Surface Water Quality Standards for PFOS and PFOA

Rule Package Technical Support Document

Rule package WY-23-19, related to
Chapters NR 102, 105, 106, and 219, Wis. Adm. Code

January 21, 2022

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Executive Summary

Poly- and perfluoroalkyl substances (PFAS) are human-made, organic compounds that have been manufactured for use in non-stick coatings, waterproof fabrics, firefighting foams, food packaging, and many other applications since the 1940s. PFAS are highly resistant to degradation and have been detected globally in water, sediment, and wildlife. This global distribution is of concern as PFAS have documented toxicity to animals and because epidemiological studies have suggested probable links to several human health effects. In Wisconsin, PFAS have been detected in drinking and surface water near sources of industrial use or manufacture and near spill locations. Perfluorooctane sulfonate (PFOS) has been found in fish tissue resulting in the issuance of special fish consumption advisories for some surface waters in the state.

The proposed rules include a water quality standard for two types of PFAS: PFOS and perfluorooctanoic acid (PFOA). Under the Clean Water Act, surface water quality standards can include criteria that are numeric or narrative and designated uses (e.g. aquatic life use, recreational use, and public health and welfare). Wisconsin's existing Administrative Codes contain both numeric and narrative criteria for toxic substances:

- Chapter NR 105, Wis. Adm. Code, contains specific numeric criteria for numerous toxic pollutants as well as formulas for calculating numeric criteria and secondary values for toxics that do not yet have promulgated criteria.
- Section NR 102.04(d), Wis. Adm. Code, contains Wisconsin's narrative criteria for toxics. This existing rule states that substances in concentrations or combinations which are toxic or harmful to humans *shall not be present in amounts found to be of public health significance* [emphasis added], nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

The proposed PFOS and PFOA standard protects public health and recreational uses of surface waters by establishing criteria that contain both narrative provisions and numeric criteria. The narrative and numeric criteria interpret Wisconsin's existing narrative standards under ss. NR 105.04(4m) and 102.04, Wis. Adm. Code, with regard to two toxic substances, PFOS and PFOA. The proposed rule defines levels of public health significance for the two types of PFAS based on preventing adverse effects from contact with or ingestion of surface waters of the state, or from ingestion of fish taken from waters of the state.

- For PFOS, the proposed level of public health significance is 8 ng/L for all waters except those that cannot naturally support fish and do not have downstream waters that support fish.
- For PFOA, the proposed levels of public health significance are 20 ng/L in waters classified as public water supplies under ch. NR 104, and 95 ng/L for other surface waters.

Related to the proposed PFOS and PFOA standards, the proposed rule also includes assessment protocols that clarify when a surface water that contains levels of PFOS or PFOA above the criteria in the narrative standard should be listed on the state's impaired waters list.

Additionally, the proposed rules establish WPDES permit requirements for wastewater discharges of PFOS and PFOA to surface waters of the state in ch. NR 106 – Subchapter VIII, including: the determination of the need for a PFOS and PFOA Minimization Plan based on data generation in a reissued permit, a general schedule for PFOS and PFOA Minimization Plan permit implementation procedures, PFOS and PFOA Minimization Plan requirements, and determination of need for and calculation procedures for water quality based effluent limits for PFOA and PFOS.

Finally, this rule adds specifications for the preservation and holding times of aqueous, biosolids (sludge), and tissue samples that will be analyzed for PFAS in ch. NR 219.

Introduction

OVERVIEW OF WATER QUALITY STANDARDS

The Clean Water Act (CWA) established the objective of restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters. To meet this objective, the act established a national goal that "water quality shall provide for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water." The CWA requires states to adopt water quality standards to protect these functions. Water quality standards consist of three components: designated uses, water quality criteria, and antidegradation. These three components are described in more detail in Fig. 1 and in the following sections.

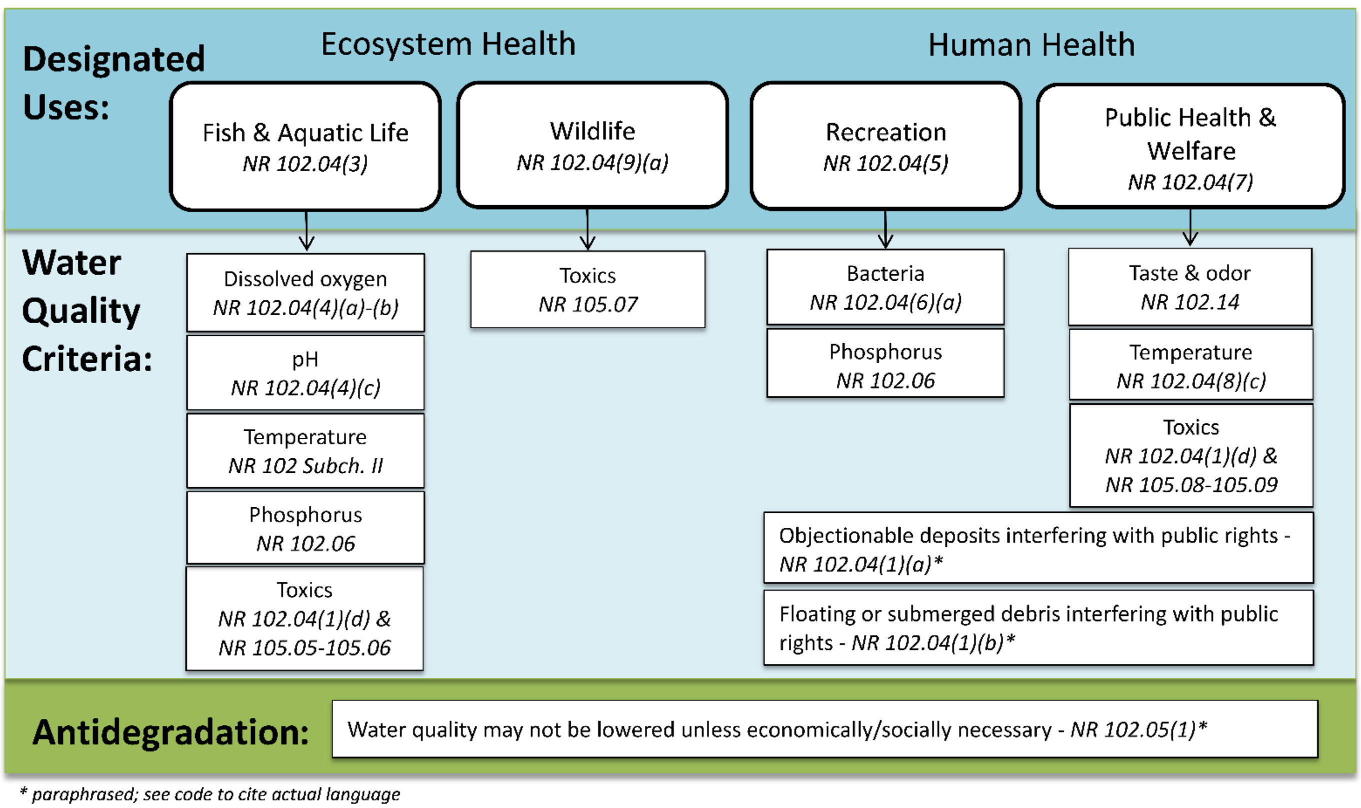

Figure 1. Components of Wisconsin's Water Quality Standards and relevant code citations.

Designated Uses

Designated uses establish the appropriate water quality goals for a given waterbody. The CWA requires each state/tribe to set designated uses that protect aquatic organisms (e.g., fish, shellfish), wildlife, and recreation and allows states/tribes to consider other uses. Wisconsin has four general designated use categories, which are defined in s. NR 102.04: fish and aquatic life, recreation, public health and welfare, and wildlife (Fig. 1).

When beginning to consider standards, the department reviews available literature to determine the relative sensitivity to exposure to a pollutant of groups protected by Wisconsin's designated uses (public health, fish and aquatic life, and wildlife). In this case, review of available data indicated that humans are the most sensitive to PFOS and PFOA exposure – that is to say, aquatic life and wildlife can be exposed to much higher amounts of PFOS and PFOA and not show negative health effects compared to amounts that cause negative health effects in humans. Thus, for this first effort to reduce the discharge of PFOS and PFOA to surface water, it is appropriate to prioritize human health protection by addressing the public health and welfare use, because protecting humans will also protect less sensitive groups of organisms.

Water Quality Criteria

Water quality criteria represent the quality of water that supports a particular use. Water quality criteria can be numeric values or narrative descriptions and are used to derive permit limits, make waterbody assessment decisions, and develop total maximum daily load (TMDL) analyses for impaired waters. As criteria are designed to protect a particular use for a given waterbody, each designated use class has its own set of criteria (Fig. 1). Narrative criteria that describe undesirable amounts of toxic substances in support of the public health and welfare use are being proposed in the rule.

Antidegradation

The antidegradation policy is designed to maintain and protect high quality waters. The policy establishes how proposed new or increased discharges to high quality waters are addressed to ensure that water quality is protected. While the antidegradation policy is a crucial component to water quality standards, it is not applicable to this rule package.

Water Quality Criteria for Human Health Protection

The CWA was adopted in 1972 and states as one of its goals that "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited"[1]. In order to accomplish this goal, the CWA requires states to adopt water quality standards to protect public health and welfare. Since adoption of the CWA, the United States Environmental Protection Agency (EPA) has published recommended human health water quality criteria for toxic substances to protect people from illness caused by incidental consumption of surface waters or consumption of fish taken from surface waters. States are permitted to adopt EPA's recommended criteria or develop their own, which may be expressed as numeric values or narrative descriptions of a waterbody's condition. Wisconsin's narrative criteria can be found in s. NR102.04. Specifically, NR102.04(1)(d) states that "Substances in concentrations or combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life."

[1] 33 USC § 1251 (a)(3)

OVERVIEW OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a group of over 5,000 synthetic chemicals that do not occur naturally in the environment. PFAS were invented in the 1930s and were introduced into industrial manufacturing and commercial use in the 1940's, with peak production occurring between 1970 and 2000.

PFAS can be broadly described as chemicals that have carbon atoms linked to one another and to fluorine atoms. This structure is also referred to as a "fluorinated carbon chain" (highlighted by the red box in Fig. 2). When all carbon atoms in the chain are bonded to fluorine atoms, the resulting chemical is called a **per**fluoroalkyl substance. When one or more carbon atoms is not bonded to a fluorine atom, the resulting chemical is called a **poly**fluoroalkyl substance (green text in Fig. 2). PFAS also contain a functional group that is attached to one end of the carbon-fluorine chain. Functional groups are most often carboxylates/carboxylic acids or sulfonates/sulfonic acids (highlighted by the blue box in Fig. 2). The functional group is reflected in the name of the substance – for example, perfluorooctane sulfonate (PFOS) has a sulfonic functional group, whereas perfluorooctanoic acid (PFOA) has a carboxylic acid functional group.

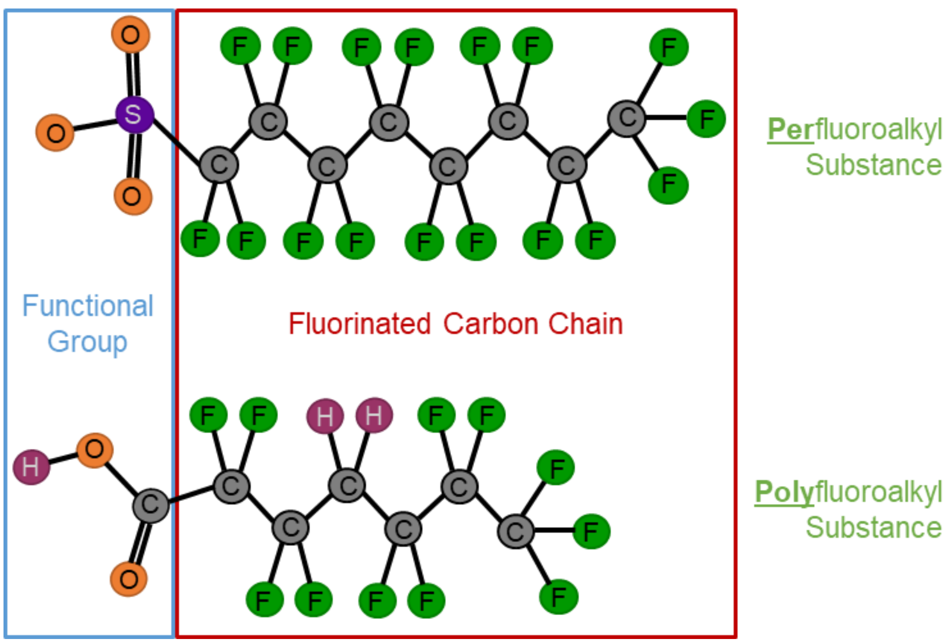

Figure 2. General structure of per- and polyfluoroalkyl substances.

In manufacturing, PFAS are particularly useful due to their carbon-fluorine bonds, which make them temperature resistant and water and oil repellent. As a result, these chemicals have been widely used in many products, including nonstick cookware, waterproof clothing, stain-resistant textiles, Aqueous Film Forming (AFFF) firefighting foam, and food packaging. However, carbon-fluorine bonds are also exceptionally resistant to degradation. Thus, when PFAS are discharged into the environment, they linger for prolonged periods of time and compounds that contain 8 or more carbon atoms are particularly likely to build up in humans, fish, and wildlife. This means that PFAS have been discovered in groundwater, soil, air, sediment, surface water and drinking water, as well as in humans, wildlife and fish across the globe.

Ingestion of contaminated water or food are the primary pathways through which PFAS enter the human body. In recent years, studies have found that most Americans have measurable levels of PFAS in their blood[2]. According to the EPA, certain PFAS substances including PFOA and PFOS have been linked to human health risks, including developmental problems in fetuses and infants, certain types of cancer, reduced antibody response, decreased immune response to vaccinations, and kidney disease[3].

Due to their widespread distribution and negative human health effects, the main PFAS-producing companies began to phase out production and use of long-chain PFAS (those with 8 or more carbon atoms) in the early 2000s. However, these chemicals may still enter the environment for several reasons: due to production of PFAS or their importation to the United States by companies not participating in the phase out program; because precursor PFAS compounds can be degraded into PFOS and PFOA; and via household dust, surface water runoff, or in landfill leachate. Figure 3 from the Interstate Technology Regulatory Council[4], below, demonstrates a how PFAS may move through the environment.

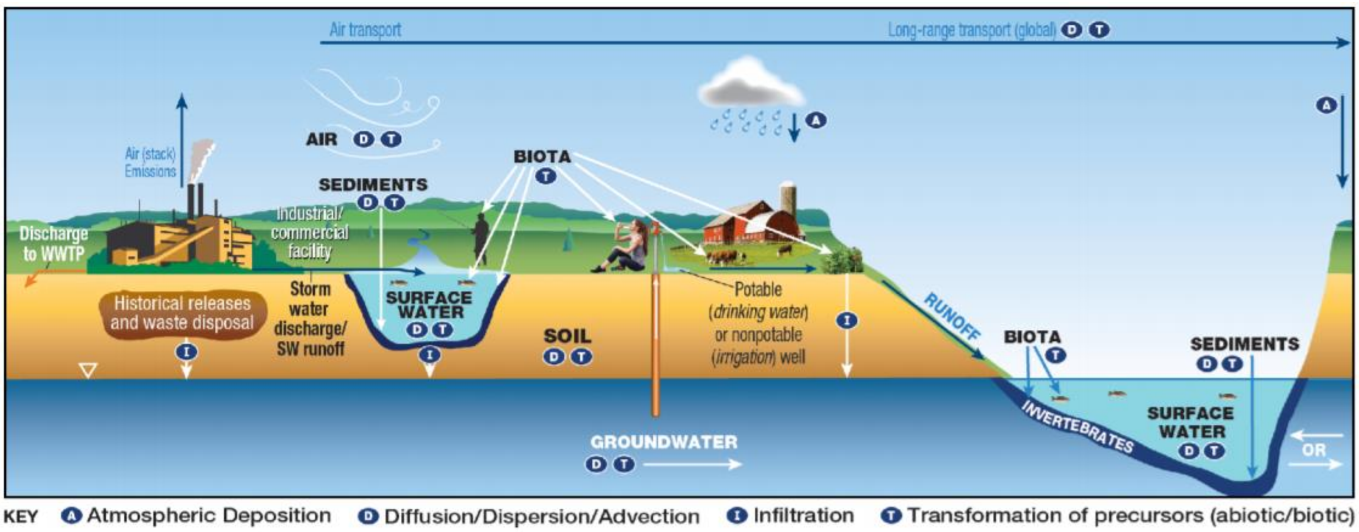

Figure 3. Depiction of how PFAS may move through different environmental media, including the processes that may facilitate movement between media types. Image credit: ITRC.

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[2] Centers for Disease Control and Prevention. 2021. Fourth National Report on Human Exposure to Environmental Chemicals Updated Tables, March 2021, Volume One. https://www.cdc.gov/exposurereport/index.html. [last accessed September 2021]

[3] United States Environmental Protection Agency. Drinking Water Health Advisories for PFOA and PFOS. https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos

[4] Image from ITRC's Site Characterization Considerations and Media-Specific Occurrence for Per- and Polyfluoroalkyl Substances (PFAS) Fact Sheet. Available: https://pfas-1.itrcweb.org/wp-content/uploads/2020/10/site_char_508_2020Aug.pdf [last accessed July 2021]

Proposed Changes

The department is proposing new water quality standards for PFOS and PFOA and related implementation procedures for the WPDES program for wastewater discharges.

- Chapter NR 102, Wis. Adm. Code, contains the water quality standards for Wisconsin's surface waters. In this rule package, the department created new water quality criteria for PFOS and PFOA that include both narrative provisions and numeric criteria.
- Chapter NR 105, Wis. Adm. Code, contains numeric surface water quality criteria and secondary values for toxic substances. In this rule package, the department included a subsection adding PFOS and PFOA narrative criteria to the list of compounds considered when determining adverse effects on public health and welfare.
- Chapter NR 106, Wis. Adm. Code, contains procedures for calculating Water Quality Based Effluent Limitations for point source discharges to surface waters. A new subsection was added to this chapter to address WPDES permit implementation procedures for the new PFOS and PFOA criteria.
- Chapter NR 219, Wis. Adm. Code, contains tables of EPA's approved analytical laboratory methods. Select tables in this chapter were updated to include specifications for the preservation and holding times of aqueous, biosolids (sludge), and tissue samples that will be analyzed for PFAS.

The following sections of this document provide more details on each of the proposed changes.

CRITERIA FOR PFOS AND PFOA

This rule package proposes to add narrative criteria for PFOS and PFOA to chs. NR 102 and NR 105. As part of this rulemaking effort, the department conducted preliminary calculations of numeric criteria using the procedures outlined ch. NR 105. At this time, however, the department selected a different methodology to develop public health based PFOS and PFOA criteria. Pursuant to Wis. Adm. Code s. NR 105.02 (2), the department has authority to promulgate a more or less stringent criterion than a criterion calculated under the standard procedures in chapter NR 105. The approach selected for deriving the PFOS standard is based on our data analysis which shows that fish consumption is the dominant exposure route of concern for PFOS. The department selected a method that allowed correlation with fish consumption advisories, which would not be included in calculation under chapter NR 105, Wis. Adm. Code. Also, with regard to the calculation of PFOA criteria, the department's calculated criteria are more protective of children that ingest or consume PFOA contaminated water compared to the procedures under chapter NR 105, Wis. Adm. Code.

Further, the department believes that these public health based criteria combined with PFOS and PFOA minimization plans will result in more timely reductions in levels of PFOS, PFOA and all other parameters regulated in WPDES permits, as permittees exceeding the proposed criteria will begin PFOS and PFOA minimization plans immediately upon permit reissuance rather than after a prolonged variance application and review process. The department expects that the selected approach will be effective at reducing sources of PFOS and PFOA in areas of the state where PFOS or PFOA concentrations in wastewater are elevated.

Defining a level of public health significance for PFOS in surface waters

Summary

Fish ingestion is the exposure pathway of most concern for PFOS (i.e., PFOS can build up to high levels in fish even when there is a small amount in the water column). There is a strong positive relationship between surface water PFOS and fish tissue PFOS, based on available data from samples taken in waterbodies in Wisconsin and Minnesota. Additionally, there are established PFOS thresholds corresponding to recommended fish consumption frequencies which are designed to reduce risks from exposure to PFOS while still receiving the benefits of fish consumption[5].

Thus, for the purposes of narrative criteria under NR102.04, it is reasonable to define public health significance as a PFOS water concentration that will not result in the issuance of a 1 meal per month PFOS-based fish consumption advisory for any species taken from that surface water. In other words, the proposed definition of public health significance aims to ensure that levels of PFOS in fish will be such that people can consume fish at a frequency of up to one meal per week (32 grams/day)[6] without exceeding EPA's non-cancer toxicity RfD of 2×10^{-5} mg/kg-day.

This approach resulted in a definition of public health significance which is not dependent on whether a waterbody is used as a public water supply. Consequently, for all surface waters that naturally support fish or have downstream waters that support fish, the department proposes that public health significance is defined as 8 ng/L PFOS.

Additional information on the basis for this proposed definition is provided in subsequent sections of this document.

Waterbody Use	Exposure Pathway	1 meal/week Maximum Fish Tissue Concentration	Level of Public Health Significance
All surface waters	Fish ingestion	50 ng/g	8 ng/L

[5] Great Lakes Consortium for Fish Consumption Advisories. 2019. Best Practice for Perfluorooctane Sulfonate (PFOS) Guidelines. Available at: https://www.health.state.mn.us/communities/environment/fish/docs/consortium/bestpracticepfos.pdf [last accessed May 2021]

[6] The department recognizes that due to concentrations of other contaminants, such as mercury and polychlorinated biphenyls (PCBs), the recommended meal frequency for some species from some waterways may be less than 1 meal per week regardless of the PFOS level.

Determining PFOS Exposure Pathways

To determine which pathway or pathways by which people might be exposed to PFOS, the department reviewed several datasets of samples analyzed for PFAS, including: 1) paired surface water and fish tissue samples collected from waterways throughout Wisconsin and Minnesota, 2) fish tissue samples collected as part of Wisconsin's fish contaminant monitoring program, and 3) surface water samples collected from major rivers as part of long term trends (LTT) monitoring in Wisconsin. Summary details about each dataset are displayed in in the table below.

Dataset	Number of Waterways	Number of Fish samples	Number of Species	Number of Water samples	Year(s)
Paired fish and water	95	2005	19	124	2006-2020
Fish contaminants	35	722	35	n/a	2006-2020
Rivers LTT	42	n/a	n/a	42	2020

In the paired fish and water dataset, PFOS was detected in over 90% of fish tissue samples, even when PFOS was not detected in the water column (Fig. 4).

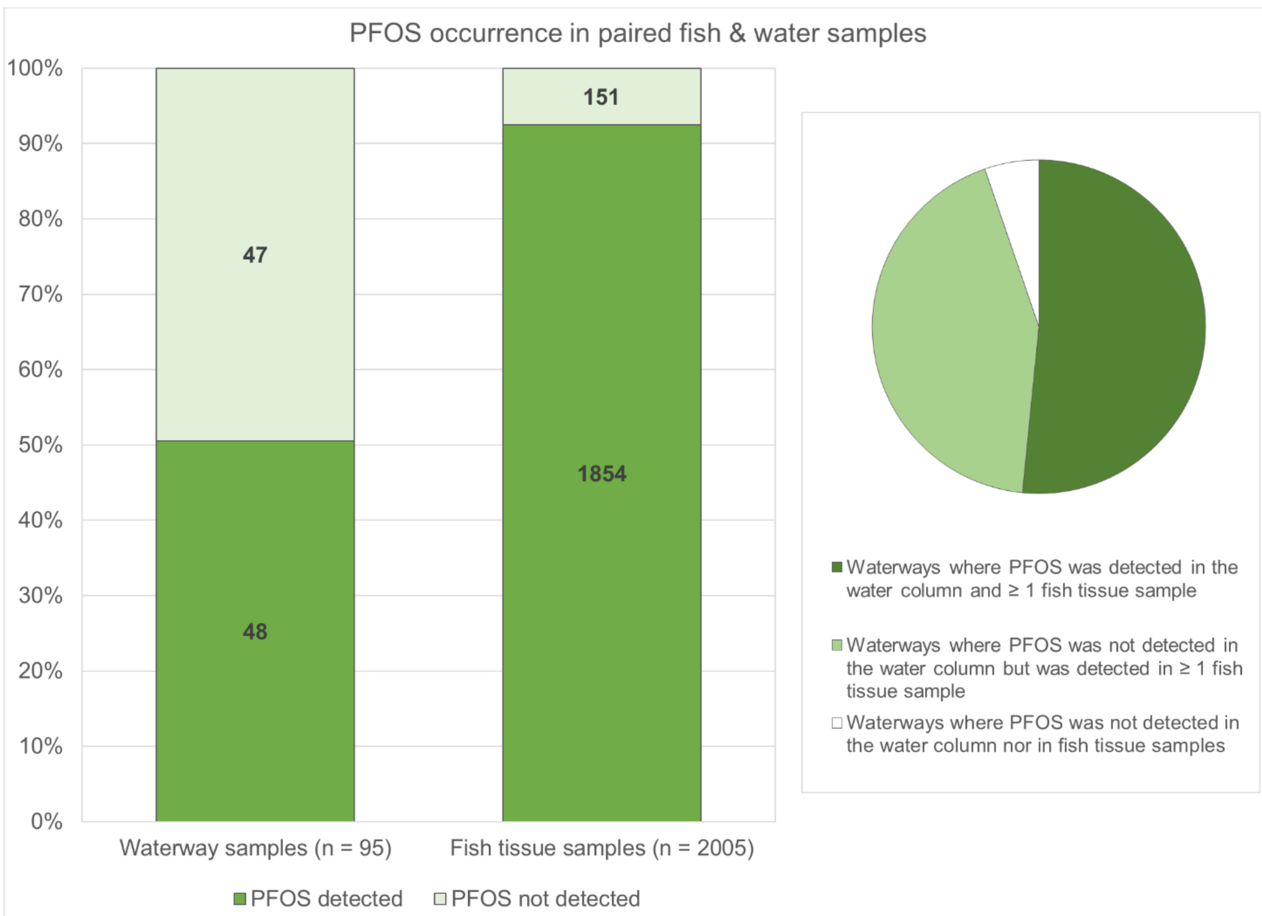


Figure 4. PFOS occurrence patterns in samples from the paired fish and water dataset. Most fish tissue samples contained detectable levels of PFOS, and surface water samples from approximately 50% of waterways contained detectable levels of PFOS. Fish that contained PFOS were found even in waterways where PFOS was not detected in water samples (pie chart).

The pattern that was observed in the paired fish and water dataset of PFOS being detected in most fish tissue samples was mirrored in the fish contaminants data, where more than 85% of fish samples contained detectable levels of PFOS. In the LTT dataset, PFOS was detected in over 62% of waterways.

The data described above suggests that PFOS is a highly bioaccumulative compound[7] (in contrast with PFOA, which is rarely detected in fish tissue samples but widely detected in the water; Fig. 7) and further suggests that exposure to PFOS via fish consumption is likely to provide a substantive contribution to overall body burdens of PFOS. This conclusion is further supported by work done by the Great Lakes Consortium for Fish Consumption Advisories. Their 2019 Best Practice for PFOS Guidelines[5] document explored sources of PFOS to determine whether it was necessary to include a measure of Relative Source Contribution (RSC) when calculating fish consumption advisories for PFOS. They used serum data from the 2013-2014 National Health and Nutrition Examination Survey (NHANES) to calculate an average background exposure of 0.423 ng/kg-day. This background exposure value was then compared to exposure from consuming one meal per month of fish containing 50 ng/g PFOS, which was estimated to be 5.4 ng/kg-day. Their analysis indicates that fish consumption is overwhelmingly the dominant PFOS exposure pathway, and they conclude that an RSC is not needed. The department agrees with these conclusions and therefore chose to define a criterion for PFOS using water concentrations that are associated with certain fish tissue concentrations (described below) in order to protect Wisconsin's public health and welfare designated use (Fig. 1).

Further, the department agrees with the Consortium on its selection of reference dose, as there are benefits to consuming fish that offset, in part, some of the negative health effects of PFOS.

