Per- and Polyfluoroalkyl Substances (PFAS) Source Water Protection Guidance Project: Technical Appendix

CADMUS

Table of Contents

List of Figures

List of Tables

Acronym List

ADONA	4,8-dioxa-3H-perfluorononanoic acid
AFFF	Aqueous Film-Forming Foam
AGQS	Ambient Groundwater Quality Standard
ASDWA	Association of State Drinking Water Administrators
ATSDR	Agency for Toxic Substances and Disease Registry
CAS	Chemical Abstracts Service
CDC	Center for Disease Control
DOD	Department of Defense
DOT	Department of Transportation
GAC	Granular Activated Carbon
HFPO-DA	Hexafluoropropylene oxide dimer acid
ITRC	Interstate Technology Regulatory Council
MCL	Maximum Contaminant Level
NAICS	North American Industry Classification System
NASA	National Aeronautics and Space Administration
NGOs	Non-governmental Organizations
PFAS	Per- and polyfluoroalkyl substances
PFBS	Perfluorobutane sulfonate
PFHxS	Perfluorohexane sulfonate
PFPHpA	Perfluoroheptanoic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
ppt	Parts per trillion
PWS	Public Water System
SIC	Standard Industrial Classification
SNUR	Significant New Use Rule
TRI	Toxics Release Inventory
SCA	Toxic Substances Control Act
UCMR	Unregulated Contaminant Monitoring Rule
U.S. EPA	United States Environmental Protection Agency
WTP	Drinking Water Treatment Plant
WWTP	Wastewater Treatment Plant

Introduction

Per- and polyfluoroalkyl substances (PFAS) are a large family of synthetic chemicals that have been used in a wide variety of consumer products and industrial processes since the mid-20th century. Toxicological studies have shown that exposure to PFAS may be harmful to humans and the environment. PFAS chemicals often contaminate ground, surface, and drinking water because the properties that make them useful for industrial and commercial purposes also make them bioaccumulative, and because the products that contain them are so widespread. Ingestion through drinking water poses an array of health risks to humans, including increased cholesterol, low infant birth weights, increased risk of certain cancers, and interference with hormones and the immune system. The U.S. Environmental Protection Agency (EPA) issued a PFAS Action Plan in 2019. The Action Plan contains the short-term and long-term strategies that EPA is taking to regulate and monitor for PFAS in drinking water, improve toxicity information and scientific understanding of PFAS, and develop cleanup and enforcement tools. The national plan was developed in 2018, in response to public input after EPA held a National Leadership Summit on PFAS and visited communities around the U.S. that have been directly affected by PFAS.

States and Non-governmental Organizations (NGOs) are taking additional steps to address PFAS within their own jurisdictions. This document provides a brief overview of what is known to date about PFAS and documents actions some states are taking to improve their ability to respond to the risk of PFAS contamination. Sections are organized in the following manner:

- **Section I: Chemicals of Concern.** A summary of the chemicals of concern, and their fate and transport.
- **Section II: PFAS in the United States.** A description of where PFAS contamination may be found, and the industrial codes to help locate sampling sites.
- **Section III: State Profiles.** A compilation of actions and resources that states have already implemented.

This Technical Appendix was developed by ASDWA with support from members of the PFAS Source Water Protection Guidance Project Advisory Council (PAC), other state agencies, and the Cadmus Group. The following state agencies participated on the PAC: Colorado Department of Public Health and Environment, Kansas Department of Health and Environment, Minnesota Department of Health, Minnesota Pollution Control Agency, New Hampshire Department of Environmental Services, North Carolina Department of Environmental Quality, Pennsylvania Department of Environmental Protection, Virginia Department of Health, Vermont Department of Environmental Conservation, and Wisconsin Department of Natural Resources.

By demonstrating and sharing effective strategies for addressing PFAS contamination risk in source waters, ASDWA hopes to inform policy decisions, assist state drinking water programs in protecting the public's health, and encourage collaboration and communication among states.

If you have questions regarding this report, please contact:

Deirdre White, Project Manager
Association of State Drinking Water Administrators
dwhite@asdwa.org

Section I - Chemicals of Concern

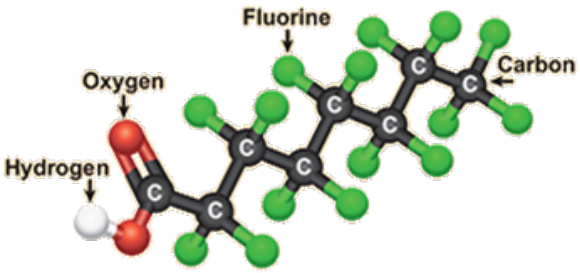
What are PFAS?

Per- and polyfluoroalkyl substances (PFAS) are a wide range of synthetic chemicals with varying chemical and physical properties (U.S. EPA, 2015). They have many industrial and manufacturing applications due to their grease, water, and stain-repellant properties. Common products that use PFAS are firefighting foams, carpets, non-stick cookware, and paper products (ITRC, 2017a). People are exposed to PFAS in multiple ways, such as ingestion (most common), inhalation, and dermal absorption.

What is the structure and classification of PFAS?

The basic structure of PFAS, shown in Figure 1, includes a carbon-fluorine chain, known as the tail, and a functional group at the end of the chain, known as the head (ATSDR, 2017a).

Figure 1: Basic structure of Perfluorooctanoic acid (PFOA) (NIHES, 2019).



The large diversity in PFAS chemical and physical properties causes scientists to group PFAS into many different subcategories, such as short- vs. long-chained or functional groups. Some common examples of PFAS and subcategories are shown in Figure 2. Note that the term *perfluorinated compounds* (PFC) is not used in scientific literature anymore as it is poorly defined and has led to confusion in research (ITRC, 2017b).

The charged functional group, also known as an R-group, is connected to the end carbon of the carbon-fluorine tail. Based on intended use, the complexity and chemical makeup of these functional groups varies greatly among PFAS chemicals (ITRC, 2017b). The functional group for PFOA is CO_2^- and the functional group for Perfluorooctanesulfonic acid (PFOS) is SO_3^-.

