Parameter	Influent			Total	[5]Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFAS		
WWTP #1	Total Concentration:	15%	0.6%	85%	100%	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
	Hazard Index:	34%	4.6%	62%	100%	
WWTP #2	Total Concentration:	12%	0.3%	87%	100%	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
	Hazard Index:	21%	1.7%	78%	100%	
WWTP #6	Total Concentration:	16%	7.8%	77%	100%	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFOA^-$, $PFPeA^-$
	Hazard Index:	12%	9.2%	78%	100%	

Table 26b. Relative PFAS Group Total Concentration and Hazard Index associated with WWTP effluent and primary risk drivers.

WWTP ID	Parameter	Effluent			Total	[5]Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
WWTP #1	Total Concentration:	1.7%	0.5%	98%	100%	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
	Hazard Index:	35%	0.7%	64%	100%	
WWTP #2	Total Concentration:	1.1%	0.8%	98%	100%	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOS^-$, $PFHxS^-$, $PFOA^-$
	Hazard Index:	14%	2.1%	84%	100%	
WWTP #6	Total Concentration:	22%	1.0%	76%	100%	Excess Fluorine PFAS (Ultrashorts); +Primary $PFOA^-$, $PFPeA^-$, $PFOS^-$, $PFHxA^-$
	Hazard Index:	15%	7.9%	77%	100%	

Table 27. PFAS Group Total Concentration and Hazard Index associated with landfill leachate and primary risk drivers.

Landfill #1 Sample ID	Parameter	Leachate			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
WGLF E-6	Total Concentration (ng/L):	36,399	5,360	98,234	139,993	Primary PFOA-, PFHxS-
	Hazard Index:	424	11	191	626	
WGLF 4B	Total Concentration (ng/L):	29,369	2,000	53,212	84,581	Primary PFHxS-, PFOA-, PFOS-
	Hazard Index:	910	28	104	1,042	
WGLF ASH	Total Concentration (ng/L):	11,340	1,125	8,429	20,909	Primary PFOA-, PFHpA-
	Hazard Index:	61	6.8	16	84	

Table 28. Relative PFAS Group Total Concentration and Hazard Index associated with Landfill #1 landfill leachate and primary risk drivers.

Landfill #1 Sample ID	Parameter	Leachate			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
WGLF E-6	% Total Concentration:	26%	3.8%	70%	100%	Primary PFOA-, PFHxS-
	% Hazard Index:	68%	1.8%	31%	100%	
WGLF 4B	% Total Concentration:	35%	2.4%	63%	100%	Primary PFHxS-, PFOA-, PFOS-
	% Hazard Index:	87%	2.7%	10%	100%	
WGLF ASH	% Total Concentration:	54%	5.4%	40%	100%	Primary PFOA-, PFHpA-
	% Hazard Index:	70%	11%	19%	100%	

Table 29. PFAS Group Total Concentration and Hazard Index associated with AFFF Release Site #2 groundwater and primary risk drivers.

AFFF Site #2 Monitoring Well ID	Parameter	Groundwater			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
MW-1	Total Concentration (ng/L):	1,291,000	632,000	2,339,808	4,262,808	Primary PFOS-, PFHxS-
	Hazard Index:	99,242	5,700	4,559	109,502	
MW-2	Total Concentration (ng/L):	1,646,000	412,000	1,840,197	3,898,197	Primary PFOS-, PFHxS-
	Hazard Index:	120,524	358	3,586	124,468	
MW-3	Total Concentration (ng/L):	494,900	206,500	578,194	1,279,594	Primary PFOS-, PFHxS-
	Hazard Index:	51,243	185	982	52,410	
MW-4	Total Concentration (ng/L):	322,500	167,700	503,756	993,956	Primary PFOS-, PFHxS-
	Hazard Index:	22,445	121	1,018	23,584	
MW-5	Total Concentration (ng/L):	275,400	40,800	647,557	963,757	Primary PFOS-, PFHxS-
	Hazard Index:	18,892	56	1,262	20,210	
MW-7	Total Concentration (ng/L):	188,830	18,300	96,704	303,834	Primary PFOS-, PFHxS-
	Hazard Index:	18,395	8.1	188	18,591	
MW-8	Total Concentration (ng/L):	283	32	1,377	1,692	Primary PFOS-, PFHxS-
	Hazard Index:	18	0.7	2.7	22	
MW-9	Total Concentration (ng/L):	15,777	1,440	11,763	28,980	Primary PFHxS-, PFOS-
	Hazard Index:	532	125	23	679	

Table 30. Relative PFAS Group Total Concentration and Hazard Index associated with AFFF-Release Site #2 groundwater and primary risk drivers.

AFFF Site #2 Monitoring Well ID	Parameter	Groundwater			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
MW-1	% Total Concentration:	30%	15%	55%	100%	Primary PFOS-, PFHxS-
	% Hazard Index:	91%	5.2%	4.2%	100%	
MW-2	% Total Concentration:	42%	11%	47%	100%	Primary PFOS-, PFHxS-
	% Hazard Index:	97%	0.3%	2.9%	100%	
MW-3	% Total Concentration:	39%	16%	45%	100%	Primary PFOS-, PFHxS-
	% Hazard Index:	98%	0.4%	1.9%	100%	
MW-4	% Total Concentration:	32%	17%	51%	100%	Primary PFOS-, PFHxS-
	% Hazard Index:	95%	0.5%	4.3%	100%	
MW-5	% Total Concentration:	29%	4.2%	67%	100%	Primary PFOS-, PFHxS-
	% Hazard Index:	93%	0.3%	6.2%	100%	
MW-7	% Total Concentration:	62%	6.0%	32%	100%	Primary PFOS-, PFHxS-
	% Hazard Index:	99%	0.0%	1.0%	100%	
MW-8	% Total Concentration:	17%	1.9%	81%	100%	Primary PFOS-, PFHxS-
	% Hazard Index:	85%	3.0%	12%	100%	
MW-9	% Total Concentration:	54%	5.0%	41%	100%	Primary PFHxS-, PFOS-
	% Hazard Index:	78%	18%	3.4%	100%	

Table 31. PFAS Group Total Concentration and Hazard Index associated with WWTP biosolids and primary risk drivers.

WWTP ID	Parameter	Biosolids			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
WWTP #1	Total Concentration (µg/Kg):	65	156	633	854	Primary PFOS-, PFHxS- +Secondary PFOA-, PFNA-, PFDA-
	Hazard Index:	1.9	0.6	0.1	3	
WWTP #2	Total Concentration (µg/Kg):	38	287	553	879	Secondary PFOA-, PFNA-, PFDA- +Primary PFOS-, PFDA-
	Hazard Index:	0.6	1.4	0.1	2	
WWTP #6	Total Concentration (µg/Kg):	26	382	1,017	1,426	Secondary PFOA-, PFNA-, PFDA- +Primary PFDA-, PFOS-, PFOA-
	Hazard Index:	0.5	0.6	0.2	1	

Table 32. Relative PFAS Group Total Concentration and Hazard Index associated with WWTP biosolids and primary risk drivers.

WWTP ID	Parameter	Biosolids			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
WWTP #1	% Total Concentration:	7.6%	18%	74%	100%	Primary PFOS-, PFHxS- +Secondary PFOA-, PFNA-, PFDA-
	% Hazard Index:	72%	23%	4.9%	100%	
WWTP #2	% Total Concentration:	4.4%	32%	63%	100%	Secondary PFOA-, PFNA-, PFDA- +Primary PFOS-, PFDA-
	% Hazard Index:	29%	66%	5.3%	100%	
WWTP #6	% Total Concentration:	1.9%	27%	71%	100%	Secondary PFOA-, PFNA-, PFDA- +Primary PFDA-, PFOS-, PFOA-
	% Hazard Index:	35%	49%	16%	100%	

Table 33. PFAS Group Total Concentration and Hazard Index associated with WWTP compost and primary risk drivers.

WWTP ID	Parameter	Compost			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
WWTP #6	Total Concentration (µg/Kg):	57	19	386	461	Primary PFOS-, PFDA-, PFOA-
	Hazard Index:	0.4	0.0	0.1	1	

Table 34. Relative PFAS Group Total Concentration and Hazard Index associated with WWTP compost and primary risk drivers.

WWTP ID	Parameter	Compost			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
WWTP #6	% Total Concentration:	12%	4.o%	84%	100%	Primary PFOS-, PFDA-, PFOA-
	% Hazard Index:	80%	5.6%	14%	100%	

Table 35. PFAS Group Total Concentration and Hazard Index associated with AFFF Release Site #1 soil (post-2005 formulation) and primary risk drivers.

AFFF Site #1 Sample ID	Parameter	Soil			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
DU-2	Total Concentration (µg/Kg):	24	23,813	-	23,837	Secondary PFHpA-, PFPeA-, PFHxA-
	Hazard Index:	0.1	5.9	-	6	
DU-3	Total Concentration (µg/Kg):	37	21,971	-	22,008	Secondary PFHpA-, PFPeA-, PFHxA-
	Hazard Index:	0.3	5.7	-	6	
DU-4a	Total Concentration (µg/Kg):	13	101	-	114	Secondary PFOS-, PFOA-/Primary PFOS-
	Hazard Index:	0.2	0.2	-	0	
DU-4b	Total Concentration (µg/Kg):	11	632	-	643	Primary PFOS- +Secondary PFOS-, PFPeA-, PFHpA-
	Hazard Index:	0.1	0.3	-	0	

Table 36. Relative PFAS Group Total Concentration and Hazard Index associated with AFFF Release Site #1 soil (post-2005 formulation) and primary risk drivers.

AFFF Site #1 Sample ID	Parameter	Soil			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
DU-2	% Total Concentration:	0.1%	100%	-	100%	Secondary PFHpA-, PFPeA-, PFHxA-
	% Hazard Index:	0.9%	99%	-	100%	
DU-3	% Total Concentration:	0.2%	100%	-	100%	Secondary PFHpA-, PFPeA-, PFHxA-
	% Hazard Index:	5.5%	94%	-	100%	
DU-4a	% Total Concentration:	11%	89%	-	100%	Primary PFOS- +Secondary PFOS-, PFOA-
	% Hazard Index:	44%	56%	-	100%	
DU-4b	% Total Concentration:	1.7%	98%	-	100%	Secondary PFOS-, PFPeA-, PFHpA- +Primary PFOS
	% Hazard Index:	24%	76%	-	100%	

Table 37. PFAS Group Total Concentration and Hazard Index associated with AFFF Release Site #2 soil (pre-2005 formulation) and primary risk drivers.

AFFF Site #2 Soil Sample ID	Parameter	Soil			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
DU5D	Total Concentration (µg/Kg):	849	212	-	1,061	Primary PFOS-
	Hazard Index:	30.5	1.0	-	32	
DU5E	Total Concentration (µg/Kg):	852	545	(<MRL)	1,397	Primary PFOS-
	Hazard Index:	30.8	9.1	0.0	40	
DU5F	Total Concentration (µg/Kg):	910	408	230	1,548	Primary PFOS-
	Hazard Index:	33.1	5.0	0.0	38	

Table 38. Relative PFAS Group Total Concentration and Hazard Index associated with AFFF Release Site #2 soil (pre-2005 formulation) and primary risk drivers.

AFFF Site #2 Soil Sample ID	Parameter	Soil			Total	Primary Risk Drivers
		Primary Terminal PFASs	Secondary Terminal PFASs	Excess Fluorine PFASs		
DU5D	% Total Concentration:	80%	20%	-	100%	Primary PFOS-
	% Hazard Index:	97%	3.2%	-	100%	
DU5E	% Total Concentration:	61%	39%	-	100%	Primary PFOS-
	% Hazard Index:	77%	23%	0.0%	100%	
DU5F	% Total Concentration:	59%	26%	15%	100%	Primary PFOS-
	% Hazard Index:	87%	13%	0.1%	100%	

12.0 Appendices

Appendix 1. ***Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances*** **(HIDOH November 2024)** ***(provided in separate pdf file)***

Appendices 2-5. Laboratory Reports (provided in separate pdf files)

Appendix 2. WWTPs Laboratory Reports

Appendix 3. Landfill Leachate Laboratory Reports

Appendix 4. AFFF-Release Sites Laboratory Reports

Appendix 5. Background Soil Laboratory Reports

Appendix 6. WWTP Influent, Effluent and Biosolids Detailed Data Summary

	WWTP #1								
	Influent (ng/L)		Effluent (ng/L)		Biosolids (ug/kg)		Biosolids SPLP (ng/L)		
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	[1]Pre-TOPs	[2]Post-TOPs	[2]Pre-TOPs	[2]Post-TOPs	Kd cm^3/g
PFEtA$^-$	328	-	397	-	-	-	ND	-	
PFPrA$^-$	ND	-	ND	-	-	-	ND	-	
PFBA$^-$	3.4	ND	3.1	ND	ND	44	13	-	
PFPeA$^-$	5.2	12	5.0	12	1.0	47	36	-	
PFHxA$^-$	5.0	9.6	5.0	10	1.1	34	27	-	
PFHpA$^-$	2.9	3.5	2.2	3.4	ND	11	3.9	-	
PFOA$^-$	4.1	6.1	4.6	5.0	0.72	12	6.7	-	
PFNA$^-$	0.80	ND	0.83	ND	1.2	4.8	4.1	-	
PFDA$^-$	ND	ND	0.56	ND	1.6	4.0	0.91	-	
PFUnDA$^-$	ND	ND	ND	ND	1.6	2.5	ND	-	
PFDoDA$^-$	ND	ND	ND	ND	1.4	2.6	ND	-	
PFTrDA$^-$	ND	ND	ND	ND	0.75	1.3	ND	-	
PFTeDA$^-$	ND	ND	ND	ND	1.1	1.4	ND	-	
PFBS$^-$	3.2	ND	5.3	3.5	12	3.2	4.1	-	
PFPeS$^-$	0.43	ND	0.82	ND	ND	ND	ND	-	
PFHxS$^-$	3.3	4.3	5.5	5.3	21	0.68	4.7	-	
PFHpS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFOS$^-$	9.4	7.3	11	8.9	21	16	16	-	
PFNS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFDS$^-$	ND	ND	ND	ND	ND	0.7	ND	-	
PFDoS-	ND	ND	ND	ND	1.0		ND	-	
4:2 FTS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
6:2 FTS$^-$	ND	ND	3.4	ND	ND	ND	7.4	-	
8:2 FTS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFOSA$^-$	ND	ND	ND	ND	1.1	0.40	ND	-	
N-MeFOSA$^-$	ND	ND	ND	ND	1.3	0.25	ND	-	
N-EtFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
MeFOSAA$^-$	ND	ND	ND	ND	0.55	ND	ND	-	
EtFOSAA$^-$	ND	ND	ND	ND	1.3	ND	ND	-	
N-MeFOSE$^-$	ND	ND	ND	ND	5.9	ND	ND	-	
N-EtFOSE$^-$	ND	ND	ND	ND	ND	ND	ND	-	
HFPO-DA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
ADONA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
9Cl-PF3ONS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
11Cl-PF3OUdS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
3:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
5:3 FTCA$^-$	ND	ND	ND	ND	14	ND	225	-	
7:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFEESA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFMPA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFMBA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
NFDHA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
Total:	**38**	**43**	**47**	**48**	**90**	**187**	**348**		
Pre- vs Post TOPs		**+13%**		**+1.5%**		**+108%**			

WWTP #1 Notes

"ND": Not Detected above laboratory Method Reporting Level (MRL). Refer to accompanying table of sample-specific MRLs.
"-": Not tested.
1. Study Phase 2 data for biosolids noted (second sample).
2. TOPs and SPLP analysis run on second biosolid sample.

WWTP #1 (Sand Island) (- PFEtA-)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
PFOS$^-$	9.4	25%
PFPeA$^-$	5.2	14%
PFHxA$^-$	5.0	13%
PFOA$^-$	4.1	11%
PFBA$^-$	3.4	9%
Other	11	28%
Total:	**38**	**100%**
PFHxS$^-$	3.3	
PFBS$^-$	3.2	
PFHpA$^-$	2.9	
PFNA$^-$	0.80	
PFPeS$^-$	0.43	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
PFOS$^-$	11	23%
PFHxS$^-$	5.5	12%
PFBS$^-$	5.3	11%
PFHxA$^-$	5.0	11%
PFPeA$^-$	5.0	10%
Other	15	33%
Total:	**47**	**100%**
PFOA$^-$	4.6	
6:2 FTS$^-$	3.4	
PFBA$^-$	3.1	
PFHpA$^-$	2.2	
PFNA$^-$	0.83	
PFPeS$^-$	0.82	
PFDA$^-$	0.56	

Compound	Pre-TOPs Biosolids (µg/kg)	% Makeup
PFOS$^-$	21	24%
PFHxS$^-$	21	24%
5:3 FTCA$^-$	14	15%
PFBS$^-$	12	13%
N-MeFOSE$^-$	5.9	6.6%
Other	16	17%
Total:	**90**	**100%**
PFDA$^-$	1.6	
PFUnDA$^-$	1.6	
PFDoDA$^-$	1.4	
N-MeFOSA$^-$	1.3	
EtFOSAA$^-$	1.3	
PFNA$^-$	1.2	
PFHxA$^-$	1.1	
PFTeDA$^-$	1.1	
PFOSA$^-$	1.1	
PFDoS-	1.0	
PFPeA$^-$	1.0	
PFTrDA$^-$	0.75	
PFOA$^-$	0.72	
MeFOSAA$^-$	0.55	

Compound	Post-TOPs Biosolids (µg/kg)	% Makeup
PFPeA$^-$	47	25%
PFBA$^-$	44	24%
PFHxA$^-$	34	18%
PFOS$^-$	16	8.8%
PFOA$^-$	12	6.6%
Other	33	17%
Total:	**187**	**100%**
PFHpA$^-$	11	
PFNA$^-$	4.8	
PFDA$^-$	4.0	
PFBS$^-$	3.2	
PFDoDA$^-$	2.6	
PFUnDA$^-$	2.5	
PFTeDA$^-$	1.4	
PFTrDA$^-$	1.3	
PFDS$^-$	0.7	
PFHxS$^-$	0.7	
PFOSA$^-$	0.4	
N-MeFOSA$^-$	0.2	

WWTP #1 (Sand Island) (+ PFEtA-)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
PFEtA$^-$	328	90%
PFOS$^-$	9.4	2.6%
PFPeA$^-$	5.2	1.4%
PFHxA$^-$	5.0	1.4%
PFOA$^-$	4.1	1.1%
Other	14	3.8%
Total:	**366**	**100%**
PFBA$^-$	3.4	
PFHxS$^-$	3.3	
PFBS$^-$	3.2	
PFHpA$^-$	2.9	
PFNA$^-$	0.80	
PFPeS$^-$	0.43	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
PFEtA$^-$	398	89%
PFOS$^-$	11	2.5%
PFHxS$^-$	5.5	1.2%
PFBS$^-$	5.3	1.2%
PFHxA$^-$	5.0	1.1%
Other	20	4.6%
Total:	**445**	**100%**
PFPeA$^-$	5.0	
PFOA$^-$	4.6	
6:2 FTS$^-$	3.4	
PFBA$^-$	3.1	
PFHpA$^-$	2.2	
PFNA$^-$	0.83	
PFPeS$^-$	0.82	
PFDA$^-$	0.56	

	WWTP #2								
	Influent (ng/L)		Effluent (ng/L)		Biosolids (µg/kg)		SPLP (ng/L)		
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	[1]Pre-TOPs	[2]Post-TOPs	[2]Pre-TOPs	[2]Post-TOPs	Kd cm^3/g
PFEtA$^-$	300	-	484	-	-	-	ND	-	
PFPrA$^-$	ND	-	ND	-	-	-	ND	-	
PFBA$^-$	2.7	ND	3.7	16	2.0	97	5.3	-	
PFPeA$^-$	3.4	8.3	7.6	17	1.6	73	4.0	-	
PFHxA$^-$	3.8	6.6	7.2	9.7	5.1	50	14	-	
PFHpA$^-$	0.80	ND	1.0	ND	ND	21	ND	-	
PFOA$^-$	1.7	3.2	2.8	4.5	1.7	27	2.9	-	
PFNA$^-$	ND	ND	0.42	ND	0.50	10	ND	-	
PFDA$^-$	ND	ND	0.50	ND	3.2	9.1	1.7	-	
PFUnDA$^-$	ND	ND	ND	ND	1.3	4.3	ND	-	
PFDoDA$^-$	ND	ND	ND	ND	2.1	4.8	ND	-	
PFTrDA$^-$	ND	ND	ND	ND	1.3	1.9	ND	-	
PFTeDA$^-$	ND	ND	ND	ND	1.9	2.1	ND	-	
PFBS$^-$	6.0	ND	6.7	ND	7.4	14	1.1	-	
PFPeS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFHxS$^-$	1.4	ND	1.4	ND	ND	0.35	ND	-	
PFHpS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFOS$^-$	6.5	3.2	4	ND	8.4	8.5	5.3	-	
PFNS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFDS$^-$	ND	ND	ND	ND	2.1	1.6	ND	-	
PFDoS-	ND	ND	ND	ND	ND	ND	ND	-	
4:2 FTS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
6:2 FTS$^-$	4.0	ND	2.5	ND	ND	1.5	ND	-	
8:2 FTS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFOSA$^-$	ND	ND	ND	ND	0.8	0.39	ND	-	
N-MeFOSA$^-$	ND	ND	ND	ND	0.79	0.25	ND	-	
N-EtFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
MeFOSAA$^-$	ND	ND	ND	ND	4.7	ND	0.94	-	
EtFOSAA$^-$	ND	ND	ND	ND	3.7	ND	ND	-	
N-MeFOSE$^-$	ND	ND	ND	ND	6.6	ND	ND	-	
N-EtFOSE$^-$	ND	ND	ND	ND	ND	ND	ND	-	
HFPO-DA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
ADONA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
9Cl-PF3ONS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
11Cl-PF3OUdS$^-$	ND	ND	ND	ND	ND	ND	ND	-	
3:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
5:3 FTCA$^-$	ND	ND	ND	ND	17	ND	131	-	
7:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFEESA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFMPA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
PFMBA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
NFDHA$^-$	ND	ND	ND	ND	ND	ND	ND	-	
Total:	**30**	**21**	**38**	**47**	**73**	**327**	**166**		
Pre- vs Post TOPs		**-30%**		**+24%**		**_+351%**			

WWTP #2 Notes

"ND": Not Detected above laboratory Method Reporting Level (MRL). Refer to accompanying table of sample-specific MRLs.
"-": Not tested.
1. Biosolids data average of triplicates (Multi Increment samples).
2. TOPs and SPLP analysis run on primary biosolid sample.

WWTP #2 (Hono'uli'uli) (- PFEtA-)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
PFOS$^-$	6.5	22%
PFBS$^-$	6.0	20%
6:2 FTS$^-$	4.0	13%
PFHxA$^-$	3.8	13%
PFPeA$^-$	3.4	11%
Other	6.5	22%
Total:	**30**	**100%**
PFBA$^-$	2.7	
PFOA$^-$	1.7	
PFHxS$^-$	1.4	
PFHpA$^-$	0.80	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
PFPeA$^-$	7.6	20%
PFHxA$^-$	7.2	19%
PFBS$^-$	6.7	18%
PFOS$^-$	4.0	11%
PFBA$^-$	3.7	10%
Other	8.7	23%
Total:	**38**	**100%**
PFOA$^-$	2.8	
6:2 FTS$^-$	2.5	
PFHxS$^-$	1.4	
PFHpA$^-$	1.0	
PFDA$^-$	0.50	
PFNA$^-$	0.42	

Compound	Pre-TOPs Biosolids (µg/kg)	% Makeup
5:3 FTCA$^-$	17	24%
PFOS$^-$	8.4	12%
PFBS$^-$	7.4	10%
N-MeFOSE$^-$	6.6	9%
PFHxA$^-$	5.1	7%
Other	28	38%
Total:	**73**	**100%**
MeFOSAA$^-$	4.7	
EtFOSAA$^-$	3.7	
PFDA$^-$	3.2	
PFDoDA$^-$	2.1	
PFDS$^-$	2.1	
PFBA$^-$	2.0	
PFTeDA$^-$	1.9	
PFOA$^-$	1.7	
PFPeA$^-$	1.6	
PFTrDA$^-$	1.3	
PFUnDA$^-$	1.3	
PFOSA$^-$	0.8	
N-MeFOSA$^-$	0.79	
PFNA$^-$	0.50	

Compound	Post-TOPs Biosolids (µg/kg)	% Makeup
PFBA$^-$	97	30%
PFPeA$^-$	73	22%
PFHxA$^-$	50	15%
PFOA$^-$	27	8%
PFHpA$^-$	21	6%
Other	59	18%
Total:	**327**	**100%**
PFBS$^-$	14	
PFNA$^-$	10	
PFDA$^-$	9.1	
PFOS$^-$	8.5	
PFDoDA$^-$	4.8	
PFUnDA$^-$	4.3	
PFTeDA$^-$	2.1	
PFTrDA$^-$	1.9	
PFDS$^-$	1.6	
6:2 FTS$^-$	1.5	
PFOSA$^-$	0.39	
PFHxS$^-$	0.35	
N-MeFOSA$^-$	0.25	

WWTP #2 (Hono'uli'uli) (+ PFEtA-)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
PFEtA$^-$	300	91%
PFOS$^-$	6.5	2.0%
PFBS$^-$	6.0	1.8%
6:2 FTS$^-$	4.0	1.2%
PFHxA$^-$	3.8	1.2%
Other	9.9	3.0%
Total:	**330**	**100%**
PFPeA$^-$	3.4	
PFBA$^-$	2.7	
PFOA$^-$	1.7	
PFHxS$^-$	1.4	
PFHpA$^-$	0.80	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
PFEtA$^-$	484	93%
PFPeA$^-$	7.6	1.5%
PFHxA$^-$	7.2	1.4%
PFBS$^-$	6.7	1.3%
PFOS$^-$	4.0	0.8%
Other	12	2.4%
Total:	**522**	**100%**
PFBA$^-$	3.7	
PFOA$^-$	2.8	
6:2 FTS$^-$	2.5	
PFHxS$^-$	1.4	
PFHpA$^-$	1.0	
PFDA$^-$	0.50	
PFNA$^-$	0.42	

	WWTP #3								
	Influent (ng/L)		Effluent (ng/L)		Biosolids (µg/kg)		SPLP (ng/L)		
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	[1]Pre-TOPs	[2]Post-TOPs	[2]Pre-TOPs	[2]Post-TOPs	Kd cm^3/g
PFBA$^-$	3.2	-	3.7	-	ND	283	21	-	
PFPeA$^-$	2.5	-	58	-	4.6	179	85	-	
PFHxA$^-$	5.5	-	50	-	3.6	64	76	-	
PFHpA$^-$	ND	-	3.3	-	0.79	58	11	-	
PFOA$^-$	3.3	-	18	-	7.3	45	65	-	
PFNA$^-$	0.55	-	0.74	-	1.2	33	3.5	-	
PFDA$^-$	0.63	-	2.0	-	20	44	21	-	
PFUnDA$^-$	ND	-	ND	-	1.6	17	0.43	-	
PFDoDA$^-$	ND	-	ND	-	10	25	1.4	-	
PFTrDA$^-$	ND	-	ND	-	1.4	8.1	0.20	-	
PFTeDA$^-$	ND	-	ND	-	3.2	9.7	0.89	-	
PFBS$^-$	3.2	-	5.3	-	1.9	7.0	25	-	
PFPeS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFHxS$^-$	0.94	-	0.97	-	ND	ND	1.1	-	
PFHpS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFOS$^-$	2.4	-	2.4	-	11	12	16	-	
PFNS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFDS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFDoS-	ND	-	ND	-	ND	ND	ND	-	
4:2 FTS$^-$	ND	-	ND	-	ND	ND	ND	-	
6:2 FTS$^-$	ND	-	ND	-	ND	ND	1.6	-	
8:2 FTS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFOSA$^-$	ND	-	ND	-	0.55	ND	0.20	-	
N-MeFOSA$^-$	ND	-	ND	-	0.45	ND	0.20	-	
N-EtFOSA$^-$	ND	-	ND	-	ND	ND	ND	-	
MeFOSAA$^-$	ND	-	ND	-	3.6	ND	1.7	-	
EtFOSAA$^-$	ND	-	ND	-	3.2	ND	0.68	-	
N-MeFOSE$^-$	ND	-	ND	-	ND	ND	ND	-	
N-EtFOSE$^-$	ND	-	ND	-	ND	ND	ND	-	
HFPO-DA$^-$	ND	-	ND	-	ND	ND	ND	-	
ADONA$^-$	ND	-	ND	-	ND	ND	ND	-	
9Cl-PF3ONS$^-$	ND	-	ND	-	ND	ND	ND	-	
11Cl-PF3OUdS$^-$	ND	-	ND	-	ND	ND	ND	-	
3:3 FTCA$^-$	ND	-	ND	-	ND	ND	ND	-	
5:3 FTCA$^-$	ND	-	ND	-	32	ND	656	-	
7:3 FTCA$^-$	ND	-	ND	-	17	ND	173	-	
PFEESA$^-$	ND	-	ND	-	ND	ND	ND	-	
PFMPA$^-$	ND	-	ND	-	ND	ND	ND	-	
PFMBA$^-$	ND	-	ND	-	ND	ND	ND	-	
NFDHA$^-$	ND	-	ND	-	ND	ND	ND	-	
Total:	**22**		**144**		**123**	**785**	**1,159**		
Pre- vs Post TOPs						**+540%**			

WWTP #3 Notes

"ND": Not Detected above laboratory Method Reporting Level (MRL). Refer to accompanying table of sample-specific MRLs.
"-": Not tested.
1. Biosolids data average of triplicates (Multi Increment samples).
2. TOPs and SPLP analysis run on primary biosolid sample.