Modeling the Relationship between PFOS in Water and in Fish Tissue

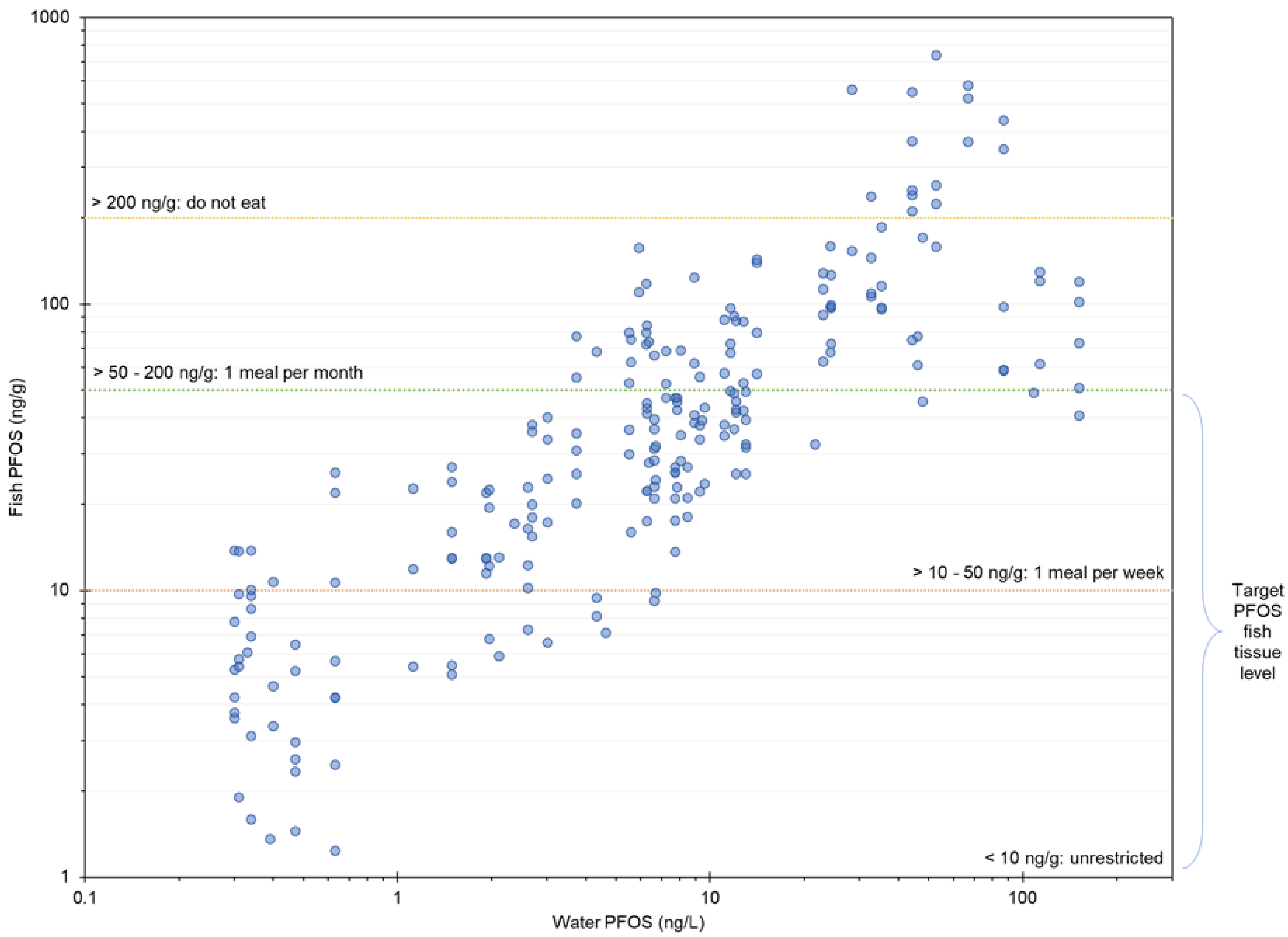
PFOS was detected in both fish tissue and water samples from 49 waterways in the paired fish tissue and water dataset described above and there is a clear log-linear relationship between levels of PFOS in the water and those in fish tissue ($R^2 = 0.69$, $p<0.001$; Fig. 5). In other words, the level of PFOS in the water is a good predictor of the level of PFOS that will be in fish taken from that water.

Once the department had identified that fish consumption is humans' primary PFOS exposure route and that water PFOS concentrations can be used to predict fish PFOS concentrations, we needed to determine a threshold where the PFOS concentration in the water will pose a risk to human health via fish consumption. Fortunately, we already have a relevant number for fish tissue concentrations we can use as a target. As shown in Fig. 5, fish PFOS concentrations are associated with different consumption advisory meal categories. These categories were developed using a reference dose (RfD) of 2×10^{-5}

[7] While the department did not incorporate a bioaccumulation factor (BAF) into the PFOS criterion as part of this proposed rule, the paired fish and water dataset was used to calculate a PFOS BAF of 4,745 L/kg for illustrative purposes. Similarly, a portion of this dataset was used by the MN Pollution Control Agency to calculate a geometric mean BAF of 4,289 L/kg, and a 90th percentile BAF of 7,210 L/kg for the purposes of site-specific PFOS criteria derivation.

mg/kg-day[8] as the non-cancer toxicity value, a body weight of 70kg, a meal size of 227g, and an RSC of 100% as described above. Detailed information on how fish PFOS concentrations correspond to each fish consumption meal category can be found in Appendix B.

When the average concentration of PFOS in a species from a waterbody exceeds 50 ng/g, the department issues a special fish consumption advisory of 1 meal/month, depending on sample sizes and variability[5]. While there are some fish species that sensitive populations (i.e., women under 50 and children under 15) are always advised to consume no more than 1 meal/month, a special advisory is more stringent than the general statewide Safe Eating Guidelines and applies to everyone[9]. More information on the Fish Contaminant Monitoring and Advisory Program can be found at https://dnr.wisconsin.gov/topic/Fishing/consumption.



[8] United States Environmental Protection Agency. 2016. Health Effects Support Document for PFOS. EPA-822-R-16-002. Washington, DC. https://www.epa.gov/sites/production/files/2016-05/documents/pfos_hesd_final_508.pdf [last accessed September 2021]

[9] Schrank CS. 2014. Wisconsin's Fish Contaminant Monitoring and Advisory Program: 1970-2010. Fisheries Management Administrative Report No. 73. Wisconsin Department of Natural Resources, Madison, WI. https://p.widencdn.net/k0h6zw/Admin_FH073 [last accessed May 2021]

Figure 5. Relationship between concentrations of PFOS in water samples (x-axis) and fish tissue samples (y-axis) in Minnesota and Wisconsin waterbodies. Both fish tissue and water samples were averaged prior to analysis; thus, each circle represents the average PFOS concentration in fillets of a fish species from a waterbody and that waterbody's average water PFOS concentration. Horizontal dashed lines delineate fish PFOS concentrations that correspond to different meal frequency categories, and the brackets indicate fish PFOS concentration range that is targeted with this standard. The data that contributed to this figure can be found in Appendix A.

The department evaluated several models to determine the water PFOS concentration that best predicts, or best delineates, fish tissue that is over or under 50 ng/g. For all analyses, individual fish tissue concentrations from a given waterbody were averaged by species and water samples taken in the same open water season were averaged. For most analyses, species-average PFOS concentrations were then transformed into a binary response variable denoting whether the concentration was over or under the 50 ng/g target concentration. Individual fish were averaged by species because fish consumption advisories are set based on the arithmetic mean concentration of a pollutant in fish tissue, not the individual fish, in order to encompass the range of exposure concentrations to which a fish consumer might be exposed. Because the PFOS standard corresponds to a target fish tissue concentration used to set consumption advisories, the department elected to average each species' PFOS concentration in order to reflect the way that data are analyzed from a fish consumption standpoint.

The department conducted several statistical analyses and compared the thresholds from binary response analysis. Additionally, the department assessed thresholds developed using the original continuous fish tissue data to ensure our analytical techniques did not artificially obscure the observed relationship. Based on these evaluations, the department ultimately selected a method called the Receiver Operating Characteristics (ROC) curve to determine a water concentration that represents a level of public health significance. Information on the models that were evaluated but not selected, as well as analysis of PFOS data from individual fish using the ROC curve, can be found in Appendix C.

The ROC Curve Tool

The department used the statistical program R to run a mathematical tool called the ROC curve using the package pROC[10] on the data to predict the water concentration where most fish tissue concentrations exceed 50 ng/g PFOS.

The ROC curve is an analytical tool used to evaluate the performance of a binary response variable using bootstrapping to test several measures of model performance. Here, the binary response was whether the average fish tissue concentration in a species from a waterbody was below or above 50 ng/g PFOS. The ROC curve evaluates overall model performance using area under the curve (AUC) method. Water column PFOS concentrations reliably predicted fish tissue classification with strong model performance (AUC = 88.5% CI = 84.1-93.8, package pROC).

The ROC curve additionally calculates two metrics, known as sensitivity and specificity, of the observed model. Sensitivity measures how often responses (fish tissue concentration) that are actually above the threshold (50 ng/g PFOS) are predicted correctly. This is known as the true positive rate. Specificity measures how often responses below that threshold are correctly predicted. This is known as the true

[10] Robin X, Turck N, Hainard A, Tiberti N, Lisacek F, Sanchez JC, Müller M. 2011. pROC: an open-source package for R and S+ to analyze and compare ROC curves. BMC Bioinformatics 12(77). https://doi.org/10.1186/1471-2105-12-77

negative rate. The point where the sensitivity and specificity converge is often considered the numeric value where the predictor variable (water concentration) best predicts the response variable (fish tissue concentration). The R code used to run the ROC model, as well as other models that were not selected, can be found in Appendix D. The paired fish and water dataset upon which the models were run can be found in Appendix A.

Figure 6 shows sensitivity and specificity for this dataset. The water concentration value where the two curves converge is 8 ng/L PFOS. This means that at a water concentration of 8 ng/L PFOS, we are ~78% sure that fish tissue concentrations below that point are actually lower than 50 ng/g, and fish tissue concentrations above that point are actually greater than 50 ng/g. This is somewhat analogous to balancing the Type I and Type II error rate.

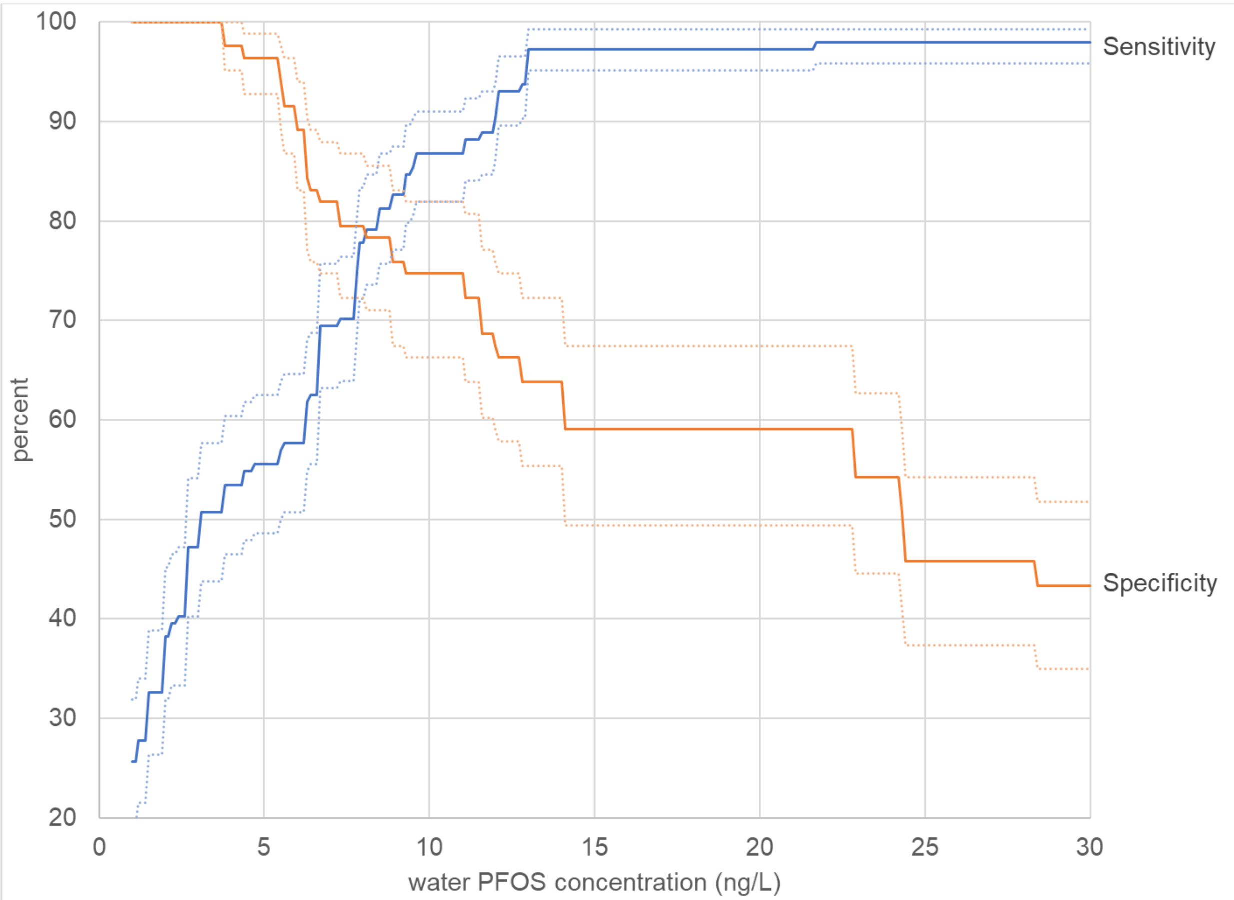


Figure 6. Specificity and sensitivity curves from the ROC analysis of the paired fish tissue and water PFOS dataset. Sensitivity measures how often the model correctly predicts fish tissue concentrations above 50 ng/g PFOS at a given water concentration. Specificity measures how often the model correctly predicts fish tissue concentrations below 50 ng/g at a given water concentration.

Thus, the department proposes that public health significance is defined as 8 ng/L PFOS in order to protect all people from adverse effects of PFOS in surface waters via consumption of fish taken from those surface waters.

Defining a level of public health significance for PFOA in surface waters

Summary

PFOA doesn't bioaccumulate to high concentrations in fish, and therefore water ingestion is the exposure pathway of most concern for PFOA. Thus, for the purposes of narrative criteria under NR102.04, it is reasonable to define public health significance based on the likelihood that, and degree to which, surface waters could be ingested.

This approach resulted in a proposed definition of public health significance which is dependent upon whether a waterbody is used as a public water supply. For public water supply waters, the department proposes that public health significance is defined as 20 ng/L PFOA. For non-public water supply waters, the department proposes that public health significance is defined as 95 ng/L PFOA.

Additional information on the basis for these proposed definitions is provided in subsequent sections of this document.

Waterbody Use	Exposure Pathway	Water Intake Rate	Level of Public Health Significance
Public Water Supply	Drinking water ingestion	1.0 L/day	20 ng/L
Non-Public Water Supply	Incidental ingestion during recreation	0.21 L/day	95 ng/L

Determining PFOA Exposure Pathways

To determine which pathway or pathways by which people might be exposed to PFOA, the department reviewed several datasets of samples analyzed for PFAS, including: 1) paired surface water and fish tissue samples collected from waterways throughout Wisconsin and Minnesota, 2) fish tissue samples collected as part of Wisconsin's fish contaminant monitoring program, and 3) surface water samples collected from major rivers as part of long term trends (LTT) monitoring in Wisconsin. Summary details about each dataset are displayed in in the table below.

Dataset	Number of Waterways	Number of Fish samples	Number of Species	Number of Water samples	Year(s)
Paired fish and water	95	2005	19	124	2006-2020
Fish contaminants	35	722	35	n/a	2006-2020
Rivers LTT	42	n/a	n/a	42	2020

In the paired fish and water dataset, PFOA was detected in surface water samples from over 80% of the waterways, but was detected in only 2% of fish tissue samples. Those fish samples that contained PFOA came from 8 waterways (Fig. 7). There were no PFOA detects in samples of fish taken from waterways where PFOA was undetected in the water itself.

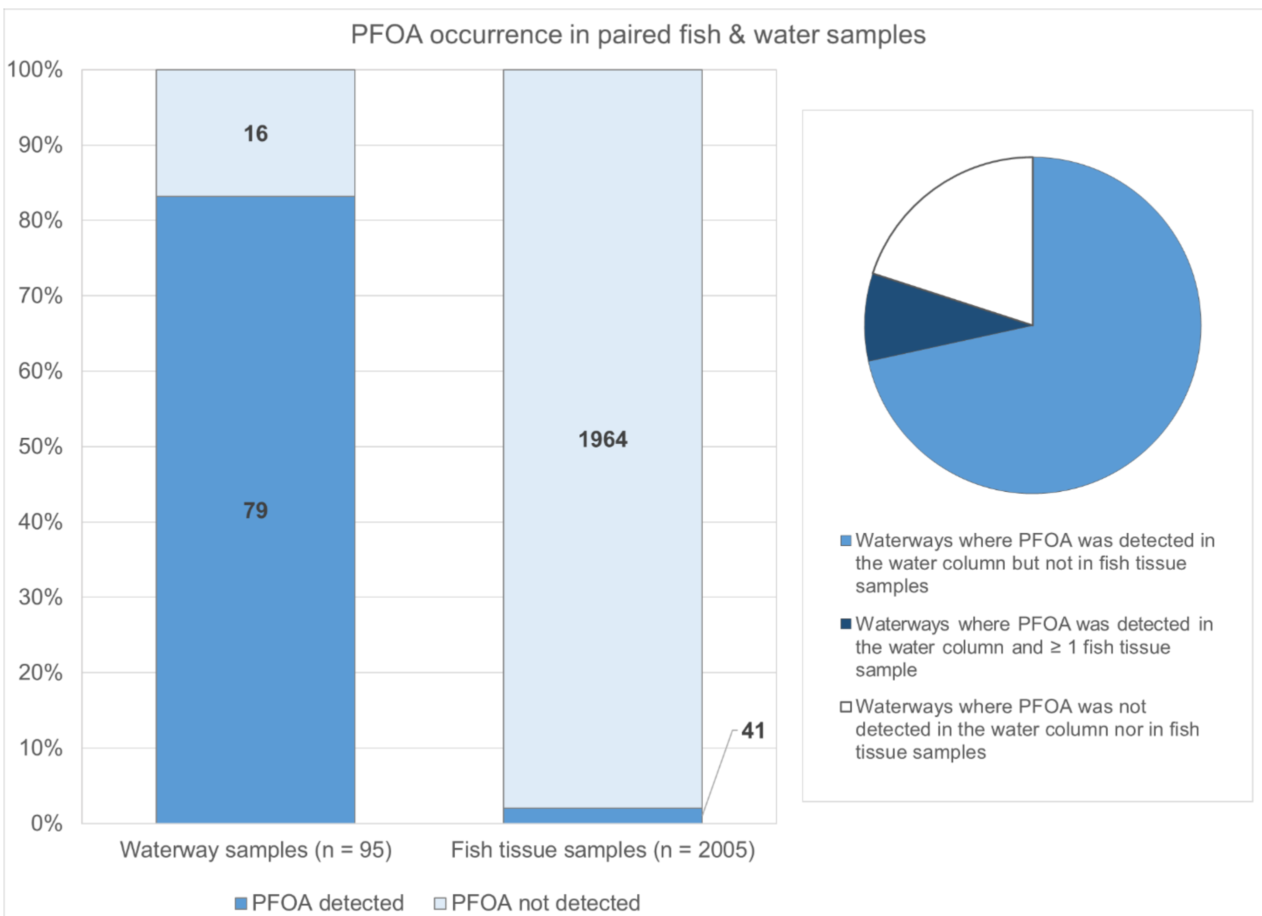


Figure 7. PFOA occurrence in samples from the paired fish and water dataset. Most water samples contained detectable levels of PFOA, while few fish tissue samples contained PFOA. Those fish that did contain PFOA were from a small proportion of waterways (pie chart).

The pattern that was observed in the paired fish and water dataset of PFOA being detected in most water samples, but few fish tissue samples, was mirrored in the fish contaminants and LTT datasets. Less than 4% of the fish samples contained detectable levels of PFOA (in contrast, over 85% of these fish samples contained detectable levels of PFOS). Similarly, in the LTT dataset, PFOA was detected in over 80% of waterways.

The data described above demonstrates that PFOA is unlikely to bioaccumulate in fish tissue. These accumulation patterns contrast with those of PFOS, which is widely detected in fish tissue samples even when it is not detected in the water (Fig. 4) and suggest that while there is widespread risk of exposure to PFOA via ingestion of surface waters, exposure via consumption of fish tissue is unlikely to provide a substantive contribution to overall body burdens of PFOA.[11]

<u>Public Health Significance for Public Water Supplies</u>

Based on the analysis described above, the department believes that for those waters currently used as public water supplies (lakes Superior, Michigan, and Winnebago), setting the level of public health significance as the level already defined by the Departments of Health Services (WDHS) and Natural Resources for the purposes of drinking water protection will protect Wisconsin's public health and welfare designated use (Fig. 1).

As part of a concurrent rulemaking process, the department is proposing to promulgate a drinking water maximum contaminant level (MCL) for PFOA of 20 ng/L. This proposed MCL is based on a recommended groundwater standard for PFOA released by WDHS in 2019[12] and was developed according to s.160.13(2)(c), Wis. Stats. using Formula 1 below. This formula is designed to protect children by incorporating a body weight of 10 kg, a drinking water intake rate of 1 L/day, and an assumption that water is the only source of PFOA (represented by an RSC of 100%). The ADI was set at 2 ng/kg-d based on risk of PFOA exposure to developing fetuses and infants. More information on how the ADI was developed can be found in the WDHS Scientific Support Document[12].

Formula 1:

$$Drinking\ Water\ MCL = \frac{ADI\left(\frac{ng/_{kg}}{day}\right) \times Body\ weight\ (kg)\ \times RSC}{Water\ Consumption\ \left(\frac{L}{day}\right)} = \frac{2\,\frac{ng/_{kg}}{day} \times 10kg \times 100\%}{1\,\frac{L}{day}} = 20\,\frac{ng}{L}$$

Where:

ADI = Acceptable Daily Intake
RSC = Relative Source Contribution

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[11] For a discussion of PFOA bioaccumulation factors and further explanation for the department's decision not to include fish consumption in the PFOA standard, see Appendix E.

[12] Wisconsin Department of Health Services. 2019. Scientific support document for PFOA groundwater standard. Madison, WI. https://dnr.wi.gov/topic/Contaminants/documents/pfas/PFOAScientificSupport.pdf [last accessed May 2021]

Public Health Significance for Non-Public Water Supplies

For waters not used as public water supplies, the water consumption rate in Formula 1 (above) may be adjusted to reflect the incidental water consumption rate by children that occurs during recreation. To determine the incidental ingestion rate, the department followed an approach published by EPA in 2019[13].

Incidental Ingestion Rate

The incidental ingestion rate (L/day) is a product of the ingestion volume (L/hour) and the recreation duration (hours/day), shown in Formula 2.

Formula 2:

$$Ingestion\ Volume\ \left(\frac{L}{hour}\right) \times Recreation\ Duration\ \left(\frac{hours}{day}\right) = Daily\ Incidental\ Ingestion\ Rate\ \left(\frac{L}{day}\right)$$

To calculate recreational incidental ingestion rates for different age groups, EPA (2019) explored the distributions of incidental ingestion volumes and exposure durations. Then, consistent with EPA's Human Health Methodology[14], the 90th percentile of the combined distribution of ingestion rate and exposure duration was used to represent incidental ingestion per day.

The resulting probability density plots of the combined distributions display how likely it is that each age group will ingest a certain amount of water per day (Fig. 8, from EPA 2019). The data that contributed to these distributions are discussed in more detail in the following sections.

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[13] United States Environmental Protection Agency. 2019. Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin. EPA/822/R-19/001. Washington, DC. https://www.epa.gov/wqc/recommended-human-health-recreational-ambient-water-quality-criteria-or-swimming-advisories [last accessed May 2021]

[14] United States Environmental Protection Agency. 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health. EPA/822/B-00/004. Washington, DC. https://www.epa.gov/wqc/methodology-deriving-ambient-water-quality-criteria-protection-human-health-2000-documents [last accessed May 2021]

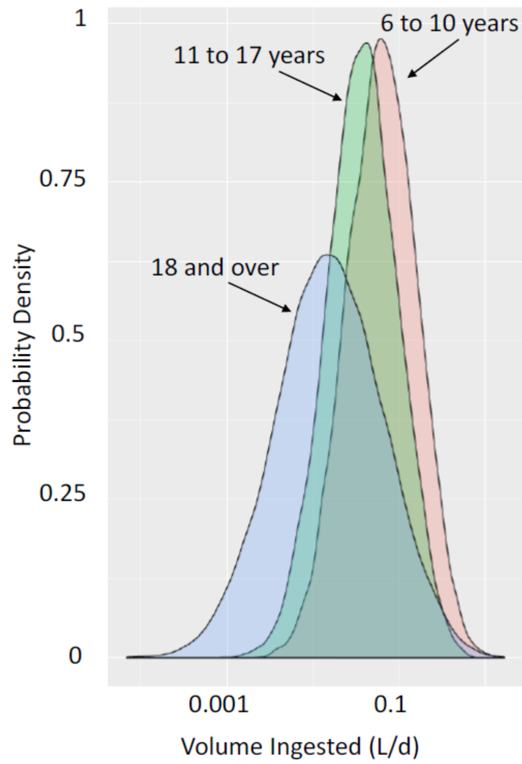

Figure 8. Probability density plots of ingestion rates for different age groups (from EPA 2019). The following sections describe how these plots were derived.

Determination of Ingestion Volume

EPA (2019) evaluated seven ingestion studies and ultimately selected the dataset collected and analyzed by Dufour et al. (2017)[15] which included age information for each participant (ages 6 to 81 years) and recorded each participant's time spent in the water. This study used the same methodology as an earlier study[16] but included 10 times more participants. Both studies used cyanuric acid as an indicator of the amount of pool water ingested while swimming in an outdoor pool. Researchers collected pool water samples before the start of swimming activities, and participants' urine was collected for 24 hours after the swimming event ended. Pool water and urine samples were then analyzed for cyanuric acid to determine ingestion rates.

EPA (2019) selected the Dufour et al. (2017) dataset to calculate incidental ingestion volume because the study included a larger number of participants and additional age groups, and recorded the duration of exposure of each participant. Appendix F of EPA (2019) describes in more detail the seven studies that were evaluated as part of this analysis and provides additional rationale for selecting Dufour et al. (2017).

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[15] Dufour AP, Behymer TD, Cantú R, Magnuson M, Wymer LJ. 2017. Ingestion of swimming pool water by recreational swimmers. Journal of Water and Health 15(3): 429-437. https://doi.org/10.2166/wh.2017.255

[16] Dufour AP, Evans O, Behymer TD, Cantú R. 2006. Water ingestion during swimming activities in a pool: A pilot study. Journal of Water Health 4(4): 425-430. https://doi.org/10.2166/wh.2006.0026

The raw data collected and analyzed by Dufour et al. (2017) was provided by the study authors. EPA (2019) normalized the volume ingested by each participant to one hour based on the length of time that the participant reported being in the water, then calculated density plots for the ingestion volume per recreation event for different age groups (Fig. 9, from EPA 2019).

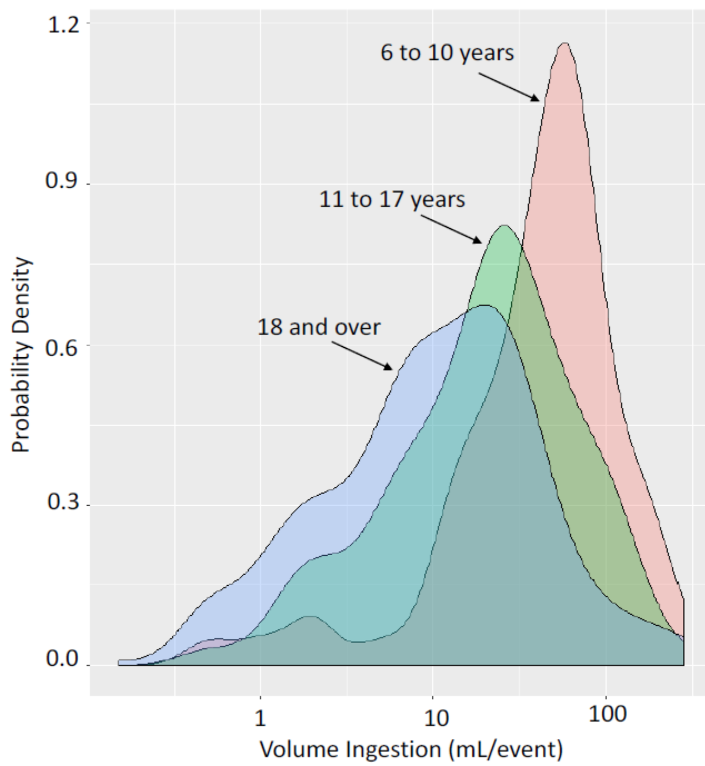

Figure 9. Probability density plots of ingestion volume per recreational event for different age groups (from EPA 2019). Plots were developed by normalizing each participant's volume ingested to one hour based on the length of time they reported being in the water. Data from this analysis, along with the data on the amount of time spent recreating each day shown in Figure 10, was combined to generate the daily ingestion rates shown in Figure 8.