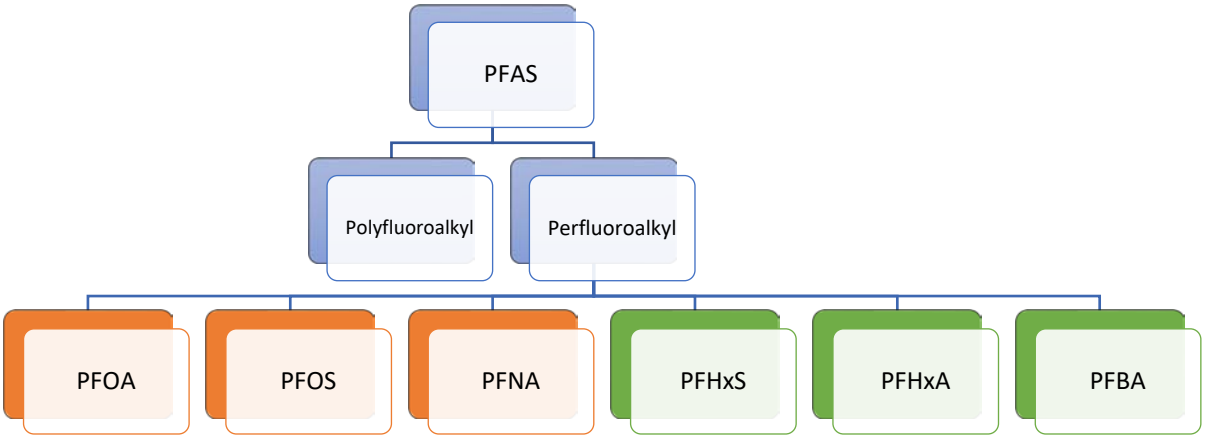
PFAS can be divided into subcategories based on their functional group, which act similarly due to their chemical properties (ITRC, 2018b). The four subcategories are:

- Carboxylic acids (PFCA);
- Sulfonic acids (PFSA);
- Perfluoroalkane Sulfonamido (FASE) compounds; and
- Fluorotelomer Alcohols (FTOHs).

The carbon-fluorine tail determines if the PFAS are a perfluoroalkyl or polyfluoroalkyl (ITRC, 2018b). For perfluoroalkyl substances, every hydrogen atom in the alkyl chain (except for any carbon that is part of the charged functional group) has been replaced by a fluorine atom. For polyfluoroalkyl substances, at least one carbon atom of the alkyl chain has not had its hydrogen atoms substituted by fluorine.

The carbon-fluorine tail also determines if the PFAS are short-or long-chained (U.S. EPA, 2015). Grouping PFAS based on chain length, which affects degradation rates in the environment, helps to predict how PFAS will react in the environment (ITRC, 2017b). Long-chained PFAS are PFCA with eight or more carbons and PFSA with six or more carbons; PFAS with fewer carbons are designated as short-chained PFAS (U.S. EPA, 2015). The toxicity of the individual PFAS chemicals varies with chain length.

Figure 2: Hierarchy of PFAS terminology (ATSDR, 2017a).
Long-chained are designated with an orange background and short-chained are designated with a green background (AWWA, 2019).



The functional group and carbon-fluorine tail have different electronegativity, which affects the behavior of the chemicals (ITRC, 2018b). The tails are hydrophobic and lipophobic, meaning that they are water and fat repellant, and the functional group head is polar and hydrophilic, meaning it has an affinity for water. This difference affects the fate and transport of PFAS (see the Fate and Transport Section).

In addition to these structural differences in PFAS, many PFAS can exist in different chemical forms depending on their physical properties (e.g., acid dissociation constant, pK_a) and environmental conditions (e.g., pH). These forms include acids (no net charge), anions (negatively charged), cations (positively charged), and zwitterions (positive and negatively charged) (ITRC, 2017b). Due to their relatively low pK_a values (which indicates fairly strong acids that tend to disassociate in water), most PFAS exist in the anionic form in the environment; however, many of the available properties for PFAS are for the protonated acid form rather than for the anionic form (ITRC, 2017b).

Due to this, it is important to pay close attention to the Chemical Abstracts Service (CAS) number as each PFAS in the acid form has a different CAS number than the non-acid form. However, some anionic forms don't have a different CAS number than their acid forms. For example, PFOS in acid form has a CAS number of 1763-23-1, PFOS as its potassium salt has a CAS number of 2795-39-3, and PFOS as its ammonium salt has a CAS number of 29081-56-9.

What are states monitoring and/or sampling for?

Many states monitor and/or sample for the six PFAS that were tested for in the Third Unregulated Contaminant Monitoring Rule (UCMR 3) (U.S. EPA, 2015). These are:

- Perfluorooctanesulfonic acid (PFOS);
- Perfluorooctanoic acid (PFOA);
- Perfluorononanoic acid (PFNA);
- Perfluorohexanesulfonic acid (PFHxS);
- Perfluoroheptanoic acid (PFHpA); and
- Perfluorobutanesulfonic acid (PFBS).

To understand what concentrations of PFAS are harmful in finished drinking water, most states follow the U.S. Environmental Protection Agency's (U.S. EPA) lifetime health advisory level of 70 parts per trillion (ppt) or ng/L for concentrations of PFOA plus PFOS (U.S. EPA, 2016b). This level was established to protect sensitive populations, such as pregnant mothers, infants, and the elderly, from adverse health effects. This is not an enforceable standard but is used as a guideline for a level of PFAS exposure that protects consumers throughout their life from adverse health effects. Some states have set stricter standards for PFAS. For example, California has set a notification level of 13 ppt for PFOS and PFOA, combined (see California's state profile).

Which chemicals pose the greatest risk to human health?

Which PFAS chemicals pose the greatest risk to human health is determined by two main features: toxicity (e.g., human health risk) and environmental fate and transport (i.e., does it partition to environmental media that may result in human exposure?).

Toxicity

PFAS can adversely affect human health (ATSDR, 2018). The six UCMR 3 PFAS are more widely studied than other PFAS; however, in general all PFAS have similar health effects. High exposure to PFAS can adversely affect human immune, endocrine, reproductive, and respiratory systems. In particular, high PFAS exposure may lead to asthma, liver damage, thyroid disease, reduced response to vaccines, and decreased fertility and birth weights.

Based on a U.S. Department of Health and Human Services (HHS) National Toxicology Program (NTP) study, long- and short-chained PFAS adversely affect rodent organs similarly; however, higher doses of the short-chained PFAS are needed to have the same effect as the long-chained PFAS (HHS, 2019). In another ongoing NTP study, preliminary results suggest that rats are able to clear short-chained PFAS faster than long-chained PFAS. This is because short-chained PFAS typically have shorter half-lives than long-chained PFAS, so the body eliminates them faster.

Fate and Transport

What is fate and transport?

Fate and transport is the study of how chemicals persist or degrade and partition among different media (e.g., water, soil, sediment, air). This is important for PFAS because people can be exposed to PFAS through contaminated water, but also through exposure to air, soil, sediment, or biota.

