

Annual Drinking Water Quality Report for 2018
United Wappinger Water District
Wappingers Falls, New York 12590
Public Water Supply ID# 1330660

INTRODUCTION

To comply with State regulations, the United Wappinger Water District is issuing an annual report describing the quality of your drinking water. The purpose of this report is to raise your understanding of drinking water and awareness of the need to protect our drinking water sources. Last year, your tap water met all State drinking water health standards. We are proud to report that our system did not violate a maximum contaminant level or any other water quality standard. This report provides an overview of last year's water quality. Included are details about where your water comes from, what it contains, and how it compares to State standards.

If you have any questions about this report or concerning your drinking water, please contact **CAMO Pollution Control, Inc.** at (845) 463-7310. We want you to be informed about your drinking water. If you want to learn more, please attend any of our regularly scheduled village board meetings. The time and place of the regularly scheduled Town Board meetings may be obtained from **Joseph Paoloni**, Town Clerk, at (845) 297-5771.

WHERE DOES OUR WATER COME FROM?

In general, the sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activities. Contaminants that may be present in source water include: microbial contaminants; inorganic contaminants; pesticides and herbicides; organic chemical contaminants; and radioactive contaminants. In order to ensure that tap water is safe to drink, the State and the EPA prescribe regulations which limit the amount of certain contaminants in water provided by public water systems. The State Health Department's and the FDA's regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

Our water source is two major well fields, the Atlas well field and the Hilltop well field. All water passes through filters at each of these well fields. During 2018 our system did not experience any restriction of our water source. All of our water is treated with chlorine as a disinfectant to destroy microorganisms prior to distribution. The estimated hardness of your water is between 14 and 18 grains.

SOURCE WATER ASSESSMENT

The New York State Health Department has completed a source water assessment for this system, based on available information. Possible and actual threats to this drinking water source were evaluated. The state source water assessment includes a susceptibility rating based on the risk posed by each potential source of contamination and how easily contaminants can move through the subsurface to the wells. The susceptibility rating is an estimated of the potential for contamination of the source water; it does not mean that the water delivered to the consumers is, or will become, contaminated. See the section “Sampling Results” for a list of the contaminants that have been detected, if any.

The source water assessments provide resource managers with additional information for protecting source waters into the future. The county and state health departments will use this information to direct future source water protection activities. These may include water quality monitoring, resource management, and planning and education programs. A copy of the assessment can be obtained by contacting us, as noted.

North Wappinger Water (Atlas) Well Field SWAP Summary

The source water assessment has rated our water source as having an elevated susceptibility to microbial and nitrate contamination. These ratings are due primarily to the close proximity of the wells to a permitted discharge facility (industrial/commercial facilities that discharge wastewater into the environment and are regulated by the state and/or federal government) and the residential land use and related activities in the assessment area. In addition, the wells are located in an area prone to flooding. The county and state health departments will use this information to direct future water protection activities.

Hilltop Water Well Field SWAP Summary

The source water assessment has rated our water source as having an elevated susceptibility to microbials, nitrates, salts, sulfate, industrial solvents, and other industrial contaminants. These ratings are due primarily to the close proximity of the wells to a permitted discharge facility (industrial/commercial facilities that discharge wastewater into the environment and are regulated by the state and/or federal government) and the residential land use and related activities in the assessment area. In addition, the wells are located in an area prone to flooding. While the source water assessment has rated our wells as being susceptible to microbials, please note that our water is disinfected to ensure that the finished water delivered into your home meets New York State’s drinking water standards for microbial contamination.

FACTS AND FIGURES

Our water system serves an estimated 14,000 customers through 3,600 service connections. The total water produced in 2018 was 355 million gallons. The daily average of water treated and pumped into the distribution system was 972,739 gallons per day. Our highest single day was 1.5 million gallons. The estimated amount of water delivered to our customers was 323.5 million gallons. This leaves an unaccounted total of 57 million gallons. This water was used for flushing mains, fighting fires, and leaks. In 2018, water customers were billed a minimum of \$66.20 for up to and including 2,500 cubic feet, with an additional charge of \$1.20 per 100 cubic feet for anything over 2,500 cubic feet.

ARE THERE CONTAMINANTS IN OUR DRINKING WATER?

As the State regulations require, we routinely test your drinking water for numerous contaminants. These contaminants include: asbestos, total coliform, turbidity, inorganic compounds, nitrate, nitrite, lead and copper, volatile organic compounds, total trihalomethanes, haloacetic acids, radiological and synthetic organic compounds. The table presented below depicts all compounds which were detected in your drinking water. The State allows us to test for some contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of our data, though representative, are more than one year old.

It should be noted that all drinking water, including bottled drinking water, may be reasonably expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (800-426-4791) or the Dutchess County Health Department at (845) 486-3404.

