Per- and Polyfluoroalkyl Substances Fish Tissue and Surface Water Sampling Project

2023 Sampling Report

APRIL 2026
WQDMASTECH-03

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ACRONYMS

Acronym	Definition
5:3 FTCA	5:3 fluorotelomer carboxylic acid
µg/kg	Microgram per kilogram
C-F	Carbon-fluorine bond
DEQ	Montana Department of Environmental Quality
EPA	United States Environmental Protection Agency
FWP	Montana Fish Wildlife and Parks
GIS	Geographic Information System
IFCAG	Interagency Fish Consumption Advisory Group
ITRC	Interstate Technology & Regulatory Council
LRL	Lower Reporting Limit
MAS	Sampling and Assessment Section
MDL	Method Detection Limit
NFDHA	Nonafluor-3,6-dioxapheptanoic
ng/L	Nanograms per liter
PFAAs	Perfluoroalkyl acids
PFAS	Pre- and Polyfluoroalkyl Substances
PFBA	Perfluorobutanoic acid
PFHxA	Perfluorohexanoic acid
PFNA	Perfluorononanoic acid
PFNS	perfluorononanesulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid

PFPeA	Perfluorovaleric acid
PWS	Public Water Supply
QAPP	Quality Assurance Project Plan
RAGs	Remedial Action Guidelines
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TSCA	Toxic Substances Control Act
UCMR	Unregulated Contaminant Sampling Regulation
WQPB	Water Quality Planning Bureau
ww	Weight Wet
WWTP	Wastewater Treatment Plant

Suggested Citation:

DEQ Monitoring and Assessment Section. 2026. Pre- and Polyfluoroalkyl Substances Fish Tissue and Surface Water Sampling Project – 2023 Sampling Report. WQDMASTECH-03. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

EXECUTIVE SUMMARY

The state of Montana recognized per- and polyfluoroalkyl substances (PFAS) as emerging contaminants of concern and implemented the Montana PFAS Action Plan in June of 2020. In the summer of 2023, the Montana Department of Environmental Quality (DEQ) partnered with Montana Fish, Wildlife and Parks (FWP) for PFAS fish tissue and surface water sampling in six of the seven FWP regions. The goal of the project was to screen for PFAS contamination in consumable size fish in waterbodies throughout Montana.

PFAS refer to a group of thousands of man-made chemicals that have been produced since the 1940s. They have been widely used in industrial and consumer products because of their unique physical and chemical properties. Due to these properties, PFAS are highly persistent, mobile, and bioaccumulative in the environment. Perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and other PFAS can enter surface water through runoff, industrial and municipal wastewater treatment plants, landfill wastewater, contaminated biosolids, and deposition from the atmosphere.

Only a few of the thousand PFAS have been studied for their potential to affect human health. Studies that have occurred suggest exposure to certain PFAS may lead to health problems including changes in the liver, cardiovascular effects, reproductive effects in women, immunological and developmental effects in infants and children, and an increased risk of kidney and testicular cancer.

Sampling Methodology

The project targeted rivers, streams, lakes, and reservoirs with previous PFAS detections in water that support a sport fishery or are deemed as important regional fisheries by FWP and are at-risk of PFAS contamination. Nine waterbodies were selected and a total of 14 sites were monitored. Fish tissue and surface water sampling occurred at each site once between April and October. Surface water and composite fish (skin-on) fillet samples were collected on the same date. Targeted fish species and size classes were determined per waterbody to represent commonly consumed fish by the local population. Fisheries staff selected alternative species and size classes based on what was caught during sampling efforts. Per composite, each sampling effort attempted to capture five fish for each species and size class. If five fish were not possible per composite, any number of fish up to five for the species and size class were analyzed. Samples were analyzed for 40 PFAS by Pace Analytical (1700 Elm St SE, Minneapolis, MN 55414) according to EPA Method 1633.

Project Findings

Detection rates of PFAS from this project are not likely representative of all waters in Montana because of the targeted sampling design. Within each waterbody a limited number of fish species and size classes were collected, which did not allow the evaluation of trends across species or fish size. Although this project provides an initial screening approach to understand PFAS conditions in fish, more sampling could occur to better understand PFAS contamination in fish tissue across Montana.

Across the 14 sites sampled, FWP collected 50 fish tissue composite samples for analysis. All composite fish tissue samples for Flathead Lake and Flathead River near Old Steel Bridge had no detections of PFAS.

and At least one PFAS analyte was detected in about 78% of the composite fish fillet samples (39 of 50). Of the 40 PFAS analyzed, only four PFAS were detected in fish tissue across the state including PFOS, perfluorononanic acid (PFNA), 5:3 fluorotelomer carboxylic acid (5:3 FTCA), and perfuoro-3,6-dioxaheptanonic (NFDHA). PFNA was detected in Channel Catfish 18-22" in Fort Peck Reservoir. Two composite samples in the East Gallatin River detected 5:3 FTCA (Rainbow Trout 10-14" and Brown Trout 14-18"). NFDHA was detected in Blue Sucker 26-30" in the Missouri River near Judith Landing and in Mountain Whitefish 14-18" in the Clark Fork River near Missoula. The most detected PFAS in fish tissue was PFOS, which was present in 39 of the 50 composite samples (78% detection rate). The highest concentration of PFOS was found in Walleye 22-26" in Fort Peck Reservoir (5.4 µg/kg wet weight (ww)). PFOS concentrations within Montana ranged from 0.11 to 5.4 µg/kg ww.

In 2023, surface water PFAS detections occurred at a lower detection rate compared to 2021 surface water sampling results. At least one PFAS analyte was detected in two out of 14 waterbodies in 2023 (East Gallatin and Prickly Pear Creek) and three PFAS were detected between the two waterbodies (PFPeA, PFHxA, and PFBA). The low detection rate may be due to sampling multiple sites during spring runoff (8 of 13 sites) leading to dilution of PFAS concentrations or due to the rapid bioaccumulation rate of PFAS in aquatic systems. Other states have detected PFAS in fish tissue even when concentrations in surface water were low or not detected. PFAS accumulates in fish tissue over time as they are repeatedly exposed. Waterbodies with confirmed or potential PFAS sources in their watershed may show higher PFAS levels in fish tissue than in the surrounding surface water.

Interagency Fish Consumption Advisory Group Coordination

Due to detections of PFAS in fish tissue and the risk PFAS may pose to human health, DEQ has submitted fish tissue results to the Interagency Fish Consumption Advisory Group (IFCAG) for review. IFCAG is made up of representatives from Fish Wildlife and Parks (FWP), Department of Public Health and Human Services (DPHHS), and Department of Environmental Quality (DEQ) who evaluate available fish tissue data from across the state to determine if concentrations of environmental contaminants pose a risk to human health. IFCAG has evaluated the PFOS results from this project and determined fish consumption health-based meal limits for certain waterbodies. Fish consumption advisories have been issued and the Montana Sport Fish Consumption Guidelines are updated to incorporate these advisories. The Montana Sport Fish Consumption Guidelines are not regulatory standards but using them helps citizens of Montana ensure the fish they catch are safe to eat. IFCAG will evaluate resources for future sampling.

1.0 INTRODUCTION AND OBJECTIVE

The state of Montana recognized per- and polyfluoroalkyl substances (PFAS) as emerging contaminants of concern and implemented the Montana PFAS Action Plan in June of 2020. In the summer of 2023, the Montana Department of Environmental Quality (DEQ) partnered with Montana Fish, Wildlife and Parks (FWP) for PFAS fish tissue and surface water sampling in six of the seven FWP regions. The goal of the project was to screen for PFAS contamination in edible size fish in waterbodies throughout Montana (Ebert 2023).

PFAS are a group of thousands of man-made chemicals that have been produced since the 1940s. PFAS have been widely used in industrial and consumer products due to their unique physical and chemical properties that include resistance to high and low temperatures, chemical stability, and water-, stain-, and grease-resistance (ITRC 2020). According to the Environmental Protection Agency's (EPA's) Toxic Substances Control Act (TSCA), approximately 650 PFAS are currently in commerce (EPA 2021). To date, perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) are the two most commonly used and studied PFAS. Due to the chemical stability of their carbon-fluorine (C-F) bond and their properties, PFAS are highly persistent, mobile, and bioaccumulative in the environment. PFOS, PFOA, and other PFAS can enter the aquatic environment through runoff, industrial and municipal wastewater treatment plants (WWTP), landfill leachate, contaminated biosolids, and deposition from the atmosphere (EPA 2021).