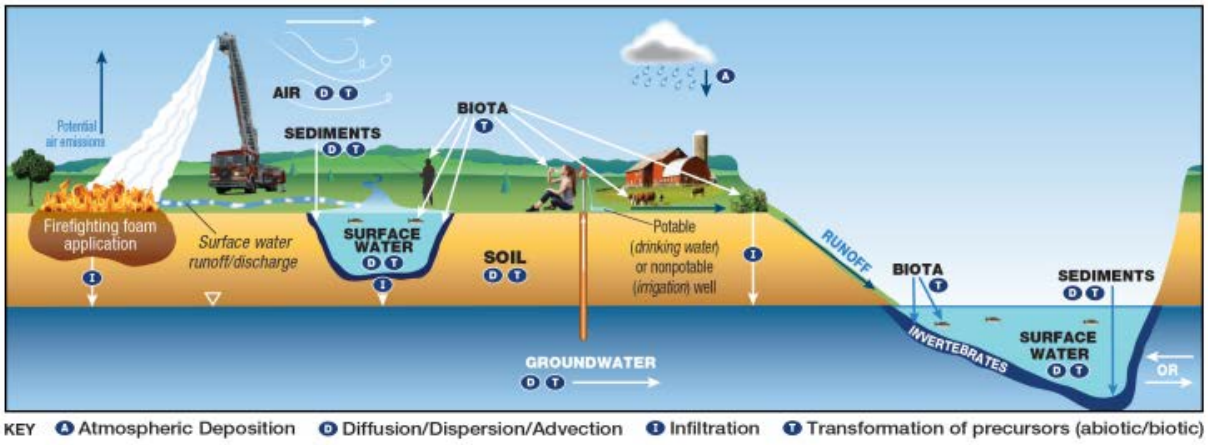
Why is fate and transport important?

The more mobile PFAS in the environment may pose the greatest risk for exposure via drinking water. This is because these highly mobile chemicals do not significantly adhere to organic matter in sediment or soil; instead, they partition to the water column and are therefore more likely to be in source water and/or finished drinking water. Less mobile chemicals, however, are more likely to adhere to organic matter and are less likely to partition to water. Understanding this chemical behavior can inform decisions about which chemicals should be monitored, as shown in examples below.

What is the fate and transport of most PFAS?

Figure 3 shows a conceptual way that PFAS firefighting foams can move through water, air, biota, and soil. There are multiple pathways by which drinking water can become contaminated with PFAS. For example, when firefighting foams are sprayed, PFAS can either contaminate surface water through runoff, groundwater through leaching into the soil, or air through emissions. From there, contaminated water, sediment, or air particles can pollute source water. Additionally, PFAS manufacturers can cause contamination if PFAS are leaked into drinking water sources. The most common industries that cause PFAS contamination are discussed later (see the NAICS Code section).

Figure 3: PFAS transport model from firefighting foams (ITRC, 2018b).



There are many chemical properties that influence fate and transport. For PFAS, K_{oc}, which is the ratio of molecules sorbed to organic carbon by molecules desorbed to organic carbon, is one of the most important properties since many of the other chemical and physical properties of PFAS are difficult to measure and are largely unknown due to the disconnect between acid and anionic forms (ITRC, 2018b). Table 1 shows common properties of PFAA in the acidic, various salt, and anionic forms. The chemical properties for the anionic forms, which tend to be predominant in the environment, are largely unknown (K_{oc} is an exception). In comparison, properties of the acid forms, which are not common in the environment, are more widely available. Also, many PFAS properties are either measured in the environment or estimated using models, which makes comparing multiple datasets challenging and potentially misleading. Therefore, understanding fate and transport of PFAS that exist in the environment is complex and studies are ongoing.

Since many of the available properties for PFAS are for the acid form rather than for the disassociated form, these properties should be used with care (ITRC, 2017b). These properties may, however, still be

useful for evaluating the relative likelihood of various PFAS partitioning to water or from water based on their fluoroalkyl chain length and the nature of the polar functional group.

Table 1: Available chemical and physical properties that influence fate and transport for PFAA (ITRC, 2017b).

Properties								Environmentally Relevant?
PFAA State	CAS No.	S_w	P^o	K_h	K_{ow}	K_{oc}	BCF and/or BAF	
Acid	Y	Y	Y	E	E	E	N	No
Cation:								No
NH_4^+	Y	Y	N	N	N	N	N	
Li^+	Y	Y	N	N	N	N	N	
Na^+	Y	Y	N	N	N	N	N	
Anion	M	N	N	N	N	Y	Y	Yes

S_w = solubility in water
P^o = vapor pressure
K_h = Henry's Law Constant
K_{ow} = octanol/water partition coefficient
K_{oc} = organic carbon partition coefficient
BAF = bioaccumulation factor
BCF = bioconcentration factor

Y = data available
N = no data available
M = data may be available for some
E = data estimated, not directly measured

How does PFAS partition among soil, sediment, and water?

As previously noted, K_{oc} is the ratio of molecules sorbed to organic carbon by molecules desorbed to organic carbon (ITRC, 2018b). It is used to measure mobility between soil and sediment to water.

- A K_{oc} greater than 1,000 (L/kg) designates a chemical that is not mobile in the water but instead sorbs to soil and sediment (ChemSafetyPro, 2019b).
- A K_{oc} less than 1,000 (L/kg) designates a chemical that is mobile in the water and does not sorb to soil and sediment.

Table 2 shows various PFAS in anionic and acidic forms organized by log K_{oc}, K_{oc}, and fluorine-carbon chain length (ITRC, 2018b). K_{oc} was extrapolated from log K_{oc} values from soil and sediment components to compare mobility. Red highlighting indicates higher K_{oc} and therefore, a greater probability of sorbing to organic matter and less mobility in water. In general, the long-chained PFAS chemicals are less likely to partition to water as opposed to soil/sediment organic matter, while short-chained PFAS are more likely to partition to water and therefore be found in drinking water.

Table 2: PFAS K_{oc} and chain length (ITRC, 2018b).

PFAS	Log K_{OC}	K_{oc} (L/kg) (extrapolated from log K_{oc})	Chain Length (number of carbons in chain)
Perfluorobutanoate (PFBA)	1.9	75.9	4
Perfluorobutane sulfonate (PFBS)	1.2 - 1.79	15.9 - 61.7	4
4:2 Fluorotelomer alcohol (4:2 FTOH)	0.93	8.5	4+
Perfluoropentanoate (PFPeA)	1.4	23.4	5
Perfluorohexanoate (PFHxA)	1.3	20.4	6
Perfluoroheptane sulfonate (PFHxS)	2.4-3.1	251 - 1,258	6

PFAS	Log K_{OC}	K_{oc} (L/kg) (extrapolated from log K_{oc})	Chain Length (number of carbons in chain)
6:2 Fluorotelomer alcohol (6:2 FTOH)	2.43	269	6+
Perfluoroheptanoate (PFHpA)	1.6	42.7	7
Perfluorooctanoate (PFOA)	1.89 - 2.63	77.6 - 426	8
Perfluorooctane sulfonate (PFOS)	2.4 - 3.7	251 - 5,011	8
Perfluorooctanesulfonamide (PFOSA)	4.10	12,589	8+
8:2 Fluorotelomer alcohol (8:2 FTOH)	4.13	13,489	8+
2-(N-ethylperfluorooctanesulfonamido) acetic acid (N-EtFOSAA)	3.23 - 3.49	1,698 - 3,090	8+
2-(N-methylperfluorooctanesulfonamido) acetic acid (N-MeFOSAA)	3.11 - 3.35	1,288 - 2,238	8+
Perfluorononanoate (PFNA)	2.36 - 3.69	229 - 4,897	9
Perfluorodecanoate (PFDA)	2.76 - 2.96	575 - 912	10
Perfluorodecane sulfonate (PFDS)	3.53 - 3.66	3,388 - 4,570	10
10:2 Fluorotelomer alcohol (10:2 FTOH)	6.20	1,584,893	10+
Perfluoroundecanoate (PFUnDA)	3.3 - 3.56	1,995 - 3,630	11

*Red highlighting indicates a greater probability of sorbing to organic matter and less mobility in water.