INORGANICS

Hilltop Well Field														Atlas Well Field				Distribution System				
Substance (Unit of Measure)	MCL	MCLG	Sample Date	Amount Detected	Range Low-High	Sample Date	Amount Detected	Range Low-High	Sample Date	Amount Detected	Range Low-High	Violation	Typical Source									
Antimony (ppm)	0.006	N/A	12/18	0.004	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder.									
Barium (ppm)	2	2	12/18	0.0095	N/A	12/18	0.0139	N/A	N/A	N/A	N/A	No	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits									
Chloride (ppm) Note 3	250	N/A	2018	127.0	76.1-148	2018	68.6	57.2-76.7	N/A	N/A	N/A	No	Naturally occurring or indicative of road salt contamination									
Manganese (ppm)	0.3	N/A	12/18	.0084	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	Naturally occurring									
Nickel (ppm)	N/A	N/A	12/18	0.0007	N/A	12/18	0.0008	N/A	N/A	N/A	N/A	No	Discharge from steel metal factories									
Nitrate (ppm)	10	10	12/18	0.760	N/A	12/18	0.766	N/A	N/A	N/A	N/A	No	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits									
Odor (TON)	3 TON	N/A	12/18	1	N/A	12/18	1	N/A	N/A	N/A	N/A	No	Naturally occurring									
Sodium ¹ (ppm) Note 3	see footnote	N/A	2018	86.7	46.8-107	2018	45.6	38.9-51.9	N/A	N/A	N/A	No	Naturally occurring; road salt; water softeners; animal waste									
Sulfate (ppm)	250	N/A	12/18	17.4	N/A	12/18	18.7	N/A	N/A	N/A	N/A	No	Naturally occurring									
Zinc (ppm)	5	N/A	12/18	0.0131	N/A	12/18	0.0079	N/A	N/A	N/A	N/A	No	Naturally occurring, mining waste									
Color (pt co)	15	N/A	12/18	5	N/A	12/18	2	N/A	N/A	N/A	N/A	No	Naturally occurring									

TAP WATER SAMPLES WERE COLLECTED FOR LEAD AND COPPER ANALYSES FROM SAMPLE SITES THROUGHOUT THE COMMUNITY

Substance (Unit of Measure)	Sample Date	AL	MCLG	Amount Detected (90 th %tile)	Range Low-High	Sites Above AL/Total Sites	Violation	Typical Source
Copper (ppm) See footnote ²	9/16	1.3	1.3	0.17	0.0148-0.268	0/35	No	Corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives
Lead (ppb) See footnote ²	9/16	15	0	4.7	ND-8.9	0/35	No	Corrosion of household plumbing systems; erosion of natural deposits

DISINFECTION BYPRODUCTS

Distribution System												
Hilltop Well Field				Atlas Well Field				Distribution System				
Substance (Unit of Measure)	MCL	MCLG	Sample Date	Amount Detected	Range Low- High	Sample Date	Amount Detected	Range Low- High	Sample Date	Amount Detected	Range Low- High	Violation
Haloacetic Acids (ppb)												
Royal Ridge STP	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Quarterly	10.9 Average	8.1- 13.4	No
Chelsea Hydrant	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Quarterly	7.5 Average	3.7- 12.7	No
By-product of drinking water disinfection needed to kill harmful organisms												
Total Trihalomethanes (TTHMs) (ppb)												
Royal Ridge STP	80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Quarterly	32.25 Average	31.1- 33.9	No
Chelsea Hydrant	80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Quarterly	27.2 Average	16.1 – 52	No
By-product of drinking water chlorination needed to kill harmful organisms. TTHMs are formed when source water contains large amounts of organic matter												
Total Organic Carbon (mg/l) See Footnote ³	TT	N/A	2018	1.09	ND – 2.62	2018	1.85	ND – 3.63	N/A	N/A	N/A	No
Naturally occurring												
Turbidity NTU	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Daily 5 Days Per Week	0.146 Average	.080 – .900	No
Soil runoff												

UNREGULATED CONTAMINANTS -see note 4 below									
Atlas Well Field									
Substance (Unit of Measure)	MCL	MCLG	Sample Date	Amount Detected	Range Low-High	Violation	Typical Source		
Perfluorooctanoic acid (PFOA)									
Well 1	N/A	70	9/19/2018	3.86	N/A	No	See attached fact sheet		
Well 3	N/A	70	9/19/2018	2.52	N/A	No			
Well 5	N/A	70	9/19/2018	3.54	N/A	No			
Well 6	N/A	70	9/19/2018	3.92	N/A	No			
POE	N/A	70	9/19/2018	3.83	N/A	No			
Perfluorooctanesulfonic acid (PFOS)									
Well 1	N/A	70	9/19/2018	8.14	N/A	No	See attached fact sheet		
Well 3	N/A	70	9/19/2018	8.43	N/A	No			
Well 5	N/A	70	9/19/2018	12.7	N/A	No			
Well 6	N/A	70	9/19/2018	3.99	N/A	No			
POE	N/A	70	9/19/2018	7.52	N/A	No			
Perfluorobutanesulfonic acid (PFBS)									
Well 1	N/A	N/A	9/19/2018	2.10	N/A	No	See attached fact sheet		
Well 3	N/A	N/A	9/19/2018	2.14	N/A	No			
Well 4	N/A	N/A	9/19/2018	1.93	N/A	No			
Well 6	N/A	N/A	9/19/2018	2.02	N/A	No			
POE	N/A	N/A	9/19/2018	2.14	N/A	No			
Perfluorohexanesulfonic acid (PFHxS)									
Well 1	N/A	N/A	9/19/2018	2.78	N/A	No	See attached fact sheet		
Well 3	N/A	N/A	9/19/2018	3.81	N/A	No			
Well 5	N/A	N/A	9/19/2018	3.83	N/A	No			
Well 6	N/A	N/A	9/19/2018	1.91	N/A	No			
POE	N/A	N/A	9/19/2018	2.81	N/A	No			

