Residual Chemical Sampling and Analysis:

N-Nitrosodimethylamine (NDMA) and Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)

Annual Report, 2024

LOTT Clean Water Alliance

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Acronyms and Abbreviations

3:3 FTCA	3-Perfluoropropyl propanoic acid
5:3 FTCA	2*H*,2*H*,3*H*,3*H*-Perfluorooctanoic acid
6:2 FTS	1*H*,1*H*,2*H*,2*H*-Perfluorooctane sulfonic acid
7:3 FTCA	3-Perfluoroheptyl propanoic acid
8:2 FTS	1*H*,1*H*, 2*H*, 2*H*-Perfluorodecane sulfonic acid
BIRWP	Budd Inlet Reclaimed Water Plant
BITP	Budd Inlet Treatment Plant
CCL 4	fourth Contaminant Candidate List
COC	chain of custody
EMPC	estimated maximum possible concentration
FP	formation potential
HAL	health advisory level
HFPO-DA	Hexafluoropropylene oxide dimer acid (aka “GenX”)
HI	hazard index
LCS	lab control sample
LCSD	lab control sample duplicate
LOTT	LOTT Clean Water Alliance
MB	method blank
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDL	method detection limit
mgd	million gallons per day
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
MWRWP	Martin Way Reclaimed Water Plant
ND	non-detect
NDMA	*N*-nitrosodimethylamine
NEtFOSAA	*N*-ethyl perfluorooctanesulfonamidoacetic acid
NEtFOSE	*N*-ethyl perfluorooctanesulfonamidoethanol
NMeFOSAA	*N*-methyl perfluorooctanesulfonamidoacetic acid
NMeFOSE	*N*-methyl perfluorooctanesulfonamidoethanol
PFBA	Perfluorobutanoic acid
PFBS	Perfluorobutanesulfonic acid
PFDA	Perfluorodecanoic acid
PFDoA	Perfluorododecanoic acid
PFDS	Perfluorodecanesulfonic acid
PFHpA	Perfluoroheptanoic acid
PFHpS	Perfluoroheptanesulfonic acid
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexanesulfonic acid

PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PFOSA	Perfluorooctanesulfonamide
PFPeA	Perfluoropentanoic acid
PFPeS	Perfluoropentanesulfonic acid
PFTeDA	Perfluorotetradecanoic acid
PFUnA	Perfluoroundecanoic acid
POTW	publicly owned treatment works
PPCPs	pharmaceutical and personal care products
PQL	practical quantitation limit
RAA	running annual average
RPD	relative percent difference
RWIS	Reclaimed Water Infiltration Study
SAL	state action level
UCMR	unregulated contaminant monitoring rule
USEPA	United State Environmental Protection Agency
WW	wastewater

1 Introduction and Background

The LOTT Clean Water Alliance (LOTT) treats and manages wastewater for the urban areas of Lacey, Olympia, and Tumwater in Thurston County, Washington. Two treatment facilities service the area: Budd Inlet Treatment Plant (BITP) / Reclaimed Water Plant (BIRWP) and Martin Way Reclaimed Water Plant (MWRWP). The current service area is approximately 52,000 acres with a residential population of approximately 123,500 (LOTT, 2023). The majority (~80%) of sewer connections are residential, with the remaining connections being commercial and institutional including hospitals, medical facilities, nursing homes and colleges. There are 11 currently permitted industrial users through LOTT's industrial pretreatment program; 4 of these are categorized as significant industrial users. Since 2004, LOTT has produced reclaimed water which can be used for irrigation and other non-potable purposes or sent to infiltration basins for percolation into groundwater. Long-term plans for the system include expanding reclaimed water production and groundwater recharge.

LOTT previously undertook a wastewater and reclaimed water quality characterization study to identify regulated and unregulated contaminants throughout its treatment systems. The Reclaimed Water Infiltration Study (RWIS) took approximately 10 years to complete and was conducted to address community questions and concerns about residual chemicals that may remain in reclaimed water after treatment and infiltration into the ground. From the RWIS, two residual chemicals of interest were identified for further monitoring: *N*-nitrosodimethylamine (NDMA) and perfluoropentanoic acid (PFPeA).

LOTT initiated a follow-up sampling study for NDMA and a suite of PFAS chemicals, extending the scope of its analysis to the wastewater collection system. A sampling and analysis plan was developed for this study (Appendix A). The study was envisioned to encompass three years, with the collection of quarterly data pertaining to the occurrence and origins of PFAS and NDMA throughout LOTTs collection and treatment systems. This current report provides data and discussion from the first year of quarterly monitoring events that took place in February, May, September and November of 2024. Profiling of PFAS, NDMA and NDMA precursors was performed to assess the contributions of industrial and residential sources, and potential removal of those residual chemicals across various stages of treatment at both BITP/BIRWP and MWRWP.

1.1 LOTT Treatment Systems

1.1.1 Budd Inlet Treatment Plant (BITP) and Budd Inlet Reclaimed Water Plant (BIRWP)

LOTT operates two wastewater treatment facilities. The Budd Inlet Treatment Plant (BITP), LOTT's largest wastewater treatment facility treating an average of approximately 13 million gallons per day (mgd), is located in downtown Olympia. The treatment process at the BITP consists of primary sedimentation, advanced secondary treatment via an activated sludge biological process with biological nutrient removal, and ultraviolet disinfection. Primary sludge and waste activated sludge are co-thickened using dissolved air flotation thickeners and sent to mesophilic anaerobic digesters for digestion and stabilization. The digested sludge is dewatered using centrifuges to produce Class B biosolids. These Biosolids are then sent to Boulder Park Beneficial Use Facility in central Washington for land application under biosolids management permit number BT0518.

The secondary treatment process includes biological nutrient removal of nitrogen, through the use of alternating anoxic and oxic zones in the biological nutrient removal basins. This removal process helps LOTT meet its more stringent permit limits for nitrogen from April to October, the warmer part of the year. Reducing the amount of nitrogen discharged into marine waters helps reduce algae growth and oxygen depletion in Budd Inlet.

A portion of the final effluent from the BITP is routed through additional treatment housed in the Budd Inlet Reclaimed Water Plant (BIRWP) to meet Class A reclaimed water quality standards (brought online in 2004). This treatment includes chemical addition and filtration through single-stage, continuous backwashing, up flow sand filters, and additional disinfection with chlorine. The reclaimed water is used for a variety of uses such as landscape irrigation, toilet flushing, and outdoor water features at multiple locations in the downtown Olympia area, as well as for irrigation of the Tumwater Valley Municipal Golf Course. The facility is designed to produce up to 1.5 mgd of reclaimed water.

The BITP and BIRWP operate under National Pollutant Discharge Elimination System (NPDES) waste discharge permit number WA0037061 issued by the Washington State Department of Ecology (Ecology).

1.1.2 Martin Way Reclaimed Water Plant (MWRWP)

The MWRWP is a satellite reclaimed water facility that has produced reclaimed water since 2006. In its current configuration, it can generate up to approximately 1.5 mgd of Class A reclaimed water but is currently limited in capacity by the rate of influent wastewater. Treatment is accomplished using membrane bioreactor (MBR) technology that is comprised of a two-stage biological nutrient removal step, followed by filtration and then chlorine disinfection. Solids removed during wastewater treatment at the MWRWP are sent back into the sewer force main where they are conveyed to the BITP.

The majority of Class A reclaimed water produced at the MWRWP is used for groundwater recharge at two locations: 1) LOTT's Hawks Prairie Ponds and Recharge Basins, and 2) the Woodland Creek Groundwater Recharge Facility owned by the Cities of Lacey and Olympia. At LOTT's Hawks Prairie site, reclaimed water is conveyed through a series of five constructed wetland ponds before flowing to groundwater recharge basins.

The MWRWP is permitted by Ecology under the reclaimed water permit ST 6206. The permit includes groundwater monitoring and enforcement limits for both groundwater recharge locations (i.e., Hawks Prairie Ponds and Recharge Basins, and Woodland Creek Groundwater Recharge Facility).

1.2 Background on Per- and Polyfluoroalkyl Substances (PFAS) and PFAS Occurrence at LOTT

Polyfluoroalkyl and perfluoroalkyl substances (PFAS) are man-made chemicals that have been used in consumer and industrial products since the 1940s. PFAS are comprised of linked carbon and fluorine atoms; because the carbon-fluorine bond is one of the strongest, these chemicals do not readily degrade in the environment and persist in soils, water, and air particles. They are found globally in detectable concentrations and even found to be ubiquitous contaminants in animals in the high arctic (Muir et al., 2019). PFAS are known to increase the risk of certain types of cancer including prostate, kidney and testicular cancer as well as contributing to increased cholesterol and/or risk of obesity. Reproductive effects may include decreased fertility and/or increased blood pressure during pregnancy as well as developmental effects including low birth weight, accelerated puberty, bone variations, and/or behavioral changes (USEPA, 2024a).

With increasing information on the occurrence of PFAS in the environment and its impacts on human health, the U.S. Environmental Protection Agency (USEPA) has undertaken measures to control PFAS in drinking water as well as initiate a nationwide survey to assess PFAS occurrence in publicly owned treatment works (POTWs) (USEPA, 2024b; discussed further below). In potable water systems, health advisory levels (HALs) were originally established in 2016 by the USEPA at 70 nanograms per liter (ng/L) for combined perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA). Since that time, national and local funding has been allocated to PFAS research to assess the occurrence of PFAS in source waters as well as identify appropriate treatment strategies and other measures of PFAS control. In 2021, state action levels (SALs) were established by the Washington State Board of Health for five PFAS compounds [PFOA, PFOS, perfluorobutanesulfonic acid (PFBS), hexafluoropropylene oxide dimer acid (HFPO-DA, aka “GenX”), perfluorononanoic acid (PFNA), and perfluorohexanesulfonic acid (PFHxS)]. In 2022, the USEPA updated PFAS HALs (Table 1). As of March 2023, the USEPA further proposed Maximum Contaminant Level Goals (MCLGs) and Maximum Contaminant Levels (MCLs) for six PFAS in drinking water, with these levels finalized as of April 10th, 2024, and displayed in Table 1. Since the USEPA is currently collecting additional data on PFAS contamination in drinking water treatment systems through the fifth Unregulated Contaminant Monitoring Rule (UCMR 5), it is possible that additional PFAS regulations will be developed for potable water in the future.

With the current potable water regulations, 4 of the 6 regulated PFAS compounds are included in a “Hazard Index (HI)” developed by the USEPA. The index is calculated in the equation that follows:

$$Hazard\ Index = \left(\frac{[GenX]}{10\ ng/L}\right) + \left(\frac{[PFBS]}{2000\ ng/L}\right) + \left(\frac{[PFNA]}{10\ ng/L}\right) + \left(\frac{[PFHxS]}{10\ ng/L}\right)$$

Table 1. Past and Current State and Federal PFAS Guidelines and Regulations

<table>
<tr><th>PFAS Compound</th><th>USEPA HALs: 2016 to 2022 (ng/L)</th><th>State of WA SALs: As of 2021 (ng/L)</th><th colspan="2">USEPA MCLs: As of 2024 (ng/L)</th><th colspan="2">USEPA MCLGs: As of 2024 (ng/L)</th><th>UCMR 5 Practical Quantitation Limit (PQL) (ng/L)</th></tr>
<tr><td>Perfluorooctanoic acid (PFOA)</td><td rowspan="2">Combined HAL = 70</td><td>10</td><td colspan="2">4.0</td><td colspan="2">Zero</td><td>4.0</td></tr>
<tr><td>Perfluorooctanesulfonic acid (PFOS)</td><td>15</td><td colspan="2">4.0</td><td colspan="2">Zero</td><td>4.0</td></tr>
<tr><td>Perfluorononanoic acid (PFNA)</td><td>N/A</td><td>9</td><td>10</td><td rowspan="4">1 (unitless) Hazard Index</td><td></td><td rowspan="4">1 (unitless) Hazard Index</td><td>4.0</td></tr>
<tr><td>Perfluorohexanesulfonic acid (PFHxS)</td><td>N/A</td><td>65</td><td>10</td><td></td><td>3.0</td></tr>
<tr><td>Perfluorobutanesulfonic acid (PFBS)</td><td>N/A</td><td>345</td><td>N/A</td><td></td><td>3.0</td></tr>
<tr><td>Hexafluoropropylene oxide dimer acid (HFPO-DA)/“GenX”</td><td>N/A</td><td>N/A</td><td>10</td><td></td><td>5.0</td></tr>
</table>

For those PFAS regulated using an HI, the quarterly running annual average (RAA) HI must be less than or equal to 1.0, otherwise it is a violation of the HI MCL. The PFAS Method Reporting Limit (MRL) is the lowest concentration that can be consistently determined within +/- 20% of the true concentration by 75% of the laboratories tested in a performance evaluation study [practical quantitation limit (PQL)]. If a result is < the PQL, a zero is used to calculate the RAA. The denominator of each PFAS fraction in the above equation is representative of the corresponding health-based water concentration, or the “level below which there are no known or anticipated adverse health effects over a lifetime of exposure, including sensitive populations and life stages, and allows for an adequate margin of safety” (CFR, 2024). The HI has one significant figure, which means that any value from 0.5 to 1.49 is rounded to a HI of 1. If HI > 1, it would be an exceedance of the MCL (Table 1).

In attempting to further address PFAS contamination in the environment, the USEPA has developed a PFAS Strategic Roadmap which includes a "deeper focus to preventing PFAS from entering the environment in the first place—a foundational step to reducing the exposure and potential risks of future PFAS contamination” (USEPA, 2024b). As part of this deeper focus, the USEPA is conducting an extensive study on influent sources to POTWs (approximately 400 POTWs). Further samples will be taken at 200 to 300 select POTWs at locations including: up to 10 industrial effluents, domestic wastewater influent, POTW influent, POTW effluent, and sewage sludge (at select facilities). These results will provide information on the type and quantity of PFAS in wastewater from industrial users.

It is noteworthy that the design of the USEPA’s PFAS POTW study is very similar to the design that LOTT developed (before the USEPA’s draft plan was even released). In comparison, the LOTT sampling plan is more comprehensive, examining various stages in treatment to further survey how PFAS varies across treatment unit processes. Also, the LOTT sampling plan is based on quarterly grab samples over three years versus the USEPA’s study that is based on a single sampling event (also with grab samples). See Section 2 for further details on the LOTT sampling plan.

Table 2 through Table 4 provide historical data from PFAS testing at BIRWP and MWRWP, including post-wetlands samples and samples from a recharge basin at Hawks Prairie, that were collected quarterly in 2014-2015 and in 2018 as part of the RWIS. Of the PFAS compounds detected, PFOA (with values up to 22 ng/L; above the proposed MCL limit), PFBS (up to 13 ng/L), perfluorohexanoic acid (PFHxA; up to 81 ng/L) and perfluoropentanoic acid (PFPeA, up to 150 ng/L) were most commonly found across both treatment systems, with perfluorobutanoic acid (PFBA) and PFHxS also detected (refer to Table 2 through Table 4 for more details on the frequency of PFAS detections and concentrations). HFPO-DA was not found at detectable limits at either facility. The remaining PFAS compounds tested were repeatedly determined to be “non-detects” (ND) which means the concentration was measured between zero and up to the method detection limit (MDL). Another measure, the Method Reporting limit (MRL) is the lowest concentration at which a given method has been validated to provide *quantifiable* results. Data between the MDL and MRL (i.e., J-value concentrations) provides insight on detectable PFAS species present at lower concentrations that are detected, but that cannot be reliably quantified.

Table 2. Historical PFAS Levels in LOTT's Budd Inlet Reclaimed Water Plant (BIRWP), 2014-2015 (in ng/L)

PFAS Compound	November 13th, 2014		February 18th, 2015		May 20th, 2015		August 19th, 2015	
	WW	Reclaim	WW	Reclaim	WW	Reclaim	WW	Reclaim
Perfluorooctanoic acid (PFOA)	*ND*	7.4 (*J*)	*ND*	**5.6**	*ND*	*ND*	*ND*	*ND*
Perfluorooctanesulfonic acid (PFOS)	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Perfluorononanoic acid (PFNA)	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Perfluorohexanesulfonic acid (PFHxS)	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Perfluorobutanesulfonic acid (PFBS)	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Perfluorobutanoic acid (PFBA)	*ND*	*ND*	**25**	*ND*	*ND*	*ND*	*ND*	*ND*
Perfluorodecanoic acid (PFDA)	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Perfluoroheptanoic acid (PFHpA)	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Perfluorohexanoic acid (PFHxA)	*ND*	**17**	*ND*	**8.8**	*ND*	*ND*	*ND*	*ND*
Perfluoropentanoic acid (PFPeA)	**26**	**10**	--	--	*ND*	*ND*	*ND*	*ND*

(WW) wastewater
(Reclaim) Reclaimed water
(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

Table 3. Historical PFAS Levels in LOTT's Martin Way Reclaimed Water Plant (MWRWP) and Post-Wetlands, 2014-2015 (in ng/L)

PFAS Compound*	November 12th, 2014			February 17th, 2015			May 20th, 2015			October 7th, 2015		
	WW	Reclaim	Post-Wetland	WW	Reclaim	Post-Wetland	WW	Reclaim	Post-Wetland	WW	Reclaim	Post-Wetland
PFOA	5.5 (*J*)	16 (*J*)	**18**	*ND*	**20**	**16**	*ND*	*ND*	*ND*	*ND*	**16**	**22**
PFOS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFNA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	**5.0**	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFBS	*ND*	*ND*	**5.6**	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	**7.3**	**12**
PFBA	*ND*	*ND*	*ND*	**32**	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxA	**14**	**23**	**43**	**5.2**	**81**	**71**	*ND*	**18**	**11**	**12**	**46**	**68**
PFPeA	**74**	**29**	**31**	--	--	--	**7.1**	**31**	**17**	**79**	**79**	**93**

(*) See Table 2 for full chemical compound name.
(WW) wastewater
(Reclaim) Reclaimed water
(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

Table 4. Historical PFAS Levels in LOTT's Hawks Prairie Recharge Facility, Outlets at Basin #4, 2018 (in ng/L)

	Reclaimed Water		Reclaimed Water		Reclaimed Water		Reclaimed Water	
PFAS Compound*	**1/15/2018**	**1/15/2018**	**4/09/2018**	**4/11/2018**	**6/11/2018**	**6/13/2018**	**8/06/2018**	**8/08/2018**
PFOA	15 (*J*)	**13**	20 (*J*)	**19**	**13**	**11**	**13**	**16**
PFOS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFNA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFBS	9.6 (*J*)	**9.5**	**7.0**	**8.3**	**8.4**	**8.3**	**12**	**13**
PFBA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxA	46 (*J*)	**46**	**32**	**67**	**26**	**47**	**26**	**72**
PFPeA	62 (*J*)	**64**	**50**	**130**	**52**	**96**	**53**	**150**

(*) See Table 2 for full chemical compound name.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*ND*) non-detect; indicates levels below the MDL.

1.3 Background on *N*-Nitrosodimethylamine (NDMA) and NDMA Occurrence at LOTT

NDMA is a probable human carcinogen (classified as a B2 carcinogen, with sufficient evidence in animals of carcinogenicity but inadequate or no evidence in humans) that was formerly used in the production of rocket fuel and various industrial antioxidants and softeners and can also enter water via the unintended byproduct of drinking water and wastewater disinfection (Bradley et al., 2005; Mitch et al., 2003). Free chlorine, chloramines, and other oxidizing agents in water react with NDMA precursors during the treatment process to form NDMA. The majority of precursors found in drinking water and wastewater systems are from pharmaceutical and personal care products (PPCPs) and various other synthetic compounds. NDMA is also notably endogenously formed in the gut, particularly with consumption of food and beverages such as beer, smoked or cured meats and cheeses (EFSA, 2023).

Exposure to high levels of NDMA may lead to liver damage (ATSDR, 1999; USEPA, 2017). Other potential health impacts include headache, fever, nausea, jaundice, vomiting, abdominal cramps, reduced function of liver/kidneys/lungs, and dizziness (USEPA, 2017; OSHA, 2005). For drinking water, the USEPA has calculated a screening level of 0.11 ng/L for NDMA, based upon a 1 in 1 million or 10^{-6} lifetime excess cancer risk (USEPA, 2017).

The USEPA monitored NDMA and five other nitrosamines as part of inclusion on the drinking water Fourth Contaminant Candidate List (CCL4) and UCMR 2 sampling efforts. These extensive surveys (CCL4: identified 97 chemicals or chemical groups and 12 microbial contaminants of concern; UCMR 2: requiring all public water systems serving more than 10,000 people to monitor 25 contaminants) helped to inform whether NDMA should be regulated in drinking water. To date, NDMA has not been federally regulated although guidelines have been established in numerous states. The State of Washington, has a groundwater criterion established under WAC 173-200 for NDMA at 2 ng/L.

From a water treatment perspective, NDMA continues to be an issue when appreciable precursors (e.g., PPCPs) are present and sufficient disinfectant dosing and contact time occurs. Water reclamation and reuse applications may have precursors present during treatment that can convert to NDMA.

Table 5 through Table 7 illustrate NDMA data collected in 2014-2015 and 2018 in LOTT's treatment systems, as part of the RWIS. NDMA values were as high as 11 ng/L in plant influent, 4.5 ng/L in reclaimed water, 2.8 ng/L in post-wetlands sampled water, and 5.1 ng/L in the outlets at the #4 basin in the Hawks Prairied Recharge Basins (note: the last concentration is a *J*-flag value). It is worth noting that concentrations varied across sampling events with many samples reported as non-detect.

Table 5. Historical NDMA Levels in LOTT's Budd Inlet Reclaimed Water Plant (BIRWP), 2014-2015 (in ng/L)

	November 13th, 2014		February 18th, 2015		May 20th, 2015		August 19th, 2015	
Compound	WW	Reclaim	WW	Reclaim	WW	Reclaim	WW	Reclaim
NDMA	**5.1**	**4.5**	*ND*	*ND*	*ND*	**3.0**	*ND*	**2.4**

(WW) wastewater
(Reclaim) Reclaimed water
(*ND*) non-detect; indicates levels below the MDL.

Table 6. Historical NDMA Levels in LOTT's Martin Way Reclaimed Water Plant (MWRWP) and Post-Wetlands, 2014-2015 (in ng/L)

	November 12th, 2014			February 17th, 2015			May 20th, 2015			October 7th, 2015		
Compound	WW	Reclaim	Post-Wetland	WW	Reclaim	Post-Wetland	WW	Reclaim	Post-Wetland	WW	Reclaim	Post-Wetland
NDMA	**4.6**	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	**11**	--	**2.8**

(WW) wastewater
(Reclaim) Reclaimed water
(*ND*) non-detect; indicates levels below the MDL.

Table 7. Historical NDMA Levels in LOTT's Hawks Prairie Recharge Facility, Outlets at Basin #4, 2018 (in ng/L)

	Reclaimed Water		Reclaimed Water		Reclaimed Water		Reclaimed Water	
Compound	1/15/2018	1/15/2018	4/09/2018	4/11/2018	6/11/2018	6/13/2018	8/06/2018	8/08/2018
NDMA	*ND*	*ND*	5.1 (*J*)	**4.4**	*ND*	*ND*	**2.7**	**3.4**

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

1.4 Monitoring Goals and Sampling Plan

In this study, a detailed sampling plan for PFAS and NDMA was prepared with sampling points at the locations of industrial wastewater dischargers and within the sewer collection system at locations primarily from residential sources, and different stages of wastewater and reclaimed water treatment processes (Table 8). The sampling plan included one year (year 1) of quarterly PFAS and NDMA monitoring at 7 key industrial discharge sites and 3 residential sites representative of Lacey, Tumwater, and Olympia (Table 8 and Table 9).

Also, the sampling plan included quarterly formation potential (FP) testing to assess total NDMA precursor loading during year 1. The analysis of NDMA-FP concentrations in industrial sources, residential sites, across treatment, and in secondary treated and reclaimed water can provide insight on how NDMA precursors are entering LOTT's treatment systems, their removal, and their overall release into the environment. After year 1 of NDMA-FP testing, targeted research may be conducted at select sites to better characterize the occurrence and removal of specific NDMA precursors.