Also, a chemical's water solubility is a measure of how easily it dissolves in water and is an important factor in fate and transport. In general, most PFAS have high water solubility because the hydrophilic, polar head can be dissolved in water (ITRC, 2018b).

How does PFAS partition between biological systems and water?

The octanol/water partition coefficient (log K_{ow}) is a proxy for chemical uptake by biological systems. It can be estimated or measured and is based on vapor pressure, melting point, and boiling point (ITRC, 2017b). K_{oc} can be used to estimate K_{ow} in other organic compounds, but this should not be done for PFAS. Since PFAS have such a wide range of chemical and physical properties, it is difficult to reliably estimate log K_{ow}. Overall, however, PFAS have high bioaccumulation in biological systems (U.S. EPA, 2016a; ChemSafetyPro, 2019a).

How does PFAS partition between water and air?

Henry's Law coefficient (K_H) is a proxy for volatility from water to air and represents the ratio of a contaminant's vapor pressure to its water solubility. Most PFAS exist in the ionized form and ions do not volatilize. Therefore, vapor pressure for PFAS is usually low and water solubility is high, indicating that partitioning from water to air is unlikely (ITRC, 2018b).

Although partitioning from water to air is unlikely, the reverse does occur. PFAS that are released directly into the air from manufacturer's smoke stacks can readily contaminate waterbodies (ITRC, 2018b). More volatile PFAS such as FTOHs are commonly found in the gaseous state, which makes them easier to move through the atmosphere.

What PFAS should states be monitoring and/or sampling for?

The EPA issued a Significant New Use Rule (SNUR) in 2002, 2007, and 2013, which requires notification before PFAS are manufactured (U.S. EPA, 2013). Although PFOS and PFOA are generally not manufactured in the U.S. anymore, they are very persistent and can be formed when long-chained PFAS degrade through electrochemical fluorination (see the NAICS Code section). Therefore, PFOS and PFOA are expected to pose a long-term risk to human health in drinking water (ATSDR, 2018; ITRC, 2017b).

Short-chained PFAS are more likely to be present in drinking water, but higher doses of them are needed to have the same adverse health effects as long-chained PFAS (HHS, 2019). The opposite is true for long-chained PFAS, which are less likely to be present in drinking water but require lower doses to have adverse health effects.

Therefore, based on current understanding of PFAS health risks and their fate and transport in the environment, long-chained PFAS with high mobility in water should be monitored in addition to the UCMR 3 PFAS. These PFAS may include, but are not limited to:

- Perfluorooctanesulfonic acid (PFOS);
- Perfluorooctanoic acid (PFOA);
- Perfluorononanoic acid (PFNA);
- Perfluorohexanesulfonic acid (PFHxS);
- Perfluoroheptanoic acid (PFHpA);
- Perfluorobutanesulfonic acid (PFBS);
- 8:2 Fluorotelomer alcohol (8:2 FTOH);
- 10:2 Fluorotelomer alcohol (10:2 FTOH);
- 2-(N-ethylperfluorooctanesulfonamido) acetic acid (N-EtFOSAA);
- 2-(N-methylperfluorooctanesulfonamido) acetic acid (N-MeFOSAA);
- Perfluorooctanesulfonamide (PFOSA);
- Perfluorodecane sulfonate (PFDS);
- Perfluoroundecanoate (PFUnDA); and
- Perfluorodecanoate (PFDA).

Additional Information:

For more information, please visit the following websites and resources:

- Agency for Toxic Substances and Disease Registry (ATSDR) – PFAS Guidance Website and PFAS Toxicological Profile
- Interstate Technology Regulatory Council (ITRC) – PFAS Guidance Website
- U.S. HHS NTP – PFAS Toxicological Research
- U.S. EPA – PFAS Health Advisory, Risk Management for PFAS, and PFAS Action Plan

Section II - PFAS in the United States

How is PFAS regulated?

Since its invention in the 1930s, the PFAS family of compounds has grown to include over 3,000 manmade chemicals (ITRC, 2017b). Due to their stability and resistance to heat, water, and oil, PFAS compounds have been used in a wide range of commercial and industrial products (U.S. EPA, 2019). A growing awareness of the potentially adverse human health effects of PFAS exposure has led to a reduction in the manufacturing and use of long-chain PFAS in the U.S., though they are still produced in other parts of the world (ITRC, 2017b).

In the U.S., PFAS production and use varies by individual PFAS compound, depending on properties and known health effects. For example, under the EPA's 2010/2015 PFOA Stewardship Program, the eight largest companies in the fluorochemical industry voluntarily phased out some long-chained PFAS and transitioned to alternative PFAS chemicals, such as GenX. Similarly, PFOS is voluntarily not manufactured or imported into the country (U.S. EPA, 2018a). The EPA has also issued a series of SNURs under the Toxic Substances Control Act (TSCA), which require manufacturers to alert the EPA at least 90 days prior to starting or resuming the use of PFAS chemicals. The EPA then reviews and, if necessary, regulates any new use of PFAS (U.S. EPA, 2018b). Furthermore, of those PFAS compounds subject to SNURs, 160 were identified as being active in commerce (on the TSCA inventory) and were added to the Toxics Release Inventory (TRI) in 2020. The TRI requires industrial facilities to annually report how much of each toxic chemical in the TRI list is released to the environment and/or managed through treatment and recycling (U.S. EPA, 2020).

PFAS Uses

Its unique properties make the PFAS group of chemicals a versatile manufacturing agent. As a result, PFAS compounds are found in a wide variety of household products, including food packaging materials, nonstick cookware, carpet and stain resistant carpet treatments, water resistant clothing, cleaning products, paints, varnishes, sealants, and some cosmetics (ATSDR, 2017b and Kotthoff et al., 2015). Although future uses of some PFAS are limited by SNURs, many older commercial products have long shelf lives and continue to pose an exposure risk. For example, non-stick cookware produced before the 2010/2015 PFOA Stewardship Program phase-out will still release PFOA when heated. Aside from household products, PFAS compounds are used in a variety of industrial goods and processes. Research into the human health and environmental effects of these uses is ongoing. All facilities associated with primary manufacturing (those that directly produce PFAS) and secondary manufacturing (those that use PFAS to make goods) are possible sources of ongoing or historical releases of PFAS to the environment. Industries that have used PFAS in the past include, but are not limited to:

- Textiles and leather;
- Paper products;
- Metal plating and etching;
- Wire manufacturing;
- Industrial surfactants, resins, molds, and plastics;
- Photolithography and semiconductors;
- Household goods (e.g., cookware, carpets);
- Automotive (e.g., lubricants, raw materials);

- Aviation, aerospace, and defense (e.g., hydraulic fluids, insulators);
- Construction (e.g., coating for building materials, paint additives);
- Medical articles (e.g., surgical patches, grafts, implants); and
- Fire-fighting (see below for more details) (ITRC, 2017b, and OECD, 2013).