Determination of Recreational Exposure Duration

For the purposes of developing surface water criteria, recreational exposure duration quantifies the length of time that people might be exposed to contaminants in surface waters during primary contact recreation. Defining the exposure duration allows for the recreational ingestion volumes calculated above to be converted to an amount incidentally ingested per day.

EPA (2019) selected recreational exposure data from Table 16-20 of the Exposure Factors Handbook[17] (EFH) for the development of incidental ingestion rates. Table 16-20 of the 2011 EFH lists time spent per 24 hours in an outdoor pool or spa for different age groups. These data are based on analysis of the

[17] United States Environmental Protection Agency. 2011. Exposure Factors Handbook 2011 Edition (Final). EPA/600/R-09/052F. Washington, DC. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252 [last accessed May 2021]

1996 National Human Activity Pattern Survey[18]. Although they do not directly measure time spent in freshwaters, previous research[19] demonstrates that time spent in outdoor swimming pools is similar to time spent in freshwaters and thus EPA (2019) concluded that these data could reasonably be used to represent recreational exposure to freshwaters. Figure 10 displays the range of recreational duration data for different age groups.

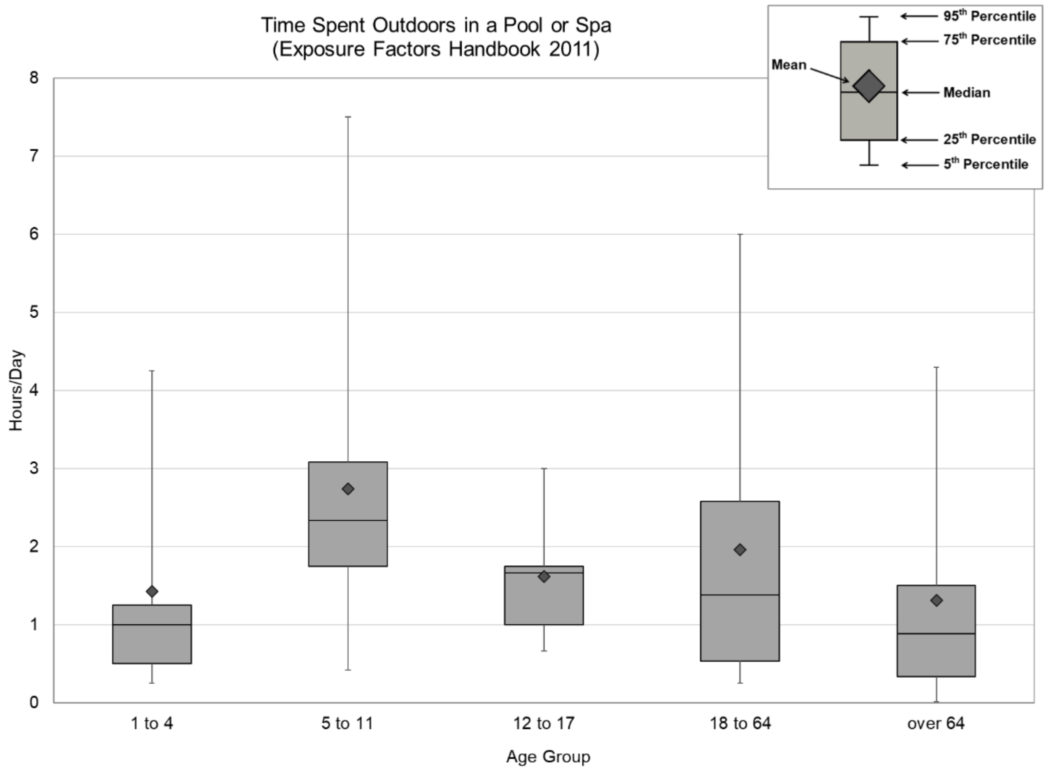

Figure 10. Summary statistics for the amount of time that was spent outdoors in a pool or spa each day by people of different age groups.

[18] United States Environmental Protection Agency. 1996. Descriptive statistics from a detailed analysis of the National Human Activity Pattern Survey (NHAPS) responses. EPA/600/R-96/148. Washington, DC.

[19] Schets FM, Schijven JF, de Roda Husman AM. 2011. Exposure assessment for swimmers in bathing waters and swimming pools. Water Research 45(7): 2392-2400. https://doi.org/10.1016/j.watres.2011.01.025

Determination of Daily Incidental Ingestion

As mentioned above, the incidental ingestion rate (L/day) is the product of the distribution of incidental ingestion volumes from Dufour et al. (2017) and the distribution of exposure durations from the EFH.

Understanding that there are many different daily ingestion rates that could be calculated from the combination of ingestion volumes and recreation durations reported in the literature, EPA (2019) used the statistical program R to run a mathematical model called a Monte Carlo simulation. This model calculates the distribution of possible ingestion rates for each age group using the following steps:

1) Using the descriptive statistics that were reported in the literature, estimate distributions for ingestion volume and recreation duration for each age group.
2) Randomly select one value from each distribution calculated in step 1.
3) Multiply the two sampled values together to produce an ingestion rate.
4) Repeat steps 2 and 3 over and over (1,000,000 times) to create the distribution of possible daily ingestion rates for each age group.

The distributions and summary statistics resulting from the Monte Carlo simulations are shown on the following pages in Figure 11 and Table 1, respectively. The annotated R code for this analysis is shown in Appendix F.

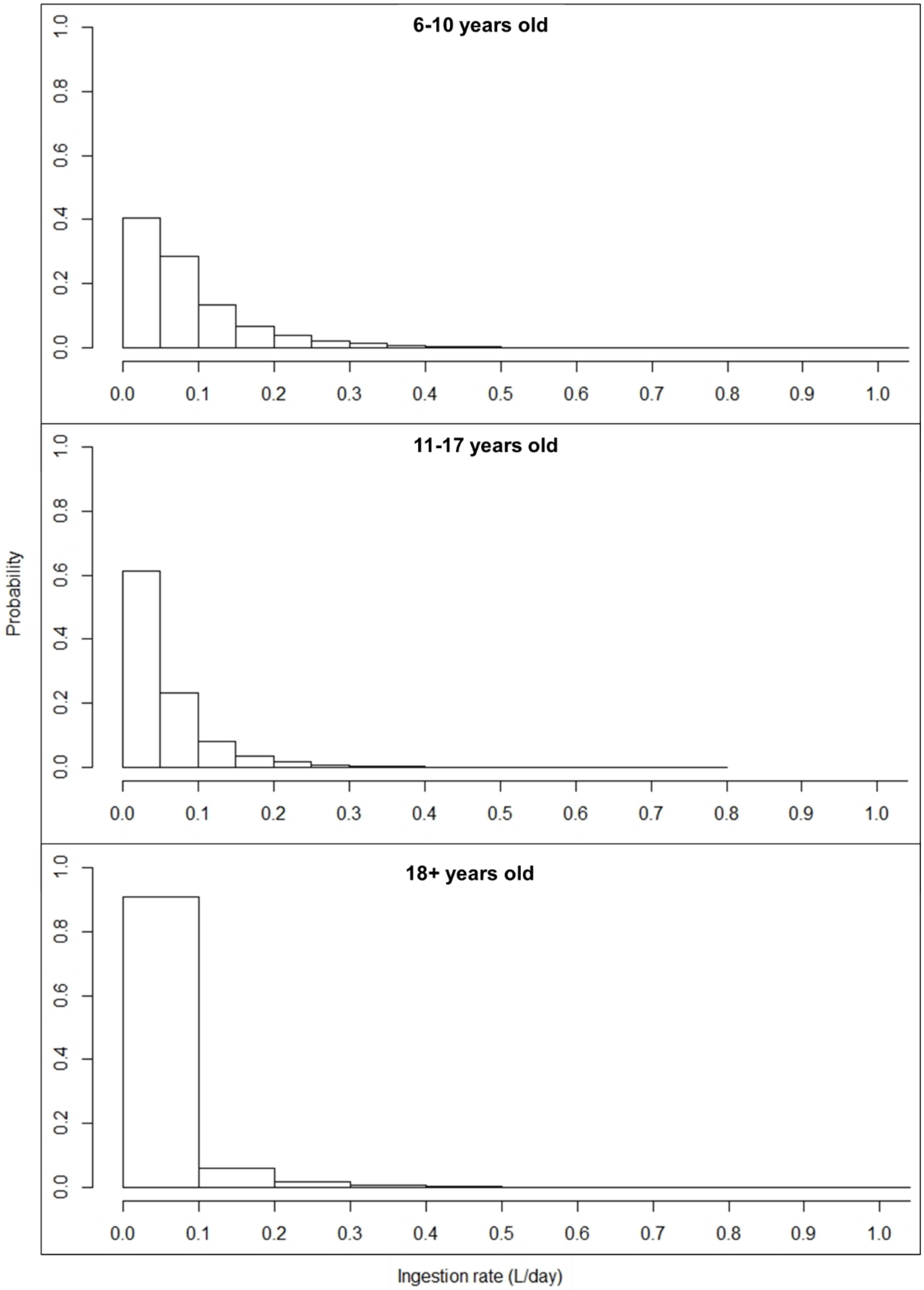

Figure 11. Probability distributions demonstrating the range of ingestion rates that could be calculated by combining ingestion volume and recreation duration data for each age group.

Table 1. Summary statistics for the different age groups based on the distributions produced by the Monte Carlo simulation.

Age Group	Summary Statistics for Ingestion Rate (L/day)		
	Median	Mean	90th Percentile
6 to 10 years	0.063	0.094	0.21
11 to 17 years	0.038	0.058	0.13
18+ years	0.015	0.04	0.10

In order to assess the risk of PFOA exposure to children during recreation in surface waters and as per EPA's 2000 Human Health Methodology, the department selected the 90th percentile of exposure for the 6 to 10 years old age group (0.21 L/day) as a point estimate for deriving the level of public health significance for PFOA in non-public water supply waters.

As mentioned on page 19 of this document, Formula 1 was used to develop the drinking water MCL and the criterion for surface waters used as public water supplies. Substituting the incidental ingestion rate of 0.21 L/day for the drinking water intake rate of 1 L/day into Formula 1 produces a value of 95.24 ng/L, which represents the PFOA criterion for non-public water supply waters.

$$\frac{ADI\left(\frac{ng/kg}{day}\right)\times Body\,weight\,(kg)\;\times RSC}{Water\;Consumption\left(\frac{L}{day}\right)} = \frac{2\frac{{}^{ng}/_{kg}}{day}\times 10kg\;\times 100\%}{0.21\,\frac{L}{day}} = 95.24\,ng/L$$

Thus, the department proposes a criterion of 95 ng/L for non-public supply waters in order to protect children from adverse effects of PFOA in surface waters via incidental ingestion while recreating.

Criteria magnitude, duration, and frequency

Water quality criteria consist of three components: magnitude, duration, and frequency. These three components are used when assessing a waterbody's impairment status and determining the need for pollutant minimization plans or setting water quality based effluent limits (WQBELs) in permits.

For waterbody assessments, magnitude is the numeric threshold for determining if the waterbody is meeting the criterion (i.e. the levels of public health significance described above), duration is used to select the period over which data are analyzed, and frequency of exceedance is used in determining whether the criterion is attained based on how frequently the threshold is exceeded.

IMPLEMENTATION

Waterbody Assessments

The CWA requires states to prepare a report every 2 years that documents the results of waterbody assessments. This report is titled Wisconsin's Water Quality Report to Congress[20] and describes which waterbodies are attaining their designated uses (healthy waters) and which are not meeting water quality standards (impaired waters).

Assessments are conducted by comparing available water quality data[21] to established criteria and then determining whether the waterbody supports its designated uses (Fig. 1). Thus, every criteria value or description should ideally contain the duration and frequency components described in the previous section, so that waterbody assessments are not based on a rare, limited-time event that does not represent the typical conditions of the waterbody.

This rule package proposes to add language in NR 102.04(8)(d)2. specifying that "a surface water shall be considered an impaired water if the PFOS or PFOA level of public health significance is exceeded more than once every 3 years". An exceedance frequency of no more than once every 3 years is consistent with what is currently recommended in Wisconsin's Consolidated Assessment and Listing Methodology (WisCALM) to protect the public health and welfare designated use[22]. Samples taken within 30 days of an exceedance event may be considered part of the same event (i.e., duration of exceedance), while samples taken 30 or more days apart will be considered separate events. The department plans to add assessment protocols specific to PFOS and PFOA in the next revision of WisCALM.

[20] The most recent version of this report as well as previous years' reports can be found at https://dnr.wisconsin.gov/topic/SurfaceWater/Congress.html
[21] Waterbodies may also be listed as impaired if PFOS in fish tissue taken from that waterbody are high enough to warrant a special fish consumption advisory.
[22] WDNR. 2021. Wisconsin 2022 Consolidated Assessment and Listing Methodology for CWA Section 303(d) and 305(b) Integrated Reporting. Guidance # 3200-2021-01.

Attainment Sampling

To reliably assess a waterbody for PFOS and PFOA using the exceedance frequency metric described above, the department must have a dataset with at least 2 sample events, which are at least 30 days apart to identify separate exceedance events, within a 3-year period. Surface water PFAS samples may be collected at the same time and same location within a waterbody as other water quality parameters (water chemistry, secchi depth, etc.) as long as collectors follow practices for sample collection, handling, and storage that minimize the potential for contamination[23].

Spills Sampling

Samples collected during and after a spill event are not necessarily representative of a waterbody's overall condition but are important for assessing public health and welfare. This is particularly true of spills of PFAS-containing products; due to their persistent nature, PFAS spills may pose an increased risk to public health and welfare because the spill impact may be longer in duration.

When conducting a waterbody assessment initial spill samples may or may not be used as representative samples for assessment purposes depending on the duration of contamination. Department staff may use best professional judgment to determine the duration of the spill event's impact, up to 3 months. If, after 3 months, PFOS or PFOA levels have returned to pre-spill levels, spill event samples will likely be excluded from the assessment because they represent a short-term impact. However, if PFOS or PFOA levels remain elevated after 3 months, spill event samples may be used for waterbody assessment.

ANALYTICAL METHODS

Chapter NR 219 contains Table F, "Required Containers, Preservation Techniques, and Holding Times for wastewater". This table is revised as part of this rule package to include requirements for sample collection and storage for the analysis of PFAS compounds in multiple media. Footnote numbering in department tables differs from EPA methods because EPA rows pertinent only to marine environments are not included in Wisconsin code.

Information about adjacent states' approaches to regulating PFAS can be found in Appendix G.

[23] A useful resource for sampling PFAS in surface waters can be found at: https://www.michigan.gov/documents/pfasresponse/Surface_Water_PFAS_Sampling_Guidance_639408_7.pdf or by visiting https://michigan.gov/pfasresponse/ and searching for "Surface Water Sampling Guidance".

Appendix A: Samples where PFOS was detected in both fish and water

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Bde Maka Ska (Calhoun)	MN	11/15/2006	Bluegill	1	Scaled, skin-on fillet	15	65	3	F	0.76	181
Bde Maka Ska (Calhoun)	MN	11/15/2006	Bluegill	1	Scaled, skin-on fillet	16	60	3	F	0.58	311
Bde Maka Ska (Calhoun)	MN	11/15/2006	Bluegill	1	Scaled, skin-on fillet	13	62	2	F	0.8	356
Bde Maka Ska (Calhoun)	MN	11/15/2006	Bluegill	1	Scaled, skin-on fillet	15.5	59	3	F	1.02	373
Bde Maka Ska (Calhoun)	MN	11/15/2006	Bluegill	1	Scaled, skin-on fillet	16	68	3	F	0.68	373
Bde Maka Ska (Calhoun)	MN	11/15/2006	Surface water								104
Bde Maka Ska (Calhoun)	MN	11/15/2006	Surface water								105
Bde Maka Ska (Calhoun)	MN	11/15/2006	Surface water								115
Bde Maka Ska (Calhoun)	MN	11/15/2006	White sucker	1	Scaled, skin-on fillet	35	660	3	J	0.78	49.1
Bde Maka Ska (Calhoun)	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	17.5	71	4	F	0.75	129
Bde Maka Ska (Calhoun)	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	14.5	47	3	M	0.68	233
Bde Maka Ska (Calhoun)	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	17	62	4	F	0.55	242
Bde Maka Ska (Calhoun)	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	18	44	4	F	0.82	296
Bde Maka Ska (Calhoun)	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	14	191	6	F	0.64	327
Bde Maka Ska (Calhoun)	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet		72	4	M	0.69	376
Bde Maka Ska (Calhoun)	MN	5/28/2008	Bluegill	1	Scaled, skin-on fillet	16	72	5	M	0.66	168
Bde Maka Ska (Calhoun)	MN	5/28/2008	Bluegill	1	Scaled, skin-on fillet	15	50	4	F	0.97	199
Bde Maka Ska (Calhoun)	MN	5/28/2008	Bluegill	1	Scaled, skin-on fillet	15	69	4	M	0.71	204
Bde Maka Ska (Calhoun)	MN	5/28/2008	Bluegill	1	Scaled, skin-on fillet	15	68	4	M	0.92	212
Bde Maka Ska (Calhoun)	MN	5/28/2008	Bluegill	1	Scaled, skin-on fillet	14	56	4	F	0.83	236
Bde Maka Ska (Calhoun)	MN	5/28/2008	Bluegill	4	Scaled, skin-on fillet	15.5	67			0.81	267
Bde Maka Ska (Calhoun)	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	41	1432	9	F	0.56	308
Bde Maka Ska (Calhoun)	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	31	392	5	F	0.24	367
Bde Maka Ska (Calhoun)	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	31	464	5	M	0.27	394
Bde Maka Ska (Calhoun)	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	43	1473	10	F	0.65	520
Bde Maka Ska (Calhoun)	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	25	236	3	M	0.63	539
Bde Maka Ska (Calhoun)	MN	8/5/2008	Surface water								33.1
Bde Maka Ska (Calhoun)	MN	8/5/2008	Surface water								35.1
Bde Maka Ska (Calhoun)	MN	8/5/2008	Surface water								42
Bde Maka Ska (Calhoun)	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	14.5	13	3	F		69
Bde Maka Ska (Calhoun)	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	14	10	3	J		84.1
Bde Maka Ska (Calhoun)	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	15	9	3	M		96.1
Bde Maka Ska (Calhoun)	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	15.5	16	3	M		105
Bde Maka Ska (Calhoun)	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	14	11	3	M		107
Bde Maka Ska (Calhoun)	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	17	17	4	F		116
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	11	24	2	J		26.6
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	13.5	40	3	J		51.7
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	10	18	2	M		81.1

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	10.5	19	2	J		85
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	14	63	4	F		109
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15.5	89	5	M		114
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	13.5	52	3	J		122
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	16	82	5	M		128
Bde Maka Ska (Calhoun)	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15	69	5	M		161
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	32	482	5	M		70.4
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	32.5	516	5	F		138
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	32.5	572	5	F		158
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	38.5	1114	7	F		160
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	32.5	552	5	F		166
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	28.5	404	4	M		183
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	29.5	412	4	J		200
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	35.5	803	7	F		231
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	33	513	5	M		235
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	38	881	7	M		243
Bde Maka Ska (Calhoun)	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	41.5	1155	9	M		264
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	51	105	4	F		63.8
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	48	108	4	M		76.8
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	50	112	4	F		93
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	52.5	116	4	F		93.5
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	48	100	4	M		109
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	54	1325	4	J		119
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	52.5	120	4	M		122
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	57	450	4	F		129
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	47.5	103	4	F		139
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	51	116	4	M		139
Bde Maka Ska (Calhoun)	MN	5/28/2013	Northern pike	1	Scaled, skin-on fillet	71	3400	4	M		190
Bde Maka Ska (Calhoun)	MN	8/29/2013	Surface water								33.8
Bde Maka Ska (Calhoun)	MN	8/29/2013	Surface water								36.0
Bde Maka Ska (Calhoun)	MN	8/29/2013	Surface water								36.1
Bde Maka Ska (Calhoun)	MN	6/28/2016	Black crappie	1	Scaled, skin-on fillet	16	65.2	4	J		71.1
Bde Maka Ska (Calhoun)	MN	6/28/2016	Black crappie	1	Scaled, skin-on fillet	16.5	65.6	4	J		94.7
Bde Maka Ska (Calhoun)	MN	6/28/2016	Black crappie	1	Scaled, skin-on fillet	22.7	203.3	6	J		132
Bde Maka Ska (Calhoun)	MN	6/28/2016	Bluegill	1	Scaled, skin-on fillet	15.5	85.2	4	M		59.4
Bde Maka Ska (Calhoun)	MN	6/28/2016	Bluegill	1	Scaled, skin-on fillet	16.6	108.1	6	F		68.4
Bde Maka Ska (Calhoun)	MN	6/28/2016	Bluegill	1	Scaled, skin-on fillet	16.8	109.7	6	M		70.3
Bde Maka Ska (Calhoun)	MN	6/28/2016	Bluegill	1	Scaled, skin-on fillet	17.7	115.5	7	M		74
Bde Maka Ska (Calhoun)	MN	6/28/2016	Bluegill	1	Scaled, skin-on fillet	17	114.1	6	J		91.7
Bde Maka Ska (Calhoun)	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	20.1	109.5	2	J		105
Bde Maka Ska (Calhoun)	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	30	459.5	5	F		111
Bde Maka Ska (Calhoun)	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	26.3	304.6	4	M		125
Bde Maka Ska (Calhoun)	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	25.8	186	4	J		141
Bde Maka Ska (Calhoun)	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	37.8	738	7	M		150
Bde Maka Ska (Calhoun)	MN	6/28/2016	Northern pike	1	Scaled, skin-on fillet	27.5	133.8	2	J		73.7
Bde Maka Ska (Calhoun)	MN	6/28/2016	Northern pike	1	Scaled, skin-on fillet	57.5	1159	4	J		120
Bde Maka Ska (Calhoun)	MN	6/28/2016	Surface water								19.3

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Bde Maka Ska (Calhoun)	MN	6/28/2016	Surface water								25.8
Bde Maka Ska (Calhoun)	MN	6/28/2016	Surface water								27.8
Bde Maka Ska (Calhoun)	MN	7/26/2018	Surface water								11.1
Bde Maka Ska (Calhoun)	MN	7/26/2018	Surface water								12.2
Bde Maka Ska (Calhoun)	MN	7/26/2018	Surface water								12.5
Bde Maka Ska (Calhoun)	MN	9/8/2018	Northern pike	1	Scaled, skin-on fillet	46	743.0	4	M		16.1
Bde Maka Ska (Calhoun)	MN	9/8/2018	Northern pike	1	Scaled, skin-on fillet	38.5	415.1	3	J		48.4
Bde Maka Ska (Calhoun)	MN	9/8/2018	Northern pike	1	Scaled, skin-on fillet	41	459.1	3	J		50.3
Bde Maka Ska (Calhoun)	MN	9/8/2018	Northern pike	1	Scaled, skin-on fillet	45.6	715.6	4	F		55.9
Bde Maka Ska (Calhoun)	MN	9/8/2018	Northern pike	1	Scaled, skin-on fillet	61	1705.6	4	F		74
Bde Maka Ska (Calhoun)	MN	9/8/2018	Walleye	1	Scaled, skin-on fillet	41.6	723.5	6	M		78
Bde Maka Ska (Calhoun)	MN	9/8/2018	Walleye	1	Scaled, skin-on fillet	54	1595.6	10	M		104
Bde Maka Ska (Calhoun)	MN	9/8/2018	Yellow perch	1	Scaled, skin-on fillet	9.6	9.9	1	F		20.5
Bde Maka Ska (Calhoun)	MN	9/8/2018	Yellow perch	1	Scaled, skin-on fillet	12	19.6	2	F		27.4
Bde Maka Ska (Calhoun)	MN	9/8/2018	Yellow perch	1	Scaled, skin-on fillet	10	11.1	1	F		31.9
Bde Maka Ska (Calhoun)	MN	9/8/2018	Yellow perch	1	Scaled, skin-on fillet	14	30.8	3	F		37.1
Bde Maka Ska (Calhoun)	MN	9/8/2018	Yellow perch	1	Scaled, skin-on fillet	10.2	11.6	1	M		46.5
Bde Maka Ska (Calhoun)	MN	9/8/2018	Yellow perch	1	Scaled, skin-on fillet	12.5	21.9	2	F		56.2
Bearskull	WI	9/2/2020	Surface water								0.333
Bearskull	WI	9/2/2020	Walleye	1	Scaled, skin-on fillet	31.8	282		F		1.58
Bearskull	WI	9/2/2020	Walleye	1	Scaled, skin-on fillet	36.8	382		F		1.98
Bearskull	WI	9/2/2020	Walleye	1	Scaled, skin-on fillet	35.6	428		F		9.56
Bearskull	WI	9/2/2020	Walleye	1	Scaled, skin-on fillet	35.1	356		F		11.3
Black Earth Creek	WI	7/14/2020	Brown trout	1	Scaled, skin-on fillet	39.4	588		F		8.55
Black Earth Creek	WI	7/14/2020	Brown trout	1	Scaled, skin-on fillet	41.9	690		M		9.54
Black Earth Creek	WI	7/14/2020	Brown trout	1	Scaled, skin-on fillet	31.8	308		M		12.7
Black Earth Creek	WI	7/14/2020	Brown trout	1	Scaled, skin-on fillet	31.5	276		F		23.3
Black Earth Creek	WI	7/14/2020	Brown trout	1	Scaled, skin-on fillet	32.5	326		M		27.7
Black Earth Creek	WI	7/14/2020	Brown trout	1	Scaled, skin-on fillet	27.2	184		F		49.8
Black Earth Creek	WI	7/14/2020	Surface water								0.34
Black Earth Creek	WI	7/14/2020	Surface water								1.16
Clear	MN	6/6/2018	Bluegill	5	Scaled, skin-on fillet	17.0	104				47.2
Clear	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	67.3	1800				46
Clear	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	58.9	1150				55.4
Clear	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	62.5	1620				77.1
Clear	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	57.4	1250				77.7
Clear	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	59.7	1310				86.4
Clear	MN	6/6/2018	Walleye	1	Scaled, skin-on fillet	30.7	220				46.9
Clear	MN	6/6/2018	Walleye	1	Scaled, skin-on fillet	63.8	2490				47.1
Clear	MN	6/6/2018	Walleye	1	Scaled, skin-on fillet	40.6	600				51.2
Clear	MN	6/6/2018	Walleye	1	Scaled, skin-on fillet	36.1	420				53.1
Clear	MN	6/6/2018	Walleye	1	Scaled, skin-on fillet	43.2	630				65.5
Clear	MN	10/11/2018	Surface water								6.64
Clear	MN	10/11/2018	Surface water								7.78
Crystal	MN	6/1/2018	Black crappie	3	Scaled, skin-on fillet	19.1	113				77.3
Crystal	MN	6/1/2018	Bluegill	4	Scaled, skin-on fillet	12.0	47.5				61.4
Crystal	MN	10/22/2018	Surface water								45.8