WWTP #3 (Kihei)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
PFHxA$^-$	5.5	25%
PFOA$^-$	3.3	15%
PFBA$^-$	3.2	15%
PFBS$^-$	3.2	14%
PFPeA$^-$	2.5	11%
Other	4.5	20%
Total:	**22**	**100%**
PFOS$^-$	2.4	
PFHxS$^-$	0.94	
PFDA$^-$	0.63	
PFNA$^-$	0.55	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
PFPeA$^-$	58	40%
PFHxA$^-$	50	35%
PFOA$^-$	18	12%
PFBS$^-$	5.3	4%
PFBA$^-$	3.7	3%
Other	9.3	6%
Total:	**144**	**100%**
PFHpA$^-$	3.3	
PFOS$^-$	2.4	
PFDA$^-$	2.0	
PFHxS$^-$	0.97	
PFNA$^-$	0.74	

Compound	Pre-TOPs Biosolids (µg/kg)	% Makeup
5:3 FTCA$^-$	32	26%
PFDA$^-$	20	16%
7:3 FTCA$^-$	17	14%
PFOS$^-$	11	9%
PFDoDA$^-$	10	8%
Other	33	27%
Total:	**123**	**100%**
PFOA$^-$	7.3	
PFPeA$^-$	4.6	
MeFOSAA$^-$	3.6	
PFHxA$^-$	3.6	
PFTeDA$^-$	3.2	
EtFOSAA$^-$	3.2	
PFBS$^-$	1.9	
PFUnDA$^-$	1.6	
PFTrDA$^-$	1.4	
PFNA$^-$	1.2	
PFHpA$^-$	0.79	
PFOSA$^-$	0.55	
N-MeFOSA$^-$	0.45	

Compound	Post-TOPs Biosolids (µg/kg)	% Makeup
PFBA$^-$	283	36%
PFPeA$^-$	179	23%
PFHxA$^-$	64	8%
PFHpA$^-$	58	7%
PFOA$^-$	45	6%
Other	156	20%
Total:	**785**	**100%**
PFDA$^-$	44	
PFNA$^-$	33	
PFDoDA$^-$	25	
PFUnDA$^-$	17	
PFOS$^-$	12	
PFTeDA$^-$	9.7	
PFTrDA$^-$	8.1	
PFBS$^-$	7.0	

	WWTP #4								
	Influent (ng/L)		Effluent (ng/L)		Biosolids (µg/kg)		SPLP (ng/L)		
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	[1]Pre-TOPs	[2]Post-TOPs	[2]Pre-TOPs	[2]Post-TOPs	Kd cm^3/g
PFBA$^-$	3.9	-	ND	-	ND	282	7.0	-	
PFPeA$^-$	1.8	-	2.5	-	ND	232	8.6	-	
PFHxA$^-$	8.3	-	6.8	-	2.0	144	26	-	
PFHpA$^-$	0.48	-	0.61	-	ND	71	1.0	-	
PFOA$^-$	2.8	-	2.1	-	0.64	68	6.1	-	
PFNA$^-$	ND	-	ND	-	ND	34	1.0	-	
PFDA$^-$	0.54	-	0.86	-	2.0	26	1.5	-	
PFUnDA$^-$	ND	-	ND	-	1.2	17	0.21	-	
PFDoDA$^-$	ND	-	ND	-	3.2	17	0.44	-	
PFTrDA$^-$	ND	-	ND	-	1.3	7.6	0.75	-	
PFTeDA$^-$	ND	-	ND	-	1.5	9.5	0.24	-	
PFBS$^-$	ND	-	0.71	-	ND	23	4.2	-	
PFPeS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFHxS$^-$	1.0	-	0.78	-	ND	ND	ND	-	
PFHpS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFOS$^-$	2.8	-	2.9	-	6.7	9.0	8.1	-	
PFNS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFDS$^-$	ND	-	ND	-	4.2	1.7	0.21	-	
PFDoS-	ND	-	ND	-	ND	ND	ND	-	
4:2 FTS$^-$	ND	-	ND	-	ND	ND	ND	-	
6:2 FTS$^-$	1.6	-	ND	-	ND	ND		-	
8:2 FTS$^-$	ND	-	ND	-	ND	ND	ND	-	
PFOSA$^-$	ND	-	ND	-	0.92	ND	0.21	-	
N-MeFOSA$^-$	ND	-	ND	-	ND	ND	ND	-	
N-EtFOSA$^-$	ND	-	ND	-	ND	ND	ND	-	
MeFOSAA$^-$	ND	-	0.56	-	5.1	ND	1.2	-	
EtFOSAA$^-$	ND	-	ND	-	3.4	ND	0.21	-	
N-MeFOSE$^-$	ND	-	ND	-	13	ND	2.1	-	
N-EtFOSE$^-$	ND	-	ND	-	6.2	ND	2.1	-	
HFPO-DA$^-$	ND	-	ND	-	ND	ND	ND	-	
ADONA$^-$	ND	-	ND	-	ND	ND	ND	-	
9Cl-PF3ONS$^-$	ND	-	ND	-	ND	ND	ND	-	
11Cl-PF3OUdS$^-$	ND	-	ND	-	ND	ND	ND	-	
3:3 FTCA$^-$	ND	-	ND	-	22	ND	ND	-	
5:3 FTCA$^-$	16	-	15	-	11	ND	435	-	
7:3 FTCA$^-$	ND	-	ND	-	ND	ND	ND	-	
PFEESA$^-$	ND	-	ND	-	ND	ND	ND	-	
PFMPA$^-$	ND	-	ND	-	ND	ND	ND	-	
PFMBA$^-$	ND	-	ND	-	ND	ND	ND	-	
NFDHA$^-$	ND	-	ND	-	ND	ND	ND	-	
Total:	**40**		**32**		**84**	**942**	**506**		
Pre- vs Post TOPs						**+1,016%**			

WWTP #4 Notes

"ND": Not Detected above laboratory Method Reporting Level (MRL). Refer to accompanying table of sample-specific MRLs.
"-": Not tested.
1. Biosolids data average of triplicates (Multi Increment samples).
2. TOPs and SPLP analysis run on primary biosolid sample.

WWTP #4 (Hilo)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
5:3 FTCA$^-$	16	41%
PFHxA$^-$	8.3	21%
PFBA$^-$	3.9	10%
PFOS$^-$	2.8	7%
PFOA$^-$	2.8	7%
Other	5.5	14%
Total:	**40**	**100%**
PFPeA$^-$	1.8	
6:2 FTS$^-$	1.6	
PFHxS$^-$	1.0	
PFDA$^-$	0.54	
PFHpA$^-$	0.48	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
5:3 FTCA$^-$	15	45%
PFHxA$^-$	6.8	21%
PFOS$^-$	2.9	9%
PFPeA$^-$	2.5	8%
PFOA$^-$	2.1	6%
Other	3.5	11%
Total:	**32**	**100%**
PFDA$^-$	0.86	
PFHxS$^-$	0.78	
PFBS$^-$	0.71	
PFHpA$^-$	0.61	
MeFOSAA$^-$	0.56	

Compound	Pre-TOPs Biosolids (µg/kg)	% Makeup
3:3 FTCA$^-$	22	26%
N-MeFOSE$^-$	13	15%
5:3 FTCA$^-$	11	13%
PFOS$^-$	6.7	8%
N-EtFOSE$^-$	6.2	7%
Other	25	30%
Total:	**84**	**100%**
MeFOSAA$^-$	5.1	
PFDS$^-$	4.2	
EtFOSAA$^-$	3.4	
PFDoDA$^-$	3.2	
PFHxA$^-$	2.0	
PFDA$^-$	2.0	
PFTeDA$^-$	1.5	
PFTrDA$^-$	1.3	
PFUnDA$^-$	1.2	
PFOSA$^-$	0.92	
PFOA$^-$	0.64	

Compound	Post-TOPs Biosolids (µg/kg)	% Makeup
PFBA$^-$	282	30%
PFPeA$^-$	232	25%
PFHxA$^-$	144	15%
PFHpA$^-$	71	8%
PFOA$^-$	68	7%
Other	145	15%
Total:	**942**	**100%**
PFNA$^-$	34	
PFDA$^-$	26	
PFBS$^-$	23	
PFDoDA$^-$	17	
PFUnDA$^-$	17	
PFTeDA$^-$	9.5	
PFOS$^-$	9.0	
PFTrDA$^-$	7.6	
PFDS$^-$	1.7	

	WWTP #5								
	Influent (ng/L)		Effluent (ng/L)		Biosolids (ug/kg)		SPLP (ng/L)		
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	[1]Pre-TOPs	[2]Post-TOPs	[2]Pre-TOPs	Post-TOPs	Kd cm^3/g
PFBA$^-$	3.3	-	2.6	-	ND	183	30	-	8.7
PFPeA$^-$	2.0	-	11	-	ND	122	24	-	-
PFHxA$^-$	16	-	7.2	-	4.7	92	166	-	13
PFHpA$^-$	0.72	-	1.2	-	ND	55	7.7	-	7.8
PFOA$^-$	5.8	-	2.9	-	1.9	56	31	-	40
PFNA$^-$	0.68	-	0.64	-	0.53	27	2.0	-	316
PFDA$^-$	1.6	-	0.93	-	7.4	30	4.8	-	1,569
PFUnDA$^-$	ND	-	ND	-	2.3	14	0.68	-	3,156
PFDoDA$^-$	0.70	-	ND	-	6.9	19	0.93	-	6,740
PFTrDA$^-$	ND	-	ND	-	2.1	6.3	1.5	-	1,263
PFTeDA$^-$	ND	-	ND	-	2.7	8.4	0.44	-	6,280
PFBS$^-$	ND	-	2.3	-	0.62	32	21	-	22
PFPeS$^-$	ND	-	ND	-	ND	ND	ND	-	-
PFHxS$^-$	0.61	-	0.55	-	ND	1.8	2.8	-	97
PFHpS$^-$	ND	-	ND	-	ND	ND	ND	-	-
PFOS$^-$	4.7	-	2.8	-	24	26	26	-	874
PFNS$^-$	ND	-	ND	-	ND	ND	ND	-	-
PFDS$^-$	ND	-	ND	-	4.1	2.6	0.20	-	18,144
PFDoS-	ND	-	ND	-	ND	ND	ND	-	-
4:2 FTS$^-$	ND	-	ND	-	ND	ND	ND	-	-
6:2 FTS$^-$	ND	-	3.2	-	3.8	ND	83	-	31
8:2 FTS$^-$	ND	-	ND	-	ND	ND	ND	-	-
PFOSA$^-$	ND	-	ND	-	1.8	1.3	0.77	-	2,253
N-MeFOSA$^-$	ND	-	ND	-	ND	ND	ND	-	-
N-EtFOSA$^-$	ND	-	ND	-	ND	ND	ND	-	-
MeFOSAA$^-$	ND	-	ND	-	13	1.4	3.1	-	3,826
EtFOSAA$^-$	ND	-	ND	-	7.7	1.3	1.7	-	4,871
N-MeFOSE$^-$	ND	-	ND	-	17	ND	2.0	-	9,184
N-EtFOSE$^-$	ND	-	ND	-	8.0	ND	2.0	-	3,657
HFPO-DA$^-$	ND	-	ND	-	ND	ND	ND	-	-
ADONA$^-$	ND	-	ND	-	ND	ND		-	-
9Cl-PF3ONS$^-$	ND	-	ND	-	ND	ND	ND	-	-
11Cl-PF3OUdS$^-$	ND	-	ND	-	ND	ND	ND	-	-
3:3 FTCA$^-$	ND	-	ND	-	ND	ND	ND	-	-
5:3 FTCA$^-$	28	-	ND	-	52	ND	1,440	-	19
7:3 FTCA$^-$	ND	-	ND	-	21	ND	307	-	51
PFEESA$^-$	ND	-	ND	-	ND	ND	ND	-	-
PFMPA$^-$	ND	-	ND	-	ND	ND	ND	-	-
PFMBA$^-$	ND	-	ND	-	ND	ND	ND	-	-
NFDHA$^-$	ND	-	ND	-	ND	ND	ND	-	-
Total:	**64**		**36**		**181**	**680**	**2,159**		
Pre- vs Post TOPs						**+192%**			

WWTP #5 Notes

"ND": Not Detected above laboratory Method Reporting Level (MRL). Refer to accompanying table of sample-specific MRLs.
"-": Not tested.
1. Biosolids data average of triplicates (Multi Increment samples).
2. TOPs and SPLP analysis run on primary biosolid sample.

WWTP #5 (Lihue)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
5:3 FTCA⁻	28	44%
PFHxA⁻	16	25%
PFOA⁻	5.8	9%
PFOS⁻	4.7	7%
PFBA⁻	3.3	5%
Other	6.3	10%
Total:	**64**	**100%**
PFPeA⁻	2.0	
PFDA⁻	1.6	
PFHpA⁻	0.72	
PFDoDA⁻	0.70	
PFNA⁻	0.68	
PFHxS⁻	0.61	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
PFPeA⁻	11	32%
PFHxA⁻	7.2	20%
6:2 FTS⁻	3.2	9%
PFOA⁻	2.9	8%
PFOS⁻	2.8	8%
Other	8.1	23%
Total:	**36**	**100%**
PFBA⁻	2.6	
PFBS⁻	2.3	
PFHpA⁻	1.2	
PFDA⁻	0.93	
PFNA⁻	0.64	
PFHxS⁻	0.55	

Compound	Pre-TOPs Biosolids (µg/kg)	% Makeup
5:3 FTCA⁻	52	29%
PFOS⁻	24	13%
7:3 FTCA⁻	21	11%
N-MeFOSE⁻	17	9%
MeFOSAA⁻	13	7%
Other	55	30%
Total:	**181**	**100%**
N-EtFOSE⁻	8.0	
EtFOSAA⁻	7.7	
PFDA⁻	7.4	
PFDoDA⁻	6.9	
PFHxA⁻	4.7	
PFDS⁻	4.1	
6:2 FTS⁻	3.8	
PFTeDA⁻	2.7	
PFUnDA⁻	2.3	
PFTrDA⁻	2.1	
PFOA⁻	1.9	
PFOSA⁻	1.8	
PFBS⁻	0.62	
PFNA⁻	0.53	

Compound	Post-TOPs Biosolids (µg/kg)	% Makeup
PFBA⁻	183	27%
PFPeA⁻	122	18%
PFHxA⁻	92	14%
PFOA⁻	56	8%
PFHpA⁻	55	8%
Other	172	25%
Total:	**680**	**100%**
PFBS⁻	32	
PFDA⁻	30	
PFNA⁻	27	
PFOS⁻	26	
PFDoDA⁻	19	
PFUnDA⁻	14	
PFTeDA⁻	8.4	
PFTrDA⁻	6.3	
PFDS⁻	2.6	
PFHxS⁻	1.8	
MeFOSAA⁻	1.4	
EtFOSAA⁻	1.3	
PFOSA⁻	1.3	

	WWTP #6			
	Influent (ng/L)		Effluent (ng/L)	
Compound	Pre-TOPs	[2]Post-TOPs	Pre-TOPs	[2]Post-TOPs
PFEtA-	287	-	308	-
PFPrA-	ND	-	ND	-
PFBA-	5.5	101	12	35
PFPeA-	145	256	397	237
PFHxA-	86	125	231	160
PFHpA-	1.1	20	1.9	3.5
PFOA-	1.7	4.4	3.1	8.1
PFNA-	ND	ND	ND	ND
PFDA-	ND	ND	0.41	ND
PFUnDA-	ND	ND	ND	ND
PFDoDA-	ND	ND	ND	ND
PFTrDA-	ND	ND	ND	ND
PFTeDA-	ND	ND	ND	ND
PFBS-	6.9	7.5	17	11
PFPeS-	ND	ND	ND	ND
PFHxS-	ND	ND	ND	ND
PFHpS-	ND	ND	ND	ND
PFOS-	4.0	ND	0.97	ND
PFNS-	ND	ND	ND	ND
PFDS-	ND	ND	ND	ND
PFDoS-	ND	ND	ND	ND
4:2 FTS-	ND	ND	ND	ND
6:2 FTS-	ND	ND	1.7	ND
8:2 FTS-	ND	ND	ND	ND
PFOSA-	ND	ND	ND	ND
N-MeFOSA-	ND	ND	ND	ND
N-EtFOSA-	ND	ND	ND	ND
MeFOSAA-	ND	ND	ND	ND
EtFOSAA-	ND	ND	ND	ND
N-MeFOSE-	ND	ND	ND	ND
N-EtFOSE-	ND	ND	ND	ND
HFPO-DA-	ND	ND	ND	ND
ADONA-	ND	ND	ND	ND
9Cl-PF3ONS-	ND	ND	ND	ND
11Cl-PF3OUdS-	ND	ND	ND	ND
3:3 FTCA-	ND	ND	ND	ND
5:3 FTCA-	ND	ND	ND	ND
7:3 FTCA-	ND	ND	ND	ND
PFEESA-	ND	ND	ND	ND
PFMPA-	ND	ND	ND	ND
PFMBA-	ND	ND	ND	ND
NFDHA-	ND	ND	ND	ND
Total:	**250**	**514**	**665**	**455**
Pre- vs Post TOPs		**+105%**		**-32%**

	WWTP #6									
	Biosolids (µg/kg)		SPLP (ng/L)			[1]Compost (µg/kg)		SPLP (ng/L)		
Compound	[1]Pre-TOPs	[2]Post-TOPs	[2]Pre-TOPs	[2]Post-TOPs	Kd cm^3/g	[1]Pre-TOPs	[2]Post-TOPs	[2]Pre-TOPs	[2]Post-TOPs	Kd cm^3/g
PFEtA$^-$	-	-	-	-		-	-	-	-	
PFPrA$^-$	-	-	-	-		-	-	4,980	-	
PFBA$^-$	ND	145	13	-		5.0	13	105	-	
PFPeA$^-$	2.68	129	30	-		9.5	14	197	-	
PFHxA$^-$	4.6	52	38	-		14	16	287	-	
PFHpA$^-$	ND	22	1.9	-		1.5	2.7	25	-	
PFOA$^-$	2.2	15	6.7	-		5.5	7.2	64	-	
PFNA$^-$	ND	8.3	ND	-		1.0	1.6	3.7	-	
PFDA$^-$	5.7	11	3.9	-		4.4	4.3	3.9	-	
PFUnDA$^-$	1.2	4.0	ND	-		0.90	0.95	ND	-	
PFDoDA$^-$	3.0	5.5	ND	-		2.1	1.9	ND	-	
PFTrDA$^-$	ND	1.7	ND	-		ND	0.43	ND	-	
PFTeDA$^-$	1.4	2.2	ND	-		0.91	0.82	ND	-	
PFBS$^-$	1.0	8.2	8.3	-		7.8	7.9	148	-	
PFPeS$^-$	ND	ND	ND	-		ND	ND	0.79	-	
PFHxS$^-$	ND	ND	ND	-		ND	ND	2.2	-	
PFHpS$^-$	ND	ND	ND	-		ND	ND	ND	-	
PFOS$^-$	4.7	4.9	3.9	-		4.9	4.2	6.3	-	
PFNS$^-$	ND	ND	ND	-		ND	ND	ND	-	
PFDS$^-$	ND	ND	ND	-		ND	ND	ND	-	
PFDoS-	ND	ND	ND	-		ND	ND	ND	-	
4:2 FTS$^-$	ND	ND	ND	-		ND	ND	ND	-	
6:2 FTS$^-$	ND	ND	7.4	-		ND	ND	ND	-	
8:2 FTS$^-$	ND	ND	ND	-		ND	ND	ND	-	
PFOSA$^-$	ND	ND	ND	-		ND	ND	ND	-	
N-MeFOSA$^-$	ND	ND	ND	-		0.73	ND	ND	-	
N-EtFOSA$^-$	ND	ND	ND	-		ND	ND	ND	-	
MeFOSAA$^-$	2.9	ND	ND	-		ND	ND	ND	-	
EtFOSAA$^-$	1.3	ND	ND	-		0.59	ND	ND	-	
N-MeFOSE$^-$	ND	ND	ND	-		ND	ND	ND	-	
N-EtFOSE$^-$	ND	ND	ND	-		ND	ND	ND	-	
HFPO-DA$^-$	ND	ND	ND	-		ND	ND	ND	-	
ADONA$^-$	ND	ND	ND	-		ND	ND	ND	-	
9Cl-PF3ONS$^-$	ND	ND	ND	-		ND	ND	ND	-	
11Cl-PF3OUdS$^-$	ND	ND	ND	-		ND	ND	ND	-	
3:3 FTCA$^-$	ND	ND	ND	-		ND	ND	ND	-	
5:3 FTCA$^-$	29	ND	633	-		ND	ND	50	-	
7:3 FTCA$^-$	ND	ND	ND	-		ND	ND	ND	-	
PFEESA$^-$	ND	ND	ND	-		ND	ND	ND	-	
PFMPA$^-$	ND	ND	ND	-		ND	ND	ND	-	
PFMBA$^-$	ND	ND	ND	-		ND	ND	ND	-	
NFDHA$^-$	ND	ND	ND	-		ND	ND	ND	-	
Total:	**59**	**409**	**747**			**58**	**74**	**892**	**0**	
Pre- vs Post TOPs		**+592%**					**+38%**			

WWTP #6 Notes

"ND": Not Detected above laboratory Method Reporting Level (MRL). Refer to accompanying table of sample-specific MRLs.
"-": Not tested.
1. Single grab sample collected.
2. TOPs and SPLP analysis run on primary biosolid and compost sample.

WWTP #6 (La'ie) (- PFEtA-)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
PFPeA⁻	145	58%
PFHxA⁻	86	34%
PFBS⁻	6.9	3%
PFBA⁻	5.5	2%
PFOS⁻	4.0	2%
Other	2.8	1%
Total:	**250**	**100%**
PFOA⁻	1.7	
PFHpA⁻	1.1	

Compound	Post-TOPs Influent (ng/L)	% Makeup
PFPeA⁻	256	50%
PFHxA⁻	125	24%
PFBA⁻	101	20%
PFHpA⁻	20	4%
PFBS⁻	7.5	1%
Other	4.4	1%
Total:	**514**	**100%**
PFOA⁻	4.4	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
PFPeA⁻	397	60%
PFHxA⁻	231	35%
PFBS⁻	17	3%
PFBA⁻	12	2%
PFOA⁻	3.1	0%
Other	4.9	1%
Total:	**665**	**100%**
PFHpA⁻	1.9	
6:2 FTS⁻	1.7	
PFOS⁻	0.97	
PFDA⁻	0.41	

Compound	Pre-TOPs Biosolids (µg/kg)	% Makeup
5:3 FTCA⁻	29	48%
PFDA⁻	5.7	10%
PFOS⁻	4.7	8%
PFHxA⁻	4.6	8%
PFDoDA⁻	3.0	5%
Other	13	21%
Total:	**59**	**100%**
MeFOSAA⁻	2.9	
PFPeA⁻	2.7	
PFOA⁻	2.2	
PFTeDA⁻	1.4	
EtFOSAA⁻	1.3	
PFUnDA⁻	1.2	
PFBS⁻	1.0	

Compound	Post-TOPs Biosolids (µg/kg)	% Makeup
PFBA⁻	145	35%
PFPeA⁻	129	32%
PFHxA⁻	52	13%
PFHpA⁻	22	5%
PFOA⁻	15	4%
Other	45	11%
Total:	**409**	**100%**
PFDA⁻	11	
PFNA⁻	8.3	
PFBS⁻	8.2	
PFDoDA⁻	5.5	
PFOS⁻	4.9	
PFUnDA⁻	4.0	
PFTeDA⁻	2.2	
PFTrDA⁻	1.7	

Compound	Pre-TOPs Compost (µg/kg)	% Makeup
PFHxA⁻	14	23%
PFPeA⁻	9.5	16%
PFBS⁻	7.8	13%
PFOA⁻	5.5	9%
PFBA⁻	5.0	9%
Other	17	29%
Total:	**58**	**100%**
PFOS⁻	4.9	
PFDA⁻	4.4	
PFDoDA⁻	2.1	
PFHpA⁻	1.5	
PFNA⁻	1.0	
PFTeDA⁻	0.91	
PFUnDA⁻	0.90	
N-MeFOSA⁻	0.73	
EtFOSAA⁻	0.59	

Compound	Post-TOPs Compost (µg/kg)	% Makeup
PFHxA⁻	16	21%
PFPeA⁻	14	19%
PFBA⁻	13	17%
PFBS⁻	7.9	11%
PFOA⁻	7.2	10%
Other	17	22%
Total:	**74**	**100%**
PFDA⁻	4.3	
PFOS⁻	4.2	
PFHpA⁻	2.7	
PFDoDA⁻	1.9	
PFNA⁻	1.6	
PFUnDA⁻	0.95	
PFTeDA⁻	0.82	
PFTrDA⁻	0.43	

WWTP #6 (La'ie) (+ PFEtA-)

Compound	Pre-TOPs Influent (ng/L)	% Makeup
PFEtA$^-$	287	53%
PFPeA$^-$	145	27%
PFHxA$^-$	86	16%
PFBS$^-$	6.9	1%
PFBA$^-$	5.5	1%
Other	6.7	1%
Total:	**537**	**100%**
PFOS$^-$	4.0	
PFOA$^-$	1.7	
PFHpA$^-$	1.1	

Compound	Pre-TOPs Effluent (ng/L)	% Makeup
PFPeA$^-$	397	41%
PFEtA$^-$	308	32%
PFHxA$^-$	231	24%
PFBS$^-$	17	1.7%
PFBA$^-$	12	1.2%
Other	8.1	0.8%
Total:	**973**	**100%**
PFOA$^-$	3.1	
PFHpA$^-$	1.9	
6:2 FTS$^-$	1.7	
PFOS$^-$	0.97	
PFDA$^-$	0.41	

WWTP Sample Method Reporting Limits

	WWTP #1 Method Report Limits							
	Influent (ng/L)		Effluent (ng/L)		Biosolids (µg/kg)		SPLP (ng/L)	
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs
PFEtA$^-$	121	-	135	-	-	-	718	-
PFPrA$^-$	19.9	-	19.7	-	-	-	102	-
PFBA$^-$	1.65	13.3	1.6	12.8	1.74	0.876	3.72	-
PFPeA$^-$	0.827	6.64	0.801	6.42	0.869	0.438	3.71	-
PFHxA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	2.13	-
PFHpA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.421	-
PFOA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
PFNA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
PFDA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
PFUnDA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
PFDoDA$^-$	0.331	2.66	0.32	2.57	0.347	0.175	0.31	-
PFTrDA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
PFTeDA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
PFBS$^-$	0.413	3.32	0.4	3.21	0.434	0.219	1.31	-
PFPeS$^-$	0.415	3.34	0.402	3.23	1.1	0.22	1.14	-
PFHxS$^-$	0.413	3.32	0.4	3.21	0.816	0.219	0.764	-
PFHpS$^-$	0.413	3.32	0.4	3.21	0.689	0.219	0.656	-
PFOS$^-$	0.413	3.32	0.4	3.21	0.854	0.219	0.387	-
PFNS$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
PFDS$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
PFDoS-	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
4:2 FTS$^-$	1.65	13.3	1.6	12.8	1.74	0.876	1.55	-
6:2 FTS$^-$	1.49	12	1.44	11.6	1.57	0.79	1.4	-
8:2 FTS$^-$	1.41	11.3	1.36	10.9	1.48	0.745	1.32	-
PFOSA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
N-MeFOSA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
N-EtFOSA$^-$	1.16	9.3	1.12	8.99	1.22	0.613	1.08	-
MeFOSAA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
EtFOSAA$^-$	0.413	3.32	0.4	3.21	0.434	0.219	0.387	-
N-MeFOSE$^-$	4.13	33.2	4	32.1	4.34	2.19	3.87	-
N-EtFOSE$^-$	4.13	33.2	4	32.1	4.34	2.19	3.87	-
HFPO-DA$^-$	1.65	-	1.6	-	1.74	-	1.55	-
ADONA$^-$	1.65	-	1.6	-	1.74	-	1.55	-
9Cl-PF3ONS$^-$	1.66	-	1.61	-	1.74	-	1.55	-
11Cl-PF3OUdS$^-$	1.66	-	1.6	-	1.74	-	1.55	-
3:3 FTCA$^-$	1.65	13.3	1.6	12.8	1.74	0.876	14.8	-
5:3 FTCA$^-$	10.3	83.1	10	80.3	10.9	5.48	9.69	-
7:3 FTCA$^-$	10.3	83.1	10	80.3	10.9	5.48	9.69	-
PFEESA$^-$	0.413	-	0.4	-	0.434	-	0.387	-
PFMPA$^-$	0.827	-	0.801	-	0.869	-	0.775	-
PFMBA$^-$	0.413	-	0.4	-	0.434	-	0.387	-
NFDHA$^-$	0.827	-	0.801	-	0.869	-	2.19	-

	WWTP #2 Method Report Limits							
	Influent (ng/L)		Effluent (ng/L)		Biosolids (µg/kg)		SPLP (ng/L)	
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs
PFEtA-	300	-	110	-	-	-	134	-
PFPrA-	19.8	-	19.2	-	-	-	19.9	-
PFBA-	1.66	12.2	1.54	12.5	1.86	0.938	3.51	-
PFPeA-	0.832	6.1	0.768	6.24	0.932	0.469	1.76	-
PFHxA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFHpA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFOA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFNA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFDA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFUnDA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFDoDA-	0.333	2.44	0.307	2.5	0.373	0.188	0.703	-
PFTrDA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFTeDA-	0.416	3.05	0.384	3.12	0.473	0.235	1.89	-
PFBS-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFPeS-	0.418	3.06	0.386	3.14	0.468	0.236	0.883	-
PFHxS-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFHpS-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFOS-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFNS-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFDS-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
PFDoS-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
4:2 FTS-	1.66	12.2	1.54	12.5	1.86	0.938	3.51	-
6:2 FTS-	1.5	11	1.38	11.3	1.68	0.846	3.17	-
8:2 FTS-	1.41	10.4	1.31	10.6	1.58	0.798	2.99	-
PFOSA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
N-MeFOSA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
N-EtFOSA-	1.17	8.53	1.08	8.74	1.3	0.657	2.46	-
MeFOSAA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
EtFOSAA-	0.416	3.05	0.384	3.12	0.466	0.235	0.879	-
N-MeFOSE-	4.16	30.5	3.84	31.2	4.66	2.35	8.79	-
N-EtFOSE-	4.16	30.5	3.84	31.2	4.66	2.35	8.79	-
HFPO-DA-	1.66	-	1.54	-	1.86	-	3.51	-
ADONA-	1.66	-	1.54	-	1.86	-	3.51	-
9Cl-PF3ONS-	1.67	-	1.54	-	1.87	-	3.52	-
11Cl-PF3OUdS-	1.67	-	1.54	-	1.87	-	3.52	-
3:3 FTCA-	1.66	12.2	1.54	12.5	1.86	0.938	3.51	-
5:3 FTCA-	10.4	76.2	9.6	78.1	11.6	5.87	22	-
7:3 FTCA-	10.4	76.2	9.6	78.1	11.6	5.87	22	-
PFEESA-	0.416	-	0.384	-	0.466	-	0.879	-
PFMPA-	0.832	-	0.768	-	0.932	-	1.76	-
PFMBA-	0.416	-	0.384	-	0.466	-	0.879	-
NFDHA-	0.832	-	0.768	-	0.932	-	1.76	-

	WWTP #3 Method Report Limits							
	Influent (ng/L)		Effluent (ng/L)		Biosolids (µg/kg)		SPLP (ng/L)	
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs
PFBA$^-$	1.52	-	1.6	-	1.71	-	3.98	13.1
PFPeA$^-$	0.761	-	0.798	-	0.856	-	0.813	6.53
PFHxA$^-$	0.38	-	0.399	-	0.428	-	0.556	3.26
PFHpA$^-$	26.5	-	0.399	-	0.428	-	0.407	3.26
PFOA$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFNA$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFDA$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFUnDA$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFDoDA$^-$	0.38	-	0.399	-	0.428	-	0.325	2.61
PFTrDA$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFTeDA$^-$	0.38	-	0.399	-	0.428	-	1.77	3.26
PFBS$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFPeS$^-$	0.382	-	0.401	-	0.43	-	0.409	3.28
PFHxS$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFHpS$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFOS$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFNS$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFDS$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
PFDoS-	0.38	-	0.399	-	0.428	-	0.407	3.26
4:2 FTS$^-$	1.52	-	1.6	-	1.71	-	1.63	13.1
6:2 FTS$^-$	1.37	-	1.44	-	1.54	-	1.47	11.8
8:2 FTS$^-$	1.52	-	1.6	-	1.71	-	1.38	11.1
PFOSA$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
N-MeFOSA$^-$	0.438	-	0.459	-	0.492	-	0.407	3.26
N-EtFOSA$^-$	0.951	-	0.998	-	1.07	-	1.14	9.14
MeFOSAA$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
EtFOSAA$^-$	0.38	-	0.399	-	0.428	-	0.407	3.26
N-MeFOSE$^-$	3.8	-	3.99	-	12.8	-	4.07	32.6
N-EtFOSE$^-$	2.85	-	2.99	-	3.2	-	4.07	32.6
HFPO-DA$^-$	1.45	-	1.52	-	1.63	-	1.63	-
ADONA$^-$	1.52	-	1.6	-	1.71	-	1.63	-
9Cl-PF3ONS$^-$	1.53	-	1.6	-	1.72	-	1.63	-
11Cl-PF3OUdS$^-$	1.52	-	1.6	-	1.71	-	1.63	-
3:3 FTCA$^-$	1.52	-	1.6	-	1.71	-	1.63	13.1
5:3 FTCA$^-$	9.51	-	9.98	-	10.7	-	10.2	81.6
7:3 FTCA$^-$	9.51	-	9.98	-	10.7	-	10.2	81.6
PFEESA$^-$	0.38	-	0.399	-	0.428	-	0.407	-
PFMPA$^-$	0.761	-	0.798	-	0.856	-	0.813	-
PFMBA$^-$	0.38	-	0.399	-	0.428	-	0.407	-
NFDHA$^-$	0.761	-	0.798	-	(not quantified)	-	3.76	-