These industries may release PFAS into the environment through wastewater and stormwater discharges, accidental releases, air emissions, and solid industrial waste.

PFAS in Firefighting Foams

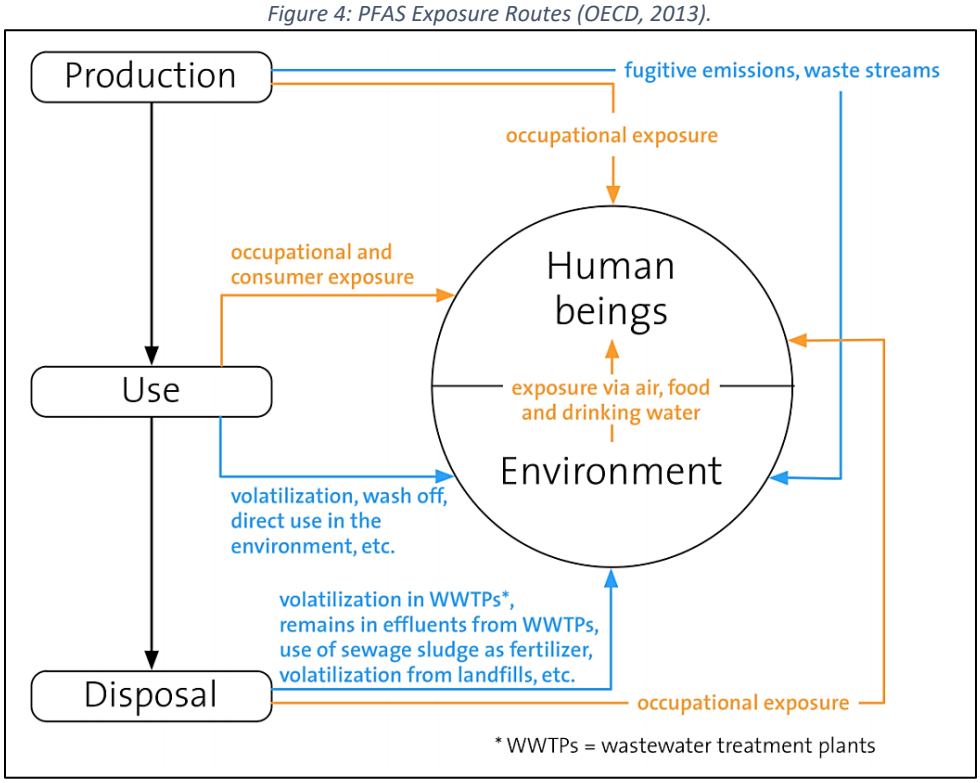
In addition to manufacturing processes, some products containing PFAS are used in a way that poses a direct risk to ground or surface water. For example, a leading cause of PFAS contamination is the use of Class B firefighting foams. There are two major classes of firefighting foams: Class A, which are used on wildfires and structure fires; and Class B, which are used on fires caused by flammable and combustible liquids, hydrocarbon fuels, and solvents and alcohol. Class B includes synthetic foam known as aqueous film-forming foam (AFFF), which contains PFAS (ITRC, 2018a). AFFF is used in locations such as chemical plants, oil refineries, fire departments and firefighting training facilities, airports, and military facilities (ITRC, 2018a and Navy, n.d.). Because AFFF is typically discharged outside, it can run off into surface water, stormwater or wastewater, or seep into groundwater (ITRC, 2018a). AFFF manufacturers are working to replace long-chain PFAS with short-chain PFAS; because of its long shelf life, however, the more harmful legacy firefighting foam is still stockpiled at many facilities (NHDES, n.d.). Some states have started legacy foam take-back programs to remove and properly dispose of AFFF (see New Hampshire and Rhode Island state profiles for more information). In addition to AFFF, ongoing research shows that ski wax, which contains PFAS and leaves residue in snowmelt, may be a cause of ground and surface water contamination in and around ski resorts (ATSDR, 2018).

What happens to PFAS once it is produced?

Once PFAS compounds are discharged, either directly by manufacturing processes or in products discarded by consumers, they enter the waste stream. Many waste management facilities have been shown to be sources of PFAS contamination (ATSDR, 2018). Leachate from municipal solid waste landfills can contain PFAS and if left uncaptured, may release PFAS directly to the environment. When leachate is properly collected at a landfill, it is commonly taken to a wastewater treatment plant (WWTP). WWTPs also receive wastewater that may contain PFAS from industrial facilities and municipal sewage systems. Standard sewage treatment methods, however, are ineffective at reducing or removing PFAS from wastewater (ITRC, 2018b and Hamid and Li, 2016). PFAS may be released from WWTPs in the form of effluent, system leaks, air emissions, and biosolids. Wastewater or landfill leachate that has been treated at a WWTP and has been distributed for commercial or agricultural use may contain PFAS (ITRC, 2018b). Similarly, because domestic sewage sludge can contain PFAS, treated biosolids applied to agricultural land may release PFAS to the soil, groundwater, or surface water (ATSDR, 2018 and Washington et al., 2010). Waste management facilities, therefore, represent possible secondary sources of PFAS contamination.

Figure 4 below summarizes the various pathways by which PFAS compounds are released to the environment and humans may be exposed.

Figure 4: PFAS Exposure Routes (OECD, 2013).



NAICS Codes

The North American Industry Classification System (NAICS) is a system for categorizing businesses. It was designed for statistical purposes and for comparing economic data across North America. Companies select the six-digit NAICS code which best describes their primary business activity, and government agencies use these codes to classify industry information. The NAICS classification scheme replaced the older and less specific Standard Industrial Classification (SIC) system (U.S. Census Bureau, 2019).

Because PFAS is used in specific industries (see the list at the beginning of this section), possible sources of PFAS contamination can be located by searching for companies by NAICS code. One possible database to use for a NAICS search is the EPA Facility Registry Service. Table 3 shows a list of NAICS codes for businesses and industries that may be primary or secondary sources of PFAS. Note that NAICS codes are broad categories that may contain manufacturers of products unrelated to PFAS; the specific sub-categories that are relevant to PFAS are indicated in the table. This code list was assembled from projects that states have already started in order to identify PFAS sources. For an example sampling plan that uses NAICS codes, see the Kansas state profile.

Table 3: North American Industry Classification System (NAICS) codes for PFAS manufacturers, with descriptions (U.S. Census Bureau, 2019).
Sub-categories within a code are marked with an asterisk (*).