Footnotes

- 1 – Water containing more than 20 ppm of sodium should not be used for drinking by people on severely restricted sodium diets. Water containing more than 270 ppm of sodium should not be used for drinking by people on moderately restricted sodium diets.
- 2 – The levels reported for lead and copper represent the 90th percentile of the total number of sites tested. A percentile is a value on a scale of 100 that indicates the percent of a distribution that is equal to or below it. The 90th percentile is equal to or greater than 90% of the lead and copper values detected at your water system.
- 3 – The amount detected is the average of all samples taken in 2018.
- 4 – See attached fact sheet regarding these contaminants.

Definitions:

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contamination.

Action Level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Non-Detects (ND): Laboratory analysis indicates that the constituent is not present.

Milligrams per liter (mg/l): Corresponds to one part of liquid in one million parts of liquid (parts per million - ppm).

Micrograms per liter (ug/l): Corresponds to one part of liquid in one billion parts of liquid (parts per billion - ppb).

WHAT DOES THIS INFORMATION MEAN?

As you can see by the table, our system had no violations. We have learned through our testing that some contaminants have been detected; however, these contaminants were detected below the level allowed by the State.

We are required to present the following information on lead in drinking water:

If present, elevated levels of lead can cause serious health problems, especially for pregnant women, infants, and young children. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. **CAMO Pollution Control, Inc.** is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline (1-800-426-4791) or at <http://www.epa.gov/safewater/lead>.

IS OUR WATER SYSTEM MEETING OTHER RULES THAT GOVERN OPERATIONS?

During 2018, our system was in compliance with applicable State drinking water operating, monitoring and reporting requirements.

DO I NEED TO TAKE SPECIAL PRECAUTIONS?

Although our drinking water met or exceeded state and federal regulations, some people may be more vulnerable to disease causing microorganisms or pathogens in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice from their health care provider about their drinking water. EPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium*, *Giardia* and other microbial pathogens are available from the Safe Drinking Water Hotline (800-426-4791).

WHY SAVE WATER AND HOW TO AVOID WASTING IT?

Although our system has an adequate amount of water to meet present and future demands, there are a number of reasons why it is important to conserve water:

- ◆ Saving water saves energy and some of the costs associated with both of these necessities of life;
- ◆ Saving water reduces the cost of energy required to pump water and the need to construct costly new wells, pumping systems and water towers; and
- ◆ Saving water lessens the strain on the water system during a dry spell or drought, helping to avoid severe water use restrictions so that essential fire fighting needs are met.

You can play a role in conserving water by becoming conscious of the amount of water your household is using, and by looking for ways to use less whenever you can. It is not hard to conserve water. Conservation tips include:

- ◆ Automatic dishwashers use 15 gallons for every cycle, regardless of how many dishes are loaded. So get a run for your money and load it to capacity.
- ◆ Turn off the tap when brushing your teeth.
- ◆ Check every faucet in your home for leaks. Just a slow drip can waste 15 to 20 gallons a day. Fix it and you can save almost 6,000 gallons per year.
- ◆ Check your toilets for leaks by putting a few drops of food coloring in the tank, watch for a few minutes to see if the color shows up in the bowl. It is not uncommon to lose up to 100 gallons a day from one of these otherwise invisible toilet leaks. Fix it and you save more than 30,000 gallons a year.
- ◆ Use your water meter to detect hidden leaks. Simply turn off all taps and water using appliances, and check the meter after 15 minutes. If it moved, you have a leak.

SYSTEM IMPROVEMENTS

In 2013, the water main extension to the Chelsea/New York City water facility was completed at no expense to the district. This extension of water main, and the agreement with New York City, has given the Town the option of using New York City water when the City's upgrades are complete. In 2014 the water mains were extended to the hamlet of Chelsea.

As noted previously, the water quality in the United Wappinger Water District meets all standards and limits set forth by the State of New York, with no violations regarding water quality. The Dutchess County Health Department formulated a schedule which required the Town to have filters installed. In the fall of 2015, the filter project was completed. Now all the water for United Wappinger Water is filtered and this will improve quality and insure that dangerous viruses cannot enter thorough our source water. Along with the filter project, two separate distribution capital projects were completed in 2015; the MacFarlane Road Loop, and the Meadowood Loop. These additional loops will help to ensure water quality and quantity throughout the system.