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Crystal	MN	10/22/2018	Surface water								46.3
Duroy	WI	9/1/2020	Black crappie	1	Scaled, skin-on fillet	24.1	220		M		2.96
Duroy	WI	9/1/2020	Black crappie	1	Scaled, skin-on fillet	24.6	250		F		4.59
Duroy	WI	9/1/2020	Black crappie	1	Scaled, skin-on fillet	20.8	136		U		5.62
Duroy	WI	9/1/2020	Black crappie	1	Scaled, skin-on fillet	26.4	290		F		5.91
Duroy	WI	9/1/2020	Black crappie	1	Scaled, skin-on fillet	25.4	260		M		7.17
Duroy	WI	9/1/2020	Bluegill	1	Scaled, skin-on fillet	19.8	158		F		1.36
Duroy	WI	9/1/2020	Bluegill	1	Scaled, skin-on fillet	15.7	82		F		2.06
Duroy	WI	9/1/2020	Bluegill	1	Scaled, skin-on fillet	18.8	136		F		2.58
Duroy	WI	9/1/2020	Bluegill	1	Scaled, skin-on fillet	18.0	118		U		3.36
Duroy	WI	9/1/2020	Walleye	1	Scaled, skin-on fillet	42.2	728		F		1.94
Duroy	WI	9/1/2020	Walleye	1	Scaled, skin-on fillet	45.0	922		F		2.28
Duroy	WI	9/1/2020	Walleye	1	Scaled, skin-on fillet	40.6	586		F		2.33
Duroy	WI	9/1/2020	Walleye	1	Scaled, skin-on fillet	38.9	540		F		3.79
Duroy	WI	9/3/2020	Surface water								0.474
Elmo	MN	7/24/2008	Bluegill	1	Scaled, skin-on fillet	13	58	3	J	0.14	98
Elmo	MN	7/24/2008	Bluegill	1	Scaled, skin-on fillet	12.5	44	3	J	0.15	109
Elmo	MN	7/24/2008	Bluegill	1	Scaled, skin-on fillet	15	82	4	M	0.29	148
Elmo	MN	7/24/2008	Bluegill	1	Scaled, skin-on fillet	13	49	3	J	0.21	175
Elmo	MN	7/24/2008	Bluegill	1	Scaled, skin-on fillet	13.5	52	3	M	0.2	193
Elmo	MN	7/24/2008	Bluegill	5	Scaled, skin-on fillet	13.4	53.4			0.5	196
Elmo	MN	7/24/2008	Largemouth bass	1	Scaled, skin-on fillet	28	378	4	F	0.13	521
Elmo	MN	7/24/2008	Largemouth bass	1	Scaled, skin-on fillet	31	462	5	F	0.44	526
Elmo	MN	8/4/2008	Surface water								23.6
Elmo	MN	8/4/2008	Surface water								30.3
Elmo	MN	8/4/2008	Surface water								31.3
Elmo	MN	7/19/2016	Black crappie	1	Scaled, skin-on fillet	16	70.3	4	J		358
Elmo	MN	7/19/2016	Black crappie	1	Scaled, skin-on fillet	15.8	64.5	4	U		410
Elmo	MN	7/19/2016	Black crappie	1	Scaled, skin-on fillet	16.1	63.0	4	F		531
Elmo	MN	7/19/2016	Black crappie	1	Scaled, skin-on fillet	18.3	89.3	5	F		799
Elmo	MN	7/19/2016	Bluegill	1	Scaled, skin-on fillet	14	64.8	4	M		197
Elmo	MN	7/19/2016	Bluegill	1	Scaled, skin-on fillet	14.6	74.2	4	M		317
Elmo	MN	7/19/2016	Bluegill	1	Scaled, skin-on fillet	14.5	64.7	4	F		353
Elmo	MN	7/19/2016	Bluegill	1	Scaled, skin-on fillet	13.8	58.1	3	J		406
Elmo	MN	7/19/2016	Bluegill	1	Scaled, skin-on fillet	13.4	49.2	3	M		431
Elmo	MN	7/19/2016	Bluegill	1	Scaled, skin-on fillet	13.6	50.4	3	F		504
Elmo	MN	7/19/2016	Largemouth bass	1	Scaled, skin-on fillet	21.6	161.7	2	M		246
Elmo	MN	7/19/2016	Largemouth bass	1	Scaled, skin-on fillet	31.9	629.4	5	M		447
Elmo	MN	7/19/2016	Largemouth bass	1	Scaled, skin-on fillet	28.8	409.4	4	M		594
Elmo	MN	7/19/2016	Largemouth bass	1	Scaled, skin-on fillet	29.2	485.8	4	M		778
Elmo	MN	7/19/2016	Largemouth bass	1	Scaled, skin-on fillet	32.5	623.8	5	M		841
Elmo	MN	7/19/2016	Surface water								57.2
Elmo	MN	7/19/2016	Surface water								65.5
Elmo	MN	7/19/2016	Surface water								77.4
Elmo	MN	6/6/2018	Black crappie	4	Scaled, skin-on fillet	20.9	130				550
Elmo	MN	6/6/2018	Bluegill	5	Scaled, skin-on fillet	15.3	68				211
Elmo	MN	6/6/2018	Cisco	1	Scaled, skin-on fillet	27.9	190				9.98

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Elmo	MN	6/6/2018	Cisco	1	Scaled, skin-on fillet	31.8	290				43.5
Elmo	MN	6/6/2018	Cisco	1	Scaled, skin-on fillet	30.5	330				84.4
Elmo	MN	6/6/2018	Cisco	1	Scaled, skin-on fillet	31.0	300				114
Elmo	MN	6/6/2018	Cisco	1	Scaled, skin-on fillet	30.5	310				123
Elmo	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	62.2	1520				158
Elmo	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	64.8	2240				161
Elmo	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	62.0	1300				214
Elmo	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	63.8	2020				297
Elmo	MN	6/6/2018	Northern pike	1	Scaled, skin-on fillet	61.5	1550				368
Elmo	MN	6/6/2018	Walleye	1	Scaled, skin-on fillet	68.6	3210				370
Elmo	MN	6/6/2018	Yellow perch	3	Scaled, skin-on fillet	17.0	57				250
Elmo	MN	10/11/2018	Surface water								43.6
Elmo	MN	10/11/2018	Surface water								44.9
Fish (Dakota)	MN	9/17/2018	Black crappie	5	Scaled, skin-on fillet	18.8	74				24.4
Fish (Dakota)	MN	9/17/2018	Bluegill	5	Scaled, skin-on fillet	13.6	42				9.81
Fish (Dakota)	MN	9/17/2018	Northern pike	1	Scaled, skin-on fillet	67.1	2230				31.9
Fish (Dakota)	MN	9/25/2018	Surface water								6.58
Fish (Dakota)	MN	9/25/2018	Surface water								6.8
Fish Lake Flowage	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	25	264	7	F	0.55	74.1
Fish Lake Flowage	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	25	205	7	M	0.38	79.1
Fish Lake Flowage	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	18.5	86	5	J	1.31	80
Fish Lake Flowage	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	26	269	7	F	0.76	97.6
Fish Lake Flowage	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	26	209	7	M	0.76	103
Fish Lake Flowage	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	19	135	7	F	0.39	33.3
Fish Lake Flowage	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	20	170	7	M	0.61	35.2
Fish Lake Flowage	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	21	214	8	M	0.68	41.9
Fish Lake Flowage	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	21	214	8	F	1.05	45.4
Fish Lake Flowage	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	17	90	6	F	0.68	57.3
Fish Lake Flowage	MN	9/24/2008	Largemouth bass	1	Scaled, skin-on fillet	36	843	7	M	1.26	48.3
Fish Lake Flowage	MN	9/24/2008	Largemouth bass	1	Scaled, skin-on fillet	32	535	5	M	1.14	63.7
Fish Lake Flowage	MN	9/24/2008	Largemouth bass	1	Scaled, skin-on fillet	36	845	7	F	0.9	94.2
Fish Lake Flowage	MN	9/24/2008	Largemouth bass	1	Scaled, skin-on fillet	36	730	7	M	0.89	111
Fish Lake Flowage	MN	9/24/2008	Largemouth bass	1	Scaled, skin-on fillet	37	845	7	M	0	124
Fish Lake Flowage	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	51	608	4	M	0.19	7.3
Fish Lake Flowage	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	48	549	4	F	0.27	43
Fish Lake Flowage	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	46	542	4	F	0.34	43.6
Fish Lake Flowage	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	43	449	4	M	0.33	58.9
Fish Lake Flowage	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	49	960	4	M	0.58	82.9
Fish Lake Flowage	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	33	311	5	F	0.38	74.3
Fish Lake Flowage	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	36	442	5	F	0.61	76.9
Fish Lake Flowage	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	44.5	1008	7	F	1.03	82.3
Fish Lake Flowage	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	31	290	5	M	0.52	86.2
Fish Lake Flowage	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	34	321	5	M	0.69	116
Fish Lake Flowage	MN	10/30/2008	Surface water								8.84
Fish Lake Flowage	MN	10/30/2008	Surface water								9.78
Fish Lake Flowage	MN	10/30/2008	Surface water								19.7
Gervais	MN	5/1/2007	Black crappie	1	Scaled, skin-on fillet	16	65	4	F	0.65	112

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Gervais	MN	5/1/2007	Black crappie	1	Scaled, skin-on fillet	23	171	6	F	0.6	132
Gervais	MN	5/1/2007	Black crappie	1	Scaled, skin-on fillet	16	86	4	M	0.71	166
Gervais	MN	5/1/2007	Black crappie	1	Scaled, skin-on fillet	22	180	6	M	0.35	170
Gervais	MN	5/1/2007	Black crappie	1	Scaled, skin-on fillet	19	122	5	M	0.59	206
Gervais	MN	5/1/2007	Bluegill	1	Scaled, skin-on fillet	15	68	4	F	0.49	39.9
Gervais	MN	5/1/2007	Bluegill	1	Scaled, skin-on fillet	17	90	6	F	0.68	90.5
Gervais	MN	5/1/2007	Bluegill	5	Scaled, skin-on fillet	10.4	34			0.65	100
Gervais	MN	5/1/2007	Bluegill	1	Scaled, skin-on fillet	16	75	5	F	0.51	148
Gervais	MN	5/1/2007	Largemouth bass	1	Scaled, skin-on fillet	31	488	5	M	0.32	153
Gervais	MN	5/1/2007	Largemouth bass	1	Scaled, skin-on fillet	28	311	4	F	0.47	158
Gervais	MN	5/1/2007	Largemouth bass	1	Scaled, skin-on fillet	47	2268	11	F	0.85	159
Gervais	MN	5/1/2007	Largemouth bass	1	Scaled, skin-on fillet	33	661	5	M	0.48	221
Gervais	MN	5/1/2007	Largemouth bass	1	Scaled, skin-on fillet	29	385	4	M	0.63	227
Gervais	MN	8/4/2008	Surface water								5.28
Gervais	MN	8/4/2008	Surface water								5.42
Gervais	MN	8/4/2008	Surface water								7.07
Gervais	MN	5/13/2018	Black crappie	1	Scaled, skin-on fillet	22.6	190				79.5
Gervais	MN	5/13/2018	Bluegill	10	Scaled, skin-on fillet	16.6	101				29.9
Gervais	MN	5/13/2018	Largemouth bass	1	Scaled, skin-on fillet	24.9	210				27.7
Gervais	MN	5/13/2018	Largemouth bass	1	Scaled, skin-on fillet	39.4	920				33.6
Gervais	MN	5/13/2018	Largemouth bass	1	Scaled, skin-on fillet	34.3	690				46.2
Gervais	MN	5/13/2018	Largemouth bass	1	Scaled, skin-on fillet	28.4	320				49.4
Gervais	MN	5/13/2018	Largemouth bass	1	Scaled, skin-on fillet	25.7	230				50.8
Gervais	MN	5/13/2018	Largemouth bass	1	Scaled, skin-on fillet	36.8	650				55.5
Gervais	MN	5/13/2018	Largemouth bass	1	Scaled, skin-on fillet	39.4	900				73.5
Gervais	MN	5/13/2018	Largemouth bass	1	Scaled, skin-on fillet	37.1	850				87.1
Gervais	MN	5/13/2018	Northern pike	1	Scaled, skin-on fillet	50.5	700				28.9
Gervais	MN	5/13/2018	Northern pike	1	Scaled, skin-on fillet	58.4	1400				44.2
Gervais	MN	8/9/2018	Surface water								5.48
Gervais	MN	8/9/2018	Surface water								5.51
Harriet	MN	5/29/2008	Black crappie	1	Scaled, skin-on fillet	20	84	5	F	0.69	113
Harriet	MN	5/29/2008	Black crappie	1	Scaled, skin-on fillet	19	70	5	F	0.61	115
Harriet	MN	5/29/2008	Black crappie	1	Scaled, skin-on fillet	17	58	4	M	0.43	141
Harriet	MN	5/29/2008	Black crappie	1	Scaled, skin-on fillet	18	78	4	M	0.7	155
Harriet	MN	5/29/2008	Black crappie	1	Scaled, skin-on fillet	20	96	5	M	0.75	168
Harriet	MN	5/29/2008	Bluegill	1	Scaled, skin-on fillet	15	52	4	M	0.63	125
Harriet	MN	5/29/2008	Bluegill	1	Scaled, skin-on fillet	17	63	6	M	0.58	125
Harriet	MN	5/29/2008	Bluegill	1	Scaled, skin-on fillet	13.5	38	3	M	0.77	132
Harriet	MN	5/29/2008	Bluegill	1	Scaled, skin-on fillet	14	39	3	M	1.05	150
Harriet	MN	5/29/2008	Bluegill	1	Scaled, skin-on fillet	15	52	15	M	0.47	153
Harriet	MN	5/29/2008	Largemouth bass	1	Scaled, skin-on fillet	33	537	5	F	0.3	128
Harriet	MN	5/29/2008	Largemouth bass	1	Scaled, skin-on fillet	29	303	4	F	0.24	151
Harriet	MN	5/29/2008	Largemouth bass	1	Scaled, skin-on fillet	29	337	4	M	0.24	199
Harriet	MN	5/29/2008	Largemouth bass	1	Scaled, skin-on fillet	33	517	5	M	0.32	252
Harriet	MN	5/29/2008	Largemouth bass	1	Scaled, skin-on fillet	43	1444	10	M	1.13	407
Harriet	MN	8/5/2008	Surface water								16.6
Harriet	MN	8/5/2008	Surface water								21.3

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Harriet	MN	8/5/2008	Surface water								50.6
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	19	131	5	F		62.8
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	20.5	136	5	F		83.3
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	21.5	150	6	F		96.8
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	19.5	146	5	F		104
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	16.5	81	4	F		105
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	18.5	107	5	F		106
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	17	93	4	F		108
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	20	141	5	F		127
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	19.5	132	5	F		135
Harriet	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	18	121	5	F		136
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15	66	4	M		88.5
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	14.5	58	4	F		92.1
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15.5	78	5	M		93.1
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15	61	4	F		93.4
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15.5	79	5	F		103
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15	70	4	F		103
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	16	84	5	F		108
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15	77	4	F		109
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15	68	4	F		111
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15.5	84	5	M		112
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15.5	55	5	F		119
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	14.5	69	4	F		121
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	14.5	64	4	M		124
Harriet	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15.5	82	5	M		126
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	24	197	3	J		171
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	28	359	4	F		207
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	25	241	3	J		208
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	25	324	3	F		212
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	24.5	213	3	F		218
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	25.5	233	3	F		219
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	37.5	756	7	M		262
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	27.5	321	4	M		262
Harriet	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	30.5	387	4	F		298
Harriet	MN	8/29/2013	Surface water								30.5
Harriet	MN	8/29/2013	Surface water								33.5
Harriet	MN	8/29/2013	Surface water								33.9
Harriet	MN	9/16/2013	Northern pike	1	Scaled, skin-on fillet	67	2275	5	F		133
Harriet	MN	9/16/2013	Northern pike	1	Scaled, skin-on fillet	58	1450	4	F		135
Harriet	MN	9/16/2013	Northern pike	1	Scaled, skin-on fillet	59	1500	4	M		146
Harriet	MN	9/16/2013	Northern pike	1	Scaled, skin-on fillet	56	1300	4	M		146
Harriet	MN	9/16/2013	Northern pike	1	Scaled, skin-on fillet	52	1000	4	M		160
Harriet	MN	9/16/2013	Northern pike	1	Scaled, skin-on fillet	52	1050	4	M		172
Harriet	MN	9/16/2013	Walleye	1	Scaled, skin-on fillet	27.5	67	4	J		86
Harriet	MN	9/16/2013	Walleye	1	Scaled, skin-on fillet	26	183	4	J		95.3
Harriet	MN	9/16/2013	Walleye	1	Scaled, skin-on fillet	24	148	3	J		97.2
Harriet	MN	9/16/2013	Walleye	1	Scaled, skin-on fillet	29	55	4	J		107

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Harriet	MN	9/16/2013	Walleye	1	Scaled, skin-on fillet	29.5	292	4	J		116
Harriet	MN	9/16/2013	Walleye	1	Scaled, skin-on fillet	29.5	48	4	J		138
Harriet	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	18.8	123.2	4	M		83.7
Harriet	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	20.2	140.9	5	U		87.9
Harriet	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	20.9	189.9	6	M		95.3
Harriet	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	19.3	123.1	5	M		111
Harriet	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	21.5	151.6	6	F		112
Harriet	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	15.2	74.4	4	M		51.8
Harriet	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	16.2	75.5	5	F		57.5
Harriet	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	14.8	69.2	4	F		59.4
Harriet	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	15.8	84.6	5	F		74
Harriet	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	15.2	77.6	4	J		96.7
Harriet	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	26.8	282	3	M		139
Harriet	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	28.3	299	3	F		139
Harriet	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	24.4	255	3	J		151
Harriet	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	29.5	387	4	M		163
Harriet	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	27.5	306	4	M		205
Harriet	MN	7/13/2016	Surface water								22.7
Harriet	MN	7/13/2016	Surface water								23
Harriet	MN	7/13/2016	Surface water								27.1
Harriet	MN	7/26/2018	Surface water								11.3
Harriet	MN	7/26/2018	Surface water								11.6
Harriet	MN	7/26/2018	Surface water								11.8
Harriet	MN	9/12/2018	Black crappie	1	Scaled, skin-on fillet	21	122.8	6	F		65.3
Harriet	MN	9/12/2018	Black crappie	1	Scaled, skin-on fillet	17.8	94.3	4	F		80.2
Harriet	MN	9/12/2018	Bluegill	1	Scaled, skin-on fillet	15	61.4	4	M		50
Harriet	MN	9/12/2018	Bluegill	1	Scaled, skin-on fillet	12.8	39.4	3	J		57
Harriet	MN	9/12/2018	Bluegill	1	Scaled, skin-on fillet	15	67	4	F		67.4
Harriet	MN	9/12/2018	Bluegill	1	Scaled, skin-on fillet	16.3	77.7	5	M		81.9
Harriet	MN	9/12/2018	Bluegill	1	Scaled, skin-on fillet	14.2	57.6	4	M		82.1
Harriet	MN	9/12/2018	Largemouth bass	1	Scaled, skin-on fillet	20.5	124.8	2	F		76.3
Harriet	MN	9/12/2018	Yellow perch	1	Scaled, skin-on fillet	14.3	34.2	3	F		34.4
Harriet	MN	9/12/2018	Yellow perch	1	Scaled, skin-on fillet	17.4	64.9	4	M		43.5
Harriet	MN	9/12/2018	Yellow perch	1	Scaled, skin-on fillet	13.2	27.9	3	F		48.4
Harriet	MN	9/12/2018	Yellow perch	1	Scaled, skin-on fillet	17.8	68.0	4	M		61.2
Harriet	MN	9/12/2018	Yellow perch	1	Scaled, skin-on fillet	17.5	78.0	4	F		62
Isles	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	14	42	3	M	0.46	81.8
Isles	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	17	72	4	M	0.28	142
Isles	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	19	99	5	M	0.37	144
Isles	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	21	101	6	M	0.32	148
Isles	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	24	169	7	M	0.69	188
Isles	MN	5/28/2008	Black crappie	1	Scaled, skin-on fillet	20	92	5	M	0.67	298
Isles	MN	5/28/2008	Bluegill	1	Scaled, skin-on fillet	15	50	4	M	0.27	37.1
Isles	MN	5/28/2008	Bluegill	1	Scaled, skin-on fillet	13	42	3	M	0.4	71.5
Isles	MN	5/28/2008	Bluegill	1	Scaled, skin-on fillet	14.5	47	3	M	0.44	96.6
Isles	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	27	252	3	F	0.28	108
Isles	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	34	482	6	M	0.32	116

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Isles	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	38	657	7	M	0.34	180
Isles	MN	5/28/2008	Largemouth bass	1	Scaled, skin-on fillet	42	1008	9	M	0.75	267
Isles	MN	8/5/2008	Surface water								12.6
Isles	MN	8/5/2008	Surface water								13
Isles	MN	8/5/2008	Surface water								14.9
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	14	57	3	F		16
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	12.5	31	2	M		22.2
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	13	34	3	M		29.7
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	14	45	3	F		34.2
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	13.5	39	3	M		36.6
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	14.5	43	3	M		36.8
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	15	51	3	F		36.9
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	12.5	36	2	M		51.5
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	16	69	4	F		52.2
Isles	MN	5/28/2013	Black crappie	1	Scaled, skin-on fillet	17	76	4	M		64
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	13	41	3	F		23.5
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	14.5	65	4	M		29.1
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	11.5	37	2	M		29.8
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	15	54	4	M		29.9
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	13	46	3	M		30.6
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	14.5	57	4	M		31.8
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	12.5	36	3	F		34.7
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	12	35	2	F		39.4
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	14	54	3	M		40.7
Isles	MN	5/28/2013	Bluegill	1	Scaled, skin-on fillet	14.5	61	4	M		57.4
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	25.5	265	3	F		43.2
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	32.5	680	5	F		45.1
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	36	811	7	F		52.2
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	32.5	528	5	F		65.5
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	29	406	4	M		75.5
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	31	581	5	M		77
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	31	507	5	M		80.7
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	36.5	914	7	M		93
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	35	732	7	F		104
Isles	MN	5/28/2013	Largemouth bass	1	Scaled, skin-on fillet	33	611	5	M		245
Isles	MN	8/29/2013	Surface water								9.98
Isles	MN	8/29/2013	Surface water								11.1
Isles	MN	8/29/2013	Surface water								12.2
Isles	MN	9/19/2013	Northern pike	1	Scaled, skin-on fillet	53	950	4	J		31.8
Isles	MN	9/19/2013	Northern pike	1	Scaled, skin-on fillet	54	1200	4	M		43.8
Isles	MN	9/19/2013	Northern pike	1	Scaled, skin-on fillet	56	1250	4	M		48.8
Isles	MN	9/19/2013	Northern pike	1	Scaled, skin-on fillet	61	1750	4	F		66.5
Isles	MN	9/19/2013	Northern pike	1	Scaled, skin-on fillet	63	2000	5	F		67.9
Isles	MN	9/19/2013	Northern pike	1	Scaled, skin-on fillet	63.5	2000	5	F		68.4
Isles	MN	9/19/2013	Northern pike	1	Scaled, skin-on fillet	63	1800	5	F		74.7
Isles	MN	6/28/2016	Black crappie	1	Scaled, skin-on fillet	14.5	55.9	2	F		22.5
Isles	MN	6/28/2016	Black crappie	1	Scaled, skin-on fillet	13.5	35	2	J		30.8

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Isles	MN	6/28/2016	Black crappie	1	Scaled, skin-on fillet	15	66.6	2	F		33.4
Isles	MN	6/28/2016	Black crappie	1	Scaled, skin-on fillet	16.5	74	2	F		33.8
Isles	MN	6/28/2016	Black crappie	1	Scaled, skin-on fillet	13.5	45	1	M		36.1
Isles	MN	6/28/2016	Bluegill	1	Scaled, skin-on fillet	15.8	78.8	4	M		38.8
Isles	MN	6/28/2016	Bluegill	1	Scaled, skin-on fillet	14.2	62.3	4	M		38.8
Isles	MN	6/28/2016	Bluegill	1	Scaled, skin-on fillet	15	73.2	4	M		41.3
Isles	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	29.1	504.5	4	M		62.1
Isles	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	15.9	59.3	2	J		62.3
Isles	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	25.7	284	4	F		67.4
Isles	MN	6/28/2016	Largemouth bass	1	Scaled, skin-on fillet	27.2	368.5	4	J		73.2
Isles	MN	6/28/2016	Surface water								6.07
Isles	MN	6/28/2016	Surface water								6.71
Isles	MN	6/28/2016	Surface water								7.11
Johanna	MN	7/14/2016	Bluegill	1	Scaled, skin-on fillet	16.5	143.6	6	F		44.2
Johanna	MN	7/14/2016	Bluegill	1	Scaled, skin-on fillet	15.9	87.9	5	M		48.5
Johanna	MN	7/14/2016	Bluegill	1	Scaled, skin-on fillet	15.2	92.7	4	F		60.1
Johanna	MN	7/14/2016	Bluegill	1	Scaled, skin-on fillet	15.5	99.3	5	M		61.8
Johanna	MN	7/14/2016	Bluegill	1	Scaled, skin-on fillet	16.4	107.5	5	M		71.8
Johanna	MN	7/14/2016	Largemouth bass	1	Scaled, skin-on fillet	27.9	423.8	4	F		125
Johanna	MN	7/14/2016	Largemouth bass	1	Scaled, skin-on fillet	27	359.3	3	F		130
Johanna	MN	7/14/2016	Largemouth bass	1	Scaled, skin-on fillet	28.5	399	4	M		163
Johanna	MN	7/14/2016	Northern pike	1	Scaled, skin-on fillet	66.3	2520	5	M		72.3
Johanna	MN	7/14/2016	Northern pike	1	Scaled, skin-on fillet	64.3	1820	5	F		86.5
Johanna	MN	7/14/2016	Surface water								13.8
Johanna	MN	7/14/2016	Surface water								13.8
Johanna	MN	7/14/2016	Surface water								14.7
Johanna	MN	7/14/2016	Walleye	1	Scaled, skin-on fillet	47.5	1340	8	F		130
Johanna	MN	7/14/2016	Walleye	1	Scaled, skin-on fillet	55.5	2050	11	F		145
Johanna	MN	7/14/2016	Walleye	1	Scaled, skin-on fillet	46	1260	8	M		147
Johanna	MN	7/14/2016	Walleye	1	Scaled, skin-on fillet	47.4	1380	8	M		150
Josephine	MN	6/25/2018	Bluegill	5	Scaled, skin-on fillet	13.8	48				17.2
Josephine	MN	8/9/2018	Surface water								2.21
Josephine	MN	8/9/2018	Surface water								2.33
Josephine	MN	8/9/2018	Surface water								2.54
Kegonsa	WI	5/15/2019	Common carp	1	Scaled, skin-on fillet	55.6	2192		F	2.32	14.5
Kegonsa	WI	5/15/2019	Common carp	1	Scaled, skin-on fillet	62.0	2908		U	5.93	17.5
Kegonsa	WI	5/15/2019	Common carp	1	Scaled, skin-on fillet	65.3	3846		M	4.82	18.4
Kegonsa	WI	5/15/2019	Common carp	1	Scaled, skin-on fillet	65.5	3904		F	5.54	18.5
Kegonsa	WI	5/15/2019	Common carp	1	Scaled, skin-on fillet	69.9	4446		M	10	19.2
Kegonsa	WI	5/15/2019	Common carp	1	Scaled, skin-on fillet	70.6	4132		M	4.04	35.4
Kegonsa	WI	5/15/2019	Walleye	1	Scaled, skin-on fillet	42.2	786		F	1.14	51.5
Kegonsa	WI	7/7/2020	Surface water								6.28
Kegonsa	WI	7/15/2020	Common carp	1	Scaled, skin-on fillet	23.6	190		U		4.99
Kegonsa	WI	7/15/2020	Common carp	1	Scaled, skin-on fillet	60.5	3266		F		9.15
Kegonsa	WI	7/15/2020	Common carp	1	Scaled, skin-on fillet	53.3	2070		M		19.8
Kegonsa	WI	7/15/2020	Freshwater drum	1	Scaled, skin-on fillet	37.3	692		F		22.8
Kegonsa	WI	7/15/2020	Freshwater drum	1	Scaled, skin-on fillet	41.7	826		F		28.9