Finally, three years of quarterly sampling are scheduled for PFAS and NDMA monitoring at BITP, BIRWP, and MWRWP. Sampling locations include influent wastewater, unit processes effluent and centrate, waste sludge and biosolids, reclaimed water, and reclaimed water post-wetlands.

Table 8. LOTT Quarterly Sampling Plan with Description of Sites Selected

Sampling Site Identifier*	Description	Notes
I-1	Metal finisher	---
I-2	Can manufacturer	---
I-3	Box manufacturer	---
I-4	Box manufacturer	---
I-5	Beverage manufacturer	---
I-6	Landfill	---
I-7	Hospital	---
R-1	Residential site in Lacey	---
R-2	Residential site in Tumwater	---
R-3	Residential site in Olympia	---
M-1	Influent wastewater at MWRWP	Characterize untreated wastewater source
M-2	Reclaimed water at MWRWP	Identify PFAS transformation and/or NMDA formation following disinfection; characterize reclaimed water prior to leaving the treatment plant
M-3	Waste sludge at MWRWP (goes to BITP)	Characterize waste sludge stream that is conveyed to BITP
M-4	Reclaimed water post-wetlands (pre-infiltration basins) at the Hawks Prairie Ponds and Recharge Basins	Identify PFAS transformation and/or NMDA formation following constructed wetlands; characterize removal associated with constructed wetlands; characterize influent reclaimed water to LOTT's infiltration basins
M-5	Reclaimed water (pre-chlorination) at MWRWP	Site just upstream of M-2, used to collect samples for NDMA-formation potential (FP) testing ONLY

Sampling Site Identifier*	Description	Notes
B-1	Influent wastewater at BITP (downstream of waste sludge addition from MWRWP)	Identify PFAS transformation and/or NMDA formation following the combination of both waste streams; characterize combined influent wastewaters (sources 1 and 2)
B-2	Primary effluent at BITP	Characterize removal associated with solids
B-3	Secondary effluent at BITP	Identify PFAS transformation and/or NMDA formation following biological nutrient removal (summer period); identify PFAS transformation and/or NMDA formation following basic activated sludge (winter period); characterize removal associated with secondary (biological) processes
B-4	Centrate at BITP	Characterize centrate (high load of organic pollutants including PFAS)
B-5	Final effluent at BITP	Identify PFAS transformation and/or NMDA formation following UV disinfection; characterize discharge from BITP
B-6	Reclaimed water at BIRWP	Identify PFAS transformation and/or NMDA formation following additional chlorine disinfection; characterize reclaimed water
B-7	Biosolids at BITP	Identify PFAS transformation and/or NDMA formation following solids stream treatment; characterize Class B biosolids produced at BITP

*(I) indicates industrial sites; (R) indicates residential sites; (M) indicates MWRWP sites; (B) indicates BITP/BIRWP sites

Table 9. Overview of PFAS, NDMA and NDMA Precursor Sampling Plan

Frequency	Analysis	Industrial	Residential	WWTP*	Biosolids	Post-Wetlands
Year 1 (quarterly)	PFAS	X	X	X	X	X
	NDMA	X	X	X	X	X
	NDMA-FP	X	X	X		X
Year 2 (quarterly)	PFAS			X	X	X
	NDMA	X		X	X	X
	Targeted NDMA Precursors*	X		X		X
Year 3 (quarterly)	PFAS			X	X	X
	NDMA			X	X	X

(*) To occur at select sites with elevated precursors from NDMA-FP testing

2 Wastewater/Reclaimed Water Quality Monitoring Methods

The wastewater and reclaimed water characterization effort was conducted according to the sampling plan that was briefly discussed in Section 1.4 (also see Appendix A). The plan was reviewed and discussed with LOTT's Science Task Force. This task force was comprised of staff from LOTT and LOTT's partner jurisdictions, as well as representatives from other local and state entities including Ecology, DOH, and the Squaxin Island Tribe. Key elements of the monitoring approach are described in detail in this section.

2.1 Water Quality Parameters Analyzed

Table 10, Table 11 and Table 12 outline this study's parameters including PFAS compounds and associated monitoring methods. Field parameters are also collected during these quarterly sampling events including pH, temperature, ammonia, free chlorine, monochloramine, and total chlorine (Table 12).

Eurofins, the selected laboratory services provider for PFAS and NDMA, uses USEPA Method 1633 to analyze PFAS in water and solids. For NDMA in solids, USEPA Method 8270C is used. In water, Eurofins uses either USEPA Method 521.1 or a modified version of USEPA Method 521.1.

The modified version of USEPA Method 521.1 is used to measure NDMA in untreated wastewater (WW). The purpose of the modification is to separate NDMA from other interfering constituents within untreated wastewater. Within this modified method *"samples are spiked with an isotopically labeled internal standard. Aqueous samples are extracted with methylene chloride using separatory funnel or solid phase extraction procedures. Soil samples are sonicated with methylene chloride. The extract is dried, concentrated to a volume of 0.5 mL, and analyzed by GC/CI/MS/MS or GC/CI/MS. Preparation procedures are performed according to SOP WS-IDP-0020*" (Eurofins, personal communication). Samples that are considered "treated" are measured with the unmodified USEPA Method 521.1 and include secondary effluent, final effluent, reclaimed water and water collected post-wetlands.

HDR also conducted an analysis of NDMA precursors to assess the formation potential for NDMA, using method USEPA 521.1 at their in-house lab in Portland, OR. More details on this procedure are given in Section 2.5.

Table 10. Parameters Analyzed by Eurofins for Wastewater and Reclaimed Water

Parameter	Matrix	Method	Locations Sampled
PFAS	Water	USEPA Draft-3 Method 1633 [1]	Industrial, residential, WW influent, primary effluent, centrate, secondary effluent, final effluent, reclaimed, post-wetlands
	Solids	USEPA Draft-3 Method 1633 [1]	Biosolids
NDMA	Water (wastewater)	Modified USEPA Method 521	Industrial, residential, WW influent, primary effluent, centrate
	Water (treated)	USEPA Method 521.1	Secondary effluent, final effluent, reclaimed, post-wetlands
	Solids	USEPA Method 8270C	Biosolids
NDMA-FP [2]	Water (wastewater)	Modified USEPA Method 521	Industrial, residential, WW influent, primary effluent, centrate
	Water (treated)	USEPA Method 521.1	Secondary effluent, final effluent, post-wetlands

([1]) See Table 11 for a complete list of PFAS compounds included in Method 1633.
([2]) NDMA-FP testing was conducted by HDR's Water Quality Laboratory (Portland, OR). Following conversion of precursors to NDMA, NDMA analysis was performed by Eurofins (Pomona, CA). See Section 2.5 for more details on NDMA-FP testing.

Table 11. List of PFAS Compounds Measured via USEPA Draft-3 Method 1633

PFAS Compound	Abbreviation	CAS Number	PFAS Compound	Abbreviation	CAS Number
Perfluorobutanoic acid	PFBA	375-22-4	1*H*,1*H*, 2*H*, 2*H*-Perfluorooctane sulfonic acid	6:2FTS	27619-97-2
Perfluoropentanoic acid	PFPeA	2706-90-3	1*H*,1*H*, 2*H*, 2*H*-Perfluorodecane sulfonic acid	8:2FTS	39108-34-4
Perfluorohexanoic acid	PFHxA	307-24-4	Perfluorooctanesulfonamide	PFOSA	754-91-6
Perfluoroheptanoic acid	PFHpA	375-85-9	*N*-methyl perfluorooctanesulfonamide	NMeFOSA	31506-32-8
Perfluorooctanoic acid	PFOA	335-67-1	*N*-ethyl perfluorooctanesulfonamide	NEtFOSA	4151-50-2
Perfluorononanoic acid	PFNA	375-95-1	*N*-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
Perfluorodecanoic acid	PFDA	335-76-2	*N*-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
Perfluoroundecanoic acid	PFUnA	2058-94-8	*N*-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7
Perfluorododecanoic acid	PFDoA	307-55-1	*N*-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2
Perfluorotridecanoic acid	PFTrDA	72629-94-8	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
Perfluorotetradecanoic acid	PFTeDA	376-06-7	4,8-Dioxa-3*H*-perfluorononanoic acid	ADONA	919005-14-4
Perfluorobutanesulfonic acid	PFBS	375-73-5	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
Perfluoropentanesulfonic acid	PFPeS	2706-91-4	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
Perfluorohexanesulfonic acid	PFHxS	355-46-4	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
Perfluorononanesulfonic acid	PFNS	68259-12-1	Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7
Perfluorodecanesulfonic acid	PFDS	335-77-3	3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	2*H*,2*H*,3*H*,3*H*-Perfluorooctanoic acid	5:3FTCA	914637-49-3
1*H*,1*H*, 2*H*, 2*H*-Perfluorohexane sulfonic acid	4:2FTS	757124-72-4	3-Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4

Table 12. List of Parameters Analyzed during Sampling in the Field*

Parameter	Method
pH	Standard Method 4500-HB
Temperature	Standard Method 2550
Free chlorine	HACH Method 10241
Total Chlorine	HACH Method 8167
Monochloramine	HACH Method 10172
Ammonia	USEPA Method 350.1

(*) All field data are included in Appendix B.

2.2 Sampling Locations and Dates

The first quarterly sampling event occurred from February 26th to 29th, 2024. The second quarterly sampling event occurred from May 20th to 22nd, 2024. The third quarterly event occurred from September 16th to 19th. The fourth quarter of sampling was conducted from November 4th to 6th, with one site (I-1: Metal finisher) sampled early on October 24th as this industrial user is a batch discharger.

Weather conditions were mostly dry in the days leading up to the first 3 sampling events, while there were multiple periods of precipitation during the week leading up to the final sampling event.

The dates associated with the various sampling sites are provided in Table 13.

Table 13. Sample Locations and Sampling Dates for Q1 Sampling Event

Sample Site Category	Treatment Location	Sample Date, Quarter 1	Sample Date, Quarter 2	Sample Date, Quarter 3	Sample Date, Quarter 4
Industrial	I-1: Metal finisher	02/28/2024	05/22/2024	09/18/2024	10/24/2024
Industrial	I-2: Can manufacturer	02/26/2024	05/20/2024	09/16/2024	11/04/2024
Industrial	I-3: Box manufacturer	02/26/2024	05/20/2024	09/19/2024	11/04/2024
Industrial	I-4: Box manufacturer	02/27/2024	05/21/2024	09/17/2024	11/05/2024
Industrial	I-5: Beverage manufacturer	02/28/2024	05/22/2024	09/18/2024	11/06/2024
Industrial	I-6: Landfill	02/27/2024	05/21/2024	09/17/2024	11/05/2024
Industrial	I-7: Hospital	02/26/2024	05/20/2024	09/16/2024	11/04/2024
Residential	R-1: Lacey	02/27/2024	05/21/2024	09/17/2024	11/05/2024
Residential	R-2: Tumwater	02/28/2024	05/22/2024	09/18/2024	11/06/2024
Residential	R-3: Olympia	02/26/2024	05/20/2024	09/16/2024	11/04/2024
BITP/BIRWP	B-1: Influent wastewater	02/26/2024	05/21/2024	09/18/2024	11/04/2024
BITP/BIRWP	B-2: Primary effluent	02/26/2024	05/21/2024	09/18/2024	11/04/2024
BITP/BIRWP	B-3: Secondary effluent	02/26/2024	05/22/2024	09/17/2024	11/05/2024
BITP/BIRWP	B-4: Centrate	02/26/2024	05/22/2024	09/17/2024	11/05/2024
BITP/BIRWP	B-5: Final effluent	02/26/2024	05/22/2024	09/17/2024	11/05/2024
BITP/BIRWP	B-6: Reclaimed water	02/26/2024	05/21/2024	09/18/2024	11/04/2024
BITP/BIRWP	B-7: Biosolids	02/26/2024	05/22/2024	09/17/2024	11/05/2024
MWRWP	M-1: Influent wastewater	02/27/2024	05/20/2024	09/17/2024	11/06/2024
MWRWP	M-2: Reclaimed water	02/27/2024	05/20/2024	09/17/2024	11/06/2024
MWRWP	M-3: Waste sludge to BITP	02/27/2024	05/20/2024	09/17/2024	11/06/2024
MWRWP	M-4: Reclaimed water post-wetlands	02/27/2024	05/20/2024	09/17/2024	11/06/2024
MWRWP	M-5: Reclaimed water (pre-chlorination)	02/27/2024	05/20/2024	09/17/2024	11/06/2024

2.3 Sample Collection Procedures

Grab samples were collected from the locations outlined in Table 13. The same sampling procedures were used across all sites. Grab samples were selected as the method of sampling as this form of sampling is included in the EPA’s upcoming study to collect data on industrial discharges of PFAS to POTWs.

LOTT staff followed sampling guidance, particularly for avoiding PFAS contamination during sampling, provided by HDR (Appendix C). Briefly, samples were collected while avoiding the materials outlined in Appendix C, with laboratory personnel wearing clean nitrile gloves and collecting samples into new sample containers provided by Eurofins (Pomona, CA) and HDR’s Water Quality Laboratory (Portland, OR). Sample bottles were labeled with unique sample identifiers, sample date and time, and requested analytics. Samples were placed in ice-filled coolers and shipped overnight to Eurofins for testing. Parallel samples were collected and placed in coolers for subsequent NDMA-FP testing at HDR’s Water Quality Laboratory in Portland, OR.

Field parameters, including pH, temperature, free chlorine, total chlorine, monochloramine and ammonia, were collected at sites at the same time as PFAS and NDMA sampling (see Appendix B for data). Collectively, these parameters provide insight into the disinfecting capabilities of sample waters; the concentration and speciation of any disinfectant present are key components in understanding NDMA formation. pH and temperature data were collected to understand the relative values of these parameters across the test sites and for comparison between sampling quarters. Free chlorine, total chlorine, and monochloramine were monitored at each site to verify that significant levels of disinfectant were not present in samples selected for NDMA FP testing. If appreciable levels of disinfectant were found to be present at sampling (e.g., >0.5 ppm) then samples undergoing FP testing would not be controlled experiments so far as the duration of exposure to disinfectant (see Section 2.5 for more details on testing durations). Sites known to have significant disinfectant residuals (M-2 and B-6), were not sampled for NDMA FP testing. The remaining sample sites in the first year did not have appreciable levels of disinfectant present. Ammonia was further collected as an important parameter relevant to disinfectant speciation (e.g., free chlorine vs. monochloramine) to provide insight into sites that would be prone to chloramine formation with the addition of hypochlorite.

Field duplicates and field blanks were collected in each quarter as part of the field sampling validation and are outlined in Table 14. Results from duplicates and field blanks are provided in Appendix D.

Table 14. Quality Control Samples Collected in Each Quarter (2024)

Quarter	QC Sample Type	Date	Sample Location
Quarter 1	Field blank	02/26/2024	B-6: Reclaimed water
	Field duplicate	02/27/2024	I-6: Landfill
	Field blank	02/29/2024	I-7: Hospital
Quarter 2	Field duplicate	05/20/2024	R-3: Olympia
	Field blank	05/20/2024	I-7: Hospital
	Field blank	05/21/2024	B-2: Primary effluent
Quarter 3	Field blank	09/17/2024	M-1: Influent
	Field blank	09/18/2024	I-4: Box manufacturer
	Field blank	09/18/2024	B-6: Reclaimed water
	Field blank	09/19/2024	I-3: Box manufacturer
Quarter 4	Field duplicate	11/05/2024	B-5: Final effluent
	Field blank	11/05/2024	B-5: Final effluent
	Field duplicate	11/06/2024	I-5: Beverage manufacturer
	Field blank	11/06/2024	R-2: Tumwater

2.4 Chain of Custody Procedures

Samples were tracked using proper chain-of-custody (COC) procedures. COC forms were filled out for each sampling group on each day of sampling, with separate COC forms submitted to Eurofins and to HDR's Water Quality Laboratory. COC forms accompanied samples from collection through shipping, sample receipt at the laboratories, and subsequent analysis.

Samples bottles were wrapped in bubble wrap sleeves, placed with ice in a double layer of garbage bags, secured to prevent leakage and shipped overnight to either Eurofins (Pomona, CA) or HDR's Water Quality Laboratory (Portland, OR).

2.5 NDMA-Formation Potential (FP) Procedures

To understand NDMA precursor loadings, NDMA-FP testing was conducted. Briefly, water samples were collected and sent to HDR's Water Quality Laboratory where they were then disinfected at specific concentrations for a predetermined interval of time to convert NDMA precursors into NDMA. Samples for NDMA-FP testing were collected from all industrial, residential, and WW treatment sites. The exception is that samples from WW sites that are downstream of disinfection unit processes (i.e., M-2: Reclaimed Water, and B-6: Reclaimed Water sites) were not used as the extra disinfection contact time may add to the overall amount of NDMA formed during FP testing and consequently create nonrepresentative results. For this reason, the sampling team acquired a site just upstream of M-2 hypochlorite addition to avoid extended exposure to disinfectant. This site is known as M-5: Reclaimed Water (pre-chlorination).

The NDMA-FP experimental matrix is provided in Table 15 and builds upon previous research that used FP testing to estimate NDMA precursor loadings (Mitch & Sedlak, 2002; Mitch et al., 2003; Mitch & Sedlak, 2004; Woods & Dickenson, 2016). Efforts were made to first match system conditions as closely as possible to the parameters outlined in Table 15, but then also to provide consistent conditions across all samples. By treating all samples in an identical fashion, the relative precursor loading across all sites as well as between quarterly sampling events is better understood. Efforts were made to keep experimental conditions conservative (i.e., form more NDMA than would typically occur) both to touch upon the high end of potential precursor loadings but also to provide enough NDMA formation to provide useful comparative data (as opposed to having a lot of the sites with non-detect NDMA concentrations).

One variable in Table 15 that is notably different is that monochloramine was used for NDMA-FP testing as opposed to free chlorine. The reason for this is that some of the samples will have ammonia present and others will not. Thus, dosing with chlorine would result in some samples having chloramines and others, free chlorine. To avoid the inconsistency, all samples were dosed with chloramines.

Table 15. NDMA-FP Experimental Testing Conditions vs. LOTT System Conditions

Parameter	LOTT System	NDMA-FP Testing Conditions	Notes / Reasoning
Temperature	14-22°C, Average 18°C	18°C	Match system
pH	Average 6.9 (BIRWP) Average 7.1 (MWRWP)	7.0	Match system
Free chlorine dosage	2-5 ppm, Average 3 ppm	N/A	Dosing chloramines
Monochloramine dosage	N/A	Determined by highest chloramine demand test	Consistency across samples; maximize formation for comparing source waters
Contact time	0.5-1 hour	4 hours	Consistency across samples; maximize formation for comparing source waters

As described above, the conditions in Table 15 for NDMA-FP testing are somewhat more extreme disinfectant dosing parameters than what occurs in the treatment systems. Subsequently, in addition to this more conservative approach, two sample sites (M-5 and B-5) were also selected to test conditions representative of normal treatment. The conditions selected for these “Low Dose” sites is outlined in Table 16. These samples were treated with free chlorine instead of monochloramine, were dosed at 5 ppm as Cl_2, and had 1 hour of contact time as opposed to 4 hours. The results from the low dose experiments allows a more direct comparison with NDMA formed during treatment and helps to put the results of the high dose experiments into perspective (i.e., the high dose experiments are not meant to be representative of actual conditions in both treatment systems, but rather an attempt to understand NDMA precursor loadings at each of the testing sites).The results of the NDMA-FP testing are discussed in Section 3.3.

Table 16. NDMA-FP Experimental Testing Conditions for "Low Dose Chlorine Samples"

Parameter	LOTT System	NDMA-FP Testing Conditions	Notes / Reasoning
Temperature	14-22°C, Average 18°C	18°C	Match system
pH	Average 6.9 (BIRWP) Average 7.1 (MWRWP)	7.0	Match system
Free chlorine dosage	2-5 ppm, Average 3 ppm	5 ppm	Match system
Chloramines dosage	N/A	N/A	N/A
Contact time	0.5-1 hour	1 hour	Match system

For the "non-low dose" testing (Table 15) the chloramines dosing conditions were determined by first evaluating the monochloramine consumption, or demand. Monochloramine demand was evaluated by taking 20mL aliquots of sample water and dosing at 10, 25, 50 and 75 ppm. These aliquots were held at the test conditions outlined in Table 15 (i.e., pH 7.0, 18°C, 4 hours). The highest chloramine demand seen among the sites was used to dose all of the samples such that a chloramine residual existed in all samples over the 4-hour test duration.

For both testing conditions (Table 15 and Table 16), samples were measured and poured into 1L amber glass bottles, or "reactors", dosed with phosphate buffer (to achieve pH 7.0), dosed with monochloramine or free chlorine, and held at 18°C in water baths for 4 hours (or 1 hour for the lose dose testing).

After the specified reaction period, samples were quenched with sodium thiosulfate, which acts to neutralize the disinfectant by converting the chlorine portion of monochloramine into chloride ions, thus inhibiting further NDMA formation. Samples were then placed on ice in coolers and shipped overnight to Eurofins.

2.6 Laboratory Data Validation Process

Upon receipt of testing results from Eurofins, data reports were downloaded and reviewed for completeness for all NDMA and PFAS sampling. A laboratory data validation / QC review was completed to confirm accuracy and completeness for these items: sample identification, COC, sample receiving notes, preservation methods, hold and extraction times, laboratory detection limits, surrogate recovery, blanks, spikes, duplicates, control samples, matrix spikes and matrix spike duplicates.

The data validation report documenting the data review process is included in Appendix D. Complete laboratory reports are included in Appendix E.

A summary of the laboratory QA/QC and data validation parameters are as follows:

- Hold Times
- Surrogate Spike Recoveries. Surrogates are organic compounds that maintain a similar response to the analytical method as the analyte of interest (e.g., similar extraction efficiency, chromatographic response, etc.). Surrogates are added to the sample and carried through all stages of preparation and analysis.
- Matrix Spike Recoveries
- Laboratory Control Sample Spike Recoveries
- Field Blanks and Duplicate Field Samples

3 PFAS and NDMA Monitoring Results

3.1 PFAS Results

Table 17 to Table 32 and Figure 1 to Figure 45 summarize the PFAS data measured via USEPA Draft-3 Method 1633, collected at all sites in the system. A total of 27 (out of 40 measured) PFAS compounds were detected across all sites over all four quarters. Compounds not included in Table 17 to Table 32 were non-detects (refer to Table 11 for the complete list of tested PFAS compounds).

3.1.1 PFAS Concentrations at Industrial Sources

Table 17 to Table 20 and Figure 1 to Figure 4 show the detection and quantification results of PFAS compounds at the sampled industrial sites. Of those sites, the landfill (I-6) consistently had higher PFAS contributions. The metal finisher (I-1) had lower PFAS values in the first three quarters, but then had a total detectable PFAS loading of 10,858 ng/L in the fourth quarter. This could be due to periodic cleaning of equipment. The beverage manufacturer (I-6) had comparatively low PFAS concentrations across all quarters, and the hospital site (I-7) had no detectable PFAS. The landfill showed high concentrations of PFOS and PFOA, low concentrations of 2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA). Overall, the concentrations are higher than the concentrations at the residential sites. The industrial site concentrations varied from quarter to quarter, illustrating that PFAS profiling from industrial contributors would be challenging to capture in just a single sampling event.

In all four quarters, there were some sites that were significantly higher in total PFAS concentration than other sites. Figure 1 to Figure 4 illustrate these sites with red boxes indicating the total PFAS value. To better visualize what PFAS species dominate at these sites, Figure 5 provides an expanded view of each. A secondary axis on the right is provided to visualize the concentrations at these two sites.