NAICS Code	Index Entry
Construction	
238320	Electrostatic painting, on site, contractors*
238330	Wood floor finishing (e.g., coating, sanding)*
Manufacturing	
313110	Fiber, yarn, and thread mills
313210	Broadwoven fabric mills
313220	Narrow fabric mills and Schiffli machine embroidery
313320	Waterproofing apparel, fabrics and textile products (e.g., oiling, rubberizing, waxing, varnishing)*
	Plastics coating of textiles and apparel*
314910	Textile bag and canvas mills
315210	Aprons, waterproof (including rubberized fabric, plastics), cut and sew apparel contractors*
315280	Coats, waterproof (e.g., plastics, rubberized fabric, similar materials), rubberizing fabric and manufacturing coats*
315990	Bibs and aprons, waterproof (e.g., plastics, rubber, similar materials), rubberizing fabric and manufacturing bibs and aprons*
316110	Upholstery leather manufacturing*
316210	Footwear manufacturing
	Footwear leather or vinyl upper with rubber or plastic soles, manufacturing*
316998	All other leather good and allied product manufacturing
	Transmission belting, leather, manufacturing*
322110	Pulp mills
322121	Paper (except newsprint) mills
322130	Paperboard mills
	Paperboard coating, laminating, or treating in paperboard mills*
	Leatherboard (i.e., paperboard based) made in paperboard mills*
322212	Folding paperboard box manufacturing
322220	Coating purchased papers for packaging applications*
	Leatherboard (i.e., paperboard based) made from purchased paperboard*
	Waxed paper*
322230	Notebooks (including mechanically bound by wire or plastics) made from purchased paper*
324110	Paraffin waxes made in petroleum refineries*
325199	Plasticizers (i.e., basic synthetic chemicals) manufacturing*

NAICS Code	Index Entry
325510	Water repellant coatings for wood, concrete and masonry manufacturing*
325520	Pipe sealing compounds manufacturing
325611	Soap and other detergent manufacturing
325612	Polish and other sanitation good manufacturing
325613	Surface active agent manufacturing
325620	Toilet preparation manufacturing
325998	Foundry core oil, wash, and wax manufacturing*
326111	Trash bags, plastics film, single wall or multiwall, manufacturing*
326112	Packaging film, plastics, single web or multiweb, manufacturing*
326113	Photographic, micrographic, and x-ray plastics, sheet, and film (except sensitized), manufacturing*
326119	Motor vehicle moldings and extrusions, plastics, manufacturing*
326150	Cushions, carpet and rug, urethane and other foam plastics (except polystyrene), manufacturing*
32619	Other plastics product manufacturing
32629	Other rubber product manufacturing
332215	Nonstick metal cooking utensils*
33281	Coating, engraving, heat treating, and allied activities
332812	Hot dip galvanizing metals and metal products for the trade*
	Coating of metal and metal products with plastics for the trade*
	Powder coating metals and metal products for the trade*
332813	Chrome plating metals and metal products for the trade*
333241	Bakery ovens manufacturing*
333242	Semiconductor making machinery manufacturing*
333318	Cooking equipment (e.g., fryers, microwave ovens, ovens, ranges) commercial- type manufacturing*
33351	Metalworking machine manufacturing
333517	Chemical milling machines, metalworking, manufacturing*
334413	Semiconductor memory chips manufacturing*
334419	Rectifiers, electronic component-type (except semiconductor), manufacturing*
334515	Semiconductor test equipment manufacturing*
335210	Ovens, portable household-type (except microwave and convection ovens), manufacturing*
335220	Microwave ovens (including portable), household-type, manufacturing*
335999	Semiconductor high-voltage power supplies manufacturing*
336412	Aircraft turbines manufacturing*
339114	Dental wax manufacturing*
339920	Sporting and athletic goods manufacturing

NAICS Code	Index Entry
Waste Management and Remediation Services	
561990	Firefighting services as a commercial activity*
562111	Solid waste collection
562112	Hazardous waste collection
562119	Other waste collection
562211	Hazardous waste treatment and disposal
562212	Solid waste landfill
562213	Solid waste combustors and incinerators
562219	Other nonhazardous waste treatment and disposal
562991	Septic tank and related services
Educational Services	
611519	Fire fighter training schools*
Public Administration	
922160	Fire protection

Additional Resources

For more information, please visit the following websites and resources:

- ITRC – PFAS Use and AFFF fact sheets
- Organization for Economic Co-operation and Development (OECD) – PFAS Portal
- States that have used industrial codes to identify possible sources (see state profiles in Section III: Arizona, Kansas, Pennsylvania, Utah)

Section III - State Profiles

In July 2019, ASDWA sent a PFAS - Source Water Protection Project Survey to the drinking water administrators in all 50 states, the District of Columbia, Puerto Rico, and the rest of the U.S. territories. The survey focused on individual drinking water programs regarding PFAS, specifically:

- State legislation on PFAS;
- Methodology for identifying PFAS contamination sources, source waters, and PWSs;
- Laboratory certification criteria;
- Planned responses to detections of PFAS;
- Partnerships with other states or state agencies;
- Case studies; and
- Guidance materials.

States provided information on how they are assessing vulnerabilities and taking additional actions to address PFAS. Their responses have been compiled to create an overview of each state's current actions on PFAS. Since PFAS is a developing concern, plans for addressing PFAS are constantly changing; therefore, these profiles show only a snapshot of each state's actions, last reviewed January 2020. For additional information, please contact the state drinking water program.

Alabama

Alabama's Primary Reponses to PFAS include:

- Sampling regions with known PFAS contamination and
- Screening sources not sampled during the Third Unregulated Contaminate Monitoring Rule (UCMR3).

Sampling regions with known PFAS contamination

Alabama Department of Environmental Management (ADEM) used information from the UCMR3 to identify seven PWSs with PFAS contamination above the U.S. EPA lifetime health advisory level. The affected systems utilized source water from the Tennessee or Coosa River Basins. These regions had PFAS contamination from industrial/municipal biosolids and/or surface discharges. All of the PWSs with PFAS contamination notified their customers and have either completed or started to blend, treat, or provide an alternative water supply to customers. A detailed summary of each of the seven PWSs' responses to PFAS contamination is available online (see in the Additional Documents table).

Screening sources not sampled during the Third Unregulated Contaminate Monitoring Rule (UCMR3)

ADEM is requiring PFAS screening at water systems that were not required to sample during UCMR3 in 2020. If PFAS is found over the U.S. EPA's heath-based advisory level, ADEM will notify the PWS and the state health department. The state health department can issue a health advisory if necessary. ADEM will work with the water system to address contamination by either treating water or using an alternative source.