	WWTP #4 Method Report Limits							
	Influent (ng/L)		Effluent (ng/L)		Biosolids (µg/kg)		SPLP (ng/L)	
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs
PFBA$^-$	1.76	-	1.68	-	1.69	-	1.69	12.6
PFPeA$^-$	0.882	-	0.84	-	0.845	-	0.847	6.3
PFHxA$^-$	0.514	-	0.42	-	0.423	-	0.423	3.15
PFHpA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFOA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFNA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFDA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFUnDA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFDoDA$^-$	0.441	-	0.42	-	0.423	-	0.339	2.52
PFTrDA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFTeDA$^-$	0.441	-	0.42	-	0.423	-	0.48	3.15
PFBS$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFPeS$^-$	0.591	-	0.422	-	1	-	1.97	3.16
PFHxS$^-$	0.441	-	0.42	-	0.855	-	0.53	3.15
PFHpS$^-$	0.441	-	0.42	-	1.74	-	0.423	3.15
PFOS$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFNS$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
PFDS$^-$	0.441	-	0.42	-	0.708	-	0.423	3.15
PFDoS-	0.441	-	0.42	-	0.423	-	0.423	3.15
4:2 FTS$^-$	1.76	-	1.68	-	1.69	-	1.69	12.6
6:2 FTS$^-$	1.59	-	1.51	-	1.52	-	1.53	11.3
8:2 FTS$^-$	1.76	-	1.68	-	1.69	-	1.44	10.7
PFOSA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
N-MeFOSA$^-$	0.507	-	0.483	-	0.486	-	0.423	3.15
N-EtFOSA$^-$	1.1	-	1.05	-	1.06	-	1.19	8.81
MeFOSAA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
EtFOSAA$^-$	0.441	-	0.42	-	0.423	-	0.423	3.15
N-MeFOSE$^-$	4.41	-	4.2	-	4.23	-	4.23	31.5
N-EtFOSE$^-$	3.3	-	3.14	-	3.16	-	4.23	31.5
HFPO-DA$^-$	1.68	-	1.6	-	1.61	-	1.69	-
ADONA$^-$	1.76	-	1.68	-	1.69	-	1.69	-
9Cl-PF3ONS$^-$	1.77	-	1.68	-	1.69	-	1.7	-
11Cl-PF3OUdS$^-$	1.77	-	1.68	-	1.69	-	1.7	-
3:3 FTCA$^-$	1.76	-	1.68	-	1.69	-	1.69	12.6
5:3 FTCA$^-$	11	-	10.5	-	10.6	-	10.6	78.7
7:3 FTCA$^-$	11	-	10.5	-	10.6	-	10.6	78.7
PFEESA$^-$	0.441	-	0.42	-	0.423	-	0.423	-
PFMPA$^-$	0.882	-	0.84	-	0.845	-	0.847	-
PFMBA$^-$	0.441	-	0.42	-	0.423	-	0.423	-
NFDHA$^-$	0.882	-	0.84	-	(not quantified)	-	0.847	-

	WWTP #5 Method Report Limits							
	Influent (ng/L)		Effluent (ng/L)		Biosolids (µg/kg)		SPLP (ng/L)	
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs
PFBA$^-$	1.79	-	1.69	-	1.72	-	3.95	13.5
PFPeA$^-$	0.897	-	0.844	-	0.86	-	1.34	6.74
PFHxA$^-$	0.461	-	0.473	-	0.43	-	0.855	3.37
PFHpA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
PFOA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
PFNA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
PFDA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
PFUnDA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
PFDoDA$^-$	0.449	-	0.422	-	0.43	-	0.33	2.69
PFTrDA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
PFTeDA$^-$	0.449	-	0.422	-	0.431	-	0.814	3.37
PFBS$^-$	0.449	-	0.422	-	0.43	-	0.772	3.37
PFPeS$^-$	0.451	-	0.489	-	0.566	-	0.453	3.39
PFHxS$^-$	0.449	-	0.422	-	0.661	-	0.412	3.37
PFHpS$^-$	0.449	-	0.422	-	0.643	-	0.412	3.37
PFOS$^-$	0.449	-	0.422	-	0.516	-	0.412	3.37
PFNS$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
PFDS$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
PFDoS-	0.449	-	0.422	-	0.43	-	0.412	3.37
4:2 FTS$^-$	1.79	-	1.69	-	1.72	-	1.65	13.5
6:2 FTS$^-$	1.62	-	1.52	-	1.55	-	1.49	12.1
8:2 FTS$^-$	1.79	-	1.69	-	1.72	-	1.4	11.5
PFOSA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
N-MeFOSA$^-$	0.516	-	0.485	-	0.494	-	0.412	3.37
N-EtFOSA$^-$	1.12	-	1.06	-	1.07	-	1.15	9.43
MeFOSAA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
EtFOSAA$^-$	0.449	-	0.422	-	0.43	-	0.412	3.37
N-MeFOSE$^-$	4.49	-	4.22	-	4.3	-	4.12	33.7
N-EtFOSE$^-$	3.36	-	3.16	-	3.22	-	4.12	33.7
HFPO-DA$^-$	1.71	-	1.6	-	1.63	-	1.65	-
ADONA$^-$	1.79	-	1.69	-	1.72	-	1.65	-
9Cl-PF3ONS$^-$	1.8	-	1.69	-	1.72	-	1.65	-
11Cl-PF3OUdS$^-$	1.8	-	1.69	-	1.72	-	1.65	-
3:3 FTCA$^-$	1.79	-	1.69	-	1.72	-	1.65	13.5
5:3 FTCA$^-$	11.2	-	10.6	-	10.7	-	10.3	84.2
7:3 FTCA$^-$	11.2	-	10.6	-	10.7	-	10.3	84.2
PFEESA$^-$	0.449	-	0.422	-	0.43	-	0.412	-
PFMPA$^-$	0.897	-	0.844	-	0.86	-	0.825	-
PFMBA$^-$	0.449	-	0.422	-	0.43	-	0.412	-
NFDHA$^-$	0.897	-	0.844	-	(not quantified)	-	2.41	-

	WWTP #6 Method Report Limits			
	Influent (ng/L)		Effluent (ng/L)	
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs
PFEtA$^-$	112	-	153	-
PFPrA$^-$	19.1	-	19.2	-
PFBA$^-$	1.6	12.9	1.57	11.8
PFPeA$^-$	0.8	6.45	0.784	5.88
PFHxA$^-$	0.4	3.23	0.392	2.94
PFHpA$^-$	0.4	3.23	0.392	2.94
PFOA$^-$	0.4	3.23	0.392	2.94
PFNA$^-$	0.4	3.23	0.392	2.94
PFDA$^-$	0.4	3.23	0.392	2.94
PFUnDA$^-$	0.4	3.23	0.392	2.94
PFDoDA$^-$	0.32	2.58	0.313	2.35
PFTrDA$^-$	0.4	3.23	0.392	2.94
PFTeDA$^-$	0.4	3.23	0.392	2.94
PFBS$^-$	0.4	3.23	0.392	2.94
PFPeS$^-$	0.402	3.24	0.394	2.96
PFHxS$^-$	0.4	3.23	0.392	2.94
PFHpS$^-$	0.4	3.23	0.392	2.94
PFOS$^-$	0.4	3.23	0.392	2.94
PFNS$^-$	0.4	3.23	0.392	2.94
PFDS$^-$	0.4	3.23	0.392	2.94
PFDoS-	0.4	3.23	0.392	2.94
4:2 FTS$^-$	1.6	12.9	1.57	11.8
6:2 FTS$^-$	1.44	11.6	1.41	10.6
8:2 FTS$^-$	1.36	11	1.33	10
PFOSA$^-$	0.4	3.23	0.392	2.94
N-MeFOSA$^-$	0.4	3.23	0.392	2.94
N-EtFOSA$^-$	1.12	9.03	1.1	8.24
MeFOSAA$^-$	0.4	3.23	0.392	2.94
EtFOSAA$^-$	0.4	3.23	0.392	2.94
N-MeFOSE$^-$	4	32.3	3.92	29.4
N-EtFOSE$^-$	4	32.3	3.92	29.4
HFPO-DA$^-$	1.6	-	1.57	-
ADONA$^-$	1.6	-	1.57	-
9Cl-PF3ONS$^-$	1.6	-	1.57	-
11Cl-PF3OUdS$^-$	1.6	-	1.57	-
3:3 FTCA$^-$	1.6	12.9	1.57	11.8
5:3 FTCA$^-$	10	80.7	9.79	73.6
7:3 FTCA$^-$	10	80.7	9.79	73.6
PFEESA$^-$	0.4	-	0.392	-
PFMPA$^-$	0.8	-	0.784	-
PFMBA$^-$	0.4	-	0.392	-
NFDHA$^-$	0.8	-	0.784	-

	WWTP #6 Method Report Limits							
	[1]Biosolids (µg/kg)		SPLP (ng/L)		[2]Compost (µg/kg)		SPLP (ng/L)	
Compound	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs	Pre-TOPs	Post-TOPs
PFEtA-	-	-	176	-	-	-	575	-
PFPrA-	-	-	19.6	-	-	-	45	-
PFBA-	3.57	1.79	5.99	-	1.81	0.912	1.47	-
PFPeA-	1.78	0.897	2.99	-	0.904	0.456	0.734	-
PFHxA-	0.891	0.449	1.5	-	0.452	0.228	0.405	-
PFHpA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFOA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFNA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFDA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFUnDA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFDoDA-	0.713	0.359	1.2	-	0.362	0.182	0.294	-
PFTrDA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFTeDA-	0.891	0.449	2.33	-	0.452	0.228	0.367	-
PFBS-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFPeS-	0.896	0.451	1.5	-	0.454	0.229	0.369	-
PFHxS-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFHpS-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFOS-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFNS-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFDS-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
PFDoS-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
4:2 FTS-	3.57	1.79	5.99	-	1.81	0.912	1.47	-
6:2 FTS-	3.21	1.62	5.39	-	1.63	0.822	1.32	-
8:2 FTS-	3.03	1.53	5.09	-	1.54	0.775	1.25	-
PFOSA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
N-MeFOSA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
N-EtFOSA-	2.5	1.26	4.19	-	1.27	0.638	1.03	-
MeFOSAA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
EtFOSAA-	0.891	0.449	1.5	-	0.452	0.228	0.367	-
N-MeFOSE-	8.91	4.49	15	-	4.52	2.28	3.67	-
N-EtFOSE-	8.91	4.49	15	-	4.52	2.28	3.67	-
HFPO-DA-	3.57	-	5.99	-	1.81	-	1.47	-
ADONA-	3.57	-	5.99	-	1.81	-	1.47	-
9Cl-PF3ONS-	3.57	-	6	-	1.81	-	1.47	-
11Cl-PF3OUdS-	3.57	-	5.99	-	1.81	-	1.47	-
3:3 FTCA-	3.57	1.79	5.99	-	1.81	0.912	1.47	-
5:3 FTCA-	22.3	11.2	37.4	-	11.3	5.7	9.18	-
7:3 FTCA-	22.3	11.2	37.4	-	11.3	5.7	9.18	-
PFEESA-	0.891	-	1.5	-	0.452	-	0.367	-
PFMPA-	1.78	-	2.99	-	0.904	-	0.734	-
PFMBA-	0.891	-	1.5	-	0.452	-	0.367	-
NFDHA-	1.78	-	2.99	-	0.904	-	0.734	-

Appendix 7. Landfill Leachate Data

Compound	LF #1 (WGLF E-6)		LF #1 (WGLF 4B)		LF #1 (WGLF ASH)	
	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)
PFBA$^-$	2,800	7,300	5,800	6,700	1,400	1,800
PFPeA$^-$	4,400	5,000	4,400	4,900	3,100	3,200
PFHxA$^-$	9,600	9,600	6,200	6,400	4,700	5,200
PFHpA$^-$	1,300	1,500	1,500	1,600	730	760
PFOA$^-$	3,200	3,100	2,900	3,200	540	610
PFNA$^-$	110	99	140	120	ND	ND
PFDA$^-$	29	28	46	43	ND	25
PFUnDA$^-$	ND	ND	ND	ND	ND	ND
PFDoDA$^-$	ND	ND	ND	ND	ND	ND
PFTrDA$^-$	ND	ND	ND	ND	ND	ND
PFTeDA$^-$	ND	ND	ND	ND	ND	ND
PFBS$^-$	14,000	13,000	3,200	3,100	870	860
PFPeS$^-$	190	120	440	220	ND	ND
PFHxS$^-$	620	680	2,900	2,800	ND	ND
PFHpS$^-$	ND	ND	43	39	ND	ND
PFOS$^-$	150	140	1,800	1,700	ND	ND
PFNS$^-$	ND	ND	ND	ND	ND	ND
PFDS$^-$	ND	ND	ND	ND	ND	ND
PFDoS-	ND	ND	ND	ND	ND	ND
4:2 FTS$^-$	ND	ND	ND	28	ND	ND
6:2 FTS$^-$	420	ND	640	480	ND	ND
8:2 FTS$^-$	ND	ND	79	75	ND	ND
PFOSA$^-$	ND	ND	ND	ND	ND	ND
N-MeFOSA$^-$	ND	ND	ND	ND	ND	ND
N-EtFOSA$^-$	ND	ND	ND	ND	ND	ND
MeFOSAA$^-$	ND	ND	ND	ND	ND	ND
EtFOSAA$^-$	ND	ND	ND	ND	ND	ND
N-MeFOSE$^-$	ND	ND	ND	ND	ND	ND
N-EtFOSE$^-$	ND	ND	ND	ND	ND	ND
HFPO-DA$^-$	ND	ND	ND	ND	ND	ND
ADONA$^-$	ND	ND	ND	ND	ND	ND
9Cl-PF3ONS$^-$	ND	ND	ND	ND	ND	ND
11Cl-PF3OUdS$^-$	ND	ND	ND	ND	ND	ND
3:3 FTCA$^-$	820	ND	330	310	180	ND
5:3 FTCA$^-$	26,000	100	8,500	4,200	1,300	ND
7:3 FTCA$^-$	980	63	1,700	920	150	ND
PFEESA$^-$	ND	ND	ND	ND	ND	ND
PFMPA$^-$	45	41	ND	ND	ND	ND
PFMBA$^-$	ND	ND	ND	ND	ND	ND
NFDHA$^-$	ND	ND	ND	ND	ND	ND
Total:	**64,664**	**40,771**	**40,618**	**36,835**	**12,970**	**12,455**

LF #1 (Waimanalo Gulch Landfill)

Sample: WGLF E-6

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	26,000	40%
PFBS$^-$	14,000	22%
PFHxA$^-$	9,600	15%
PFPeA$^-$	4,400	7%
PFOA$^-$	3,200	5%
Other	7,464	12%
Total:	**64,664**	**100%**

PFBA$^-$	2,800
PFHpA$^-$	1,300
7:3 FTCA$^-$	980
3:3 FTCA$^-$	820
PFHxS$^-$	620
6:2 FTS$^-$	420
PFPeS$^-$	190
PFOS$^-$	150
PFNA$^-$	110
PFMPA$^-$	45
PFDA$^-$	29

Sample: WGLF 4-B

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	8,500	21%
PFHxA$^-$	6,200	15%
PFBA$^-$	5,800	14%
PFPeA$^-$	4,400	11%
PFBS$^-$	3,200	8%
Other	12,518	31%
Total:	**40,618**	**100%**

PFOA$^-$	2,900
PFHxS$^-$	2,900
PFOS$^-$	1,800
7:3 FTCA$^-$	1,700
PFHpA$^-$	1,500
6:2 FTS$^-$	640
PFPeS$^-$	440
3:3 FTCA$^-$	330
PFNA$^-$	140
8:2 FTS$^-$	79
PFDA$^-$	46
PFHpS$^-$	43

Sample: WGLF-ASH

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
PFHxA$^-$	4,700	36%
PFPeA$^-$	3,100	24%
PFBA$^-$	1,400	11%
5:3 FTCA$^-$	1,300	10%
PFBS$^-$	870	6.7%
Other	1,600	12%
Total:	**12,970**	**100%**

PFHpA$^-$	730
PFOA$^-$	540
3:3 FTCA$^-$	180
7:3 FTCA$^-$	150

Compound	LF #2 (PVTLF) Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Post-TOPs (unfiltered) (ng/L)
PFBA$^-$	3,280	7,860	18,700
PFPeA$^-$	4,630	9,910	13,600
PFHxA$^-$	15,100	24,900	22,600
PFHpA$^-$	3,500	3,800	3,530
PFOA$^-$	2,470	2,680	2,770
PFNA$^-$	131	172	157
PFDA$^-$	66	75	69
PFUnDA$^-$	ND	ND	ND
PFDoDA$^-$	ND	ND	ND
PFTrDA$^-$	ND	ND	ND
PFTeDA$^-$	ND	ND	ND
PFBS$^-$	9,410	20,600	16,900
PFPeS$^-$	11,000	14,700	12,200
PFHxS$^-$	42,600	50,000	45,000
PFHpS$^-$	516	531	423
PFOS$^-$	9,900	11,600	10,800
PFNS$^-$	ND	ND	ND
PFDS$^-$	ND	ND	ND
PFDoS-	ND	ND	ND
4:2 FTS$^-$	96	165	ND
6:2 FTS$^-$	251	281	ND
8:2 FTS$^-$	ND	ND	ND
PFOSA$^-$	ND	ND	ND
N-MeFOSA$^-$	ND	ND	ND
N-EtFOSA$^-$	ND	ND	ND
MeFOSAA$^-$	ND	ND	ND
EtFOSAA$^-$	ND	ND	ND
N-MeFOSE$^-$	ND	ND	ND
N-EtFOSE$^-$	ND	ND	ND
HFPO-DA$^-$	ND	ND	-
ADONA$^-$	ND	ND	-
9Cl-PF3ONS$^-$	ND	ND	-
11Cl-PF3OUdS$^-$	ND	ND	-
3:3 FTCA$^-$	ND	ND	ND
5:3 FTCA$^-$	ND	ND	ND
7:3 FTCA$^-$	ND	ND	ND
PFEESA$^-$	ND	ND	ND
PFMPA$^-$	ND	ND	ND
PFMBA$^-$	ND	ND	ND
NFDHA$^-$	ND	ND	ND
Total:	**102,950**	**147,274**	**146,749**

	LF #3 (CMLF IV-A)		LF #3 (CMLF IV-B)		LF #3 (CMLF VBE)		
Compound	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Post-TOPs (unfiltered) (ng/L)
PFBA$^-$	3,580	3,620	2,590	4,300	6,010	5,460	7,170
PFPeA$^-$	3,790	4,010	1,890	3,170	18,700	17,500	19,800
PFHxA$^-$	9,690	8,350	4,320	7,530	13,900	15,800	14,600
PFHpA$^-$	1,550	1,600	706	1,240	4,270	5,250	4,950
PFOA$^-$	4,860	4,690	1,560	2,220	10,600	11,800	11,200
PFNA$^-$	231	287	233	346	209	243	270
PFDA$^-$	133	198	74	110	502	580	604
PFUnDA$^-$	ND	4.1	5.1	5.9	13	17	ND
PFDoDA$^-$	ND	ND	ND	ND	28	55	58
PFTrDA$^-$	ND	ND	ND	ND	ND	ND	ND
PFTeDA$^-$	ND	ND	ND	ND	ND	ND	ND
PFBS$^-$	2,340	2,540	2,380	3,410	46	31	ND
PFPeS$^-$	110	99	41	58	ND	ND	ND
PFHxS$^-$	766	732	469	682	8.5	7.9	ND
PFHpS$^-$	34	35	6.7	7.8	ND	ND	ND
PFOS$^-$	1,140	1,550	204	274	12	13	ND
PFNS$^-$	ND	ND	ND	ND	ND	ND	ND
PFDS$^-$	ND	ND	ND	ND	ND	ND	ND
PFDoS-	ND	ND	ND	ND	ND	ND	ND
4:2 FTS$^-$	ND	ND	ND	ND	ND	ND	ND
6:2 FTS$^-$	287	341	264	341	18	20	ND
8:2 FTS$^-$	34	32	ND	16	ND	ND	ND
PFOSA$^-$	4.4	7.7	4.6	5.8	ND	ND	ND
N-MeFOSA$^-$	ND	ND	ND	ND	ND	ND	ND
N-EtFOSA$^-$	ND	ND	ND	ND	ND	ND	ND
MeFOSAA$^-$	68	112	56	84	ND	ND	ND
EtFOSAA$^-$	4.5	8.1	7.5	10	ND	ND	ND
N-MeFOSE$^-$	ND	ND	ND	ND	ND	ND	ND
N-EtFOSE$^-$	ND	ND	ND	ND	ND	ND	ND
HFPO-DA$^-$	ND	ND	ND	ND	ND	ND	-
ADONA$^-$	ND	ND	ND	ND	ND	ND	-
9Cl-PF3ONS$^-$	ND	ND	ND	ND	ND	ND	-
11Cl-PF3OUdS$^-$	ND	ND	ND	ND	ND	ND	-
3:3 FTCA$^-$	990	1,500	752	637	403	365	ND
5:3 FTCA$^-$	80,900	79,800	85,900	148,000	1,550	1,710	ND
7:3 FTCA$^-$	11,500	16,800	6,090	16,900	135	161	ND
PFEESA$^-$	ND	ND	ND	ND	ND	ND	-
PFMPA$^-$	ND	ND	ND	ND	ND	ND	-
PFMBA$^-$	ND	3.9	ND	ND	ND	ND	-
NFDHA$^-$	ND	ND	ND	ND	ND	ND	-
Total:	**122,011**	**126,320**	**107,553**	**189,348**	**56,404**	**59,012**	**58,652**

LF #3 (Central Maui)

Sample: CMLF IV-A

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	80,900	66%
7:3 FTCA$^-$	11,500	9%
PFHxA$^-$	9,690	8%
PFOA$^-$	4,860	4%
PFPeA$^-$	3,790	3%
Other	11,271	9%
Total:	**122,011**	**100%**

PFBA$^-$	3,580
PFBS$^-$	2,340
PFHpA$^-$	1,550
PFOS$^-$	1,140
3:3 FTCA$^-$	990
PFHxS$^-$	766
6:2 FTS$^-$	287
PFNA$^-$	231
PFDA$^-$	133
PFPeS$^-$	110
MeFOSAA$^-$	68
8:2 FTS$^-$	34
PFHpS$^-$	34
EtFOSAA$^-$	4.5
PFOSA$^-$	4.4

Sample: CMLF IV-B

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	85,900	80%
7:3 FTCA$^-$	6,090	6%
PFHxA$^-$	4,320	4%
PFBA$^-$	2,590	2%
PFBS$^-$	2,380	2%
Other	6,273	6%
Total:	**107,553**	**100%**

PFPeA$^-$	1,890
PFOA$^-$	1,560
3:3 FTCA$^-$	752
PFHpA$^-$	706
PFHxS$^-$	469
6:2 FTS$^-$	264
PFNA$^-$	233
PFOS$^-$	204
PFDA$^-$	74
MeFOSAA$^-$	56
PFPeS$^-$	41
EtFOSAA$^-$	7.5
PFHpS$^-$	6.7
PFUnDA$^-$	5.1
PFOSA$^-$	4.6

Sample: CMLF VBE

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
PFPeA$^-$	18,700	33%
PFHxA$^-$	13,900	25%
PFOA$^-$	10,600	19%
PFBA$^-$	6,010	11%
PFHpA$^-$	4,270	7.6%
Other	2,924	5%
Total:	**56,404**	**100%**

5:3 FTCA$^-$	1,550
PFDA$^-$	502
3:3 FTCA$^-$	403
PFNA$^-$	209
7:3 FTCA$^-$	135
PFBS$^-$	46
PFDoDA$^-$	28
6:2 FTS$^-$	18
PFUnDA$^-$	13
PFOS$^-$	12
PFHxS$^-$	8.5

Compound	LF #4 (WHLF-LECH-R1)		LF #4 (WHLF-LECH-R2)		LF #4 (WHLF-LECH-R3)		LF #4 (WHLF-LECH-R4)	
	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)
PFBA$^-$	7,120	7,110	4,330	3,390	3,630	3,790	7,410	7,420
PFPeA$^-$	10,500	10,200	6,450	5,000	6,080	6,010	12,400	12,800
PFHxA$^-$	10,500	11,600	9,200	6,880	21,200	22,800	56,300	51,900
PFHpA$^-$	7,230	6,710	3,840	3,150	2,550	2,690	3,110	2,830
PFOA$^-$	11,600	11,800	4,910	4,450	6,000	6,330	11,100	11,100
PFNA$^-$	737	795	283	280	185	218	253	302
PFDA$^-$	327	418	99	122	140	171	358	459
PFUnDA$^-$	22	34	12	16	9.3	11	ND	24
PFDoDA$^-$	ND	10	6.7	9.0	ND	ND	ND	ND
PFTrDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFTeDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFBS$^-$	1,250	1,330	1,150	759	4,110	3,570	4,490	4,960
PFPeS$^-$	313	293	174	126	18	19	ND	22
PFHxS$^-$	1,060	1,120	760	638	84	88	93	87
PFHpS$^-$	101	108	30	28	ND	ND	ND	ND
PFOS$^-$	3,610	4,470	970	999	68	84	164	201
PFNS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFDS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFDoS-	ND	ND	ND	ND	ND	ND	ND	ND
4:2 FTS$^-$	34	29	40	27	ND	ND	ND	ND
6:2 FTS$^-$	1,120	1,160	921	979	194	203	234	222
8:2 FTS$^-$	990	1,250	942	1,080	ND	ND	ND	ND
PFOSA$^-$	65	72	32	31	ND	ND	ND	ND
N-MeFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
N-EtFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
MeFOSAA$^-$	63	118	370	460	ND	15	42	61
EtFOSAA$^-$	671	960	691	897	43	61	ND	ND
N-MeFOSE$^-$	ND	ND	ND	ND	ND	ND	ND	ND
N-EtFOSE$^-$	ND	ND	ND	ND	ND	ND	ND	ND
HFPO-DA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
ADONA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
9Cl-PF3ONS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
11Cl-PF3OUdS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
3:3 FTCA$^-$	165	94	334	216	441	457	1,080	1,180
5:3 FTCA$^-$	10,400	11,800	23,100	20,400	31,000	36,400	86,000	78,300
7:3 FTCA$^-$	232	371	837	926	2,080	3,230	1,790	2,210
PFEESA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFMPA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFMBA$^-$	ND	ND	3.2	ND	ND	ND	ND	ND
NFDHA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
Total:	**68,110**	**71,852**	**59,485**	**50,863**	**77,832**	**86,147**	**184,824**	**174,079**

LF #4 (West Hawai'i)

Sample: WHLF R1

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
PFOA$^-$	11,600	17%
PFPeA$^-$	10,500	15%
PFHxA$^-$	10,500	15%
5:3 FTCA$^-$	10,400	15%
PFHpA$^-$	7,230	11%
Other	17,880	26%
Total:	**68,110**	**100%**
PFBA$^-$	7,120	
PFOS$^-$	3,610	
PFBS$^-$	1,250	
6:2 FTS$^-$	1,120	
PFHxS$^-$	1,060	
8:2 FTS$^-$	990	
PFNA$^-$	737	
EtFOSAA$^-$	671	
PFDA$^-$	327	
PFPeS$^-$	313	
7:3 FTCA$^-$	232	
3:3 FTCA$^-$	165	
PFHpS$^-$	101	
PFOSA$^-$	65	
MeFOSAA$^-$	63	
4:2 FTS$^-$	34	
PFUnDA$^-$	22	

Sample: WHLF R2

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	23,100	39%
PFHxA$^-$	9,200	15%
PFPeA$^-$	6,450	11%
PFOA$^-$	4,910	8%
PFBA$^-$	4,330	7%
Other	11,495	19%
Total:	**59,485**	**100%**
PFHpA$^-$	3,840	
PFBS$^-$	1,150	
PFOS$^-$	970	
8:2 FTS$^-$	942	
6:2 FTS$^-$	921	
7:3 FTCA$^-$	837	
PFHxS$^-$	760	
EtFOSAA$^-$	691	
MeFOSAA$^-$	370	
3:3 FTCA$^-$	334	
PFNA$^-$	283	
PFPeS$^-$	174	
PFDA$^-$	99	
4:2 FTS$^-$	40	
PFOSA$^-$	32	
PFHpS$^-$	30	
PFUnDA$^-$	12	
PFDoDA$^-$	6.7	
PFMBA$^-$	3.2	

Sample: WHLF R3

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	31,000	40%
PFHxA$^-$	21,200	27%
PFPeA$^-$	6,080	8%
PFOA$^-$	6,000	8%
PFBS$^-$	4,110	5.3%
Other	9,442	12%
Total:	**77,832**	**100%**
PFBA$^-$	3,630	
PFHpA$^-$	2,550	
7:3 FTCA$^-$	2,080	
3:3 FTCA$^-$	441	
6:2 FTS$^-$	194	
PFNA$^-$	185	
PFDA$^-$	140	
PFHxS$^-$	84	
PFOS$^-$	68	
EtFOSAA$^-$	43	
PFPeS$^-$	18	
PFUnDA$^-$	9.3	

Sample: WHLF R4

	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	86,000	47%
PFHxA$^-$	56,300	30%
PFPeA$^-$	12,400	7%
PFOA$^-$	11,100	6.0%
PFBA$^-$	7,410	4.0%
Other	11,614	6%
Total:	**184,824**	**100%**
PFBS$^-$	4,490	
PFHpA$^-$	3,110	
7:3 FTCA$^-$	1,790	
3:3 FTCA$^-$	1,080	
PFDA$^-$	358	
PFNA$^-$	253	
6:2 FTS$^-$	234	
PFOS$^-$	164	
PFHxS$^-$	93	
MeFOSAA$^-$	42	

Compound	LF #5 (KKLF-WW1)		LF #5 (KKLF-WW2)		LF #5 (KKLF-WW3)		LF #5 (KKLF-WW2A1)		LF #5 (KKLF-WW2B)	
	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)
PFBA$^-$	1,800	1,870	3,100	3,020	1,000	1,050	1,280	1,280	1,190	1,170
PFPeA$^-$	4,080	4,140	8,110	7,720	3,060	3,640	2,130	2,150	1,970	2,250
PFHxA$^-$	3,800	3,490	6,880	6,100	2,870	2,900	4,180	4,050	4,780	4,030
PFHpA$^-$	1,810	2,080	2,420	2,370	437	453	883	887	682	689
PFOA$^-$	2,860	2,470	1,870	2,100	521	555	604	572	663	628
PFNA$^-$	83	74	75	73	20	25	22	22	36	36
PFDA$^-$	51	39	34	33	40	55	7.5	7.2	13	14
PFUnDA$^-$	ND	ND	ND	3.8	5.3	8.3	ND	ND	ND	ND
PFDoDA$^-$	ND	4.9	ND	4.0	4.6	10	ND	ND	ND	ND
PFTrDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFTeDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFBS$^-$	283	244	569	579	417	346	651	639	714	783
PFPeS$^-$	98	101	421	390	91	104	1,010	989	1,110	1,110
PFHxS$^-$	796	814	2,880	3,180	748	818	6,820	6,820	7,220	7,540
PFHpS$^-$	52	34	23	24	8	11	45	45	69	70
PFOS$^-$	1,400	936	549	615	640	790	1,200	1,220	1,660	1,740
PFNS$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFDS$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFDoS-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4:2 FTS$^-$	ND	ND	15	ND	ND	ND	ND	ND	ND	ND
6:2 FTS$^-$	87	79	303	279	76	73	36	31	60	64
8:2 FTS$^-$	48	61	139	147	42	48	ND	ND	ND	ND
PFOSA$^-$	78	76	11	13	68	74	ND	ND	ND	ND
N-MeFOSA$^-$	10	14	ND	4.5	ND	3.8	ND	ND	ND	ND
N-EtFOSA$^-$	12	19	ND	9.4	ND	ND	ND	ND	ND	ND
MeFOSAA$^-$	1,950	1,460	244	320	992	1,300	ND	ND	ND	ND
EtFOSAA$^-$	618	544	239	279	449	578	ND	ND	ND	ND
N-MeFOSE$^-$	961	2,120	ND	52	252	616	ND	ND	ND	ND
N-EtFOSE$^-$	993	2,290	53	86	154	441	ND	ND	ND	ND
HFPO-DA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ADONA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9Cl-PF3ONS$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11Cl-PF3OUdS$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3:3 FTCA$^-$	195	181	794	771	277	307	904	871	576	645
5:3 FTCA$^-$	14,900	12,500	19,700	22,400	38,000	40,900	33,400	31,900	15,000	14,400
7:3 FTCA$^-$	2,720	2,660	778	885	3,320	3,700	217	224	ND	ND
PFEESA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFMPA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFMBA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NFDHA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total:	**39,684**	**38,300**	**49,206**	**51,458**	**53,492**	**58,806**	**53,390**	**51,706**	**35,743**	**35,169**