Table 17. PFAS Results from First Quarter 2024, Industrial Sites (in ng/L)

Analyte	I-1: Metal Finisher	I-2: Can Manufacturer	I-3: Box Manufacturer	I-4: Box Manufacturer	I-5: Beverage Manufacturer	I-6: Landfill	I-7: Hospital
PFOA	*ND*	*ND*	*ND*	**2.5**	*ND*	**150**	*ND*
PFOS	*ND*	*ND*	*ND*	*ND*	*ND*	**66**	*ND*
PFNA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	*ND*	1.0 (*J*)	*ND*	28 (*J*)	*ND*
PFBS	*ND*	*ND*	*ND*	**1.9**	8.8 (*J*)	32 (*J*)	*ND*
HFPO-DA	*ND*	*ND*	*ND*	2.6 (*J*)	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	*ND*	5.1 (*J*)	3.3 (*J*)	130 (*J*)	*ND*
PFDA	*ND*	*ND*	*ND*	*ND*	*ND*	15 (*J*)	*ND*
PFHpS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*	*ND*	*ND*	**48**	*ND*
PFHxA	*ND*	*ND*	*ND*	**3.1**	*ND*	**120**	*ND*
PFPeS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*	*ND*	*ND*	**84**	*ND*
8:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	**46**	*ND*	**26**	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	**67**	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	**47**	*ND*
PFDoA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*

Analyte	I-1: Metal Finisher	I-2: Can Manufacturer	I-3: Box Manufacturer	I-4: Box Manufacturer	I-5: Beverage Manufacturer	I-6: Landfill	I-7: Hospital
PFDS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

Table 18. PFAS Results from Second Quarter 2024, Industrial Sites (in ng/L)

Analyte	I-1: Metal Finisher	I-2: Can Manufacturer	I-3: Box Manufacturer	I-4: Box Manufacturer	I-5: Beverage Manufacturer	I-6: Landfill	I-7: Hospital
PFOA	*ND*	*ND*	*ND*	7.4 (*J*)	*ND*	**20**	*ND*
PFOS	*ND*	*ND*	*ND*	*ND*	*ND*	**22**	*ND*
PFNA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	*ND*	*ND*	*ND*	9.1 (*J*)	*ND*
PFBS	*ND*	0.55 (*J*)	*ND*	*ND*	*ND*	5.7 (*J*)	*ND*
HFPO-DA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	3.4 (*J*)	*ND*	*ND*	*ND*	11 (*J*)	*ND*
PFDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*	7.0 (*J*)	*ND*	6.2 (*J, EMPC*)	*ND*
PFHxA	*ND*	*ND*	*ND*	*ND*	*ND*	**39**	*ND*
PFPeS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*	5.4 (*J*)	*ND*	**16**	*ND*
8:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	**46**	*ND*	**59**	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	**43**	*ND*
NMeFOSE	*ND*	**64**	*ND*	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	**16**	*ND*

Analyte	I-1: Metal Finisher	I-2: Can Manufacturer	I-3: Box Manufacturer	I-4: Box Manufacturer	I-5: Beverage Manufacturer	I-6: Landfill	I-7: Hospital
PFDoA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all the identification criteria are met, except for the mass-ion abundance ratio.

Table 19. PFAS Results from Third Quarter 2024, Industrial Sites (in ng/L)

Analyte	I-1: Metal Finisher	I-2: Can Manufacturer	I-3: Box Manufacturer	I-4: Box Manufacturer	I-5: Beverage Manufacturer	I-6: Landfill	I-7: Hospital
PFOA	2.5 (*J*)	*ND*	*ND*	**5.3** (*EMPC*)	*ND*	18 (*J*)	*ND*
PFOS	*ND*	*ND*	*ND*	*ND*	*ND*	11 (*J*)	*ND*
PFNA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	*ND*	*ND*	*ND*	7.2 (*J*)	*ND*
PFBS	*ND*	*ND*	*ND*	1.8 (*J*)	0.74 (*J*, EMPC)	*ND*	*ND*
HFPO-DA	*ND*	*ND*	*ND*	8.5 (*J*)	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	*ND*	*ND*	*ND*	27 (*J*)	*ND*
PFDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*	3.8 (*J*)	*ND*	9.4 (*J*)	*ND*
PFHxA	*ND*	*ND*	*ND*	*ND*	*ND*	**38**	*ND*
PFPeS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*	2.8 (*J*)	*ND*	31 (*J*)	*ND*
8:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	**11**	21 (*J*)	**27**	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	17 (*J*)	*ND*
NMeFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	5.2 (*J*, *EMPC*)	*ND*

Analyte	I-1: Metal Finisher	I-2: Can Manufacturer	I-3: Box Manufacturer	I-4: Box Manufacturer	I-5: Beverage Manufacturer	I-6: Landfill	I-7: Hospital
PFDoA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all the identification criteria are met, except for the mass-ion abundance ratio.

Table 20. PFAS Results from Fourth Quarter 2024, Industrial Sites (in ng/L)

Analyte	I-1: Metal Finisher	I-2: Can Manufacturer	I-3: Box Manufacturer	I-4: Box Manufacturer	I-5: Beverage Manufacturer	I-6: Landfill	I-7: Hospital
PFOA	**300**	*ND*	*ND*	*ND*	*ND*	**500**	*ND*
PFOS	**5,600** (*E*)	*ND*	*ND*	*ND*	*ND*	**150**	*ND*
PFNA	**210**	*ND*	*ND*	*ND*	*ND*	**26**	*ND*
PFHxS	**1,000**	*ND*	*ND*	*ND*	*ND*	**75**	*ND*
PFBS	**91**	*ND*	*ND*	*ND*	0.84 (*J*)	**100**	*ND*
HFPO-DA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFBA	**90**	*ND*	*ND*	*ND*	*ND*	**440**	*ND*
PFDA	6.3 (*J*)	*ND*	*ND*	*ND*	*ND*	**16**	*ND*
PFHpS	**110**	*ND*	*ND*	*ND*	*ND*	3.6 (*J*)	*ND*
PFHpA	**140**	*ND*	*ND*	3.0 (*J*, *EMPC*)	*ND*	**130**	*ND*
PFHxA	**460**	*ND*	*ND*	*ND*	*ND*	**410**	*ND*
PFPeS	**120**	*ND*	*ND*	*ND*	*ND*	**10**	*ND*
PFPeA	**280**	*ND*	*ND*	5.1 (*J*)	*ND*	**310**	*ND*
8:2 FTS	**620**	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
6:2 FTS	**1,800**	**21**	**42**	**41**	*ND*	4.1 (*J*)	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	**29**	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	**170**	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	3.7 (*J*)	*ND*	*ND*	*ND*	*ND*	**130**	*ND*
NMeFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	**46**	*ND*

Analyte	I-1: Metal Finisher	I-2: Can Manufacturer	I-3: Box Manufacturer	I-4: Box Manufacturer	I-5: Beverage Manufacturer	I-6: Landfill	I-7: Hospital
PFDoA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFOSA	**10**	*ND*	*ND*	*ND*	*ND*	**12**	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*	0.54 (*J*)	*ND*	*ND*
PFUnA	**17**	*ND*	*ND*	*ND*	ND	1.8 (*J*)	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*E*) result exceeded calibration range.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all the identification criteria are met, except for the mass-ion abundance ratio.

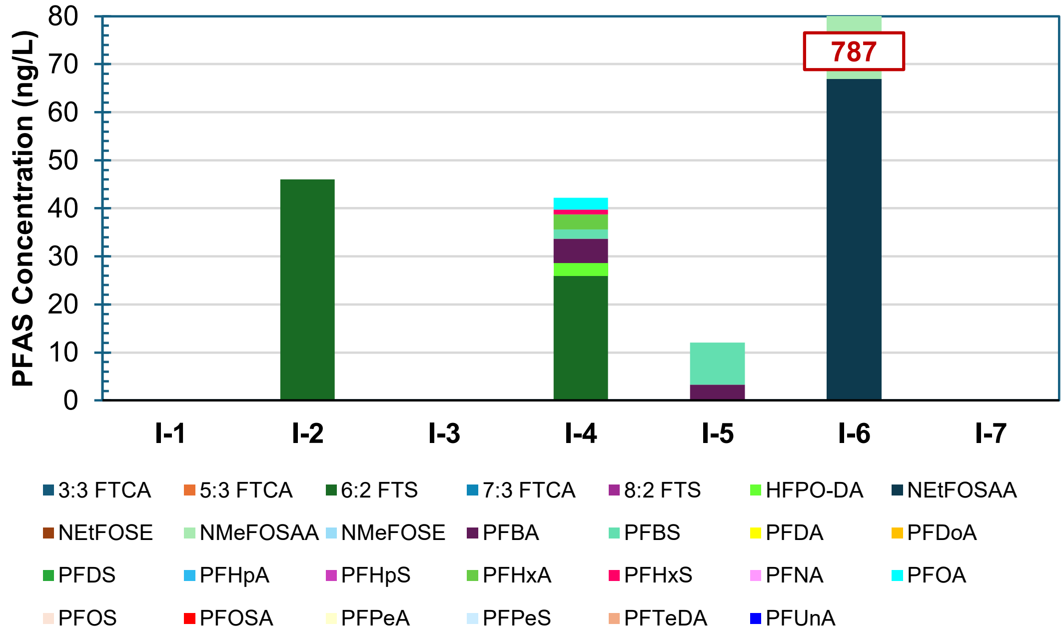

Figure 1. Total PFAS from First Quarter 2024, Industrial Sites; *red box indicates value past y-axis limit*

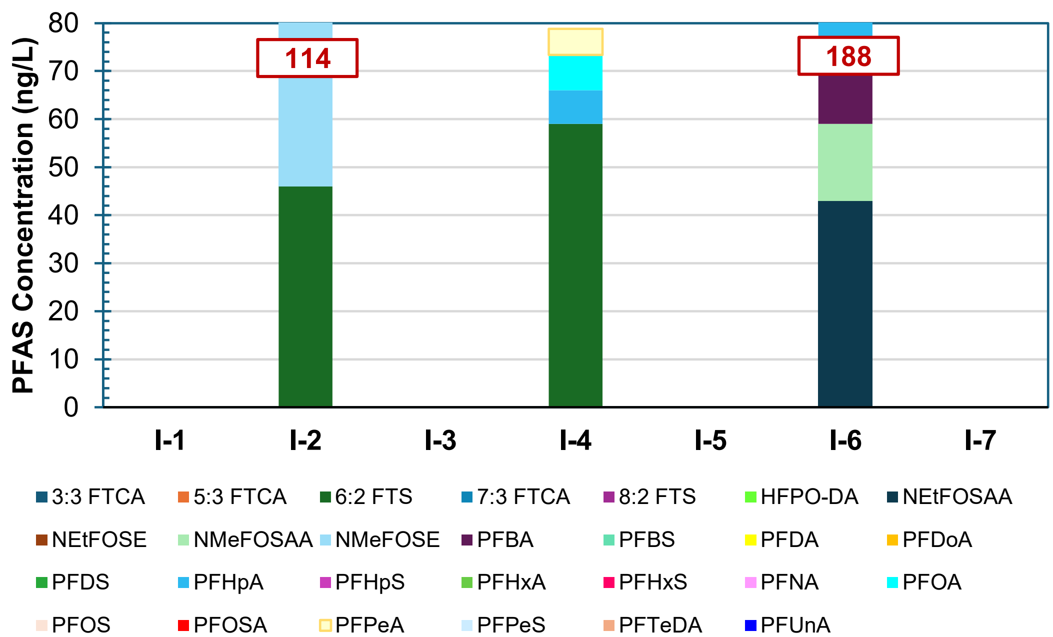

Figure 2. Total PFAS from Second Quarter 2024, Industrial Sites; *red box indicates value past y-axis limit*

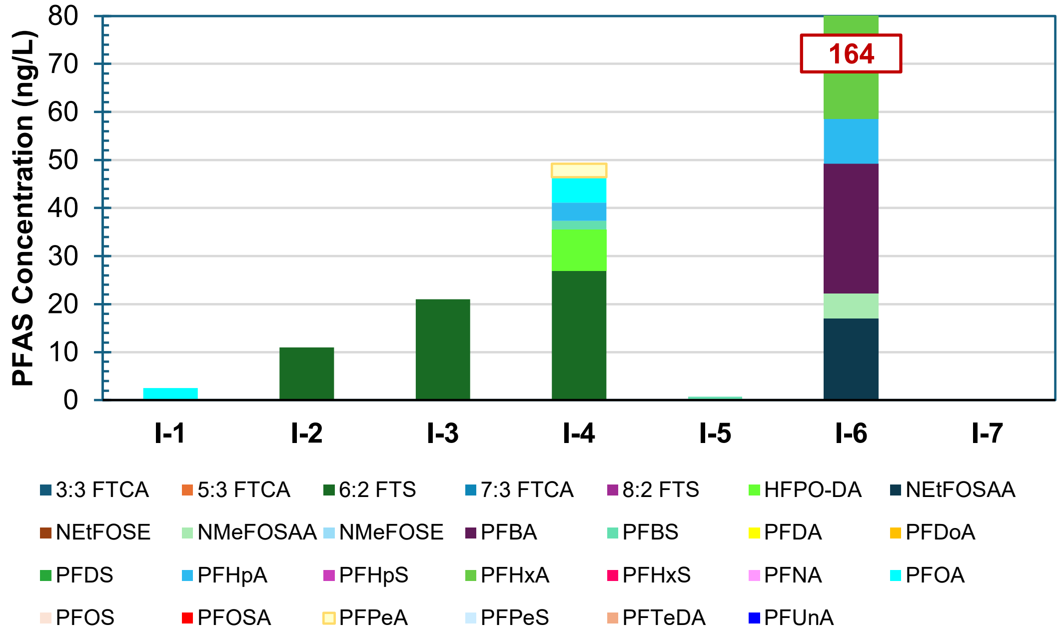

Figure 3. Total PFAS from Third Quarter 2024, Industrial Sites; ***red box indicates value past y-axis limit***

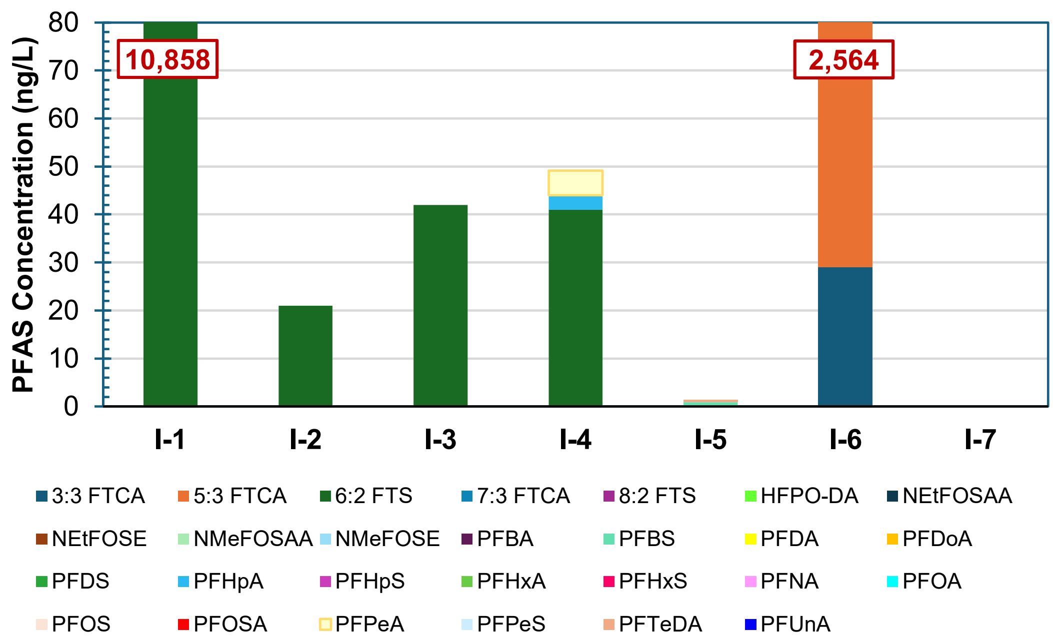

Figure 4. Total PFAS from Fourth Quarter 2024, Industrial Sites; ***red box indicates value past y-axis limit***

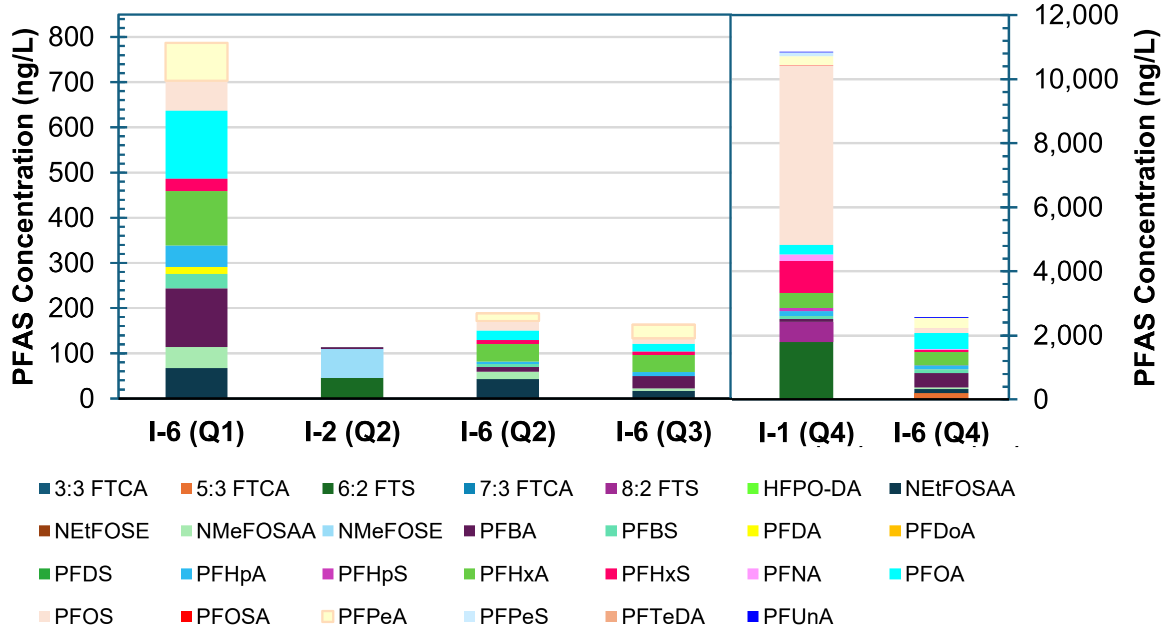

Figure 5. Expanded View of Total PFAS from Industrial Sites with High Concentrations; *sites I-1 and I-6 from quarter 4 have scale provided on right*

3.1.2 PFAS Concentrations at Residential Sites

Table 21 to Table 24 and Figure 6 show the detection and quantification results of PFAS compounds at the sampled residential sites. The Olympia site had up to 12 ng/L of total detectable PFAS in quarter one, while the remaining total PFAS concentrations remained below 10 ng/L across all sites and sampling events. Concentrations of PFAS at residential sites are notably lower than at industrial sites.

Table 21. PFAS Results from First Quarter 2024, Residential Sites (in ng/L)

Analyte	R-1: Lacey	R-2: Tumwater	R-3: Olympia
PFOA	*ND*	*ND*	**3.0**
PFOS	*ND*	*ND*	**4.0** (*EMPC*)
PFNA	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	0.58 (*J*)
PFBS	*ND*	*ND*	1.6 (*J*)
HFPO-DA	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	*ND*
PFDA	*ND*	*ND*	*ND*
PFHpS	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	0.88 (*J*)
PFHxA	*ND*	*ND*	1.6 (*J*)
PFPeS	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*
8:2 FTS	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*
NETFOSE	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*
NMeFOSE	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected and all of the identification criteria are met except for the mass-ion abundance ratio (m/z ratio).

Table 22. PFAS Results from Second Quarter 2024, Residential Sites (in ng/L)

Analyte	R-1: Lacey	R-2: Tumwater	R-3: Olympia
PFOA	*ND*	3.2 (*J*)	4.5 (*J*)
PFOS	*ND*	*ND*	3.6 (*J*)
PFNA	*ND*	*ND*	*ND*
PFHxS	*ND*	2.8 (*J*)	*ND*
PFBS	*ND*	*ND*	*ND*
HFPO-DA	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	*ND*
PFDA	*ND*	*ND*	*ND*
PFHpS	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*
PFHxA	*ND*	*ND*	*ND*
PFPeS	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*
8:2 FTS	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*
NETFOSE	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*
NMeFOSE	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

Table 23. PFAS Results from Third Quarter 2024, Residential Sites (in ng/L)

Analyte	R-1: Lacey	R-2: Tumwater	R-3: Olympia
PFOA	*ND*	*ND*	*ND*
PFOS	*ND*	*ND*	*ND*
PFNA	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	*ND*
PFBS	*ND*	*ND*	*ND*
HFPO-DA	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	*ND*
PFDA	*ND*	*ND*	*ND*
PFHpS	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*
PFHxA	*ND*	*ND*	*ND*
PFPeS	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*
8:2 FTS	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*
NETFOSE	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*
NMeFOSE	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.

Table 24. PFAS Results from Fourth Quarter 2024, Residential Sites (in ng/L)

Analyte	R-1: Lacey	R-2: Tumwater	R-3: Olympia
PFOA	2.5 (*J*)	*ND*	*ND*
PFOS	*ND*	*ND*	*ND*
PFNA	*ND*	*ND*	*ND*
PFHxS	*ND*	1.3 (*J*)	*ND*
PFBS	*ND*	*ND*	*ND*
HFPO-DA	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	*ND*
PFDA	*ND*	*ND*	*ND*
PFHpS	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*
PFHxA	1.6 (*J*)	*ND*	*ND*
PFPeS	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*
8:2 FTS	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*
NETFOSE	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*
NMeFOSE	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

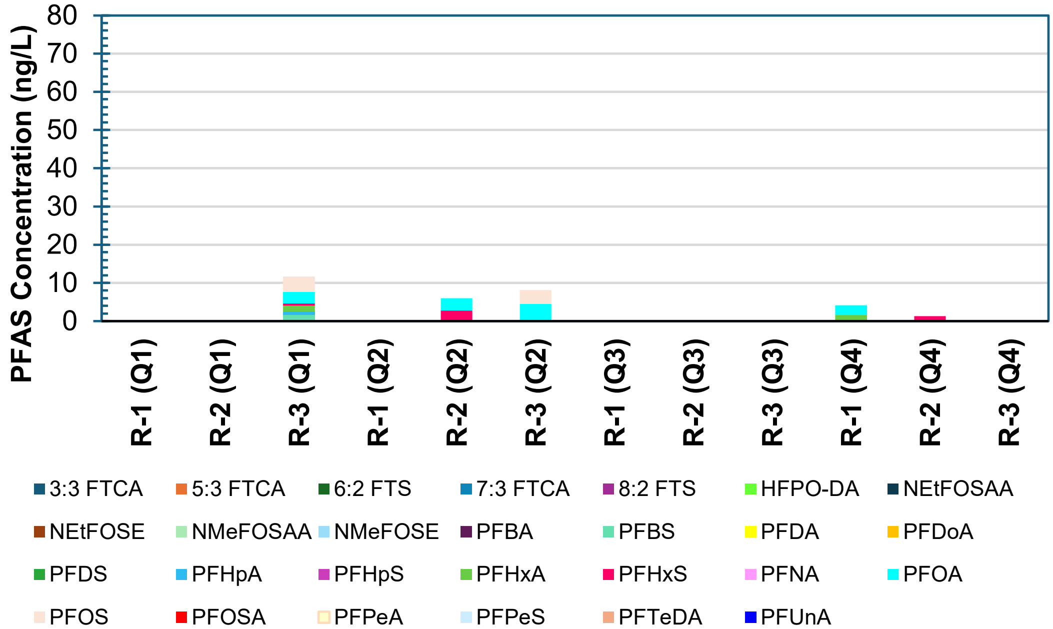

Figure 6. Total PFAS from All Quarters 2024, Residential Sites

3.1.3 PFAS Concentrations at BITP/BIRWP

Table 25 to Table 28 and Figure 7 to Figure 10 show the detection and quantification results of PFAS compounds at the sampled BITP/BIRWP sites. Of those sites, it is noteworthy that the centrate sample (B-4) had higher concentrations of PFAS, particularly of 2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA) which was found in the thousands of ng/L at each sampling event. Most of the PFAS compounds detected were in single-digit concentrations, with many of them flagged as *J*-values.

Figure 7 to Figure 10 display that the concentration of PFAS in the influent (B-1) is less than the concentrations in the effluent (B-5), the reclaimed water (B-6), and the biosolids (B-7).