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Kegonsa	WI	7/15/2020	Freshwater drum	1	Scaled, skin-on fillet	40.4	822		F		32.6
Kegonsa	WI	7/15/2020	Freshwater drum	1	Scaled, skin-on fillet	42.9	864		F		35.2
Kegonsa	WI	7/15/2020	Freshwater drum	1	Scaled, skin-on fillet	40.6	856		F		88
Kegonsa	WI	7/15/2020	Largemouth bass	1	Scaled, skin-on fillet	39.9	918		U		37.5
Kegonsa	WI	7/15/2020	Largemouth bass	1	Scaled, skin-on fillet	35.3	674		F		41.4
Kegonsa	WI	7/15/2020	Largemouth bass	1	Scaled, skin-on fillet	34.5	686		U		48.7
Kegonsa	WI	7/15/2020	Largemouth bass	1	Scaled, skin-on fillet	41.9	1108		U		53.3
Kegonsa	WI	7/15/2020	Pumpkinseed	1	Scaled, skin-on fillet	14.0	72		U		18.7
Kegonsa	WI	7/15/2020	Pumpkinseed	1	Scaled, skin-on fillet	14.7	86		M		18.8
Kegonsa	WI	7/15/2020	Pumpkinseed	1	Scaled, skin-on fillet	11.7	40		U		19.5
Kegonsa	WI	7/15/2020	Pumpkinseed	1	Scaled, skin-on fillet	14.2	82		M		32.1
Kegonsa	WI	7/15/2020	Walleye	1	Scaled, skin-on fillet	48.8	1054		F		35.1
Kegonsa	WI	7/15/2020	Walleye	1	Scaled, skin-on fillet	37.3	434		U		38.3
Kegonsa	WI	7/15/2020	Walleye	1	Scaled, skin-on fillet	36.8	448		U		40
Kegonsa	WI	7/15/2020	Walleye	1	Scaled, skin-on fillet	41.7	682		F		47.3
Kegonsa	WI	7/15/2020	Walleye	1	Scaled, skin-on fillet	27.2	174		U		48
Kegonsa	WI	7/15/2020	White bass	1	Scaled, skin-on fillet	35.1	586		U		66.8
Kegonsa	WI	7/15/2020	White bass	1	Scaled, skin-on fillet	36.6	588		F		75.1
Kegonsa	WI	7/15/2020	White bass	1	Scaled, skin-on fillet	35.8	568		F		111
Kegonsa	WI	7/15/2020	Yellow perch	1	Scaled, skin-on fillet	23.4	146		F		7.53
Kegonsa	WI	7/15/2020	Yellow perch	1	Scaled, skin-on fillet	21.3	122		F		20.6
Kegonsa	WI	7/15/2020	Yellow perch	1	Scaled, skin-on fillet	23.4	184		F		38.9
Keller	MN	Jul-07	Bluegill	1	Scaled, skin-on fillet	13.5	50	3	M	0.55	26.2
Keller	MN	Jul-07	Bluegill	1	Scaled, skin-on fillet	15	58	4	F	0.45	50.1
Keller	MN	Jul-07	Bluegill	1	Scaled, skin-on fillet	14.5	54	4	J	0.78	64.6
Keller	MN	Jul-07	Bluegill	5	Scaled, skin-on fillet	14.5	53			0.47	70
Keller	MN	Jul-07	Bluegill	1	Scaled, skin-on fillet	14	56	4	M	0.43	97.1
Keller	MN	Jul-07	Bluegill	1	Scaled, skin-on fillet	15	58	4	M	0.4	106
Keller	MN	8/4/2008	Surface water								7.63
Keller	MN	8/4/2008	Surface water								7.85
Keller	MN	8/4/2008	Surface water								8.63
Mccarron	MN	6/8/2018	Bluegill	1	Scaled, skin-on fillet	17.0	114				28
Mccarron	MN	6/8/2018	Largemouth bass	1	Scaled, skin-on fillet	34.5	640				65.3
Mccarron	MN	6/8/2018	Largemouth bass	1	Scaled, skin-on fillet	38.9	940				72.7
Mccarron	MN	6/8/2018	Largemouth bass	2	Scaled, skin-on fillet	23.0	180				74.3
Mccarron	MN	6/8/2018	Largemouth bass	1	Scaled, skin-on fillet	35.8	780				83.2
Mccarron	MN	8/9/2018	Surface water								6.05
Mccarron	MN	8/9/2018	Surface water								6.14
Mccarron	MN	8/9/2018	Surface water								6.85
Mead	WI	7/20/2020	Black crappie	1	Scaled, skin-on fillet	19.3	136		U		1.2
Mead	WI	7/20/2020	Black crappie	1	Scaled, skin-on fillet	21.6	162		U		1.52
Mead	WI	7/22/2020	Surface water								0.391
Mendota	WI	6/25/2020	Rock bass	1	Scaled, skin-on fillet	17.8	110		M		2.93
Mendota	WI	6/25/2020	Rock bass	1	Scaled, skin-on fillet	25.1	280		F		3.13
Mendota	WI	6/25/2020	Rock bass	1	Scaled, skin-on fillet	17.0	110		M		4.03
Mendota	WI	6/25/2020	Rock bass	1	Scaled, skin-on fillet	16.0	82		U		6.44
Mendota	WI	6/25/2020	Rock bass	1	Scaled, skin-on fillet	16.8	98		U		6.72

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mendota	WI	6/25/2020	Walleye	1	Scaled, skin-on fillet	31.5	274		F		2.99
Mendota	WI	6/25/2020	Walleye	1	Scaled, skin-on fillet	31.5	258		M		3
Mendota	WI	6/25/2020	Walleye	1	Scaled, skin-on fillet	34.3	380		F		3.55
Mendota	WI	6/25/2020	Walleye	1	Scaled, skin-on fillet	43.2	768		F		3.98
Mendota	WI	6/25/2020	Yellow perch	1	Scaled, skin-on fillet	25.4	216		F		6.64
Mendota	WI	6/25/2020	Yellow perch	1	Scaled, skin-on fillet	24.6	208		F		7.78
Mendota	WI	6/25/2020	Yellow perch	1	Scaled, skin-on fillet	23.6	176		F		8.64
Mendota	WI	6/25/2020	Yellow perch	1	Scaled, skin-on fillet	23.1	160		M		9.01
Mendota	WI	6/25/2020	Yellow perch	1	Scaled, skin-on fillet	22.1	142		M		10.8
Mendota	WI	6/25/2020	Yellow perch	1	Scaled, skin-on fillet	23.6	180		F		12.3
Mendota	WI	6/25/2020	Yellow perch	1	Scaled, skin-on fillet	22.1	154		M		19.9
Mendota	WI	7/7/2020	Surface water								0.399
Menominee, center Scott Flowage	WI	6/27/2019	Surface water								0.29
Menominee, center Scott Flowage	WI	7/29/2019	Black crappie	1	Scaled, skin-on fillet	31.8					2.6
Menominee, center Scott Flowage	WI	7/29/2019	Black crappie	1	Scaled, skin-on fillet	26.7					4.9
Menominee, center Scott Flowage	WI	7/29/2019	Largemouth bass	1	Scaled, skin-on fillet	29.7					4.2
Menominee, center Scott Flowage	WI	7/29/2019	Largemouth bass	1	Scaled, skin-on fillet	45.0					6.4
Menominee, center Scott Flowage	WI	7/29/2019	Pumpkinseed	1	Scaled, skin-on fillet	15.7					7.8
Menominee, center Scott Flowage	WI	7/29/2019	Rock bass	1	Scaled, skin-on fillet	15.0					4.7
Menominee, center Scott Flowage	WI	7/29/2019	Rock bass	1	Scaled, skin-on fillet	15.5					23
Menominee, center Scott Flowage	WI	7/29/2019	Smallmouth bass	1	Scaled, skin-on fillet	28.7					3.6
Menominee, center Scott Flowage	WI	7/29/2019	Surface water								0.31
Menominee, center Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	20.1					2
Menominee, center Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	15.7					2.2
Menominee, center Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	16.3					6.4
Menominee, center Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	21.1					6.4
Menominee, lower Scott Flowage	WI	6/27/2019	Surface water								0.3
Menominee, lower Scott Flowage	WI	7/29/2019	Northern pike	1	Scaled, skin-on fillet	45.5					3.04
Menominee, lower Scott Flowage	WI	7/29/2019	Northern pike	1	Scaled, skin-on fillet	55.6					6.19
Menominee, lower Scott Flowage	WI	7/29/2019	Northern pike	1	Scaled, skin-on fillet	62.5					7.12
Menominee, lower Scott Flowage	WI	7/29/2019	Pumpkinseed	1	Scaled, skin-on fillet	10.9					9.19
Menominee, lower Scott Flowage	WI	7/29/2019	Pumpkinseed	1	Scaled, skin-on fillet	11.9					12.2
Menominee, lower Scott Flowage	WI	7/29/2019	Pumpkinseed	1	Scaled, skin-on fillet	8.9					19.8
Menominee, lower Scott Flowage	WI	7/29/2019	Rock bass	1	Scaled, skin-on fillet	16.5					5.78
Menominee, lower Scott Flowage	WI	7/29/2019	Smallmouth bass	1	Scaled, skin-on fillet	32.8					1.28
Menominee, lower Scott Flowage	WI	7/29/2019	Smallmouth bass	1	Scaled, skin-on fillet	28.7					2.51
Menominee, lower Scott Flowage	WI	7/29/2019	Surface water								0.32
Menominee, lower Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	12.7					5.96
Menominee, lower Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	12.4					6.6
Menominee, lower Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	14.2					8.7
Menominee, lower Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	14.7					9.69
Menominee, lower Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	14.0					10.1
Menominee, lower Scott Flowage	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	14.5					17.5
Menominee, mouth to Green Bay	WI	7/29/2019	Bluegill	1	Scaled, skin-on fillet	13.7					4.94
Menominee, mouth to Green Bay	WI	7/29/2019	Bluegill	1	Scaled, skin-on fillet	15.0					7.2
Menominee, mouth to Green Bay	WI	7/29/2019	Bluegill	1	Scaled, skin-on fillet	14.5					7.62
Menominee, mouth to Green Bay	WI	7/29/2019	Bluegill	1	Scaled, skin-on fillet	14.7					10

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Menominee, mouth to Green Bay	WI	7/29/2019	Bluegill	1	Scaled, skin-on fillet	14.5					13.4
Menominee, mouth to Green Bay	WI	7/29/2019	Pumpkinseed	1	Scaled, skin-on fillet	14.0					5.46
Menominee, mouth to Green Bay	WI	7/29/2019	Pumpkinseed	1	Scaled, skin-on fillet	13.7					13.7
Menominee, mouth to Green Bay	WI	7/29/2019	Smallmouth bass	1	Scaled, skin-on fillet	37.3					3.38
Menominee, mouth to Green Bay	WI	7/29/2019	Smallmouth bass	1	Scaled, skin-on fillet	37.1					10.5
Menominee, mouth to Green Bay	WI	7/29/2019	Surface water								0.32
Menominee, mouth to Green Bay	WI	7/29/2019	Surface water								0.4
Menominee, mouth to Green Bay	WI	7/29/2019	Walleye	1	Scaled, skin-on fillet	48.8					8.82
Menominee, mouth to Green Bay	WI	7/29/2019	Walleye	1	Scaled, skin-on fillet	48.8					9.91
Menominee, mouth to Green Bay	WI	7/29/2019	Walleye	1	Scaled, skin-on fillet	51.6					11.5
Menominee, mouth to Green Bay	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	18.5					9.73
Menominee, mouth to Green Bay	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	17.3					11.6
Menominee, mouth to Green Bay	WI	7/29/2019	Yellow perch	1	Scaled, skin-on fillet	16.3					20.2
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	13	46.3	3	F	0.61	18.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	14	66	4	F	0.34	24.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	13	51.8	3	F	0.6	25.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	17	98.8	6	M	0.42	30.3
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	15	76	4	M	0.62	36.4
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	14	60.7	4	F	0.5	37.8
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	13	50.7	3	M	0.53	43.8
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	14	61	4	M	0.57	44.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	15	59	5	J	0.61	44.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	13	43.3	3	F	0.37	45.4
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	18	117.7	6	F	0.41	46.5
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	14	83.7	4	M	0.49	47.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	12	48.3	3	F	0.65	50.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	13	55.8	3	F	0.59	55.4
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Bluegill	1	Scaled, skin-on fillet	12	42.2	3	J	1.31	55.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	39	883	4	M	2.2	5.57
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	47	1538	5	M	1.2	10.7
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	55	2488	6	M	8.04	10.8
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	55	2427	6	M	4.49	11.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	52	1922	6	M	2.48	12.4
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	55	2872	6	F	3.17	12.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	56	2455	6	F	2.63	13.7
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	45	1073	5	M	3.25	15.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	47	1693	5	M	4.59	16.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	47	1502	5	F	4.09	19.2
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	49	1439	5	M	3.66	26.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	51	1704	5	M	2.95	32.3
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Common carp	1	Scaled, skin-on fillet	58	2365	7	M	2.73	41.8
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	31	405	4	M	1	19.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	31	316	4	M	2.62	22.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	32	400	4	F	2.26	36.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	34	484	5	M	2.77	38.8
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	31	329	4	M	2.11	39.3
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	26	201	2	J	0.38	41.8

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	28	335	3	J	1.41	52.3
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	35	561	5	F	1.6	64.4
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	36	550	6	M	4.23	67.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	41	755	8	M	2.78	71.8
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	30	376	4	J	1.39	77.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	30	368	4	F	2.21	90.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Freshwater drum	1	Scaled, skin-on fillet	35	496	5	M	1.25	104
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	24	164	2	F	0.28	12.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	32	513	5	M	0.46	13.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	27	292	3	M	0.7	13.3
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	25	222	3	F	0.36	14
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	36	642	7	M	0.8	14.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	31	468	5	F	0.55	19.2
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	29	374	4	M	1.07	22.5
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	26	256	3	F	0.54	25
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	29	358	4	F	0.47	25.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	35	750	7	F	1.13	30.2
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	28	438	3	M	0.93	30.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	23	196	2	M	0.54	30.8
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	34	662	6	M	0.64	38.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	35	689	6	M	1.04	39
Mississippi River Pool 2 Reach 2	MN	5/29/2009	Smallmouth bass	1	Scaled, skin-on fillet	33	573	5	M	0.81	59.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	29	310	2	F	1.11	37.7
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	31	482	3	M	1.01	46.8
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	37	760	5	F	2.82	57.7
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	29	342	2	F	0.88	59.3
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	33	633	4	F	3.28	61.9
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	38	779	6	F	2.52	63.1
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	31	393	3	F	1.4	71.3
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	32	486	3	F	2.82	71.4
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	26	239	2	F	2.78	73.5
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	30	362	3	F	1.27	75.2
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	30	440	3	F	3.02	75.6
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	26	290	2	F	2.95	77.5
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	35	819	4	M	4.45	79.7
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	36	744	5	F	1.01	94.7
Mississippi River Pool 2 Reach 2	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	31	430	3	F	2.53	130
Mississippi River Pool 2 Reach 2	MN	8/2/2009	Surface water								7.1
Mississippi River Pool 2 Reach 2	MN	8/2/2009	Surface water								7.8
Mississippi River Pool 2 Reach 2	MN	8/2/2009	Surface water								8.24
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	14	68.6	3	M	0.44	34
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	15	79.1	4	F	0.98	37.6
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	13	47.9	3	F	0.47	55.9
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	12	47.6	2	M	0.85	63.6
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	13	49.6	3	F	0.86	71.3
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	13	42.4	3	M	0.72	74.6
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	13	43.3	3	M	0.47	80.7

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	17	117.6	6	M	0.72	82.3
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	16	94.8	5	M	0.36	84.4
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	14	62.9	4	M	0.26	94.6
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	13	46.9	3	F	1.01	105
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	13	68.4	3	F	0.86	143
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	13	49.5	3	F	0.34	155
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	14	51.7	4	J	0.52	201
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Bluegill	1	Scaled, skin-on fillet	17	126.2	5	M	1.16	204
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	47	1379	5	F	0.57	7.29
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	56	2178	6	M	2.37	10.2
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	59	2452	7	M	3.23	18.9
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	40	968	4	M	3.27	23.6
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	49	1659	5	F	5.62	23.9
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	54	2208	6	M	4.88	25.7
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	38	652	4	F	0.43	27.1
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	46	1684	5	F	1.72	30.6
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	38	824	4	F	2.04	38.7
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	60	2734	7	M	4.86	45.2
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	47	1560	5	M	3.56	52.3
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	48	1603	5	M	3.77	53.3
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	56	2199	6	M	5.43	57.3
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	49	1822	5	M	3.67	58.8
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	56	2296	6	M	4.99	65.5
Mississippi River Pool 2 Reach 3	MN	5/28/2009	Common carp	1	Scaled, skin-on fillet	40	1032	4	M	11.8	90.6
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	35	611	4	F	3.41	57.6
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	33	552	4	F	1.85	60.6
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	33	587	4	F	3.28	61.6
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	35	597	4	F	0.5	63.1
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	30	418	3	F	1.9	68.9
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	33	435	4	F	1.13	69.6
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	36	639	5	M	1.57	71.2
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	36	617	5	F	1.53	73.9
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	30	369	3	M	2.29	85.9
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	34	541	4	M	2.19	90.2
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	31	430	3	F	1.99	101
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	35	615	4	M	2.34	105
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	37	748	5	M	4.37	106
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	36	809	5	F	2.66	111
Mississippi River Pool 2 Reach 3	MN	5/29/2009	White bass	1	Scaled, skin-on fillet	32	516	3	M	2.07	114
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	33	400	5	F	0.61	11.4
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	32	383	4	F	0.35	27
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	36	537	6	F	0.6	31.8
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	34	495	5	F	0.65	38.8
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	31	353	4	M	0.69	45.7
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	33	335	5	F	0.76	57.5
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	36	461	6	F	0.66	57.9
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	41	925	8	F	0.48	63.3

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	27	273	3	M	1.39	92.4
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	36	530	0	F	0.54	98.3
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	34	457	5	F	0.35	99
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	34	478	5	F	0.57	103
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	33	448	5	F	0.47	104
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	33	459	5	F	0.55	106
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	30	297	4	M	0.77	137
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	34	560	6	F	0.37	25.9
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	28	358	4	F	0.27	27.9
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	36	673	7	F	0.53	30.8
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	28	299	4	F	0.38	32.6
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	25	229	3	F	0.57	37.1
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	26	251	3	M	0.3	37.6
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	24	191	2	J	0.59	44.9
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	25	235	3	M	0.43	46
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	26	327	3	M	0.59	48.6
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	26	255	3	J	0.56	49.3
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	31	432	5	M	0.36	52.6
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	38	833	7	F	0.47	60.3
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	32	445	5	M	0.33	60.9
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	25	269	3	F	0.54	70.3
Mississippi River Pool 2 Reach 3	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	32	511	5	M	0.46	111
Mississippi River Pool 2 Reach 3	MN	8/2/2009	Surface water								8.4
Mississippi River Pool 2 Reach 3	MN	8/2/2009	Surface water								8.4
Mississippi River Pool 2 Reach 3	MN	8/2/2009	Surface water								8.74
Mississippi River Pool 2 Reach 3	MN	8/2/2009	Surface water								9.91
Mississippi River Pool 2 Reach 3	MN	8/2/2009	Surface water								10.5
Mississippi River Pool 2 Reach 3	MN	8/2/2009	Surface water								10.5
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	17.5	137	6	F		12.1
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	17	121	6	F		12.8
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	17	116	6	M		19.9
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	17	123.6	6	M		24.5
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	16.5	129	5	M		25.2
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	14.5	66.4	4	F		26.1
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	17.5	115	6	F		26.5
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	19.5	173	8	U		31.1
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	18.5	160.2	7	M		34.5
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	15	93	5	M		36.2
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	17.5	110	6	M		37.9
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	17.5	144	6	M		40.4
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	18.5	274	7	F		44.9
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	17.5	113	6	F		53
Mississippi River Pool 2 Reach 3	MN	8/1/2012	Bluegill	1	Scaled, skin-on fillet	16.5	119	6	M		60.4
Mississippi River Pool 2 Reach 3	MN	8/1/2012	White bass	1	Scaled, skin-on fillet	37	815	6	M		41.2
Mississippi River Pool 2 Reach 3	MN	8/1/2012	White bass	1	Scaled, skin-on fillet	28	367	2	M		52.2
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	36.5	839	3	M		3.9
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	37.5	934	3	M		4.6

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	34.5	604	3	F		7
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	47	1722	5	M		12.1
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	56.5	3200	7	M		18.8
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	52.5	2300	7	M		35.9
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	56	3300	7	F		37.7
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	55	3800	7	M		42.2
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	51.5	2500	6	M		43.2
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	56	3000	7	F		61.6
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	43	1617	4	M		68.1
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	55.5	3200	7	F		87.5
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	43	1248	4	F		106
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	39.5	1184	4	M		107
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Common carp	1	Scaled, skin-on fillet	41	1256	4	J		108
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Smallmouth bass	1	Scaled, skin-on fillet	16	69	2	J		15.6
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Smallmouth bass	1	Scaled, skin-on fillet	16.5	65	2	J		15.8
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Smallmouth bass	1	Scaled, skin-on fillet	15.5	52	1	J		17.9
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Smallmouth bass	1	Scaled, skin-on fillet	22	168	2	J		20.4
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Smallmouth bass	1	Scaled, skin-on fillet	14	48.4	1	J		22.7
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Smallmouth bass	1	Scaled, skin-on fillet	24.5	267	2	J		29.1
Mississippi River Pool 2 Reach 3	MN	8/2/2012	Smallmouth bass	1	Scaled, skin-on fillet	35.5	698	6	F		44.2
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	37.5	985	6	F		20.4
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	36	870	5	F		24.5
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	28	379	2	M		26.4
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	36	721	5	F		32.8
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	31	541	3	F		33.5
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	33	636	3	J		37.9
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	36.5	849	5	M		38.6
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	31	566	3	F		40.7
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	31.5	592	3	F		41.9
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	34	728	4	M		42.8
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	31.5	500	3	M		42.9
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	35	780	4	F		52.8
Mississippi River Pool 2 Reach 3	MN	8/2/2012	White bass	1	Scaled, skin-on fillet	33	605	4	U		62.7
Mississippi River Pool 2 Reach 3	MN	8/6/2012	Smallmouth bass	1	Scaled, skin-on fillet	25	195	3	F		19.7
Mississippi River Pool 2 Reach 3	MN	8/6/2012	Smallmouth bass	1	Scaled, skin-on fillet	22.5	172	2	J		21.2
Mississippi River Pool 2 Reach 3	MN	8/6/2012	Smallmouth bass	1	Scaled, skin-on fillet	21.5	168	2	J		21.9
Mississippi River Pool 2 Reach 3	MN	8/6/2012	Smallmouth bass	1	Scaled, skin-on fillet	22.5	161	2	J		22.7
Mississippi River Pool 2 Reach 3	MN	8/6/2012	Smallmouth bass	1	Scaled, skin-on fillet	34.5	755	6	U		25.5
Mississippi River Pool 2 Reach 3	MN	8/6/2012	Smallmouth bass	1	Scaled, skin-on fillet	25.5	266	3	J		30.3
Mississippi River Pool 2 Reach 3	MN	8/6/2012	Smallmouth bass	1	Scaled, skin-on fillet	23.5	215	2	J		32.8
Mississippi River Pool 2 Reach 3	MN	8/6/2012	Smallmouth bass	1	Scaled, skin-on fillet	26	309	3	J		43.5
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	48	1280	11	F		7.6
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	37.5	654	7	F		12.3
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	36	1264	6	M		13.4
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	26.5	260	3	J		14.5
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	28	309	3	F		21.8
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	38.5	828	7	F		21.8

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	33.5	523	5	M		25.1
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	34	432	5	U		31
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	34	497	5	F		31.8
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	33	494	5	F		32.8
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	34.5	530	5	M		35.9
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	40.5	938	8	F		50.4
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	37	736	6	F		50.7
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	31.5	407	4	M		60.1
Mississippi River Pool 2 Reach 3	MN	8/7/2012	Freshwater drum	1	Scaled, skin-on fillet	33.5	397	5	M		65
Mississippi River Pool 2 Reach 3	MN	9/24/2012	Surface water								6.09
Mississippi River Pool 2 Reach 3	MN	9/24/2012	Surface water								19.8
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	10	21.3	2	J	0.77	32.3
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	18	148.3	6	M	0.38	36.1
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	18	134.3	6	M	0.77	37.8
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	12	39.1	3	J	0.66	39.2
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	17	131.1	6	F	0.73	39.5
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	17	89.4	5	M	0.81	42.3
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	15	79.2	4	F	0.98	48.1
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	14	59.6	4	M	0.76	53.1
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	13	47.1	3	J	0.61	65.4
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	11	31	2	F		84.8
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	15	94.5	5	M	0.45	313
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	17	113.6	6	M	0.38	399
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	15	77	4	F	0.4	451
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	10	19.6	2	F		910
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Bluegill	1	Scaled, skin-on fillet	13	63.2	3	J	0.77	1350
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	46	1633	5	F	4.29	8.68
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	44	1015	5	F	0.77	19.6
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	34	700	2	M	2.67	27.1
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	36	754	3	J	1.28	37.9
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	51	1594	6	M	3.21	52.6
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	38	896	2	M	2.09	56.4
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	48	1450	5	F	3.26	58.6
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	47	1432	6	F	6.92	86.9
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	54	1918	6	M	0.95	106
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	38	815	4	M	2.54	117
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	53	2124	6	M	3.97	130
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	52	2010	6	F	11	158
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	47	1411	5	F	0.79	283
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	49	1597	5	F	2.66	874
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Common carp	1	Scaled, skin-on fillet	43	952	5	M	3.24	1340
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	34	750	5	F	1.79	24.2
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	37	714	6	F	0.41	29.8
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	39	791	8	F	1.71	30.2
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	35	519	5	M	1.55	49.8
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	36	684	6	J	1.62	67.6
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	30	344	4	F	1.4	91.6

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	31	365	4	M	1.76	210
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	36	868	6	F	0.76	401
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	27	375	3	F	0.91	441
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	33	430	5	F	0.63	592
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	37	669	6	F	1.24	632
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	36	608	6	F	1.8	997
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	34	510	5	M	0.88	1090
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	28	391	3	M	0.72	2850
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Freshwater drum	1	Scaled, skin-on fillet	39	788	8	F	3.14	3580
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	29	382	4	F	0.34	52.1
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	41	911	9	F	0.54	71.7
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	28	372	3	F	0.49	76.5
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	25	236	3	F	0.28	92.8
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	22	200	2	M	0.67	98.6
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	27	308	3	J	1.01	153
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	27	231	3	F	0.22	210
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	28	360	4	M	0.39	219
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	30	419	4	M	0.4	259
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	33	547	5	F	0.44	436
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	27	293	3	F	0.48	495
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	37	886	7	M	0.3	521
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	30	432	4	F	0.38	561
Mississippi River Pool 2 Reach 4	MN	6/1/2009	Smallmouth bass	1	Scaled, skin-on fillet	40	990	8	F	0.46	612
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	30	363	3	M	3.42	44
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	35	514	4	F	1.17	56.8
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	32	389	2	M	2.23	65.3
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	37	684	5	F	3.33	80.7
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	31	423	3	F	1.92	81.3
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	32	364	3	F	1.48	82
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	34	539	4	F	2.73	87.4
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	34	645	4	F	2.98	88.1
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	37	704	5	F	2.67	128
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	36	621	6	F	3.06	162
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	36	620	5	M	1.13	163
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	34	535	4	M	1.05	171
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	35	614	4	F	4.2	174
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	31	394	3	F	3.26	230
Mississippi River Pool 2 Reach 4	MN	6/1/2009	White bass	1	Scaled, skin-on fillet	28	233	2	F	2.57	764
Mississippi River Pool 2 Reach 4	MN	8/2/2009	Surface water								11.2
Mississippi River Pool 2 Reach 4	MN	8/2/2009	Surface water								15.1
Mississippi River Pool 2 Reach 4	MN	8/2/2009	Surface water								19.2
Mississippi River Pool 2 Reach 4	MN	8/2/2009	Surface water								84.4
Mississippi River Pool 2 Reach 4	MN	8/2/2009	Surface water								91.3
Mississippi River Pool 2 Reach 4	MN	8/2/2009	Surface water								94.5
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	11	29.2	2	J		11
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	15	94.3	5	M		13.4
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	9	16.2	1	J		17.1

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	9	15.6	1	J		18.9
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	15	99.2	5	M		25.4
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	12	45.9	2	F		28.4
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	15	91.9	5	J		30.8
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	14	85.1	4	J		44.8
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	8	11.6	1	J		45.2
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	14	86.1	4	F		46
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	15.5	101	5	F		47.4
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Bluegill	1	Scaled, skin-on fillet	12	46.9	2	F		1020
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	26	301	2	M		6
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	40	1004	4	M		6.5
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	30	497	3	F		7.8
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	26	339	2	J		8.2
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	50	2072	6	M		9.9
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	34	682	3	M		10
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	49.5	1876	6	M		13.8
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	56	2350	7	F		15.1
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	52	2260	6	M		17.5
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	34	710	3	M		24
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	53	2100	7	M		25.4
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	56	2300	7	M		28
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	43	1424	5	M		113
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	35	735	3	M		132
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Common carp	1	Scaled, skin-on fillet	53.5	2800	7	M		6160
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	40	831	8	M		6
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	40	794	8	F		8.2
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	43	908	9	F		8.2
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	40	888	8	M		10.8
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	33.5	425	5	M		13.4
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	51.5	1590	12	M		17.1
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	49	1430	11	F		19
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	34	439	5	M		23.3
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	36	540	6	M		34.2
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	32	463	4	M		104
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	42	932	8	M		440
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	38	708	7	F		661
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	38	718	7	M		718
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	33	476	5	M		1560
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Freshwater drum	1	Scaled, skin-on fillet	32	407	4	M		1580
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	16	283	2	J		8.1
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	23	198	3	J		14.6
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	26	236	3	F		19.6
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	32	490	5	F		26.6
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	21	168	2	M		27.9
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	16	65.0	2	J		29.1
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	12.5	171	1	J		45.7
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	31	522	5	U		47.1