In 2019 the emergency connection to the 82 homes of the Tall Trees Development was terminated and a permanent connection was installed. Additionally, the Town has an approved plan for 2020 to activate two (2) new wells and filters at the Meadowood Water Plant.

CLOSING

Thank you for allowing us to continue to provide your family with quality drinking water this year. In order to maintain a safe and dependable water supply, we sometimes need to make improvements that will benefit all of our customers. The costs of these improvements may be reflected in the rate structure. Rate adjustments may be necessary in order to address these improvements. We ask that all our customers help us protect our water sources, which are the heart of our community. Please call **CAMO Pollution Control, Inc. at (845) 463-7310** if you have questions.

**WE ASK THAT ALL OF OUR RESIDENTS BE VIGILANT AND
REPORT ANY SUSPICIOUS ACTIVITY IN THE AREA OF OUR
WATER TREATMENT PLANT. PLEASE CONTACT LAW
ENFORCEMENT AT 911.**

Emerging Contaminants – Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA)

March 2014



EMERGING CONTAMINANTS FACT SHEET – PFOS and PFOA

At a Glance

- ❖ Fully fluorinated compounds that are human-made substances and are not naturally found in the environment.
- ❖ Used as a surface-active agent and in a variety of products, such as firefighting foams, coating additives and cleaning products.
- ❖ Do not hydrolyze, photolyze or biodegrade under typical environmental conditions and are extremely persistent in the environment.
- ❖ Studies have shown they have the potential to bioaccumulate and biomagnify in wildlife.
- ❖ Readily absorbed after oral exposure and accumulate primarily in the serum, kidney and liver.
- ❖ Toxicological studies on animals indicate potential developmental, reproductive and systemic effects.
- ❖ Health-based advisories or screening levels for PFOS and PFOA have been developed by the EPA and state agencies.
- ❖ Standard detection methods include high-performance liquid chromatography and tandem mass spectrometry.
- ❖ Common ex situ water treatment technologies include activated carbon filters and reverse osmosis units.

Introduction

An “emerging contaminant” is a chemical or material that is characterized by a perceived, potential, or real threat to human health or the environment or by a lack of published health standards. A contaminant may also be “emerging” because a new source or a new pathway to humans has been discovered or a new detection method or treatment technology has been developed (DoD 2011). This fact sheet, developed by the U.S. Environmental Protection Agency (EPA) Federal Facilities Restoration and Reuse Office (FFRRO), provides a summary of the emerging contaminants perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), including physical and chemical properties; environmental and health impacts; existing federal and state guidelines; detection and treatment methods; and additional sources of information. This fact sheet is intended for use by site managers who may address PFOS and PFOA at cleanup sites or in drinking water supplies and for those in a position to consider whether these chemicals should be added to the analytical suite for site investigations.

PFOS and PFOA are extremely persistent in the environment and resistant to typical environmental degradation processes. As a result, they are widely distributed across the higher trophic levels and are found in soil, air and groundwater at sites across the United States. The toxicity, mobility and bioaccumulation potential of PFOS and PFOA pose potential adverse effects for the environment and human health.

What are PFOS and PFOA?

- ❖ PFOS and PFOA are fully fluorinated, organic compounds and are the two perfluorinated chemicals (PFCs) that have been produced in the largest amounts within the United States (ATSDR 2009; EFSA 2008).
- ❖ PFOS is a perfluoralkyl sulfonate that is commonly used as a simple salt (such as potassium, sodium or ammonium) or is incorporated into larger polymers (EFSA 2008; EPA 2009c).
- ❖ PFOA is a perfluoralkyl carboxylate that is produced synthetically as a salt. Ammonium salt is the most widely produced form (EFSA 2008; EPA 2009c).

Disclaimer: The U.S. EPA prepared this fact sheet from publicly available sources; additional information can be obtained from the source documents. This fact sheet is not intended to be used as a primary source of information and is not intended, nor can it be relied on, to create any rights enforceable by any party in litigation with the United States. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

What are PFOS and PFOA? (continued)

- ❖ PFOS synonyms include 1-octanesulfonic acid, heptadecafluoro-, 1-perfluorooctanesulfonic acid, heptadecafluoro-1-octanesulfonic acid, perfluoro-n-octanesulfonic acid, perfluorooctanesulfonic acid and perfluorooctylsulfonic acid (ATSDR 2009; UNEP 2005).
- ❖ PFOA synonyms include pentadecafluoro-1-octanoic acid, pentadecafluoro-n-octanoic acid, pentadecafluorooctanoic acid, perfluorocaprylic acid, perfluorooctanoic acid, perfluoroheptanecarboxylic acid and octanoic acid (ATSDR 2009).
- ❖ They are stable chemicals that include long carbon chains. Because of their unique lipid- and water-repellent characteristics, PFOS and PFOA are used as surface-active agents in various high-temperature applications and as a coating on surfaces that contact with strong acids or bases (Schultz and others 2003; UNEP 2005).
- ❖ PFCs are used in a wide variety of industrial and commercial products such as textiles and leather products, metal plating, the photographic industry, photolithography, semi-conductors, paper and packaging, coating additives, cleaning products and pesticides (ATSDR 2009; EPA 2009c; OECD 2002).
- ❖ Through 2001, PFCs were used to manufacture Aqueous Film Forming Foam (AFFF). PFOS-based AFFF is used to extinguish flammable liquid fires (for example, hydrocarbon fueled), such as fires involving gas tankers and oil refineries (EPA 2013a; DoD SERDP 2012).
- ❖ They are human-made compounds and do not occur naturally in the environment (ATSDR 2009; EPA 2009c).
- ❖ PFOS and PFOA can also be formed by environmental microbial degradation or by metabolism in larger organisms from a large group of related substances or precursor compounds (ATSDR 2009; UNEP 2006).
- ❖ The 3M Company, the primary manufacturer of PFOS, completed a voluntary phase-out of PFOS production in 2002 (ATSDR 2009; 3M 2008).