In warmer seasons, the concentrations in the effluent and reclaimed water increased. Other studies have similarly found that warmer seasons are correlated with higher concentrations of PFAS.

A study in California found that POTW effluent concentrations ranged from 30 to 100 ng/L, with a median concentration of 58 ng/L (Lin et al., 2024). This is similar to the results seen in this study.

The highest concentration of PFAS was found in the centrate with high levels of 5:3 FTCA. Generally, 5:3 FTCA is created from decomposition of other PFAS compounds under anaerobic conditions. Centrate is recycled through the plant, contributing a redistribution of PFAS contaminants. When future PFAS regulations for POTWs are released, if source control of industrial users is not sufficient, removing PFAS from the centrate is a potential candidate for removal of contaminants.

Table 25. PFAS Results from First Quarter 2024, BITP/BIRWP (in ng/L)

Analyte	B-1: Influent	B-2: Primary Effluent	B-3: Secondary Effluent	B-4: Centrate	B-5: Final Effluent	B-6: Reclaimed	B-7: Biosolids*
PFOA	*ND*	**3.3**	**3.5**	*ND*	**3.4**	**3.6**	*ND*
PFOS	*ND*	*ND*	**2.2**	*ND*	**2.3**	**2.4**	**2.6**
PFNA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxS	*ND*	**4.1** (*EMPC*)	1.4 (*J*)	*ND*	1.3 (*J*)	1.4 (*J*)	*ND*
PFBS	*ND*	**2.8**	**2.2**	*ND*	**2.2**	**2.4**	*ND*
HFPO-DA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	*ND*	*ND*	*ND*	1.8 (*J*)	*ND*
PFDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	0.59 (*J*)
PFHpS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	0.84 (*J*)	0.88 (*J*)	*ND*	0.86 (*J*)	0.95 (*J*)	*ND*
PFHxA	*ND*	**2.9**	**5.6**	*ND*	**5.4**	**8.0**	*ND*
PFPeS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*	*ND*	*ND*	**4.6**	*ND*
8:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	2,600 (*J*)	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	1.1 (*J*)
NMeFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	**2.4**
PFDoA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	0.90 (*J*)	*ND*	*ND*	*ND*	0.46 (*J*)
PFTeDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*

(*) indicates units are in µg/Kg.
(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all of the identification criteria are met except for the mass-ion abundance ratio.

Table 26. PFAS Results from Second Quarter 2024, BITP/BIRWP (in ng/L)

Analyte	B-1: Influent	B-2: Primary Effluent	B-3: Secondary Effluent	B-4: Centrate	B-5: Final Effluent	B-6: Reclaimed	B-7: Biosolids*
PFOA	3.9 (*J*)	4.4 (*J*)	**4.5**	4.7 (*J*)	**4.0**	**4.0**	*ND*
PFOS	6.6 (*J*)	4.0 (*J*)	**2.3**	*ND*	1.8 (*J*)	1.7 (*J*)	1.2 (*J*)
PFNA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	1.1 (*J*)	*ND*	1.1 (*J*)	0.92 (*J*)	*ND*
PFBS	*ND*	*ND*	1.6 (*J*)	*ND*	1.8 (*J*)	**1.9**	*ND*
HFPO-DA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	4.7 (*J*)	21 (*J*)	4.7 (*J*)	*ND*	*ND*
PFDA	*ND*	*ND*	0.65 (*J*)	*ND*	*ND*	*ND*	0.74 (*J*)
PFHpS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	1.2 (*J*)	2.7 (*J*)	1.1 (*J*)	0.96 (*J*)	*ND*
PFHxA	3.1 (*J*)	3.3 (*J*)	**7.3**	**68**	**6.6**	**8.5**	*ND*
PFPeS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	**6.6**	19 (*J*)	**7.0**	**5.4**	*ND*
8:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	**55**	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	**7,400**	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NMeFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	0.65 (*J*)	*ND*	0.64 (*J*)	*ND*	1.8 (*J*)
PFDoA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	0.60 (*J*, *EMPC*)
PFOSA	*ND*	*ND*	0.65 (*J*)	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*

(*) indicates units are in µg/Kg.
(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all of the identification criteria are met except for the mass-ion abundance ratio.

Table 27. PFAS Results from Third Quarter 2024, BITP/BIRWP (in ng/L)

Analyte	B-1: Influent	B-2: Primary Effluent	B-3: Secondary Effluent	B-4: Centrate	B-5: Final Effluent	B-6: Reclaimed	B-7: Biosolids*
PFOA	2.9 (*J*, *EMPC*)	*ND*	**5.4**	6.0 (*EMPC*)	5.8 (*EMPC*)	**5.6**	*ND*
PFOS	*ND*	*ND*	**2.3**	*ND*	**1.9**	**2.1**	**2.1**
PFNA	*ND*	*ND*	0.51 (*J*)	*ND*	*ND*	0.86 (*J*, *EMPC*)	*ND*
PFHxS	*ND*	*ND*	1.1 (*J*)	*ND*	0.92 (*J*)	1.1 (*J*)	*ND*
PFBS	1.4 (*J*)	1.7 (*J*)	**2.5**	*ND*	**2.7**	**2.2**	*ND*
HFPO-DA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	2.9 (*J*)	*ND*	3.0 (*J*)	1.9 (*J*)	*ND*
PFDA	*ND*	*ND*	0.50 (*J*)	*ND*	*ND*	0.48 (*J*)	0.79 (*J*)
PFHpS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	0.89 (*J*)	*ND*	1.0 (*J*)	0.85 (*J*)	*ND*
PFHxA	**4.1**	**4.0**	**8.9**	**39**	**8.8**	**9.1**	*ND*
PFPeS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	**12**	*ND*	**12**	**12**	*ND*
8:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	15 (*J*)	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	31 (*J*)	*ND*	**3,700**	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	0.72 (*J*)
NMeFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	0.64 (*J*)	*ND*	*ND*	0.56 (*J*)	**2.2**
PFDoA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	0.75 (*J*)	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*

(*) indicates units are in µg/Kg.
(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all of the identification criteria are met except for the mass-ion abundance ratio.

Table 28. PFAS Results from Fourth Quarter 2024, BITP/BIRWP (in ng/L)

Analyte	B-1: Influent	B-2: Primary Effluent	B-3: Secondary Effluent	B-4: Centrate	B-5: Final Effluent	B-6: Reclaimed	B-7: Biosolids*
PFOA	**5.4**	**7.4** (*EMPC*)	**6.8**	**29** (*EMPC*)	**6.6**	**5.9**	0.32 (*J, EMPC*)
PFOS	**3.8**	*ND*	2.0 (*J*)	6.9 (*J*)	1.9 (*J*)	**2.7**	**2.2**
PFNA	*ND*	1.0 (*J*)	1.0 (*J*)	5.5 (*J*)	0.91 (*J, EMPC*)	1.4 (*J, EMPC*)	*ND*
PFHxS	1.1 (*J*)	0.91 (*J*)	1.1 (*J*)	4.1 (*J*)	1.1 (*J*)	0.98 (*J*)	*ND*
PFBS	**2.3**	**2.5**	**2.7**	4.7 (*J, EMPC*)	**2.2**	**2.7**	*ND*
HFPO-DA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFBA	3.0 (*J*)	3.0 (*J*)	2.4 (*J*)	*16 (J)*	2.2 (*J*)	2.6 (*J*)	*ND*
PFDA	1.5 (*J, EMPC*)	1.4 (*J*)	0.56 (*J*)	4.4 (*J*)	*ND*	0.95 (*J*)	1.2 (*EMPC*)
PFHpS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFHpA	1.0 (*J*)	1.6 (*J*)	1.2 (*J*)	*ND*	1.2 (*J*)	1.0 (*J*)	*ND*
PFHxA	**4.5**	**5.9**	**12**	**47**	**9.9**	**12**	*ND*
PFPeS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFPeA	**4.7**	**5.2**	**12**	15 (*J*)	**11**	**9.5**	*ND*
8:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	77 (*J*)	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	29 (*J*)	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	**5,700**	*ND*	*ND*	12 (*J*)
NEtFOSE	*ND*	6.4 (*J*)	*ND*	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	0.85 (*J*)
NMeFOSE	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	3.5 (*J*)	*ND*	*ND*	**1.9**
PFDoA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	0.43 (*J*)
PFDS	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	0.57 (*J*)	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	0.27 (*J*)

(*) indicates units are in µg/Kg.
(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all of the identification criteria are met except for the mass-ion abundance ratio.

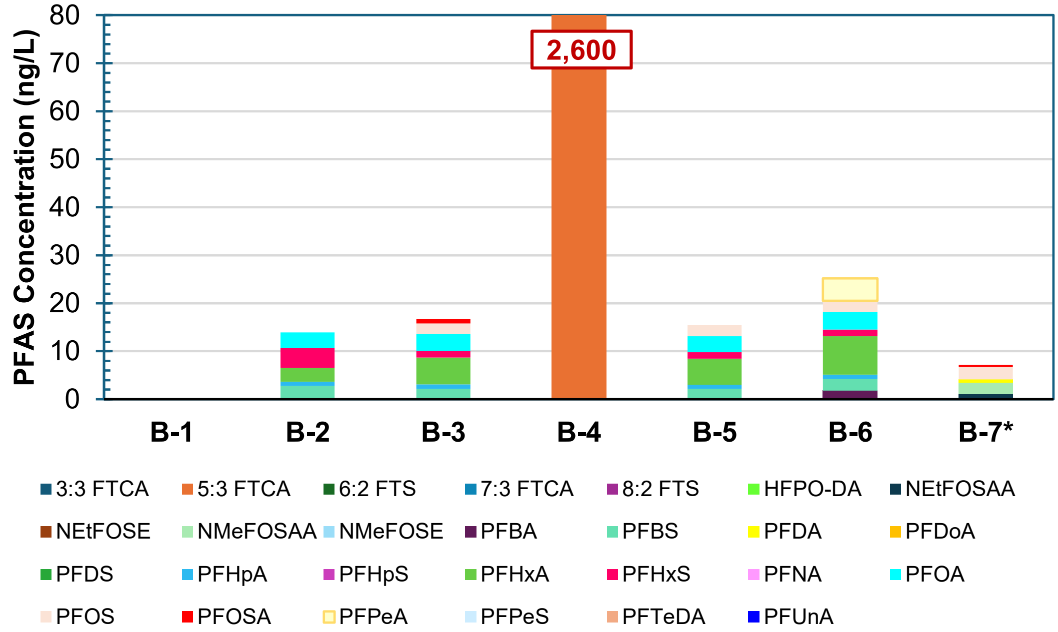

Figure 7. Total PFAS from First Quarter 2024, BITP/BIRWP Sites; ***red box indicates value past y-axis limit; (*) indicates units are in µg/kg***

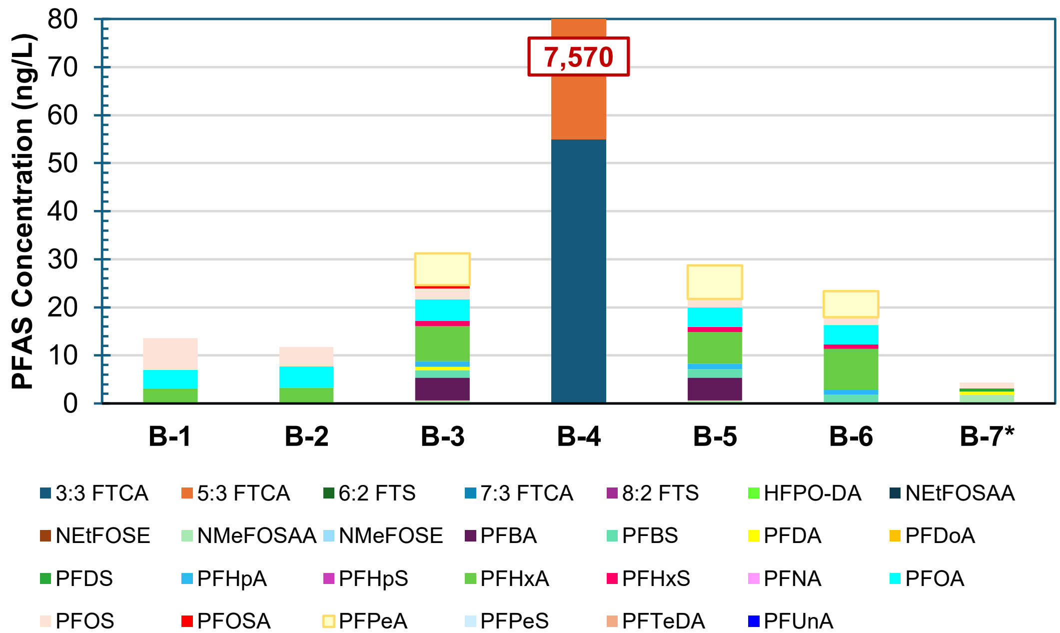

Figure 8. Total PFAS from Second Quarter 2024, BITP/BIRWP Sites; ***red box indicates value past y-axis limit, (*) indicates units are in µg/kg***

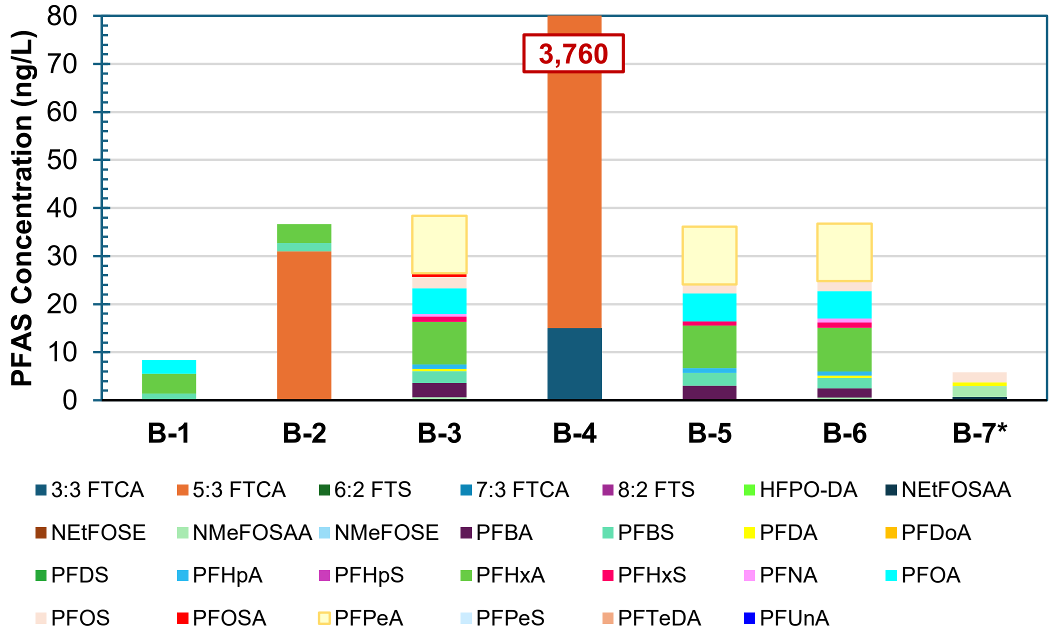

Figure 9. Total PFAS from Third Quarter 2024, BITP/BIRWP Sites; ***red box indicates value past y-axis limit, (*) indicates units are in µg/kg***

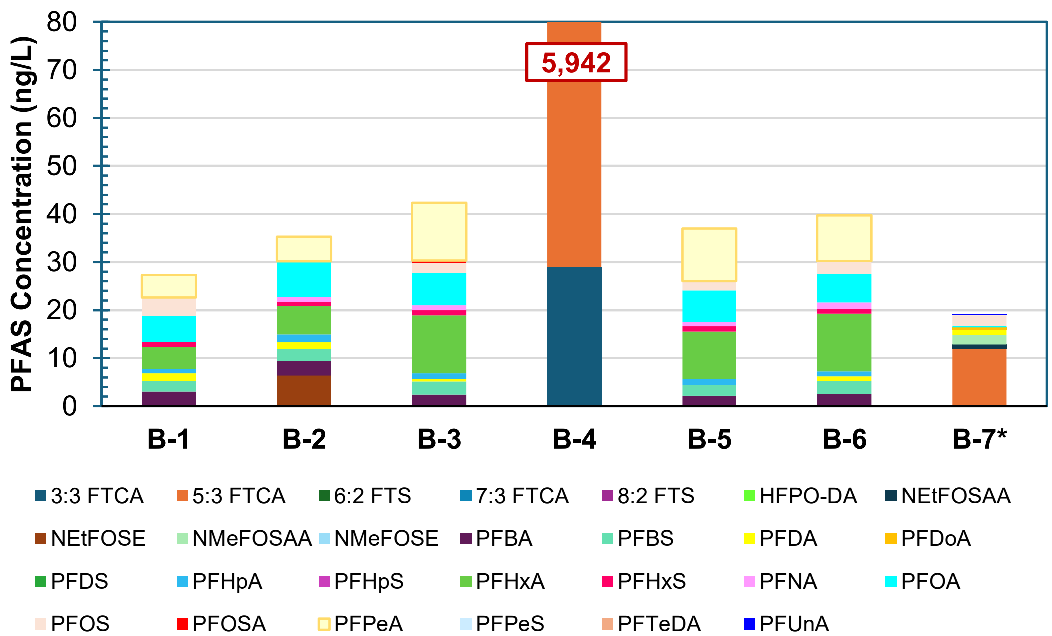

Figure 10. Total PFAS from Fourth Quarter 2024, BITP/BIRWP Sites; ***red box indicates value past y-axis limit, (*) indicates units are in µg/kg***

3.1.4 PFAS Concentrations at MWRWP

Table 29 to Table 32 and Figure 11 show the detection and quantification results of PFAS compounds at the sampled MWRWP sites. Influent sample M-1 had low to no detectable levels of PFAS while downstream locations had measurable PFAS concentrations. The post-wetlands sample (M-4) had similar PFAS concentrations to the reclaimed water sample (M-2). The waste sludge (M3) had low PFAS concentrations with the exception of quarter two when double digit concentrations were measured for six PFAS species.

Similar to the influent sample (B-1) at BITP/BIRWP, Figure 11 displays that the concentration of PFAS in the influent (M-1) is less than the concentrations in the reclaimed water (M-2), and the waste sludge (M-3). The reclaimed water values were consistent over all sampling events. The difference between the influent and the reclaimed water concentrations is higher than the difference in concentrations at BITP/BIRWP. PFOS was a steady and consistent contributor found in the reclaimed water but was minimally present in the influent.

Site M-3 in the second quarter had elevated total PFAS. Figure 11 provides an expanded view of this sample to better visualize which PFAS species dominate. A secondary axis on the right is provided to visualize the concentrations at these two sites.

Table 29. PFAS Results from First Quarter 2024, MWRWP (in ng/L)

Analyte	M-1: Influent	M-2: Reclaimed	M-3: Waste Sludge	M-4: Post Wetlands
PFOA	*ND*	**7.2**	*ND*	**6.9**
PFOS	*ND*	*ND*	*ND*	*ND*
PFNA	*ND*	*ND*	*ND*	0.51 (*J*)
PFHxS	*ND*	1.0 (*J*)	*ND*	1.2 (*J*)
PFBS	*ND*	**2.9**	*ND*	**4.2**
HFPO-DA	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	3.0 (*J*)	*ND*	4.9 (*J*)
PFDA	*ND*	*ND*	*ND*	*ND*
PFHpS	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	1.3 (*J*)	*ND*	1.8 (*J*)
PFHxA	*ND*	**14**	*ND*	15
PFPeS	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	**29**	*ND*	27
8:2 FTS	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*
NMeFOSE	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

Table 30. PFAS Results from Second Quarter 2024, MWRWP (in ng/L)

Analyte	M-1: Influent	M-2: Reclaimed	M-3: Waste Sludge	M-4: Post Wetlands
PFOA	2.5 (*J*)	**9.1**	60 (*J*)	**6.8**
PFOS	*ND*	*ND*	96 (*J*)	*ND*
PFNA	*ND*	1.0 (*J*, *EMPC*)	39 (*J*, *EMPC*)	*ND*
PFHxS	2.7 (*J*, *EMPC*)	1.5 (*J*)	*ND*	1.2 (*J*)
PFBS	*ND*	**5.0**	*ND*	**4.8**
HFPO-DA	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	2.0 (*J*)	*ND*	3.3 (*J*)
PFDA	*ND*	0.70 (*J*)	77 (*J*)	0.59 (*J*)
PFHpS	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	1.2 (*J*)	*ND*	1.7 (*J*)
PFHxA	*ND*	**12**	68 (*J*)	**19**
PFPeS	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	**27**	80 (*J*)	**39**
8:2 FTS	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*
NMeFOSE	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all of the identification criteria are met except for the mass-ion abundance ratio.

Table 31. PFAS Results from Third Quarter 2024, MWRWP (in ng/L)

Analyte	M-1: Influent	M-2: Reclaimed	M-3: Waste Sludge	M-4: Post Wetlands
PFOA	**2.3**	**10**	0.080 (*J*)	**9.7**
PFOS	*ND*	*ND*	**0.16**	*ND*
PFNA	*ND*	0.49 (*J*, *EMPC*)	*ND*	*ND*
PFHxS	*ND*	0.72 (*J*)	*ND*	0.78 (*J*)
PFBS	**2.8**	**6.7**	*ND*	**6.8**
HFPO-DA	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	2.1 (*J*)	*ND*	2.9 (*J*)
PFDA	*ND*	*ND*	0.076 (*J*)	*ND*
PFHpS	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	0.99 (*J*)	*ND*	0.95 (*J*)
PFHxA	**2.3**	**12**	*ND*	**13**
PFPeS	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	**36**	*ND*	**27**
8:2 FTS	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	0.028 (*J*)	*ND*
NMeFOSE	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all of the identification criteria are met except for the mass-ion abundance ratio.

Table 32. PFAS Results from Fourth Quarter 2024, MWRWP (in ng/L)

Analyte	M-1: Influent	M-2: Reclaimed	M-3: Waste Sludge	M-4: Post Wetlands
PFOA	**5.1** (*EMPC*)	**10**	0.089 (*J*, *EMPC*)	**12**
PFOS	*ND*	0.65 (*J*, *EMPC*)	**0.14**	0.78 (*J*, *EMPC*)
PFNA	*ND*	*ND*	*ND*	*ND*
PFHxS	1.1 (*J*)	1.2 (*J*)	*ND*	1.0 (*J*)
PFBS	**2.8**	**5.7**	*ND*	**7.7**
HFPO-DA	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	3.4 (*J*)	*ND*	3.6 (*J*)
PFDA	*ND*	*ND*	0.054 (*J*)	*ND*
PFHpS	*ND*	*ND*	*ND*	*ND*
PFHpA	0.57 (*J*)	1.4 (*J*)	*ND*	1.2 (*J*)
PFHxA	**3.6**	**14**	0.037 (*J*)	**14**
PFPeS	*ND*	*ND*	*ND*	*ND*
PFPeA	**4.6**	**33**	*ND*	**34**
8:2 FTS	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	0.029 (*J*)	*ND*
NMeFOSE	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all of the identification criteria are met except for the mass-ion abundance ratio

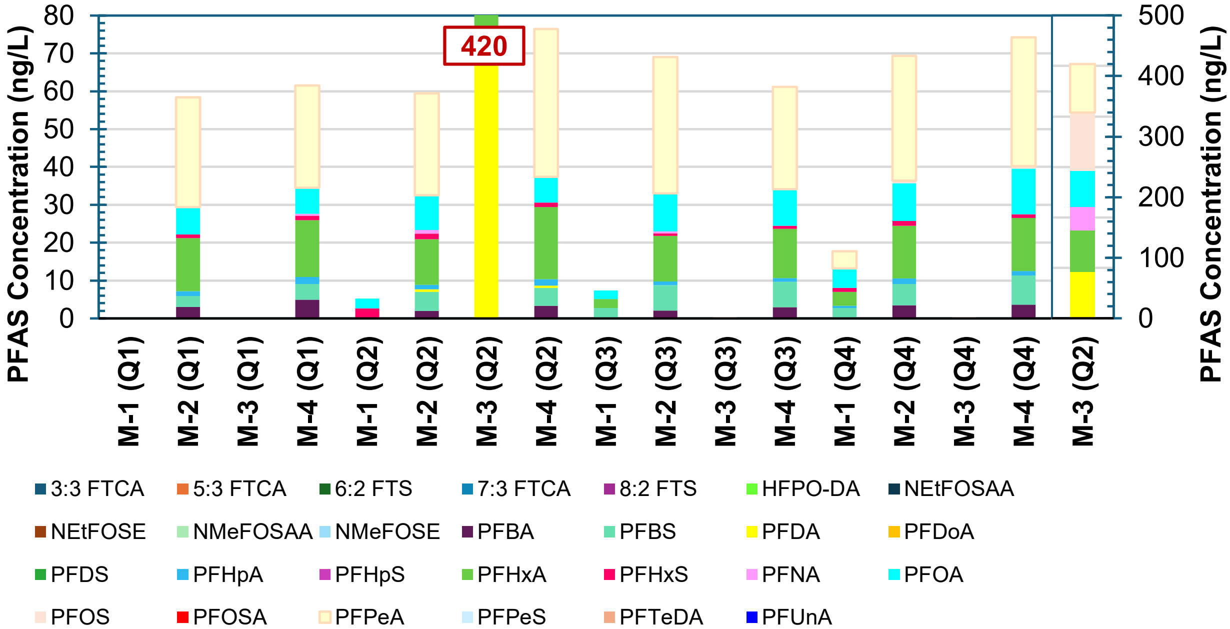

Figure 11. Total PFAS from All Quarters, 2024, MWRWP Sites; ***red box indicates value past left y-axis limit, expanded view of this site provided on the right***

3.2 NDMA Results

Table 33 to Table 36 illustrate the NDMA data at all the sampled sites. Note that the state of California established a public health goal of 3 ng/L in drinking water based on the lifetime excess cancer risk assessment (USEPA. 2017b) and the State of Washington established a groundwater criterion for NDMA at 2 ng/L.