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	33	628	5	M		55.4
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	28	376	4	M		66.4
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	29	417	4	U		67.5
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	17	330	2	J		74
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	22.5	485	2	J		103
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	17	62.4	2	J		112
Mississippi River Pool 2 Reach 4	MN	7/31/2012	Smallmouth bass	1	Scaled, skin-on fillet	26	288	3	M		192
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	20	127	1	J		27.1
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	19	118	1	M		31.1
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	39	956	7	F		37.5
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	19.5	112	1	J		41.3
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	18	99.3	1	J		44.5
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	19.5	112.2	1	J		45.5
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	19.6	123.9	1	J		53.2
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	35	731	4	M		61.9
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	35.5	705	5	M		82.6
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	27	338	2	M		87
Mississippi River Pool 2 Reach 4	MN	7/31/2012	White bass	1	Scaled, skin-on fillet	33	604	4	F		153
Mississippi River Pool 2 Reach 4	MN	9/14/2012	Bluegill	1	Scaled, skin-on fillet	15	101	4	M		34.5
Mississippi River Pool 2 Reach 4	MN	9/14/2012	Bluegill	1	Scaled, skin-on fillet	16.5	126	5	F		38.7
Mississippi River Pool 2 Reach 4	MN	9/14/2012	Bluegill	1	Scaled, skin-on fillet	14.5	79	4	M		46.4
Mississippi River Pool 2 Reach 4	MN	9/14/2012	White bass	1	Scaled, skin-on fillet	23.5	198	2	F		21.4
Mississippi River Pool 2 Reach 4	MN	9/14/2012	White bass	1	Scaled, skin-on fillet	27.5	403	2	M		75.6
Mississippi River Pool 2 Reach 4	MN	9/24/2012	Surface water								23.1
Mississippi River Pool 2 Reach 4	MN	9/24/2012	Surface water								24.2
Mississippi River Pool 2 Reach 4	MN	9/24/2012	Surface water								25.9
Mississippi River Pool 2 Reach 4	MN	9/24/2012	Surface water								142
Mississippi River Pool 2 Reach 4	MN	9/24/2012	Surface water								150
Mississippi River Pool 2 Reach 4	MN	9/24/2012	Surface water								155
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	19.3					10
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	20.1					12
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	14.2					14
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	14.7					15
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	16.3					15
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	9.7					16
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	16.5					22
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	11.7					24
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	18.8					24
Mississippi River Pool 3	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	13.2					28
Mississippi River Pool 3	WI	6/24/2019	Freshwater drum	1	Scaled, skin-on fillet	52.1					36
Mississippi River Pool 3	WI	6/24/2019	Largemouth bass	1	Scaled, skin-on fillet	35.8					20
Mississippi River Pool 3	WI	6/24/2019	Sauger	1	Scaled, skin-on fillet	38.6					15
Mississippi River Pool 3	WI	6/24/2019	Sauger	1	Scaled, skin-on fillet	36.6					16
Mississippi River Pool 3	WI	6/24/2019	White bass	1	Scaled, skin-on fillet	38.9					38
Mississippi River Pool 3	WI	6/27/2019	Surface water								3.1
Mississippi River Pool 3	WI	7/25/2019	Surface water								1.5
Mississippi River Pool 3	WI	8/14/2019	Surface water								4.2

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	17.8					0.96
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	16.3					2.5
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	16.0					3.6
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	15.2					4.1
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	10.9					4.2
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	20.8					4.8
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	10.4					5
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	22.1					7.2
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	12.2					7.2
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	18.3					7.8
Mississippi River Pool 4	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	20.6					8.9
Mississippi River Pool 4	WI	6/24/2019	Freshwater drum	1	Scaled, skin-on fillet	36.8					16
Mississippi River Pool 4	WI	6/24/2019	Largemouth bass	1	Scaled, skin-on fillet	35.6					27
Mississippi River Pool 4	WI	6/24/2019	Rock bass	1	Scaled, skin-on fillet	15.7					6.9
Mississippi River Pool 4	WI	6/24/2019	Rock bass	1	Scaled, skin-on fillet	11.2					19
Mississippi River Pool 4	WI	6/24/2019	Sauger	1	Scaled, skin-on fillet	36.1					24
Mississippi River Pool 4	WI	6/24/2019	Smallmouth bass	1	Scaled, skin-on fillet	36.8					13
Mississippi River Pool 4	WI	6/24/2019	Yellow perch	1	Scaled, skin-on fillet	29.0					5.5
Mississippi River Pool 4	WI	6/27/2019	Surface water								1.7
Mississippi River Pool 4	WI	7/25/2019	Surface water								1.3
Mississippi River Pool 4	WI	8/14/2019	Surface water								1.5
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	22.1					4.7
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	21.6					7.1
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	17.8					7.2
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	21.8					8.2
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	17.5					9.9
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	22.6					10
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	20.1					12
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	14.0					13
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	20.6					14
Mississippi River Pool 6	WI	6/25/2019	Bluegill	1	Scaled, skin-on fillet	11.7					36
Mississippi River Pool 6	WI	6/25/2019	Largemouth bass	1	Scaled, skin-on fillet	37.3					20
Mississippi River Pool 6	WI	6/25/2019	Largemouth bass	1	Scaled, skin-on fillet	41.9					25
Mississippi River Pool 6	WI	6/25/2019	Northern pike	1	Scaled, skin-on fillet	48.5					6.8
Mississippi River Pool 6	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	24.6					16
Mississippi River Pool 6	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	21.8					23
Mississippi River Pool 6	WI	6/27/2019	Surface water								1.7
Mississippi River Pool 6	WI	7/25/2019	Surface water								2.1
Mississippi River Pool 6	WI	8/14/2019	Surface water								2.1
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	19.3					6.1
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	21.1					8.8
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	22.9					9.5
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	16.0					10
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	17.3					11
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	15.5					13
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	15.0					14
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	17.3					14

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	15.0					17
Mississippi River Pool 8	WI	6/24/2019	Bluegill	1	Scaled, skin-on fillet	15.0					26
Mississippi River Pool 8	WI	6/24/2019	Rock bass	1	Scaled, skin-on fillet	17.8					22
Mississippi River Pool 8	WI	6/24/2019	Smallmouth bass	1	Scaled, skin-on fillet	39.1					13
Mississippi River Pool 8	WI	6/24/2019	Yellow perch	1	Scaled, skin-on fillet	24.4					9.6
Mississippi River Pool 8	WI	6/24/2019	Yellow perch	1	Scaled, skin-on fillet	22.9					10
Mississippi River Pool 8	WI	6/24/2019	Yellow perch	1	Scaled, skin-on fillet	18.0					15
Mississippi River Pool 8	WI	6/27/2019	Surface water								2.5
Mississippi River Pool 8	WI	7/25/2019	Surface water								1.9
Mississippi River Pool 8	WI	8/14/2019	Surface water								1.5
Monona @ center	WI	3/23/2020	Black crappie	1	Scaled, skin-on fillet	18.3	100		U		34.2
Monona @ center	WI	3/23/2020	Black crappie	1	Scaled, skin-on fillet	19.6	114		U		41.5
Monona @ center	WI	3/23/2020	Bluegill	1	Scaled, skin-on fillet	18.5	136		U		25.7
Monona @ center	WI	3/23/2020	Bluegill	1	Scaled, skin-on fillet	19.3	158		U		27.4
Monona @ center	WI	3/23/2020	Bluegill	1	Scaled, skin-on fillet	20.1	162		U		30.2
Monona @ center	WI	3/23/2020	Bluegill	1	Scaled, skin-on fillet	18.3	134		U		33.1
Monona @ center	WI	3/23/2020	Bluegill	1	Scaled, skin-on fillet	18.3	122		U		52.4
Monona @ center	WI	3/24/2020	Walleye	1	Scaled, skin-on fillet	38.1	530		M		7.39
Monona @ center	WI	3/24/2020	Walleye	1	Scaled, skin-on fillet	40.9	612		M		46.5
Monona @ center	WI	3/24/2020	Walleye	1	Scaled, skin-on fillet	42.2	768		F		56.6
Monona @ center	WI	3/24/2020	Walleye	1	Scaled, skin-on fillet	41.9	728		M		58.2
Monona @ center	WI	3/24/2020	Walleye	1	Scaled, skin-on fillet	41.4	698		M		59.5
Monona @ center	WI	3/24/2020	Walleye	1	Scaled, skin-on fillet	41.4	652		M		69.4
Monona @ center	WI	3/24/2020	Walleye	1	Scaled, skin-on fillet	39.4	592		M		69.8
Monona @ center	WI	3/24/2020	Walleye	1	Scaled, skin-on fillet	40.6	562		M		78.3
Monona @ center	WI	7/7/2020	Surface water								9.23
Monona @ center	WI	7/20/2020	Yellow perch	1	Scaled, skin-on fillet	17.3	74		U		12.7
Monona @ center	WI	7/20/2020	Yellow perch	1	Scaled, skin-on fillet	19.3	94		U		21.5
Monona @ center	WI	7/20/2020	Yellow perch	1	Scaled, skin-on fillet	17.8	74		U		24.8
Monona @ center	WI	7/20/2020	Yellow perch	1	Scaled, skin-on fillet	22.4	166		U		25.4
Monona @ center	WI	7/20/2020	Yellow perch	1	Scaled, skin-on fillet	18.5	78		U		26.7
Monona @ Starkweather	WI	6/20/2019	Surface water								160
Monona @ Starkweather	WI	7/17/2019	Surface water								180
Monona @ Starkweather	WI	7/23/2019	Largemouth bass	1	Scaled, skin-on fillet	37.1					33
Monona @ Starkweather	WI	7/23/2019	Largemouth bass	1	Scaled, skin-on fillet	27.4					140
Monona @ Starkweather	WI	7/23/2019	Northern pike	1	Scaled, skin-on fillet	67.1					72
Monona @ Starkweather	WI	7/23/2019	Yellow perch	1	Scaled, skin-on fillet	21.6					120
Monona @ Starkweather	WI	8/16/2019	Surface water								120
Monona @ Starkweather	WI	8/30/2019	Largemouth bass	1	Scaled, skin-on fillet	29.5					180
Monona @ Starkweather	WI	8/30/2019	Northern pike	1	Scaled, skin-on fillet	85.9					21
Monona @ Starkweather	WI	8/30/2019	Northern pike	1	Scaled, skin-on fillet	74.9					52
Monona @ Starkweather	WI	8/30/2019	Northern pike	1	Scaled, skin-on fillet	76.2					59
Monona @ Starkweather	WI	8/30/2019	Walleye	1	Scaled, skin-on fillet	50.8					55
Monona @ Starkweather	WI	8/30/2019	Walleye	1	Scaled, skin-on fillet	38.1					91
Monona @ Starkweather	WI	8/30/2019	Yellow perch	1	Scaled, skin-on fillet	20.3					120
Monona @ Starkweather	WI	9/16/2019	Bluegill	1	Scaled, skin-on fillet	18.0					30
Monona @ Starkweather	WI	9/16/2019	Bluegill	1	Scaled, skin-on fillet	19.1					30

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Monona @ Starkweather	WI	9/16/2019	Bluegill	1	Scaled, skin-on fillet	19.6					43
Monona @ Starkweather	WI	9/16/2019	Bluegill	1	Scaled, skin-on fillet	18.0					46
Monona @ Starkweather	WI	9/16/2019	Bluegill	1	Scaled, skin-on fillet	19.3					48
Monona @ Starkweather	WI	9/16/2019	Bluegill	1	Scaled, skin-on fillet	18.3					48
Monona @ Starkweather	WI	9/16/2019	Largemouth bass	1	Scaled, skin-on fillet	36.8					77
Monona @ Starkweather	WI	9/16/2019	Largemouth bass	1	Scaled, skin-on fillet	38.1					84
Monona @ Starkweather	WI	9/16/2019	Largemouth bass	1	Scaled, skin-on fillet	41.9					92
Monona @ Starkweather	WI	9/16/2019	Largemouth bass	1	Scaled, skin-on fillet	43.2					97
Monona @ Starkweather	WI	9/16/2019	Largemouth bass	1	Scaled, skin-on fillet	40.6					110
Monona Bay	WI	3/17/2020	Black crappie	1	Scaled, skin-on fillet	21.3	142		F		48.4
Monona Bay	WI	3/17/2020	Black crappie	1	Scaled, skin-on fillet	23.1	198		U		60.3
Monona Bay	WI	3/17/2020	Black crappie	1	Scaled, skin-on fillet	23.6	198		U		63.6
Monona Bay	WI	3/17/2020	Black crappie	1	Scaled, skin-on fillet	24.9	248		F		66.6
Monona Bay	WI	3/17/2020	Black crappie	1	Scaled, skin-on fillet	25.9	308		F		75.2
Monona Bay	WI	3/18/2020	Common carp	1	Scaled, skin-on fillet	54.6	1860		U	5.8	7.63
Monona Bay	WI	3/18/2020	Common carp	1	Scaled, skin-on fillet	49.0	1626		U	3.77	8.05
Monona Bay	WI	3/18/2020	Common carp	1	Scaled, skin-on fillet	59.2	2248		U	3.05	15
Monona Bay	WI	3/18/2020	Common carp	1	Scaled, skin-on fillet	56.1	2792		U	9	16.9
Monona Bay	WI	3/18/2020	Common carp	1	Scaled, skin-on fillet	72.1	5122		U	7.05	20.5
Monona Bay	WI	3/18/2020	Common carp	1	Scaled, skin-on fillet	63.5	3366		U	1.96	28
Monona Bay	WI	3/20/2020	Walleye	1	Scaled, skin-on fillet	45.5	744		U		75.3
Monona Bay	WI	7/7/2020	Surface water								5.57
Northstar (Unnamed)	MN	8/21/2018	Common carp	1	Scaled, skin-on fillet	49.6	1965.1	6	F		3.27
Northstar (Unnamed)	MN	8/21/2018	Common carp	1	Scaled, skin-on fillet	53.5	2733.2	7	M		4.24
Northstar (Unnamed)	MN	8/21/2018	Common carp	1	Scaled, skin-on fillet	62.5	4450	8	M		4.51
Northstar (Unnamed)	MN	8/21/2018	Common carp	1	Scaled, skin-on fillet	65	4740	10	F		5.73
Northstar (Unnamed)	MN	8/21/2018	Common carp	1	Scaled, skin-on fillet	57.5	2506.9	6	M		18
Northstar (Unnamed)	MN	8/21/2018	Surface water								4.3
Northstar (Unnamed)	MN	8/21/2018	Surface water								4.64
Northstar (Unnamed)	MN	8/21/2018	Surface water								4.91
Owasso	MN	6/26/2018	Bluegill	5	Scaled, skin-on fillet	16.7132	110				5.93
Owasso	MN	6/26/2018	Largemouth bass	1	Scaled, skin-on fillet	43.18	960				8.61
Owasso	MN	6/26/2018	Largemouth bass	1	Scaled, skin-on fillet	28.448	370				10.5
Owasso	MN	6/26/2018	Largemouth bass	1	Scaled, skin-on fillet	33.274	540				12.3
Owasso	MN	6/26/2018	Largemouth bass	1	Scaled, skin-on fillet	34.544	670				13.7
Owasso	MN	6/26/2018	Largemouth bass	1	Scaled, skin-on fillet	31.75	520				20.5
Owasso	MN	8/9/2018	Surface water								2.11
Rebecca	MN	9/12/2018	Bluegill	5	Scaled, skin-on fillet	15.748	96				45.8
Rebecca	MN	9/12/2018	Largemouth bass	2	Scaled, skin-on fillet	22.86	180				135
Rebecca	MN	9/12/2018	Largemouth bass	1	Scaled, skin-on fillet	32.766	620				167
Rebecca	MN	9/12/2018	Largemouth bass	1	Scaled, skin-on fillet	35.56	830				188
Rebecca	MN	9/12/2018	Largemouth bass	1	Scaled, skin-on fillet	28.194	460				192
Rebecca	MN	10/11/2018	Surface water								47.8
Rebecca	MN	10/11/2018	Surface water								47.8
Round	WI	7/16/2020	Black crappie	1	Scaled, skin-on fillet	20.3	106		U		3.11
Round	WI	7/16/2020	Largemouth bass	1	Scaled, skin-on fillet	32.3	562		U		1.59
Round	WI	9/2/2020	Surface water								0.336

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Snelling	MN	9/10/2018	Northern pike	1	Scaled, skin-on fillet	50.292	760				29.4
Snelling	MN	9/10/2018	Northern pike	1	Scaled, skin-on fillet	53.594	910				33.6
Snelling	MN	9/10/2018	Northern pike	1	Scaled, skin-on fillet	53.594	800				34.2
Snelling	MN	10/11/2018	Surface water								21.4
Snelling	MN	10/11/2018	Surface water								21.8
St. Louis River, Mouth	WI	4/16/2019	Northern pike	1	Scaled, skin-on fillet	82.6	3580		F	1.47	1.2
St. Louis River, Mouth	WI	6/25/2019	Black crappie	1	Scaled, skin-on fillet	17.5					3.47
St. Louis River, Mouth	WI	6/25/2019	Black crappie	1	Scaled, skin-on fillet	20.6					4.36
St. Louis River, Mouth	WI	6/25/2019	Black crappie	1	Scaled, skin-on fillet	20.1					4.36
St. Louis River, Mouth	WI	6/25/2019	Black crappie	1	Scaled, skin-on fillet	21.8					5.53
St. Louis River, Mouth	WI	6/25/2019	Black crappie	1	Scaled, skin-on fillet	30.7					6.45
St. Louis River, Mouth	WI	6/25/2019	Black crappie	1	Scaled, skin-on fillet	22.1					7.53
St. Louis River, Mouth	WI	6/25/2019	Black crappie	1	Scaled, skin-on fillet	26.9					8.05
St. Louis River, Mouth	WI	6/25/2019	Channel catfish	1	Skin off fillet	36.8					1.24
St. Louis River, Mouth	WI	6/25/2019	Musky	1	Edible portion	89.2	3450			0.235	25.9
St. Louis River, Mouth	WI	6/25/2019	Northern pike	1	Edible portion	49.8					1.95
St. Louis River, Mouth	WI	6/25/2019	Northern pike	1	Edible portion	48.8					1.95
St. Louis River, Mouth	WI	6/25/2019	Northern pike	1	Edible portion	49.3					2.07
St. Louis River, Mouth	WI	6/25/2019	Northern pike	1	Edible portion	60.5					2.22
St. Louis River, Mouth	WI	6/25/2019	Northern pike	1	Edible portion	44.7					2.57
St. Louis River, Mouth	WI	6/25/2019	Northern pike	1	Edible portion	59.2					2.63
St. Louis River, Mouth	WI	6/25/2019	Northern pike	1	Edible portion	48.5					5.2
St. Louis River, Mouth	WI	6/25/2019	Walleye	1	Scaled, skin-on fillet	42.9	710		F	2.17	5.43
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	23.9					3.49
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	22.6					4.9
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	26.9					5.86
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	22.6					7.88
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	19.3					8.21
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	21.6					8.4
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	20.8					8.82
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	16.3					14.4
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	17.5					19.3
St. Louis River, Mouth	WI	6/25/2019	Yellow perch	1	Scaled, skin-on fillet	21.6					25.7
St. Louis River, Mouth	WI	6/27/2019	Walleye	1	Scaled, skin-on fillet	49.3	1150		F	2.8	3.02
St. Louis River, Mouth	WI	7/1/2019	Surface water								0.63
St. Louis River, Mouth	WI	7/16/2019	Common carp	1	Scaled, skin-on fillet	71.6	5330		M	9.15	2.15
St. Louis River, Mouth	WI	7/16/2019	Common carp	1	Edible portion	70.9	4540		F	13.3	2.84
St. Louis River, Mouth	WI	7/16/2019	Common carp	1	Edible portion	69.9	3920		M	13.1	7.75
Tanners	MN	6/12/2007	Black crappie	1	Scaled, skin-on fillet	17	56	4	F	0.39	64
Tanners	MN	6/12/2007	Black crappie	1	Scaled, skin-on fillet	15	63	3	M	0.44	75.9
Tanners	MN	6/12/2007	Black crappie	1	Scaled, skin-on fillet	18	56	4	F	0.37	91.2
Tanners	MN	6/12/2007	Black crappie	1	Scaled, skin-on fillet	18.5	80	4	M	0.38	94.6
Tanners	MN	6/12/2007	Black crappie	1	Scaled, skin-on fillet	18	69	4	M	0.53	265
Tanners	MN	6/12/2007	Bluegill	5	Scaled, skin-on fillet	12.5	50			1.06	55
Tanners	MN	6/12/2007	Bluegill	1	Scaled, skin-on fillet	18	92	7	F	0.61	56.6
Tanners	MN	6/12/2007	Bluegill	1	Scaled, skin-on fillet	16.5	89	6	F	0.76	70.4
Tanners	MN	6/12/2007	Bluegill	1	Scaled, skin-on fillet	10	12	2	J		105

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Tanners	MN	6/12/2007	Largemouth bass	1	Scaled, skin-on fillet	50	1570	12	F	0.43	74.1
Tanners	MN	6/12/2007	Largemouth bass	1	Scaled, skin-on fillet	37	823	7	M	1.35	74.9
Tanners	MN	6/12/2007	Largemouth bass	1	Scaled, skin-on fillet		619	5	F	0.34	75.7
Tanners	MN	6/12/2007	Largemouth bass	1	Scaled, skin-on fillet	35	576	6	F	0.57	76.6
Tanners	MN	6/12/2007	Largemouth bass	1	Scaled, skin-on fillet		378	4	F	0.55	96.5
Tanners	MN	8/4/2008	Surface water								5.36
Tanners	MN	8/4/2008	Surface water								6.32
Tanners	MN	8/4/2008	Surface water								7.01
Tanners	MN	6/11/2018	Black crappie	5	Scaled, skin-on fillet	19.9	156				41.1
Tanners	MN	6/11/2018	Bluegill	5	Scaled, skin-on fillet	17.5	136				62.1
Tanners	MN	6/11/2018	Largemouth bass	4	Scaled, skin-on fillet	15.2	75				76.7
Tanners	MN	6/11/2018	Largemouth bass	1	Scaled, skin-on fillet	39.1	1100				171
Tanners	MN	6/11/2018	Northern pike	1	Scaled, skin-on fillet	35.1	250				38.5
Tanners	MN	8/9/2018	Surface water								8.79
Tanners	MN	8/9/2018	Surface water								8.97
Twin	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	15.6	81.4	3	U		10
Twin	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	14.3	56.1	3	J		13.5
Twin	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	14.2	56.0	3	J		14.5
Twin	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	13.7	46.7	3	F		19.6
Twin	MN	7/13/2016	Black crappie	1	Scaled, skin-on fillet	17.8	95.7	4	J		32.8
Twin	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	15	94.2	4	M		10.5
Twin	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	16.4	100.8	5	M		11.3
Twin	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	14.6	83.4	4	M		17.5
Twin	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	14.5	70	4	M		17.8
Twin	MN	7/13/2016	Bluegill	1	Scaled, skin-on fillet	14.5	68.3	4	M		48.4
Twin	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	22.3	223	3	F		16.4
Twin	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	19.7	124.6	2	F		21.5
Twin	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	19.5	148.4	2	J		23
Twin	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	21.2	186.8	2	M		25.6
Twin	MN	7/13/2016	Largemouth bass	1	Scaled, skin-on fillet	20.4	151.7	2	J		48.3
Twin	MN	7/14/2016	Surface water								8.11
Twin	MN	7/14/2016	Surface water								8.81
Twin	MN	6/13/2018	Bluegill	5	Scaled, skin-on fillet	15.1	66				28.4
Twin	MN	6/13/2018	Largemouth bass	2	Scaled, skin-on fillet	21.8	160				34.7
Twin	MN	6/13/2018	Largemouth bass	1	Scaled, skin-on fillet	31.5	500				35.2
Twin	MN	7/26/2018	Surface water								7.64
Twin	MN	7/26/2018	Surface water								8.22
Twin	MN	7/26/2018	Surface water								8.24
Van Zile	WI	8/13/2020	Surface water								0.474
Van Zile	WI	8/27/2020	Bluegill	1	Scaled, skin-on fillet	17.8	108		F		1.45
Van Zile	WI	8/27/2020	Largemouth bass	1	Scaled, skin-on fillet	46.0	1330		F		1.51
Van Zile	WI	8/27/2020	Largemouth bass	1	Scaled, skin-on fillet	33.3	488		M		1.69
Van Zile	WI	8/27/2020	Largemouth bass	1	Scaled, skin-on fillet	33.3	492		M		3.39
Van Zile	WI	8/27/2020	Largemouth bass	1	Scaled, skin-on fillet	36.6	652		F		3.65
Van Zile	WI	8/27/2020	Largemouth bass	1	Scaled, skin-on fillet	34.0	542		F		4.56
Van Zile	WI	8/27/2020	Walleye	1	Scaled, skin-on fillet	47.8	928		F		2.21
Van Zile	WI	8/27/2020	Walleye	1	Scaled, skin-on fillet	38.9	512		F		7.24

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Van Zile	WI	8/27/2020	Walleye	1	Scaled, skin-on fillet	43.4	660		F		8.23
Van Zile	WI	8/27/2020	Walleye	1	Scaled, skin-on fillet	39.9	520		F		8.34
Waubesa	WI	7/7/2020	Bluegill	1	Scaled, skin-on fillet	20.1	188		F		15.1
Waubesa	WI	7/7/2020	Bluegill	1	Scaled, skin-on fillet	20.8	214		U		18
Waubesa	WI	7/7/2020	Bluegill	1	Scaled, skin-on fillet	21.6	220		F		24.9
Waubesa	WI	7/7/2020	Bluegill	1	Scaled, skin-on fillet	21.3	248		F		26.4
Waubesa	WI	7/7/2020	Bluegill	1	Scaled, skin-on fillet	19.6	184		U		30.7
Waubesa	WI	7/7/2020	Freshwater drum	1	Scaled, skin-on fillet	31.2	414		U		14.2
Waubesa	WI	7/7/2020	Freshwater drum	1	Scaled, skin-on fillet	28.7	288		U		22.1
Waubesa	WI	7/7/2020	Freshwater drum	1	Scaled, skin-on fillet	36.6	570		U		55.9
Waubesa	WI	7/7/2020	Freshwater drum	1	Scaled, skin-on fillet	40.1	790		U		78.7
Waubesa	WI	7/7/2020	Largemouth bass	1	Scaled, skin-on fillet	41.1	1144		F		39.8
Waubesa	WI	7/7/2020	Largemouth bass	1	Scaled, skin-on fillet	39.1	934		U		44.8
Waubesa	WI	7/7/2020	Largemouth bass	1	Scaled, skin-on fillet	41.9	1006		U		48.7
Waubesa	WI	7/7/2020	Largemouth bass	1	Scaled, skin-on fillet	42.7	1026		U		49.2
Waubesa	WI	7/7/2020	Largemouth bass	1	Scaled, skin-on fillet	36.1	710		M		53.8
Waubesa	WI	7/7/2020	Surface water								7.83
Waubesa	WI	7/7/2020	Walleye	1	Scaled, skin-on fillet	32.5	274		U		14.6
Waubesa	WI	7/7/2020	Walleye	1	Scaled, skin-on fillet	33.3	290		U		46.7
Waubesa	WI	7/7/2020	Walleye	1	Scaled, skin-on fillet	42.2	606		U		52
Waubesa	WI	7/7/2020	Walleye	1	Scaled, skin-on fillet	35.1	342		U		54.3
Waubesa	WI	7/7/2020	Walleye	1	Scaled, skin-on fillet	33.5	304		U		59.9
WI River, Above Hat Rapids Dam	WI	6/27/2019	Surface water								3.1
WI River, Above Hat Rapids dam	WI	8/8/2019	Bluegill	1	Scaled, skin-on fillet						6.7
WI River, Above Hat Rapids dam	WI	8/8/2019	Bluegill	1	Scaled, skin-on fillet						14.4
WI River, Above Hat Rapids dam	WI	8/8/2019	Bluegill	1	Scaled, skin-on fillet						19.4
WI River, Above Hat Rapids dam	WI	8/8/2019	Bluegill	1	Scaled, skin-on fillet						25.4
WI River, Above Hat Rapids dam	WI	8/8/2019	Northern pike	1	Scaled, skin-on fillet						7.33
WI River, Above Hat Rapids dam	WI	8/8/2019	Pumpkinseed	1	Scaled, skin-on fillet						14.7
WI River, Above Hat Rapids dam	WI	8/8/2019	Pumpkinseed	1	Scaled, skin-on fillet						21.3
WI River, Above Hat Rapids dam	WI	8/8/2019	Pumpkinseed	1	Scaled, skin-on fillet						32.9
WI River, Above Hat Rapids dam	WI	8/8/2019	Rock bass	1	Scaled, skin-on fillet						12.3
WI River, Above Hat Rapids dam	WI	8/8/2019	Smallmouth bass	1	Scaled, skin-on fillet						4.56
WI River, Above Hat Rapids dam	WI	8/8/2019	Smallmouth bass	1	Scaled, skin-on fillet						6.53
WI River, Above Hat Rapids dam	WI	8/8/2019	Smallmouth bass	1	Scaled, skin-on fillet						7.31
WI River, Above Hat Rapids dam	WI	8/8/2019	Smallmouth bass	1	Scaled, skin-on fillet						8.21
WI River, Above Hat Rapids dam	WI	8/8/2019	Smallmouth bass	1	Scaled, skin-on fillet						11.1
WI River, Above Hat Rapids dam	WI	8/8/2019	Smallmouth bass	1	Scaled, skin-on fillet						23.8
WI River, Above Hat Rapids Dam	WI	8/9/2019	Surface water								3.6
WI River, Above Hat Rapids Dam	WI	9/3/2019	Surface water								1.6
WI River, Below Merrill	WI	6/27/2019	Surface water								2.7
WI River, Below Merrill	WI	8/9/2019	Largemouth bass	1	Scaled, skin-on fillet						6.61
WI River, Below Merrill	WI	8/9/2019	Northern pike	1	Scaled, skin-on fillet						16.7
WI River, Below Merrill	WI	8/9/2019	Northern pike	1	Scaled, skin-on fillet						17.9
WI River, Below Merrill	WI	8/9/2019	Rock bass	1	Scaled, skin-on fillet						40.2
WI River, Below Merrill	WI	8/9/2019	Smallmouth bass	1	Scaled, skin-on fillet						18.8
WI River, Below Merrill	WI	8/9/2019	Smallmouth bass	1	Scaled, skin-on fillet						24.2