LF #5
Kekaha

Sample: KKHLF WW1

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	14,900	38%
PFPeA$^-$	4,080	10%
PFHxA$^-$	3,800	10%
PFOA$^-$	2,860	7%
7:3 FTCA$^-$	2,720	7%
Other	11,324	29%
Total:	**39,684**	**100%**
MeFOSAA$^-$	1,950	
PFHpA$^-$	1,810	
PFBA$^-$	1,800	
PFOS$^-$	1,400	
N-EtFOSE$^-$	993	
N-MeFOSE$^-$	961	
PFHxS$^-$	796	
EtFOSAA$^-$	618	
PFBS$^-$	283	
3:3 FTCA$^-$	195	
PFPeS$^-$	98	
6:2 FTS$^-$	87	
PFNA$^-$	83	
PFOSA$^-$	78	
PFHpS$^-$	52	
PFDA$^-$	51	
8:2 FTS$^-$	48	
N-EtFOSA$^-$	12	
N-MeFOSA$^-$	10	

Sample: KKHLF WW2

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	19,700	40%
PFPeA$^-$	8,110	16%
PFHxA$^-$	6,880	14%
PFBA$^-$	3,100	6%
PFHxS$^-$	2,880	6%
Other	8,536	17%
Total:	**49,206**	**100%**
PFHpA$^-$	2,420	
PFOA$^-$	1,870	
3:3 FTCA$^-$	794	
7:3 FTCA$^-$	778	
PFBS$^-$	569	
PFOS$^-$	549	
PFPeS$^-$	421	
6:2 FTS$^-$	303	
MeFOSAA$^-$	244	
EtFOSAA$^-$	239	
8:2 FTS$^-$	139	
PFNA$^-$	75	
N-EtFOSE$^-$	53	
PFDA$^-$	34	
PFHpS$^-$	23	
4:2 FTS$^-$	15	
PFOSA$^-$	11	

Sample: KKHLF WW3

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	38,000	71%
7:3 FTCA$^-$	3,320	6%
PFPeA$^-$	3,060	6%
PFHxA$^-$	2,870	5%
PFBA$^-$	1,000	2%
Other	5,242	10%
Total:	**53,492**	**100%**
MeFOSAA$^-$	992	
PFHxS$^-$	748	
PFOS$^-$	640	
PFOA$^-$	521	
EtFOSAA$^-$	449	
PFHpA$^-$	437	
PFBS$^-$	417	
3:3 FTCA$^-$	277	
N-MeFOSE$^-$	252	
N-EtFOSE$^-$	154	
PFPeS$^-$	91	
6:2 FTS$^-$	76	
PFOSA$^-$	68	
8:2 FTS$^-$	42	
PFDA$^-$	40	
PFNA$^-$	20	
PFHpS$^-$	8	
PFUnDA$^-$	5.3	
PFDoDA$^-$	4.6	

LF #5
Kekaha

Sample: KKHLF 2A

Compound	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	33,400	63%
PFHxS$^-$	6,820	13%
PFHxA$^-$	4,180	8%
PFPeA$^-$	2,130	4%
PFBA$^-$	1,280	2.4%
Other	5,580	10%
Total:	**53,390**	**100%**
PFOS$^-$	1,200	
PFPeS$^-$	1,010	
3:3 FTCA$^-$	904	
PFHpA$^-$	883	
PFBS$^-$	651	
PFOA$^-$	604	
7:3 FTCA$^-$	217	
PFHpS$^-$	45	
6:2 FTS$^-$	36	
PFNA$^-$	22	
PFDA$^-$	7.5	

Sample: KKHLF 2B

	Pre-TOPs Leachate (ng/L)	% Makeup
5:3 FTCA$^-$	15,000	42%
PFHxS$^-$	7,220	20%
PFHxA$^-$	4,780	13%
PFPeA$^-$	1,970	5.5%
PFOS$^-$	1,660	4.6%
Other	5,113	14%
Total:	**35,743**	**100%**
PFBA$^-$	1,190	
PFPeS$^-$	1,110	
PFBS$^-$	714	
PFHpA$^-$	682	
PFOA$^-$	663	
3:3 FTCA$^-$	576	
PFHpS$^-$	69	
6:2 FTS$^-$	60	
PFNA$^-$	36	
PFDA$^-$	13	

Leachate Sample Method Reporting Levels

Compound	LF #1 WGLF E-6 Leachate MRLs		LF #1 WGLF 4B Leachate MRLs		LF #1 WGLF ASH Leachate MRLs	
	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)
PFBA$^-$	63	63	63	63	63	63
PFPeA$^-$	25	25	25	25	25	25
PFHxA$^-$	25	25	25	25	25	25
PFHpA$^-$	25	25	25	25	25	25
PFOA$^-$	25	25	25	25	25	25
PFNA$^-$	25	25	25	25	25	25
PFDA$^-$	25	25	25	25	25	25
PFUnDA$^-$	25	25	25	25	25	25
PFDoDA$^-$	25	25	25	25	25	25
PFTrDA$^-$	25	25	25	25	25	25
PFTeDA$^-$	25	25	25	25	25	25
PFBS$^-$	25	25	25	25	25	25
PFPeS$^-$	25	25	25	25	25	25
PFHxS$^-$	25	25	25	25	25	25
PFHpS$^-$	25	25	25	25	25	25
PFOS$^-$	25	25	25	25	25	25
PFNS$^-$	25	25	25	25	25	25
PFDS$^-$	25	25	25	25	25	25
PFDoS-	25	25	25	25	25	25
4:2 FTS$^-$	63	63	63	63	63	63
6:2 FTS$^-$	25	25	25	25	25	25
8:2 FTS$^-$	25	25	25	25	25	25
PFOSA$^-$	25	25	25	25	25	25
N-MeFOSA$^-$	25	25	25	25	25	25
N-EtFOSA$^-$	63	63	63	63	63	63
MeFOSAA$^-$	63	63	63	63	63	63
EtFOSAA$^-$	50	50	50	50	50	50
N-MeFOSE$^-$	25	25	25	25	25	25
N-EtFOSE$^-$	25	25	25	25	25	25
HFPO-DA$^-$	50	50	50	50	50	50
ADONA$^-$	25	25	25	25	25	25
9Cl-PF3ONS$^-$	25	25	25	25	25	25
11Cl-PF3OUdS$^-$	25	25	25	25	25	25
3:3 FTCA$^-$	25	25	25	25	25	25
5:3 FTCA$^-$	25	25	25	25	25	25
7:3 FTCA$^-$	25	25	25	25	25	25
PFEESA$^-$	25	25	25	25	25	25
PFMPA$^-$	25	25	25	25	25	25
PFMBA$^-$	25	25	25	25	25	25
NFDHA$^-$	25	25	25	25	25	25

Compound	LF #2 PVTLF Leachate MRLs	
	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)
PFBA$^-$	62.2	66.1
PFPeA$^-$	31.1	83.4
PFHxA$^-$	15.6	16.5
PFHpA$^-$	15.6	16.5
PFOA$^-$	15.6	16.5
PFNA$^-$	15.6	16.5
PFDA$^-$	15.6	16.5
PFUnDA$^-$	15.6	16.5
PFDoDA$^-$	15.6	16.5
PFTrDA$^-$	15.6	16.5
PFTeDA$^-$	15.6	16.5
PFBS$^-$	15.6	16.5
PFPeS$^-$	15.6	16.6
PFHxS$^-$	15.6	16.5
PFHpS$^-$	15.6	16.5
PFOS$^-$	15.6	16.5
PFNS$^-$	15.6	16.5
PFDS$^-$	15.6	16.5
PFDoS-	15.6	16.5
4:2 FTS$^-$	62.2	66.1
6:2 FTS$^-$	56.1	59.6
8:2 FTS$^-$	62.2	66.1
PFOSA$^-$	15.6	16.5
N-MeFOSA$^-$	17.9	19
N-EtFOSA$^-$	38.9	41.3
MeFOSAA$^-$	15.6	16.5
EtFOSAA$^-$	15.6	16.5
N-MeFOSE$^-$	156	165
N-EtFOSE$^-$	116	124
HFPO-DA$^-$	59.1	62.8
ADONA$^-$	62.2	66.1
9Cl-PF3ONS$^-$	62.4	66.3
11Cl-PF3OUdS$^-$	62.3	66.2
3:3 FTCA$^-$	62.2	66.1
5:3 FTCA$^-$	389	413
7:3 FTCA$^-$	389	413
PFEESA$^-$	15.6	16.5
PFMPA$^-$	31.1	33.1
PFMBA$^-$	15.6	16.5
NFDHA$^-$	31.1	33.1

Compound	LF #3 CMLF IV-A Leachate MRLs		LF #3 CMLF IV-B Leachate MRLs		LF #3 CMLF VBE Leachate MRLs	
	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)	Pre-TOPs (filtered) (ng/L)	Pre-TOPs (unfiltered) (ng/L)
PFBA$^-$	12.9	13.2	17.8	12.7	13.2	12.4
PFPeA$^-$	31.6	16.3	12.8	14.1	96.2	28
PFHxA$^-$	45.9	17.6	10.7	20.8	10.1	3.92
PFHpA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFOA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFNA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFDA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFUnDA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFDoDA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFTrDA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFTeDA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFBS$^-$	3.21	6.24	5.88	5.6	3.3	3.11
PFPeS$^-$	3.28	5.58	4.47	6.59	3.32	3.13
PFHxS$^-$	3.21	3.29	4.44	29.2	3.3	3.11
PFHpS$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFOS$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFNS$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFDS$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFDoS-	3.21	3.29	4.44	3.17	3.3	3.11
4:2 FTS$^-$	12.9	13.2	17.8	12.7	13.2	12.4
6:2 FTS$^-$	11.6	11.9	16	11.4	11.9	11.2
8:2 FTS$^-$	12.9	13.2	17.8	12.7	13.2	12.4
PFOSA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
N-MeFOSA$^-$	3.7	3.79	5.11	3.64	3.8	3.58
N-EtFOSA$^-$	8.03	8.24	11.1	7.92	8.26	7.77
MeFOSAA$^-$	3.21	3.29	6.28	3.17	3.3	3.11
EtFOSAA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
N-MeFOSE$^-$	32.1	32.9	44.4	31.7	33	31.1
N-EtFOSE$^-$	24	24.6	33.2	23.7	24.7	23.3
HFPO-DA$^-$	12.2	12.5	16.9	12	12.6	11.8
ADONA$^-$	12.9	13.2	17.8	12.7	13.2	12.4
9Cl-PF3ONS$^-$	12.9	13.2	17.8	12.7	13.2	12.5
11Cl-PF3OUdS$^-$	12.9	13.2	17.8	12.7	13.2	12.5
3:3 FTCA$^-$	20.4	15.3	17.9	16.6	13.2	12.4
5:3 FTCA$^-$	80.3	82.4	111	79.2	82.6	77.7
7:3 FTCA$^-$	80.3	82.4	111	79.2	82.6	77.7
PFEESA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
PFMPA$^-$	6.43	6.59	8.89	6.34	6.61	6.22
PFMBA$^-$	3.21	3.29	4.44	3.17	3.3	3.11
NFDHA$^-$	6.43	6.59	8.89	6.34	6.61	6.22

Compound	LF #4 WHLF-LECH-R1 Leachate MRLs Pre-TOPs (filtered) (ng/L)	LF #4 WHLF-LECH-R2 Leachate MRLs Pre-TOPs (filtered) (ng/L)	LF #4 WHLF-LECH-R3 Lechate MRLS Pre-TOPs (filtered) (ng/L)	LF #4 WHLF-LECH-R4 Leachate MRLs Pre-TOPs (filtered) (ng/L)
PFBA$^-$	26.9	14.8	26.3	67.3
PFPeA$^-$	13.8	100	113	81.2
PFHxA$^-$	16.8	17	9.6	16.8
PFHpA$^-$	6.72	5.85	6.59	16.8
PFOA$^-$	6.72	3.16	6.59	16.8
PFNA$^-$	6.72	3.16	6.59	16.8
PFDA$^-$	6.72	3.16	6.59	16.8
PFUnDA$^-$	6.72	3.16	6.59	16.8
PFDoDA$^-$	6.72	3.16	6.59	16.8
PFTrDA$^-$	6.72	3.16	6.59	16.8
PFTeDA$^-$	6.72	3.16	6.59	25.2
PFBS$^-$	6.72	4.1	6.59	16.8
PFPeS$^-$	6.75	3.18	6.62	16.9
PFHxS$^-$	6.72	3.16	6.59	16.8
PFHpS$^-$	6.72	3.16	6.59	16.8
PFOS$^-$	6.72	3.16	6.59	16.8
PFNS$^-$	6.72	3.16	6.59	16.8
PFDS$^-$	6.72	3.16	6.59	16.8
PFDoS-	6.72	3.16	6.59	16.8
4:2 FTS$^-$	26.9	12.6	26.3	67.3
6:2 FTS$^-$	24.2	11.4	23.7	60.7
8:2 FTS$^-$	26.9	12.6	26.3	67.3
PFOSA$^-$	6.72	3.16	6.59	16.8
N-MeFOSA$^-$	7.73	3.64	7.57	19.4
N-EtFOSA$^-$	16.8	7.9	16.5	42.1
MeFOSAA$^-$	6.72	3.16	6.59	16.8
EtFOSAA$^-$	6.72	3.16	6.59	16.8
N-MeFOSE$^-$	67.2	31.6	65.9	168
N-EtFOSE$^-$	50.3	23.6	49.3	126
HFPO-DA$^-$	25.5	12	25	64
ADONA$^-$	26.9	12.6	26.3	67.3
9Cl-PF3ONS$^-$	26.9	12.7	26.4	67.5
11Cl-PF3OUdS$^-$	26.9	12.7	26.4	67.4
3:3 FTCA$^-$	26.9	14.1	26.3	67.3
5:3 FTCA$^-$	168	79	165	421
7:3 FTCA$^-$	168	79	165	421
PFEESA$^-$	6.72	3.16	6.59	16.8
PFMPA$^-$	13.4	6.32	13.2	33.7
PFMBA$^-$	6.72	3.16	6.59	16.8
NFDHA$^-$	13.4	6.32	13.2	33.7

	LF #5 KKLF-WW1 Leahate MRLs		LF #5 KKLF-WW2 Leahate MRLs		LF #5 KKLF-WW3 Leahate MRLs		LF #5 KKLF-WW2A Leahate MRLs		LF #5 KKLF-WW2B Leahate MRLs	
Compound	**Pre-TOPs (filtered) (ng/L)**	**Pre-TOPs (unfiltered) (ng/L)**	**Pre-TOPs (filtered) (ng/L)**	**Pre-TOPs (unfiltered) (ng/L)**	**Pre-TOPs (filtered) (ng/L)**	**Pre-TOPs (unfiltered) (ng/L)**	**Pre-TOPs (filtered) (ng/L)**	**Pre-TOPs (unfiltered) (ng/L)**	**Pre-TOPs (filtered) (ng/L)**	**Pre-TOPs (unfiltered) (ng/L)**
PFBA$^-$	12.4	12.4	13.1	12.3	12.8	12.6	12.5	12.7	13.3	12.6
PFPeA$^-$	6.18	6.22	7.63	6.98	114	6.29	28.9	6.34	15.8	63
PFHxA$^-$	7.38	3.56	3.28	6.63	3.2	3.14	7.29	7.45	5.27	7.56
PFHpA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFOA$^-$	3.62	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFNA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFDA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFUnDA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFDoDA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFTrDA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFTeDA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFBS$^-$	3.09	3.11	3.28	3.12	3.2	3.14	3.12	3.17	3.34	3.16
PFPeS$^-$	3.1	3.13	3.3	3.09	3.22	3.16	3.14	3.18	3.35	3.18
PFHxS$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFHpS$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFOS$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFNS$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFDS$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFDoS-	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
4:2 FTS$^-$	12.4	12.4	13.1	12.3	12.8	12.6	12.5	12.7	13.3	12.6
6:2 FTS$^-$	11.1	11.2	11.8	11.1	11.5	11.3	11.3	11.4	12	11.4
8:2 FTS$^-$	12.4	12.4	13.1	12.3	12.8	12.6	12.5	12.7	13.3	12.6
PFOSA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
N-MeFOSA$^-$	3.55	3.58	3.78	3.54	3.68	3.62	3.59	3.64	3.84	3.64
N-EtFOSA$^-$	7.72	7.78	8.21	7.7	8.01	7.86	7.81	7.92	8.34	7.9
MeFOSAA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
EtFOSAA$^-$	3.09	3.11	8.38	3.08	3.2	3.14	3.12	3.17	3.34	3.16
N-MeFOSE$^-$	30.9	31.1	32.8	30.8	32	31.4	31.2	31.7	33.4	31.6
N-EtFOSE$^-$	23.1	23.3	24.6	23	24	23.5	23.4	23.7	24.9	23.6
HFPO-DA$^-$	11.7	11.8	12.5	11.7	12.2	11.9	11.9	12	12.7	12
ADONA$^-$	12.4	12.4	13.1	12.3	12.8	12.6	12.5	12.7	13.3	12.6
9Cl-PF3ONS$^-$	12.4	12.5	13.2	12.3	12.8	12.6	12.5	12.7	13.4	12.7
11Cl-PF3OUdS$^-$	12.4	12.5	13.2	12.3	12.8	12.6	12.5	12.7	13.4	12.7
3:3 FTCA$^-$	12.4	12.4	13.1	12.3	12.8	12.6	12.5	12.7	13.3	12.6
5:3 FTCA$^-$	77.2	77.8	82.1	77	80.1	78.6	78.1	79.2	83.4	79
7:3 FTCA$^-$	77.2	77.8	82.1	77	80.1	78.6	78.1	79.2	83.4	79
PFEESA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
PFMPA$^-$	6.18	6.22	6.57	6.16	6.4	6.29	6.25	6.34	6.67	6.32
PFMBA$^-$	3.09	3.11	3.28	3.08	3.2	3.14	3.12	3.17	3.34	3.16
NFDHA$^-$	6.18	-	6.57	-	6.4	-	6.25	-	6.67	-

Appendix 8. AFFF Release Site #1 Data

AFFF Release Site #1

Compound	3% AFFF Concentrate Released	
	Pre-TOPs (ng/L)	Post-TOPs (ng/L)
PFBA$^-$	940,000	50,000,000,000
PFPeA$^-$	ND	100,000,000,000
PFHxA$^-$	1,500,000	26,000,000,000
PFHpA$^-$	ND	4,500,000,000
PFOA$^-$	ND	ND
PFNA$^-$	ND	ND
PFDA$^-$	ND	ND
PFUnDA$^-$	ND	ND
PFDoDA$^-$	ND	ND
PFTrDA$^-$	ND	ND
PFTeDA$^-$	ND	ND
PFBS$^-$	ND	ND
PFPeS$^-$	ND	ND
PFHxS$^-$	ND	ND
PFHpS$^-$	ND	ND
PFOS$^-$	ND	ND
PFNS$^-$	ND	ND
PFDS$^-$	ND	ND
PFDoS-	ND	ND
4:2 FTS$^-$	ND	ND
6:2 FTS$^-$	29,000,000	11,000,000,000
8:2 FTS$^-$	ND	ND
PFOSA$^-$	ND	ND
N-MeFOSA$^-$	ND	ND
N-EtFOSA$^-$	ND	ND
MeFOSAA$^-$	ND	ND
EtFOSAA$^-$	ND	ND
N-MeFOSE$^-$	ND	ND
N-EtFOSE$^-$	ND	ND
HFPO-DA$^-$	ND	ND
ADONA$^-$	ND	ND
9Cl-PF3ONS$^-$	ND	ND
11Cl-PF3OUdS$^-$	ND	ND
3:3 FTCA$^-$	ND	ND
5:3 FTCA$^-$	ND	ND
7:3 FTCA$^-$	ND	ND
PFEESA$^-$	ND	ND
PFMPA$^-$	ND	ND
PFMBA$^-$	ND	ND
NFDHA$^-$	ND	ND
Total:	**31,440,000**	**191,500,000,000**
	Post-TOPs/Pre-TOPs:	**609,097%**

AFFF Release Site #1 AFFF Concentrate (Red Hill Fuel Storage Facility)

AFFF Concentrate

Compound	Pre-TOPs (ng/L)	% Makeup
6:2 FTS$^-$	29,000,000	92%
PFHxA$^-$	1,500,000	4.8%
PFBA$^-$	940,000	3.0%
Other	0	0%
Total:	**31,440,000**	**100%**

AFFF Concentrate

Compound	Post-TOPs (ng/L)	% Makeup
PFPeA$^-$	100,000,000,000	52%
PFBA$^-$	50,000,000,000	26%
PFHxA$^-$	26,000,000,000	14%
6:2 FTS$^-$	11,000,000,000	5.7%
PFHpA$^-$	4,500,000,000	2.3%
Other	0	0%
Total:	**191,500,000,000**	**100%**

AFFF Release Site #1 Soil (Red Hill Fuel Storage Facility)

	DU-2		DU-3		DU-4a		DU-4b	
Compound	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)
PFBA$^-$	5.6	6,410	6.5	6,183	1.3	30	1.2	204
PFPeA$^-$	1.8	11,800	2.9	10,267	4.3	47	4.5	298
PFHxA$^-$	14	4,980	17	4,840	1.9	22	1.7	118
PFHpA$^-$	0.40	643	ND	707	1.3	4.2	1.1	15
PFOA$^-$	1.3	1.9	6.6	1.7	ND	1.1	ND	1.0
PFNA$^-$	ND	0.43	ND	0.30	ND	0.33	ND	0.39
PFDA$^-$	ND	0.42	ND	0.36	ND	0.45	ND	0.36
PFUnA$^-$	ND	0.21	ND	ND	ND	0.30	ND	0.36
PFDoA$^-$	ND	ND	ND	ND	ND	0.30	ND	0.38
PFTrDA$^-$	ND	ND	ND	ND	ND	0.31	ND	0.24
PFTeDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFBS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFPeS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFHxS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFHpS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFOS$^-$	0.35	1.0	4.0	0.36	4.2	7.5	2.4	5.3
PFNS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFDS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFDoS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
4:2 FTS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
6:2 FTS$^-$	120	2.4	227	4.5	2.7	ND	1.7	ND
8:2 FTS$^-$	ND	ND	ND	ND	ND	ND	ND	ND
PFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
N-MeFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
N-EtFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
MeFOSAA$^-$	ND	ND	ND	4.1	ND	ND	ND	ND
EtFOSAA$^-$	ND	ND	ND	4.7	ND	ND	ND	ND
N-MeFOSE$^-$	ND	ND	ND	ND	ND	ND	ND	ND
N-EtFOSE$^-$	ND	ND	ND	ND	ND	ND	ND	ND
3:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
5:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
7:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	ND
	144	**23,839**	**264**	**22,013**	**16**	**114**	**13**	**643**
Post-TOPs/Pre-TOPs:		**16,491%**		**8,234%**		**626%**		**5,003%**

AFFF Release Site #1 Soil (Red Hill Fuel Storage Facility)

DU-2

Compound	Pre-TOPs Soil (µg/kg)	% Makeup
6:2 FTS$^-$	120	84%
PFHxA$^-$	14	10%
PFBA$^-$	5.6	3.9%
PFPeA$^-$	1.8	1.3%
PFOA$^-$	1.3	0.90%
Other	0.8	0.55%
Total:	**144**	**100%**
PFHpA$^-$	0.44	
PFOS$^-$	0.35	

DU-2

Compound	Post-TOPs Soil (µg/kg)	% Makeup
PFPeA$^-$	11,800	49%
PFBA$^-$	6,410	27%
PFHxA$^-$	4,980	21%
PFHpA$^-$	643	2.7%
6:2 FTS$^-$	2.37	0.01%
Other	4.0	0.02%
Total:	**23,839**	**100%**
PFOA$^-$	1.9	
PFOS$^-$	1.03	
PFNA$^-$	0.43	
PFDA$^-$	0.42	
PFUnA$^-$	0.21	

DU-3

Compound	Pre-TOPs Soil (µg/kg)	% Makeup
6:2 FTS$^-$	227	86%
PFHxA$^-$	17	6.4%
PFOA$^-$	6.6	2.5%
PFBA$^-$	6.5	2.5%
PFOS$^-$	4.0	1.5%
Other	2.9	1.1%
Total:	**264**	**100%**
PFPeA$^-$	2.9	

DU-3

Compound	Post-TOPs Soil (µg/kg)	% Makeup
PFPeA$^-$	10,267	47%
PFBA$^-$	6,183	28%
PFHxA$^-$	4,840	22%
PFHpA$^-$	707	3.2%
EtFOSAA$^-$	4.7	0.02%
Other	11	0.05%
Total:	**22,013**	**100%**
6:2 FTS$^-$	4.5	
MeFOSAA$^-$	4.1	
PFOA$^-$	1.7	
PFOS$^-$	0.36	
PFDA$^-$	0.36	
PFNA$^-$	0.30	

AFFF Release Site #1 Soil (Red Hill Fuel Storage Facility)

DU-4A

Compound	Pre-TOPs Soil (µg/kg)	% Makeup
PFPeA$^-$	4.3	27%
PFOS$^-$	4.2	27%
6:2 FTS$^-$	2.7	17%
PFHxA$^-$	1.9	12%
PFBA$^-$	1.3	8.3%
Other	1.3	8.3%
Total:	**16**	**100%**
PFHpA$^-$	1.3	

DU-4A

Compound	Post-TOPs Soil (µg/kg)	% Makeup
PFPeA$^-$	47	42%
PFBA$^-$	30	27%
PFHxA$^-$	22	19%
PFOS$^-$	7.4	6.5%
PFHpA$^-$	4.2	3.7%
Other	2.8	2.5%
Total:	**114**	**100%**
PFOA$^-$	1.1	
PFDA$^-$	0.45	
PFNA$^-$	0.33	
PFTrDA$^-$	0.31	
PFUnA$^-$	0.30	
PFDoA$^-$	0.30	

DU-4B

Compound	Pre-TOPs Soil (µg/kg)	% Makeup
PFPeA$^-$	4.5	36%
PFOS$^-$	2.4	19%
PFHxA$^-$	1.7	13%
6:2 FTS$^-$	1.7	13%
PFBA$^-$	1.2	10%
Other	1.1	9%
Total:	**13**	**100%**
PFHpA$^-$	1.1	

DU-4B

Compound	Post-TOPs Soil (µg/kg)	% Makeup
PFPeA$^-$	298	46%
PFBA$^-$	204	32%
PFHxA$^-$	118	18%
PFHpA$^-$	15	2.3%
PFOS$^-$	5.3	0.82%
Other	2.8	0.43%
Total:	**643**	**100%**
PFOA$^-$	1.0	
PFNA$^-$	0.39	
PFDoA$^-$	0.38	
PFUnA$^-$	0.36	
PFDA$^-$	0.36	
PFTrDA$^-$	0.24	

AFFF Release Site #1 Sample Method Reporting Levels

Compound	3% AFFF Concentrate MRLs	
	Pre-TOPs MRLs (ng/L)	Post-TOPs MRLs (ng/L)
PFBA$^-$	630,000	630,000,000
PFPeA$^-$	250,000	1,300,000,000
PFHxA$^-$	250,000	250,000,000
PFHpA$^-$	250,000	250,000,000
PFOA$^-$	250,000	250,000,000
PFNA$^-$	250,000	250,000,000
PFDA$^-$	250,000	250,000,000
PFUnDA$^-$	250,000	250,000,000
PFDoDA$^-$	250,000	250,000,000
PFTrDA$^-$	250,000	250,000,000
PFTeDA$^-$	250,000	250,000,000
PFBS$^-$	250,000	250,000,000
PFPeS$^-$	250,000	250,000,000
PFHxS$^-$	250,000	250,000,000
PFHpS$^-$	250,000	250,000,000
PFOS$^-$	250,000	250,000,000
PFNS$^-$	250,000	250,000,000
PFDS$^-$	250,000	250,000,000
PFDoS-	250,000	250,000,000
4:2 FTS$^-$	250,000	250,000,000
6:2 FTS$^-$	630,000	630,000,000
8:2 FTS$^-$	250,000	250,000,000
PFOSA$^-$	250,000	250,000,000
N-MeFOSA$^-$	500,000	500,000,000
N-EtFOSA$^-$	250,000	250,000,000
MeFOSAA$^-$	250,000	250,000,000
EtFOSAA$^-$	250,000	250,000,000
N-MeFOSE$^-$	630,000	630,000,000
N-EtFOSE$^-$	630,000	630,000,000
HFPO-DA$^-$	500,000	500,000,000
ADONA$^-$	250,000	250,000,000
9Cl-PF3ONS$^-$	250,000	250,000,000
11Cl-PF3OUdS$^-$	250,000	250,000,000
3:3 FTCA$^-$	250,000	250,000,000
5:3 FTCA$^-$	250,000	250,000,000
7:3 FTCA$^-$	250,000	250,000,000
PFEESA$^-$	250,000	250,000,000
PFMPA$^-$	250,000	250,000,000
PFMBA$^-$	250,000	250,000,000
NFDHA$^-$	250,000	250,000,000

Compound	DU-2 Soil MRLs		DU-3 Soil MRLS		DU-4a Soil MRLS		DU-4b Soil MRLS	
	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)
PFBA$^-$	1.0	12.5	1.0	12.2	1.0	0.845	1.0	0.855
PFPeA$^-$	1.0	6.25	1.0	6.11	1.0	0.422	1.0	0.428
PFHxA$^-$	1.0	3.12	1.0	3.06	1.0	0.211	1.0	0.214
PFHpA$^-$	1.0	3.12	1.0	3.06	1.0	0.211	1.0	0.214
PFOA$^-$	1.0	0.208	1.0	0.204	1.0	0.244	1.0	0.303
PFNA$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
PFDA$^-$	5.1	0.208	5.1	0.204	1.0	0.211	1.0	0.214
PFUnA$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
PFDoA$^-$	1.0	0.167	1.0	0.163	1.0	0.169	5.1	0.171
PFTrDA$^-$	1.0	0.208	1.0	0.204	1.0	0.211	5.1	0.214
PFTeDA$^-$	1.0	0.208	1.0	0.204	1.0	0.231	5.1	0.214
PFBS$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
PFPeS$^-$	1.0	0.209	1.0	0.205	1.0	0.212	1.0	0.215
PFHxS$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
PFHpS$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
PFOS$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
PFNS$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
PFDS$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
PFDoS$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
4:2 FTS$^-$	1.0	0.833	1.0	0.815	1.0	0.845	1.0	0.855
6:2 FTS$^-$	1.0	0.75	1.0	0.734	1.0	0.761	1.0	0.771
8:2 FTS$^-$	1.0	0.708	1.0	0.693	1.0	0.718	1.0	0.727
PFOSA$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
N-MeFOSA$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
N-EtFOSA$^-$	1.0	0.583	1.0	0.57	1.0	0.591	1.0	0.599
MeFOSAA$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
EtFOSAA$^-$	1.0	0.208	1.0	0.204	1.0	0.211	1.0	0.214
N-MeFOSE$^-$	1.0	2.08	1.0	2.04	1.0	2.11	1.0	2.14
N-EtFOSE$^-$	1.0	2.08	1.0	2.04	1.0	2.11	1.0	2.14
3:3 FTCA$^-$	1.0	0.833	1.0	0.815	1.0	0.845	1.0	0.855
5:3 FTCA$^-$	1.0	5.2	1.0	5.09	1.0	5.28	1.0	5.35
7:3 FTCA$^-$	1.0	5.2	1.0	5.09	1.0	5.28	1.0	5.35

Notes

AFFF Release Site #1

Appendix 9. AFFF Release Site #2 Data

	MW-1		MW-2		MW-3		MW-4		MW-5		MW-7		MW-8		MW-9	
Compound	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)
PFBA$^-$	54,000	230,000	210,000	77,000	52,000	ND	55,000	15,000	12,000	26,000	3,900	8,900	43	30	920	1,400
PFPeA$^-$	160,000	420,000	200,000	370,000	36,000	96,000	52,000	120,000	57,000	54,000	14,000	11,000	46	50	2,300	2,200
PFHxA$^-$	220,000	360,000	300,000	390,000	43,000	130,000	55,000	110,000	65,000	46,000	16,000	25,000	37	47	3,800	3,400
PFHpA$^-$	29,000	39,000	34,000	39,000	16,000	8,500	13,000	9,600	8,800	12,000	3,500	2,900	12	11	ND	250
PFOA$^-$	24,000	23,000	27,000	28,000	7,300	ND	6,200	6,500	4,000	5,200	3,600	3,100	5.6	5.4	ND	120
PFNA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	120	ND	ND	ND	ND	ND
PFDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	ND	ND	ND	ND
PFUnDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFDoDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFTrDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.0
PFTeDA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFBS$^-$	23,000	26,000	51,000	45,000	ND	5,600	6,700	7,400	3,100	4,100	5,700	4,700	6.9	6.5	2,700	2,100
PFPeS$^-$	27,000	28,000	56,000	50,000	ND	6,500	8,000	8,600	3,800	4,400	6,100	5,800	10	9.2	1,400	1,700
PFHxS$^-$	180,000	170,000	260,000	270,000	48,000	43,000	46,000	40,000	30,000	23,000	40,000	40,000	62	65	3,100	3,200
PFHpS$^-$	15,000	16,000	14,000	13,000	ND	ND	3,200	3,700	ND	2,500	2,200	ND	ND	ND	42	ND
PFOS$^-$	600,000	560,000	630,000	600,000	340,000	320,000	110,000	120,000	71,000	110,000	98,000	69,000	76	71	1,700	840
PFNS$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	19	ND	ND	ND	ND
PFDS$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFDoS-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4:2 FTS$^-$	ND	ND	ND	ND	ND	ND	2,100	ND	ND	ND	24	ND	ND	ND	ND	ND
6:2 FTS$^-$	930,000	34,000	610,000	35,000	260,000	ND	230,000	11,000	230,000	160,000	ND	11,000	24	ND	560	ND
8:2 FTS$^-$	ND	ND	ND	ND	24,000	ND	ND	4,800	ND	2,400	ND	130	ND	ND	ND	ND
PFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	34	ND	ND	ND	ND
N-MeFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-EtFOSA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MeFOSAA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EtFOSAA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-MeFOSE$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-EtFOSE$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HFPO-DA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ADONA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9Cl-PF3ONS$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Compound	MW-1		MW-2		MW-3		MW-4		MW-5		MW-7		MW-8		MW-9	
	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)
11Cl-PF3OUdS$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5:3 FTCA$^-$	20,000	ND	ND	ND	ND	ND	2,300	ND	ND	ND	44	ND	ND	ND	ND	ND
7:3 FTCA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFEESA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFMPA$^-$	ND	110	380	ND	150	ND	ND	28	ND	17	5.6	7.1	ND	ND	ND	ND
PFMBA$^-$	ND	200	ND	500	200	ND	32	ND	ND	19	8.6	9.2	ND	ND	ND	ND
NFDHA$^-$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total:	**2,282,000**	**1,906,310**	**1,817,380**	**2,492,500**	**826,650**	**609,600**	**589,532**	**456,628**	**484,700**	**449,636**	**193,212**	**181,599**	**322**	**295**	**16,522**	**15,215**

Notes:

"ND": No detected above the laboratory Method Reporting Level (refer to MRL tables below).