3.2.1 NDMA Concentrations at Industrial Sources

Table 33 shows the detection and quantification results of NDMA at the sampled industrial sites. Of those sites, the metal finisher (I-1) and the can manufacturer (I-2) had higher overall NDMA than the other sites. As with the PFAS data from the industrial sites, the NDMA concentrations varied across quarters.

Table 33. NDMA Results from all Quarters 2024, Industrial Sites (in ng/L)

Quarter	I-1: Metal Finisher	I-2: Can Manuf.	I-3: Box Manuf.	I-4: Box Manuf.	I-5: Beverage Manuf.	I-6: Landfill	I-7: Hospital
Quarter 1	**97**	**9.2**	**26**	*ND*	**3.6**	1.9 (*J*)	**3.5**
Quarter 2	**86** (*B*)	**35** (*B*)	**16** (*B*)	2.2 (*J*)	**4.8** (*B*)	**24**	**13** (*B*)
Quarter 3	**45**	**65**	**8.1**	**15**	*ND*	**19**	2.2 (*J*)
Quarter 4	**47**	**140**	**9.6**	**14**	9.7 (*J*)	**7.7**	**3.5**

(*ND*) non-detect; indicates levels below the MDL.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*B*) indicates that NDMA was found in the associated method blank.

3.2.2 NDMA Concentrations at Residential Sites

Table 34 shows the detection and quantification results of NDMA at the sampled residential sites. Overall, the sampled residential sites were low in NDMA, with only single-digit concentrations measured. One exception is a concentration of 32 ng/L detected in R-2 (Tumwater) during the third quarter sampling. This value is flagged as a *J*-value and subsequently must be viewed as an estimate. It is, however, noteworthy as it is a detected value with an MDL of 7.3 ng/L. The MDL and flagged result are higher in this instance than the others, as the sample had to be diluted.

Table 34. NDMA Results from all Quarter 2024, Residential Sites (in ng/L)

Quarter	R-1: Lacey	R-2: Tumwater	R-3: Olympia
Quarter 1	**3.3**	**3.1**	**5.3**
Quarter 2	**3.4**	**2.8** (*B*)	1.2 (*J*, *B*)
Quarter 3	**3.9**	32 (*J*)	1.6 (*J*)
Quarter 4	**2.7**	**2.8**	0.89 (*J*)

(*B*) indicates that NDMA was found in the associated method blank.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

3.2.3 NDMA Concentrations at BITP/BIRWP

Table 35 shows the detection and quantification results of NDMA at the sampled BITP/BIRWP sites. NDMA was low across the treatment train with concentrations not exceeding 3.8 ng/L. Overall, values decreased from the influent (B-1) to the final reclaimed water (B-6). No detectable NDMA was found in the biosolids (B-7). The reclaimed water concentrations are generally lower than the historical levels from LOTT's sampling in 2014-2015 (Table 5 to Table 7). Note that the final effluent and reclaimed concentrations are below the State of California drinking water guidelines, and one reclaimed water sample had a higher concentration than the Washington groundwater criterion.

Table 35. NDMA Results from all Quarters 2024, BITP/BIRWP (in ng/L)

Quarter	B-1: Influent	B-2: Primary Effluent	B-3: Secondary Effluent	B-4: Centrate	B-5: Final Effluent	B-6: Reclaimed	B-7: Biosolids*
Quarter 1	**2.7**	2.0 (*J*)	1.5 (*J*)	1.2 (*J*)	1.4 (*J*)	1.7 (*J*)	*ND* (*F1*)
Quarter 2	**3.1**	**3.8**	**2.1** (*B*)	1.7 (*J*, *B*)	1.0 (*J*, **3*)	1.4 (*J*)	*ND*
Quarter 3	**3.4**	**3.8**	1.9 (*J*)	1.9 (*J*)	1.6 (*J*)	**2.2**	*ND*
Quarter 4	2.6 (*J*)	3.1 (*J*)	1.3 (*J*)	**3.5**	1.1 (*J*)	1.7 (*J*)	*ND*

(*) units are in mg/Kg.
(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*ND*) non-detect; indicates levels below the MDL.
(*F1*) MS and/or MSD recovery exceeds control limits (see Appendix D for more details).
(*B*) indicates that NDMA was found in the associated method blank.
(**3*) indicates internal standard response or retention time outside acceptable limits.

3.2.4 NDMA Concentrations at MWRWP

Table 36 illustrates the detection and quantification results of NDMA at the sampled MWRWP sites. NDMA did not exceed 5.2 ng/L, and as with the BITP/BIRWP, NDMA was lower in reclaimed water (M-2) than influent water (M-1). NDMA was not detected in the waste sludge, and only low concentrations were detected in post wetlands (M-4) samples in quarters three and four. Note that the reclaimed water concentrations are below the California drinking water guideline and the Washington groundwater criterion.

Table 36. NDMA Results from all Quarters 2024, MWRWP (in ng/L)

Quarter	M-1: Influent	M-2: Reclaimed	M-3: Waste Sludge*	M-4: Post Wetlands
Quarter 1	**3.1**	0.62 (*J*)	*ND*	*ND*
Quarter 2	**4.4**	1.1 (*J*)	*ND*	*ND*
Quarter 3	**5.2**	1.7 (*J*)	(no sample pulled)	1.1 (*J*)
Quarter 4	**3.5**	0.67 (*J*)	*ND*	0.7 (*J*)

(*) units are in µg/L.
J) J-flag; indicates that the value is between the MDL and MRL.
(*ND*) non-detect; indicates levels below the MDL.

3.3 NDMA Precursor Results

Table 37 to Table 40 illustrate the NDMA-FP data at all the sampled sites. FP was conducted at HDR's Water Quality Laboratory in Portland (OR). Samples were treated with monochloramine for 4 hours before adding sodium thiosulfate as a quenching agent. The samples were then shipped overnight to Eurofins (Pomona, CA) for NDMA analysis (see Section 2.5 for more details).

NDMA-FP results are not meant to mimic actual NDMA concentrations within LOTT's system. NDMA-FP testing conditions are more aggressive than actual disinfection practices and represent an extreme disinfection scenario. The concentrations in Table 37 to Table 40 provide the *relative* amount of NDMA precursors across the sampling sites, indicating locations of high NDMA precursor loadings.

3.3.1 NDMA-FP Concentrations at Industrial Sources

Table 37 shows the detection and quantification results of NDMA precursors at the sampled industrial sites. The sites varied in both background NDMA and estimated NDMA precursors across the quarters. There were instances where the majority of NDMA was formed prior to FP testing (e.g., I-1 in quarter one and I-1 and I-2 in quarter four). Other sampling events revealed that chloramine-reactive precursors were present in high concentrations (e.g., I-3 in quarter one, I-7 in quarter two and I-3 in quarter four). The box manufacturer (I-4), beverage manufacturer (I-5) and landfill (I-6) samples had lower overall NDMA and NDMA precursors. Samples from I-3 (box manufacturer) had notably more precursors present than background NDMA. The samples from the hospital site (I-7) had the highest demonstration of NDMA formation following FP testing in quarter two with an estimated 867 ng/L of NDMA FP.

Table 37. NDMA-FP Results from Three Quarters 2024, Industrial Sites (in ng/L)

Quarter	NDMA or Precursor Estimate	I-1: Metal Finisher	I-2: Can Manuf.	I-3: Box Manuf.	I-4: Box Manuf.	I-5: Beverage Manuf.	I-6: Landfill	I-7: Hospital
Quarter 1	NDMA-FP	**96**	**28**	**240**	**20**	**4.4**	1.9 (*J*)	5.8 (*J*)
	NDMA	**97**	**9.2**	**26**	*ND*	**3.6**	1.9 (*J*)	**3.5**
	Estimated FP Precursors*	0.0	19	214	20	0.8	0.0	2.3
Quarter 2	NDMA-FP	**170**	**350** (*B*)	**30** (*B*)	**42** (*B*)	**13** (*B*)	**19** (*B*)	**880** (*B*)
	NDMA	**86** (*B*)	**35** (*B*)	**16** (*B*)	2.2 (*J*)	**4.8** (*B*)	**24**	**13** (*B*)
	Estimated FP Precursors*	84	315	14	40	8.2	0.0	867
Quarter 4	NDMA-FP	27 (*J*)	**130**	**600**	**74**	4.6 (*J*)	**5.5**	**18**
	NDMA	**47**	**140**	**9.6**	**14**	9.7 (*J*)	**7.7**	**3.5**
	Estimated FP Precursors*	0.0	0.0	590	60	0.0	0.0	15

(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*ND*) non-detect; indicates levels below the MDL.
(*) precursors estimated via subtracting existing NMDA from total NDMA measured after FP testing.
(*B*) indicates that NDMA was found in the associated method blank.

3.3.2 NDMA-FP Concentrations at Residential Sources

Table 38 shows the detection and quantification results of NDMA precursors at the sampled residential sites. Of those sites, Olympia (R-3) had more NDMA formation in quarter one and particularly in quarter two. Tumwater (R-2) also had elevated precursors in quarter two.

Table 38. NDMA-FP Results from Three Quarters 2024, Residential Sites (in ng/L)

Quarter	NDMA or Precursor Estimate	R-1: Lacey	R-2: Tumwater	R-3: Olympia
Quarter 1	NDMA-FP	**6.1**	**4.6**	**46**
	NDMA	**3.3**	**3.1**	**5.3**
	Estimated FP Precursors*	2.8	1.5	41
Quarter 2	NDMA-FP	**39** (*B*)	**420** (*B*)	**1,200** (*B*)
	NDMA	**3.4**	**2.8** (*B*)	1.2 (*J*, *B*)
	Estimated FP Precursors*	36	417	1,199
Quarter 4	NDMA-FP	**7.2**	**10**	**4.0**
	NDMA	**2.7**	**2.8**	0.89 (*J*)
	Estimated FP Precursors*	4.5	7.2	3.1

(*) precursors estimated via subtracting existing NMDA from total NDMA after FP testing.
(*B*) indicates that NDMA was found in the associated method blank.
(*J*) J-flag; indicates that the value is between the MDL and MRL.

3.3.3 NDMA-FP Concentrations at BITP/BIRWP Sites

Table 39 shows the detection and quantification results of NDMA precursors at the sampled BITP/BIRWP sites. The estimated concentrations of NDMA precursors through the BITP/BIRWP was variable between sampling events and between sample locations. In quarters two and four, not all of these locations were sampled on the same day (Table 13). Even sites sampled on the same day, however, (e.g., B-1 and B-2 in quarter two), there were large differences in precursor concentration estimates (18 and 366 ng/L, respectively). Overall, there are not discernible trends in precursor occurrence from these three quarters at BITP/BIRWP.

Table 39. NDMA-FP Results from Three Quarters 2024, BITP/BIRWP (in ng/L)

Quarter	NDMA or Precursor Estimate	B-1: Influent	B-2: Primary Effluent	B-3: Secondary Effluent	B-4: Centrate	B-5: Final Effluent
Quarter 1	NDMA-FP	**6.0**	**5.4**	**53**	**9.3**	**35**
	NDMA	**2.7**	2.0 (*J*)	1.5 (*J*)	1.2 (*J*)	1.4 (*J*)
	Estimated FP Precursors*	3.3	3.4	52	8.1	34

Quarter	NDMA or Precursor Estimate	B-1: Influent	B-2: Primary Effluent	B-3: Secondary Effluent	B-4: Centrate	B-5: Final Effluent
Quarter 2	NDMA-FP	**21** (*B*)	**370** (*B*)	**79**	**55** (*B*)	**79**
	NDMA	**3.1**	**3.8**	**2.1** (*B*)	1.7 (*J*, *B*)	1.0 (*J*, *3)
	Estimated FP Precursors*	18	366	77	53	78
Quarter 4	NDMA-FP	**24**	**26**	**36**	**5.2**	**62**
	NDMA	2.6 (*J*)	3.1 (*J*)	1.3 (*J*)	**3.5**	1.1 (*J*)
	Estimated FP Precursors*	21	23	35	1.7	61

(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*) precursors estimated via subtracting existing NMDA from total NDMA after FP testing.
(*B*) indicates that NDMA was found in the associated method blank.
(*3) indicates internal standard response or retention time outside acceptable limits.

3.3.4 NDMA-FP Concentrations at MWRWP Sites

Table 40 shows the detection and quantification results of NDMA precursors at the sampled MWRWP sites. There was a maximum formation of 100 ng/L of NDMA from samples pulled post wetlands (M-4) in quarter two, which is almost an order of magnitude higher than the influent. As with the BITP/BIRWP system, there was variability across sites and between quarters.

Table 40. NDMA-FP Results from Three Quarters 2024, MWRWP (in ng/L)

Quarter	NDMA or Precursor Estimate	M-1: Influent	M-5: Reclaimed (pre-chlorination)	M-4: Post Wetlands
Quarter 1	NDMA-FP	**15**	**27**	**10**
	NDMA	**3.1**	0.62 (*J*)	*ND*
	Estimated FP Precursors*	12	26	10
Quarter 2	NDMA-FP	**13** (*B*)	**41**	**100**
	NDMA	**4.4**	1.1 (*J*)	*ND*
	Estimated FP Precursors*	8.6	40	100
Quarter 4	NDMA-FP	**5.6**	8.0 (*J*)	**39**
	NDMA	**3.5**	0.67 (*J*)	*ND*
	Estimated FP Precursors*	2.1	7.3	39

(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*ND*) non-detect; indicates levels below the MDL.
(*) precursors estimated via subtracting existing NMDA from total NDMA after FP testing.
(*B*) indicates that NDMA was found in the associated method blank.

3.3.5 Results from "Low Dose" FP Testing

Two additional NDMA-FP samples at B-5 and M-5 were run with free chlorine instead of monochloramine under conditions more consistent with disinfection practices at BITP/BIRWP and MWRWP. M-2 may be compared to M-5 since the only difference in these sample sites is the added chlorination at M-2. Details about the experimental conditions can be found in Section 2.5 and Table 16. The data from these low dose tests are provided in Table 41 along with measured NDMA data from Section 3.2. Data from site B-5 (final effluent at BITP/BIRWP) and M-5 (reclaimed water at MWRWP prior to chlorination) illustrate that low dose testing resulted in NDMA formation concentrations similar to actual measured NDMA concentrations from the system. This data confirms that the higher dose FP testing is not representative of what would actually occur in the treatment systems, but is instead a tool to provide insight to the quantity of precursors present at given locations.

Table 41. Low Dose NDMA-FP Results from Three Quarters, along with Actual NDMA Data (in ng/L)

Quarter	NDMA or Precursor Estimate	B-5: Final Effluent	M-2: Reclaimed Water	M-5: Reclaimed Water (pre-chlorination)
Quarter 1	NDMA-FP	1.6 (*J*)	--	0.82 (*J*)
	NDMA	1.4 (*J*)	0.62 (*J*)	--
Quarter 2	NDMA-FP	**3.6**	--	**5.0**
	NDMA	1.0 (*J*, *3)	1.1 (*J*)	--
Quarter 4	NDMA-FP	1.7 (*J*)	--	3.4 (*J*)
	NDMA	1.1 (*J*)	0.67 (*J*)	--

(*J*) J-flag; indicates that the value is between the MDL and MRL.
(*3) indicates internal standard response or retention time outside acceptable limits.

4 Summary of Results

The data presented here provide insight into potential trends of PFAS and NDMA occurrence in the collection system, reflecting contributions from both industrial and residential sources. The data also illustrate potential trends in PFAS and NDMA transformations and removal within LOTT's wastewater treatment systems. Because the samples were not obtained from the same unit of water moving through the systems, the sample data represent distinct water qualities that are not directly tied to samples collected upstream or downstream of a given site. Trends that can be noted from four quarters of sampling include:

- PFAS
  - PFAS was highly variable at many of the industrial sites.
  - There was relatively little PFAS detected from the beverage manufacturing company (I-5) and no PFAS detected in samples taken from the hospital (I-7).
  - Residential sites contributed lower PFAS concentrations than most of the industrial sites, and residential concentrations were found to be lower than in both wastewater treatment systems.
  - Both wastewater treatment systems had lower PFAS concentrations in influent waters than subsequent stages of treatment; there is potential for this to be a product of sample matrix effects or PFAS transformations.
  - For MWRWP, the post wetlands PFAS concentrations were similar to the final reclaimed water.
- NDMA
  - NDMA and NDMA precursor estimates were highly variable at many of the industrial sites.
  - Although NDMA was low at residential sites, NDMA precursors (as estimated) were found in high concentrations during some of the sampling events.
  - NDMA was relatively low across both wastewater treatment systems but estimated precursor concentrations were variable from location-to-location as well as across sampling quarters.
  - In reclaimed water samples, "low dose" NDMA formation potential testing resulted in NDMA formation concentrations similar to actual measured NDMA concentrations. This confirms that the higher dose testing, useful in identifying formation potential throughout the collection system, is not representative of what would actually occur in the wastewater treatment systems.

The data collected to-date illustrate how a comprehensive sampling campaign (both in the number of sites and the number of sampling events) can aid in developing more robust datasets for understanding the origins and fate of contaminants through wastewater treatment systems.

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Appendix A. Sampling Plan

Appendix A is available upon request.

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Appendix B. Field Data

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LOTT
Reclaimed Water Infiltration Study Residual Chlorine Log

Sample Date	Sample ID	Sample Collection Time	Analysis Time	Total Cl Residual (mg/L)	Free Cl Residual (mg/L)	Mono chloramines (mg/L)	Temperature (°C)	pH Std. Units	Comments
2/26/2024	R-3	0924	0926	--	--	--	10.6	6.43	
2/26/2024	R-3	0925	0936	0.03	0.00	0.00	--	--	Filtered once, weather was overcast
2/26/2024	R-3	0941	0952	0.00	0.35*	0.00	--	--	*Powder pillow reage-- was not added to free chlorine blank. Results are not valid. Filtered once, weather was overcast
2/26/2024	R-3	0953	1001	0.00	0.00	0.1	--	--	Filtered once, weather was overcast
2/26/2024	I-3	1046	1048	--	--	--	18.3	8.48	
2/26/2024	I-3	1049	N/A	--	--	--	--	--	Sample was too colored from ink to analyze. Filtered twice.
2/26/2024	I-2	1133	1134	--	--	--	28.5	7.59	
2/26/2024	I-2	1135	1141	0.00	--	--	--	--	Filtered twice, sampled indoors.
2/26/2024	I-7	1433		--	--	--	25.5	7.89	
2/26/2024	I-7	1438	1447	0.02	--	--	--	--	Filtered three times, i--ermitte-- sun.
2/26/2024	I-7	1453	1501	--	0.00	--	--	--	Filtered three times, i--ermitte-- sun.
2/26/2024	I-7	1505	1515	--	--	0.1	--	--	Filtered three times, i--ermitte-- sun.
2/27/2024	R-1	0945	0947	--	--	--	12.8	8.34	
2/27/2024	R-1	0954	1001	0.00	--	--	--	--	Filtered three times, overast.