Exhibit 1: Physical and Chemical Properties of PFOS and PFOA

(ATSDR 2009; Brooke and others 2004; EFSA 2008; Environment Canada 2012; EPA 2002b; OECD 2002; UNEP 2006)

Property	PFOS (Potassium Salt)	PFOA (Free Acid)
Chemical Abstracts Service (CAS) Number	2795-39-3	335-67-1
Physical Description (physical state at room temperature and atmospheric pressure)	White powder	White powder/ waxy white solid
Molecular weight (g/mol)	538	414
Water solubility at 25°C (mg/L)	550 to 570 (purified), 370 (fresh water), 25 (filtered sea water)	9.5 X 10 ³ (purified)
Melting Point (°C)	> 400	45 to 54
Boiling point (°C)	Not measurable	188 to 192
Vapor pressure at 20 °C (mm Hg)	2.48 X10 ⁻⁶	0.017 ¹
Octanol-water partition coefficient (log K _{ow})	Not measurable	Not measurable
Organic-carbon partition coefficient (log K _{oc})	2.57 (Value estimated based on anion and not the salt)	2.06
Henry's law constant (atm-m ³ /mol)	3.05 × 10 ⁻⁹	Not measurable
Half-Life	Atmospheric: 114 days Water: > 41 years (at 25° C)	Atmospheric: 90 days ² Water: > 92 years (at 25° C)

Abbreviations: g/mol – grams per mole; mg/L – milligrams per liter; °C – degree Celsius; mm Hg – millimeters of mercury; atm-m³/mol – atmosphere-cubic meters per mole.

¹ Extrapolation from measurement.

² The atmospheric half-life value identified for PFOA is estimated based on available data determined from short study periods.

What are PFOS and PFOA? (continued)

- ❖ PFOS chemicals are no longer manufactured in the United States; however, EPA significant new use rules (SNURs) allow for the continuation of a few, limited, highly technical applications of PFOS-related substances where no known alternatives are available. In addition, existing stocks of PFC-based chemicals that were manufactured or imported into the United States before the effective date of the SNURs (for example, PFOS-based AFFF produced before the rules took effect in 2002) can still be used (EPA 2009c, 2013a).
- ❖ PFOA as its ammonium salt is manufactured primarily for use as an aqueous dispersion agent and in the manufacture of fluoropolymers (which are used in a wide variety of mechanical and industrial components) such as electrical wire casings, fire- and chemical-resistant tubing and plumbing seal tape. They are also produced unintentionally by the degradation of some fluorotelomers (ATSDR 2009; EPA 2009c).
- ❖ As part of the EPA's PFOA stewardship program, eight companies committed to achieve the following by 2010: (1) reduce global facility emissions of PFOA to all media; (2) reduce precursor chemicals that break down to PFOA and related higher homologue chemicals; and (3) PFOA product content (95 percent). The companies also agreed to work toward eliminating these chemicals from emissions and products by 2015 (EPA 2013a).

What are the environmental impacts of PFOS and PFOA?