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
WI River, Below Merrill	WI	8/9/2019	Smallmouth bass	1	Scaled, skin-on fillet						25.1
WI River, Below Merrill	WI	8/9/2019	Smallmouth bass	1	Scaled, skin-on fillet						30.3
WI River, Below Merrill	WI	8/9/2019	Surface water								3.9
WI River, Below Merrill	WI	8/9/2019	Walleye	1	Scaled, skin-on fillet						16.5
WI River, Below Merrill	WI	8/9/2019	Walleye	1	Scaled, skin-on fillet						24.9
WI River, Below Merrill	WI	8/9/2019	Walleye	1	Scaled, skin-on fillet						59.6
WI River, Below Merrill	WI	9/3/2019	Surface water								2.6
WI River, Biron Flowage	WI	4/1/2019	Channel catfish	1	Skin off fillet	62.0	2224		M	1.8	1.37
WI River, Biron Flowage	WI	4/1/2019	Channel catfish	1	Skin off fillet	54.6	1434		U	1.6	2.22
WI River, Biron Flowage	WI	4/1/2019	Channel catfish	1	Skin off fillet	45.7	752		M	1.59	4.28
WI River, Biron Flowage	WI	4/1/2019	Channel catfish	1	Skin off fillet	57.2	1598		U	2.73	4.56
WI River, Biron Flowage	WI	4/1/2019	Channel catfish	1	Skin off fillet	42.2	536		U	3.19	5.28
WI River, Biron Flowage	WI	4/1/2019	Channel catfish	1	Skin off fillet	56.9	1380		M	4.63	6.09
WI River, Biron Flowage	WI	4/1/2019	Channel catfish	1	Skin off fillet	51.1	1058		U	3.38	6.12
WI River, Biron Flowage	WI	4/1/2019	Channel catfish	1	Skin off fillet	45.0	696		M	0.865	35.3
WI River, Biron Flowage	WI	4/1/2019	Redhorses	1	Scaled, skin-on fillet	50.0	1128		M	1.74	2.02
WI River, Biron Flowage	WI	4/1/2019	Redhorses	1	Scaled, skin-on fillet	47.0	1012		M	4.41	4.63
WI River, Biron Flowage	WI	4/1/2019	Redhorses	1	Scaled, skin-on fillet	52.8	1668		U	8.59	8.73
WI River, Biron Flowage	WI	4/1/2019	Redhorses	1	Scaled, skin-on fillet	46.2	1018		F	2.71	12.2
WI River, Biron Flowage	WI	4/1/2019	Redhorses	1	Scaled, skin-on fillet	56.4	1586		U	0.47	13.6
WI River, Biron Flowage	WI	4/1/2019	Redhorses	1	Scaled, skin-on fillet	52.3	1550		F	6.69	15.6
WI River, Biron Flowage	WI	4/1/2019	White bass	1	Scaled, skin-on fillet	34.0	476		F	2.44	38.5
WI River, Biron Flowage	WI	4/1/2019	White bass	1	Scaled, skin-on fillet	34.3	524		F	2.72	41.1
WI River, Biron Flowage	WI	4/1/2019	White bass	1	Scaled, skin-on fillet	35.3	648		M	3.91	66.1
WI River, Biron Flowage	WI	4/1/2019	White bass	1	Scaled, skin-on fillet	35.6	660		U	3.57	75
WI River, Biron Flowage	WI	4/1/2019	White bass	1	Scaled, skin-on fillet	36.1	634		F	5.47	86.1
WI River, Biron Flowage	WI	4/1/2019	White bass	1	Scaled, skin-on fillet	32.5	416		M	1.88	103
WI River, Biron Flowage	WI	7/15/2020	Surface water								4.33
WI River, Upper Petenwell Flowage	WI	6/27/2019	Surface water								3
WI River, Upper Petenwell Flowage	WI	8/9/2019	Black crappie	1	Scaled, skin-on fillet						55.4
WI River, Upper Petenwell Flowage	WI	8/9/2019	Bluegill	1	Scaled, skin-on fillet						16.8
WI River, Upper Petenwell Flowage	WI	8/9/2019	Bluegill	1	Scaled, skin-on fillet						18.8
WI River, Upper Petenwell Flowage	WI	8/9/2019	Bluegill	1	Scaled, skin-on fillet						21.1
WI River, Upper Petenwell Flowage	WI	8/9/2019	Bluegill	1	Scaled, skin-on fillet						24.6
WI River, Upper Petenwell Flowage	WI	8/9/2019	Bluegill	1	Scaled, skin-on fillet						28.5
WI River, Upper Petenwell Flowage	WI	8/9/2019	Bluegill	1	Scaled, skin-on fillet						31.1
WI River, Upper Petenwell Flowage	WI	8/9/2019	Bluegill	1	Scaled, skin-on fillet						38
WI River, Upper Petenwell Flowage	WI	8/9/2019	Rock bass	1	Scaled, skin-on fillet						77.3
WI River, Upper Petenwell Flowage	WI	8/9/2019	Smallmouth bass	1	Scaled, skin-on fillet						18.9
WI River, Upper Petenwell Flowage	WI	8/9/2019	Smallmouth bass	1	Scaled, skin-on fillet						20.6
WI River, Upper Petenwell Flowage	WI	8/9/2019	Smallmouth bass	1	Scaled, skin-on fillet						21
WI River, Upper Petenwell Flowage	WI	8/9/2019	Surface water								5.6
WI River, Upper Petenwell Flowage	WI	8/9/2019	Walleye	1	Scaled, skin-on fillet						22.7
WI River, Upper Petenwell Flowage	WI	8/9/2019	Walleye	1	Scaled, skin-on fillet						39.1
WI River, Upper Petenwell Flowage	WI	8/9/2019	Yellow perch	1	Scaled, skin-on fillet						35.5
WI River, Upper Petenwell Flowage	WI	9/3/2019	Surface water								3.1
Wild Rice	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	29	350	9	M	0.6	132

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Wild Rice	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	22	146	6	F	0.3	148
Wild Rice	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	24	193	7	F	0.54	152
Wild Rice	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	15	40.4	3	J	0.67	175
Wild Rice	MN	9/24/2008	Black crappie	1	Scaled, skin-on fillet	23	160	6	M	0.42	213
Wild Rice	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	21	156	8	F	0.45	46.4
Wild Rice	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	19	131	7	F	0.33	50
Wild Rice	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	18.5	123	7	F	0.44	61.2
Wild Rice	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	18	139	6	F	0.87	62.9
Wild Rice	MN	9/24/2008	Bluegill	1	Scaled, skin-on fillet	18.5	134	7	F	0.55	88.6
Wild Rice	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	44	539	4	F	0.2	72.5
Wild Rice	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	59	1317	4	F	0.7	112
Wild Rice	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	45	580	4	M	0.16	123
Wild Rice	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	45.5	532	4	M	0.21	144
Wild Rice	MN	9/24/2008	Northern pike	1	Scaled, skin-on fillet	44	600	4	F	0.18	146
Wild Rice	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	43	921	7	F	1.25	70.4
Wild Rice	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	50	1210	9	M	1.55	121
Wild Rice	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	40	653	6	F	0.6	144
Wild Rice	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	42	741	6	M	2	160
Wild Rice	MN	9/24/2008	Walleye	1	Scaled, skin-on fillet	33	328	5	M	1.75	163
Wild Rice	MN	10/30/2008	Surface water								108
Wild Rice	MN	10/30/2008	Surface water								110
Wild Rice	MN	10/30/2008	Surface water								122
Wild Rice	MN	9/25/2018	Surface water								22.1
Wild Rice	MN	9/25/2018	Surface water								23.7
Wild Rice	MN	10/8/2018	Black crappie	1	Scaled, skin-on fillet	27.5	329.8	8	F		63.1
Wild Rice	MN	10/8/2018	Bluegill	1	Scaled, skin-on fillet	20.5	220.1	8	M		47.9
Wild Rice	MN	10/8/2018	Bluegill	1	Scaled, skin-on fillet	19.5	188.1	7	F		58.7
Wild Rice	MN	10/8/2018	Bluegill	1	Scaled, skin-on fillet	20.7	207.3	8	M		107
Wild Rice	MN	10/8/2018	Bluegill	1	Scaled, skin-on fillet	20.5	244.8	8	F		112
Wild Rice	MN	10/8/2018	Bluegill	1	Scaled, skin-on fillet	20.5	192.4	8	M		134
Wild Rice	MN	10/8/2018	Northern pike	1	Scaled, skin-on fillet	69	2133.7	5	F		55.6
Wild Rice	MN	10/8/2018	Northern pike	1	Scaled, skin-on fillet	74	3320	6	F		82.3
Wild Rice	MN	10/8/2018	Northern pike	1	Scaled, skin-on fillet	54	1470.8	4	F		110
Wild Rice	MN	10/8/2018	Northern pike	1	Scaled, skin-on fillet	45	630.7	4	M		127
Wild Rice	MN	10/8/2018	Northern pike	1	Scaled, skin-on fillet	49	908.8	4	M		191
Wild Rice	MN	10/8/2018	Walleye	1	Scaled, skin-on fillet	33.3	418.0	5	M		71.4
Wild Rice	MN	10/8/2018	Walleye	1	Scaled, skin-on fillet	39	741.4	6	M		135
Wild Rice	MN	10/8/2018	Walleye	1	Scaled, skin-on fillet	32	361.4	5	M		137
Wild Rice	MN	10/8/2018	Walleye	1	Scaled, skin-on fillet	37	537.5	5	M		147
Wild Rice	MN	10/8/2018	Walleye	1	Scaled, skin-on fillet	33.5	428.0	5	M		150
Wingra	WI	7/1/2020	Bluegill	1	Scaled, skin-on fillet	13.5	40		U		1.13
Wingra	WI	7/1/2020	Bluegill	1	Scaled, skin-on fillet	14.2	50		U		2.61
Wingra	WI	7/1/2020	Bluegill	1	Scaled, skin-on fillet	15.5	64		U		4.21
Wingra	WI	7/1/2020	Bluegill	1	Scaled, skin-on fillet	14.7	56		U		83.2
Wingra	WI	7/1/2020	Largemouth bass	1	Scaled, skin-on fillet	46.2	1780		U		10.5
Wingra	WI	7/1/2020	Largemouth bass	1	Scaled, skin-on fillet	30.5	430		U		11.5
Wingra	WI	7/1/2020	Largemouth bass	1	Scaled, skin-on fillet	29.7	352		U		11.7

Waterway	State	Sample Date	Sample Type	N	Form	Length (cm)	Weight (g)	Age (yr)	Sex	Lipid (%)	PFOS (ng/g - fish) (ng/L - water)
Wingra	WI	7/1/2020	Largemouth bass	1	Scaled, skin-on fillet	39.9	960		U		12.1
Wingra	WI	7/1/2020	Largemouth bass	1	Scaled, skin-on fillet	43.7	1422		U		13.8
Wingra	WI	7/1/2020	Yellow perch	1	Scaled, skin-on fillet	22.1	124		U		2.98
Wingra	WI	7/1/2020	Yellow perch	1	Scaled, skin-on fillet	21.6	114		U		5.38
Wingra	WI	7/1/2020	Yellow perch	1	Scaled, skin-on fillet	21.6	102		U		5.76
Wingra	WI	7/1/2020	Yellow perch	1	Scaled, skin-on fillet	19.8	76		U		6.47
Wingra	WI	7/1/2020	Yellow perch	1	Scaled, skin-on fillet	21.3	98		U		6.59
Wingra	WI	7/7/2020	Surface water								1.12
Winona	MN	10/3/2018	Bluegill	1	Scaled, skin-on fillet	15.2	88.2	4	M		16.7
Winona	MN	10/3/2018	Bluegill	1	Scaled, skin-on fillet	15	85.9	4	M		17.1
Winona	MN	10/3/2018	Bluegill	1	Scaled, skin-on fillet	15	80.1	4	F		19.9
Winona	MN	10/3/2018	Bluegill	1	Scaled, skin-on fillet	15.5	89.0	5	M		32.1
Winona	MN	10/3/2018	Bluegill	1	Scaled, skin-on fillet	15	79.5	4	F		32.4
Winona	MN	10/3/2018	Largemouth bass	1	Scaled, skin-on fillet	31.4	543.3	5	F		32.2
Winona	MN	10/3/2018	Largemouth bass	1	Scaled, skin-on fillet	34.2	780.3	6	F		41.2
Winona	MN	10/3/2018	Largemouth bass	1	Scaled, skin-on fillet	33.2	750.8	6	F		42.3
Winona	MN	10/3/2018	Largemouth bass	1	Scaled, skin-on fillet	34.8	848.1	6	F		48.3
Winona	MN	10/3/2018	Largemouth bass	1	Scaled, skin-on fillet	30	483.3	5	F		54.3
Winona	MN	10/3/2018	Surface water								8.59
Winona	MN	10/3/2018	Surface water								10.6

Metadata

Surface water data are colored in orange for ease of distinguishing between sample types.

Location Information

Mississippi River Pool 2, Reach 2 = RM 836-843
Mississippi River Pool 2, Reach 3 = RM 821-834
Mississippi River Pool 2, Reach 4 = RM 815-820

Sample Form Information

Edible portion = Full cross section of the fish, no less than 3" wide, taken from the area 9-12" anterior to the dorsal fin. Sample form used for large specimens that are difficult to transport. Only muscle tissue is analyzed.
Scaled, skin-on fillet = Lateral muscle fillets of both sides, scaled but with skin intact. Sample form used for species with scales (standard form).
Skin off fillet = Lateral muscle fillets of both sides with skin removed. Sample form used for catfish, bullheads, and species without scales.

Sex Information

F = female
J = juvenile
M = male
U = unknown sex

Appendix B: Calculating Fish Consumption Advisory Meal Categories

Fish consumption meal categories are calculated by inputting the reference dose, body weight, and fish consumption rate into Equation B1 to get the maximum concentration of a pollutant (here, PFOS) that is safe to consume at a given consumption rate.

Equation B1:

$$Maximum\ concentration_{\ meal\ frequency} \left(\frac{\mu g}{g}\ or\ ppm\right) = \frac{RfD\left(\frac{\mu g/_{kg}}{day}\right) \times BW(kg)}{FCR\left(\frac{g}{day}\right)}$$

Where:

$$PFOS\ Reference\ Dose = 2\ x\ 10^{-2}\ \frac{\mu g/_{kg}}{day}$$

$$Body\ weight = 70kg$$

$$Fish\ consumption\ rate\ \left(\frac{g}{day}\right) = meal\ size\ (g) \times \frac{Meals}{Year} \times \frac{Year}{365\ days}$$

$$Meal\ size = 227g\ or\ 8oz$$

These maximum concentrations then become the thresholds between different meal categories, as demonstrated in the Table B1 below from the Consortium 2019 PFOS Best Practice Guidelines document. Equations B2 through B4 demonstrate how these meal frequency thresholds were derived.

PFOS in Fish (µg/kg)	Meal Frequency
≤ 10	Unrestricted
> 10 – 50	1 meal/week
> 50 – 200	1 meal/month
> 200	DO NOT EAT

Equation B2:

$$Maximum\ concentration_{Unrestricted} = \frac{(2 \times 10^{-2}) \times 70}{140\ \frac{g}{day}} = 0.01\ ppm = 10\ ppb$$

Equation B3:

$$Maximum\ concentration_{1\ meal/\ week} = \frac{(2 \times 10^{-2}) \times 70}{32\ \frac{g}{day}} = 0.044\ ppm \approx 50\ ppb$$

Equation B4:

$$Maximum\ concentration_{1\ meal/month} = \frac{(2\times 10^{-2})\times 70}{7.4\frac{g}{day}} = 0.189\ ppm \approx 200\ ppb$$

Appendix C: Models that were evaluated, but not selected, during PFOS criteria derivation

Classification and Regression Trees

Classification and Regression Trees (CART) is an analytical technique that attempts to split a response variable into two (or more) homogenous groups based on a predictor variable (R package rpart). CART uses recursive partitioning to find the numeric value of the predictor variable that best splits the response variable into two groups that minimizes with group variability while maximizing between group mean differences. We used CART to find only the single strongest split value (i.e. single node), although multiple splits can be computed. CART excels at finding thresholds, although it does not typically generalize the data as well as other methods, meaning that it is sensitive to the exact input data and confidence intervals (90% for this and all subsequent analyses) calculated through bootstrapping tend to be large (see Table 1, Figure 1 for all results). The final model predicted classification well; the group with water concentrations of PFOS >13.52 ng/l contained 93.0% of fish samples above 50.0 ng/g, and the group with PFOS water concentrations <13.52 ng/l only 17.6 % above 50.0 ng/g (post hoc t-test p <0.001). The department did not select CART for the final analysis because of the large variability in confidence intervals and known statistical issues with being less generalizable (i.e. very sensitive to exact input data) than other measures of model performance.

Logistic Regression

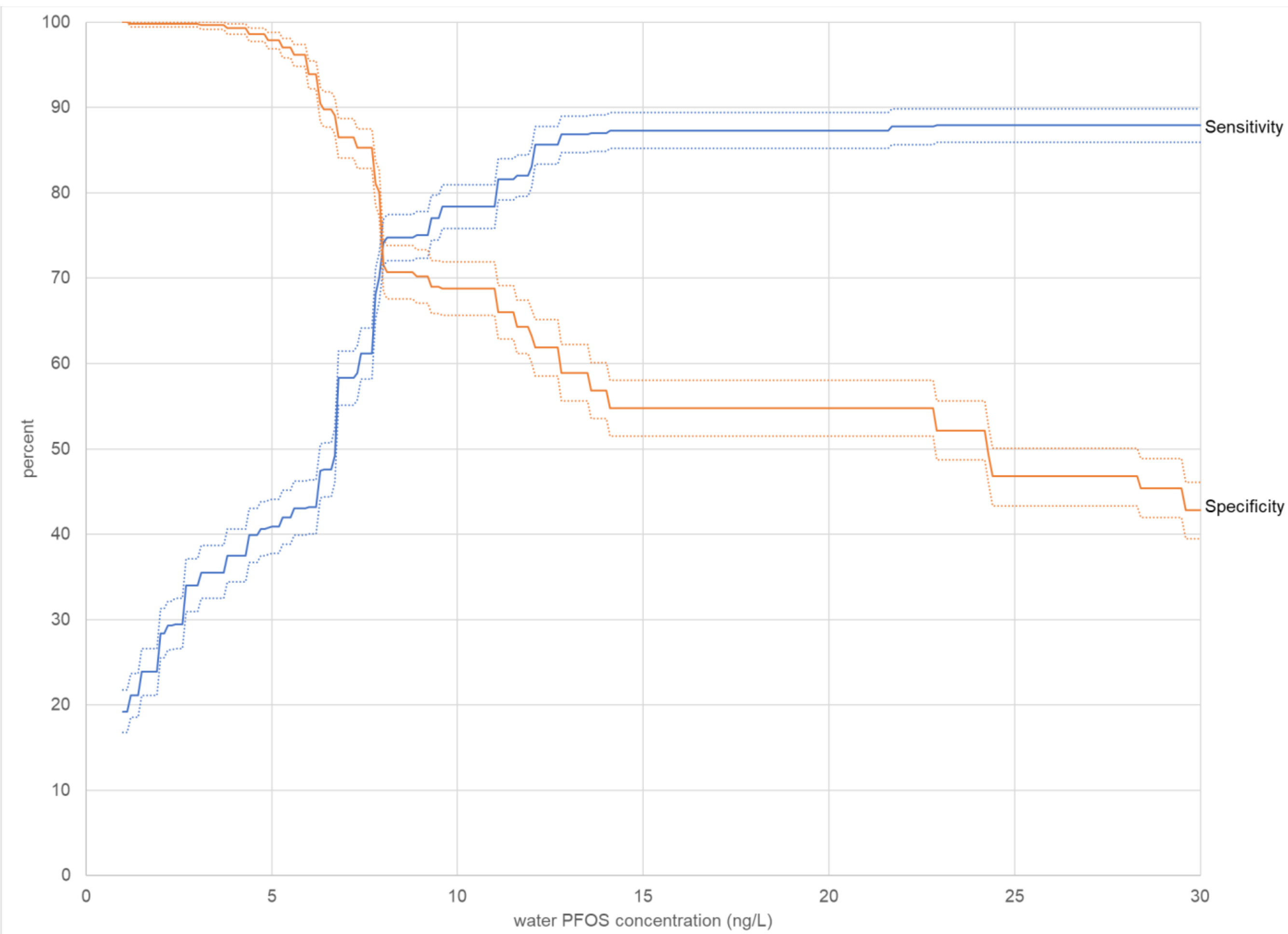
Logistic regression (LR) is a type of regression analysis that is especially suited to predicting a binary response variable. LR is more generalizable that CART (i.e. should be more resilient to adding new data) but determining specific thresholds of the predictor variable is not as clear cut. Using LR in conjunction with CART will provide a range of possible thresholds of PFOS water that best predict the fish tissue response variable. We used the glm function in R to create a LR model and used the model inflection point (where chances Positive fish tissue is ~50%) and the maximum rate of change-point (numeric value where % of Positive responses increases most rapidly) as two possible thresholds. Using LR water column PFOS predicted fish tissue binary variable well (p<0.001, log odds = 1.67). LR was not selected for the final model as the inflection point necessarily means 50% error on each side of the threshold. The maximum rate of change is more protective and ecologically significant, however not as easily interpreted as the ROC analysis.

Quantile Regression

Quantile regression (QR) is an extension of linear regression but instead of estimating the mean trend between two variables the user defines a particular percentile (20th, 50th [median], 80th, etc.) of the relationship. We used QR to examine the relationship between PFOS in water and numeric PFOS in fish tissue. In all previous analyses we examined fish tissue as a binary response variable. By adding QR we can examine the same type of threshold analyses (where fish tissue equals 50 ng/g) but using a continuous response variable. If the QR analyses are relatively similar to the binary analyses, then we are more certain that transforming the fish tissue to a binary response variable did not ultimately obscure the relationship between water and fish tissue PFOS. QR at the 50th percentile provides the water concentration where 50% of the fish are predicted to be above 50 ng/l (e.g. Positive). The 80th percentile QR estimates the point where 20% of the fish are Positive. In other words, a more protective water concentrations where fish are just starting to be consistently above the fish tissue threshold. Because the response variable is continuous extreme percentiles in QR are sensitive to outliers (high fish tissue concentration per water PFOS concentration) so we choose a moderately large percentile (80th) to balance human health protection and resilience to outliers. The department ultimately did not select QR because the more protective percentiles (e.g. high ends of the distribution) are potentially sensitive to outliers that over-influence the point the regression line meets 50 ng/l fish tissue.

ROC Curve with Individual Fish Data

As mentioned on page 14, the department averaged PFOS concentrations by species and waterbody prior to analysis in order to align our data with the way that fish consumption advisories are calculated. However, the department also ran the ROC model with individual fish data and found that the sensitivity and specificity lines still crossed at 8 ng/L PFOS (Fig. C1 below).