2/27/2024	I-6	1045	1049	--	--	--	8.1	7.33	
2/27/2024	I-6	1050	1058	0.00	--	--	--	--	Filtered twice
2/27/2024	I-4	1136	1137	--	--	--	18.3	9.37	
2/27/2024	I-4	1139	1144	0.00	--	--	--	--	Overcast
2/28/2024	R-2	0918	0926	0.00	--	--	--	--	Sample was filtered twice.
2/28/2024	I-5	1052	1100	0.00	--	--	--	--	
2/28/2024	I-1	N/A	N/A	--	--	--	17.7	24.7	
5/20/2024	R-3	0830	0832	--	--	--	14.4	7.37	
5/20/2024	R-3	0842	0849	0.00	--	--	--	--	filtered once
5/20/2024	I-3	0924	0926	--	--	--	24.6	7.28	
5/20/2024	I-3	0933	0941	0.00	--	--	--	--	filtered once
5/20/2024	I-2	1005	1009	--	--	--	29.2	7.93	
5/20/2024	I-2	1019	1026	0.00	--	--	--	--	filtered twice
5/20/2024	I-7	not recorded	1206	--	--	--	27.2	7.97	
5/20/2024	I-7	1225	1231	0.88	--	--	--	--	filtered twice
5/20/2024	I-7	1225	1236	--	0.00	--	--	--	filtered twice
5/20/2024	I-7	1239	1249	--	--	0.00	--	--	filtered twice

5/21/2024	R-1	0823	0825	--	--	--	15.4	7.74	
5/21/2024	R-1	0834	0941	0.00	--	--	--	--	filtered twice
5/21/2024	I-6	0912	0916	--	--	--	25.0	7.26	
5/21/2024	I-6	0934	0942	0.00	--	--	--	--	filtered 4X
5/21/2024	I-4	1009	1011	--	--	--	21.50	7.79	
5/21/2024	I-4	1015	1022	0.06	--	--	--	--	
5/21/2024	I-4	1026	1028	--	0.28	--	--	--	
5/22/2024	R-2	0923	0934	--	--	--	25.0	8.13	
5/22/2024	I-1	1019	1020	--	--	--	25.0	5.57	
5/22/2024	I-5	1050	1100	--	--	--	25.00	7.31	
5/22/2024	I-5	1106	1113	0.00	--	--	--	--	filtered twice
9/16/2024	I-7	0922	0945	0.22	--	--	25.00	7.79	Temp was in default 25°C
9/16/2024	I-7	--	1000	--	0.65	--	25	7.79	Temp was in default 25°C
9/16/2024	I-7	1007	1026	--	--	0.00	25	7.71	Temp was in default 25°C
9/16/2024	I-2	1050	1100	0.07	--	--	25	9.33	Temp was in default 25°C
9/16/2024	I-2	1050	1105	--	0.30	--	25	9.33	Temp was in default 25°C
9/16/2024	I-2	1050	1117	--	--	0.60	25	9.33	Temp was in default 25°C

9/16/2024	R-3	1157	1205	0.01	--	--	25	7.44	Temp was in default 25°C
9/16/2024	R-3	1210	1214	--	0.22	--	25	7.27	Temp was in default 25°C
9/16/2024	R-3	1210	1222	--	--	0.00	25	7.27	Temp was in default 25°C
9/17/2024	R-1	0856	0903	0.00	--	--	20.50	8.49	Filtered 1x
9/17/2024	I-6	1037	1038	0.00	--	--	15.20	7.44	standing leachate 1x filtered
9/17/2024	I-4	1120	1121	0.09	--	--	25.20	7.48	Filtered 1x
9/17/2024	I-4	1120	1131	--	0.53	--	25.2	7.48	Filtered 1x
9/17/2024	I-4	1132	1140	--	--	0.00	25.1	7.48	Filtered 1x
9/18/2024	R-2	0843	0844	0.00	--	--	21.5	8.1	Filtered 2x's
9/18/2024	I-1	0956	0956	0.00	--	--	20.4	4.86	
9/18/2024	I-5	1036	1037	0.00	--	--	25.9	6.73	
9/19/2024	I-3	N/A	N/A	0.08	0.10	0.0`	24.7	7.57	
11/4/2024	R-3	0853	0859	--	--	--	25	8.01	Filtered once
11/4/2024	R-3	0853	0900	0.18	--	--	--	--	Filtered once
11/4/2024	R-3	0853	0906	--	0.00	--	--	--	Filtered once
11/4/2024	R-3	0909	0920	--	--	1.20	--	--	Filtered once
11/4/2024	I-3	0958	1006	0.00	--	--	--	--	Filtered once

11/4/2024	I-3	0958	1007	--	--	--	25	8.03	Filtered once
11/4/2024	I-2	1035	1037	--	--	--	25	9.15	Filtered once
11/4/2024	I-2	1038	1045	0.00	--	--	--	--	Filtered once
11/4/2024	I-7	1233	1239	--	--	--	--	8.1	Filtered once
11/4/2024	I-7	1233	1241	0.00	--	--	--	--	Filtered once
11/5/2024	R-1	0840	0842	--	--	--	17.6	8.46	
11/5/2024	R-1	0840	0847	0.00	--	--	--	--	filtered twice
11/5/2024	I-6	0914	0920	--	--	--	10.3	8.14	
11/5/2024	I-6	0914	0923	0.08	--	--	--	--	filtered twice
11/5/2024	I-6	0927	0938	--	0.12	--	--	--	filtered twice
11/5/2024	I-6	0939	0946	--	--	0.00	--	--	filtered twice
11/5/2024	I-4	1014	1020	0.24	--	--	--	--	filtered twice
11/5/2024	I-4	1014	1019	--	--	--	18	8.35	
11/5/2024	I-4	1014	1025	--	0.18	--	--	--	filtered twice
11/5/2024	I-4	1014	1031	--	--	0.50	--	--	filtered twice
11/6/2024	R-2	0841	0847	--	--	--	17.5	8.57	
11/6/2024	R-2	0841	0849	0.00	--	--	--	--	filtered twice

11/6/2024	I-5	0924	0928	--	--	--	17.3	6.70	
11/6/2024	I-5	0924	0930	0.00	--	--	--	--	filtered once
10/24/2024	I-1	N/A	N/A	--	--	--	--	8.27	

LOTT
Reclaimed Water Infiltration Study Residual Chlorine Log, Q1

Sample Date	Sample ID	Analyst Initials	Sample Collection Time	Analysis Time	Total Cl Residual (mg/L)	Free Cl Residual (mg/L)	Mono chloramines (mg/L)	Temperature (°C)	pH Std. Units	Comments
2/26/2024	B-6		0830	0830				14.7	6.89	
2/26/2024	B-6		0830	0836	3.10					
2/26/2024	B-6		0830	0844		1.71				
2/26/2024	B-6		0849	0854			0.2			
2/26/2024	B-5		0927	0930	0.20			14.2	6.77	
2/26/2024	B-5		0927	0946		0.07				
2/26/2024	B-5		1000	1006			0.20			Repeated monochloramines, same results.
2/26/2024	B-3		1022	1022				13.60	6.67	
2/26/2024	B-3		1022	1027	0.20					
2/26/2024	B-3		1022	1036		0.29				
2/26/2024	B-3		1040	1046			0.50			
2/26/2024	B-2		1113	1117	0.00			11.80	7.53	
2/26/2024	B-1		1235	1239	0.00			12.9	7.39	

2/26/2024	B-4		1312	1312				24.20	7.93	
2/26/2024	B-4		1312	1320	0.30					
2/26/2024	B-4		1312	1325		0.15				
2/26/2024	B-4		1333	1333			0.10			
2/27/2024	M-4		0839	0840	0.00			9.60	7.36	
2/27/2024	M-2		0917	0918				10.6	7.13	
2/27/2024	M-2		0917	0922	0.88					
2/27/2024	M-2		0917	0933		0.48				
2/27/2024	M-2		0934	0941			0.40			
2/27/2024	M-1		1031	1033				10.9	8.02	
2/27/2024	M-1		1031	1038	0.05					
2/27/2024	M-1		1031	1040		0.22				Repeated, same results
2/27/2024	M-1		1045	1056			0.00			

LOTT
Reclaimed Water Infiltration Study Residual Chlorine Log, Q2

Sample Date	Sample ID	Analyst Initials	Sample Collection Time	Analysis Time	Total Cl Residual (mg/L)	Free Cl Residual (mg/L)	Mono chloramines (mg/L)	Temperature (°C)	pH Std. Units	Comments
5/20/2025	M-4		0828							
5/20/2025	M-4		0833	0839	0.00			13.9	7.2	
5/20/2025	M-2		0902	0844						
5/20/2025	M-2		0911	0920	1.61			15.8	7.08	
5/20/2025	M-2		0911	0926		0.53				
5/20/2024	M-2		0925				1.00			
5/20/2024	M-5		0947	0952	0.06	0.00		16.7	7.11	
5/20/2024	M-5		1003	1008			0.20			
5/20/2024	M-3		1021							
5/20/2024	M-1		1035							
5/20/2024	M-1		1047	1052	0.00			16.70	7.91	
5/21/2024	B-2		0826							
5/21/2024	Field Blank		0819							

5/21/2024	B-2		0849	0850	0.00			14.60	7.00	
5/21/2024	B-1		0906							
5/21/2024	B-1		0919	0922	0.00			14.2	7.24	
5/21/2024	B-6		0935							
5/21/2024	B-6		0940	0946	1.96			15.80	7.04	
5/21/2024	B-6		0940	0950		0.38				
5/21/2024	B-6		1000	1001			0.10			
5/22/2024	B-4		1030							
5/22/2024	B-4		1040	1046	0.03			29.9	7.87	
5/22/2024	B-4		1040	1048		0.00				
5/22/2024	B-4		1040	1051			0.00			
5/22/2024	B-3		1114	1116				20	6.73	
5/22/2024	B-3		1114	1118	0.05					
5/22/2024	B-3		1114	1119		0.00				
5/22/2024	B-5			1129			0.20			
5/22/2024	B-5		1151	1153	0.16			2.0	6.9	
5/22/2024	B-5		1151	1157		0.00				

5/22/2024	B-5		1151	1202			0.10			

LOTT
Reclaimed Water Infiltration Study Residual Chlorine Log, Q3

Sample Date	Sample ID	Analyst Initials	Sample Collection Time	Analysis Time	Total Cl Residual (mg/L)	Free Cl Residual (mg/L)	Mono chloramines (mg/L)	Temperature (°C)	pH Std. Units	Comments
9/16/2024	M-1		0939	0919	0.0			7.69	16.4	
9/16/2024	M-2		0939	0948	2.18			7.07	18.2	
9/16/2024	M-2		0939	0951		0.93				
9/16/2024	M-2		0952	0959			0.4			
9/16/2024	M-5		1007	1012	0.46					
9/16/2024	M-5		1007	1017		0.00				
9/16/2024	M-5		1018	1025			0.20			
9/16/2024	M-4		1247	1255	0.06			6.87	18.20	
9/16/2024	M-4		1247	1302		0.00				
9/16/2024	M-4		1302	1309			1.00			
9/17/2024	B-4		0902	0910	0.70			7.83	27.90	
9/17/2024	B-4		0902	0913		0.00				
9/17/2024	B-4		0915	0923			0.30			

9/17/2024	B-3		0953	1001	0.05			6.80	19.40	
9/17/2024	B-3		0953	1010		0.03				
9/17/2024	B-3		1010	1019			0.10			
9/17/2024	B-5		1047	1054	0.07			6.98	19.6	
9/17/2024	B-5		1047	1058		0.00				
9/17/2024	B-5		1059	1103			0.30			
9/18/2024	B-1		0857	0858				18.4	7.33	
9/18/2024	B-1		0857	0904	0.00					
9/18/2024	B-6		0923	0925				19.1	7.2	
9/18/2024	B-6		0923	0931	2.22					
9/18/2024	B-6		0923	0933		0.57				
9/18/2024	B-6		0933	0941			0.40			
9/18/2024	B-2		1004	1005				18.8	7.39	
9/18/2024	B-2		1004	1010	0.00					

LOTT
Reclaimed Water Infiltration Study Residual Chlorine Log, Q4

Sample Date	Sample ID	Analyst Initials	Sample Collection Time	Analysis Time	Total Cl Residual (mg/L)	Free Cl Residual (mg/L)	Mono chloramines (mg/L)	Temperature (°C)	pH Std. Units	Comments
11/4/2024	B-6		0944	0953				18.5	7.2	
11/4/2024	B-6		0944	0953	2.52					
11/4/2024	B-6		0944	1003		1.12				
11/4/2024	B-6		1004	1014			0.3			
11/4/2024	B-1		1043	1043				13.8	7.57	
11/4/2024	B-1		1043	1050	0.00					
11/4/2024	B-2		1103	1103				13.6	7.59	
11/4/2024	B-2		1103	1115	0.00					
11/5/2024	B-3		1056	1057				16.8	6.67	
11/5/2024	B-3		1056	1103	0.05					
11/5/2024	B-3		1056	1112		0.00				
11/5/2024	B-3		1113	1124			0.3			
11/5/2024	B-5		1148	1150				16.6	6.78	

11/5/2024	B-5		1148	1156	0.05						
11/5/2024	B-5		1201	1209		0.02					
11/5/2024	B-5		1308	1315			0.50				
11/5/2024	B-4		1338	1348	0.14	0.00		23.30	7.90		
11/5/2024	B-4		1352	1400			0.30				
11/6/2024	M-1		0900	0903				14.3	7.1		
11/6/2024	M-1		0900	0908	0.00						
11/6/2024	M-2		0929	0933				16.4	7.13		
11/6/2024	M-2		0929	0935	1.73						
11/6/2024	M-2		0929	0941		0.00					
11/6/2024	M-2		0939	0948			0.30				
11/6/2024	M-5		1002	1011	0.06			17.3	7.13		
11/6/2024	M-5		1012	1021		0.0					
11/6/2024	M-5		1022	1032			0.2				
11/6/2024	M-4		1117	1119				11.4	7.1		
11/6/2024	M-4		1117	1124	0.0						

Sample Date	Analysis Date	Sample ID	Ammonia (mg/L)	Nitrate + Nitrite (mg/L)
2/26/2024	3/4/2024	B-1	34.97	
2/26/2024	3/4/2024	B-2	28.03	
2/26/2024	3/4/2024	B-3	0.072	
2/26/2024	3/4/2024	B-4	1559.45	
2/26/2024	3/4/2024	B-5	0.080	
2/26/2024	3/4/2024	B-6	0.067	
2/27/2024	3/4/2024	M-1	50.73	
2/27/2024	3/4/2024	M-2	0.069	
2/27/2024	3/4/2024	M-4	0.11	
2/27/2024	3/4/2024	R-1	37.04	
2/28/2024	3/4/2024	R-2	41.20	
2/26/2024	3/4/2024	R-3	5.28	
2/28/2024	3/4/2024	I-1	0.26	
2/26/2024	3/4/2024	I-2	2.80	
2/26/2024	3/20/2024	I-3	113.29	
2/27/2024	3/4/2024	I-4	14.26	
2/28/2024	3/4/2024	I-5	0.11	
2/28/2024	3/20/2024	I-6	26.21	
2/26/2024	3/4/2024	I-7	22.56	
5/21/2024	6/3/2024	B-1	41.71	0.15
5/21/2024	6/3/2024	B-2	25.9	0.047
5/22/2024	6/3/2024	B-3	0.052	1.11
5/22/2024	6/3/2024	B-4	1538.85	0.08
5/22/2024	6/3/2024	B-5	0.047	1.11
5/21/2024	6/3/2024	B-6	0.051	2.24
5/20/2024	6/3/2024	M-1	55.87	1.22
5/20/2024	6/3/2024	M-2	0.056	1.38
5/20/2024	6/3/2024	M-4	0.068	0.079
5/20/2024	6/3/2024	M-5	0.11	1.73
5/21/2024	6/3/2024	R-1	24.38	0.25
5/22/2024	6/3/2024	R-2	41.85	0.54
5/20/2024	6/3/2024	R-3	18.42	0.93
5/22/2024	6/3/2024	I-1	0.76	0.066
5/20/2024	6/3/2024	I-2	2.16	0.019
5/20/2024	6/3/2024	I-3	49.6	0.077
5/21/2024	6/3/2024	I-4	21.19	0.36
5/22/2024	6/3/2024	I-5	1.26	0.76
5/21/2024	6/3/2024	I-6	74.73	0.075
5/20/2024	6/3/2024	I-7	26.68	0.6
9/18/2024	10/3/2024	B-1	41.44	0.031
9/18/2024	10/3/2024	B-2	38.02	0.12
9/17/2024	10/3/2024	B-3	0.055	1.79

9/17/2024	10/3/2024	B-4	1504.16	0.21
9/17/2024	10/3/2024	B-5	0.58	1.69
9/18/2024	10/3/2024	B-6	0.049	1.95
9/16/2024	10/3/2024	M-1	55.1431	0.69
9/16/2024	10/3/2024	M-2	0.58	1.38
9/16/2024	10/3/2024	M-4	0.064	0.041
9/16/2024	10/3/2024	M-5	0.056	1.53
9/17/2024	10/3/2024	R-1	51.58	0.29
9/18/2024	10/3/2024	R-2	58.33	0.45
9/16/2024	10/3/2024	R-3	39.13	0.14
9/18/2024	10/3/2024	I-1	27.34	0.044
9/16/2024	10/3/2024	I-2	2.32	0.099
9/19/2024	10/3/2024	I-3	70.19	0.087
9/17/2024	10/3/2024	I-4	36.13	2.16
9/18/2024	10/3/2024	I-5	0.014	0.026
9/17/2024	10/3/2024	I-6	59.4	0.093
9/16/2024	10/3/2024	I-7	28.72	0.75
11/4/2024	11/20/2024	B-1	31.8	
11/4/2024	11/20/2024	B-2	23.33	
11/5/2024	11/20/2024	B-3	0.076	
11/5/2024	11/20/2024	B-4	1581.96	
11/5/2024	11/20/2024	B-5	0.068	
11/4/2024	11/20/2024	B-6	0.053	
11/6/2024	11/20/2024	M-1	54.02	
11/6/2024	11/20/2024	M-2	0.056	
11/6/2024	11/20/2024	M-4	0.041	
11/6/2024	11/20/2024	M-5	0.5	
11/5/2024	11/20/2024	R-1	49.5	
11/6/2024	11/20/2024	R-2	62.8	
11/4/2024	11/20/2024	R-3	53.7	
10/24/2024	11/20/2024	I-1	0.44	
11/4/2024	11/20/2024	I-2	1.25	
11/4/2024	11/20/2024	I-3	36.43	
11/5/2024	11/20/2024	I-4	17027	
11/6/2024	11/20/2024	I-5	0.12	
11/5/2024	11/20/2024	I-6	16.93	
11/4/2024	11/20/2024	I-7	34.64	

Appendix C. PFAS Sampling Guidelines

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1.1 Sampling for PFAS

Many consumer products contain PFAS. Samplers should take care when sampling to not accidently introduce PFAS contamination into samples. Products that may contain PFAS include:

- Personal care products (PCPs) such as lotions, deodorant and cosmetics should be avoided or minimized as they may contain PFAS from the containers they are supplied in. More information about confirmed PFAS-free PCPs may be found at: https://www.ewg.org/skindeep/learn_more/is-teflon-in-your-cosmetics/
- Sun and biological protection: sunscreen, insect repellants. (Samplers should avoid applying these prior to sampling). If products (such as sunscreen or mosquito repellant are necessary for protection of field staff, it should be noted in the field notes that they have been used. If they are used, they should be applied well in advance of sampling, hands should be washed and new gloves used before each PFAS sample. A list of some PFAS-free sunscreens and insect repellants can be found in Michigan's PFAS Sampling Quick Reference Field Guide (Appendix A).
- Polytetrafluoroethylene (PTFE), including the trademark Teflon® and Hostaflon® which can be in ball check-valves on certain bailers, lining of some hoses and tubing, wiring, certain kinds of gears, lubricant, and some objects that require the sliding action of parts
- Polyvinylidene fluoride (PVDF), including the trademark Kynar®, which can be in tubing, films/coatings on aluminum, galvanized or aluminized steel, wire insulators, and lithium-ion batteries.
- Polychlorotrifluoroethylene (PCTFE), including the trademark Neoflon®, which can be in many valves, seals, gaskets, and food packaging
- Ethylene-tetrafluoro-ethylene (ETFE), including the trademark Tefzel®, which can be in many wire and cable insulation and covers, films for roofing and siding, liners in pipes, and some cable tie wraps
- Fluorinated ethylene propylene (FEP), including the trademarks Teflon® FEP and Hostaflon® FEP, and may also include Neoflon®, which can be in wire and cable insulation and covers, pipe linings, and some labwareChemical or blue ice pack materials
- Prepackaged foods, including paper plates, aluminum foil, paper towels, food containers, bags, and wraps. (Samplers should avoid taking fast food containers and other food packaging with them within the immediate vicinity of sampling; a designated food and beverage area should be established away from where samples are collected and hands should be washed after handling food packaging materials, prior to sampling).
- Post-it notes
- Plastic clipboards

- Waterproof paper and notebooks (Rite in the Rain® notebooks are acceptable provided that gloves are changed after note taking)
- New unwashed clothing
- Clothing washed with fabric softener
- Tyvek material, Gore-Tex® and any other water- or stain-resistant materials; if personal protective equipment (PPE) requires use of waterproof clothing to ensure health and safety of sampling personnel, record the use of the PPE in field notes
- Other clothing that has been washed with stain resistant fabrics
- Low-density polyethylene (LDPE) supplies (unless an equipment blank verifies that it is PFAS-free)

Materials that are considered acceptable for use during PFAS sampling include:

- High-density polyethylene (HDPE) supplies
- Polypropylene (PP) supplies
- Stainless steel
- Natural rubber (or rubber-coated sampling supplies)
- Nylon (or nylon-coated sampling supplies)
- Nitrile gloves
- Ziploc bags
- Silicone
- "Certified PFAS-Free water" for decontamination between sampling

Consideration of acceptable and unacceptable field clothing and PPE include:

Acceptable materials	Prohibited materials
Synthetic or 100% cotton clothing that has been well-laundered (without use of fabric softener)	Water/stain/dirt-resistant treated clothes (including but not limited to Gore-Tex™, Scotchgard™, and RUCO®)
Waterproof clothing made with polyurethane, PVC, wax-coated fabrics, rubber, or neoprene	New unwashed clothing
Boots made of polyurethane and/or PVC	Clothes recently washed with fabric softeners
Powderless nitrile gloves	Clothes chemically treated for insect resistance and ultraviolet protection
	Coated Tyvek®
	Latex gloves

Other PFAS sampling considerations:

- PFAS samples should be collected before other non-PFAS samples
- Samples should be taken below the top layer of the water body to avoid surface scum and otherwise elevated levels of PFAS that are expected to accumulate at the air-water interface
- If possible, use clean, disposable sampling equipment
- Non-disposable material should be decontaminated after each use (as well as just before the next sampling event)
- Decontamination should consist of triple rinsing all materials with PFAS-free water
- If detergents are needed, use Alconox®, Liquinox®, or Citranox® laboratory detergents
- Hands should be washed thoroughly before each PFAS sampling event
- Do not touch the inside of the PFAS lids or sample containers
- Samples labels and COC forms should be filled out with ball point pens or "Rite in the Rain" pens
- **New, "fresh" nitrile gloves should be put on just prior to pulling each PFAS sample**

Biosolids-specific PFAS sampling considerations:

- Samples should be collected with the highest solids content possible
- To ensure that biosolids are representative, consider that the grab sample should sufficiently represent the composition of the biosolid stream passing through the sampling point
- Information collected at the time of sampling should include: A description of the sample location, biosolids classification, and step within the treatment plant's material processing sequence that the sample was taken.

Appendix D. Data Validation Report

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DATA VALIDATION REPORT

LOTT Wastewater and Reclaimed Water
Water Quality Characterization Sampling Events

Laboratory: Eurofins (Pomona, CA)

The following table summarizes for which sampling dates and locations each laboratory report relates:

Table D1. Quarterly sample dates and locations of LOTT wastewater and reclaimed water

Laboratory Report Number	Sampling Dates	Cooler Arrival Temperature	Locations Sampled
380-84883-1	02/26/2024	0.2 & 0.4 °C (2 coolers)	B-1: Influent B-2: Primary Effluent B-3 Secondary Effluent B-4: Centrate B-5: Final Effluent B-6: Reclaimed Water B-7: Biosolids
380-84949-1	02/27/2024	1.0°C	I-4: Box manufacturer I-6: Landfill R-1: Lacey
380-84896-1	02/27/2024	0.9°C	M-1: Influent M-2: Reclaimed Water M-3: Waste sludge M-4: Post Wetlands
380-85145-1	02/28/2024	0.2 °C	I-1: Metal finisher I-5: Beverage Manufacturer R-2: Tumwater
380-84882-1	02/27/2024	0.9°C	R-3: Olympia I-3: Box manufacturer I-2: Can manufacturer I-7: Hospital
380-86172-1	03/05/2024	1.8 °C	NDMA-FP: I-1: Metal finisher I-2: Can manufacturer I-3: Box manufacturer I-4: Box manufacturer I-5: Beverage manufacturer I-6: Landfill
380-86187-1	03/05/2024	1.1 °C	NDMA-FP: R-2: Tumwater R-3: Olympia B-5: Final Effluent B-5: Final Effluent, Low Cl_2 Dose M-1: Influent M-4: Post Wetlands M-5: Reclaimed Water M-5: Reclaimed Water, Low Cl_2 Dose
380-86174-1	03/05/2024	0.2 °C	NDMA-FP: B-1: Influent B-2: Primary Effluent B-3: Secondary Effluent B-4: Centrate I-7: Hospital R-1: Lacey
380-96532-1	05/20/2024	1.3 °C	I-3: Box manufacturer I-7: Hospital

Laboratory Report Number	Sampling Dates	Cooler Arrival Temperature	Locations Sampled
380-96555-1	05/20/2024	1.0 °C	M-1: Influent M-2: Reclaimed Water M-3: Waste sludge M-4: Post Wetlands
380-96587-1	05/20/2024	1.6 °C	R-3: Olympia I-2: Can manufacturer
380-96822-1	05/21/2024	1.1 °C	B-1: Influent B-2: Primary Effluent B-6: Reclaimed Water
380-96876-1	05/21/2024	3.1 °C	R-1: Lacey I-4: Box manufacturer I-6: Landfill
380-97129-1	05/22/2024	0.7 °C	B-3 Secondary Effluent B-4: Centrate B-5: Final Effluent B-7: Biosolids
380-97119-1	05/22/2024	1.0 °C	R-2: Tumwater I-1: Metal finisher I-5: Beverage manufacturer
380-98005-1	05/30/2024	3.5 °C	NDMA-FP: B-1: Influent B-2: Primary Effluent B-3 Secondary Effluent B-4: Centrate B-5: Final Effluent
380-97971-1	05/30/2024	6.6 °C	NDMA-FP: I-1: Metal finisher I-2: Can manufacturer I-3: Box manufacturer I-4: Box manufacturer B-5: Final Effluent, Low Cl_2 Dose
380-97978-1	05/30/2024	5.9 °C	NDMA-FP: I-5: Beverage manufacturer I-6: Landfill I-7: Hospital M-4: Post Wetlands M-5: Reclaimed Water
380-97979-1	05/30/2024	4.8 °C	NDMA-FP: R-1: Lacey R-2: Tumwater R-3: Olympia M-1: Influent M-5: Reclaimed Water, Low Cl_2 Dose
380-113335-1	09/16/2024	2.7 °C	M-1: Influent M-2: Reclaimed Water M-3: Waste sludge M-4: Post Wetlands
380-113351-1	09/16/2024	2.1 °C	R-3: Olympia I-2: Can manufacturer I-7: Hospital
380-113546-1	09/17/2024	2.1 °C	R-1: Lacey I-4: Box manufacturer I-6: Landfill
380-113624-1	09/17/2024	2.3 °C	B-3 Secondary Effluent B-4: Centrate B-5: Final Effluent B-7: Biosolids

Laboratory Report Number	Sampling Dates	Cooler Arrival Temperature	Locations Sampled
380-113900-1	09/18/2024	5.1 °C	B-1: Influent B-2: Primary Effluent B-6: Reclaimed Water
380-113840-1	09/18/2024	3.3 °C	R-2: Tumwater I-1: Metal finisher I-5: Beverage manufacturer
380-114064-1	09/19/2024	3.3°C	I-3: Box manufacturer
380-119500-1	10/24/2024	2.9 °C	I-1: Metal finisher
380-120614-1 & 380-120619-1	11/04/2024	4.4 °C	R-3: Olympia I-2: Can manufacturer I-3: Box manufacturer I-7: Hospital
380-120599-1	11/04/2024	2.5 °C	B-1: Influent B-2: Primary Effluent B-6: Reclaimed Water
380-120891-1	11/05/2024	2.0 °C	B-3: Secondary effluent B-4: Centrate B-5: Final effluent B-7: Biosolids
380-120888-1	11/05/2024	1.2 °C	R-1: Lacey I-4: Box manufacturer I-6: Landfill
380-121175-1	11/06/2024	4.7 °C	M-1: Influent M-2: Reclaimed Water M-3: Waste sludge M-4: Post Wetlands
380-121172-1	11/06/2024	4.8 °C	R-2: Tumwater I-5: Beverage manufacturer
380-124522-1	11/26/2024	4.3 °C	NDMA-FP: B-3 Secondary Effluent I-4: Box manufacturer I-5: Beverage manufacturer I-6: Landfill
380-124524-1	11/26/2024	3.7 °C	NDMA-FP: R-1: Lacey R-2: Tumwater M-5: Reclaimed Water, Low Cl_2 Dose I-7: Hospital
380-124450-1	11/26/2024	3.2 °C	NDMA-FP: I-1: Metal finisher I-2: Can manufacturer I-3: Box manufacturer B-5: Final Effluent, Low Cl_2 Dose
380-124481-1	11/26/2024	7.2 °C	NDMA-FP: B-1: Influent B-2: Primary Effluent B-3 Secondary Effluent B-4: Centrate B-5: Final Effluent
380-124519-1	11/26/2024	4.9 °C	NDMA-FP: R-3: Olympia M-1: Influent

INTRODUCTION

This report presents data validation for the wastewater and reclaimed water quality characterization sampling events collected in the first quarter of 2024 for MWRWP and BITP/BIRWP facilities for LOTT Clean Water Alliance. The laboratory data report and QA/QC data are included in this data validation report.