- ❖ During past manufacturing processes, large amounts of PFOS and PFOA were released to the air, water and soil in and around fluorochemical facilities (ATSDR 2009).
- ❖ PFOS and PFOA have been detected in a number of U.S. cities in surface water and sediments downstream of former fluorochemical production facilities and in wastewater treatment plant effluent, sewage sludge and landfill leachate (EPA 2002b; OECD 2002).
- ❖ The environmental release of PFOS-based AFFF may also occur from tank and supply line leaks, use of aircraft hangar fire suppression systems and firefighting training (DoD SERDP 2012).
- ❖ Both PFOS and PFOA are the stable end products resulting from the degradation of precursor substances through a variety of abiotic and biotic transformation pathways (Conder and others 2010).
- ❖ Because of their chemical structure, PFCs, including PFOS and PFOA, are chemically and biologically stable in the environment and resist typical environmental degradation processes, including atmospheric photooxidation, direct photolysis and hydrolysis. As a result, these chemicals are extremely persistent in the environment (OECD 2002; Schultz and others 2003).
- ❖ PFOS and PFOA have very low volatility because of their ionic nature. Therefore, they will be persistent in water and soil (3M 2000; ATSDR 2009).
- ❖ When released directly to the atmosphere, PFCs are expected to adsorb to particles and settle to the ground through wet or dry deposition (Barton and others 2007; Hurley and others 2004).
- ❖ In their anionic forms, PFOA and PFOS are water-soluble and can migrate readily from soil to groundwater, where they can be transported long distances (Davis and others 2007; Post and others 2012).
- ❖ Monitoring data from the Arctic region and at sites remote from known point sources have shown levels of PFOS and PFOA in environmental media and biota, indicating that long-range transport has occurred. For example, PFOA and PFOS have been detected in concentrations from the low- to mid- picograms per liter (pg/L) range in remote regions of the Arctic caps. In addition, PFOS concentrations detected in the liver of the Canadian Arctic polar bear range from 1,700 to more than 4,000 nanograms per gram (ng/g) (Lau and others 2007; Martin and others 2004; Young and others 2007).
- ❖ Causes of long-range PFC transport include (1) atmospheric transport of precursor compounds (such as perfluoroalkyl sulfonamides), followed by degradation to form PFCs and (2) direct, long-range transport of PFCs via ocean currents or in the form of marine aerosols (Armitage and others 2006; Post and others 2012).

What are the environmental impacts of PFOS and PFOA? (continued)

- ❖ The wide distribution of PFCs increases the potential for bioaccumulation and bioconcentration as they are transferred from low to higher trophic level organisms. Because of their persistence and long-term accumulation, higher trophic level wildlife such as fish, piscivorous birds and other biota can continue to be exposed to PFOS and PFOA (EPA 2006a; UNEP 2006).
- ❖ The bioaccumulation potential of PFCs increases with increasing carbon chain length (ATSDR 2009; Furdui and others 2007).
- ❖ PFOS is the only PFC that has been shown to accumulate to levels of concern in fish tissue. The estimated bioconcentration factor in fish ranges from 1,000 to 4,000 (EFSA 2008; MDH 2011; OECD 2002).
- ❖ As of 2013, the Superfund Information Systems Database indicates PFCs have been reported in the 5-year reviews of 14 hazardous waste sites on the EPA National Priorities List (EPA 2013b).
- ❖ Data gathered in 2008 from the DoD Knowledge Based Corporate Reporting System show that 594 DoD facilities have been categorized as Fire/Crash/Training Sites and, therefore, have the potential for PFC contamination based on historical use of AFFF (DoD 2008; DoD SERDP 2012).

What are the routes of exposure and the health effects of PFOS and PFOA?

- ❖ Studies have found PFOS and PFOA in the blood samples of the general human population and wildlife nationwide, indicating that exposure to the chemicals is widespread (ATSDR 2009; EPA 2006a).
- ❖ Reported data indicate that serum concentrations of PFOS and PFOA are higher in workers and individuals living near fluorochemical production facilities than for the general population (Calafat and others 2007; EPA 2009c).
- ❖ Potential pathways, which may lead to widespread exposure, include ingestion of food and water, use of commercial products or inhalation from long-range air transport of PFC-containing particulate matter (ATSDR 2009; EPA 2009c).
- ❖ Based on the limited information available, fish and fishery products seem to be one of the primary sources of human exposure to PFOS (EFSA 2008).
- ❖ While a federal screening level or toxicity value for the consumption of fish has not yet been established, the Dutch National Institute for Public Health and the Environment has calculated a maximum permissible concentration for PFOS of 0.65 nanograms per liter (ng/L) for fresh water (based on consumption of fish by humans as the most critical route) (Moermond and others 2010).
- ❖ Studies also indicate that continued exposure to low levels of PFOA in drinking water may result in adverse health effects (Post and others 2012).
- ❖ Toxicology studies show that PFOS and PFOA are readily absorbed after oral exposure and accumulate primarily in the serum, kidney and liver. No further metabolism is expected (EPA 2006a, 2009c).
- ❖ PFOS and PFOA have half-lives in humans ranging from 2 to 9 years, depending on the study. This half-life results in continued exposure that could increase body burdens to levels that would result in adverse outcomes (ATSDR 2009; EPA 2009c; Kärman and others 2006; Olsen and others 2007).
- ❖ Acute- and intermediate-duration oral studies on rodents have raised concerns about potential developmental, reproductive and other systemic effects of PFOS and PFOA (Austin and others 2003; EPA 2006a).
- ❖ The ingestion of PFOA-contaminated water was found to cause adverse effects on mammary gland development in mice (Post and others 2012).
- ❖ One study indicated that exposure to PFOS can affect the neuroendocrine system in rats; however, the mechanism by which PFOS affects brain neurotransmitters is still unclear (Austin and others 2003).
- ❖ Both PFOS and PFOA have a high affinity for binding to B-lipoproteins and liver fatty acid-binding protein. Several studies on animals have shown that these compounds can interfere with fatty acid metabolism and may deregulate metabolism of lipids and lipoproteins (EFSA 2008; EPA 2009c).