Only a few of the thousands of PFAS have been studied for their potential to affect human health. Research is ongoing and more will be learned over time. Studies that have occurred suggest exposure to certain PFAS may lead to health problems including changes in the liver, cardiovascular effects, reproductive effects in women, immunological and developmental effects in infants and children, and an increased risk of kidney and testicular cancer.

2.0 METHODS

2.1 Site Selection Process

This multi-agency project was designed to look at the prevalence of PFAS in consumable size fish within six FWP Regions. The project targeted rivers, streams, lakes, and reservoirs with previous PFAS detections that support a sport fishery or are deemed as important regional fisheries by FWP and are at-risk of PFAS contamination. A total of 14 sites were selected to be monitored in 2023. Nelson Reservoir sampling occurred in 2024 due to adverse weather conditions in 2023. More information on how sites were determined can be found in Section 4.1 of the PFAS Quality Assurance Project Plan (QAPP) (Ebert 2023) and the Sampling and Analysis Plan (SAP) (Ebert 2023). **Figure 1** shows DEQ's sample locations throughout the state. **Appendix A** provides a detailed list of sampling locations.

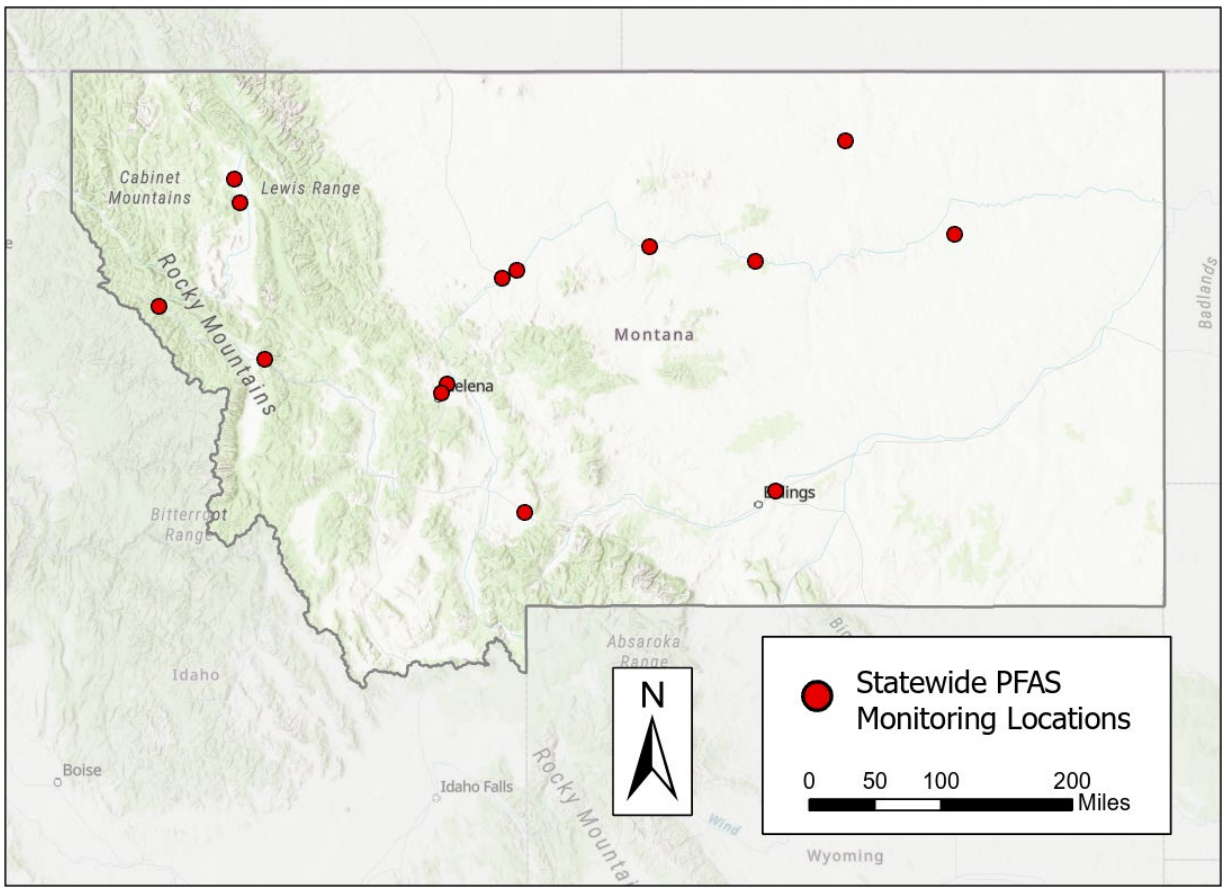

Figure 1. PFAS Fish Tissue and Surface Water Sampling Locations in Montana

2.2 Sampling and Analytical Methods

In 2023 or 2024, fish tissue and surface water sampling occurred at each site once between April and October. Surface water and fish tissue samples were collected on the same date and at the same location (**Appendix A**). Targeted fish species and size classes were determined per waterbody to represent commonly consumed fish by the local population (**Table 1**). **Table 1** provides information on fish species and size classes targeted, compared to what was collected. Fisheries staff selected alternative species and size classes based on what was caught during sampling efforts. Composite fish fillets and surface water samples were collected at each site for PFAS analysis. Per composite, each sampling effort attempted to capture five fish for each selected species and size class. If five fish were not possible per composite, any number of fish up to five for the selected species and size class were analyzed.

Table 1. Comparison of the species and size classes targeted to what was collected.

Site	Priority Species	Preferred Size Class	Species Collected	Size Class Collected
Missouri River upstream of Black Eagle Dam	Yellow Perch	10-14”	Not Captured	
	Not Prioritized		Northern Pike	14-18"
	Rainbow Trout	10-14”	Rainbow Trout	14-18"
	Brown Trout	10-14”	Not Captured	
Missouri River, Cochrane Reservoir Section	Walleye	10-14" and 14-18"	Walleye	14-18" and 18-22"
	Rainbow Trout	10-14" and 14-18"	Not Captured	
	Not Prioritized		Northern Pike	30"+
Lake Helena	Walleye	10-14" and 14-18"	Walleye	10-14" and 14-18"
	Yellow Perch	14-18"	Yellow Perch	10-14"
	Rainbow Trout	14-18"	Rainbow Trout	18-22"
	Not Prioritized		Brown Trout	14-18" and 18-22"
Prickly Pear Creek	Rainbow Trout	10-14"	Not Captured	
	Brown Trout	10-14" and 14-18"	Brown Trout	10-14"
East Gallatin River	Rainbow Trout	10-14" and 14-18"	Rainbow Trout	10-14" and 14-18"
	Brown Trout	10-14" and 14-18"	Brown Trout	10-14" and 14-18"
Yellowstone River	Channel Catfish	18-22" and 22-26"	Channel Catfish	18-22" and 22-26"
	Smallmouth Bass	10-14"	Smallmouth Bass	10-14"
	Mountain Whitefish	10-14"	Mountain Whitefish	10-14" and 14-18"
	Burbot	14-18" and 18-22"	Not Captured	
Missouri River near Judith Landing	Blue Sucker	Was Not Determined	Blue Sucker	26-30"
Missouri River near Fred Robinson Bridge	Walleye	14-18” and 18-22”	Walleye	14-18"
	Channel Catfish	18-22" and 22-26"	Channel Catfish	18-22" and 22-26"
Fort Peck Reservoir	Smallmouth Bass	10-14” or 14-18”	Not Captured	
	Not Prioritized		Channel Catfish	18-22"
	Walleye	14-18” and 18-22”	Walleye	22-26" and 26-30"
	Northern Pike	22-26” and 26-30”	Northern Pike	26-30"
Nelson Reservoir	Walleye	14-18” and 18-22”	Walleye	14-18” and 18-22”
	Northern Pike	18-22" and 22-26"	Northern Pike	22-26" and 26-30”
	Yellow Perch	6-10"	Yellow Perch	6-10"
	Rainbow Trout	14-18" and 18-22"	Rainbow Trout	10-14" and 14-18"

Site	Priority Species	Preferred Size Class	Species Collected	Size Class Collected
Clark Fork River near Missoula	Brown Trout	10-14" and 14-18"	Not Captured	
	Not Prioritized		Mountain Whitefish	10-14" and 14-18"
Clark Fork River upstream of St. Regis	Rainbow Trout	10-14" and 14-18"	Rainbow Trout	10-14" and 14-18"
	Westslope Cutthroat	10-14"	Not Captured	
	Not Prioritized		Mountain Whitefish	10-14" and 14-18"
	Brown Trout	10-14" or 14-18"	Not Captured	
Flathead Lake	Lake Trout	18-22" and 22-26"	Lake Trout	18-22" and 22-26"
	Lake Whitefish	14-18" and 18-22"	Lake Whitefish	14-18" and 18-22"
Flathead River	Westslope Cutthroat	6-10" and 10-14"	Not Captured	
	Not Prioritized		Rainbow Trout	10-14" and 14-18"
	Mountain Whitefish	6-10" and 10-14"	Mountain Whitefish	10-14" and 14-18"

Sampling procedures followed are outlined in DEQ's Water Quality Planning Bureau (WQPB) guidance provided in the PFAS Standard Operating Procedures (SOP) (Makarowski & Skibicki 2021) and the Per- and Polyfluoroalkyl Substances Fish Tissue and Surface Water Sampling SAP (Ebert 2023).