AFFF #2 Groundwater (Kahului Fire Training Area)

MW-1

Compound	Pre-TOPs (ng/L)	% Makeup
6:2 FTS$^-$	930,000	41%
PFOS$^-$	600,000	26%
PFHxA$^-$	220,000	10%
PFHxS$^-$	180,000	8%
PFPeA$^-$	160,000	7%
Other	192,000	8%
Total:	**2,282,000**	**100%**
PFBA$^-$	54,000	
PFHpA$^-$	29,000	
PFPeS$^-$	27,000	
PFOA$^-$	24,000	
PFBS$^-$	23,000	
5:3 FTCA$^-$	20,000	
PFHpS$^-$	15,000	

MW-2

Compound	Pre-TOPs (ng/L)	% Makeup
PFOS-	630,000	26%
6:2 FTS-	610,000	25%
PFHxA-	300,000	13%
PFHxS-	260,000	11%
PFBA-	210,000	9%
Other	382,380	16%
Total:	**2,392,380**	**100%**
PFPeA$^-$	200,000	
PFPeS$^-$	56,000	
PFBS$^-$	51,000	
PFHpA$^-$	34,000	
PFOA$^-$	27,000	
PFHpS$^-$	14,000	
PFMPA$^-$	380	

MW-3

Compound	Pre-TOPs (ng/L)	% Makeup
PFOS$^-$	340,000	41%
6:2 FTS$^-$	260,000	31%
PFBA$^-$	52,000	6%
PFHxS$^-$	48,000	6%
PFHxA$^-$	43,000	5.2%
Other	83,650	10%
Total:	**826,650**	**100%**
PFPeA$^-$	36,000	
8:2 FTS$^-$	24,000	
PFHpA$^-$	16,000	
PFOA$^-$	7,300	
PFMBA$^-$	200	
PFMPA$^-$	150	

MW-4

Compound	Pre-TOPs (ng/L)	% Makeup
6:2 FTS$^-$	230,000	39%
PFOS$^-$	110,000	19%
PFBA$^-$	55,000	9%
PFHxA$^-$	55,000	9.3%
PFPeA$^-$	52,000	8.8%
Other	87,532	15%
Total:	**589,532**	**100%**
PFHxS$^-$	46,000	
PFHpA$^-$	13,000	
PFPeS$^-$	8,000	
PFBS$^-$	6,700	
PFOA$^-$	6,200	
PFHpS$^-$	3,200	
5:3 FTCA$^-$	2,300	
4:2 FTS$^-$	2,100	
PFMBA$^-$	32	

AFFF #2 Groundwater (Kahului Fire Training Area)

MW-5

Compound	Pre-TOPs (ng/L)	% Makeup
6:2 FTS$^-$	230,000	47%
PFOS$^-$	71,000	15%
PFHxA$^-$	65,000	13%
PFPeA$^-$	57,000	12%
PFHxS$^-$	30,000	6%
Other	31,700	7%
Total:	**484,700**	**100%**
PFBA$^-$	12,000	
PFHpA$^-$	8,800	
PFOA$^-$	4,000	
PFPeS$^-$	3,800	
PFBS$^-$	3,100	

MW-7

Compound	Pre-TOPs (ng/L)	% Makeup
PFOS$^-$	98,000	51%
PFHxS$^-$	40,000	21%
PFHxA$^-$	16,000	8%
PFPeA$^-$	14,000	7%
PFPeS$^-$	6,100	3%
Other	19,112	10%
Total:	**193,212**	**100%**
PFBS$^-$	5,700	
PFBA$^-$	3,900	
PFOA$^-$	3,600	
PFHpA$^-$	3,500	
PFHpS$^-$	2,200	
PFNA$^-$	120	
5:3 FTCA$^-$	44	
4:2 FTS$^-$	24	
PFDA$^-$	10	
PFMBA$^-$	8.6	
PFMPA$^-$	5.6	

MW-8

Compound	Pre-TOPs (ng/L)	% Makeup
PFOS$^-$	76	24%
PFHxS$^-$	62	19%
PFPeA$^-$	46	14%
PFBA$^-$	43	13%
PFHxA$^-$	37	11%
Other	58	18%
Total:	**322**	**100%**
6:2 FTS$^-$	24	
PFHpA$^-$	12	
PFPeS$^-$	10	
PFBS$^-$	7	
PFOA$^-$	6	

MW-9

Compound	Pre-TOPs (ng/L)	% Makeup
PFHxA$^-$	3,800	23%
PFHxS$^-$	3,100	19%
PFBS$^-$	2,700	16%
PFPeA$^-$	2,300	14%
PFOS$^-$	1,700	10%
Other	2,922	18%
Total:	**16,522**	**100%**
PFPeS$^-$	1,400	
PFBA$^-$	920	
6:2 FTS$^-$	560	
PFHpS$^-$	42	

Compound	KFTA DU5D		KFTA DU5E		KFTA DU5F	
	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)	Pre-TOPs (µg/Kg)	Post-TOPs (µg/Kg)
PFBA	15	52	12	89	13	86
PFPeA	16	57	16	88	16	77
PFHxA	15	99	14	145	14	128
PFHpA	2.2	18	2.6	23	2.6	23
PFOA	3.8	22	4.0	30	4.2	27
PFNA	4.9	11	5.0	14	4.7	13
PFDA	4.6	8.2	5.0	12	5.1	11
PFUnA	6.2	5.9	5.4	6.9	6.2	7.3
PFDoA	1.6	2.0	1.8	2.7	1.9	2.8
PFTrDA	0.49	0.88	0.54	0.93	0.55	1.0
PFTeDA	0.32	0.56	0.44	0.66	0.28	0.70
PFBS	7.1	7.2	6.9	7.8	6.2	7.1
PFPeS	6.1	6.6	6.3	7.5	4.8	6.6
PFHxS	36	39	37	44	32	44
PFHpS	5.2	5.4	5.2	7.5	5.0	7.4
PFOS	720	710	726	914	788	871
PFNS	4.2	2.4	3.6	2.8	3.9	2.8
PFDS	4.7	2.3	4.5	2.4	5.2	2.7
PFDoS	1.5	0.67	1.6	0.97	1.8	0.95
4:2 FTS	ND (<0.82)	ND (<1.6)	ND (<0.82)	ND (<1.6)	ND (<0.82)	ND (<1.6)
6:2 FTS	15	ND (<1.5)	17	ND (<1.5)	27	ND (<1.5)
8:2 FTS	6.3	ND (<1.4)	6.6	ND (<1.4)	8.4	ND (<1.4)
PFOSA	1.2	ND (<0.41)	1.2	ND (<0.41)	1.3	ND (<0.41)
Total:	**878**	**1,051**	**882**	**1,398**	**952**	**1,319**

AFFF #2 Soil (Kahului Fire Training Area)

KFTA-DU5D

Compound	Pre-TOPs Soil (µg/kg)	% Makeup
PFOS	720	82%
PFHxS	36	4%
PFPeA	16	2%
PFHxA	15	2%
6:2 FTS	15	2%
Other	75	9%
Total:	**878**	**100%**
PFBA	15	
PFBS	7.1	
8:2 FTS	6.3	
PFUnA	6.2	
PFPeS	6.1	
PFHpS	5.2	
PFNA	4.9	
PFDS	4.7	
PFDA	4.6	
PFNS	4.2	
PFOA	3.8	
PFHpA	2.2	
PFDoA	1.6	
PFDoS	1.5	
PFOSA	1.2	
PFTrDA	0.49	
PFTeDA	0.32	

KFTA-DU5D

Compound	Post-TOPs Soil (µg/kg)	% Makeup
PFOS	710	68%
PFHxA	99	9%
PFPeA	57	5%
PFBA	52	5%
PFHxS	39	4%
Other	94	9%
Total:	**1,051**	**100%**
PFOA	22	
PFHpA	18	
PFNA	11	
PFDA	8.2	
PFBS	7.2	
PFPeS	6.6	
PFUnA	5.9	
PFHpS	5.4	
PFNS	2.4	
PFDS	2.3	
PFDoA	2.0	
PFTrDA	0.88	
PFDoS	0.67	
PFTeDA	0.56	

KFTA-DU5E

Compound	Pre-TOPs Soil (µg/kg)	% Makeup
PFOS	726	82%
PFHxS	37	4%
6:2 FTS	17	2%
PFPeA	16	2%
PFHxA	14	1.6%
Other	72	8%
Total:	**882**	**100%**
PFBA	12	
PFBS	6.9	
8:2 FTS	6.6	
PFPeS	6.3	
PFUnA	5.4	
PFHpS	5.2	
PFDA	5.0	
PFNA	5.0	
PFDS	4.5	
PFOA	4.0	
PFNS	3.6	
PFHpA	2.6	
PFDoA	1.8	
PFDoS	1.6	
PFOSA	1.2	
PFTrDA	0.54	
PFTeDA	0.44	

KFTA-DU5E

Compound	Post-TOPs Soil (µg/kg)	% Makeup
PFOS	914	65%
PFHxA	145	10%
PFBA	89	6%
PFPeA	88	6%
PFHxS	44	3%
Other	118	8%
Total:	**1,398**	**100%**
PFOA	30	
PFHpA	23	
PFNA	14	
PFDA	12	
PFBS	7.8	
PFHpS	7.5	
PFPeS	7.5	
PFUnA	6.9	
PFNS	2.8	
PFDoA	2.7	
PFDS	2.4	
PFDoS	0.97	
PFTrDA	0.93	
PFTeDA	0.66	

AFFF #2 Soil (Kahului Fire Training Area)

KFTA-DU5F

Compound	Pre-TOPs Soil (µg/kg)	% Makeup
PFOS	788	83%
PFHxS	32	3%
6:2 FTS	27	3%
PFPeA	16	2%
PFHxA	14	1%
Other	75	8%
Total:	**952**	**100%**
PFBA	13	
8:2 FTS	8.4	
PFUnA	6.2	
PFBS	6.2	
PFDS	5.2	
PFDA	5.1	
PFHpS	5.0	
PFPeS	4.8	
PFNA	4.7	
PFOA	4.2	
PFNS	3.9	
PFHpA	2.6	
PFDoA	1.9	
PFDoS	1.8	
PFOSA	1.3	
PFTrDA	0.55	
PFTeDA	0.28	

KFTA-DU5F

Compound	Post-TOPs Soil (µg/kg)	% Makeup
PFOS	871	66%
PFHxA	128	10%
PFBA	86	7%
PFPeA	77	6%
PFHxS	44	3%
Other	113	9%
Total:	**1,319**	**100%**
PFOA	27	
PFHpA	23	
PFNA	13	
PFDA	11	
PFHpS	7.4	
PFUnA	7.3	
PFBS	7.1	
PFPeS	6.6	
PFNS	2.8	
PFDoA	2.8	
PFDS	2.7	
PFTrDA	1.0	
PFDoS	0.95	
PFTeDA	0.70	

AFFF Release Site #2 Sample Method Reporting Levels

	MW-1		MW-2		MW-3		MW-4		MW-5		MW-7		MW-8		MW-9	
Compound	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)
PFBA$^-$	25,000	25,000	25,000	25,000	13,000	25,000	5,000	5,000	5,000	5,000	1,300	5,000	13	13	13	1,300
PFPeA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	50	500
PFHxA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	50	500
PFHpA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	5.0	500
PFOA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	5.0	500
PFNA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFDA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFUnDA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFDoDA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFTrDA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFTeDA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFBS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	50	500
PFPeS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	50	500
PFHxS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	5.0	500
PFHpS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	5.0	500
PFOS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFNS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFDS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFDoS-	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
4:2 FTS$^-$	25,000	25,000	25,000	25,000	13,000	25,000	5,000	5,000	5,000	5,000	1,300	5,000	13	13	13	1,300
6:2 FTS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
8:2 FTS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFOSA$^-$	500	10,000	500	10,000	500	10,000	500	2,000	500	2,000	5.0	2,000	5.0	5.0	5.0	500
N-MeFOSA$^-$	500	10,000	500	10,000	500	10,000	500	2,000	500	2,000	5.0	2,000	5.0	5.0	5.0	500
N-EtFOSA$^-$	25,000	25,000	25,000	25,000	13,000	25,000	5,000	5,000	5,000	5,000	13	5,000	13	13	13	1,300
MeFOSAA$^-$	25,000	25,000	25,000	25,000	13,000	25,000	5,000	5,000	5,000	5,000	13	5,000	13	13	13	1,300
EtFOSAA$^-$	1,000	20,000	1,000	20,000	1,000	20,000	1,000	4,000	1,000	4,000	10	4,000	10	10	10	1,000
N-MeFOSE$^-$	500	10,000	500	10,000	500	10,000	500	2,000	500	2,000	5	2,000	5.0	5.0	5.0	500
N-EtFOSE$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	500	2,000	5.0	5.0	50	500
HFPO-DA$^-$	20,000	20,000	20,000	20,000	10,000	20,000	4,000	4,000	4,000	4,000	10	4,000	10	10	10	1,000
ADONA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
9Cl-PF3ONS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500

Compound	MW-1		MW-2		MW-3		MW-4		MW-5		MW-7		MW-8		MW-9	
	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)	Pre-TOPs (ng/L)	Post-TOPs (ng/L)
11Cl-PF3OUdS$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
3:3 FTCA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
5:3 FTCA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
7:3 FTCA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFEESA$^-$	10,000	10,000	10,000	10,000	5,000	10,000	2,000	2,000	2,000	2,000	5.0	2,000	5.0	5.0	5.0	500
PFMPA$^-$	10,000	5.0	10,000	5.0	5,000	5.0	2,000	5.0	2,000	5.0	5.0	5.0	5.0	5.0	5.0	5.0
PFMBA$^-$	10,000	5.0	10,000	5.0	5,000	5.0	2,000	5.0	2,000	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NFDHA$^-$	10,000	5.0	10,000	5.0	5,000	5.0	2,000	5.0	2,000	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Appendix 10. Background Soil Data

Compound	[1]KOKEE-BCKG		[2]KP-BCKG		[3]NPALI-BCKG		[4]MP-BCKG	
	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)
PFBA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	1.1	ND(<0.99)	ND(<0.98)
PFPeA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFHxA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFHpA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFOA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFNA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFDA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFUnDA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFDoDA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFTrDA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFTeDA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFBS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFPeS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFHxS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFHpS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFOS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFNS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFDS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFDoS-	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
4:2 FTS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
6:2 FTS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
8:2 FTS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFOSA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
N-MeFOSA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
N-EtFOSA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
MeFOSAA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
EtFOSAA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
N-MeFOSE$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
N-EtFOSE$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
HFPO-DA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
ADONA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
9Cl-PF3ONS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
11Cl-PF3OUdS$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
3:3 FTCA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
5:3 FTCA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
7:3 FTCA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFEESA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFMPA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
PFMBA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
NFDHA$^-$	ND(<0.96)	ND(<0.98)	ND(<0.99)	ND(<0.96)	ND(<0.98)	ND(<0.97)	ND(<0.99)	ND(<0.98)
Total:	**ND**	**ND**	**ND**	**ND**	**ND**	**1.1**	**ND**	**ND**

Compound	[5]POLI-PFAS-BCKG		[6]MAK-PFHI-BCKG		[7]ML#1		[8]KUD		[9]KALOLI POINT BCKG	
	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)	Pre-TOPs PFASs (µg/Kg)	Post-TOPs PFASs (µg/Kg)
PFBA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFPeA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFHxA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFHpA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFOA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFNA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFDA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFUnDA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFDoDA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFTrDA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFTeDA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFBS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFPeS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFHxS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFHpS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFOS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFNS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFDS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFDoS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
4:2 FTS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
6:2 FTS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
8:2 FTS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFOSA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
N-MeFOSA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
N-EtFOSA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
MeFOSAA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
EtFOSAA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
N-MeFOSE-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
N-EtFOSE-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
HFPO-DA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
ADONA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
9Cl-PF3ONS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
11Cl-PF3OUdS-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
3:3 FTCA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
5:3 FTCA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
7:3 FTCA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFEESA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFMPA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
PFMBA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
NFDHA-	ND(<0.99)	ND(<0.97)	ND(<0.99)	ND(<0.99)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.96)	ND(<0.99)	ND(<0.99)
Total:	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**

Background Soil Notes

1. KOKEE-BCKG: Koke'e State Park, Kauai.
2. KP-BCKG: Ka'ena Point, O'ahu.
3. NPALI-BCKG: Nu'uanu Pali, O'ahu.
4. MP-BCKG: Makapu'u Point, O'ahu.
5. POLI-PFAS-BCKG: Polipoli State Recreation Area/Haleakala (Maui)
6. MAK-PFHI-BCKG: Pu’u One’uli
7. ML#1: Mauna Loa, Big Island.
8. KUD: Ka'u Desert, Big Island.
9. KALOLI POINT BCKG: Kaloli Point, Big Island.

Appendix 11. Total PFAS Risk Summary Worksheets

WWTP Total PFAS Risk Worksheets

Project Name: WWTP #1
Sample ID: Influent
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1,695	3.15	0.00	0.00	0.9%		1.8	1.9E-03	0.0E+00	**0.1%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	0.43	0.00	0.00	0.1%		0.4	7.5E-04	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	7.7	3.25	4.29	1.04	0.9%	7.0%	2.7	4.2E-01	1.4E-01	**19.1%**	**41.8%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	7.7	9.43	7.32	0.00	2.6%		6.1	1.2E+00	0.0E+00	**55.5%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	328.00	0.00	0.00	89.6%		164.0	1.8E-02	0.0E+00	**0.8%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	14,615	3.37	0.00	0.00	0.9%		2.1	2.3E-04	0.0E+00	**0.0%**	**0.0%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	1,538	5.19	11.90	6.71	1.4%	45.1%	7.7	3.4E-03	4.4E-03	**0.2%**	**1.3%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	1,923	4.97	9.55	4.58	1.4%	30.8%	6.4	2.6E-03	2.4E-03	**0.1%**	**0.7%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	77	2.94	3.49	0.55	0.8%	3.7%	2.4	3.8E-02	7.2E-03	**1.7%**	**2.2%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	12	4.08	6.09	2.01	1.1%	13.5%	4.2	3.5E-01	1.7E-01	**16.0%**	**53.9%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	12	0.80	0.00	0.00	0.2%		0.6	7.0E-02	0.0E+00	**3.2%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	7.7	0.56	0.00	0.00	0.2%		0.4	7.3E-02	0.0E+00	**3.3%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**366**	**43**	**15**	**100%**	**100%**	**199**	**2.2**	**0.3**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**1,400**
[4]Excess Fluorine (ng/L):	**1,201**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**2,078**
Excess Fluorine Hazard Quotient:	**4.0**

Project Name: WWTP #1
Sample ID: Effluent
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1,695	5.32	3.45	0.00	1.2%		3.0	3.1E-03	0.0E+00	**0.1%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	0.82	0.00	0.00	0.2%		0.7	1.4E-03	0.0E+00	**0.1%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	7.7	5.52	5.30	0.00	1.2%		3.4	7.2E-01	0.0E+00	**26.1%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	7.7	11.00	8.88	0.00	2.5%		7.1	1.4E+00	0.0E+00	**52.0%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	398.00	0.00	0.00	90.1%		199.0	2.2E-02	0.0E+00	**0.8%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	14,615	3.06	0.00	0.00	0.7%		1.9	2.1E-04	0.0E+00	**0.0%**	**0.0%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	1,538	4.95	11.80	6.85	1.1%	50.5%	7.7	3.2E-03	4.5E-03	**0.1%**	**7.9%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	1,923	5.03	10.20	5.17	1.1%	38.1%	6.8	2.6E-03	2.7E-03	**0.1%**	**4.8%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	77	2.22	3.38	1.16	0.5%	8.5%	2.3	2.9E-02	1.5E-02	**1.0%**	**26.9%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	12	4.57	4.96	0.39	1.0%	2.9%	3.4	4.0E-01	3.4E-02	**14.4%**	**60.3%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	12	0.83	0.00	0.00	0.2%		0.6	7.2E-02	0.0E+00	**2.6%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	7.7	0.56	0.00	0.00	0.1%		0.4	7.3E-02	0.0E+00	**2.6%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**442**	**48**	**14**	**100%**	**100%**	**236**	**2.8**	**0.1**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**1,500**
[4]Excess Fluorine (ng/L):	**1,264**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**2,186**
Excess Fluorine Hazard Quotient:	**4.3**

Project Name: WWTP #1
Sample ID: Biosolids
Date:

Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations		% Total Risk	
											Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C4F9SO3^-$	299	3,793	11.80	3.19	0.00	18.2%	6.7	1.82	3.1E-03	0.0E+00	**0.2%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C5F11SO3^-$	349	1,909	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C6F13SO3^-$	399	25	21.30	0.68	0.00	32.8%	13.2	0.42	8.4E-01	0.0E+00	**45.4%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C7F15SO3^-$	449	126	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C8F17SO3^-$	499	25	21.40	16.40	0.00	33.0%	13.8	10.61	8.5E-01	0.0E+00	**45.6%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C10F21SO3^-$	599	126	0.00	0.71	0.71		0.5	0.47	0.0E+00	5.6E-03	**0.0%**	**0.9%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C2F3O2^-$	114	29,087	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C3F5O2^-$	164	5,038	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C3F7COO^-$	213	48,042	0.00	44.00	44.00		27.5	27.47	0.0E+00	9.2E-04	**0.0%**	**0.2%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C4F9COO^-$	263	5,057	1.01	47.20	46.19	1.6%	30.7	30.68	2.0E-04	9.1E-03	**0.0%**	**1.5%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C5F11CO2^-$	313	6,321	1.13	34.40	33.27	1.7%	23.0	22.96	1.8E-04	5.3E-03	**0.0%**	**0.9%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C6F13CO2^-$	363	253	0.00	11.00	11.00		7.5	7.48	0.0E+00	4.4E-02	**0.0%**	**7.3%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C7F15CO2^-$	413	38	0.72	12.30	11.58	1.1%	8.5	8.49	1.9E-02	3.1E-01	**1.0%**	**51.4%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C8F17CO2^-$	463	38	1.17	4.75	3.58	1.8%	3.3	3.31	3.1E-02	9.4E-02	**1.7%**	**15.9%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C9F19CO2^-$	513	25	1.59	3.97	2.38	2.4%	2.8	2.79	6.3E-02	9.4E-02	**3.4%**	**15.8%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C10F21CO2^-$	563	63	1.56	2.51	0.95	2.4%	1.8	1.78	2.5E-02	1.5E-02	**1.3%**	**2.5%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C11F23CO2^-$	613	85	1.38	2.56	1.18	2.1%	1.8	1.82	1.6E-02	1.4E-02	**0.9%**	**2.3%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C12F25CO2^-$	663	85	0.75	1.30	0.55	1.2%	0.9	0.93	8.9E-03	6.5E-03	**0.5%**	**1.1%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C13F27CO2^-$	713	847	1.13	1.38	0.25	1.7%	1.0	0.99	1.3E-03	3.0E-04	**0.1%**	**0.0%**
				Totals:	**65**	**186**	**156**	**100%**	**14296%**	**122**	**1.9**	**0.6**	**100.0%**	**100.0%**

Input Sample TOF (µg/kg):	509
[4]Excess Fluorine (µg/kg):	387
[5]Excess Fluorine Mass Adjustment Factor:	1.73
[6]Excess Fluorine PFASs (µg/kg):	669
Excess Fluorine Hazard Quotient:	0.1

Project Name: WWTP #2
Sample ID: Influent
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1,695	6.01	0.00	0.00	1.8%		3.4	3.5E-03	0.0E+00	**0.3%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	7.7	1.37	0.00	0.00	0.4%		0.8	1.8E-01	0.0E+00	**14.7%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	7.7	6.53	3.20	0.00	2.0%		4.2	8.5E-01	0.0E+00	**70.1%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	300.00	0.00	0.00	91.9%		150.0	1.7E-02	0.0E+00	**1.4%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	14,615	2.67	0.00	0.00	0.8%		1.7	1.8E-04	0.0E+00	**0.0%**	**0.0%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	1,538	3.39	8.29	4.90	1.0%	53.4%	5.4	2.2E-03	3.2E-03	**0.2%**	**2.4%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	1,923	3.80	6.58	2.78	1.2%	30.3%	4.4	2.0E-03	1.4E-03	**0.2%**	**1.1%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	77	0.80	0.00	0.00	0.2%		0.5	1.0E-02	0.0E+00	**0.9%**	**0.0%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	12	1.71	3.20	1.49	0.5%	16.2%	2.2	1.5E-01	1.3E-01	**12.2%**	**96.5%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**326**	**21**	**9**	**100%**	**100%**	**173**	**1.2**	**0.1**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**1,500**
[4]Excess Fluorine (ng/L):	**1,327**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**2,296**
Excess Fluorine Hazard Quotient:	**4.5**

Project Name: WWTP #2
Sample ID: Effluent
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1,695	6.68	0.00	0.00	1.3%		3.8	3.9E-03	0.0E+00	**0.4%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	7.7	1.40	0.00	0.00	0.3%		0.9	1.8E-01	0.0E+00	**16.6%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	7.7	4.00	0.00	0.00	0.8%		2.6	5.2E-01	0.0E+00	**47.3%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	484.00	0.00	0.00	93.2%		242.0	2.7E-02	0.0E+00	**2.4%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	14,615	3.67	16.30	12.63	0.7%	49.0%	10.2	2.5E-04	8.6E-04	**0.0%**	**0.5%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	1,538	7.61	16.50	8.89	1.5%	34.5%	10.7	4.9E-03	5.8E-03	**0.5%**	**3.6%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	1,923	7.18	9.68	2.50	1.4%	9.7%	6.5	3.7E-03	1.3E-03	**0.3%**	**0.8%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	77	1.01	0.00	0.00	0.2%		0.7	1.3E-02	0.0E+00	**1.2%**	**0.0%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	12	2.80	4.54	1.74	0.5%	6.8%	3.1	2.4E-01	1.5E-01	**22.1%**	**95.0%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	12	0.42	0.00	0.00	0.1%		0.3	3.6E-02	0.0E+00	**3.3%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	7.7	0.50	0.00	0.00	0.1%		0.4	6.5E-02	0.0E+00	**5.9%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**519**	**47**	**26**	**100%**	**100%**	**281**	**1.1**	**0.2**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**1,900**
[4]Excess Fluorine (ng/L):	**1,619**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**2,801**
Excess Fluorine Hazard Quotient:	**5.5**

Facility WWTP #2
Sample ID: Biosolids Sample HNWWTP BIOS
Date: July 9, 2024
Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations		% Total Risk	
											Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C4F9SO3^-$	299	1.6E+04	7.40	13.93	6.53	19.2%	2.3%	7.97	4.5E-04	4.0E-04	**0.1%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C5F11SO3^-$	349	8.3E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C6F13SO3^-$	399	2.5E+01		0.35	0.35		0.1%	0.22		1.4E-02		**1.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C7F15SO3^-$	449	1.3E+02										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C8F17SO3^-$	499	2.5E+01	8.39	8.48	0.09	21.8%	0.0%	5.49	3.3E-01	3.7E-03	**55.5%**	**0.3%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C10F21SO3^-$	599	1.3E+02	2.11	1.58		5.5%		1.05	1.7E-02		**2.8%**	
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C3F5O2^-$	164	5.0E+03										
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C3F7COO^-$	213	4.8E+04	1.95	96.93	94.98	5.1%	33.1%	60.51	4.1E-05	2.0E-03	**0.0%**	**0.1%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C4F9COO^-$	263	5.1E+03	1.60	73.03	71.43	4.2%	24.9%	47.47	3.2E-04	1.4E-02	**0.1%**	**1.0%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C5F11CO2^-$	313	6.3E+03	5.05	50.10	45.05	13.1%	15.7%	33.44	8.0E-04	7.1E-03	**0.1%**	**0.5%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C6F13CO2^-$	363	2.5E+02		21.00	21.00		7.3%	14.29		8.3E-02		**6.1%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C7F15CO2^-$	413	3.8E+01	1.67	27.40	25.73	4.3%	9.0%	18.90	4.4E-02	6.8E-01	**7.4%**	**49.4%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C8F17CO2^-$	463	3.8E+01	0.50	10.08	9.58	1.3%	3.3%	7.03	1.3E-02	2.5E-01	**2.2%**	**18.4%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C9F19CO2^-$	513	2.5E+01	3.23	9.07	5.84	8.4%	2.0%	6.38	1.3E-01	2.3E-01	**21.4%**	**16.8%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C10F21CO2^-$	563	6.3E+01	1.25	4.33	3.08	3.2%	1.1%	3.07	2.0E-02	4.9E-02	**3.3%**	**3.5%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C11F23CO2^-$	613	8.5E+01	2.14	4.76	2.62	5.6%	0.9%	3.39	2.5E-02	3.1E-02	**4.2%**	**2.3%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C12F25CO2^-$	663	8.5E+01	1.32	1.86	0.54	3.4%	0.2%	1.33	1.6E-02	6.4E-03	**2.6%**	**0.5%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C13F27CO2^-$	713	8.5E+02	1.87	2.14	0.27	4.9%	0.1%	1.54	2.2E-03	3.1E-04	**0.4%**	**0.0%**
				Totals:	**38**	**325**	**287**	**100%**	**100%**	**212**	**0.6**	**1.4**	**100.0%**	**100.0%**

