Summary of the 2022 Red River PFAS Sampling Project

Figure 1. NDDEQ PFAS sampling locations on the Bois de Sioux and Red rivers. Site locations numbered 1-8.

In June and July of 2022, the North Dakota Department of Environmental Quality's (NDDEQ) Watershed Management Program supported a citizen science project addressing emerging contaminants in North Dakota surface water. The project, which focused on PFAS (Per- and Polyfluoroalkyl Substances), partnered with resident Madison Eklund during a kayaking expedition to Hudson Bay. Eklund collected ten water quality samples for PFAS analysis from the Bois de Sioux and Red rivers in eastern North Dakota (Figure 1).

Background on PFAS

PFAS are man-made chemicals first created in the 1930s that have since been developed into thousands of different chemical compounds. They have become widespread in consumer goods and manufacturing processes because they are able to repel oil and water and can be temperature and friction resistant. These properties make them extremely useful in many products like nonstick cookware, grease-resistant fast-food wrappers, water-resistant clothing, and cleaning products. Many industries, such as automotive, construction, electronics, and aviation rely on these types of properties and use PFAS in equipment and processing.

As PFAS developed and became more widely used, scientific studies began identifying potential human and environmental health impacts associated with PFAS compounds. Scientists observed that PFAS did not break down in the environment but instead accumulated and easily moved through the food chain. As a result, PFAS are called "forever chemicals." In the United States, the federal Environmental Protection Agency has developed actions to address PFAS contamination and protect public and environmental health.

Previous Studies

In 2018 the North Dakota Department of Environmental Quality began conducting baseline assessments to determine the presence/absence of PFAS in North Dakota. Sampling efforts have been focused on drinking water and groundwater, including drinking water treatment plants, wastewater treatment plants, biosolids, landfills, and ambient groundwater from industrial areas. In 2018 a total of 88 samples were collected and analyzed from 47 sites; in 2020, 62 samples from 55 sites (all public water systems); and in 2021, 121 samples from 121 sites. Study reports can be found at https://deq.nd.gov/MF/PFAS/. A 2022 assessment report is currently in development for an additional study focused on drinking water systems.

Surface Water Sampling

PFAS sampling on the Bois de Sioux and Red rivers in 2022 created a foundation for surface water sampling in the state and provides a first look at the presence/absence of PFAS in North Dakota's surface waters. Sample locations on the Bois de Sioux and Red rivers were selected based on upstream and downstream proximity to municipalities and major tributary confluences. A sampling training and audit was conducted by NDDEQ staff at the first site on the Bois de Sioux River. Due to the high potential for sample contamination, a PFAS-specific sampling procedure was followed. Two duplicate samples and two blank samples (filled with PFAS-free water) were collected at different sites on the Red River for quality assurance/quality control. All samples, including duplicates and blanks, were collected within a 2.5-week period from late June into early July.

Laboratory Analysis

Sample containers and analysis were provided by and performed by Pace Analytical. A total of 36 PFAS compounds were tested for in each sample, based on the laboratory's isotope dilution method. The list of compounds was selected based on previous NDDEQ groundwater sampling efforts, which focused on the same list of compounds (Attachment 1).

Results

Sample results showed measurable levels of four of the 36 PFAS compounds that were included in the analysis. The remaining 32 compounds were not detected in samples, including field and laboratory blanks. One compound, Perfluorobutanoic acid (PFBA), was detected in each sample (except blanks) and varied in concentration from 6.5 nanograms per liter (ng/L) to 11 ng/L (ng/L = part per trillion, or ppt). Three additional compounds were detected in two of the samples; Perfluorooctanesulfonic acid (PFOS), Perfluorohexanoic acid (PFHxA), and 6:2 Fluorotelomer sulfonic acid (6:2 FTS). The highest concentrations of compounds were detected at sites 6-8, downstream of Grand Forks, ND. (Figure 2, Table 1)

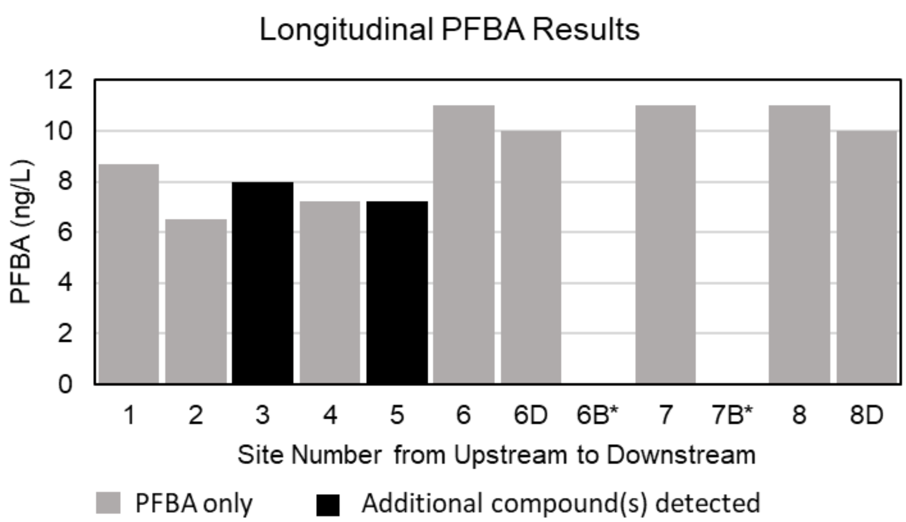

*Figure 2. Longitudinal results of Perfluorobutanoic acid (PFBA) concentrations from upstream (1) to downstream (8) locations on the Bois de Sioux and Red rivers (B = blank; D = duplicate; *non-detect).*

Table 1. 2022 surface water sample PFAS results above laboratory detection limits.