Samples were analyzed for 40 PFAS by Pace Analytical (1700 Elm St SE, Minneapolis, MN 55414) according to EPA Method 1633. The analyte list includes common PFAS that have been detected in the environment, which are mostly perfluoroalkyl acids (PFAAs). A full analyte list for the project and laboratory detection limits are provided in **Appendix B**. The analyte list does not cover all the potential PFAS that may be found in the environment.

3.0 RESULTS

The following sections provide an overview of results for each site monitored and specific reasons for sampling the location. Fish tissue results are reported in µg/kg weight wet (ww). PFAS fish tissue results provided in wet weight concentration are expressed as the weight of the chemical divided by the total weight of filleted fish tissue, including any water present. For more succinct reporting, non-detect results for individual PFAS are not provided in tables below. If all 40 PFAS analyzed were reported as non-detect in a composite sample, they are reported in the result tables as "Not Detected". Results detected between the method detection limit (MDL) and the lower reporting limit (LRL) are provided in the result tables and indicated with a "J" flag. All results are available via the National Water Quality Portal or direct request to DEQ.

3.1 Missouri River Results

Multiple sections of the Missouri River were sampled in 2023 according to DEQ and FWP priorities. Black Eagle Reservoir and Cochrane Reservoir sections were prioritized by DEQ due to previous PFAS detections in 2021. Around Judith Landing, FWP conducted a population assessment on Blue Suckers where fish were already being euthanized for other studies. FWP requested PFAS tissue analysis to be completed on a rare long-lived native fish species. Lastly, the Fred Robinson Bridge section was selected by FWP to assess additional species in the Missouri River before entering Fort Peck Reservoir. The following sections provide results for each sampling reach monitored along the Missouri River.

3.1.1 Black Eagle Section

In November 2023, FWP completed gill, hoop, and trap netting over three miles between White Bear Island and Central Ave Bridge in Great Falls, MT (**Figure 2**). **Table 1** provides a list of the composite samples sent to the lab for analysis. Of the 40 PFAS analyzed in the two composite samples, only PFOS was detected in Northern Pike 14-18" (**Table 2**). No PFAS were detected in surface water.

Figure 2. Black Eagle Section Sampling Reach

3.1.2 Cochrane Reservoir Section

In November 2023, FWP completed gill netting between Rainbow Dam and Cochrane Dam. **Table 1** provides a list of the composite samples sent to the lab for analysis. PFOS was detected in each of the

composite samples collected: Northern Pike 30”+, Walleye 14-18”, and Walleye 18-22” (**Table 2**). No PFAS were detected in surface water.

3.1.3 Judith Landing Section

In May 2023, FWP completed electrofishing along a half mile stretch upstream of the Judith Landing Fishing Access Site (**Figure 3**). **Table 1** provides a list of the composite samples sent to the lab for analysis. Of the 40 PFAS analyzed in the composite sample, nonafluor-3,6-dioxaheptanoic acid (NFDHA) and PFOS were detected in Blue Sucker 26-30” (**Table 2**). No PFAS were detected in surface water.

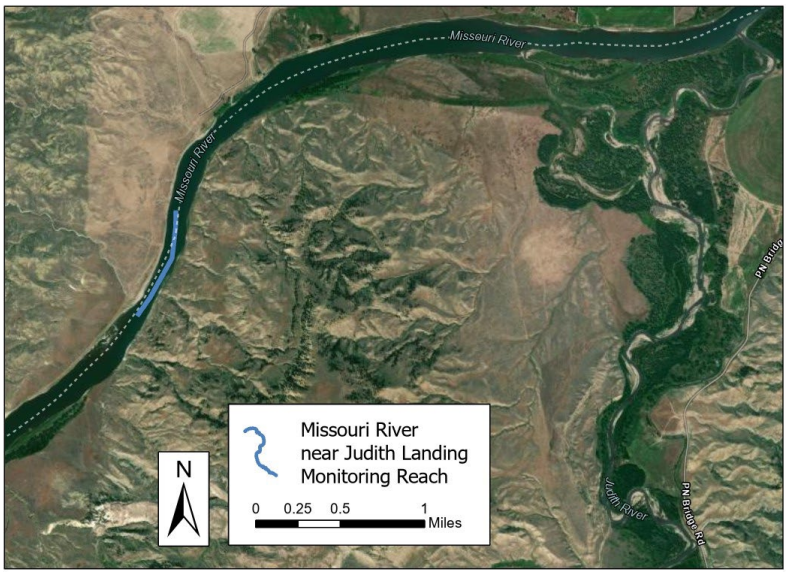

Figure 3. Judith Landing Section Sampling Reach

3.1.4 Fred Robinson Bridge Section

In April 2023, FWP collected fish using set lines along a 25 mile stretch downstream of the James Kipp Recreation Area (**Figure 4**). **Table 1** provides a list of the composite samples sent to the lab for analysis. PFOS was detected in the three composite samples collected: Walleye 14-18” and Channel Catfish 18-22” and 22-26” (**Table 2**). No PFAS were detected in surface water.

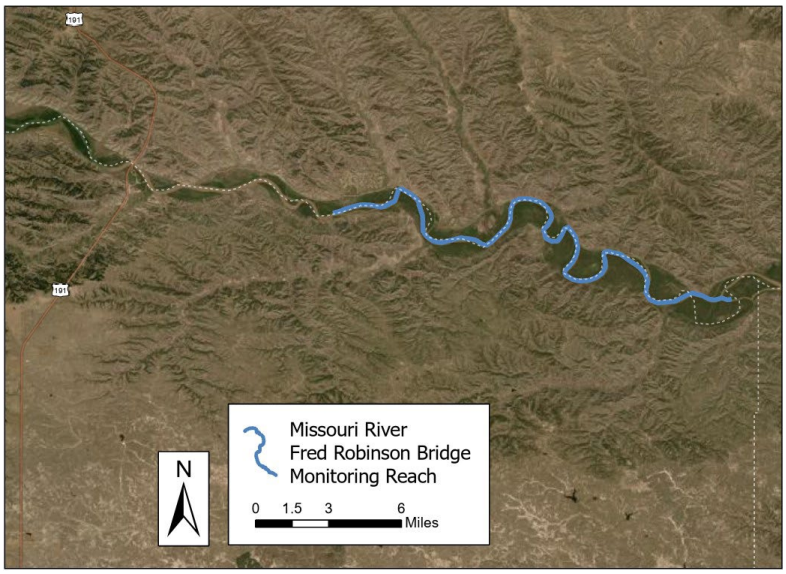

Figure 4. Fred Robinson Bridge Section Sampling Reach

Table 2. Missouri River PFAS Fish Tissue Results.

Site	Species	Size Class	# of individual fish per composite	PFAS Analyte	Concentration (µg/kg ww)
Missouri River upstream of Black Eagle Reservoir	Northern Pike[1]	14-18"	4	Perfluorooctanesulfonic acid (PFOS)	0.57
	Rainbow Trout	14-18”	2	40 PFAS Analyzed	Not Detected
Missouri River, Cochrane Reservoir Section	Northern Pike[1]	30"+	1	Perfluorooctanesulfonic acid (PFOS)	4
	Walleye[1]	14-18"	3	Perfluorooctanesulfonic acid (PFOS)	1.4
	Walleye[1]	18-22"	3	Perfluorooctanesulfonic acid (PFOS)	2.9
Missouri River near Judith Landing	Blue Sucker[1]	26-30"	5	Nonafluor-3,6-dioxaheptanoic acid (NFDHA)	1.68
				Perfluorooctanesulfonic acid (PFOS)	1.21
Missouri River near Fred Robinson Bridge	Channel Catfish[1]	18-22"	5	Perfluorooctanesulfonic acid (PFOS)	0.23
	Channel Catfish[1]	22-26"	5	Perfluorooctanesulfonic acid (PFOS)	0.19 J
	Walleye[1]	14-18"	4	Perfluorooctanesulfonic acid (PFOS)	0.51

[1] – All other PFAS analytes not listed in the table were not detected in the composite sample.