Input Sample TOF (µg/kg):	**532**
[4]Excess Fluorine (µg/kg):	**320**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Excess Fluorine PFASs (µg/kg):	**553**
Excess Fluorine Hazard Quotient:	**0.1**

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #3
Sample ID: Influent Sample KIWWTP INFL
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	3.18			14.3%			4.3E-04		**0.1%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	0.94			4.2%			1.2E-01		**14.3%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01										
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	2.35			10.6%			3.1E-01		**36.0%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	3.24			14.6%			2.2E-04		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	2.48			11.2%			1.6E-03		**0.2%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	5.53			24.9%			2.9E-03		**0.3%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01										
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	3.32			14.9%			2.9E-01		**33.9%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	0.55			2.5%			4.7E-02		**5.6%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	0.63			2.8%			8.2E-02		**9.7%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**22**			**100%**			**0.8**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #3
Sample ID: Effluent Sample KIWWTP EFFL
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	5.27			3.7%			7.2E-04		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	0.97			0.7%			1.3E-01		**5.2%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01										
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	2.36			1.6%			3.1E-01		**12.8%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	3.65			2.5%			2.5E-04		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	58.00			40.2%			3.8E-02		**1.6%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	50.30			34.8%			2.6E-02		**1.1%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	3.25			2.3%			4.2E-02		**1.8%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	17.80			12.3%			1.5E+00		**64.1%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	0.74			0.5%			6.4E-02		**2.7%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	2.00			1.4%			2.6E-01		**10.8%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**144**			**100%**			**2.4**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #3
Sample ID: Biosolids Sample KIWWTP BIOS
Date: July 9, 2024
Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations		% Total Risk	
											Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C4F9SO3^-$	299	1.6E+04	1.86	6.98	5.12	2.8%	0.7%	3.99	1.1E-04	3.1E-04	0.0%	0.0%
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C5F11SO3^-$	349	8.3E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C6F13SO3^-$	399	2.5E+01										
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C7F15SO3^-$	449	1.3E+02										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C8F17SO3^-$	499	2.5E+01	10.70	12.30	1.60	16.1%	0.2%	7.96	4.2E-01	6.3E-02	26.5%	1.7%
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C10F21SO3^-$	599	1.3E+02										
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C3F5O2^-$	164	5.0E+03										
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C3F7COO^-$	213	4.8E+04		283.00	283.00		39.4%	176.66		5.9E-03		0.2%
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C4F9COO^-$	263	5.1E+03	4.63	179.00	174.37	7.0%	24.3%	116.35	9.2E-04	3.4E-02	0.1%	0.9%
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C5F11CO2^-$	313	6.3E+03	3.56	64.00	60.44	5.4%	8.4%	42.72	5.6E-04	9.6E-03	0.0%	0.3%
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C6F13CO2^-$	363	2.5E+02	0.79	58.40	57.61	1.2%	8.0%	39.73	3.1E-03	2.3E-01	0.2%	6.3%
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C7F15CO2^-$	413	3.8E+01	7.29	44.60	37.31	11.0%	5.2%	30.77	1.9E-01	9.8E-01	12.0%	27.1%
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C8F17CO2^-$	463	3.8E+01	1.18	33.00	31.82	1.8%	4.4%	23.02	3.1E-02	8.4E-01	2.0%	23.1%
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C9F19CO2^-$	513	2.5E+01	19.67	44.00	24.33	29.7%	3.4%	30.95	7.8E-01	9.6E-01	48.7%	26.5%
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C10F21CO2^-$	563	6.3E+01	1.63	17.30	15.67	2.5%	2.2%	12.26	2.6E-02	2.5E-01	1.6%	6.8%
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C11F23CO2^-$	613	8.5E+01	10.30	24.90	14.60	15.5%	2.0%	17.75	1.2E-01	1.7E-01	7.6%	4.7%
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C12F25CO2^-$	663	8.5E+01	1.43	8.07	6.64	2.2%	0.9%	5.78	1.7E-02	7.8E-02	1.1%	2.2%
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C13F27CO2^-$	713	8.5E+02	3.22	9.66	6.44	4.9%	0.9%	6.95	3.8E-03	7.6E-03	0.2%	0.2%
				Totals:	66	785	719	100%	100%		1.6	3.6	100.0%	100.0%

Input Sample TOF (µg/kg):	
[4]Excess Fluorine (µg/kg):	
[5]Excess Fluorine Mass Adjustment Factor:	1.73
[6]Excess Fluorine PFASs (µg/kg):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #4
Sample ID: Influent Sample HLWWTP INFL
Date: July 9, 2024

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03										
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	1.02			4.7%			1.3E-01		**16.1%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01										
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	2.82			13.0%			3.7E-01		**44.5%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	3.87			17.8%			2.6E-04		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	1.84			8.5%			1.2E-03		**0.1%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	8.33			38.4%			4.3E-03		**0.5%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	0.48			2.2%			6.2E-03		**0.7%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	2.80			12.9%			2.4E-01		**29.4%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01										
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	0.54			2.5%			7.0E-02		**8.5%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**22**			**100%**			**0.8**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #4
Sample ID: Effluent Sample HLWWTP EFFL
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03										
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	2.51			19.5%			9.9E-04		**0.1%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	6.83			53.1%			8.9E-01		**75.6%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	0.61			4.7%			1.6E-02		**1.4%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	2.06			16.0%			2.7E-01		**22.8%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02	0.86			6.7%			1.7E-03		**0.1%**	
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04										
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03										
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03										
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01										
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01										
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01										
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00										
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**13**			**100%**			**1.2**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #4
Sample ID: Biosolids Sample HLWWTP BIOS
Date: July 9, 2024
Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations		% Total Risk	
											Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C4F9SO3^-$	299	1.6E+04		22.70	22.70		2.5%	12.98		1.4E-03		**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C5F11SO3^-$	349	8.3E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C6F13SO3^-$	399	2.5E+01										
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C7F15SO3^-$	449	1.3E+02										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C8F17SO3^-$	499	2.5E+01	6.66	9.03	2.37	29.3%	0.3%	5.84	2.6E-01	9.4E-02	**56.6%**	**2.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C10F21SO3^-$	599	1.3E+02	4.20	1.66		18.5%		1.11	3.3E-02		**7.1%**	
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C3F5O2^-$	164	5.0E+03										
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C3F7COO^-$	213	4.8E+04		282.00	282.00		30.6%	176.04		5.9E-03		**0.1%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C4F9COO^-$	263	5.1E+03		232.00	232.00		25.2%	150.81		4.6E-02		**1.0%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C5F11CO2^-$	313	6.3E+03	2.03	144.00	141.97	8.9%	15.4%	96.13	3.2E-04	2.2E-02	**0.1%**	**0.5%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C6F13CO2^-$	363	2.5E+02		71.30	71.30		7.7%	48.50		2.8E-01		**6.2%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C7F15CO2^-$	413	3.8E+01	0.64	67.80	67.16	2.8%	7.3%	46.77	1.7E-02	1.8E+00	**3.6%**	**38.6%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C8F17CO2^-$	463	3.8E+01		34.20	34.20		3.7%	23.85		9.0E-01		**19.7%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C9F19CO2^-$	513	2.5E+01	1.95	26.40	24.45	8.6%	2.7%	18.57	7.7E-02	9.7E-01	**16.6%**	**21.1%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C10F21CO2^-$	563	6.3E+01	1.23	16.60	15.37	5.4%	1.7%	11.76	1.9E-02	2.4E-01	**4.2%**	**5.3%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C11F23CO2^-$	613	8.5E+01	3.17	17.40	14.23	14.0%	1.5%	12.40	3.7E-02	1.7E-01	**8.0%**	**3.7%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C12F25CO2^-$	663	8.5E+01	1.31	7.56	6.25	5.8%	0.7%	5.41	1.5E-02	7.4E-02	**3.3%**	**1.6%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C13F27CO2^-$	713	8.5E+02	1.53	9.46	7.93	6.7%	0.9%	6.80	1.8E-03	9.4E-03	**0.4%**	**0.2%**
				Totals:	**23**	**942**	**922**	**100%**	**100%**		**0.5**	**4.6**	**100.0%**	**100.0%**
									Input Sample TOF (µg/kg):					
									[4]Excess Fluorine (µg/kg):					
									[5]Excess Fluorine Mass Adjustment Factor:	**1.73**				
									[6]Excess Fluorine PFASs (µg/kg):					
									Excess Fluorine Hazard Quotient:					

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #5
Sample ID: Influent Sample LIWWTP INFL
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03										
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	0.61			1.7%			7.9E-02		**5.2%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01										
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	4.66			13.0%			6.1E-01		**40.2%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	3.33			9.3%			2.3E-04		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	1.96			5.5%			1.3E-03		**0.1%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	15.70			43.8%			8.2E-03		**0.5%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	0.72			2.0%			9.3E-03		**0.6%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	5.84			16.3%			5.1E-01		**33.6%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	0.68			1.9%			5.9E-02		**3.9%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	1.63			4.6%			2.1E-01		**14.1%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01	0.00						0.0E+00		**0.0%**	
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01	0.70			1.9%			2.7E-02		**1.8%**	
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**36**			**100%**			**1.5**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #5
Sample ID: Effluent Sample LIWWTP EFFL
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	2.25			7.0%			3.1E-04		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	0.55			1.7%			7.1E-02		**8.0%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01										
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	2.75			8.5%			3.6E-01		**40.4%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	2.59			8.0%			1.8E-04		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	11.30			35.0%			7.3E-03		**0.8%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	7.19			22.3%			3.7E-03		**0.4%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	1.17			3.6%			1.5E-02		**1.7%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	2.93			9.1%			2.5E-01		**28.7%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	0.64			2.0%			5.5E-02		**6.2%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	0.93			2.9%			1.2E-01		**13.7%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
			Totals:		**32**			**100%**			**0.9**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility WWTP #5
Sample ID: Biosolids Sample LIWWTP BIOS
Date: July 9, 2024
Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations		% Total Risk	
											Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1.6E+04	0.62	32.20	31.58	1.1%	5.1%	18.41	3.8E-05	1.9E-03	**0.0%**	**0.1%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	8.3E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	2.5E+01		1.78	1.78		0.3%	1.10		7.0E-02		**1.8%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	1.3E+02										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	2.5E+01	24.27	26.00	1.73	42.2%	0.3%	16.82	9.6E-01	6.9E-02	**64.1%**	**1.8%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	1.3E+02	4.08	2.62		7.1%		1.74	3.2E-02		**2.2%**	
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	5.0E+03										
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	4.8E+04		183.00	183.00		29.5%	114.24		3.8E-03		**0.1%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	5.1E+03		122.00	122.00		19.7%	79.30		2.4E-02		**0.6%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	6.3E+03	4.65	91.90	87.25	8.1%	14.1%	61.35	7.4E-04	1.4E-02	**0.0%**	**0.4%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	2.5E+02		55.20	55.20		8.9%	37.55		2.2E-01		**5.7%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	3.8E+01	1.87	56.20	54.33	3.2%	8.8%	38.77	4.9E-02	1.4E+00	**3.3%**	**37.4%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	3.8E+01	0.53	27.30	26.77	0.9%	4.3%	19.04	1.4E-02	7.1E-01	**0.9%**	**18.4%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	2.5E+01	7.44	30.30	22.86	12.9%	3.7%	21.32	2.9E-01	9.0E-01	**19.7%**	**23.6%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	6.3E+01	2.33	13.90	11.57	4.0%	1.9%	9.85	3.7E-02	1.8E-01	**2.5%**	**4.8%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	8.5E+01	6.94	19.10	12.16	12.1%	2.0%	13.61	8.2E-02	1.4E-01	**5.5%**	**3.8%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	8.5E+01	2.09	6.27	4.18	3.6%	0.7%	4.49	2.5E-02	4.9E-02	**1.6%**	**1.3%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	8.5E+02	2.72	8.44	5.72	4.7%	0.9%	6.07	3.2E-03	6.8E-03	**0.2%**	**0.2%**
				Totals:	**58**	**676**	**620**	**100%**	**100%**		**1.5**	**3.8**	**100.0%**	**100.0%**
									Input Sample TOF (µg/kg):					
									[4]Excess Fluorine (µg/kg):					
									[5]Excess Fluorine Mass Adjustment Factor:	**1.73**				
									[6]Excess Fluorine PFASs (µg/kg):					
									Excess Fluorine Hazard Quotient:					

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Project Name: WWTP #6
Sample ID: Influent
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1,695	6.91	7.54	0.63	1.3%	0.2%	4.3	4.1E-03	3.7E-04	**0.5%**	**0.1%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	7.7	3.95	0.00	0.00	0.7%		2.6	5.1E-01	0.0E+00	**61.7%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	287.00	0.00	0.00	53.4%		143.5	1.6E-02	0.0E+00	**1.9%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	14,615	5.48	101.00	95.52	1.0%	35.7%	63.0	3.7E-04	6.5E-03	**0.0%**	**1.1%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	1,538	145.00	256.00	111.00	27.0%	41.5%	166.4	9.4E-02	7.2E-02	**11.3%**	**12.5%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	1,923	85.90	125.00	39.10	16.0%	14.6%	83.4	4.5E-02	2.0E-02	**5.4%**	**3.5%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	77	1.08	19.60	18.52	0.2%	6.9%	13.3	1.4E-02	2.4E-01	**1.7%**	**41.6%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	12	1.68	4.43	2.75	0.3%	1.0%	3.1	1.5E-01	2.4E-01	**17.5%**	**41.2%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**537**	**514**	**268**	**100%**	**100%**	**480**	**0.8**	**0.6**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**2,000**
[4]Excess Fluorine (ng/L):	**1,520**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**2,630**
Excess Fluorine Hazard Quotient:	**5.1**

Project Name: WWTP #6
Sample ID: Effluent
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	1,695	17.00	11.30	0.00	1.8%		9.7	1.0E-02	0.0E+00	**1.1%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7	0.97	0.00	0.00	0.1%		0.6	1.3E-01	0.0E+00	**14.3%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	308.00	0.00	0.00	31.7%		154.0	1.7E-02	0.0E+00	**1.9%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	14,615	11.50	35.30	23.80	1.2%	78.4%	22.0	7.9E-04	1.6E-03	**0.1%**	**0.4%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1,538	397.00	237.00	0.00	40.9%		258.1	2.6E-01	0.0E+00	**29.3%**	**0.0%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1,923	231.00	160.00	0.00	23.8%		154.2	1.2E-01	0.0E+00	**13.6%**	**0.0%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	77	1.87	3.53	1.66	0.2%	5.5%	2.4	2.4E-02	2.2E-02	**2.8%**	**4.8%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	12	3.14	8.05	4.91	0.3%	16.2%	5.6	2.7E-01	4.3E-01	**30.9%**	**94.8%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7	0.41	0.00	0.00	0.0%		0.3	5.3E-02	0.0E+00	**6.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**971**	**455**	**30**	**100%**	**100%**	**607**	**0.9**	**0.4**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**1,600**
[4]Excess Fluorine (ng/L):	**993**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**1,718**
Excess Fluorine Hazard Quotient:	**3.3**

Project Name: WWTP #6
Sample ID: Compost
Date:

Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations		% Total Risk	
											Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C4F9SO3^-$	299	3,793	7.77	7.94	0.17	13.6%	4.5	4.54	2.0E-03	4.5E-05	**0.5%**	**0.1%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C5F11SO3^-$	349	1,909	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C6F13SO3^-$	399	25	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C7F15SO3^-$	449	126	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C8F17SO3^-$	499	25	4.85	4.16	0.00	8.5%	3.1	2.69	1.9E-01	0.0E+00	**43.4%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C10F21SO3^-$	599	126	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C2F3O2^-$	114	29,087	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C3F5O2^-$	164	5,038	4.99	12.70	7.71	8.8%	7.4	7.36	9.9E-04	1.5E-03	**0.2%**	**4.9%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C3F7COO^-$	213	48,042	9.53	14.10	4.57	16.7%	8.8	8.80	2.0E-04	9.5E-05	**0.0%**	**0.3%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C4F9COO^-$	263	5,057	13.50	15.80	2.30	23.7%	10.3	10.27	2.7E-03	4.5E-04	**0.6%**	**1.5%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C5F11CO2^-$	313	6,321	1.50	2.68	1.18	2.6%	1.8	1.79	2.4E-04	1.9E-04	**0.1%**	**0.6%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C6F13CO2^-$	363	253	5.46	7.16	1.70	9.6%	4.9	4.87	2.2E-02	6.7E-03	**4.9%**	**21.7%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C7F15CO2^-$	413	38	1.04	1.61	0.57	1.8%	1.1	1.11	2.7E-02	1.5E-02	**6.2%**	**48.6%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C8F17CO2^-$	463	38	4.37	4.25	0.00	7.7%	3.0	2.96	1.2E-01	0.0E+00	**26.1%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C9F19CO2^-$	513	25	0.90	0.95	0.04	1.6%	0.7	0.67	3.6E-02	1.8E-03	**8.1%**	**5.8%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C10F21CO2^-$	563	63	2.12	1.85	0.00	3.7%	1.5	1.31	3.4E-02	0.0E+00	**7.6%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C11F23CO2^-$	613	85	0.00	0.43	0.43		0.3	0.31	0.0E+00	5.1E-03	**0.0%**	**16.4%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C12F25CO2^-$	663	85	0.91	0.82	0.00	1.6%	0.6	0.59	1.1E-02	0.0E+00	**2.4%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C13F27CO2^-$	713	847	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**57**	**74**	**19**	**100%**	**4805%**	**47**	**0.4**	**0.0**	**100.0%**	**100.0%**

Input Sample TOF (µg/kg):	271
[4]Excess Fluorine (µg/kg):	224
[5]Excess Fluorine Mass Adjustment Factor:	1.73
[6]Excess Fluorine PFASs (µg/kg):	387
Excess Fluorine Hazard Quotient:	0.1

Project Name: WWTP #6
Sample ID: Compost
Date:

Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations		% Total Risk	
											Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C4F9SO3^-$	299	3,793	7.77	7.94	0.17	13.6%	4.5	4.54	2.0E-03	4.5E-05	**0.5%**	**0.1%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C5F11SO3^-$	349	1,909	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C6F13SO3^-$	399	25	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C7F15SO3^-$	449	126	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C8F17SO3^-$	499	25	4.85	4.16	0.00	8.5%	3.1	2.69	1.9E-01	0.0E+00	**43.4%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C10F21SO3^-$	599	126	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C2F3O2^-$	114	29,087	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C3F5O2^-$	164	5,038	4.99	12.70	7.71	8.8%	7.4	7.36	9.9E-04	1.5E-03	**0.2%**	**4.9%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C3F7COO^-$	213	48,042	9.53	14.10	4.57	16.7%	8.8	8.80	2.0E-04	9.5E-05	**0.0%**	**0.3%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C4F9COO^-$	263	5,057	13.50	15.80	2.30	23.7%	10.3	10.27	2.7E-03	4.5E-04	**0.6%**	**1.5%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C5F11CO2^-$	313	6,321	1.50	2.68	1.18	2.6%	1.8	1.79	2.4E-04	1.9E-04	**0.1%**	**0.6%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C6F13CO2^-$	363	253	5.46	7.16	1.70	9.6%	4.9	4.87	2.2E-02	6.7E-03	**4.9%**	**21.7%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C7F15CO2^-$	413	38	1.04	1.61	0.57	1.8%	1.1	1.11	2.7E-02	1.5E-02	**6.2%**	**48.6%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C8F17CO2^-$	463	38	4.37	4.25	0.00	7.7%	3.0	2.96	1.2E-01	0.0E+00	**26.1%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C9F19CO2^-$	513	25	0.90	0.95	0.04	1.6%	0.7	0.67	3.6E-02	1.8E-03	**8.1%**	**5.8%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C10F21CO2^-$	563	63	2.12	1.85	0.00	3.7%	1.5	1.31	3.4E-02	0.0E+00	**7.6%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C11F23CO2^-$	613	85	0.00	0.43	0.43		0.3	0.31	0.0E+00	5.1E-03	**0.0%**	**16.4%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C12F25CO2^-$	663	85	0.91	0.82	0.00	1.6%	0.6	0.59	1.1E-02	0.0E+00	**2.4%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C13F27CO2^-$	713	847	0.00	0.00	0.00		0.0	0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**57**	**74**	**19**	**100%**	**4805%**	**47**	**0.4**	**0.0**	**100.0%**	**100.0%**

Input Sample TOF (µg/kg):	**271**
[4]Excess Fluorine (µg/kg):	**224**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Excess Fluorine PFASs (µg/kg):	**387**

Landfill Leachate Total PFAS Risk Worksheets

roject Name: LF #1
Sample ID: WGLF E-6
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	C4F9SO3$^-$	299	1,695	14000.00	13000.00	0.00	38.5%		8003.4	8.3E+00	0.0E+00	**1.9%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	C5F11SO3$^-$	349	581	190.00	120.00	0.00	0.5%		155.1	3.3E-01	0.0E+00	**0.1%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	C6F13SO3$^-$	399	7.7	620.00	680.00	60.00	1.7%	1.1%	420.8	8.1E+01	7.8E+00	**19.0%**	**70.3%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	C7F15SO3$^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	C8F17SO3$^-$	499	7.7	150.00	140.00	0.00	0.4%		97.1	2.0E+01	0.0E+00	**4.6%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	C10F21SO3$^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	C2F3O2$^-$	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	C3F5O2$^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	C3F7COO$^-$	213	14,615	2800.00	7300.00	4500.00	7.7%	84.0%	4557.1	1.9E-01	3.1E-01	**0.0%**	**2.8%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	C4F9COO$^-$	263	1,538	4400.00	5000.00	600.00	12.1%	11.2%	3250.1	2.9E+00	3.9E-01	**0.7%**	**3.5%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	C5F11CO2$^-$	313	1,923	9600.00	9600.00	0.00	26.4%		6408.6	5.0E+00	0.0E+00	**1.2%**	**0.0%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	C6F13CO2$^-$	363	77	1300.00	1500.00	200.00	3.6%	3.7%	1020.4	1.7E+01	2.6E+00	**4.0%**	**23.4%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	C7F15CO2$^-$	413	12	3200.00	3100.00	0.00	8.8%		2207.7	2.8E+02	0.0E+00	**65.4%**	**0.0%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	C8F17CO2$^-$	463	12	110.00	99.00	0.00	0.3%		76.7	9.5E+00	0.0E+00	**2.2%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	C9F19CO2$^-$	513	7.7	29.00	28.00	0.00	0.1%		20.4	3.8E+00	0.0E+00	**0.9%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	C10F21CO2$^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	C11F23CO2$^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	C12F25CO2$^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	C13F27CO2$^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**36,399**	**40,567**	**5,360**	**100%**	**100%**	**26,217**	**424.3**	**11.1**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**83,000**
[4]Excess Fluorine (ng/L):	**56,783**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**98,234**
Excess Fluorine Hazard Quotient:	**191.4**

roject Name: LF #1
Sample ID: WGLF 4B
Date:
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	C4F9SO3$^-$	299	1,695	3200.00	3100.00	0.00	10.9%		1829.4	1.9E+00	0.0E+00	**0.2%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	C5F11SO3$^-$	349	581	440.00	220.00	0.00	1.5%		359.3	7.6E-01	0.0E+00	**0.1%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	C6F13SO3$^-$	399	7.7	2900.00	2800.00	0.00	9.9%		1794.6	3.8E+02	0.0E+00	**41.4%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	C7F15SO3$^-$	449	38	43.00	39.00	0.00	0.1%		27.3	1.1E+00	0.0E+00	**0.1%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	C8F17SO3$^-$	499	7.7	1800.00	1700.00	0.00	6.1%		1164.7	2.3E+02	0.0E+00	**25.7%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	C10F21SO3$^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	C2F3O2$^-$	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	C3F5O2$^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	C3F7COO$^-$	213	14,615	5800.00	6700.00	900.00	19.7%	45.0%	4182.5	4.0E-01	6.2E-02	**0.0%**	**0.2%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	C4F9COO$^-$	263	1,538	4400.00	4900.00	500.00	15.0%	25.0%	3185.1	2.9E+00	3.3E-01	**0.3%**	**1.2%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	C5F11CO2$^-$	313	1,923	6200.00	6400.00	200.00	21.1%	10.0%	4272.4	3.2E+00	1.0E-01	**0.4%**	**0.4%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	C6F13CO2$^-$	363	77	1500.00	1600.00	100.00	5.1%	5.0%	1088.4	2.0E+01	1.3E+00	**2.1%**	**4.7%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	C7F15CO2$^-$	413	12	2900.00	3200.00	300.00	9.9%	15.0%	2207.7	2.5E+02	2.6E+01	**27.6%**	**93.6%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	C8F17CO2$^-$	463	12	140.00	120.00	0.00	0.5%		97.6	1.2E+01	0.0E+00	**1.3%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	C9F19CO2$^-$	513	7.7	46.00	43.00	0.00	0.2%		32.4	6.0E+00	0.0E+00	**0.7%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	C10F21CO2$^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	C11F23CO2$^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	C12F25CO2$^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	C13F27CO2$^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**29,369**	**30,822**	**2,000**	**100%**	**100%**	**20,241**	**910.2**	**27.8**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**51,000**
[4]Excess Fluorine (ng/L):	**30,759**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**53,212**
Excess Fluorine Hazard Quotient:	**103.7**

roject Name: LF #1
Sample ID: WGLF ASH
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	C4F9SO3$^-$	299	1,695	870.00	860.00	0.00	7.7%		497.4	5.1E-01	0.0E+00	**0.8%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	C5F11SO3$^-$	349	581	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	C6F13SO3$^-$	399	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	C7F15SO3$^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	C8F17SO3$^-$	499	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	C10F21SO3$^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	C2F3O2$^-$	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	C3F5O2$^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	C3F7COO$^-$	213	14,615	1400.00	1800.00	400.00	12.3%	35.6%	1123.7	9.6E-02	2.7E-02	**0.2%**	**0.3%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	C4F9COO$^-$	263	1,538	3100.00	3200.00	100.00	27.3%	8.9%	2080.1	2.0E+00	6.5E-02	**3.3%**	**0.6%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	C5F11CO2$^-$	313	1,923	4700.00	5200.00	500.00	41.4%	44.4%	3471.3	2.4E+00	2.6E-01	**4.0%**	**2.6%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	C6F13CO2$^-$	363	77	730.00	760.00	30.00	6.4%	2.7%	517.0	9.5E+00	3.9E-01	**15.5%**	**3.9%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	C7F15CO2$^-$	413	12	540.00	610.00	70.00	4.8%	6.2%	420.8	4.7E+01	6.1E+00	**76.3%**	**60.3%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	C8F17CO2$^-$	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	C9F19CO2$^-$	513	7.7	0.00	25.00	25.00		2.2%	17.6	0.0E+00	3.3E+00	**0.0%**	**32.3%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	C10F21CO2$^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	C11F23CO2$^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	C12F25CO2$^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	C13F27CO2$^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**11,340**	**12,455**	**1,125**	**100%**	**100%**	**8,128**	**61.4**	**10.1**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**13,000**
[4]Excess Fluorine (ng/L):	**4,872**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**8,429**
Excess Fluorine Hazard Quotient:	**16.4**