Verification and validation steps addressed in this report are:

- Sampling Procedures and Chain of Custody
- Holding Times
- Surrogate Spike Recoveries
- Laboratory Matrix Spike/Matrix Spike Duplicates (MS/MSD) Recoveries and Relative Percent Difference (RPD)
- Field Blanks and Duplicate Field Sample

SAMPLING PROCEDURES and CHAIN OF CUSTODY

Grab samples were collected at both LOTT treatment facilities, MWRWP and BITP/BIRWP, according to the sampling plan developed between HDR and LOTT Personnel (HDR, 2023). Samples were collected at dedicated taps or outflows where water samples were placed directly into new laboratory bottles. Samples were labeled, sealed, placed in coolers with ice and shipped overnight to Eurofins in Pomona (CA). Appropriate COC forms were filled out during the time of sample collection and included with sample coolers. A subset of samples was sent to HDR's Water Quality Laboratory in Portland (OR) for NDMA precursor or formation potential analysis. These samples were also shipped in coolers with ice and associated COC forms.

Copies of the COC forms are included in the data reports (Appendix E) for all batches analyzed for the sampling event. The forms were properly filled out and include relinquished and received signatures, or if items were improperly completed, communications via email were conducted to correct the COC. Shipments were received by the laboratory on the day following sampling. The cooler temperatures ranged from 0.2°C to 1.8°C.

Table D2. Quarterly water quality monitoring analytical parameters for characterization of LOTT wastewater, reclaimed water and sludge

Parameter	Method	Hold Time	QC Conducted by Eurofins*
PFAS – wastewater, reclaimed water	EPA Draft-3 Method 1633	28 days	MS, MSD, LCS, LCSD, MB
PFAS – solids	EPA Draft-3 Method 1633	28 days	MS, MSD, LCS, LCSD, MB
NDMA – wastewater	Nitrosamines by Isotope Dilution and GC/CI/MS/MS (Modified USEPA Method 521)	7 days	MS, MSD, LCS, LCSD, MB
NDMA – reclaimed water	EPA Method 521.1	14 days	MS, MSD, LCS, LCSD, MB, MRL
NDMA – solids	EPA Method 8270C SIM	14 days	MS, MSD, LCS, LCSD, MB

(*) Abbreviations:

MB method blank
MRL method reporting limit
MS matrix spike
MSD matrix spike duplicate
LCS lab control sample
LCSD lab control sample duplicate

HOLDING TIMES

The maximum holding times for the various analyses are included in Table D3. Samples were extracted and analyzed within the holding times with the exceptions noted below. These samples would not meet regulatory requirements because of the excess hold time.

Table D3. Holding Time Exceeding QC Limits

Lab Report No.	Sample ID	Analyte / Test	Sample Result (ng/L)	QC Limit (days)	Actual No. of Days	Analytical Method	Qualifier
380-85145-1	I-1: Metal finisher	NDMA	**97**	7	26	Modified EPA Method 521	*H*
380-86172-1	I-1: Metal finisher	NDMA-FP	**96**	7	21	Modified EPA Method 521	*H*
380-97971-1	I-1: Metal finisher	NDMA-FP	**170**	7	23	Modified EPA Method 521	*H*
380-121175-1	M-3: Waste sludge	NDMA	ND	14	14	EPA 8270C	*H*
380-124450-1	I-1: Metal finisher	NDMA-FP	27 (*J*)	7	10	Modified EPA Method 521	*H*
380-124450-1	I-2: Can manufacturer	NDMA-FP	**130**	7	10	Modified EPA Method 521	*H*
380-124450-1	I-3: Box manufacturer	NDMA-FP	**600**	7	10	Modified EPA Method 521	*H*
380-124522-1	I-4: Box manufacturer	NDMA-FP	**74**	7	10	Modified EPA Method 521	*H*
380-124522-1	I-5: Beverage manufacturer	NDMA-FP	4.6 (*J*)	7	10	Modified EPA Method 521	*H*

Lab Report No.	Sample ID	Analyte / Test	Sample Result (ng/L)	QC Limit (days)	Actual No. of Days	Analytical Method	Qualifier
380-124522-1	I-6: Landfill	NDMA-FP	**5.5**	7	10	Modified EPA Method 521	*H*
380-124524-1	I-7: Hospital	NDMA-FP	**18**	7	10	Modified EPA Method 521	*H*
380-124524-1	R-1: Lacey	NDMA-FP	**7.2**	7	10	Modified EPA Method 521	*H*
380-124524-1	R-2: Tumwater	NDMA-FP	**10**	7	10	Modified EPA Method 521	*H*
380-124519-1	R-3: Olympia	NDMA-FP	**4.0**	7	10	Modified EPA Method 521	*H*
380-124481-1	B-1: Influent	NDMA-FP	**24**	7	10	Modified EPA Method 521	*H*
380-124481-1	B-2: Primary effluent	NDMA-FP	**26**	7	10	Modified EPA Method 521	*H*
380-124481-1	B-4: Centrate	NDMA-FP	**5.2**	7	10	Modified EPA Method 521	*H*
380-124519-1	M-1: Influent	NDMA-FP	**5.6**	7	10	Modified EPA Method 521	*H*

SURROGATE RECOVERIES

Surrogates are organic compounds that are similar in chemical composition, extraction, and chromatography to analytes of interest. The surrogates (in this case isotopes of the parent compound) are used to determine the probable response of the group of analytes that are chemically related to that surrogate. Surrogates are added to the sample and carried through all stages of preparation and analysis. Surrogate spikes were added to each sample associated with all USEPA Draft-3 Method 1633, USEPA Method 521.1, Modified USEPA Method 521, and USEPA 8270C SIM.

Recoveries were reviewed and evaluated for adherence to the control limits specified for the various analytical methods. In instances where the surrogate recovery is high, but the result is ND, there is reasonably no impact on the data since ND with high recovery is still ND.

Surrogate recoveries were outside of the acceptable range for the following samples. Results are qualified as estimates.

Table D4. Surrogate Isotope Recovery Control Limits Exceeding QC Limits, First Quarter (2024)

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
380-85145-1	I-1: Metal finisher	PFOSA	ND	13C8 PFOSA	40-130	3.70	EPA Draft-3 1633	*5-
		NMeFOSA	ND	d3-NMePFOSA	10-130	2.16	EPA Draft-3 1633	*5-
		NEtFOSA	ND	d5-NEtPFOSA	10-130	1.33	EPA Draft-3 1633	*5-
		NMeFOSE	ND	d7-N-MeFOSE-M	10-130	0.577	EPA Draft-3 1633	*5-
		NEtFOSE	ND	d9-N-EtFOSE-M	10-130	0.658	EPA Draft-3 1633	*5-
		NDMA	**97**	NDMA-d6	25-150	20	Modified EPA 521	*5-
380-84882-1	I-2: Can manufacturer	4:2 FTS	ND	13C2 4:2 FTS	40-200	35	EPA Draft-3 1633	*5-
		PFPeA	ND	13C5 PFPeA	40-130	15.2	EPA Draft-3 1633	*5-
	I-3: Box manufacturer	4:2 FTS	ND	13C2 4:2 FTS	40-200	15.1	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	33.6	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	38.3	EPA Draft-3 1633	*5-
		PFPeA	ND	13C5 PFPeA	40-130	6.98	EPA Draft-3 1633	*5-
		NDMA	**26**	NDMA-d6	25-150	19	Modified EPA 521	*5-
380-84949-1	I-4: Box manufacturer	HFPO-DA	2.6 (*J*)	13C3 HFPO-DA	40-130	39.2	EPA Draft-3 1633	*5-
		PFHpA	ND	13C4 PFHpA	40-130	36.5	EPA Draft-3 1633	*5-
		PFHxA	**3.1**	13C5 PFHxA	40-130	35.7	EPA Draft-3 1633	*5-
		PFPeA	ND	13C5 PFPeA	40-130	29.7	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	39.9	EPA Draft-3 1633	*5-
		PFOA	**2.5**	13C8 PFOA	40-130	37.6	EPA Draft-3 1633	*5-
		PFOS	ND	13C8 PFOS	40-130	39.4	EPA Draft-3 1633	*5-
380-84883-1	B-1: Influent	HFPO-DA	ND	13C3 HFPO-DA	40-130	34.5	EPA Draft-3 1633	*5-
		PFBS	ND	13C3 PFBS	40-135	34.5	EPA Draft-3 1633	*5-

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
		PFHxS	ND	13C3 PFHxS	40-130	27.1	EPA Draft-3 1633	*5-
		PFHpA	ND	13C4 PFHpA	40-130	36.6	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	31.6	EPA Draft-3 1633	*5-
		PFPeA	ND	13C5 PFPeA	40-130	32.6	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	21.9	EPA Draft-3 1633	*5-
		PFUnA	ND	13C7 PFUnA	30-130	20.0	EPA Draft-3 1633	*5-
		PFOS	ND	13C8 PFOS	40-130	27.8	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	25.4	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	27.4	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	25.5	EPA Draft-3 1633	*5-
		PFOA	ND	13C8 PFOA	40-130	25.9	EPA Draft-3 1633	*5-
380-84883-1	B-2: Primary Effluent	8:2 FTS	ND	13C2 8:2 FTS	40-300	33.5	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	22.6	EPA Draft-3 1633	*5-
		PFBS	**2.8**	13C3 PFBS	40-135	28.8	EPA Draft-3 1633	*5-
		PFHxS	**4.1**	13C3 PFHxS	40-130	24.8	EPA Draft-3 1633	*5-
		PFHpA	0.84 (*J*)	13C4 PFHpA	40-130	21.5	EPA Draft-3 1633	*5-
		PFHxA	**2.9**	13C5 PFHxA	40-130	20.6	EPA Draft-3 1633	*5-
		PFPeA	ND	13C5 PFPeA	40-130	20.1	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	28.0	EPA Draft-3 1633	*5-
		PFUnA	ND	13C7 PFUnA	30-130	20.9	EPA Draft-3 1633	*5-
		PFOA	**3.3**	13C8 PFOA	40-130	25.0	EPA Draft-3 1633	*5-
		PFOS	ND	13C8 PFOS	40-130	21.3	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	23.2	EPA Draft-3 1633	*5-

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	22.6	EPA Draft-3 1633	*5-
		PFBS	**2.8**	13C3 PFBS	40-135	26.1	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	20.8	EPA Draft-3 1633	*5-
		NEtFOSAA	ND	d5-NEtFOSAA	25-135	22.2	EPA Draft-3 1633	*5-
380-84896-1	M-1: Influent	PFOSA	ND	13C8 PFOSA	40-130	39.6	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	26.9	EPA Draft-3 1633	*5-
NDMA-FP samples:								
380-86172-1	I-1: Metal finisher	NDMA	**96**	NDMA-d6	25-150	22	Modified EPA 521	*5-
380-86172-1	I-3: Box manufacturer	NDMA	**240**	NDMA-d6	25-150	24	Modified EPA 521	*5-
380-86174-1	I-7: Hospital	NDMA	5.8 (*J*)	NDMA-d6	25-150	23	Modified EPA 521	*5-
380-86174-1	R-1: Lacey	NDMA	**6.1**	NDMA-d6	25-150	18	Modified EPA 521	*5-
380-86187-1	B-5: Final Effluent	NDMA	**35**	NDMA-d6	70-130	65	EPA 521.1	S1-

(*5-) indicates that the isotope dilution analyte is outside acceptance limits, low biased.
(*J*) indicates that value is between MDL and MRL.
(S1-) indicates that the surrogate recovery exceeds control limits, low biased.

Table D5. Surrogate Isotope Recovery Control Limits Exceeding QC Limits, Second Quarter (2024)

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
380-96822-1	B-1: Influent	NEtFOSAA	ND	d5-NEtFOSAA	25-135	137	EPA Draft-3 1633	*5+
		4:2 FTS	ND	13C2 4:2 FTS	40-200	227	EPA Draft-3 1633	*5+
		6:2 FTS	ND	13C2 6:2 FTS	40-200	213	EPA Draft-3 1633	*5+
380-97129-1	B-4: Centrate	PFPeA	19 (*J*)	13C5 PFPeA	40-130	34.0	EPA Draft-3 1633	*5-
		PFOA	4.7(*J*)	13C8 PFOA	40-130	30.8	EPA Draft-3 1633	*5-
		PFTeDA	ND	13C2 PFTeDA	10-130	7.55	EPA Draft-3 1633	*5-
380-96532-1	I-3: Box manufacturer	NEtFOSAA	ND	d3-NEtFOSAA	25-135	145	EPA Draft-3 1633	*5+
		4:2 FTS	ND	13C2 4:2 FTS	40-200	293	EPA Draft-3 1633	*5+
380-96555-1	M-4: Post wetlands	NDMA	ND	NDMA-d6	70-130	64	EPA 521.1	S1-
380-96876-1	I-6: Landfill	4:2 FTS	ND	13C2 4:2 FTS	40-200	298	EPA Draft-3 1633	*5+
	I-4: Box Manufacturer	PFPeA	5.4 (*J*)	13C5 PFPeA	40-130	22.0	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	23.4	EPA Draft-3 1633	*5-
		PFHpA	7.0 (*J*, *EMPC*)	13C4 PFHpA	40-130	20.3	EPA Draft-3 1633	*5-
		PFOA	7.4 (*J*)	13C8 PFOA	40-130	24.6	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	23.0	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	19.7	EPA Draft-3 1633	*5-
		PFUnA	ND	13C7 PFUnA	30-130	10.8	EPA Draft-3 1633	*5-
		PFDoA	ND	13C2 PFDoA	10-130	4.56	EPA Draft-3 1633	*5-
		PFTeDA	ND	13C2 PFTeDA	10-130	4.07	EPA Draft-3 1633	*5-
		PFBS	ND	13C3 PFBS	40-135	29.4	EPA Draft-3 1633	*5-
		PFHxS	ND	13C3 PFHxS	40-130	20.2	EPA Draft-3 1633	*5-

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
		PFOS	ND	13C8 PFOS	40-130	21.0	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	22.5	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	21.7	EPA Draft-3 1633	*5-
		NEtFOSAA	ND	d5-NEtFOSAA	25-135	20.0	EPA Draft-3 1633	*5-
		8:2 FTS	ND	13C2 8:2 FTS	40-300	28.5	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	24.7	EPA Draft-3 1633	*5-
		NMeFOSE	ND	d7-N-MeFOSE-M	10-130	4.83	EPA Draft-3 1633	*5-
		NEtFOSE	ND	d9-N-EtFOSE-M	10-130	3.24	EPA Draft-3 1633	*5-
		NEtFOSA	ND	d5-NEtPFOSA	10-130	4.73	EPA Draft-3 1633	*5-
		NMeFOSA	ND	d3-NMePFOSA	10-130	6.64	EPA Draft-3 1633	*5-
380-97119-1	I-1: Metal finisher	NDMA	86	NDMA-d6	25-150	3	Modified EPA 521	*5-
		NMeFOSE	ND	d7-N-MeFOSE-M	10-130	0.634	EPA Draft-3 1633	*5-
		NEtFOSE	ND	d9-N-EtFOSE-M	10-130	0.723	EPA Draft-3 1633	*5-
		NEtFOSA	ND	d5-NEtPFOSA	10-130	7.47	EPA Draft-3 1633	*5-
380-96587-1	I-2: Can manufacturer	PFBA	3.4 (*J*)	13C4 PFBA	5-130	3.09	EPA Draft-3 1633	*5-
		PFPeA	ND	13C5 PFPeA	40-130	7.56	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	33.1	EPA Draft-3 1633	*5-
		4:2 FTS	ND	13C2 4:2 FTS	40-200	15.7	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	33.3	EPA Draft-3 1633	*5-
		NMeFOSE	**64**	d7-N-MeFOSE-M	10-130	2.24	EPA Draft-3 1633	*5-
		NEtFOSE	ND	d9-N-EtFOSE-M	10-130	4.09	EPA Draft-3 1633	*5-
NDMA-FP samples:								
	B-1: Influent	NDMA	**21** (*B*)	NDMA-d6	25-150	24	Modified EPA 521	*5-

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
380-98005-1	B-5: Final effluent	NDMA	**79**	NDMA-d6	70-130	68	EPA 521.1	S1-
380-97978-1	M-4: Post wetlands	NDMA	**41**	NDMA-d6	70-130	64	EPA 521.1	S1-
	M-5: Reclaimed	NDMA	**100**	NDMA-d6	70-130	67	EPA 521.1	S1-

(*5+) indicates that the isotope dilution analyte is outside acceptance limits, high biased.
(*J*) indicates that value is between MDL and MRL.
(*5-) indicates that the isotope dilution analyte is outside acceptance limits, low biased.
(S1-) indicates that the surrogate recovery exceeds control limits, low biased.
(*EMPC*) estimated maximum possible concentration; analyte is detected, and all the identification criteria are met, except for the mass-ion abundance ratio.
(*B*) indicates that NDMA was found in the associated method blank.

Table D6. Surrogate Isotope Recovery Control Limits Exceeding QC Limits, Third Quarter (2024)

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
380-113840-1	R-2: Tumwater	NDMA	32 (*J*)	NDMA-d6	25-150	21	Modified EPA 521	*5-
		PFPeA	ND	13C5 PFPeA	40-130	26.1	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	35.8	EPA Draft-3 1633	*5-
		PFHpA	ND	13C4 PFHpA	40-130	39.9	EPA Draft-3 1633	*5-
		PFOA	ND	13C8 PFOA	40-130	32.8	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	32.6	EPA Draft-3 1633	*5-
		PFBS	ND	13C3 PFBS	40-135	36.5	EPA Draft-3 1633	*5-
		PFHxS	ND	13C3 PFHxS	40-130	37.3	EPA Draft-3 1633	*5-
		PFOS	ND	13C8 PFOS	40-130	35.4	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	35.4	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	28.5	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	35.0	EPA Draft-3 1633	*5-
	I-1: Metal finisher	PFOSA	ND	13C8 PFOSA	40-130	23.0	EPA Draft-3 1633	*5-
		NMeFOSE	ND	d7-N-MeFOSE-M	10-130	0.293	EPA Draft-3 1633	*5-
		NEtFOSE	ND	d9-N-EtFOSE-M	10-130	0.363	EPA Draft-3 1633	*5-
		NEtFOSA	ND	d5-NEtPFOSA	10-130	1.74	EPA Draft-3 1633	*5-
		NMeFOSA	ND	d3-NMePFOSA	10-130	3.80	EPA Draft-3 1633	*5-
	I-5: Beverage manufacturer	NDMA	ND	NDMA-d6	25-150	21	Modified EPA 521	*5-
380-113900-1	B-1: Influent	PFPeA	ND	13C5 PFPeA	40-130	36.7	EPA Draft-3 1633	*5-
380-114064-1	I-3: Box manufacturer	4:2 FTS	ND	13C2 4:2 FTS	40-200	226	EPA Draft-3 1633	*5+
		6:2 FTS	21 (*J*)	13C2 6:2 FTS	40-200	225	EPA Draft-3 1633	*5+

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
380-113351-1	I-2: Can manufacturer	PFPeA	ND	13C5 PFPeA	40-130	15.9	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	17.0	EPA Draft-3 1633	*5-
		PFHpA	ND	13C4 PFHpA	40-130	16.9	EPA Draft-3 1633	*5-
		PFOA	ND	13C8 PFOA	40-130	16.6	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	16.4	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	19.2	EPA Draft-3 1633	*5-
		PFUnA	ND	13C7 PFUnA	30-130	18.9	EPA Draft-3 1633	*5-
		PFBS	ND	13C3 PFBS	40-135	15.7	EPA Draft-3 1633	*5-
		PFHxS	ND	13C3 PFHxS	40-130	17.7	EPA Draft-3 1633	*5-
		PFOS	ND	13C8 PFOS	40-130	17.6	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	17.9	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	18.3	EPA Draft-3 1633	*5-
		NEtFOSAA	ND	d5-NEtFOSAA	25-135	20.1	EPA Draft-3 1633	*5-
		4:2 FTS	ND	13C2 4:2 FTS	40-200	23.3	EPA Draft-3 1633	*5-
		6:2 FTS	**11**	13C2 6:2 FTS	40-200	21.5	EPA Draft-3 1633	*5-
		8:2 FTS	ND	13C2 8:2 FTS	40-300	23.1	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	17.7	EPA Draft-3 1633	*5-
	R-3: Olympia	NMeFOSAA	ND	d3-NMeFOSAA	40-170	39.1	EPA Draft-3 1633	*5-
380-113546-1	R-1: Lacey	PFOSA	ND	13C8 PFOSA	40-130	34.4	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	37.1	EPA Draft-3 1633	*5-
	I-4: Box manufacturer	NDMA	**15**	NDMA-d6	25-150	17	Modified EPA 521	*5-
380-113335-1	M-1: Influent	PFPeA	ND	13C5 PFPeA	40-130	26.4	EPA Draft-3 1633	*5-
		PFHxA	**2.3**	13C5 PFHxA	40-130	25.4	EPA Draft-3 1633	*5-

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
		PFHpA	ND	13C4 PFHpA	40-130	27.3	EPA Draft-3 1633	*5-
		PFOA	**2.3**	13C8 PFOA	40-130	28.1	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	25.4	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	26.3	EPA Draft-3 1633	*5-
		PFUnA	ND	13C7 PFUnA	30-130	24.6	EPA Draft-3 1633	*5-
		PFBS	**2.8**	13C3 PFBS	40-135	24.8	EPA Draft-3 1633	*5-
		PFHxS	ND	13C3 PFHxS	40-130	26.6	EPA Draft-3 1633	*5-
		PFOS	ND	13C8 PFOS	40-130	25.8	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	25.6	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	21.6	EPA Draft-3 1633	*5-
		NEtFOSAA	ND	d5-NEtFOSAA	25-135	24.6	EPA Draft-3 1633	*5-
		4:2 FTS	ND	13C2 4:2 FTS	40-200	36.5	EPA Draft-3 1633	*5-
		8:2 FTS	ND	13C2 8:2 FTS	40-300	35.7	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	25.7	EPA Draft-3 1633	*5-

(*5-) indicates that the isotope dilution analyte is outside acceptance limits, low biased.
(*J*) indicates that value is between MDL and MRL.
(*5+) indicates that the isotope dilution analyte is outside acceptance limits, high biased.