J – Result between the MDL and LRL.

3.2 Yellowstone River Results

The Yellowstone River was monitored downstream of the Huntley Diversion Dam due to previous detection of PFAS in surface water downstream of Billings in 2021 (**Figure 5**). In June 2023, FWP completed electrofishing along four miles of the river. PFOS was detected in the five composite samples collected: Channel Catfish 18-22" and 22-16", Mountain Whitefish 10-14" and 14-18", and Smallmouth Bass 10-14" (**Table 3**). No PFAS were detected in surface water.

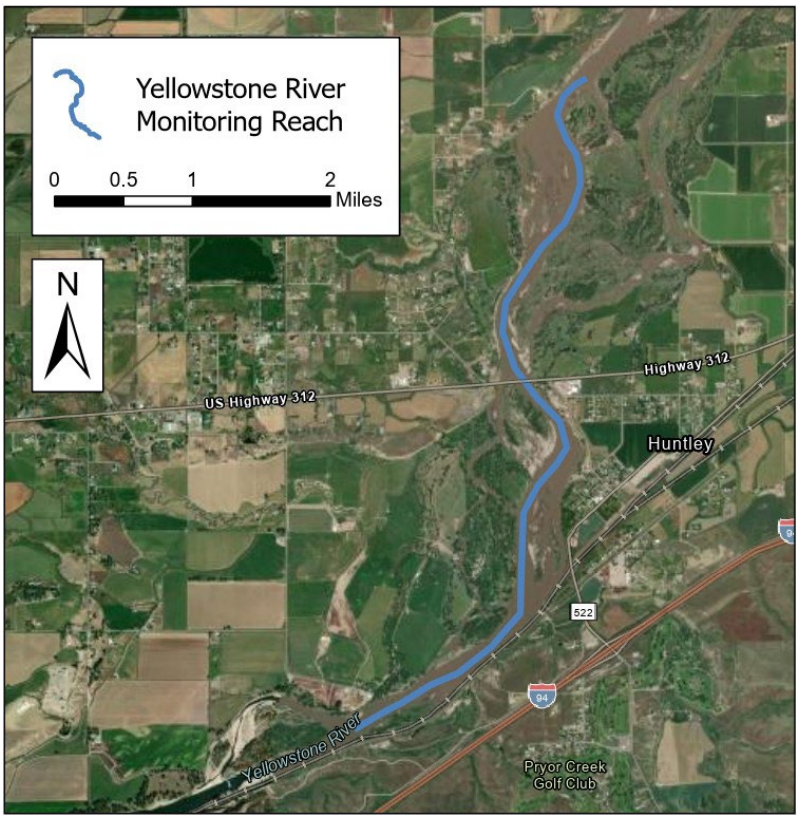

Figure 5. Vermillion Section Sampling Reach

Table 3. Yellowstone River PFAS Fish Tissue Results

Species	Size Class	# of individual fish per composite	PFAS Analyte	Concentration (µg/kg ww)
Channel Catfish[1]	18-22"	5	Perfluorooctanesulfonic acid (PFOS)	0.40 J
Channel Catfish[1]	22-26"	5	Perfluorooctanesulfonic acid (PFOS)	0.58
Mountain Whitefish[1]	10-14"	5	Perfluorooctanesulfonic acid (PFOS)	3.26
Mountain Whitefish[1]	14-18"	5	Perfluorooctanesulfonic acid (PFOS)	4.48
Smallmouth Bass[1]	10-14"	5	Perfluorooctanesulfonic acid (PFOS)	4.61

[1] – All other PFAS analytes not listed in the table were not detected in the composite sample.

J – Result between the MDL and LRL.

3.3 Clark Fork River Results

The Clark Fork River was monitored at two locations near Missoula and St. Regis. Sampling sites were selected due to the river being a sport fishery and to expand sampling into FWP Region 2. Rainbow Trout and Mountain Whitefish were collected at both locations (**Table 1**).

3.3.1 Clark Fork River Near Missoula Section

In June 2023, FWP completed electrofishing along a mile and half stretch in the Council Grove Section east of Missoula (**Figure 6**). PFOS was detected in all four of the composite samples collected: Rainbow Trout 10-14" and 14-18" and Mountain Whitefish 10-14" and 14-18" (**Table 4**). Nonafluor-3,6-dioxaheptanoic acid (NFDHA) was detected in one of the composite samples collected (Mountain Whitefish 14-18"). No PFAS were detected in surface water.

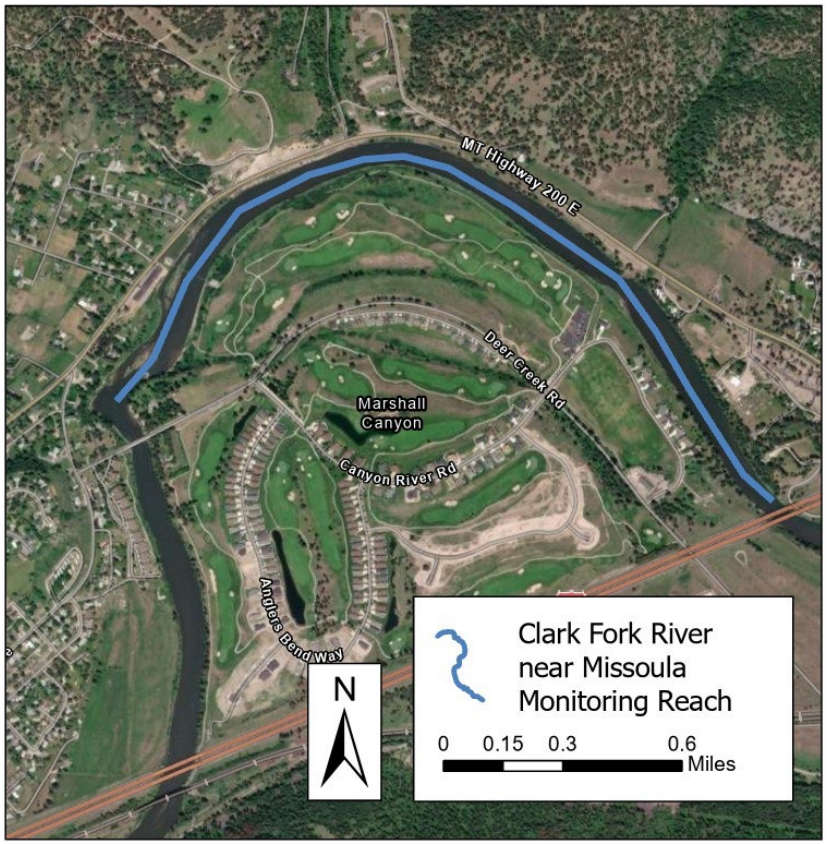

Figure 6. Council Grove Section Sampling Reach

3.3.2 Clark Fork River St. Regis Section

In June 2023, FWP completed electrofishing over a mile stretch downstream of the Hwy 90 bridge near St. Regis (**Figure 7**). PFOS was detected in all four composite samples collected: Rainbow Trout 10-14" and 14-18" and Mountain Whitefish 10-14" and 14-18" (**Table 4**). No PFAS were detected in surface water.