Facility: Landfill #2
Sample ID: Leachate Sample PVTLF
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[2]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS-)	$C4F9SO3^-$	299	7.3E+03	9410.00			9.2%			1.3E+00		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C5F11SO3^-$	349	2.5E+03	11000.00			10.7%			4.3E+00		**0.1%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS-)	$C6F13SO3^-$	399	7.7E+00	42600.00			41.5%			5.5E+03		**77.6%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS-)	$C7F15SO3^-$	449	3.8E+01	516.00			0.5%			1.3E+01		**0.2%**	
45298-90-6	Perfluorooctane sulfonate (PFOS-)	$C8F17SO3^-$	499	7.7E+00	9900.00			9.6%			1.3E+03		**18.0%**	
126105-34-8	Perfluorodecane sulfonate (PFDS-)	$C10F21SO3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA-)	$C3F5O2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA-)	$C3F7COO^-$	213	1.5E+04	3280.00			3.2%			2.2E-01		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA-)	$C4F9COO^-$	263	1.5E+03	4630.00			4.5%			3.0E+00		**0.0%**	
92612-52-7	Perfluoro hexanoate (PFHxA-)	$C5F11CO2^-$	313	1.9E+03	15100.00			14.7%			7.9E+00		**0.1%**	
120885-29-2	Perfluoro heptanoate (PFHpA-)	$C6F13CO2^-$	363	7.7E+01	3500.00			3.4%			4.6E+01		**0.6%**	
45285-51-6	Perfluoro octanoate (PFOA-)	$C7F15CO2^-$	413	1.2E+01	2470.00			2.4%			2.1E+02		**3.0%**	
72007-68-2	Perfluoro nonanoate (PFNA-)	$C8F17CO2^-$	463	1.2E+01	131.00			0.1%			1.1E+01		**0.2%**	
73829-36-4	Perfluoro decanoate (PFDA-)	$C9F19CO2^-$	513	7.7E+00	66.20			0.1%			8.6E+00		**0.1%**	
196859-54-8	Perfluoro undecanoate (PFUnDA-)	$C10F21CO2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA-)	$C11F23CO2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA-)	$C12F25CO2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA-)	$C13F27CO2^-$	713	2.6E+02										
				Totals:	**102603**			**100%**			**7,134.6**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #3
Sample ID: Leachate Sample CMLF IV-A
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	2340.00			8.3%			3.2E-01		0.0%	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	110.00			0.4%			4.3E-02		0.0%	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	766.00			2.7%			1.0E+02		13.5%	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	33.50			0.1%			8.7E-01		0.1%	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	1140.00			4.0%			1.5E+02		20.2%	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	3580.00			12.7%			2.4E-01		0.0%	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	3790.00			13.4%			2.5E+00		0.3%	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	9690.00			34.3%			5.0E+00		0.7%	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	1550.00			5.5%			2.0E+01		2.7%	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	4860.00			17.2%			4.2E+02		57.3%	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	231.00			0.8%			2.0E+01		2.7%	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	133.00			0.5%			1.7E+01		2.4%	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**28224**			**100%**			**735.4**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #3
Sample ID: Leachate Sample CMLF IV-B
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	2380.00			16.4%			3.2E-01		**0.1%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	40.50			0.3%			1.6E-02		**0.0%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	469.00			3.2%			6.1E+01		**22.9%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	6.70			0.0%			1.7E-01		**0.1%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	204.00			1.4%			2.7E+01		**10.0%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	2590.00			17.9%			1.8E-01		**0.1%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	1890.00			13.1%			1.2E+00		**0.5%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	4320.00			29.8%			2.2E+00		**0.8%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	706.00			4.9%			9.2E+00		**3.4%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	1560.00			10.8%			1.4E+02		**50.8%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	233.00			1.6%			2.0E+01		**7.6%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	74.40			0.5%			9.7E+00		**3.6%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01	5.14			0.0%			2.7E-01		**0.1%**	
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**14479**			**100%**			**266.2**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #3
Sample ID: Leachate Sample VBE
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	46.40			0.1%			6.3E-03		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	8.49			0.0%			1.1E+00		**0.1%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01										
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	11.70			0.0%			1.5E+00		**0.1%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	6010.00			11.1%			4.1E-01		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	18700.00			34.4%			1.2E+01		**1.1%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	13900.00			25.6%			7.2E+00		**0.7%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	4270.00			7.9%			5.6E+01		**5.1%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	10600.00			19.5%			9.2E+02		**84.9%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	209.00			0.4%			1.8E+01		**1.7%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	502.00			0.9%			6.5E+01		**6.0%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01	13.10			0.0%			6.8E-01		**0.1%**	
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01	27.80			0.1%			1.1E+00		**0.1%**	
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**54298**			**100%**			**1,081.7**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #4
Sample ID: Leachate Sample WHLF-LECH-R1
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	1250.00			2.3%			1.7E-01		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	313.00			0.6%			1.2E-01		**0.0%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	1060.00			1.9%			1.4E+02		**7.5%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	101.00			0.2%			2.6E+00		**0.1%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	3610.00			6.6%			4.7E+02		**25.6%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	7120.00			13.1%			4.9E-01		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	10500.00			19.3%			6.8E+00		**0.4%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	10500.00			19.3%			5.5E+00		**0.3%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	7230.00			13.3%			9.4E+01		**5.1%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	11600.00			21.3%			1.0E+03		**54.9%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	737.00			1.4%			6.4E+01		**3.5%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	327.00			0.6%			4.3E+01		**2.3%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01	22.00			0.0%			1.1E+00		**0.1%**	
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**54370**			**100%**			**1,829.6**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #4
Sample ID: Leachate Sample WHLF-LECH-R2
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	1150.00			3.6%			1.6E-01		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	174.00			0.5%			6.9E-02		**0.0%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	760.00			2.4%			9.9E+01		**13.2%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	30.40			0.1%			7.9E-01		**0.1%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	970.00			3.0%			1.3E+02		**16.8%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	4330.00			13.4%			3.0E-01		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	6450.00			20.0%			4.2E+00		**0.6%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	9200.00			28.6%			4.8E+00		**0.6%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	3840.00			11.9%			5.0E+01		**6.7%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	4910.00			15.2%			4.3E+02		**56.8%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	283.00			0.9%			2.5E+01		**3.3%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	99.30			0.3%			1.3E+01		**1.7%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01	11.90			0.0%			6.2E-01		**0.1%**	
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01	6.73			0.0%			2.6E-01		**0.0%**	
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**32215**			**100%**			**749.0**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #4
Sample ID: Leachate Sample WHLF-LECH-R3
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	4110.00			9.3%			5.6E-01		0.1%	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	17.60			0.0%			6.9E-03		0.0%	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	84.00			0.2%			1.1E+01		1.8%	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01										
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	67.70			0.2%			8.8E+00		1.4%	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	3630.00			8.2%			2.5E-01		0.0%	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	6080.00			13.8%			4.0E+00		0.6%	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	21200.00			48.1%			1.1E+01		1.8%	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	2550.00			5.8%			3.3E+01		5.3%	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	6000.00			13.6%			5.2E+02		83.4%	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	185.00			0.4%			1.6E+01		2.6%	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	140.00			0.3%			1.8E+01		2.9%	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01	9.26			0.0%			4.8E-01		0.1%	
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**44074**			**100%**			**623.4**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #4
Sample ID: Leachate Sample WHLF-LECH-R4
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	4490.00			4.7%			6.1E-01		**0.1%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	92.90			0.1%			1.2E+01		**1.1%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01										
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	164.00			0.2%			2.1E+01		**1.9%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	7410.00			7.7%			5.1E-01		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	12400.00			13.0%			8.1E+00		**0.7%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	56300.00			58.8%			2.9E+01		**2.6%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	3110.00			3.3%			4.0E+01		**3.5%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	11100.00			11.6%			9.6E+02		**84.2%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	253.00			0.3%			2.2E+01		**1.9%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	358.00			0.4%			4.7E+01		**4.1%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**95678**			**100%**			**1,142.7**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #5
Sample ID: Leachate Sample KKLF-WW1
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	283.00			1.7%			3.9E-02		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	97.60			0.6%			3.8E-02		**0.0%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	796.00			4.7%			1.0E+02		**17.9%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	52.30			0.3%			1.4E+00		**0.2%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	1400.00			8.2%			1.8E+02		**31.5%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	1800.00			10.5%			1.2E-01		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	4080.00			23.8%			2.7E+00		**0.5%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	3800.00			22.2%			2.0E+00		**0.3%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	1810.00			10.6%			2.4E+01		**4.1%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	2860.00			16.7%			2.5E+02		**43.0%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	82.90			0.5%			7.2E+00		**1.2%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	51.10			0.3%			6.6E+00		**1.2%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**17113**			**100%**			**576.9**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #5
Sample ID: Leachate Sample KKLF-WW2
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	569.00			2.1%			7.7E-02		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	421.00			1.6%			1.7E-01		**0.0%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	2880.00			10.7%			3.7E+02		**56.7%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	23.40			0.1%			6.1E-01		**0.1%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	549.00			2.0%			7.1E+01		**10.8%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	3100.00			11.5%			2.1E-01		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	8110.00			30.1%			5.3E+00		**0.8%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	6880.00			25.5%			3.6E+00		**0.5%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	2420.00			9.0%			3.1E+01		**4.8%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	1870.00			6.9%			1.6E+02		**24.6%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	74.60			0.3%			6.5E+00		**1.0%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	33.60			0.1%			4.4E+00		**0.7%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**26931**			**100%**			**660.0**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #5
Sample ID: Leachate Sample KKLF-WW3
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	417.00			4.2%			5.7E-02		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	91.10			0.9%			3.6E-02		**0.0%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	748.00			7.6%			9.7E+01		**40.1%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	8.46			0.1%			2.2E-01		**0.1%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	640.00			6.5%			8.3E+01		**34.3%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	1000.00			10.1%			6.8E-02		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	3060.00			31.0%			2.0E+00		**0.8%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	2870.00			29.1%			1.5E+00		**0.6%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	437.00			4.4%			5.7E+00		**2.3%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	521.00			5.3%			4.5E+01		**18.6%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	20.20			0.2%			1.8E+00		**0.7%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	40.20			0.4%			5.2E+00		**2.2%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01	5.29			0.1%			2.8E-01		**0.1%**	
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01	4.60			0.0%			1.8E-01		**0.1%**	
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**9863**			**100%**			**242.6**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #5
Sample ID: Leachate Sample KKLF-WW2A
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	651.00			3.5%			8.9E-02		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	1010.00			5.4%			4.0E-01		**0.0%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	6820.00			36.2%			8.9E+02		**79.5%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	45.00			0.2%			1.2E+00		**0.1%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	1200.00			6.4%			1.6E+02		**14.0%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	1280.00			6.8%			8.8E-02		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	2130.00			11.3%			1.4E+00		**0.1%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	4180.00			22.2%			2.2E+00		**0.2%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	883.00			4.7%			1.1E+01		**1.0%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	604.00			3.2%			5.2E+01		**4.7%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	22.20			0.1%			1.9E+00		**0.2%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	7.50			0.0%			9.8E-01		**0.1%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**18833**			**100%**			**1,114.6**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Facility: Landfill #5
Sample ID: Leachate Sample KKLF-WW2B
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	7.3E+03	714.00			3.6%			9.7E-02		**0.0%**	
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	2.5E+03	1110.00			5.5%			4.4E-01		**0.0%**	
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7E+00	7220.00			35.9%			9.4E+02		**76.2%**	
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	3.8E+01	69.20			0.3%			1.8E+00		**0.1%**	
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7E+00	1660.00			8.3%			2.2E+02		**17.5%**	
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	3.8E+01										
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	5.1E+02										
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	1.5E+04	1190.00			5.9%			8.1E-02		**0.0%**	
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1.5E+03	1970.00			9.8%			1.3E+00		**0.1%**	
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1.9E+03	4780.00			23.8%			2.5E+00		**0.2%**	
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	7.7E+01	682.00			3.4%			8.9E+00		**0.7%**	
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	1.2E+01	663.00			3.3%			5.7E+01		**4.7%**	
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	1.2E+01	35.80			0.2%			3.1E+00		**0.3%**	
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7E+00	13.00			0.1%			1.7E+00		**0.1%**	
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	1.9E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	2.6E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	2.6E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	2.6E+02										
				Totals:	**20107**			**100%**			**1,231.7**		**100.0%**	

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

AFFF Release Site #1 Soil Total PFAS Risk Worksheets

Project Name: HDOH AFFF Release Site #1
Sample ID: AFFF Concentrate
Date: July 9, 2024
Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	C4F9SO3⁻	299	7,345										
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	C5F11SO3⁻	349	2,538										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	C6F13SO3⁻	399	7.7										
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	C7F15SO3⁻	449	38										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	C8F17SO3⁻	499	7.7										
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	C10F21SO3⁻	599	38										
44864-55-3	Perfluoro propanoate (PFPrA⁻)	C3F5O2⁻	164	513										
45048-62-2	Perfluoro butanoate (PFBA⁻)	C3F7COO⁻	213	14,615	940,000	50,000,000,000	49,999,060,000	38.5%	27.7%	31,212,828,180	6.4E+01	3.4E+06	**7.6%**	**2.4%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	C4F9COO⁻	263	1,538		100,000,000,000	100,000,000,000		55.4%	65,002,528,142		6.5E+07		**46.3%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	C5F11CO2⁻	313	1,923	1,500,000	26,000,000,000	25,998,500,000	61.5%	14.4%	17,356,588,627	7.8E+02	1.4E+07	**92.4%**	**9.6%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	C6F13CO2⁻	363	77		4,500,000,000	4,500,000,000		2.5%	3,061,197,339		5.9E+07		**41.7%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	C7F15CO2⁻	413	12										
72007-68-2	Perfluoro nonanoate (PFNA⁻)	C8F17CO2⁻	463	12										
73829-36-4	Perfluoro decanoate (PFDA⁻)	C9F19CO2⁻	513	7.7										
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	C10F21CO2⁻	563	19										
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	C11F23CO2⁻	613	26										
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	C12F25CO2⁻	663	26										
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	C13F27CO2⁻	713	258										
				Totals:	**2,440,000**	**180,500,000,000**	**180,497,560,000**	**100%**	**100%**	**116,633,142,289**	**844.3**	**140,440,208.3**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	
[4]Excess Fluorine (ng/L):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Project Name: HDOH AFFF Release Site #1
Sample ID: Soil Sample DU2
Date: July 9, 2024
Worksheet 4: Calculation of Total PFASs Risk - Solids

											[4]Calculations		% Total Risk	
[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1.6E+04										
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	8.3E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	2.5E+01										
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	1.3E+02										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	2.5E+01	0.35	1.03	0.68	1.5%	0.0%	0.67	1.4E-02	2.7E-02	**26.3%**	**0.5%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	1.3E+02										
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	5.0E+03										
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	4.8E+04	5.60	6410.00	6404.40	23.6%	26.9%	4001.48	1.2E-04	1.3E-01	**0.2%**	**2.3%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	5.1E+03	1.80	11800.00	11798.20	7.6%	49.5%	7670.30	3.6E-04	2.3E+00	**0.7%**	**39.8%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	6.3E+03	14.20	4980.00	4965.80	59.9%	20.9%	3324.45	2.2E-03	7.9E-01	**4.3%**	**13.4%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	2.5E+02	0.44	643.00	642.56	1.9%	2.7%	437.41	1.7E-03	2.5E+00	**3.3%**	**43.3%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	3.8E+01	1.30	1.87	0.57	5.5%	0.0%	1.29	3.4E-02	1.5E-02	**65.2%**	**0.3%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	3.8E+01		0.43	0.43		0.0%	0.30		1.1E-02		**0.2%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	2.5E+01		0.42	0.42		0.0%	0.29		1.7E-02		**0.3%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	6.3E+01		0.21	0.21		0.0%	0.15		3.4E-03		**0.1%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	8.5E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	8.5E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	8.5E+02										
				Totals:	**24**	**23837**	**23813**	**100%**	**100%**		**0.1**	**5.9**	**100.0%**	**100.0%**
										Input Sample TOF (µg/kg):				
										[4]Excess Fluorine (µg/kg):				
										[5]Excess Fluorine Mass Adjustment Factor:	**1.73**			
										[6]Excess Fluorine PFASs (µg/kg):				
										Excess Fluorine Hazard Quotient:				

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Project Name: HDOH AFFF Release Site #1
Sample ID: Soil Sample DU3
Date: July 9, 2024
Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations: Pre-TOPs PFASs Hazard Quotient	[4]Calculations: Precursor PFASs Hazard Quotient	% Total Risk: Pre-TOPs PFASs Hazard Quotient	% Total Risk: Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1.6E+04										
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	8.3E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	2.5E+01										
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	1.3E+02										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	2.5E+01	4.00	0.36		10.9%		0.24	1.6E-01		**47.1%**	
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	1.3E+02										
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	5.0E+03										
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	4.8E+04	6.53	6183.33	6176.80	17.7%	28.1%	3859.99	1.4E-04	1.3E-01	**0.0%**	**2.2%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	5.1E+03	2.85	10266.67	10263.82	7.7%	46.7%	6673.59	5.6E-04	2.0E+00	**0.2%**	**35.4%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	6.3E+03	16.83	4840.00	4823.17	45.7%	22.0%	3231.00	2.7E-03	7.6E-01	**0.8%**	**13.3%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	2.5E+02		707.00	707.00		3.2%	480.95		2.8E+00		**48.7%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	3.8E+01	6.60	1.68		17.9%		1.16	1.7E-01		**51.9%**	
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	3.8E+01		0.30	0.30		0.0%	0.21		8.0E-03		**0.1%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	2.5E+01		0.36	0.36		0.0%	0.25		1.4E-02		**0.2%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	6.3E+01										
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	8.5E+01										
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	8.5E+01										
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	8.5E+02										
				Totals:	**37**	**22000**	**21971**	**100%**	**100%**		**0.3**	**5.7**	**100.0%**	**100.0%**

Input Sample TOF (µg/kg):	
[4]Excess Fluorine (µg/kg):	
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Excess Fluorine PFASs (µg/kg):	
Excess Fluorine Hazard Quotient:	

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Project Name: HDOH AFFF Release Site #1
Sample ID: Soil Sample DU4a
Date: July 9, 2024
Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations		% Total Risk	
											Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1.6E+04										
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	8.3E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	2.5E+01										
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	1.3E+02										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	2.5E+01	4.20	7.36	3.16	32.3%	3.1%	4.76	1.7E-01	1.2E-01	**96.3%**	**57.7%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	1.3E+02										
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	5.0E+03										
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	4.8E+04	1.30	30.20	28.90	10.0%	28.6%	18.85	2.7E-05	6.0E-04	**0.0%**	**0.3%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	5.1E+03	4.30	47.40	43.10	33.1%	42.7%	30.81	8.5E-04	8.5E-03	**0.5%**	**3.9%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	6.3E+03	1.90	22.00	20.10	14.6%	19.9%	14.69	3.0E-04	3.2E-03	**0.2%**	**1.5%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	2.5E+02	1.30	4.16	2.86	10.0%	2.8%	2.83	5.1E-03	1.1E-02	**3.0%**	**5.2%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	3.8E+01		1.12	1.12		1.1%	0.77		3.0E-02		**13.6%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	3.8E+01		0.33	0.33		0.3%	0.23		8.6E-03		**4.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	2.5E+01		0.45	0.45		0.4%	0.32		1.8E-02		**8.3%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	6.3E+01		0.30	0.30		0.3%	0.21		4.8E-03		**2.2%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	8.5E+01		0.30	0.30		0.3%	0.21		3.5E-03		**1.6%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	8.5E+01		0.31	0.31		0.3%	0.22		3.6E-03		**1.7%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	8.5E+02										
				Totals:	**13**	**114**	**101**	**100%**	**100%**		**0.2**	**0.2**	**100.0%**	**100.0%**
										Input Sample TOF (µg/kg):				
										[4]Excess Fluorine (µg/kg):				
										[5]Excess Fluorine Mass Adjustment Factor:	**1.73**			
										[6]Excess Fluorine PFASs (µg/kg):				
										Excess Fluorine Hazard Quotient:				

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

Project Name: HDOH AFFF Release Site #1
Sample ID: Soil Sample DU4b
Date: July 9, 2024
Worksheet 4: Calculation of Total PFASs Risk - Solids

											[4]Calculations		% Total Risk	
[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]TOPs-Predicted Total Organic Fluorine (µg/Kg)	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient	Pre-TOPs PFASs Hazard Quotient	Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	1.6E+04										
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	8.3E+03										
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	2.5E+01										
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	1.3E+02										
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	2.5E+01	2.40	5.27	2.87	22.0%	0.5%	3.41	9.5E-02	1.1E-01	**94.5%**	**36.2%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	1.3E+02										
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	5.0E+03										
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	4.8E+04	1.20	204.00	202.80	11.0%	32.1%	127.35	2.5E-05	4.2E-03	**0.0%**	**1.3%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	5.1E+03	4.50	298.00	293.50	41.3%	46.4%	193.71	8.9E-04	5.8E-02	**0.9%**	**18.5%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	6.3E+03	1.70	118.00	116.30	15.6%	18.4%	78.77	2.7E-04	1.8E-02	**0.3%**	**5.9%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	2.5E+02	1.10	15.00	13.90	10.1%	2.2%	10.20	4.4E-03	5.5E-02	**4.3%**	**17.5%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	3.8E+01		1.03	1.03		0.2%	0.71		2.7E-02		**8.7%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	3.8E+01		0.39	0.39		0.1%	0.27		1.0E-02		**3.3%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	2.5E+01		0.36	0.36		0.1%	0.25		1.4E-02		**4.5%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	6.3E+01		0.36	0.36		0.1%	0.26		5.7E-03		**1.8%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	8.5E+01		0.38	0.38		0.1%	0.27		4.5E-03		**1.4%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	8.5E+01		0.24	0.24		0.0%	0.17		2.8E-03		**0.9%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	8.5E+02										
				Totals:	**11**	**643**	**632**	**100%**	**100%**		**0.1**	**0.3**	**100.0%**	**100.0%**
									Input Sample TOF (µg/kg):					
									[4]Excess Fluorine (µg/kg):					
									[5]Excess Fluorine Mass Adjustment Factor:	**1.73**				
									[6]Excess Fluorine PFASs (µg/kg):					
									Excess Fluorine Hazard Quotient:					

Reference: HIDOH, 2024, Interim Soil and Water Environmental Action Levels (EALs) for Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs): Hawaii Department of Health, Hazard Evaluation and Emergency Response, April 2024.

AFFF Release Site #2 Soil Total PFAS Risk Worksheets

Project Name: AFFF Release Site #2
Sample ID: DU5E
Date:

Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations: Pre-TOPs PFASs Hazard Quotient	[4]Calculations: Precursor PFASs Hazard Quotient	% Total Risk: Pre-TOPs PFASs Hazard Quotient	% Total Risk: Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	3,793	6.90	7.75	0.85	0.8%	0.2%	4.43	1.8E-03	2.2E-04	0.0%	0.0%
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	1,909	6.25	7.46	1.21	0.7%	0.2%	6.09	3.3E-03	6.3E-04	0.0%	0.0%
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	25	36.90	43.80	6.90	4.3%	1.3%	27.10	1.5E+00	2.7E-01	4.7%	3.0%
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	126	5.24	7.49	2.25	0.6%	0.4%	4.75	4.1E-02	1.8E-02	0.1%	0.2%
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	25	726.00	914.00	188.00	85.2%	34.5%	591.42	2.9E+01	7.4E+00	93.2%	82.1%
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	126	4.50	2.41	0.00	0.5%		3.00	3.6E-02	0.0E+00	0.1%	0.0%
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C_2F_3O_2^-$	114	29,087	0.00	0.00	0.00			0.00	0.0E+00	0.0E+00	0.0%	0.0%
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	5,038	0.00	0.00	0.00			0.00	0.0E+00	0.0E+00	0.0%	0.0%
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	48,042	11.70	89.40	77.70	1.4%	14.3%	55.81	2.4E-04	1.6E-03	0.0%	0.0%
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	5,057	15.60	87.60	72.00	1.8%	13.2%	56.94	3.1E-03	1.4E-02	0.0%	0.2%
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	6,321	14.00	145.00	131.00	1.6%	24.0%	96.80	2.2E-03	2.1E-02	0.0%	0.2%
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	253	2.55	23.20	20.65	0.3%	3.8%	15.78	1.0E-02	8.2E-02	0.0%	0.9%
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	38	3.97	29.50	25.53	0.5%	4.7%	20.35	1.0E-01	6.7E-01	0.3%	7.4%
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	38	4.95	14.00	9.05	0.6%	1.7%	9.76	1.3E-01	2.4E-01	0.4%	2.6%
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	25	4.98	11.60	6.62	0.6%	1.2%	8.16	2.0E-01	2.6E-01	0.6%	2.9%
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	63	5.41	6.92	1.51	0.6%	0.3%	4.90	8.6E-02	2.4E-02	0.3%	0.3%
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	85	1.79	2.74	0.95	0.2%	0.2%	1.95	2.1E-02	1.1E-02	0.1%	0.1%
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	85	0.54	0.93	0.38	0.1%	0.1%	0.66	6.4E-03	4.5E-03	0.0%	0.0%
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	847	0.44	0.66	0.22	0.1%	0.0%	0.48	5.2E-04	2.6E-04	0.0%	0.0%
				Totals:	852	1,394	545	100%	100%	908	30.8	9.1	100.0%	100.0%

Input Sample TOF (µg/kg):	250
[4]Excess Fluorine (µg/kg):	Error
[5]Excess Fluorine Mass Adjustment Factor:	1.73
[6]Excess Fluorine PFASs (µg/kg):	Error
Excess Fluorine Hazard Quotient:	

Error - Input TOF Less Than TOPs-Predicted TOF

roject Name: AFFF Release Site #2
Sample ID: DU5E
Date:
Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations: Pre-TOPs PFASs Hazard Quotient	[4]Calculations: Precursor PFASs Hazard Quotient	% Total Risk: Pre-TOPs PFASs Hazard Quotient	% Total Risk: Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C_4F_9SO_3^-$	299	3,793	6.90	7.75	0.85	0.8%	0.2%	4.43	1.8E-03	2.2E-04	0.0%	0.0%
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	1,909	6.25	7.46	1.21	0.7%	0.2%	6.09	3.3E-03	6.3E-04	0.0%	0.0%
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C_6F_{13}SO_3^-$	399	25	36.90	43.80	6.90	4.3%	1.3%	27.10	1.5E+00	2.7E-01	4.7%	3.0%
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C_7F_{15}SO_3^-$	449	126	5.24	7.49	2.25	0.6%	0.4%	4.75	4.1E-02	1.8E-02	0.1%	0.2%
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C_8F_{17}SO_3^-$	499	25	726.00	914.00	188.00	85.2%	34.5%	591.42	2.9E+01	7.4E+00	93.2%	82.1%
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C_{10}F_{21}SO_3^-$	599	126	4.50	2.41	0.00	0.5%		3.00	3.6E-02	0.0E+00	0.1%	0.0%
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C_2F_3O_2^-$	114	29,087	0.00	0.00	0.00			0.00	0.0E+00	0.0E+00	0.0%	0.0%
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C_3F_5O_2^-$	164	5,038	0.00	0.00	0.00			0.00	0.0E+00	0.0E+00	0.0%	0.0%
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C_3F_7COO^-$	213	48,042	11.70	89.40	77.70	1.4%	14.3%	55.81	2.4E-04	1.6E-03	0.0%	0.0%
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C_4F_9COO^-$	263	5,057	15.60	87.60	72.00	1.8%	13.2%	56.94	3.1E-03	1.4E-02	0.0%	0.2%
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C_5F_{11}CO_2^-$	313	6,321	14.00	145.00	131.00	1.6%	24.0%	96.80	2.2E-03	2.1E-02	0.0%	0.2%
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C_6F_{13}CO_2^-$	363	253	2.55	23.20	20.65	0.3%	3.8%	15.78	1.0E-02	8.2E-02	0.0%	0.9%
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C_7F_{15}CO_2^-$	413	38	3.97	29.50	25.53	0.5%	4.7%	20.35	1.0E-01	6.7E-01	0.3%	7.4%
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C_8F_{17}CO_2^-$	463	38	4.95	14.00	9.05	0.6%	1.7%	9.76	1.3E-01	2.4E-01	0.4%	2.6%
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C_9F_{19}CO_2^-$	513	25	4.98	11.60	6.62	0.6%	1.2%	8.16	2.0E-01	2.6E-01	0.6%	2.9%
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C_{10}F_{21}CO_2^-$	563	63	5.41	6.92	1.51	0.6%	0.3%	4.90	8.6E-02	2.4E-02	0.3%	0.3%
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C_{11}F_{23}CO_2^-$	613	85	1.79	2.74	0.95	0.2%	0.2%	1.95	2.1E-02	1.1E-02	0.1%	0.1%
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C_{12}F_{25}CO_2^-$	663	85	0.54	0.93	0.38	0.1%	0.1%	0.66	6.4E-03	4.5E-03	0.0%	0.0%
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C_{13}F_{27}CO_2^-$	713	847	0.44	0.66	0.22	0.1%	0.0%	0.48	5.2E-04	2.6E-04	0.0%	0.0%
				Totals:	852	1,394	545	100%	100%	908	30.8	9.1	100.0%	100.0%

Input Sample TOF (µg/kg):	250
[4]Excess Fluorine (µg/kg):	Error
[5]Excess Fluorine Mass Adjustment Factor:	1.73
[6]Excess Fluorine PFASs (µg/kg):	Error
Excess Fluorine Hazard Quotient:	

Error - Input TOF Less Than TOPs-Predicted TOF

roject Name: **AFFF Release Site #2**
Sample ID: DU5F
Date:
Worksheet 4: Calculation of Total PFASs Risk - Solids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Soil Action Level (µg/Kg)	Input Pre-TOPs Concentration (µg/Kg)	Input Post-TOPs Concentration (µg/Kg)	[2]Precursor PFASs Concentration (µg/Kg)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Makeup (%)	[3]Predicted Total Organic Fluorine (µg/Kg)	[4]Calculations: Pre-TOPs PFASs Hazard Quotient	[4]Calculations: Precursor PFASs Hazard Quotient	% Total Risk: Pre-TOPs PFASs Hazard Quotient	% Total Risk: Precursor PFASs Hazard Quotient
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	$C4F9SO3^-$	299	3,793	6.17	7.06	0.89	0.7%	0.2%	4.04	1.6E-03	2.3E-04	**0.0%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C5F11SO3^-$	349	1,909	4.79	6.62	1.83	0.5%	0.4%	5.41	2.5E-03	9.6E-04	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	$C6F13SO3^-$	399	25	31.80	44.00	12.20	3.5%	3.0%	27.23	1.3E+00	4.8E-01	**3.8%**	**9.7%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	$C7F15SO3^-$	449	126	4.95	7.39	2.44	0.5%	0.6%	4.69	3.9E-02	1.9E-02	**0.1%**	**0.4%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	$C8F17SO3^-$	499	25	788.00	871.00	83.00	86.6%	20.3%	563.60	3.1E+01	3.3E+00	**94.2%**	**65.8%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	$C10F21SO3^-$	599	126	5.21	2.70	0.00	0.6%		3.47	4.1E-02	0.0E+00	**0.1%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	$C2F3O2^-$	114	29,087	0.00	0.00	0.00			0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	$C3F5O2^-$	164	5,038	0.00	0.00	0.00			0.00	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	$C3F7COO^-$	213	48,042	13.20	85.80	72.60	1.5%	17.8%	53.56	2.7E-04	1.5E-03	**0.0%**	**0.0%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	$C4F9COO^-$	263	5,057	16.30	77.10	60.80	1.8%	14.9%	50.12	3.2E-03	1.2E-02	**0.0%**	**0.2%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	$C5F11CO2^-$	313	6,321	13.70	128.00	114.30	1.5%	28.0%	85.45	2.2E-03	1.8E-02	**0.0%**	**0.4%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	$C6F13CO2^-$	363	253	2.59	22.60	20.01	0.3%	4.9%	15.37	1.0E-02	7.9E-02	**0.0%**	**1.6%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	$C7F15CO2^-$	413	38	4.19	27.20	23.01	0.5%	5.6%	18.77	1.1E-01	6.1E-01	**0.3%**	**12.2%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	$C8F17CO2^-$	463	38	4.66	13.00	8.34	0.5%	2.0%	9.07	1.2E-01	2.2E-01	**0.4%**	**4.4%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	$C9F19CO2^-$	513	25	5.11	10.90	5.79	0.6%	1.4%	7.67	2.0E-01	2.3E-01	**0.6%**	**4.6%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	$C10F21CO2^-$	563	63	6.17	7.31	1.14	0.7%	0.3%	5.18	9.8E-02	1.8E-02	**0.3%**	**0.4%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	$C11F23CO2^-$	613	85	1.86	2.77	0.91	0.2%	0.2%	1.97	2.2E-02	1.1E-02	**0.1%**	**0.2%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	$C12F25CO2^-$	663	85	0.55	1.03	0.48	0.1%	0.1%	0.74	6.4E-03	5.7E-03	**0.0%**	**0.1%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	$C13F27CO2^-$	713	847	0.28	0.70	0.42	0.0%	0.1%	0.51	3.3E-04	5.0E-04	**0.0%**	**0.0%**
				Totals:	**910**	**1,315**	**408**	**100%**	**100%**	**857**	**33.1**	**5.0**	**100.0%**	**100.0%**

Input Sample TOF (µg/kg):	**990**
[4]Excess Fluorine (µg/kg):	**133**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Excess Fluorine PFASs (µg/kg):	**230**
Excess Fluorine Hazard Quotient:	**0.0**

AFFF Release Site #2 Groundwater Total PFAS Risk Worksheets

Project Name: AFFF Site #2
Sample ID: MW-1
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	1,695	23000.00	26000.00	3000.00	1.8%	0.5%	14863.5	1.4E+01	1.8E+00	**0.0%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	27000.00	28000.00	1000.00	2.1%	0.2%	22862.9	4.6E+01	1.7E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7	180000.00	170000.00	0.00	13.9%		111388.9	2.3E+04	0.0E+00	**23.6%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	38	15000.00	16000.00	1000.00	1.2%	0.2%	10152.3	3.9E+02	2.6E+01	**0.4%**	**0.5%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7	560000.00	600000.00	40000.00	43.4%	6.3%	388242.5	7.3E+04	5.2E+03	**73.4%**	**91.2%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	14,615	54000.00	230000.00	176000.00	4.2%	27.8%	143579.0	3.7E+00	1.2E+01	**0.0%**	**0.2%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1,538	160000.00	420000.00	260000.00	12.4%	41.1%	273010.6	1.0E+02	1.7E+02	**0.1%**	**3.0%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1,923	220000.00	360000.00	140000.00	17.0%	22.2%	240322.0	1.1E+02	7.3E+01	**0.1%**	**1.3%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	77	29000.00	39000.00	10000.00	2.2%	1.6%	26530.4	3.8E+02	1.3E+02	**0.4%**	**2.3%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	12	23000.00	24000.00	1000.00	1.8%	0.2%	16557.5	2.0E+03	8.7E+01	**2.0%**	**1.5%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**1,291,000**	**1,913,000**	**632,000**	**100%**	**100%**	**1,247,510**	**99,242.5**	**5,700.0**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**2,600,000**
[4]Excess Fluorine (ng/L):	**1,352,490**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**2,339,808**
Excess Fluorine Hazard Quotient:	**4559.3**