Table D7. Surrogate Isotope Recovery Control Limits Exceeding QC Limits, Fourth Quarter (2024)

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
380-120891-1	B-4: Centrate	NDMA	**3.5**	NDMA-d6	25-150	17	Modified EPA 521	*5-
	B-7: Biosolids	PFHpA	ND	13C4 PFHpA	20-150	158	EPA Draft-3 1633	*5+
		4:2 FTS	ND	13C2 4:2 FTS	20-150	254	EPA Draft-3 1633	*5+
		6:2 FTS	ND	13C2 6:2 FTS	20-150	255	EPA Draft-3 1633	*5+
		8:2 FTS	ND	13C2 8:2 FTS	20-150	295	EPA Draft-3 1633	*5+
	B-3: Secondary effluent	NDMA	1.3 (*J*)	NDMA-d6	70-130	60	EPA 521.1	S1-
	B-5: Final effluent	NDMA	1.1 (*J*)	NDMA-d6	70-130	54	EPA 521.1	S1-
380-120614-1	I-3: Box manufacturer	NDMA	**9.6**	NDMA-d6	25-150	23	Modified EPA 521	*5-
	I-2: Can manufacturer	NDMA	**140**	NDMA-d6	25-150	23	Modified EPA 521	*5-
380-120888-1	R-1: Lacey	NDMA	**2.7**	NDMA-d6	25-150	24	Modified EPA 521	*5-
	I-4: Box manufacturer	NDMA	**14**	NDMA-d6	25-150	15	Modified EPA 521	*5-
380-120619-1	I-2: Can manufacturer	PFPeA	ND	13C5 PFPeA	40-130	24.0	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	25.6	EPA Draft-3 1633	*5-
		PFHpA	ND	13C4 PFHpA	40-130	29.5	EPA Draft-3 1633	*5-
		PFOA	ND	13C8 PFOA	40-130	28.4	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	24.1	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	26.7	EPA Draft-3 1633	*5-
		PFUnA	ND	13C7 PFUnA	30-130	27.0	EPA Draft-3 1633	*5-
		PFBS	ND	13C3 PFBS	40-135	27.6	EPA Draft-3 1633	*5-
		PFHxS	ND	13C3 PFHxS	40-130	25.2	EPA Draft-3 1633	*5-

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
		PFOS	ND	13C8 PFOS	40-130	28.9	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	24.1	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	27.5	EPA Draft-3 1633	*5-
		4:2 FTS	ND	13C2 4:2 FTS	40-200	34.1	EPA Draft-3 1633	*5-
		6:2 FTS	**21**	13C2 6:2 FTS	40-200	36.0	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	28.8	EPA Draft-3 1633	*5-
	I-7: Hospital	PFPeA	ND	13C5 PFPeA	40-130	30.5	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	30.2	EPA Draft-3 1633	*5-
		PFHpA	ND	13C4 PFHpA	40-130	36.5	EPA Draft-3 1633	*5-
		PFOA	ND	13C8 PFOA	40-130	30.8	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	29.1	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	28.6	EPA Draft-3 1633	*5-
		PFUnA	ND	13C7 PFUnA	30-130	26.6	EPA Draft-3 1633	*5-
		PFBS	ND	13C3 PFBS	40-135	33.1	EPA Draft-3 1633	*5-
		PFHxS	ND	13C3 PFHxS	40-130	30.0	EPA Draft-3 1633	*5-
		PFOS	ND	13C8 PFOS	40-130	32.1	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	21.9	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	31.1	EPA Draft-3 1633	*5-
		4:2 FTS	ND	13C2 4:2 FTS	40-200	33.2	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-130	26.8	EPA Draft-3 1633	*5-
380-121175-1	M-2: Reclaimed water	NDMA	0.67 (*J*)	NDMA-d6	70-130	66	EPA 521.1	S1-
380-121172-1	R-2: Tumwater	PFPeA	ND	13C5 PFPeA	40-130	29.1	EPA Draft-3 1633	*5-
		PFHxA	ND	13C5 PFHxA	40-130	29.0	EPA Draft-3 1633	*5-

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Isotope	Control Limits (% Recovery)	Actual % Recovery	Analytical Method	Qualifier
		PFHpA	ND	13C4 PFHpA	40-130	36.6	EPA Draft-3 1633	*5-
		PFOA	ND	13C8 PFOA	40-130	27.7	EPA Draft-3 1633	*5-
		PFNA	ND	13C9 PFNA	40-130	28.4	EPA Draft-3 1633	*5-
		PFDA	ND	13C6 PFDA	40-130	28.1	EPA Draft-3 1633	*5-
		PFUnA	ND	13C7 PFUnA	30-130	22.8	EPA Draft-3 1633	*5-
		PFBS	ND	13C3 PFBS	40-135	26.9	EPA Draft-3 1633	*5-
		PFHxS	1.3 (*J*)	13C3 PFHxS	40-130	30.1	EPA Draft-3 1633	*5-
		PFOS	ND	13C8 PFOS	40-130	29.7	EPA Draft-3 1633	*5-
		PFOSA	ND	13C8 PFOSA	40-130	24.6	EPA Draft-3 1633	*5-
		NMeFOSAA	ND	d3-NMeFOSAA	40-170	26.0	EPA Draft-3 1633	*5-
		NEtFOSAA	ND	d5-NEtFOSAA	25-135	24.5	EPA Draft-3 1633	*5-
		4:2 FTS	ND	13C2 4:2 FTS	40-200	30.4	EPA Draft-3 1633	*5-
		6:2 FTS	ND	13C2 6:2 FTS	40-200	39.2	EPA Draft-3 1633	*5-
		8:2 FTS	ND	13C2 8:2 FTS	40-200	32.0	EPA Draft-3 1633	*5-
		HFPO-DA	ND	13C3 HFPO-DA	40-200	28.5	EPA Draft-3 1633	*5-
	I-5: Beverage manufacturer	PFOSA	ND	13C8 PFOSA	40-130	37.3	EPA Draft-3 1633	*5-
NDMA-FP samples:								
380-124450-1	I-1: Metal finisher	NDMA	27 (*J*, *H*)	NDMA-d6	25-150	17	Modified EPA 521	*5-

(*5+) indicates that the isotope dilution analyte is outside acceptance limits, high biased.
(*J*) indicates that value is between MDL and MRL.
(*5-) indicates that the isotope dilution analyte is outside acceptance limits, low biased.
(S1-) indicates that the surrogate recovery exceeds control limits, low biased.

LABORATORY MATRIX SPIKE/MATIRX SPIKE DUPLICATES (MS/MSD) RECOVERIES and RELATIVE PERCENT DIFFERENCES (RPD)

To assess potential matrix effects, an environmental sample and a duplicate are spiked with known concentrations of target analytes. The percent recovery of the target analytes is compared to statistical control limits.

MS and MSD recoveries were all within the QC limits with the following exceptions noted in Table D8 and Table D9. Samples that had at least one of the two MS/MSD samples within limits are not noted. In addition, in instances where the spike recovery is high, but the result is ND, there is reasonably no impact on the data since ND with high recovery is still ND.

Analytes that failed both MS and MSD are qualified as estimated.

Table D8. Laboratory Matrix Spikes and Spike Duplicates Exceeding QC Limits, Quarter 1 (2024)

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	MS% Yield	MSD% Yield	QC Limits (%)	Analytical Method	Qualifier
380-84883-1	B-7: Biosolids	NDMA	ND	0	N/A	37-125	EPA Draft-3 1633	F1

(F1) indicates MS and/or MSD recovery exceeds control limits.

Table D9. Laboratory Matrix Spikes and Spike Duplicates Exceeding QC Limits, Quarter 4 (2024)

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	MS% Yield	MSD% Yield	QC Limits (%)	Analytical Method	Qualifier
380-120891-1	B-7: Biosolids	PFTrDA	ND	168	171	40-150	EPA Draft-3 1633	F1

(F1) indicates MS and/or MSD recovery exceeds control limits.

LABORATORY CONTROL SAMPLE (LCS) AND LABORATORY CONTROL SAMPLE DUPLICATE (LCSD) RECOVERIES

To assess potential matrix effects, an LCS and LCSD are spiked with known concentrations of target analytes. The percent recovery of the target analytes is compared to statistical control limits.

LCS and LCSD recoveries were all within the QC limits with the following exceptions noted in Table D10 and Table D11. In addition, in instances where the spike recovery is high, but the results are ND, there is no impact on the data since ND with high recovery is still ND.

Table D10. Laboratory Control Samples and Laboratory Control Sample Duplicates Exceeding QC Limits, Quarter 2 (2024)

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Spike Added (ng/L)	LCS Result (ng/L)	% Recovery Limits	Actual % Recovery	Analytical Method	Qualifier
380-96555-1	M-1: Influent	PFTeDA	ND	32.0	45.1	60-140	141	EPA Draft-3 1633	*+
	M-2: Reclaimed water	PFTeDA	ND	32.0	45.1	60-140	141	EPA Draft-3 1633	*+
	M-3: Waste sludge	PFTeDA	ND	32.0	45.1	60-140	141	EPA Draft-3 1633	*+
	M-4: Post wetlands	PFTeDA	ND	32.0	45.1	60-140	141	EPA Draft-3 1633	*+

(*+) indicates LCS and/or LCSD is outside acceptable limits, high biased.

Table D11. Laboratory Control Samples and Laboratory Control Sample Duplicates Exceeding QC Limits, Quarter 4 (2024)

Lab Report	Sample ID	Analyte	Sample Result (ng/L)	Spike Added (ng/L)	LCS Result (ng/L)	LCSD Result (ng/L)	RPD Limit	Actual RPD	Analytical Method	Qualifier
380-121175-1	M-3: Waste sludge	NDMA	ND	100	71.1	48.2	30	38	EPA 8270C	*1

(*1) indicates that LCS/LCSD RPD exceeds control limits.

FIELD BLANKS AND DUPLICATE FIELD SAMPLE

Field blanks were collected for USEPA Draft-3 Method 1633. Additionally, field duplicates were collected. All field blanks came back clean (i.e., no PFAS detections), and the RPDs for duplicate samples ranged from 0 to 32 percent. Generally, a RPD of less than 20 percent is desirable. Values detected close to method detection limits are likely to have higher variability and a greater RPD. Table D12 to Table D15 provides the data for these field control samples.

Table D12. PFAS Data (ng/L) for Field Control Samples, Quarter 1 (2024)

Analyte	Field Blank (Industrial / Residential)	Field Blank (Budd Inlet / Martin Way)	I-6: Landfill	I-6: Landfill (duplicate)	RPD (%) of Duplicate Samples
11Cl-PF3OUdS	*ND*	*ND*	*ND*	*ND*	---
8:2 FTS	*ND*	*ND*	*ND*	*ND*	---
4:2 FTS	*ND*	*ND*	*ND*	*ND*	---
6:2 FTS	*ND*	*ND*	*ND*	*ND*	---
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	---
5:3 FTCA	*ND*	*ND*	*ND*	*ND*	---
3:3 FTCA	*ND*	*ND*	*ND*	*ND*	---
ADONA	*ND*	*ND*	*ND*	*ND*	---
9Cl-PF3ONS	*ND*	*ND*	*ND*	*ND*	---
HFPO-DA	*ND*	*ND*	*ND*	*ND*	---
NEtFOSA	*ND*	*ND*	*ND*	*ND*	---
NEtFOSE	*ND*	*ND*	*ND*	*ND*	---
NEtFOSAA	*ND*	*ND*	**67**	**66**	1.5
NMeFOSA	*ND*	*ND*	*ND*	*ND*	---
NMeFOSE	*ND*	*ND*	*ND*	*ND*	---
NMeFOSAA	*ND*	*ND*	**47**	**42**	11
NFDHA	*ND*	*ND*	*ND*	*ND*	---
PFEESA	*ND*	*ND*	*ND*	*ND*	---
PFMPA	*ND*	*ND*	*ND*	*ND*	---
PFMBA	*ND*	*ND*	*ND*	*ND*	---
PFBS	*ND*	*ND*	32 (*J*)	34 (*J*)	6.1
PFBA	*ND*	*ND*	130 (*J*)	130 (*J*)	0.0
PFDS	*ND*	*ND*	*ND*	*ND*	---
PFDA	*ND*	*ND*	15 (*J*)	*ND*	---
PFDoS	*ND*	*ND*	*ND*	*ND*	---
PFDoA	*ND*	*ND*	*ND*	*ND*	---
PFHpS	*ND*	*ND*	*ND*	*ND*	---

Analyte	Field Blank (Industrial / Residential)	Field Blank (Budd Inlet / Martin Way)	I-6: Landfill	I-6: Landfill (duplicate)	RPD (%) of Duplicate Samples
PFHpA	*ND*	*ND*	**48**	**51**	6.1
PFHxS	*ND*	*ND*	28 (*J*)	33 (*J*)	16
PFHxA	*ND*	*ND*	**120**	**130**	8.0
PFNS	*ND*	*ND*	*ND*	*ND*	---
PFNA	*ND*	*ND*	*ND*	*ND*	---
PFOSA	*ND*	*ND*	*ND*	*ND*	---
PFOS	*ND*	*ND*	**66**	**69**	4.4
PFOA	*ND*	*ND*	**150**	**160**	6.5
PFPeS	*ND*	*ND*	*ND*	*ND*	---
PFPeA	*ND*	*ND*	**84**	**85**	1.2
PFTeDA	*ND*	*ND*	*ND*	*ND*	---
PFTrDA	*ND*	*ND*	*ND*	*ND*	---
PFUnA	*ND*	*ND*	*ND*	*ND*	---

(*J*) indicates that values are between MDL and MRL.

Table D13. PFAS Data (ng/L) for Field Control Samples, Quarter 2 (2024)

Analyte	Field Blank (Industrial / Residential)	Field Blank (Budd Inlet / Martin Way)	R-3: Olympia	R-3: Olympia (duplicate)	RPD (%) of Duplicate Samples
11Cl-PF3OUdS	*ND*	*ND*	*ND*	*ND*	---
8:2 FTS	*ND*	*ND*	*ND*	*ND*	---
4:2 FTS	*ND*	*ND*	*ND*	*ND*	---
6:2 FTS	*ND*	*ND*	*ND*	*ND*	---
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	---
5:3 FTCA	*ND*	*ND*	*ND*	*ND*	---
3:3 FTCA	*ND*	*ND*	*ND*	*ND*	---
ADONA	*ND*	*ND*	*ND*	*ND*	---
9Cl-PF3ONS	*ND*	*ND*	*ND*	*ND*	---
HFPO-DA	*ND*	*ND*	*ND*	*ND*	---
NEtFOSA	*ND*	*ND*	*ND*	*ND*	---
NEtFOSE	*ND*	*ND*	*ND*	*ND*	---
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	---
NMeFOSA	*ND*	*ND*	*ND*	*ND*	---
NMeFOSE	*ND*	*ND*	*ND*	*ND*	---
NMeFOSAA	*ND*	*ND*	*ND*	*ND*	---
NFDHA	*ND*	*ND*	*ND*	*ND*	---
PFEESA	*ND*	*ND*	*ND*	*ND*	---
PFMPA	*ND*	*ND*	*ND*	*ND*	---
PFMBA	*ND*	*ND*	*ND*	*ND*	---
PFBS	*ND*	*ND*	*ND*	*ND*	---
PFBA	*ND*	*ND*	*ND*	*ND*	---
PFDS	*ND*	*ND*	*ND*	*ND*	---
PFDA	*ND*	*ND*	*ND*	*ND*	---
PFDoS	*ND*	*ND*	*ND*	*ND*	---
PFDoA	*ND*	*ND*	*ND*	*ND*	---
PFHpS	*ND*	*ND*	*ND*	*ND*	---
PFHpA	*ND*	*ND*	*ND*	*ND*	---
PFHxS	*ND*	*ND*	*ND*	*ND*	---
PFHxA	*ND*	*ND*	*ND*	*ND*	---
PFNS	*ND*	*ND*	*ND*	*ND*	---
PFNA	*ND*	*ND*	*ND*	*ND*	---
PFOSA	*ND*	*ND*	*ND*	*ND*	---

Analyte	Field Blank (Industrial / Residential)	Field Blank (Budd Inlet / Martin Way)	R-3: Olympia	R-3: Olympia (duplicate)	RPD (%) of Duplicate Samples
PFOS	*ND*	*ND*	3.6 (*J*)	2.6 (*J*)	32
PFOA	*ND*	*ND*	4.5 (*J*)	4.3 (*J*)	4.5
PFPeS	*ND*	*ND*	*ND*	*ND*	---
PFPeA	*ND*	*ND*	*ND*	*ND*	---
PFTeDA	*ND*	*ND*	*ND*	*ND*	---
PFTrDA	*ND*	*ND*	*ND*	*ND*	---
PFUnA	*ND*	*ND*	*ND*	*ND*	---

(*J*) indicates that values are between MDL and MRL.

Table D14. PFAS Data (ng/L) for Field Control Samples, Quarter 3 (2024)

Analyte	Field Blank (Industrial / Residential) 09/18/2024	Field Blank (Industrial / Residential) 09/19/2024	Field Blank (Budd Inlet / Martin Way) 09/17/2024	Field Blank (Budd Inlet / Martin Way) 09/18/2024
11Cl-PF3OUdS	*ND*	*ND*	*ND*	*ND*
8:2 FTS	*ND*	*ND*	*ND*	*ND*
4:2 FTS	*ND*	*ND*	*ND*	*ND*
6:2 FTS	*ND*	*ND*	*ND*	*ND*
7:3 FTCA	*ND*	*ND*	*ND*	*ND*
5:3 FTCA	*ND*	*ND*	*ND*	*ND*
3:3 FTCA	*ND*	*ND*	*ND*	*ND*
ADONA	*ND*	*ND*	*ND*	*ND*
9Cl-PF3ONS	*ND*	*ND*	*ND*	*ND*
HFPO-DA	*ND*	*ND*	*ND*	*ND*
NEtFOSA	*ND*	*ND*	*ND*	*ND*
NEtFOSE	*ND*	*ND*	*ND*	*ND*
NEtFOSAA	*ND*	*ND*	*ND*	*ND*
NMeFOSA	*ND*	*ND*	*ND*	*ND*
NMeFOSE	*ND*	*ND*	*ND*	*ND*
NMeFOSAA	*ND*	*ND*	*ND*	*ND*
NFDHA	*ND*	*ND*	*ND*	*ND*
PFEESA	*ND*	*ND*	*ND*	*ND*
PFMPA	*ND*	*ND*	*ND*	*ND*
PFMBA	*ND*	*ND*	*ND*	*ND*
PFBS	*ND*	*ND*	*ND*	*ND*
PFBA	*ND*	*ND*	*ND*	*ND*
PFDS	*ND*	*ND*	*ND*	*ND*
PFDA	*ND*	*ND*	*ND*	*ND*
PFDoS	*ND*	*ND*	*ND*	*ND*
PFDoA	*ND*	*ND*	*ND*	*ND*
PFHpS	*ND*	*ND*	*ND*	*ND*
PFHpA	*ND*	*ND*	*ND*	*ND*
PFHxS	*ND*	*ND*	*ND*	*ND*
PFHxA	*ND*	*ND*	*ND*	*ND*
PFNS	*ND*	*ND*	*ND*	*ND*
PFNA	*ND*	*ND*	*ND*	*ND*
PFOSA	*ND*	*ND*	*ND*	*ND*

Analyte	Field Blank (Industrial / Residential) 09/18/2024	Field Blank (Industrial / Residential) 09/19/2024	Field Blank (Budd Inlet / Martin Way) 09/17/2024	Field Blank (Budd Inlet / Martin Way) 09/18/2024
PFOS	*ND*	*ND*	*ND*	*ND*
PFOA	*ND*	*ND*	*ND*	*ND*
PFPeS	*ND*	*ND*	*ND*	*ND*
PFPeA	*ND*	*ND*	*ND*	*ND*
PFTeDA	*ND*	*ND*	*ND*	*ND*
PFTrDA	*ND*	*ND*	*ND*	*ND*
PFUnA	*ND*	*ND*	*ND*	*ND*

Table D15. PFAS Data (ng/L) for Field Control Samples, Quarter 4 (2024)

Analyte	Field Blank (Industrial / Residential)	Field Blank (Budd Inlet / Martin Way)	B-5: Final Effluent	B-5: Final Effluent (duplicate)	RPD (%) of Duplicate Samples	I-5: Beverage Manufacturer	I-5: Beverage Manufacturer (duplicate)	RPD (%) of Duplicate Samples
11Cl-PF3OUdS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
8:2 FTS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
4:2 FTS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
6:2 FTS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
7:3 FTCA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
5:3 FTCA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
3:3 FTCA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
ADONA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
9Cl-PF3ONS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
HFPO-DA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
NEtFOSA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
NEtFOSE	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
NEtFOSAA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
NMeFOSA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
NMeFOSE	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
NMeFOSAA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
NFDHA	*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*	---
PFBS	*ND*	*ND*	**2.2**	**2.3**	4.4	0.84 (*J*)	0.67 (*J*)	23

Analyte	Field Blank (Industrial / Residential)	Field Blank (Budd Inlet / Martin Way)	B-5: Final Effluent	B-5: Final Effluent (duplicate)	RPD (%) of Duplicate Samples	I-5: Beverage Manufacturer	I-5: Beverage Manufacturer (duplicate)	RPD (%) of Duplicate Samples
PFBA	*ND*	*ND*	2.2 (*J*)	2.4 (*J*)	8.7	*ND*	*ND*	---
PFDS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFDA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFDoS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFDoA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFHpS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFHpA	*ND*	*ND*	1.2 (*J*)	1.2 (*J*)	0.0	*ND*	*ND*	---
PFHxS	*ND*	*ND*	1.1 (*J*)	1.4 (*J*)	24	*ND*	*ND*	---
PFHxA	*ND*	*ND*	**9.9**	**11**	11	*ND*	*ND*	---
PFNS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFNA	*ND*	*ND*	0.91 (*J*, *EMPC*)	0.94 (*J*)	3.2	*ND*	*ND*	---
PFOSA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFOS	*ND*	*ND*	1.9 (*J*)	2.0 (*J*)	5.1	*ND*	*ND*	---
PFOA	*ND*	*ND*	**6.6**	**5.7**	15	*ND*	*ND*	---
PFPeS	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFPeA	*ND*	*ND*	**11**	**12**	8.7	*ND*	*ND*	---
PFTeDA	*ND*	*ND*	*ND*	*ND*	---	0.54 (*J*)	*ND*	---
PFTrDA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---
PFUnA	*ND*	*ND*	*ND*	*ND*	---	*ND*	*ND*	---

(*J*) indicates that values are between MDL and MRL.

(*EMPC*) estimated maximum possible concentration; analyte is detected, and all the identification criteria are met, except for the mass-ion abundance ratio.

Appendix E. Eurofins Laboratory Reports

Provided as a separate file due to size.

Note: Some Chain of Custody (COC) forms have been removed to protect the anonymity of industrial users.

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