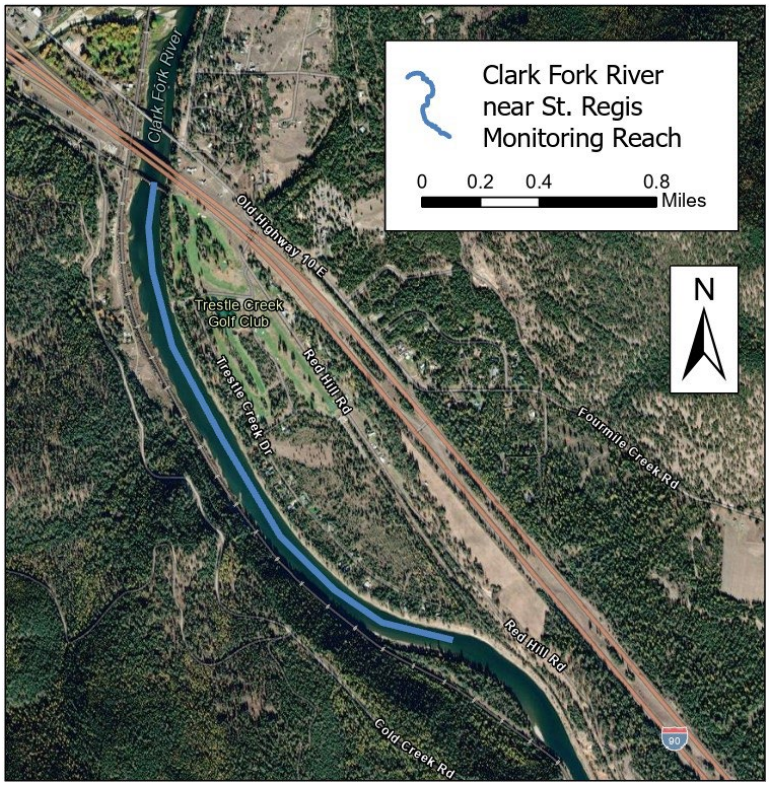

Figure 7. St. Regis Sampling Reach

Table 4. Clark Fork River PFAS Fish Tissue Results

Site	Species	Size Class	# of individual fish per composite	PFAS Analyte	Concentration (µg/kg ww)
Clark Fork River near Missoula	Mountain Whitefish[1]	10-14”	5	Perfluorooctanesulfonic acid (PFOS)	0.19
	Mountain Whitefish[1]	14-18”	5	Perfluorooctanesulfonic acid (PFOS)	0.23
				Nonafluor-3,6-dioxaheptanoic acid (NFDHA)	0.49
	Rainbow Trout[1]	10-14”	5	Perfluorooctanesulfonic acid (PFOS)	0.18
	Rainbow Trout[1]	14-18”	5	Perfluorooctanesulfonic acid (PFOS)	0.12
Clark Fork River near St. Regis	Mountain Whitefish[1]	10-14”	5	Perfluorooctanesulfonic acid (PFOS)	0.23
	Mountain Whitefish[1]	14-18”	5	Perfluorooctanesulfonic acid (PFOS)	0.27
	Rainbow Trout[1]	10-14”	5	Perfluorooctanesulfonic acid (PFOS)	0.17 J

Site	Species	Size Class	# of individual fish per composite	PFAS Analyte	Concentration (µg/kg ww)
Clark Fork River near St. Regis	Rainbow Trout[1]	14-18”	5	Perfluorooctanesulfonic acid (PFOS)	0.11

[1] – All other PFAS analytes not listed in the table were not detected in the composite sample.
J – Result between the MDL and LRL.

3.4 Flathead River Results

The Flathead River was selected to be sampled by FWP because it is a popular sport fishery and to expand sampling into FWP Region 1. Electrofishing occurred along a six and half mile stretch near Old Steel Bridge in May 2023 (**Figure 8**). No PFAS were detected in fish tissue composite samples or the surface water sample.

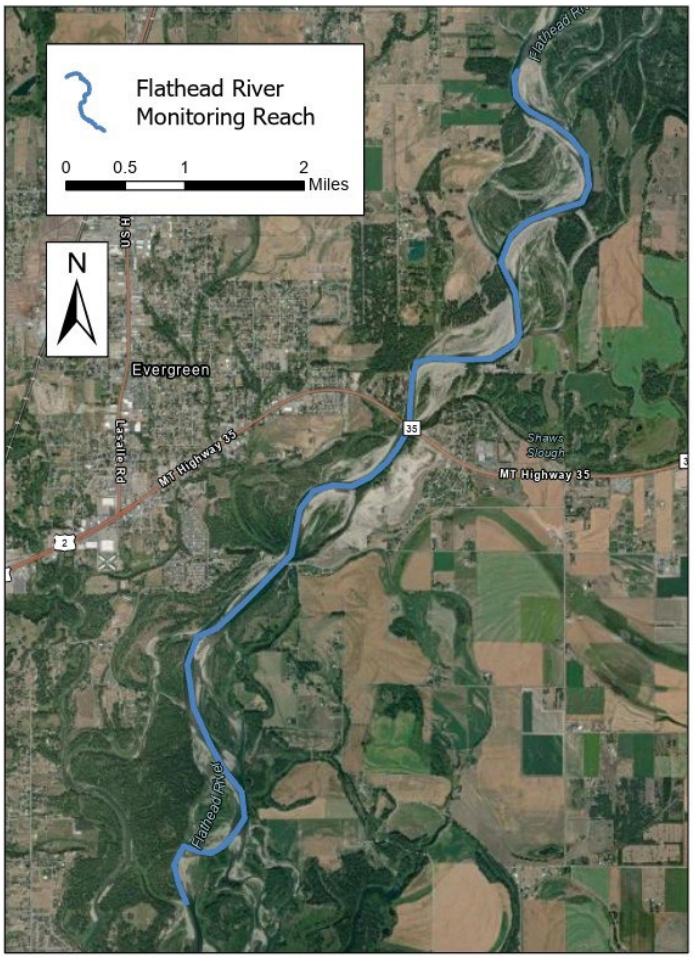

Figure 8. Old Steel Bridge Sampling Reach

Table 5. Flathead River PFAS Fish Tissue Results

Site	Species	Size Class	# of individual fish per composite	PFAS Analyte	Concentration (µg/kg ww)
Flathead River near Old Steel Bridge	Mountain Whitefish	10-14”	5	40 PFAS Analyzed	Not Detected
	Mountain Whitefish	14-18”	5	40 PFAS Analyzed	Not Detected
	Rainbow Trout	10-14”	5	40 PFAS Analyzed	Not Detected
	Rainbow Trout	14-18”	4	40 PFAS Analyzed	Not Detected

3.5 East Gallatin River Results

The East Gallatin River was monitored downstream of Springhill Road due to previous detections of PFAS in surface water in 2021 (**Figure 9**). In September 2023, FWP completed electrofishing along a half mile stretch of the river. PFOS and 5:3 fluorotelomer carboxylic acid (5:3 FTCA) were detected in Rainbow and Brown Trout samples (**Table 5**). Two PFAS were detected in surface water: perfluorohexanoic acid (PFHxA) and perfluorovaleric acid (PFPeA) (**Table 6**). The Rainbow Trout 14-18” duplicate sample on the East Gallatin River did not meet 25% relative percent difference and the detection for 5:3 FTCA in Rainbow Trout 14-18” was rejected (**Table 6**).

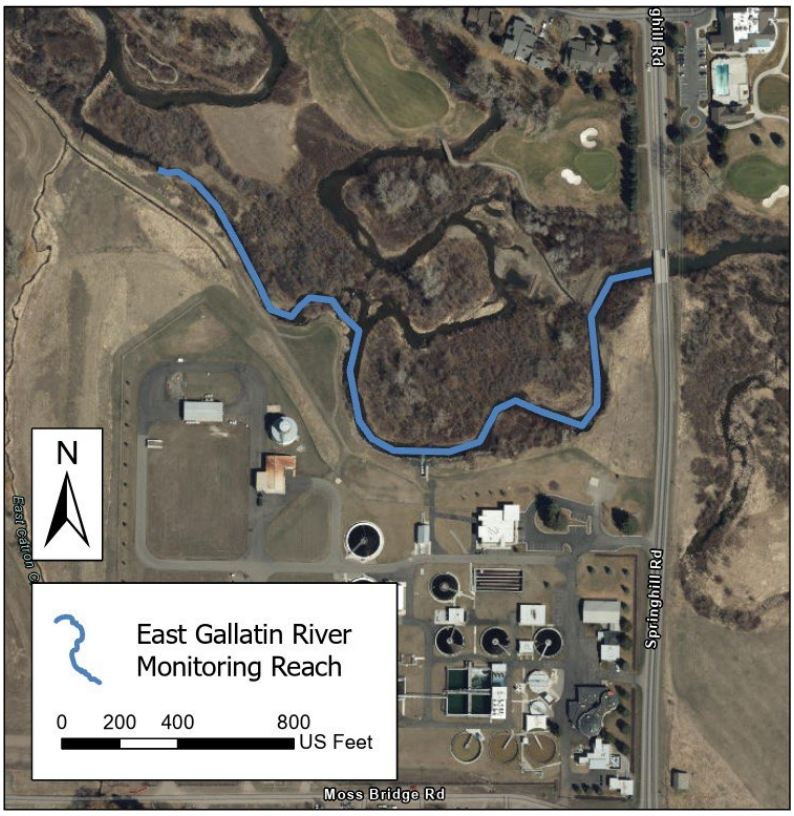

Figure 9. East Gallatin River Sampling Reach

Table 6. East Gallatin Fish Tissue PFAS Results

Species	Size Class	# of individual fish per composite	PFAS Analyte	PFAS Concentration (µg/kg ww)
Rainbow Trout[1]	14-18”	3	5:3 fluorotelomer carboxylic acid (5:3 FTCA)	Data Rejected*
Rainbow Trout[1]	10-14”	4	Perfluorooctanesulfonic acid (PFOS)	0.48 J
			5:3 fluorotelomer carboxylic acid (5:3 FTCA)	18.1
Brown Trout[1]	14-18”	3	Perfluorooctanesulfonic acid (PFOS)	1.0
			5:3 fluorotelomer carboxylic acid (5:3 FTCA)	14.5
Brown Trout[1]	10-14”	4	Perfluorooctanesulfonic acid (PFOS)	1.3

[1] – All other PFAS analytes not listed in the table were not detected in the composite sample.

