Investigation of Per- and Polyfluoroalkyl Substances (PFAS)
City of Cadillac
Surface Water Sampling Update
May 2025

Per- and polyfluorinated alkyl substances (PFAS) are a very large class of man-made organic chemicals that have been used in numerous industrial processes and consumer products for over 60 years. Validated analytical methods are available for relatively few of the thousands of compounds. Much of the environmental monitoring of PFAS in Michigan has focused on measuring perfluorinated chemicals.

Many PFAS are persistent, some bioaccumulate in the environment, and several are toxic to mammals and/or birds in laboratory tests. The toxicities of most PFAS have not been evaluated. Two perfluorinated compounds; perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), have been the subject of the most toxicological work and environmental monitoring. Both compounds were manufactured intentionally, but they can also be generated as byproducts when other fluorinated compounds break down. Many products containing PFOS and PFOA were historically used in numerous industrial processes including metal plating, textile production and treatment, and specialty paper production. Other PFAS chemicals are still widely used today in industrial and consumer products. Industrial and domestic waste containing these compounds can enter the environment through municipal or private waste treatment systems, stormwater runoff, venting groundwater, or as atmospheric deposition via emissions. In addition, several PFAS are key ingredients in Aqueous Film-Forming Foam (AFFF). These foams have been used extensively in fire suppression training exercises at military bases nationwide as well as in emergency firefighting. In recent years, PFAS have been detected in surface and groundwater near many military facilities. Both PFOS and PFOA have been measured in surface waters across the state, and PFOS has been detected in most fish tissue samples from Michigan waters that have been analyzed for PFAS.

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) has generated Rule 57 surface water quality values for the protection of human health and aquatic life for PFOS, PFOA, perfluorobutane sulfonate (PFBS), perfluorohexanesulphonic acid (PFHxS), and perfluorononanoic acid (PFNA). The Rule 57 Water Quality Values (listed in nanograms per liter which is equivalent to parts per trillion) are as follows:

PFAS	Human Noncancer Value (HNV) (drinking) (ng/L)*	HNV (nondrinking) (ng/L)	Final Chronic Value (FCV) (ng/L)	Aquatic Maximum Value (AMV) (ng/L)	Final Acute Value (FAV) (ng/L)
PFOS	11	12	140,000	780,000	1,600,000
PFOA	66	170	880,000	7,700,000	15,000,000
PFBS	8,300	670,000	24,000,000	120,000,000	240,000,000
PFHxS	59	210	-	-	-
PFNA	19	30	-	-	-

(-) Aquatic Life Values for PFHxS and PFNA are currently under development.
(*) nanograms per liter (ng/L) is equivalent to parts per trillion (ppt)
The Aquatic Maximum Value (AMV) is the highest concentration of a substance to which an aquatic community can be exposed briefly without resulting in adverse effects, whereas the Final Chronic Value (FCV) is the highest concentration of a substance to which an aquatic community can be exposed for a long period of time without experiencing adverse effects. The Final Acute Value (FAV) is the value applied directly at the end of an effluent point source for EGLE discharge permitting purposes.

Surface water sampling was conducted in Cadillac, MI in 2022. No exceedances of Michigan's Rule 57 Water Quality Values were observed, and concentrations of PFAS were predominately at or around background levels.

Sampling of residential wells within the Cadillac, MI area has found detectable concentrations of PFAS and/or concentrations of PFAS exceeding the generic cleanup criteria for groundwater used as drinking water established under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act (NREPA) [MCL 323.20120a(5)]. This has resulted in numerous areas of interest.

1. Wexford-Missaukee Career Technical Center Area of Interest (Cadillac, Wexford County)
2. Cadillac Industrial Park Area of Interest (Cadillac, Wexford County)
3. Wexford Area of Interest Self-Sampling Investigation (Haring, Clam Lake, Selma, and Boon Townships and City of Cadillac, Wexford County)
4. US 131 & Mackinaw Trail Area of Interest (Clam Lake Township, Wexford County)

Samples were collected in accordance with the EGLE Surface Water PFAS Sampling Guidance document (EGLE 2022). Samples were collected by pipette into two polypropylene (PP) bottles (certified PFAS-free). All personnel handling sample bottles used nitrile gloved hands. One replicate sample was collected. One site was randomly selected for the replicate sample.