Additional Documents:

Category	Document	Description
State Website	Summary of PFAS - General	This document provides an overview of all known PFAS contamination across Alabama as well as ADEM's actions to reduce further contamination.
State Website	Summary of PFAS - Drinking Water	This document provides an overview of PFAS contamination in Alabama's PWSs. Data from the UCMR3 on the seven PWSs that had PFAS over the heath advisory level are here.
Case Study	Decatur Water Utilities	U.S. EPA worked with Decatur Water Utilities to assess PFAS contamination from industrial biosolids discharged into the Tennessee River. Currently, none of the soil or public drinking water samples contain PFAS above EPA's health advisory level.
Government Action	Fish Consumption Advisory	ADEM partnered with Alabama Department of Public Health (ADPH) to collect fish tissue samples in the Wheeler and Wilson reservoirs to understand the risk to citizens if fish are consumed. The resulting fish consumption advisories can be found here.

Contact Information:

Aubrey White Drinking Water Branch Chief: ADEM	ahw@adem.alabama.gov

Alaska

Alaska's Primary Reponses to PFAS include:

- Establishing an action level for PFAS;
- Focusing on known sources of PFAS for cleanup; and
- Partnering with other agencies.

Establishing an action level for PFAS

Alaska Department of Environmental Conservation (ADEC) established an action level of 70 ppt for the sum of five PFAS chemicals: PFOA, PFOS, PFNA, PFHxS, and PFPHpA. Additionally, an action level of 2,000 ppt was set for PFBS, a short-chain PFAS.

If there is a known release of PFAS above or at the action level, the responsible party is required to develop a work plan to address the required cleanup. In the plan, they must characterize the extent of the contamination (i.e., conduct surface, ground, and drinking water sampling), identify impacted wells, and sample public and private drinking water. If levels are over the action level, they must also provide an alternative source of drinking water (e.g., switching sources or providing bottled water), ensure all pumped well water is below the action level, and disconnect or decommission wells that are above the action level.

Focusing on known sources of PFAS for cleanup

ADEC developed and makes available online a map of all known sources of PFAS contamination (see in the Additional Documents table below). The main sources of PFAS contamination in Alaska are from firefighting foams that contain PFAS (e.g., AFFF) used at airports and military training facilities. ADEC is addressing clean up at PWSs near these facilities.

Partnering with other agencies

ADEC has partnered with state and national agencies such as ATSDR, Alaska Department of Health and Social Services (ADHSS), Department of Transportation (DOT), and Department of Defense (DOD). In addition, they have partnered with other state environmental agencies and local governments.

Additional Documents:

Category	Document	Description
State Website	ADEC PFAS Guidance	ADEC's PFAS homepage provides a quick overview about Alaska's use of PFAS. PFAS contamination is mainly from use of firefighting foams at airports and military training facilities.
Government Action	Technical Memorandum	In October 2019, ADEC updated the Technical Memorandum: Action Levels for PFAS in Water and Guidance on Sampling Groundwater and Drinking Water. This established an action level and guidance on how to respond to PFAS contamination.
Map	PFAS GIS Map	ADEC developed a map of known PFAS contamination sites from the Contaminated Sites Database. This map helps inform where to focus clean up and identify nearby PWSs.

Category	Document	Description
Case Study	Eielson Air Force Base	Firefighting foams were used at the Eielson Air Force Base and lead to contamination of groundwater and surface water in Polaris Lake and the Garrison Slough. In 2015, drinking water tested higher than the EPA heath advisory level. In 2019, fishing was restricted due to the contaminated surface water. Efforts for cleanup are still ongoing.

Contact Information:

Cindy Christian Program Manager: ADEC Drinking Water Program	cindy.christian@alaska.gov 907-451-2138
John Halverson Environmental Program Manager: ADEC Contaminated Sites Program	john.halverson@alaska.gov 907-269-7545
Sarah Yoder Public Health Specialists: DHSS Division of Public Health	sarah.yoder@alaska.gov 907-269-8054

Arizona

Arizona's Primary Reponses to PFAS include:

- Creating a list of potential PFAS contamination sources and source waters;
- Developing a plan for testing for PFAS; and
- Developing a criterion for laboratory certification.

Creating a list of potential PFAS contamination sources and source waters

In 2016, based on results from their UCMR3, Arizona Department of Environmental Quality (ADEQ) received a grant from U.S. EPA to test PWSs that may be contaminated.

First ADEQ developed GIS maps, showing facilities that currently or historically used PFAS. They identified potential sources of PFAS contamination using SIC data paired with extensive research. They then used hydrogeological data to identify PWSs' drinking water wells within a 2-mile radius of potential sources of contamination. These facilities were selected based on information on (i) groundwater velocities and flow of direction, (ii) well construction data to understand subsurface lithology, (iii) flow direction analysis to locate wells located up gradient, and (iv) cross gradient and down gradient of groundwater flow directions. ADEQ identified 162 PWS drinking water wells and through this process determined that 100 wells at 68 PWSs met the selection criteria for testing.

Developing a plan for testing for PFAS

ADEQ conducted the testing of groundwater wells based on U.S. EPA analytical method 537. Detailed results for this testing are available in the PWS Screening Report (see in the Additional Documents table below). Eighty-nine wells did not detect PFOS or PFOA, fourteen tested below the U.S. EPA lifetime health advisory level, and six tested above the advisory level.

When PFAS was found in levels higher than U.S. EPA's health advisory level, ADEQ would notify the owner of the PWS. ADEQ would recommend the PWS to notify the public and limit exposure (e.g. providing bottled water, switching to an alternative source water, blending water sources, treating contaminated water).

In 2020, ADEQ will conduct a second round of PFAS testing. The fourteen wells that had a detection below the health advisory and the six well above the advisory will be tested again to determine if the PFAS levels are increasing. The sampling will extend to other potable wells near these initial detections.

Developing a criterion for laboratory certification

The Arizona Department of Health Services (ADHS) handles all licensing and regulation of drinking water laboratories. As of July 2019, there are no PFAS certified laboratories in Arizona, but many cities are pursuing the license.

Additional Documents:

Category	Document	Description
State Website	Source Water Protection	ADEQ's Source Water Protection program handles PFAS water contamination. This website details their work.

Category	Document	Description
State Report	Public Water System Screening	This report, completed in November 2018, details the results of ADEQ's PFOS and PFOA PWS Screenings.
Case Study	Marana Water	In 2016 Marana Water started voluntarily testing water for PFAS. They keep a publicly available database online where customers can enter their address to see test results if their water has been tested.
Case Study	Tucson Water	In 2009 Tucson Water found PFAS in certain wells, mainly near the airport, well fields, and areas that use reclaimed water. They have not provided water to customers that was over the EPA health advisory and have been transparent about their findings.

Contact Information:

Karen Shanafelt Drinking Water Unit Manager: ADEQ	shanafelt.karen@azdeq.gov

California

California's Primary Reponses to PFAS include:

- Requiring PFAS testing for select water systems;
- Requiring notification of PFAS contamination; and
- Partnering with other agencies.