* Routine and duplicated failed the relative difference calculation (**Section 4.0**).

J – Result between the MDL and LRL.

Table 7. East Gallatin River Surface Water PFAS Detection Results

PFAS Parameter	PFAS Concentration (ng/L)
Perfluorohexanoic acid (PFHxA)	2.5
Perfluorovaleric acid (PFPeA)	1.7 J

J – Result between the MDL and LRL.

3.6 Prickly Pear Creek Results

Prickly Pear Creek was monitored near the Prickly Pear Fishing Access Site due to detection of PFAS in surface water in 2021 (**Figure 10**). In September 2023, FWP completed electrofishing for a half mile reach of the creek. PFOS was detected in Brown Trout 10-14” (**Table 8**). One PFAS was detected in surface water Perfluorobutanoic (PFBA) (**Table 9**).

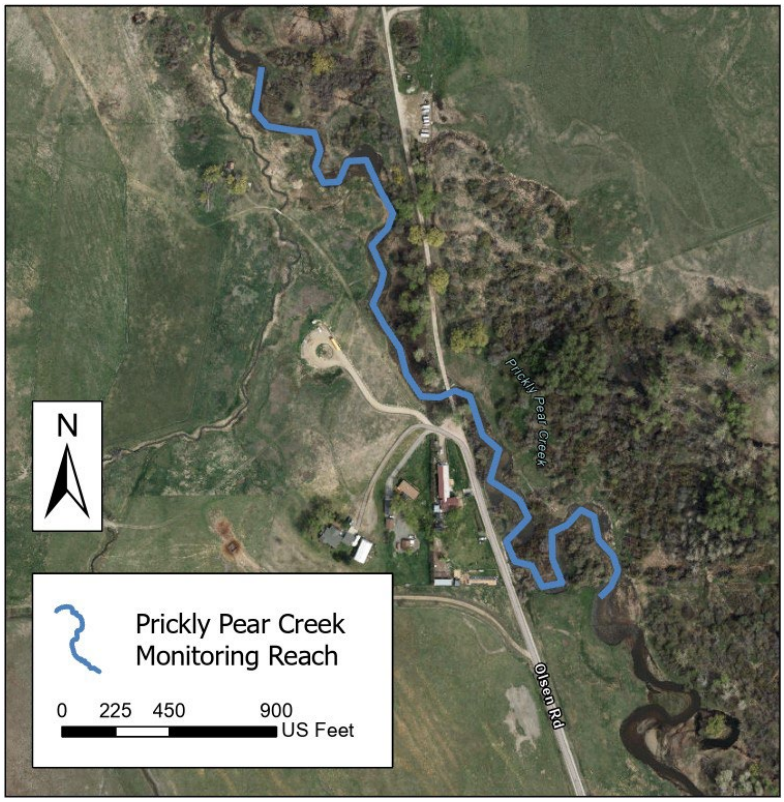

Figure 10. Prickly Pear Creek Sampling Reach

Table 8. Prickly Pear Creek Fish Tissue PFAS Results

Species	Size Class	# of individual fish per composite	PFAS Analyte	PFAS Concentration (µg/kg ww)
Brown Trout[1]	10-14”	5	Perfluorooctanesulfonic acid (PFOS)	1.5

[1] – All other PFAS analytes not listed in the table were not detected in the composite sample.

Table 9. Prickly Pear Creek Surface Water PFAS Detection Results

PFAS Parameter	PFAS Concentration (ng/L)
Perfluorobutanoic (PFBA)	9.1

3.7 Fort Peck Reservoir Results

Fort Peck Reservoir was selected to be sampled by FWP because it is a popular sport fishery and to expand sampling to FWP Region 6. In July 2023, FWP completed gill netting in the Lower Big Dry Arm of the reservoir. Two PFAS were detected in fish tissue composite samples, PFOS and perfluorononanoic acid (PFNA) (**Table 10**). No PFAS were detected in surface water.

Table 10. Fort Peck PFAS Fish Tissue Results

Species	Size Class	# of individual fish per composite	PFAS Analyte	PFAS Concentration (µg/kg ww)
Northern Pike[1]	26-30”	5	Perfluorooctanesulfonic acid (PFOS)	3.5
Channel Catfish[1]	18-22”	5	Perfluorooctanesulfonic acid (PFOS)	2.4
			Perfluorononanoic acid (PFNA)	1.2
Walleye[1]	22-26”	5	Perfluorooctanesulfonic acid (PFOS)	5.4
Walleye[1]	26-30”	5	Perfluorooctanesulfonic acid (PFOS)	4.0

[1] – All other PFAS analytes not listed in the table were not detected in the composite sample.

3.8 Flathead Lake Results

Flathead Lake was selected to be sampled by FWP because it is a popular sport and subsistence fishery and to expand sampling to FWP Region 1. Gill netting occurred near Somers in April 2023. No PFAS were detected in the four fish tissue composite samples or the surface water sample (**Table 11**).

Table 11. Flathead Lake PFAS Fish Tissue Results

Site	Species	Size Class	# of individual fish per composite	PFAS Analyte	Concentration (µg/kg ww)
Flathead Lake near Somers	Lake Trout	18-22”	2	40 PFAS Analyzed	Not Detected
	Lake Trout	22-26”	2	40 PFAS Analyzed	Not Detected
	Lake Whitefish	14-18”	5	40 PFAS Analyzed	Not Detected
	Lake Whitefish	18-22”	5	40 PFAS Analyzed	Not Detected

3.9 Lake Helena Results

Lake Helena was monitored due to previous detection of PFAS in surface water in 2021. In May 2023, FWP completed gill netting throughout the reservoir. PFOS was detected in each of the six composite samples collected: Brown Trout 14-18” and 18-22”, Rainbow Trout 18-22”, Walleye 10-14” and 14-18”, and Yellow Perch 10-14” (**Table 12**). No PFAS were detected in surface water.

Table 12. Lake Helena PFAS Fish Tissue Results

Species	Size Class	# of individual fish per composite	PFAS Analyte	PFAS Concentration (µg/kg ww)
Brown Trout[1]	14-18”	4	Perfluorooctanesulfonic acid (PFOS)	0.42
Brown Trout[1]	18-22”	4	Perfluorooctanesulfonic acid (PFOS)	0.33
Rainbow Trout[1]	18-22”	4	Perfluorooctanesulfonic acid (PFOS)	0.36
Walleye[1]	10-14”	5	Perfluorooctanesulfonic acid (PFOS)	1.02
Walleye[1]	14-18”	5	Perfluorooctanesulfonic acid (PFOS)	0.79
Yellow Perch[1]	10-14”	5	Perfluorooctanesulfonic acid (PFOS)	1.11

[1] – All other PFAS analytes not listed in the table were not detected in the composite sample.

3.10 Nelson Reservoir

Nelson Reservoir was selected to be sampled by FWP because it is a popular sport fishery and to expand sampling to FWP Region 6. In September 2024, FWP completed gill netting throughout the reservoir. PFOS was detected in four composite samples collected: Walleye 14-18" and 18-22" and Northern Pike 22-26" and 26-30" (**Table 13**). No PFAS were detected in surface water.

Table 13. Nelson Reservoir PFAS Fish Tissue Results

Species	Size Class	# of individual fish per composite	PFAS Analyte	PFAS Concentration (µg/kg ww)
Walleye[1]	14-18"	5	Perfluorooctanesulfonic acid (PFOS)	0.62
Walleye[1]	18-22"	5	Perfluorooctanesulfonic acid (PFOS)	0.68
Northern Pike[1]	22-26"	5	Perfluorooctanesulfonic acid (PFOS)	0.51
Northern Pike[1]	26-30"	5	Perfluorooctanesulfonic acid (PFOS)	0.52
Yellow Perch	6-10"	5	40 PFAS Analyzed	Not Detected

[1] – All other PFAS analytes not listed in the table were not detected in the composite sample.