All samples were delivered to the analytical laboratory within the required holding period for surface water PFAS samples. Samples were analyzed for selected PFAS, as described in the Quality Assurance Project Plan (QAPP; EGLE 2022) and listed in Table 2.

References:

Michigan Department of Environmental, Great Lakes, and Energy. (2022). Surface Water PFAS Sampling Guidance.

Michigan Department of Environment, Great Lakes, and Energy. (2022). Michigan Surface Water Perfluoroalkyl and Polyfluoroalkyl Compound (PFAS) Investigation: Quality Assurance Project Plan (QAPP).

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Table 1. PFOS, PFOA, PFBS, PFHxS, and PFNA concentrations in surface water samples collected at locations in Cadillac, Michigan in May 2025. None of the samples exceeded the Rule 57 HNV (nondrinking) criteria.

Sample ID	Sample Location Description	Latitude	Longitude	PFOS (ng/L)	PFOA (ng/L)	PFBS (ng/L)	PFHxS (ng/L)	PFNA (ng/L)
42-CAP-0010	South 39 1/2 Road	44.270506	-85.435151	<2.0	<2.0	<2.0	<2.0	<2.0
42-BERL-0010	DNR Boat launch East 44 Road	44.223452	-85.354371	<2.0	<2.0	<2.0	<2.0	1.0
42-BRC-0010	West Lake Mitchell Drive	44.256813	-85.501529	<2.0	1.3	<2.0	<2.0	1.5
42-CM-0280	Off 43 ½ Rd bridge	44.281778	-85.382434	<2.0	<2.0	1.85	0.8	<2.0
42-CM-0280R	Off 43 ½ Rd bridge -Replicate	44.281778	-85.382434	<2.0	1.1	1.6	0.9	<2.0
42-CD-0010	Clay Drive	44.287383	-85.420543	1.6	1.6	1.8	1.0	1.6
42-LC-0020	William Mitchell State Park	44.239056	-85.450169	<2.0	<2.0	<2.0	<2.0	<2.0
42-LMT-0020	DNR Boat launch Hemlock Campground	44.233779	-85.502821	<2.0	<2.0	<2.0	<2.0	<2.0
42-LL-0010	East Long Lake Road Boat Launch	44.334606	-85.37881	<2.0	<2.0	<2.0	<2.0	<2.0
42-LL-0010D	East Long Lake Road Boat Launch -Duplicate	44.334606	-85.37881	<2.0	<2.0	<2.0	<2.0	1.2
42-MTC-0010	West Lake Mitchell Drive	44.236228	-85.517514	<2.0	<2.0	<2.0	<2.0	<2.0
42-MSPC-0010	North Blvd	44.244469	-85.444775	<2.0	1.7	1.1	<2.0	<2.0
42-SD-0010	South 39 Road	44.289358	-85.436909	Dry; Did Not Sample	Dry; Did Not Sample	Dry; Did Not Sample	Dry; Did Not Sample	Dry; Did Not Sample
42-WGD-0020	Weigel Street	44.264346	-85.447578	<2.0	1.2	1.4	<2.0	<2.0
37-SGC-0060	South 17 Road	44.305391	-85.660396	<2.0	<2.0	<2.0	<2.0	<2.0
42-PL-0010	Pleasant Lake	44.295498	-85.475894	<2.0	<2.0	<2.0	<2.0	1.0

Table 2. Per- and polyfluoroalkyl substances (PFAS) analyzed in surface water

Compound	Abbreviation	CAS #
Perfluorotetradecanoic acid	PFTeA	376-06-7
Perfluorotridecanoic acid	PFTriA	72629-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorononanoic acid	PFNA	375-95-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorobutanoic acid	PFBA	375-22-4
Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorooctanesulfonamide	PFOSA	754-91-6
Fluorotelomer sulphonic acid 8:2	FTS 8:2	39108-34-4
Fluorotelomer sulphonic acid 6:2	FTS 6:2	27619-97-2
Fluorotelomer sulphonic acid 4:2	FTS 4:2	757124-72-4
2-N-Ethylperfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6
2-N-Methylperfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
11-chloroeicosafluoro-3 oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
9-chlorohexadecafluoro-3-oxanone1-sulfonic acid	9Cl-PF3ONS	756426-58-1
4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
Perfluoroethylcyclohexane sulfonate	PFECHS	67584-42-3
Perfluorobutylsulfonamide	PFBSA	30334-69-1
Perfluorohexanesulfonamide	PFHxSA	41997-13-1