Project Name: AFFF Site #2
Sample ID: MW-2
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	1,695	45000.00	51000.00	6000.00	2.7%	1.5%	29155.4	2.7E+01	3.5E+00	**0.0%**	**1.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	50000.00	56000.00	6000.00	3.0%	1.5%	45725.8	8.6E+01	1.0E+01	**0.1%**	**2.9%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7	270000.00	260000.00	0.00	16.4%		167083.4	3.5E+04	0.0E+00	**29.1%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	38	13000.00	14000.00	1000.00	0.8%	0.2%	8883.3	3.4E+02	2.6E+01	**0.3%**	**7.3%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7	630000.00	600000.00	0.00	38.3%		407654.6	8.2E+04	0.0E+00	**68.0%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	14,615	77000.00	210000.00	133000.00	4.7%	32.3%	131093.9	5.3E+00	9.1E+00	**0.0%**	**2.5%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1,538	200000.00	370000.00	170000.00	12.2%	41.3%	240509.4	1.3E+02	1.1E+02	**0.1%**	**30.9%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1,923	300000.00	390000.00	90000.00	18.2%	21.8%	260348.8	1.6E+02	4.7E+01	**0.1%**	**13.1%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	77	34000.00	39000.00	5000.00	2.1%	1.2%	26530.4	4.4E+02	6.5E+01	**0.4%**	**18.2%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	12	27000.00	28000.00	1000.00	1.6%	0.2%	19317.1	2.3E+03	8.7E+01	**1.9%**	**24.2%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**1,646,000**	**2,018,000**	**412,000**	**100%**	**100%**	**1,336,302**	**120,523.9**	**357.9**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**2,400,000**
[4]Excess Fluorine (ng/L):	**1,063,698**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**1,840,197**
Excess Fluorine Hazard Quotient:	**3585.8**

Project Name: AFFF Site #2
Sample ID: MW-3
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	1,695	5600.00	0.00	0.00	1.1%		3201.4	3.3E+00	0.0E+00	**0.0%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	6500.00	0.00	0.00	1.3%		5307.5	1.1E+01	0.0E+00	**0.0%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7	48000.00	43000.00	0.00	9.7%		29703.7	6.2E+03	0.0E+00	**12.2%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7	340000.00	320000.00	0.00	68.7%		220004.1	4.4E+04	0.0E+00	**86.3%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	14,615	0.00	52000.00	52000.00		25.2%	32461.3	0.0E+00	3.6E+00	**0.0%**	**1.9%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1,538	36000.00	96000.00	60000.00	7.3%	29.1%	62402.4	2.3E+01	3.9E+01	**0.0%**	**21.0%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1,923	43000.00	130000.00	87000.00	8.7%	42.1%	86782.9	2.2E+01	4.5E+01	**0.0%**	**24.4%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	77	8500.00	16000.00	7500.00	1.7%	3.6%	10884.3	1.1E+02	9.8E+01	**0.2%**	**52.6%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	12	7300.00	0.00	0.00	1.5%		5036.2	6.3E+02	0.0E+00	**1.2%**	**0.0%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**494,900**	**657,000**	**206,500**	**100%**	**100%**	**455,784**	**51,243.4**	**185.3**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**790,000**
[4]Excess Fluorine (ng/L):	**334,216**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**578,194**
Excess Fluorine Hazard Quotient:	**1126.7**

Project Name: AFFF Site #2
Sample ID: MW-4
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	C4F9SO3⁻	299	1,695	6700.00	7400.00	700.00	2.1%	0.4%	4230.4	4.0E+00	4.1E-01	**0.0%**	**0.3%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	C5F11SO3⁻	349	581	8000.00	8600.00	600.00	2.5%	0.4%	7022.2	1.4E+01	1.0E+00	**0.1%**	**0.9%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	C6F13SO3⁻	399	7.7	46000.00	40000.00	0.00	14.3%		28466.1	6.0E+03	0.0E+00	**26.6%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	C7F15SO3⁻	449	38	3700.00	3200.00	0.00	1.1%		2347.7	9.6E+01	0.0E+00	**0.4%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	C8F17SO3⁻	499	7.7	120000.00	110000.00	0.00	37.2%		77648.5	1.6E+04	0.0E+00	**69.5%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	C10F21SO3⁻	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	C2F3O2⁻	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	C3F5O2⁻	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	C3F7COO⁻	213	14,615	15000.00	55000.00	40000.00	4.7%	23.9%	34334.1	1.0E+00	2.7E+00	**0.0%**	**2.3%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	C4F9COO⁻	263	1,538	52000.00	120000.00	68000.00	16.1%	40.5%	78003.0	3.4E+01	4.4E+01	**0.2%**	**36.5%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	C5F11CO2⁻	313	1,923	55000.00	110000.00	55000.00	17.1%	32.8%	73431.7	2.9E+01	2.9E+01	**0.1%**	**23.6%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	C6F13CO2⁻	363	77	9600.00	13000.00	3400.00	3.0%	2.0%	8843.5	1.2E+02	4.4E+01	**0.6%**	**36.5%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	C7F15CO2⁻	413	12	6500.00	6200.00	0.00	2.0%		4484.3	5.6E+02	0.0E+00	**2.5%**	**0.0%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	C8F17CO2⁻	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	C9F19CO2⁻	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	C10F21CO2⁻	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	C11F23CO2⁻	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	C12F25CO2⁻	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	C13F27CO2⁻	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**322,500**	**473,400**	**167,700**	**100%**	**100%**	**318,812**	**22,445.5**	**121.2**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**610,000**
[4]Excess Fluorine (ng/L):	**291,188**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**503,756**
Excess Fluorine Hazard Quotient:	**981.6**

Project Name: AFFF Site #2
Sample ID: MW-5
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	C4F9SO3⁻	299	1,695	3100.00	4100.00	1000.00	1.1%	2.5%	2343.9	1.8E+00	5.9E-01	**0.0%**	**1.1%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	C5F11SO3⁻	349	581	3800.00	4400.00	600.00	1.4%	1.5%	3592.7	6.5E+00	1.0E+00	**0.0%**	**1.8%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	C6F13SO3⁻	399	7.7	30000.00	23000.00	0.00	10.9%		18564.8	3.9E+03	0.0E+00	**20.6%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	C7F15SO3⁻	449	38	2500.00	0.00	0.00	0.9%		1586.3	6.5E+01	0.0E+00	**0.3%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	C8F17SO3⁻	499	7.7	110000.00	71000.00	0.00	39.9%		71177.8	1.4E+04	0.0E+00	**75.7%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	C10F21SO3⁻	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	C2F3O2⁻	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	C3F5O2⁻	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	C3F7COO⁻	213	14,615	12000.00	26000.00	14000.00	4.4%	34.3%	16230.7	8.2E-01	9.6E-01	**0.0%**	**1.7%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	C4F9COO⁻	263	1,538	54000.00	57000.00	3000.00	19.6%	7.4%	37051.4	3.5E+01	2.0E+00	**0.2%**	**3.5%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	C5F11CO2⁻	313	1,923	46000.00	65000.00	19000.00	16.7%	46.6%	43391.5	2.4E+01	9.9E+00	**0.1%**	**17.6%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	C6F13CO2⁻	363	77	8800.00	12000.00	3200.00	3.2%	7.8%	8163.2	1.1E+02	4.2E+01	**0.6%**	**74.3%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	C7F15CO2⁻	413	12	5200.00	4000.00	0.00	1.9%		3587.5	4.5E+02	0.0E+00	**2.4%**	**0.0%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	C8F17CO2⁻	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	C9F19CO2⁻	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	C10F21CO2⁻	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	C11F23CO2⁻	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	C12F25CO2⁻	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	C13F27CO2⁻	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**275,400**	**266,500**	**40,800**	**100%**	**100%**	**205,690**	**18,898.3**	**56.0**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**580,000**
[4]Excess Fluorine (ng/L):	**374,310**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**647,557**
Excess Fluorine Hazard Quotient:	**1261.8**

Project Name: AFFF Site #2
Sample ID: MW-7
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	C4F9SO3$^-$	299	1,695	4700.00	5700.00	1000.00	2.5%	5.5%	3258.5	2.8E+00	5.9E-01	**0.0%**	**7.3%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	C5F11SO3$^-$	349	581	5800.00	6100.00	300.00	3.1%	1.6%	4980.9	1.0E+01	5.2E-01	**0.1%**	**6.4%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	C6F13SO3$^-$	399	7.7	40000.00	40000.00	0.00	21.2%		24753.1	5.2E+03	0.0E+00	**28.3%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	C7F15SO3$^-$	449	38	2200.00	0.00	0.00	1.2%		1395.9	5.7E+01	0.0E+00	**0.3%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	C8F17SO3$^-$	499	7.7	98000.00	69000.00	0.00	51.9%		63412.9	1.3E+04	0.0E+00	**69.3%**	**0.0%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	C10F21SO3$^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	C2F3O2$^-$	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	C3F5O2$^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	C3F7COO$^-$	213	14,615	3900.00	8900.00	5000.00	2.1%	27.3%	5555.9	2.7E-01	3.4E-01	**0.0%**	**4.2%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	C4F9COO$^-$	263	1,538	11000.00	14000.00	3000.00	5.8%	16.4%	9100.4	7.2E+00	2.0E+00	**0.0%**	**24.1%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	C5F11CO2$^-$	313	1,923	16000.00	25000.00	9000.00	8.5%	49.2%	16689.0	8.3E+00	4.7E+00	**0.0%**	**57.9%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	C6F13CO2$^-$	363	77	3500.00	2900.00	0.00	1.9%		2380.9	4.6E+01	0.0E+00	**0.2%**	**0.0%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	C7F15CO2$^-$	413	12	3600.00	3100.00	0.00	1.9%		2483.6	3.1E+02	0.0E+00	**1.7%**	**0.0%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	C8F17CO2$^-$	463	12	120.00	0.00	0.00	0.1%		83.7	1.0E+01	0.0E+00	**0.1%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	C9F19CO2$^-$	513	7.7	9.70	0.00	0.00	0.0%		6.8	1.3E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	C10F21CO2$^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	C11F23CO2$^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	C12F25CO2$^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	C13F27CO2$^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**188,830**	**174,700**	**18,300**	**100%**	**100%**	**134,102**	**18,394.9**	**8.1**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**190,000**
[4]Excess Fluorine (ng/L):	**55,898**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**96,704**
Excess Fluorine Hazard Quotient:	**188.4**

Project Name: AFFF Site #2
Sample ID: MW-8
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS$^-$)	$C_4F_9SO_3^-$	299	1,695	6.90	6.50	0.00	2.4%		3.9	4.1E-03	0.0E+00	**0.0%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	$C_5F_{11}SO_3^-$	349	581	9.60	9.20	0.00	3.4%		7.8	1.7E-02	0.0E+00	**0.1%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS$^-$)	$C_6F_{13}SO_3^-$	399	7.7	65.00	62.00	0.00	23.0%		40.2	8.5E+00	0.0E+00	**45.9%**	**0.0%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS$^-$)	$C_7F_{15}SO_3^-$	449	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS$^-$)	$C_8F_{17}SO_3^-$	499	7.7	71.00	76.00	5.00	25.1%	15.6%	49.2	9.2E+00	6.5E-01	**50.2%**	**98.7%**
126105-34-8	Perfluorodecane sulfonate (PFDS$^-$)	$C_{10}F_{21}SO_3^-$	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA$^-$) (Trifluoroacetate)	$C_2F_3O_2^-$	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA$^-$)	$C_3F_5O_2^-$	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA$^-$)	$C_3F_7COO^-$	213	14,615	30.00	43.00	13.00	10.6%	40.6%	26.8	2.1E-03	8.9E-04	**0.0%**	**0.1%**
45167-47-3	Perfluoro pentanoate (PFPeA$^-$)	$C_4F_9COO^-$	263	1,538	46.00	50.00	4.00	16.2%	12.5%	32.5	3.0E-02	2.6E-03	**0.2%**	**0.4%**
92612-52-7	Perfluoro hexanoate (PFHxA$^-$)	$C_5F_{11}CO_2^-$	313	1,923	37.00	47.00	10.00	13.1%	31.3%	31.4	1.9E-02	5.2E-03	**0.1%**	**0.8%**
120885-29-2	Perfluoro heptanoate (PFHpA$^-$)	$C_6F_{13}CO_2^-$	363	77	12.00	11.00	0.00	4.2%		8.2	1.6E-01	0.0E+00	**0.8%**	**0.0%**
45285-51-6	Perfluoro octanoate (PFOA$^-$)	$C_7F_{15}CO_2^-$	413	12	5.60	5.40	0.00	2.0%		3.9	4.9E-01	0.0E+00	**2.6%**	**0.0%**
72007-68-2	Perfluoro nonanoate (PFNA$^-$)	$C_8F_{17}CO_2^-$	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA$^-$)	$C_9F_{19}CO_2^-$	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA$^-$)	$C_{10}F_{21}CO_2^-$	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA$^-$)	$C_{11}F_{23}CO_2^-$	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA$^-$)	$C_{12}F_{25}CO_2^-$	663	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA$^-$)	$C_{13}F_{27}CO_2^-$	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**283**	**310**	**32**	**100%**	**100%**	**204**	**18.4**	**0.7**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**1,000**
[4]Excess Fluorine (ng/L):	**796**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**1,377**
Excess Fluorine Hazard Quotient:	**2.7**

Project Name: AFFF Site #2
Sample ID: MW-8
Date:

Worksheet 5: Calculation of Total PFASs Risk - Liquids

[1]CAS #	[1]Chemical	Chemical Formula	Molecular Weight	Tapwater Action Level (ng/L)	Input Pre-TOPs Concentration (ng/L)	Input Post-TOPs Concentration (ng/L)	[2]Precursor PFASs Concentration (ng/L)	PFASs: Pre-TOPs Makeup (%)	PFASs: Post-TOPs Precursor Makeup (%)	[3]Predicted Total Organic Fluorine (ng/L)	Calculations: Pre-TOPs PFASs Hazard Quotient	Calculations: Precursor PFASs Hazard Quotient	Percent Pre-TOPs PFASs Hazard Index	Percent Precursor PFASs Hazard Index
45187-15-3	Perfluorobutane sulfonate (PFBS⁻)	C4F9SO3⁻	299	1,695	2700.00	2100.00	0.00	17.1%		1543.5	1.6E+00	0.0E+00	**0.3%**	**0.0%**
146689-46-5	Perfluoropentanesulfonate (PFPeS-)	C5F11SO3⁻	349	581	1700.00	1400.00	0.00	10.8%		1388.1	2.9E+00	0.0E+00	**0.5%**	**0.0%**
108427-53-8	Perfluorohexane sulfonate (PFHxS⁻)	C6F13SO3⁻	399	7.7	3100.00	3200.00	100.00	19.6%	6.9%	1980.2	4.0E+02	1.3E+01	**75.3%**	**10.4%**
146689-46-5	Perfluoroheptane sulfonate (PFHpS⁻)	C7F15SO3⁻	449	38	42.00	0.00	0.00	0.3%		26.6	1.1E+00	0.0E+00	**0.2%**	**0.0%**
45298-90-6	Perfluorooctane sulfonate (PFOS⁻)	C8F17SO3⁻	499	7.7	840.00	1700.00	860.00	5.3%	59.7%	1100.0	1.1E+02	1.1E+02	**20.4%**	**89.6%**
126105-34-8	Perfluorodecane sulfonate (PFDS⁻)	C10F21SO3⁻	599	38	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
14477-72-6	Perfluoro ethanoate (PFEtA⁻) (Trifluoroacetate)	C2F3O2⁻	114	18,000	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
44864-55-3	Perfluoro propanoate (PFPrA⁻)	C3F5O2⁻	164	513	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
45048-62-2	Perfluoro butanoate (PFBA⁻)	C3F7COO⁻	213	14,615	920.00	1400.00	480.00	5.8%	33.3%	874.0	6.3E-02	3.3E-02	**0.0%**	**0.0%**
45167-47-3	Perfluoro pentanoate (PFPeA⁻)	C4F9COO⁻	263	1,538	2300.00	2200.00	0.00	14.6%		1495.1	1.5E+00	0.0E+00	**0.3%**	**0.0%**
92612-52-7	Perfluoro hexanoate (PFHxA⁻)	C5F11CO2⁻	313	1,923	3800.00	3400.00	0.00	24.1%		2536.7	2.0E+00	0.0E+00	**0.4%**	**0.0%**
120885-29-2	Perfluoro heptanoate (PFHpA⁻)	C6F13CO2⁻	363	77	250.00	0.00	0.00	1.6%		170.1	3.3E+00	0.0E+00	**0.6%**	**0.0%**
45285-51-6	Perfluoro octanoate (PFOA⁻)	C7F15CO2⁻	413	12	120.00	0.00	0.00	0.8%		82.8	1.0E+01	0.0E+00	**1.9%**	**0.0%**
72007-68-2	Perfluoro nonanoate (PFNA⁻)	C8F17CO2⁻	463	12	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
73829-36-4	Perfluoro decanoate (PFDA⁻)	C9F19CO2⁻	513	7.7	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
196859-54-8	Perfluoro undecanoate (PFUnDA⁻)	C10F21CO2⁻	563	19	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
171978-95-3	Perfluoro dodecanoate (PFDoDA⁻)	C11F23CO2⁻	613	26	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
862374-87-6	Perfluoro tridecanoate (PFTrDA⁻)	C12F25CO2⁻	663	26	5.00	0.00	0.00	0.0%		3.6	1.9E-01	0.0E+00	**0.0%**	**0.0%**
365971-87-5	Perfluoro tetradecanoate (PFTeDA⁻)	C13F27CO2⁻	713	258	0.00	0.00	0.00			0.0	0.0E+00	0.0E+00	**0.0%**	**0.0%**
				Totals:	**15,777**	**15,400**	**1,440**	**100%**	**100%**	**11,201**	**535.2**	**124.8**	**100.0%**	**100.0%**

Input Sample TOF (ng/L):	**18,000**
[4]Excess Fluorine (ng/L):	**6,799**
[5]Excess Fluorine Mass Adjustment Factor:	**1.73**
[6]Estimated Excess Fluorine PFASs (ng/L):	**11,763**
Excess Fluorine Hazard Quotient:	**22.9**

Appendix 12. Total PFAS Risk Summaries

Wastewater Treatment Plant Influent, Effluent, Biosolids and Compost

WWTP #1 Influent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**366**	**2.2**	$PFOS^-$, $PFHxS^-$, $PFOA^-$
Secondary Terminal PFASs:	**15**	**0.3**	$PFOA^-$, $PFHxS^-$
Excess Fluorine PFASs:	**2,078**	**4.0**	Ultrashorts
Total PFASs:	**2,459**	**7**	

WWTP #1 Effluent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**442**	**2.8**	$PFOS^-$, $PFHxS^-$, $PFOA^-$
Secondary Terminal PFASs:	**14**	**0.1**	$PFOA^-$, $PFHpA^-$
Excess Fluorine PFASs:	**2,186**	**4.3**	Ultrashorts
Total PFASs:	**2,642**	**7**	

WWTP #1 Biosolids Total PFAS Risk

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**65**	**1.9**	$PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	**156**	**0.6**	$PFOA^-$, $PFNA^-$, $PFDA^-$
Excess Fluorine PFASs:	**670**	**0.1**	-
Total PFASs:	**890**	**3**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 1 and 6.

2. Presented in order of relative risk.

WWTP #2 Influent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**326**	**1.2**	$PFOS^-$, $PFHxS^-$, $PFOA^-$
Secondary Terminal PFASs:	**9**	**0.1**	$PFOA^-$
Excess Fluorine PFASs:	**2,296**	**4.5**	Ultrashorts
Total PFASs:	**2,632**	**6**	

WWTP #2 Effluent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**519**	**1.1**	$PFOS^-$, $PFOA^-$, PFHxS-
Secondary Terminal PFASs:	**26**	**0.2**	$PFOA^-$
Excess Fluorine PFASs:	**2,801**	**5.5**	Ultrashorts
Total PFASs:	**3,346**	**7**	

WWTP #2 Biosolids Total PFAS Risk

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**38**	**0.6**	$PFOS^-$, $PFDA^-$
Secondary Terminal PFASs:	**287**	**1.4**	$PFOA^-$, $PFNA^-$, PFDA-
Excess Fluorine PFASs:	**553**	**0.1**	-
Total PFASs:	**879**	**2**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 1 and 6.

2. Presented in order of relative risk.

WWTP #3 Influent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**22**	**0.8**	$PFOS^-$, $PFOA^-$
Secondary Terminal PFASs:	**(not tested)**	**-**	-
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**22**	**1**	

WWTP #3 Effluent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**144**	**2.4**	$PFOA^-$, $PFOS^-$, PFDA-
Secondary Terminal PFASs:	**(not tested)**	**-**	-
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**144**	**2**	

WWTP #3 Biosolids Total PFAS Risk

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**66**	**1.6**	$PFDA^-$, $PFOS^-$, PFOA-
Secondary Terminal PFASs:	**719**	**3.6**	$PFOA^-$, $PFNA^-$, PFDA-
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**785**	**5**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 1 and 6.

2. Presented in order of relative risk.

WWTP #4 Influent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**22**	**0.8**	PFOS$^-$, PFOA$^-$, PFHxS-
Secondary Terminal PFASs:	**(not tested)**	**-**	-
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**22**	**1**	

WWTP #4 Effluent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**17**	**0.8**	PFOS$^-$, PFOA$^-$, PFDA-
Secondary Terminal PFASs:	**(not tested)**	**-**	-
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**17**	**1**	

WWTP #4 Biosolids Total PFAS Risk

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**23**	**0.5**	PFOS$^-$, PFDA-
Secondary Terminal PFASs:	**922**	**4.6**	PFOS$^-$, PFDA$^-$, PFNA-
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**945**	**5**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 1 and 6.

2. Presented in order of relative risk.

WWTP #5 Influent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**36**	**1.5**	$PFOS^-$, $PFOA^-$, $PFDA^-$
Secondary Terminal PFASs:	**(not tested)**	**-**	-
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**36**	**2**	

WWTP #5 Effluent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**32**	**0.9**	$PFOS^-$, $PFOA^-$, $PFDA^-$
Secondary Terminal PFASs:	**(not tested)**	**-**	-
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**32**	**1**	

WWTP #5 Biosolids Total PFAS Risk

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**58**	**1.5**	$PFOS^-$, $PFDA^-$
Secondary Terminal PFASs:	**620**	**3.8**	$PFOA^-$, $PFDA^-$, $PFNA^-$
Excess Fluorine PFASs:	**(not tested)**	**-**	-
Total PFASs:	**678**	**5**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 1 and 6.

2. Presented in order of relative risk.

WWTP #6 Influent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**537**	**0.8**	$PFOS^-$, PFOA-, $PFPeA^-$
Secondary Terminal PFASs:	**268**	**0.6**	$PFHpA^-$, PFOA-, $PFPeA^-$
Excess Fluorine PFASs:	**2,630**	**5.1**	Ultrashorts?
Total PFASs:	**3,435**	**7**	

WWTP #6 Effluent Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**971**	**0.9**	$PFOA^-$, PFPeA-, $PFOS^-$, PFHxA-
Secondary Terminal PFASs:	**30**	**0.4**	$PFOA^-$
Excess Fluorine PFASs:	**1,718**	**3.3**	Ultrashorts?
Total PFASs:	**2,719**	**5**	

WWTP #6 Biosolids Total PFAS Risk

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**26**	**0.5**	$PFDA^-$, PFOS-, $PFOA^-$
Secondary Terminal PFASs:	**382**	**1.0**	$PFOA^-$, PFNA-, $PFDA^-$
Excess Fluorine PFASs:	**998**	**0.2**	-
Total PFASs:	**1,406**	**2**	

WWTP #6 Compost Total PFAS Risk

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**57**	**0.6**	$PFOS^-$, PFDA-, $PFOA^-$
Secondary Terminal PFASs:	**19**	**0.1**	$PFOA^-$, PFNA-
Excess Fluorine PFASs:	**385**	**0.1**	-
Total PFASs:	**460**	**1**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 1 and 6.

2. Presented in order of relative risk.

Landfill Leachate

Landfill #1 Leachate Sample WGLF E-6 A Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	36,399	417.7	$PFOA^-$, $PFHxS^-$
Secondary Terminal PFASs:	5,360	11.1	$PFHxS^-$, PFOA-
Excess Fluorine PFASs:	99,467	193.8	ultrashorts?
Total PFASs:	**141,226**	**623**	

Landfill #1 Leachate Sample WGLF 4B Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	29,369	908.2	$PFHxS^-$, $PFOA^-$, $PFOS^-$
Secondary Terminal PFASs:	2,000	27.8	PFOA-
Excess Fluorine PFASs:	53,873	105.0	ultrashorts?
Total PFASs:	**85,242**	**1,041**	

Landfill #1 Leachate Sample WGLF ASH Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	11,340	61.0	$PFOA^-$, $PFHpA^-$
Secondary Terminal PFASs:	1,100	6.8	$PFOA^-$
Excess Fluorine PFASs:	8,469	16.5	ultrashorts?
Total PFASs:	**20,909**	**84**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 2 and 7.

2. Presented in order of relative risk.

Landfill #2 Leachate Sample PVTLF Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	102,603	7,134.6	$PFHxS^-$, $PFOS^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**102,603**	**7,135**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 2 and 7.

2. Presented in order of relative risk.

Landfill #3 Leachate CMLF IV-A Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	28,224	735.4	$PFOA^-$, $PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	1,046	67.7	$PFOS^-$, PFDA -
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**29,270**	**803**	

Landfill #3 Leachate CMLF IV-B Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	14,479	266	$PFOA^-$, $PFHxS^-$, $PFOS^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**14,479**	**266**	

Landfill #3 Leachate CMLF VBE Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	54,298	1,082	$PFOA^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**54,298**	**1,082**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 2 and 7.

2. Presented in order of relative risk.

Landfill #4 Leachate Sample WHLF R1 Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**54,370**	**1,829.6**	$PFOA^-$, $PFHxS^-$, $PFOS^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**54,370**	**1,830**	

Landfill #4 Leachate Sample WHLF R2 Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**32,215**	**749.0**	$PFOA^-$, $PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**32,215**	**749**	

Landfill #4 Leachate Sample WHLF R3 Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**44,074**	**623.4**	$PFOA^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**44,074**	**623**	

Landfill #4 Leachate Sample WHLF R4 Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	**95,678**	**1,142.7**	$PFOA^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**95,678**	**1,143**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 2 and 7.

2. Presented in order of relative risk.

Landfill #5 Leachate Sample KKHLF WW1 Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	17,113	576.9	$PFOA^-$, $PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**17,113**	**577**	

Landfill #5 Leachate Sample KKHLF WW2 Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	26,931	660.0	$PFHxS^-$, $PFOA^-$, $PFOS^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**26,931**	**660**	

Landfill #5 Leachate Sample KKHLF WW3 Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	9,863	242.6	$PFHxS^-$, $PFOS^-$, $PFOA^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**9,863**	**243**	

Landfill #5 Leachate Sample KKHLF WW2A Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	18,833	1,114.6	$PFHxS^-$, $PFOS^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**18,833**	**1,115**	

Landfill #5 Leachate Sample KKHLF WW2B Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	20,107	1,231.7	$PFHxS^-$, $PFOS^-$
Secondary Terminal PFASs:	-	-	-
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**20,107**	**1,232**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 2 and 7.

2. Presented in order of relative risk.

AFFF Release Site #1 Soil

AFFF Release Site #1 Soil Total PFAS Risk

AFFF Release Site #1 DU-2

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	24	0.1	$PFOA^-$, $PFOS^-$
Secondary Terminal PFASs:	23,813	5.9	$PFHpA^-$, $PFPeA^-$, $PFHxA^-$
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**23,837**	**6**	

AFFF Release Site #1 DU-3

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	37	0.3	$PFOA^-$, $PFOS^-$
Secondary Terminal PFASs:	21,971	5.7	$PFHpA^-$, $PFPeA^-$, $PFHxA^-$
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**22,008**	**6**	

AFFF Release Site #1 DU-4a

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	13	0.2	$PFOS^-$
Secondary Terminal PFASs:	101	0.2	$PFOS^-$, $PFOA^-$
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**114**	**0**	

AFFF Release Site #1 DU-4b

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	11	0.1	$PFOS^-$
Secondary Terminal PFASs:	632	0.3	$PFOS^-$, $PFPeA^-$, $PFHpA^-$
Excess Fluorine PFASs:	-	-	-
Total PFASs:	**643**	**0**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 3 and 8.

2. Presented in order of relative risk.

AFFF Release Site #2 Soil

AFFF Release Site #2 Soil Total PFAS Risk

AFFF Release Site #2 DU5D

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	849	30.5	$PFOS^-$
Secondary Terminal PFASs:	212	1.0	$PFOA^-$, $PFNA^-$, $PFDA^-$, $PFHxS^-$
Excess Fluorine PFASs:	[3](error)		-
Total PFASs:	**1,061**	**32**	

AFFF Release Site #2 DU5E

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	852	30.8	$PFOS^-$
Secondary Terminal PFASs:	545	9.1	$PFOS^-$
Excess Fluorine PFASs:	(below MRL)		-
Total PFASs:	**1,397**	**40**	

AFFF Release Site #2 DU5F

PFAS Group	Concentration (µg/Kg)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	910	33.1	$PFOS^-$
Secondary Terminal PFASs:	408	5.0	$PFOS^-$, $PFOA^-$
Excess Fluorine PFASs:	233	0.0	-
Total PFASs:	**1,551**	**38**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 4 and 9.
2. Presented in order of relative risk.
3. Reported EOF less than EOF predicted based on TOPs data.

AFFF Release Site #2 Groundwater

AFFF Site #2 MW-1 Groundwater Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	1,291,000	99,196	$PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	632,000	5,697	$PFPeA^-$, $PFHpA^-$, $PFHxA^-$
Excess Fluorine PFASs:	2,350,514	4,580	ultrashorts
Total PFASs:	**4,273,514**	**109,474**	

AFFF Site #2 MW-2 Groundwater Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	1,646,000	120,437.1	$PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	412,000	347.2	$PFPeA^-$, $PFOA^-$, $PFHpA^-$, $PFHxA^-$
Excess Fluorine PFASs:	1,884,486	3,672.1	ultrashorts
Total PFASs:	**3,942,486**	**124,456**	

AFFF Site #2 MW-3 Groundwater Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	494,900	51,232	$PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	206,500	185	$PFHpA^-$, $PFHxA^-$, $PFPeA^-$
Excess Fluorine PFASs:	629,368	1,226	ultrashorts
Total PFASs:	**1,330,768**	**52,644**	

AFFF Site #2 MW-4 Groundwater Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	322,500	22,432	$PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	167,700	120	$PFHpA^-$, $PFHxA^-$, $PFPeA^-$
Excess Fluorine PFASs:	522,281	1,018	ultrashorts
Total PFASs:	**1,012,481**	**23,570**	

AFFF Site #2 MW-5 Groundwater Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	275,400	18,892	$PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	40,800	55	$PFPeA^-$, $PFHxA^-$
Excess Fluorine PFASs:	702,885	1,370	ultrashorts
Total PFASs:	**1,019,085**	**20,316**	

AFFF Site #2 MW-7 Groundwater Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	188,830	18,385	$PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	18,300	7.2	$PFHxA^-$, $PFPeA^-$
Excess Fluorine PFASs:	133,042	259	ultrashorts
Total PFASs:	**340,172**	**18,651**	

AFFF Site #2 MW-8 Groundwater Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	283	18	$PFOS^-$, $PFHxS^-$
Secondary Terminal PFASs:	32	0.7	$PFOS^-$
Excess Fluorine PFASs:	1,383	2.7	ultrashorts (1/2 MRL used)
Total PFASs:	**315**	**19**	

AFFF Site #2 MW-9 Groundwater Total PFAS Risk

PFAS Group	Concentration (ng/L)	[1]Hazard Indices	[2]Primary Risk Drivers (>10% of Total)
Primary Terminal PFASs:	15,777	532	$PFHxS^-$, $PFOS^-$
Secondary Terminal PFASs:	1,440	125	$PFOS^-$, $PFHxS^-$
Excess Fluorine PFASs:	13,844	27	ultrashorts
Total PFASs:	**31,061**	**684**	

1. Hazard Indices calculated using HDOH Total PFAS Risk calculator and data presented in Appendices 4 and 9.
2. Presented in order of relative risk.