4.0 QUALITY ASSURANCE SAMPLE RESULTS

Quality assurance samples are collected to allow data users to assess data quality. This section summarizes the quality assurance samples and results for this project.

The SAP outlined a goal of collecting field duplicates for fish tissue and surface water at a rate of at least 10% of the total number of routine samples collected. Field duplicates are two samples of ambient water or fish tissue collected from a waterbody as close as possible in time and place by the same person (Ebert 2023B). A total of four fish tissue duplicates were collected. Four batches of samples were sent to the lab and three batches included fish tissue duplicates. Duplicate samples collected on the Yellowstone River, Missouri River, and Nelson Reservoir met 25% relative percent difference requirements between the routine and duplicate samples. The Rainbow Trout 14-18" duplicate sample on the East Gallatin River did not meet 25% relative percent difference and the detection for 5:3 FTCA in Rainbow Trout 14-18" was rejected (**Table 6**). Duplicate water samples were collected at four sites. Due to collecting additional samples then outlined in the sampling and analysis plan, duplicates were only collected at an 8% rate. The surface water duplicates collected on Flathead Lake and Nelson Reservoir met 25% relative percent difference requirements. The surface water duplicate collected on Fort Peck Reservoir did not meet the 25% relative percent difference requirements and will be recorded with a J flag in the database. Due to the difference between Fort Peck Reservoir routine and duplicate samples, data was not provided in this report.

For this project, both field blanks and equipment rinsate blanks were collected for quality assurance purposes. Field blanks are samples of analyte-free, laboratory-grade deionized water poured into a sample container in the field using the same method, container, and preservation as routine samples, and shipped to the lab along with other field (i.e., routine and duplicate) samples. The SAP outlined collecting one field blank per batch of samples sent to the laboratory. One field blank was not collected and shipped with the third batch of samples. No PFAS were detected in the three field blanks collected.

When field equipment decontamination procedures are followed for non-dedicated sampling equipment between uses at multiple sites, an equipment rinsate blank was collected after field equipment decontamination is complete. Rinsate blanks were submitted to the laboratory alongside each batch of samples sent to Pace Analytical. Rinsate blanks were analyzed for the sample analytes to ensure that decontamination protocols of fish fillet equipment were cleaned sufficiently between samples to avoid contamination that could stem from the reuse of sampling equipment. A total of 14 equipment rinsate blanks were provided to the laboratory. The rinsate blank collected for Missouri River near Fred Robinson Bridge fish tissue samples detected perfluorononanesulfonic acid (PFNA). PFNA was not detected in the corresponding routine sample and the detection does not indicate contamination of the routine sample. The rinsate blank collected for Nelson Reservoir fish tissue samples detected perfluoropentanonic acid (PFPeA). PFPeA was not detected in the corresponding routine sample, and the detection does not indicate contamination of the routine sample.

The quality assurance data validates the fish tissue and surface water results presented in this report. Effective PFAS sampling can be challenging because a variety of products contain PFAS. Collected quality assurance samples showed a lack of contamination of PFAS in surface water and fish tissue samples.

5.0 PROJECT FINDINGS

The goal of the project was to screen for PFAS contamination in consumable sized fish in waterbodies throughout Montana. This project targeted waterbodies with potential or known sources of PFAS. Additionally, waterbodies suspected of PFAS accumulation in fish tissue and waterbodies with important regional fisheries were included in the study design, such as reservoirs and large rivers. Detection rates of PFAS from this project are not likely representative of all waters in Montana because of the targeted project design. Within each waterbody a limited number of fish species and size classes were collected, which did not allow the evaluation of trends across species or fish size. Although this project provides an initial screening approach to understand PFAS conditions in fish, more sampling could occur to better understand PFAS contamination in fish tissue across Montana.

Across the 14 sites sampled, FWP collected 50 fish tissue composite samples for analysis. At least one PFAS analyte was detected in about 78% of the composite samples analyzed for PFAS (39 of 50). Of the PFAS analyzed in each composite, only four PFAS were detected across the state in fish tissue (PFOS, PFNA, 5:3 FTCA, and NFDHA). PFNA was detected in Channel Catfish 18-22” in Fort Peck Reservoir. Two composite samples in the East Gallatin River detected 5:3 FTCA (Rainbow Trout 10-14” and Brown Trout 14-18”). NFDHA was detected in Blue Sucker 26-30” in the Missouri River near Judith Landing and in Mountain Whitefish 14-18” in the Clark Fork River near Missoula. The most detected PFAS in fish tissue was PFOS, which was present in 39 of the 50 composite samples (78% detection rate) (**Figure 11**). The highest concentration of PFOS was found in Walleye 22-26” in Fort Peck Reservoir (5.4 µg/kg ww). PFOS concentrations with Montana ranged from 0.11 to 5.4 µg/kg ww.

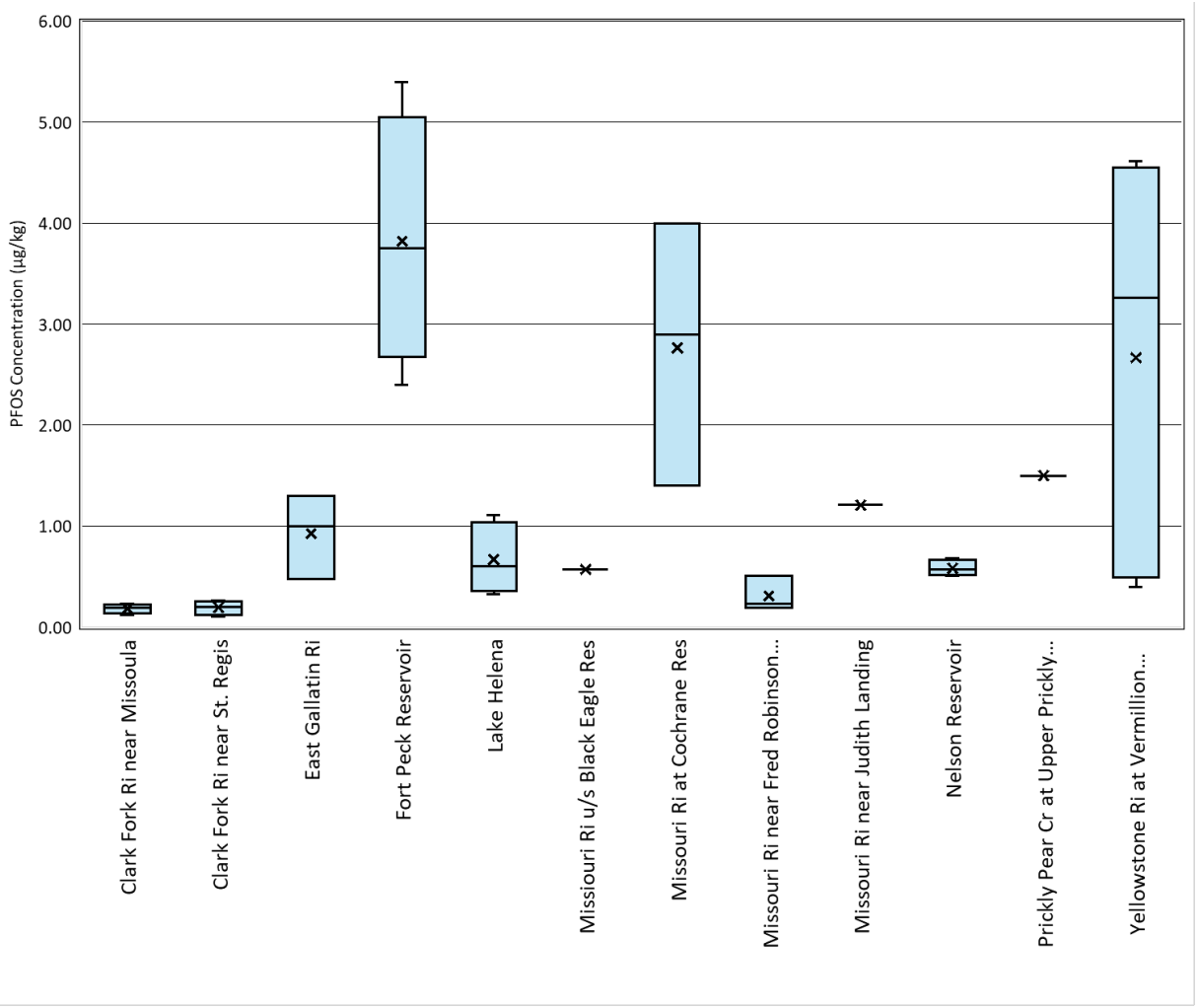

Figure 11. Box and whisker plot representing PFOS concentrations (µg/kg) per site. The boxes and extended lines represent all the data collected at each site. The box represents the data between the 25th and 75th percentiles. Inside the box, the x represents the average, while the small horizontal line represents the median (the middle data point).