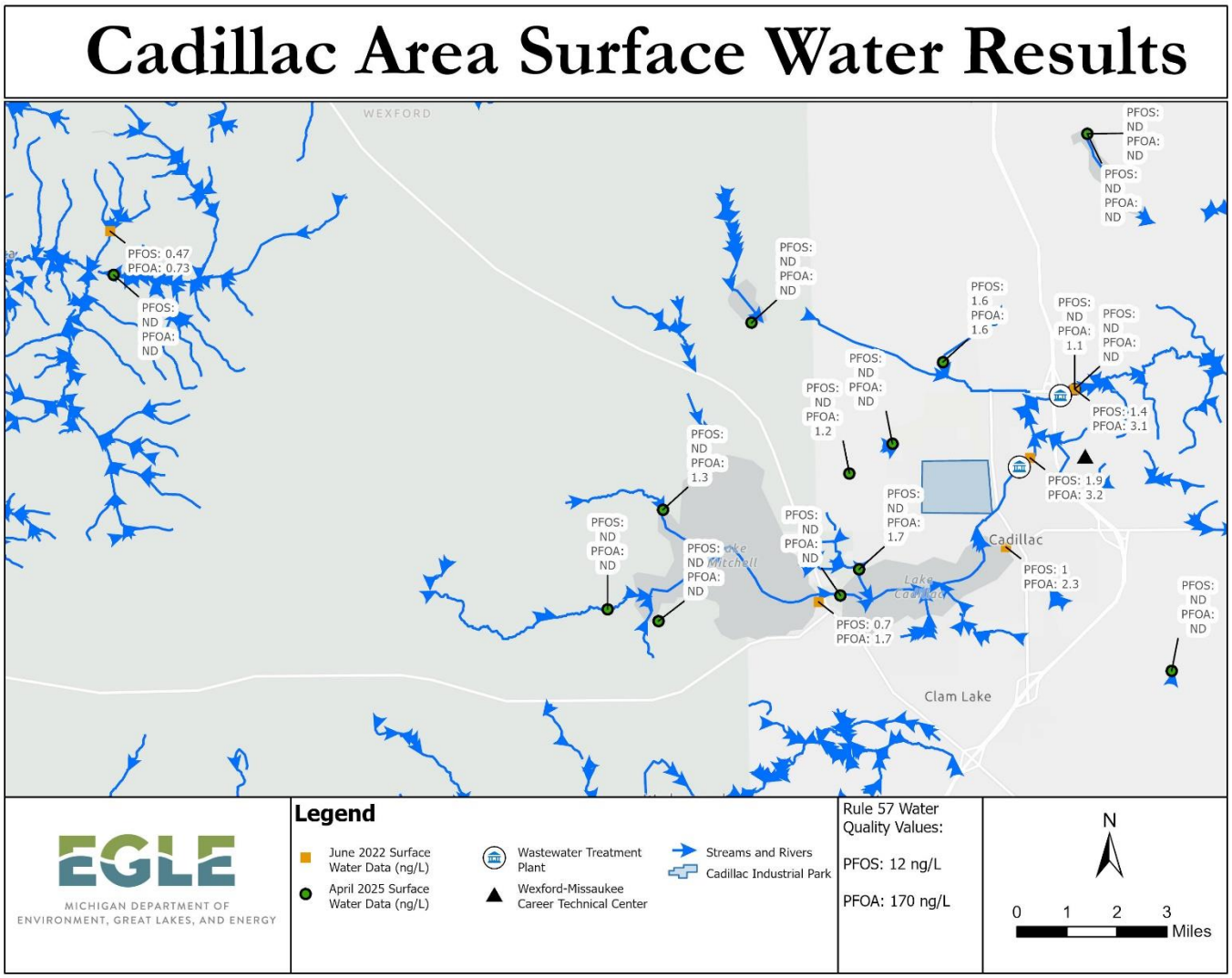

Figure 1. Overview map of surface water PFOS and PFOA concentrations (ng/L) at locations collected in Cadillac, Michigan in May 2025.