What are the routes of exposure and the health effects of PFOS and PFOA? (continued)

- ❖ In May 2006, the EPA Science Advisory Board suggested that PFOA cancer data are consistent with the EPA guidelines for the Carcinogen Risk Assessment descriptor “likely to be carcinogenic to humans.” EPA is still evaluating this information and additional research pertaining to the carcinogenicity of PFOA (EPA 2006b, 2013a).
- ❖ The American Conference of Governmental Industrial Hygienists (ACGIH) has classified PFOA as a Group A3 carcinogen — confirmed animal carcinogen with unknown relevance to humans (ACGIH 2002).
- ❖ The chronic exposure to PFOS and PFOA can lead to the development of tumors in the liver of rats; however, more research is needed to determine if there are similar cancer risks for humans (ATSDR 2009; OECD 2002).
- ❖ In a retrospective cohort mortality study of more than 6,000 PFOA-exposed employees at one plant, results identified elevated standardized mortality ratios for kidney cancer and a statistically significant increase in diabetes mortality for male workers. The study noted that additional investigations are needed to confirm these findings (DuPont 2006; Lau and others 2007).
- ❖ Studies have shown that PFCs may induce modest effects on reactive oxygen species and deoxyribonucleic acid (DNA) damage in the cells of the human liver (Eriksen and others 2010; Reistad and others 2013).
- ❖ Analysis of U.S. National Health and Nutrition Examination Survey representative study samples indicate that higher concentrations of serum PFOA and PFOS are associated with thyroid disease in the U.S. general adult population. Further analysis is needed to identify the mechanisms underlying this association (Melzer and others 2010).
- ❖ Epidemiologic studies have shown an association between PFOS exposure and bladder cancer; however, further research and analysis are needed to understand this association (Alexander and others 2004; Lau and others 2007).

Are there any federal and state guidelines and health standards for PFOS and PFOA?

- ❖ In January 2009, the EPA's Office of Water established a provisional health advisory (PHA) of 0.2 micrograms per liter (µg/L) for PFOS and 0.4 µg/L for PFOA to assess the potential risk from short-term exposure of these chemicals through drinking water. PHAs reflect reasonable, health-based hazard concentrations above which action should be taken to reduce exposure to unregulated contaminants in drinking water (EPA 2009d, 2013a).
- ❖ EPA Region 4 calculated a residential soil screening level of 6 milligrams per kilogram (mg/kg) for PFOS and 16 mg/kg for PFOA (EPA Region 4 2009).
- ❖ Various states have established drinking water and groundwater guidelines, including the following:
 - Minnesota has established a chronic health risk limit of 0.3 µg/L for PFOS and PFOA in drinking water (MDH 2011).
 - New Jersey has established a preliminary health-based guidance value of 0.04 µg/L for PFOA in drinking water (NJDEP 2013).
 - North Carolina has established an interim maximum allowable concentration (IMAC) of 2 µg/L for PFOA in groundwater (NCDENR 2006).
 - In 2010, the North Carolina Secretary's Science Advisory Board (NCSAB) on Toxic Air Pollutants recommended that the IMAC be reduced to 1 µg/L based on a review of the toxicological literature and discussions with scientists conducting research on the health effects associated with exposure to PFOA. As of February 2014, the NCSAB's recommendation was still pending review by the North Carolina Division of Water Quality (NCSAB 2010).
- ❖ Under the Toxic Substances Control Act (TSCA), the EPA finalized two SNURs in 2002 for 88 PFOS-related substances, which require companies to notify the EPA 90 days before starting to manufacture or importing these substances for a significant new use; this pre-notification allows time to evaluate the new use (EPA 2002a, 2013a).
- ❖ In 2007, the SNURs were amended to include 183 additional PFOS-related substances (EPA 2006a, 2013a).

Are there any federal and state guidelines and health standards for PFOS and PFOA? (continued)

- ❖ On September 30, 2013, the EPA issued a final SNUR requiring companies to report 90 days in advance of all new uses of long-chain perfluoroalkyl carboxylic (LCPFAC) chemicals (defined as having perfluorinated carbon chain lengths equal to or greater than seven carbons and less than or equal to 20 carbons) for use as part of carpets or to treat carpets, including the import of new carpet containing LCPFACs. In addition, the EPA is amending the existing SNUR to add PFOS-related substances that have completed the TSCA new chemical review process but have not yet commenced production or importation, and to designate processing as a significant new use (EPA 2012, 2013a).
- ❖ The SNURs allow for continued use for a few highly technical applications of PFOS-related substances where no alternatives are available; these specialized uses are characterized by very low volume, low exposure and low releases (EPA 2009c, 2013a).
- ❖ The Agency for Toxic Substances and Disease Registry has not established a minimal risk level (MRL) for PFOS or PFOA; when the draft toxicological profile was published, human studies were insufficient to determine with a sufficient degree of certainty that the effects are either exposure-related or adverse (ATSDR 2009).
- ❖ The EPA has not derived a chronic oral reference dose (RfD) or chronic inhalation reference concentration (RfC) for PFOS or PFOA and has not classified PFOS or PFOA carcinogenicity.
- ❖ The EPA removed PFOS and PFOA from the Integrated Risk Information System (IRIS) agenda in a Federal Register notice released on October 18, 2010. At this time, EPA is not conducting an IRIS assessment for these chemicals (EPA 2010).
- ❖ PFOS and PFOA were included on the third drinking water contaminant candidate list, which is a list of unregulated contaminants that are known to, or anticipated to, occur in public water systems and may require regulation under the Safe Drinking Water Act (EPA 2009a).