In a prior effort, surface water was sampled in four at-risk areas for PFAS contamination in 2021 (MAS 2022). Samples were collected during baseflow conditions between August and October. Collection occurred during baseflow because PFAS concentrations in surface water can be diluted during spring runoff. Overall, in 2021 at least one PFAS analyte was detected in 67% of the at-risk sites sampled.

In 2023, surface water PFAS detections occurred at a lower detection rate compared to 2021 surface water results. At least one PFAS analyte was detected in two out of 14 waterbodies in 2023 and 2024 (East Gallatin and Prickly Pear Creek) and three PFAS were detected between the two waterbodies (PFPeA, PFHxA, and PFBA). The low detection rate may be due to sampling multiple sites during spring runoff (8 of 13 sites), leading to dilution of PFAS concentrations or due to the bioaccumulation rate of PFAS in aquatic systems. Other states have detected PFAS in fish tissue even when concentrations in surface water are low or not detected. PFAS accumulates in fish over time as they are repeatedly

exposed. Waterbodies with confirmed or potential PFAS sources in their watershed can show higher PFAS levels in fish tissue than in the surrounding surface water (MPCA).

Overall, fish tissue sampling in the prairie and mountain west has been limited. Across EPA Region 8 and Idaho, two other states have completed similar fish tissue sampling projects. North Dakota collected 32 whole fish tissue samples from Lake Sakakawea in 2023 to determine the presence or absence of PFAS in multiple environmental and industrial media (ND DEQ, 2024). PFAS were detected in all fish tissue samples collected. In Lake Sakakawea, PFOS concentrations ranged from 1.95 µg/kg to 11.90 µg/kg. The range of North Dakota PFOS fish tissue results are higher than the results in Montana, however whole fish tissue concentrations are typically higher than fillet tissue concentrations.

In 2020 and 2023, Colorado completed fish tissue sampling to gather data to better understand how people may be exposed to PFAS (TRA, 2024). Colorado results showed PFOS was detected in 100% of the fish tissue tested in 2020, and PFOS concentrations ranged from 0.67 to 241 µg/kg. The Colorado report did not indicate if whole fish tissue or fillet tissue were collected, however, the range of Colorado PFAS fish results are higher than the results in Montana. Results from the 2023 Colorado sampling effort led to fish PFOS consumption advisories in three waterbodies.

6.0 Next Steps

Due to detections of PFAS in fish tissue and the risk PFAS may pose to human health, DEQ has submitted fish tissue results to the Interagency Fish Consumption Advisory Group (IFCAG) for review. IFCAG is made up of representatives from Fish Wildlife and Parks (FWP), Department of Public Health and Human Services (DPHHS), and Department of Environmental Quality (DEQ) who evaluate available fish tissue data from across the state to determine if concentrations of environmental contaminants pose a risk to human health. IFCAG has evaluated the PFOS results from this project and has determined fish consumption health-based meal limits for certain waterbodies. Fish consumption advisories have been issued and the Montana Sport Fish Consumption Guidelines are updated to incorporate these advisories. The Montana Sport Fish Consumption Guidelines are not regulatory standards but using them helps citizens of Montana ensure the fish they catch are safe to eat. DEQ and FWP will evaluate resources and future needs for additional sampling.

7.0 References

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APPENDIX A: SAMPLING LOCATIONS

Site Name	Site Description	Station ID	Sample Date	Latitude	Longitude
Missouri River	upstream Black Eagle Reservoir	M12MISSR25	11/2/2023	47.48831	-111.31511
Missouri River	Cochrane Reservoir section	M12 MISSR50	11/2/2023	47.55055	-111.158
Lake Helena	at mid-point west	M09LHLNW02	5/16/2023	46.69681	-111.92911
Prickly Pear Creek	at Upper Prickly Pear FAS	M09PKPRC01	9/7/2023	46.63359	-111.97932
East Gallatin River	Hoffman section	M05EGALR05	9/26/2023	45.7245	-111.06935
Yellowstone River	Vermillion section	Y12YELSR05	6/2/2023	45.88944	-108.31889
Missouri River	near Judith Landing	M23MISSR60	5/4/2023	47.72294	-109.69292
Missouri River	near Fred Robinson Bridge	M31MISSR02	4/25/2023	47.62379	-108.67598
Fort Peck Reservoir	Lower Big Dry	M31FTPKL30	7/25/2023	47.812	-106.34369
Nelson Reservoir	Mid reservoir		9/17/2024	48.49488	-107.54806
Clark Fork River	near Missoula	C04CKFKR90	6/12/2023	46.88714	-113.9233
Clark Fork River	near St. Regis	C04CKFKR30	6/19/2023	47.27951	-115.08506
Flathead Lake	near Somers	C11FLATL07	4/28/2023	48.0429	-114.20098
Flathead River	at Old Steel Bridge	C11FLATR03	5/15/2023	48.21596	-114.25364

APPENDIX B: LABORATORY ANALYTICAL LOWER REPORTING LIMITS AND METHOD DETECTION LIMITS

	Fish Tissue EPA Method 1633		Surface Water EPA Method 1633	
PFAS Parameter	**Method Detection Limit (µg/kg)**	**Lower Reporting Limit (µg/kg)**	**Method Detection Limit (µg/L)**	**Lower Reporting Limit (µg/L)**
7:3 FTCA	2.6	12.4	0.005	0.024
PFBA	0.62	2	0.00059	0.0039
Perfluorononanoic acid	0.088	0.49	0.00022	0.00096
5:3 FTCA	1.9	12.4	0.0047	0.024
NEtFOSAA	0.066	0.49	0.00034	0.00096
Perfluorobutanesulfonic acid	0.057	0.49	0.00031	0.00096
8:2 FTS	0.44	2	0.001	0.0039
PFOSA	0.071	0.49	0.00023	0.00096
Perfluoroheptanoic acid	0.1	0.49	0.00021	0.00096
4:2 FTS	0.3	2	0.00046	0.0039
ADONA	0.38	2	0.00056	0.0039
NMeFOSAA	0.18	0.49	0.00031	0.00096
PFDoS	0.23	0.49	0.00027	0.00096
Perfluorododecanoic acid	0.078	0.49	0.00021	0.00096
NFDHA	0.14	0.99	0.00054	0.0019
PFMBA	0.16	0.99	0.00031	0.0019
Perfluoro-3-methoxypropanoic acid	0.16	0.99	0.00047	0.0019
PFNS	0.12	0.49	0.00023	0.00096
PFPeA	0.18	0.99	0.00029	0.0019
PFPeS	0.098	0.49	0.00018	0.00096
Perfluorohexanesulfonic acid	0.11	0.49	0.00025	0.00096
Perfluorooctanesulfonic acid	0.11	0.49	0.00017	0.00096
Perfluorooctanoic acid	0.065	0.49	0.00035	0.00096
6:2 FTS	0.35	2	0.00094	0.0039
9Cl-PF3ONS	0.42	2	0.00079	0.0039
Perfluorohexanoic acid	0.061	0.49	0.00015	0.00096
Perfluorotetradecanoic acid	0.074	0.49	0.00027	0.00096
3:3 FTCA	1.1	2.5	0.0022	0.0048
PFDS	0.11	0.49	0.00026	0.00096
PFEESA	0.15	0.99	0.00031	0.0019
Perfluorotridecanoic acid	0.13	0.49	0.00019	0.00096
11Cl-PF3OUdS	0.57	2	0.00075	0.0039

	Fish Tissue EPA Method 1633		Surface Water EPA Method 1633	
PFAS Parameter	**Method Detection Limit (µg/kg)**	**Lower Reporting Limit (µg/kg)**	**Method Detection Limit (µg/L)**	**Lower Reporting Limit (µg/L)**
HFPO-DA	0.4	2	0.00075	0.0039
PFHpS	0.082	0.49	0.00023	0.00096
Perfluorodecanoic acid	0.098	0.49	0.00017	0.00096
Perfluoroundecanoic acid	0.09	0.49	0.00024	0.00096
NEtFOSA	NA	NA	0.00025	0.00096
N-methylperfluoro-1-octanesulfonamide	NA	NA	0.00026	0.00096
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol	NA	NA	0.0026	0.0096
NEtFOSE	NA	NA	0.0031	0.0096