Sample No.	PFAS Compound	Concentration (ng/L, or ppt)	Water Body
1	Perfluorobutanoic acid (PFBA)	8.7	Bois de Sioux River
2	Perfluorobutanoic acid (PFBA)	6.5	Red River
3	Perfluorobutanoic acid (PFBA)	8.0	Red River
	Perfluorohexanoic acid (PFHxA)	2.2	
	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	5.1	
4	Perfluorobutanoic acid (PFBA)	7.2	Red River
5	Perfluorobutanoic acid (PFBA)	7.2	Red River
	Perfluorooctanesulfonic acid (PFOS)	3.9	
6	Perfluorobutanoic acid (PFBA)	11	Red River
6D*	Perfluorobutanoic acid (PFBA)	10	Red River
6B*	*non-detect*	-	Red River (blank)
7	Perfluorobutanoic acid (PFBA)	11	Red River
7B*	*non-detect*	-	Red River (blank)
8	Perfluorobutanoic acid (PFBA)	11	Red River
8D*	Perfluorobutanoic acid (PFBA)	10	Red River
Sample numbers ordered from upstream (1) to downstream (8) locations. *Indicates duplicate sample (D) collection at site, or blank sample (B) of PFAS-free water.			

The four PFAS compounds detected in surface water samples were also detected in samples from the NDDEQ's 2018 and 2021 groundwater and drinking water studies. The 2020 study, which focused on public water systems, used a drinking water specific laboratory testing method (537.1) consisting of a different list of PFAS compounds for analysis. One of the four compounds, PFOS, is included in method 537.1 and was not detected in any drinking water samples.

The U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) has conducted toxicological assessments of multiple PFAS compounds. Draft reports and final documents can be found at https://www.epa.gov/iris. Health assessments for Perfluorobutanoic acid (PFBA) and Perfluorohexanoic acid (PFHxA) are currently under development with final assessments for PFBA and PFHxA anticipated for release by the end of 2022. Health advisories (HAs) have been developed for four PFAS compounds, including an interim health advisory for PFOS (HA = 0.02 ng/L). Health advisories are limits established for chemicals found in drinking water that do not have regulatory standards. Notice and information on drinking water health advisories can be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has#published.

Planning for additional PFAS assessments in North Dakota is ongoing. In addition to drinking water and groundwater monitoring, the NDDEQ is considering expanding sampling to include additional rivers and streams and to begin assessing PFAS accumulation in fish tissue. For more information on PFAS visit the U.S. Environmental Protection Agency website https://www.epa.gov/pfas. For more information on PFAS studies in North Dakota visit https://deq.nd.gov/MF/PFAS/ or contact the North Dakota Department of Environmental Quality at deq@nd.gov or 701-328-5150.

Attachment 1 – PFAS Compounds Included in 2022 Surface Water Analysis

List of PFAS compounds included in the NDDEQ surface water sample analysis in alphabetical order by abbreviation. Compounds in bold were detected in one or more samples.

Compound	Abbreviation		Compound	Abbreviation
Fluorotelomer sulphonic acid 4:2	4:2 FTS		Perfluorododecanesulfonic acid	PFDoS
Fluorotelomer sulphonic acid 6:2	**6:2 FTS**		Perfluorodecanesulfonic acid	PFDS
Fluorotelomer sulphonic acid 8:2	8:2 FTS		Perfluoroheptanoic acid	PFHpA
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS		Perfluoroheptanesulfonic acid	PFHpS
10:2 Fluorotelomer sulfonic acid	10:2 FTS		**Perfluorohexanoic acid**	**PFHxA**
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS		Perfluorohexadecanoic acid	PFHxDA
4,8-Dioxa-3H-perfluorononanoic acid	DONA or ADONA		Perfluorohexanesulfonic acid	PFHxS
Hexafluoropropylene oxide dimer acid	HFPO-DA		Perfluorononanoic acid	PFNA
N-ethylperfluorooctane sulfomide	N-EtFOSA		Perfluorononanesulfonic acid	PFNS
N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA		Perfluorooctanoic acid	PFOA
N-ethylperfluorooctane sulfomidoethanol	N-EtFOSE		Perfluorooctadecanoic acid	PFODA
N-methylperfluorooctane sulfomide	N-MeFOSA		**Perfluorooctanesulfonic acid**	**PFOS**
N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA		Perfluorooctanesulfonamide	PFOSAm
N-methylperfluorooctane sulfomidoethanol	N-MeFOSE		Perfluoropentanoic acid	PFPeA
Perfluorobutanoic acid	**PFBA**		Perfluoropentanesulfonic acid	PFPeS
Perfluorobutanesulfonic acid	PFBS		Perfluorotetradecanoic acid	PFTeDA
Perfluorodecanoic acid	PFDA		Perfluorotridecanoic acid	PFTrDA
Perfluorododecanoic acid	PFDoA		Perfluoroundecanoic acid	PFUdA or PFUnA