What detection and site characterization methods are available for PFOS and PFOA?

- ❖ PFOS and PFOA are commonly deposited in the environment as discrete particles with strongly heterogeneous spatial distributions. Unless precautions are taken, this distribution causes highly variable soil data that can lead to confusing or contradictory conclusions about the location and degree of contamination. Proper sample collection (using an incremental field sampling approach), sample processing (which includes grinding) and incremental subsampling are required to obtain reliable soil data (EPA 2003, 2013c).
- ❖ PFOS and PFOA in anionic form can be extracted from environmental media by conventional methods using either acidification or ion pairing to obtain a neutral form of the analyte. Sample preparation methods used for PFCs have included solvent extraction, ion-pair extraction, solid-phase extraction and column-switching extraction (Flaherty and others 2005).
- ❖ Precursors and intermediate degradation products can be extracted using solvents (Dasu and others 2012; Ellington and others 2009).
- ❖ Air samples may be collected using high-volume air samplers that employ sampling modules containing glass-fiber filters and glass columns with a polyurethane foam (Jahnke and others 2007a).
- ❖ Detection methods for PFCs are primarily based on high-performance liquid chromatography (HPLC) coupled with tandem mass spectrometry (MS/MS). HPLC-MS/MS has allowed for more sensitive determinations of individual PFOS and PFOA in air, water and soil (EFSA 2008; Jahnke and others 2007b; Washington and others 2008).
- ❖ Both liquid chromatography (LC)-MS/MS and gas chromatography-mass spectrometry (GC-MS) can be used to identify the precursors of PFOS and PFOA (EFSA 2008).
- ❖ EPA Method 537, Version 1.1, is an LC-MS/MS method used to analyze selected perfluorinated alkyl acids in drinking water. While most sampling protocols for organic compounds require sample collection in glass, this method requires plastic sample bottles because PFCs are known to adhere to glass (EPA 2009b).
- ❖ The development of LC - electrospray ionization (ESI) MS and LC-MS/MS has improved the analysis of PFOS and PFOA (EFSA 2008).
- ❖ Reported sensitivities for the available detection methods include low picograms per cubic meter (pg/m^3) levels in air, high picograms per liter (pg/L) to low ng/L levels in water and high picogram per gram to low ng/g levels in soil (ATSDR 2009).

What technologies are being used to treat PFOS and PFOA?

- ❖ Because of their unique physicochemical properties (strong fluorine-carbon bond and low vapor pressure), PFOS and PFOA resist most conventional in situ treatment technologies, such as direct oxidation (Hartten 2009; Vectis and others 2009).
- ❖ Factors to consider when selecting a treatment method in all media include: (1) initial concentration of PFCs; (2) the background organic and metal concentration; (3) available degradation time; and (4) other site-specific conditions (Vectis and others 2009).
- ❖ Ex situ treatments including activated carbon filters, nanofiltration and reverse osmosis units have been shown to remove PFCs from water; however, incineration of the concentrated waste would be needed for the complete destruction of PFCs (Hartten 2009; MDH 2008; Vectis and others 2009).
- ❖ Research into a cost-effective treatment approach for PFOS and PFOA is ongoing (DoD SERDP 2012).
- ❖ Alternative technologies studied for PFOS and PFOA degradation in water, soil and solid waste include photochemical oxidation and thermally induced reduction, which have achieved some bench-scale success (Hartten 2009; Vectis and others 2009).
- ❖ Laboratory-scale studies have also evaluated sonochemical degradation (that is, ultrasonic irradiation) to treat PFOS and PFOA in groundwater and have reported a sonochemical degradation half-life less than 30 minutes for both PFOS and PFOA (Cheng and others 2008, 2010).
- ❖ Results from a laboratory-scale study suggested the promising potential of using a double-layer permeable reactive barrier (DL-PRB) system for the in situ containment of PFC-contaminated soil and groundwater. The DL-PRB system is composed of an oxidant-releasing material layer followed by a layer of quartz sands immobilized with humification enzymes. The system drives enzyme-catalyzed oxidative humification reactions to degrade PFCs in the PRB (DoD SERDP 2013).
- ❖ In situ chemical oxidation is being explored as a possible means to treat PFCs in water. Laboratory-scale study results indicate that heat-activated persulfate and permanganate can effectively degrade PFOS and PFOA in water (Liu and others 2012a, b).

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Contact Information

If you have any questions or comments on this fact sheet, please contact: Mary Cooke, FFRRO, by phone at (703) 603-8712 or by email at cooke.maryt@epa.gov.