Appendix D: R code for all PFOS models

```
require(rpart)
require(boot)
require(epitools)
require(pROC)
require(growthrates)
options(max.print=99999)

PFOS = data.table(read.csv("PFOS.csv")) #reads PFOS data into R

#Create rating variable for fish that are > or <50
PFOS$FishRating = NA

for(i in 1:nrow(PFOS)){
if(PFOS$Fish_PFOS[i] >= 50) PFOS$FishRating[i] = 1
if(PFOS$Fish_PFOS[i] <  50) PFOS$FishRating[i] = 0
}

####################################################################
#Classification and regression tree (cart)
control <- rpart.control(cp=0.0010,maxdepth=1, minbucket=10)
cart = rpart(FishRating~Water_PFOS, PFOS, control = control)
summary(cart)
print(cart)
plot(cart, uniform=TRUE, margin=0.1)
text(cart) # Best water PFOS value to split fish

######################################################################################
PFOS$WaterRating = NA
for(i in 1:nrow(PFOS)){
  if(PFOS$Water_PFOS[i] >= 13.52) PFOS$WaterRating[i] = "high"
  if(PFOS$Water_PFOS[i] <  13.52) PFOS$WaterRating[i] = "low"
}
t.test(PFOS$FishRating~PFOS$WaterRating)

############################################################
#Manually bootstrap cart to get 90% CI on estimate
NDR1 <- function(formula, data, indices){
  d<-data[indices,]
  control <- control
  fit<- rpart(formula, data=d, method="anova", control=control)
  fit$splits[4]
}

#Do the bootstrap
  df1 <- boot(data=PFOS, statistic=NDR1, R=5000, formula=FishRating~Water_PFOS)
  plot(df1)
  cartci = boot.ci(df1, conf= 0.9, type="norm")
  T_a = cartci[2]
  L_a = cartci[4]$normal[2]
  H_a = cartci[4]$normal[3]
##################################################################################

##############################################################################################
#Reciever Operating Characteristc
Predictor <- PFOS$Water_PFOS
Response <- PFOS$FishRating

test1 <- roc(response=Response, predictor=Predictor, ci=TRUE, of="auc",ci.type="shape", plot=TRUE,
smooth=FALSE, auc=TRUE, percent=TRUE, boot.n=20000)
test1

#Examins sensitivity and specificity
thresh = seq(1,30,0.1)
r1<-ci.thresholds(test1, conf.level=0.9, boot.n=10000,thresholds=thresh, smooth.roc=TRUE)
r1

plot(r1$specificity[,2]  ~ thresh, type="l")
lines(r1$specificity[,1] ~ thresh, lty=2) # lower CI
```

```
lines(r1$specificity[,3] ~ thresh, lty=2) # Upper CI

lines(r1$sensitivity[,2] ~ thresh, col="blue")
lines(r1$sensitivity[,1] ~ thresh, lty=2) # lower CI
lines(r1$sensitivity[,3] ~ thresh, lty=2) # Upper CI

#Find thresholds and CIs
T_c = names(which.min(abs(r1$specificity[,2]-90)))
H_c = names(which.min(abs(r1$specificity[,1]-90)))
L_c = names(which.min(abs(r1$specificity[,3]-90)))

T_b = names(which.min(abs(r1$sensitivity[,2]-90)))
H_b = names(which.min(abs(r1$sensitivity[,3]-90)))
L_b = names(which.min(abs(r1$sensitivity[,1]-90)))

T_d = names(which.min(abs(r1$sensitivity[,2]-78)))#78%, point where sensitivity and specificity meet
H_d = names(which.min(abs(r1$sensitivity[,3]-78)))
L_d = names(which.min(abs(r1$sensitivity[,1]-78)))

##################################################################################

#################################################################
#FancyPlot
plot(r1$specificity[,2]  ~ thresh, type="l")
polygon(c(thresh, rev(thresh)),
        c(r1$specificity[,1], rev(r1$specificity[,3])),
        col = "grey90", border = NA)

polygon(c(thresh, rev(thresh)),
        c(r1$sensitivity[,1], rev(r1$sensitivity[, 3])),
        col = "lightsteelblue1", border = NA)
lines(r1$specificity[,2]  ~ thresh, type="l")
lines(r1$sensitivity[,2] ~ thresh, col="blue")

##################################################################################

##################################################################################
#Logistic regression
for(i in 1:nrow(PFOS)){
  if(PFOS$Fish_PFOS[i] >= 50) PFOS$FishRating[i] = 1
  if(PFOS$Fish_PFOS[i] <  50) PFOS$FishRating[i] = 0
}
PFOS$FishRating = as.numeric(PFOS$FishRating)

PFOS$logPFOS = log(PFOS$Water_PFOS)
lr = glm(FishRating~logPFOS, data=PFOS, family = binomial())
summary(lr)
exp(coef(lr))
exp(confint(lr))

#Create a plot
start = 0.9*range(PFOS$logPFOS)[1]
end   = range(PFOS$logPFOS)[2]*1.1
xweight = seq(start,end, (end-start)/200)
yweight = predict(lr, list(logPFOS=xweight), type="response")
plot(FishRating~logPFOS, data=PFOS)
lines(xweight, yweight)

#Find the inflection point
inflect = which(round(yweight, 2) == 0.5)[1]
T_e = exp(xweight[inflect]) # inflection point

L_e = exp(xweight[inflect]-(1.64*summary(lr)$coefficients[2,2]))#Lower CI
H_e = exp(xweight[inflect]+(1.64*summary(lr)$coefficients[2,2]))#upper CI

#Find maximum rate of change of logistic regression
res <- fit_spline(xweight , yweight)
T_f = exp(coef(res))[2] # maximum rate of change 5.50
L_f = exp(coef(res)[2]-(1.64*summary(lr)$coefficients[2,2]))#Lower CI
H_f = exp(coef(res)[2]+(1.64*summary(lr)$coefficients[2,2]))#upper CI
##################################################################

##################################################################
```

```
# Linear and quantile regression
PFOS$log10_fish = log10(PFOS$Fish_PFOS)
PFOS$log10_water = log10(PFOS$Water_PFOS)

rq_fit = function(formula, data, indices, tau){
  fit = rq(formula, data=data[indices,], tau=tau)
  below_90 = 10^((log10(50) - coef(fit)[1]) / coef(fit)[2])
  return(below_90)
}
rq_i_80 = boot(
  data=PFOS,
  statistic=rq_fit,
  R=5000,
  formula=log10_fish ~ log10_water,
  tau=0.8
)

plot(rq_i_80)
rq_ci = boot.ci(rq_i_80, conf=0.9, type="norm")
T_g = rq_ci[2]
L_g = rq_ci[4]$normal[2]
H_g = rq_ci[4]$normal[3]

rq_i_50 = boot(
  data=PFOS,
  statistic=rq_fit,
  R=5000,
  formula=log10_fish ~ log10_water,
  tau=0.5
)

plot(rq_i_50)
rq_ci = boot.ci(rq_i_50, conf=0.9, type="norm")
T_h = rq_ci[2]
L_h = rq_ci[4]$normal[2]
H_h = rq_ci[4]$normal[3]

#####################
#Plot quatile regression
plot(log10(Fish_PFOS)~log10(Water_PFOS), data = PFOS, pch=21, bg="grey80", cex=1.75)
top    = rq(log10(Fish_PFOS)~log10(Water_PFOS), data=PFOS, tau=0.8)
center = rq(log10(Fish_PFOS)~log10(Water_PFOS), data=PFOS, tau=0.5)
abline(top, col="red", lwd=2)
abline(center, col="blue", lwd=2)
abline(h=log10(50), lty=2)
#############################################################

####################################################################
#Build a plot to bring it all together
type = c("CART",  "Sens90", "Spec90", "ROC", "LRinflec", "LRmaxRate", "QuantReg80", "QuantReg50")
threshold = c(T_a, T_b, T_c, T_d, T_e, T_f, T_g, T_h)
threshUp  = c(H_a, H_b, H_c, H_d, H_e, H_f, H_g, H_h)
threshLow = c(L_a, L_b, L_c, L_d, L_e, L_f, L_g, L_h)

allFig = data.table(cbind(type,threshold, threshUp, threshLow))
allFig$threshold = as.numeric(allFig$threshold)
allFig$threshUp = as.numeric(allFig$threshUp)
allFig$threshLow = as.numeric(allFig$threshLow)

allFig = setorderv(allFig, cols = "threshold", order=1)
allFig$order = seq(1,8,1)

par(mar=c(5,6,4,2))
plot(order~threshold,allFig, pch=19, cex=2.5, xlim = c(0,20), yaxt="n", ylab ="", xlab = "PFOS Water
Threshold")
axis(2, at=allFig$order, labels=allFig$type, las = 2)
segments(allFig$threshLow,allFig$order, allFig$threshUp, allFig$order, lwd=2)
####################################################################

####################################################################
#Relative Risk at different thresholds of PFOS water
#plus all of the thresholds and CIs from the above plot
#at x concentration of water we are X.X times more likely to have fish >50
```

```
PFOS$FishRating = NA
PFOS$WaterRating = NA

tmp  = c(threshold, 10)
tmp2 = c(threshLow, 10)
tmp3 = c(threshUp, 10)

tmp  = as.numeric(tmp)
tmp2 = as.numeric(tmp2)
tmp3 = as.numeric(tmp3)

outTable = data.frame(matrix(ncol = 7, nrow = length(tmp)))
colnames(outTable) = c("Threshold","LowCI", "UpCI", "RR", "LowCI_RR", "UpCI_RR", "P_RR")

#Loop through different thresholds for RR
for(j in 1:length(tmp)){

for(i in 1:nrow(PFOS)){
  if(PFOS$Water_PFOS[i] >= tmp[j]) PFOS$WaterRating[i] = "b_W_high"
  if(PFOS$Water_PFOS[i] <  tmp[j]) PFOS$WaterRating[i] = "a_W_low"
  if(PFOS$Fish_PFOS[i]  >= 50)     PFOS$FishRating[i]  = "b_F_high"
  if(PFOS$Fish_PFOS[i]  <  50)     PFOS$FishRating[i]  = "a_F_low"
}

x = table(PFOS$WaterRating, PFOS$FishRating)
RR = epitab(x, method = "riskratio", verbose=TRUE, conf.level = 0.9)

outTable[j,1] = round(tmp[j],3)
outTable[j,2] = round(tmp2[j],3)
outTable[j,3] = round(tmp3[j],3)
outTable[j,4] = round(RR$tab[2,5],3)
outTable[j,5] = round(RR$tab[2,6],3)
outTable[j,6] = round(RR$tab[2,7],3)
outTable[j,7] = round(RR$tab[2,8],4)
}

#Thresholds and RR table
rownames(outTable) = c(type, "10")
outTable = setorderv(outTable, cols = "Threshold", order=1)
outTable

#####################################################
```

Appendix E: PFOA In Fish Tissue

The department conducted an assessment of PFOA occurrence in surface waters and fish taken from surface waters and determined that ingestion of surface waters is the exposure route of concern, as PFOA was detected in only 2% of MN and WI fish samples (41/2005) analyzed for PFAS between 2006-2020. Nonetheless, the department endeavored to preliminarily calculate a statewide PFOA BAF as part of this rulemaking effort. But because PFOA was detected in so few fish samples, the department was not confident in calculating a statewide BAF from the MN and WI dataset alone, and thus conducted a literature search to gather additional data from published literature on field-measured BAFs calculated from samples taken within the Great Lakes basin. Our literature search resulted in two publications[24,25] containing data from Pool 2 of the Mississippi River and from Lake Niapenco in the province of Ontario, Canada.

The final PFOA BAF dataset (summarized in the table below) represents 186 samples from 15 fish species and generates a PFOA BAF of 40 L/kg.

Species	N	PFOA BAF (L/kg)
Black crappie	18	18.9
Bluegill	19	99.7
Brown bullhead	3	25.1
Channel catfish	7	10.0
Common carp	33	89.1
Freshwater drum	36	276.8
Largemouth bass	16	12.6
Northern pike	9	89.0
Pumpkinseed	4	7.9
Smallmouth bass	8	29.1
Walleye	2	199.8
White bass	8	15.0
White crappie	13	7.9
White sucker	1	121.1
Yellow perch	9	113. 3
Geometric mean BAF		**39.8**

If the department were to calculate water quality criteria according to the GLI procedures (codified in NR 105, Wis. Adm. Code) and using the BAF of 40 L/kg from this dataset (Equation E1 below), the resulting value for non-public water supplies would be 138 ng/L.

Equation E1:

$$\text{Human Non-Cancer Criterion}_{NPWS} = \frac{\text{ADE} \times 70\text{ kg} \times \text{RSC}}{0.01\text{ L/d}+(0.02\text{ kg/d} \times \text{BAF})} = \frac{0.000002 \times 70 \times 0.8}{0.01+(0.02 \times 39.8)} = 138.3\frac{ng}{L}$$

---

[24] Bhavsar SP, Fowler C, Day S, Petro S, Gandhi N, Gewurtz SB, Hao C, Zhao X, Drouillard KG, Morse D. 2016. High levels, partitioning and fish consumption based water guidelines of perfluoroalkyl acids downstream of a former firefighting training facility in Canada. Environment International 94: 415-423.

[25] Newsted JL, Holem R, Hohenstein G, Lange C, Ellefson M, Reagen W, Wolf S. 2017. Spatial and temporal trends of poly- and perfluoroalkyl substances in Fish fillets and water collected from Pool 2 of the Upper Mississippi River. Environmental Toxicology and Chemistry 36(11): 3138–3147.

However, the department elected to maintain its current approach for several reasons:

- First, as previously stated in the main body of this Technical Support Document, the department is confident that exposure via surface water ingestion contributes to the majority of exposure.
- Second, the department has elected to use child-specific exposure parameters (i.e., body weight and water ingestion rates) to derive the proposed PFOA criterion because children consume more water per unit of body weight than adults and because PFOA exposure has the potential to adversely affect development, and the GLI procedures (codified in NR 105) specify adult-specific exposure parameters.
- Finally, even with the additional data from the literature there is an overwhelming amount of uncertainty in the calculated BAF due to the number of fish samples without detectable levels of PFOA, which would lead to an estimate of exposure to PFOA via fish consumption in which the department would have little confidence.

Ultimately, the department believes that its alternative methodology provides better protection for children than the methodology provided in 40 C.F.R. Part 132, appendix C and ch. NR 105, Wis. Adm. Code.

Appendix F: R code for PFOA Monte Carlo simulation (from EPA 2019)

```
# This script is to combine distributions for water ingestion rate (L/hr) and recreational exposure
duration (hr/day) to develop a distribution for ingestion/day (L/day) and to generate a histogram of this
combined distribution

# The first distribution is the incidental ingestion rate per hour from the Dufour dataset

# The second distribution is the recreational exposure duration (hr/day) from the EPA 2011 Exposure
Factors Handbook Table 16-20. Time Spent (minutes/day) in Selected Outdoor Locations, Doers Only, At Home
in the Outdoor Pool or Spa

# Both distributions are assumed to be log-normal

#####Read required libraries and set simulation sample size ################

rm(list=ls()) # Remove all current R objects from memory
library(truncnorm) #import library for truncated normal distribution
nsamp = 1000000 # specify number of samples in monte-carlo analysis
set.seed(1984756) # set seed for analysis replicability

##################################################
# The combined distribution function (cdist) assumes a log-normal distribution for ingestion rate (L/hour)
and a log-normal distribution for exposure duration (hr/d) using the mean and sd as parameter inputs. This
function is called in later sections of the code for each age group analysis.

cdist<-function(nsamp,mean_dur,sd_dur,min_dur,max_dur,mean_ing,sd_ing,min_ing,max_ing){

n<-nsamp # number of samples to be drawn

# transform mean and sd of duration
sd_dur_ln<-sqrt(log((sd_dur/mean_dur)^2+1)) # standard deviation of duration in log space
mean_dur_ln<-log(mean_dur)-((sd_dur_ln^2)/2) # mean of duration in log space
min_dur_ln<-log(min_dur) # minimum duration in log space
max_dur_ln<-log(max_dur)

# transform mean and sd of ingestion rate
sd_ing_ln<-sqrt(log((sd_ing/mean_ing)^2+1))
mean_ing_ln<-log(mean_ing)-((sd_ing_ln^2)/2)
min_ing_ln<- -10^10
max_ing_ln<-log(max_ing)

# draw n samples from the truncated ingestion rate distribution in L/hr
ingperhr_ln_trunc<-exp(rtruncnorm(n=n, a=min_ing_ln, b=max_ing_ln, mean=mean_ing_ln, sd=sd_ing_ln))
#truncated log normal distribution

# draw n samples from the truncated duration distribution (hr/d)
duration_hr_ln_trunc<-exp(rtruncnorm(n=n, a=min_dur_ln, b=max_dur_ln, mean=mean_dur_ln, sd=sd_dur_ln))

# compute n samples for the combined ingestion rate per day distribution (L/d)
ingperday<-ingperhr_ln_trunc*duration_hr_ln_trunc #combine distributions
print(summary(ingperday)) # print summary statistics of the combined distribution
print(quantile(ingperday, probs=0.90)) # print 90th percentile of the combined distribution

# Generate histogram
hist(ingperday,xlab="Ingestion rate (L/day)",ylab="Probability", main ="Truncated hybrid distribution
fit", xlim=c(0, 2.0), ylim=c(0, 1))
h=hist(ingperday)
h$density=h$counts/sum(h$counts)
plot(h,xlab="Ingestion rate (L/day)",ylab="Probability", main ="Log-normal distribution fit", xlim=c(0,
1), ylim=c(0, 0.99), xaxp=c(0,1.5,15), freq=FALSE)
}

##################################################
#I. Analysis for 6 to 10 age group
# These values are from 2011 EFH table 16-20 for ages 5 to 11.
mean_dur_min=164.2
```

```
sd_dur_min=103.97
min_dur_min=25
max_dur_min=450

# Convert exposure data from the EPA's EFH from min/day to hr/day
mean_dur<-mean_dur_min/60 #mean exposure duration hr/day
sd_dur<-sd_dur_min/60 #sd exposure duration hr/day
min_dur<-min_dur_min/60 #minimum exposure duration hr/day
max_dur<-max_dur_min/60 #maximum exposure duration hr/day

# These ingestion rate values are computed from the Dufour dataset
mean_ing<- 0.03745 # mean ingestion rate in L/hr
sd_ing<-0.03355 # sd ingestion rate in L/hr
min_ing<-0.00033 # minimum ingestion rate in L/hr
max_ing<-0.20000 # maximum ingestion rate in L/hr
cdist(nsamp,mean_dur,sd_dur,min_dur,max_dur,mean_ing,sd_ing,min_ing,max_ing) # call combined distribution
function

####################################################
#II. Analysis for 11 to 17 age group
# These values are from 2011 EFH table 16-20 for age 12 to 17
mean_dur_min=97
sd_dur_min=53.81
med_dur_min=100
min_dur_min=40
max_dur_min=180

# Convert exposure data from the EPA's EFH from min/day to hr/day
mean_dur<-mean_dur_min/60 #mean exposure duration hr/day
sd_dur<-sd_dur_min/60 #sd exposure duration hr/day
med_dur<-med_dur_min/60 #median exposure duration hr/day
min_dur<-min_dur_min/60 #minimum exposure duration hr/day
max_dur<-max_dur_min/60 #maximum exposure duration hr/day

# These ingestion rate values are computed from the Dufour dataset
mean_ing<-0.03996 # mean ingestion rate in L/hr
sd_ing<-0.04377 # sd ingestion rate in L/hr
min_ing<-0.00067 # minimum ingestion rate in L/hr
max_ing<-0.26800 # maximum ingestion rate in L/hr
cdist(nsamp,mean_dur,sd_dur,min_dur,max_dur,mean_ing,sd_ing,min_ing,max_ing) # call combined distribution
function

####################################################
#III. Analysis for 18+ age group
# Combine exposure duration data for 18 to 64 and for >64 age groups from 2011 EFH table 16-20.
mean_dur_min=(117.61+78.9)/2
sd_dur_min=sqrt((112.72^2+85.32^2)/2)
min_dur_min=1
max_dur_min=450

# Convert exposure data from the EPA's EFH from min/day to hr/day
mean_dur<-mean_dur_min/60 #mean exposure duration hr/day
sd_dur<-sd_dur_min/60 #sd exposure duration hr/day
min_dur<-min_dur_min/60 #minimum exposure duration hr/day
max_dur<-max_dur_min/60 #maximum exposure duration hr/day

# These ingestion rate values are computed from the Dufour dataset
mean_ing<-0.02811 # mean ingestion rate in L/hr
sd_ing<-0.04960 # sd ingestion rate in L/hr
min_ing<-0.00012 # minimum ingestion rate in L/hr
max_ing<-0.36800 # maximum ingestion rate in L/hr
cdist(nsamp,mean_dur,sd_dur,min_dur,max_dur,mean_ing,sd_ing,min_ing,max_ing) # call combined distribution
function

####################################################
# IV. Analysis for all age groups (including 1-4 yo)
# Combine exposure duration data for all age groups (1 to 4, 5 to 11, 12 to 17, 18 to 64, >64) from 2011
EFH table 16-20.
mean_dur_min=(85.56+164.2+97+117.61+78.9)/5
sd_dur_min=103.71 # SD reported in EFH for all ages
min_dur_min=1
max_dur_min=450
```

```
# Convert exposure duration data from min/day to hr/day
mean_dur<-mean_dur_min/60 #mean exposure duration hr/day
sd_dur<-sd_dur_min/60 #sd exposure duration hr/day
min_dur<-min_dur_min/60 #minimum exposure duration hr/day
max_dur<-max_dur_min/60 #maximum exposure duration hr/day

# These ingestion rate values are computed from the Dufour dataset
mean_ing<- 0.03290 # mean ingestion rate in L/hr
sd_ing<- 0.04643 # sd ingestion rate in L/hr
min_ing<-0.00012 # minimum ingestion rate in L/hr
max_ing<-0.36800 # maximum ingestion rate in L/hr

cdist(nsamp,mean_dur,sd_dur,min_dur,max_dur,mean_ing,sd_ing,min_ing,max_ing) # call combined distribution
function
```

Appendix G: Adjacent States Comparison

This appendix summarizes general narrative water quality criteria and PFOS and PFOA criteria and implementation procedure policies from Minnesota, Michigan, Illinois, and Iowa.

Narrative Water Quality Criteria

The administrative codes of adjacent states contain narrative criteria for the protection of surface waters, although none of the adjacent states' narrative criteria are specific to PFOS or PFOA. The narrative criteria of Illinois, Iowa, and Michigan specifically prohibit concentrations of toxic substances in surface waters in amounts that will adversely affect human health or public health. Minnesota's narrative criteria prohibits discharge of wastes in such quantities that will cause pollution as defined by law. Code citations for these narrative criteria are as follows:

Minnesota *Minn. Stat. 7050.0210-13*

"Pollution prohibited. No sewage, industrial waste, or other wastes shall be discharged from either a point or a nonpoint source into the waters of the state in such quantity or in such manner alone or in combination with other substances as to cause pollution as defined by law. In any case where the waters of the state into which sewage, industrial waste, or other waste effluents discharge are assigned different standards than the waters of the state into which the receiving waters flow, the standards applicable to the waters into which the sewage, industrial waste, or other wastes discharged shall be supplemented by the following: The quality of any waters of the state receiving sewage, industrial waste, or other waste effluents shall be such that no violation of the standards of any waters of the state in any other class shall occur by reason of the discharge of the sewage, industrial waste, or other waste effluents."

Michigan *R 323.1057, Mich. Admin. Code*

"Rule 51. (1) Toxic substances shall not be present in the surface waters of the state at levels that are or may become injurious to the public health, safety, or welfare, plant and animal life, or the designated uses of the waters. As a minimum level of protection, toxic substances shall not exceed the water quality values specified in, or developed pursuant to, the provisions of subrules (2) to (4) of this rule or conditions set forth by the provisions of subrule (6) of this rule. A variance to these values may be granted consistent with the provisions of R 323.1103."

Illinois *Ill. Admin. Code tit. 35, § 302.210*

"Other Toxic Substances. Waters of the State shall be free from any substances or combination of substances in concentrations toxic or harmful to human health, or to animal, plant or aquatic life. Individual chemical substances or parameters for which numeric standards are specified in the Subpart are not subject to this Section."

Iowa *IAC § 567.61.3(2)(d)*

“General water quality criteria. The following criteria are applicable to all surface waters including general use and designated use waters, at all places and at all times for the uses described in 61.3(1) ‘a.’ … ‘d.’ Such waters shall be free from substances attributable to wastewater discharges or agricultural practices in concentrations or combinations which are acutely toxic to human, animal, or plant life.”

PFOS and PFOA Water Quality Criteria

Two adjacent states – Michigan and Minnesota – have released numeric water quality values for PFOS, or PFOS and PFOA. Both states developed their values according to the procedures outlined in 40 CFR 132, but each state used different inputs which resulted in different numeric values. Similarly, Wisconsin selected a different methodology and different inputs, as described in Section 9 below, and thus the proposed standards are different. Further, Minnesota released site-specific criteria (SSC) for PFOS rather than implementing the criteria statewide. Michigan has calculated statewide values as Wisconsin is proposing to do. Wisconsin chose not to pursue the development of SSC for this rulemaking effort. Over the past several years, the department has endeavored to collect data on the occurrence of PFAS across the state, and this data indicates the possibility of human exposure to PFOA and PFOS via surface waters or fish taken from surface waters in areas throughout the state. With statewide criteria the department seeks to provide protection for citizens’ use of all waters. Additionally, Minnesota’s code includes provisions for developing SSCs without rulemaking, but Wisconsin’s statutory framework require rulemaking for SSCs. Thus, there would be no administrative time saved or expedited human health protections gained by developing SSCs compared to statewide criteria.

Wisconsin’s proposed standard of 8 ng/L for PFOS is slightly more stringent than Michigan’s value of 11 ng/L and, compared to Minnesota’s PFOS criterion in waters where it applies, less stringent than Minnesota’s criterion of 0.05 ng/L. Wisconsin’s proposed standards of 20 ng/L and 95 ng/L for PFOA in public drinking water supply waters and non-public drinking supply waters, respectively, are more stringent than Michigan’s values of 420 and 12,000 ng/L for PFOA in drinking and non-drinking waters, respectively. The primary reason for the significant difference between Michigan’s PFOA criteria and Wisconsin’s PFOA criteria is that the reference dose (maximum amount of toxic substance that can be consumed to avoid public health impacts) that Michigan used in its calculations (conducted in 2011) is higher and not based on the most recent science. Furthermore, the bioaccumulation factor (BAF) that Michigan used in its PFOA calculation was experimentally derived based on laboratory data while the department used actual field measured fish tissue and water sampling data from surface waters for its PFOA calculations. Federal regulations state that field measured data should be used if available. Finally, Michigan used adult-specific exposure factors (body weight and water ingestion rates) rather than the child-specific factors that the department used. This difference is discussed below in more detail as well as in the technical support document.

Minnesota

In 2020, the Minnesota Pollution Control Agency (MPCA) released SSC for PFOS in surface waters and fish tissue for Lake Elmo and two connected waterbodies, Bde Maka Ska and Mississippi River Pool 2. These SSC are not promulgated standards but were developed according to the procedures outlined in 40 CFR 132 pursuant to Minnesota’s state statutory provisions. Minnesota’s administrative code provides the flexibility to implement SSCs without going through rulemaking. The value for fish tissue is 0.37 ng PFOS/g and the value for water that supports the fish tissue criterion is 0.05 ng PFOS/L. MPCA's SSC incorporated the Minnesota Department of Health's toxicity value, which was derived using a model that focuses on the protection of infants and women of childbearing age (WCBA). Accordingly, MPCA's SSC derivation also included WCBA-specific body weights and fish consumption and drinking water intake rates.

Michigan

Michigan Department of Environmental Quality (now called the Department of Environment, Great Lakes, and Energy; EGLE) released statewide water quality values for PFOS in 2014 and PFOA in 2011. The process for calculating surface water quality values, outlined in 40 CFR 132, is promulgated in Michigan's administrative code R. 323.1057. However, values resulting from this process are not promulgated and appear in "Rule 57 Water Quality Values Spreadsheets" available at https://www.michigan.gov/egle/0,9429,7-135-3313_3681_3686_3728-11383--,00.html. Michigan's PFOS and PFOA values apply to surface waters statewide. Concentrations of PFOS may not exceed 11 and 12 ng/L in drinking and non-drinking waters, respectively. Concentrations of PFOA may not exceed 420 and 12,000 ng/L in drinking and non-drinking waters, respectively. Michigan derived their water quality values for PFOA in 2011 (formally published in 2014) with the information that was available at the time. Their values incorporate data from studies where cynomolgus monkeys were exposed to PFOS or PFOA for 182 days (Butenhoff et al. 2002; Seacat et al. 2002). Their selected reference dose (RfD) is based on effects on liver weight and is higher than RfDs that have been subsequently developed based on developmental or immune effects which occur at lower doses. Michigan currently uses a lower RfD, developed by ATSDR, as the basis of their Health-Based Drinking Water Value for PFOA. Additionally, in derivation of their 2011 surface water values, Michigan incorporated a bioaccumulation factor (BAF) of 4 L/kg based on an experimentally derived bioconcentration factor (BCF). Calculating a BAF using at BCF is a method that is less preferred compared to the method of calculating a BAF using field-measured data from fish and water samples according to 40 CFR part 132. During the course of this rulemaking effort, as part of preliminary numeric criteria calculations, the department calculated BAFs for PFOS and PFOA based on field-measured data. As noted in Appendix E, the BAF calculated for PFOA was 40 L/kg, which is higher than the experimentally derived value used by Michigan in 2011.

Illinois

None

Iowa

None

Implementation of PFOS and PFOA Criteria

Minnesota

Minnesota implements SSC for PFOS in a handful of waterbodies in the Minneapolis-St. Paul metro area – both in the East Metro cleanup area and in other parts. For the most part, PFOS criteria was developed in order to provide appropriate cleanup values for the East Metro and for an area of Minneapolis that has been impacted by a chrome plater. Limitations based on the numeric PFOS SSC described above have not yet been applied in NPDES permits. In 2007, MPCA and STS Consultants, LTD., developed SSCs for PFOA and PFOS for Bde Maka Ska and Mississippi River Pool 2. Minnesota has had limited permit implementation of the 2007 criteria; to date, there is only one wastewater plant that has PFAS limits based on these criteria. See: https://www.pca.state.mn.us/waste/water-quality-criteria-development-pfas for more information.

Michigan

Michigan implements surface water PFOS and PFOA values through various water quality programs. Michigan is carrying out an Industrial Pretreatment Program PFAS Initiative, a Municipal NPDES Permitting Strategy, and an Industrial Direct and Industrial Storm Water Discharge Compliance Strategy for monitoring and addressing PFOS and PFOA in regulated discharges. Under the Municipal NPDES Permitting Strategy, municipal permits issued/re-issued after October 1, 2021 will include effluent limits for PFOS/PFOA if applicable. In addition, after July 1, 2021, Michigan will require sampling of biosolids prior to land application as part of a biosolids Interim Strategy. Michigan supports these programs through ambient surface water and fish tissue monitoring.

These programs have been funded through general funds, federal PPG grant, permit fee programs, and special appropriations at the state level as well as by local governments operating wastewater treatment plants and private industries found to be discharging PFAS to WWTPs and/or surface waters.

Illinois

Not applicable

Iowa

Not applicable