Requiring PFAS testing for select water systems

California State Water Resources Control Board (SWRCB) ordered specific PWSs within areas that are vulnerable to PFAS contamination to test quarterly for a year. Phase I required PFAS testing at all PWSs that were within:

- One mile of a landfill that accepted materials containing PFAS;
- Two miles of an airport that used firefighting foams containing PFAS (e.g., AFFF); or
- One mile of a site that previously detected PFAS during the Federal EPA UCMR3 effort.

The results from these tests are available online in GIS maps (see in the Additional Documents table below). Future testing will include PWSs near chrome plating and manufacturing facilities and wastewater discharge areas. Water systems that aren't within these areas are not required to test their drinking water for PFAS, yet many systems voluntarily do so and share their results with customers.

Requiring notification of PFAS contamination

If PWSs test for PFAS, SWRCB requires them to notify the local governing body (e.g., city council) and the SWRCB if PFAS is detected in drinking water at or above the notification level (NL). The NL is set at the lowest level at which PFAS can reliably be detected, which is 5.1 ppt for PFOA and 6.5 ppt for PFOS.

If PFAS is detected above the response level (RL), which is 70 ppt combined for PFOA and PFOS, the PWS is advised to switch source waters or treat water to remove PFAS. Public notification at this level is encouraged.

Partnering with other agencies

SWRCB partners with a variety of agencies to ensure a complete assessment of PFAS contamination in California. This includes both the California Air Resources Board (CARB) to address air contamination and the Department of Toxic Substances Control (DTSC) to address contamination in consumer products such as carpets. They also partner with agencies that manage landfills, airport discharges, and wastewater discharges.

Additional Documents:

Category	Document	Description
State Website	PFAS Guidance	SWRCB's PFOS and PFOA website provides updates to citizens on current efforts to address contamination. The website provides guidance on health effects, regulations, drinking water contamination, non-drinking water contamination, and treatment options.

Category	Document	Description
Map	PFAS Maps	Results from PWSs' PFAS tests can be found on this website. To access a summary of these results, choose Drinking Water, then PWS Testing Results. An interactive map is also available online.
Government Action	CARB Regulation on PFOS	Chrome plating facilities can lead to PFAS air contamination due to the fume suppressants used. CARB is regulating the use of PFOS fume suppressants.
Government Action	DTSC Proposed Priority Product	DTSC proposed designating carpets and rugs with PFAS as Priority Products under the Safe Consumers Product Regulations (SCPR). This will ensure products are safe for consumers.
State Regulation	AB-756 PWSs: PFAS	CA Assembly Bill No. 756 gives the CA Division of Drinking Water the authority to require additional monitoring of drinking water sources for PFAS.

Contact Information:

Dan Newton Assistant Deputy Director: CA Division of Drinking Water	daniel.newton@waterboards.ca.gov
SWRCB PFAS Contact	PFAS@waterboards.ca.gov

Colorado

Colorado's Primary Reponses to PFAS include:

- Evaluating contamination at the local level;
- Regulating PFAS contamination; and
- Creating a PFAS policy work group.

Evaluating contamination at the local level

Colorado Department of Public Health and Environment (CDPHE) is evaluating potential PFAS contamination at the local level. They are asking water utilities to use local knowledge to understand if PFAS testing is necessary. If PFAS is found, the water utility and local health department will be notified. Additional samples will be taken, and they will locate potentially contaminated wells or intake sites. From there they will inform the community of the contamination. If necessary, additional sampling and treatment techniques will be encouraged.

Regulating PFAS contamination

HB 19-1279 banned training with Class B fluorine containing firefighting foams in Colorado. This will help reduce future PFAS contamination in drinking water and firefighters' exposure to PFAS.

Also, due to high levels of PFAS found in El Paso County's drinking water and source water, the government passed regulation 42. This states that PFOA and PFOS cannot exceed the U.S. EPA lifetime health advisory level, 70 ppt, in El Paso County.

Creating a policy work group

CDPHE has created a work group of stakeholders to participate in the PFAS Narrative Policy Work Group and provide input on Colorado PFAS policy. Any stakeholders can join this workgroup or email list to get updated information on pending PFAS policy.

Additional Documents:

Category	Document	Description
State Website	PFAS Guidance	This guidance website provides lots of helpful information on many different topics regarding PFAS. It details all the various sources of PFAS contamination and provides in-depth details on each.
Case Study	El Paso County	PFAS was found in El Paso County in the Security, Widefield, and Fountain areas. This website provides guidance to customers in the contaminated area on the quality of their drinking and source water.
Government Action	Regulation 42	In May 2018, Regulation 42 was enacted, which set ground water quality standards for the El Paso County region (see case study linked above for details). The sum of PFOA and PFOS cannot exceed 0.070 mg/L (70 ppt).

Category	Document	Description
Government Action	Colorado House Bill 19-1279	The Colorado House Bill 19-1279, "Protect Public Health Firefighter Safety Regulation PFAS Polyfluoroalkyl Substances", banned training with Class B firefighting foams that contain PFAS. This reduces firefighters' exposure to PFAS.
Government Action	PFAS Narrative Policy Work Group	The PFAS Narrative Policy Work Group provides information to stakeholders regarding PFAS legislation. Anyone interested can join their email list to receive updates.

Contact Information:

John Duggan Source Water Assessment and Protection (SWAP) Workgroup Leader: CDPHE	john.duggan@state.co.us

Idaho

Idaho's Primary Reponses to PFAS include:

- Preparing to handle detection of PFAS;
- Developing a comprehensive assessment of PFAS at the municipal level; and
- Creating a public guidance on PFAS.

Preparing to handle detection of PFAS

If the Idaho Department of Environmental Quality (DEQ) is notified of PFAS testing results in drinking water which exceed U.S. EPA lifetime health advisory level of 70 ppt, the regional office and owner/operator of the PWS will coordinate a plan to address the contamination. If levels are very high, the system may be required to notify the public, conduct follow up tests, and treat to remove PFAS. However, this depends on the level of PFAS that is found and will be dealt with on a case-by-case basis.

Developing a comprehensive assessment of PFAS at the municipal level

The city of Boise, ID is conducting an audit on all city processes to identify and reduce any PFAS use. They have already discovered that the Boise Airport uses firefighting foam that contains PFAS. Boise is also evaluating levels of PFAS throughout the city's wastewater treatment system. They are coordinating with the EPA to test groundwater, irrigation water, biosolids, soils, influent, and effluent at wastewater treatment facilities to support development of a nationwide analytical method. Currently, the city is working to establish a long-term PFAS action plan and engaging with their drinking water provider to assess PFAS testing results.

Creating a public guidance on PFAS

Idaho DEQ created a website to provide guidance to citizens on unregulated contaminants such as PFOS and PFOA. This includes useful information to help citizens understand the health advisory. It also lays out monitoring systems, removal, and testing processes. Lastly, it details human health effects and guidance on what contaminated water can and cannot be safely used for.

Additional Documents:

Category	Document	Description
State Website	Drinking Water Health Advisories	Idaho DEQ provides guidance on drinking water health advisories for contaminants of interest such as PFOA and PFOS.
Case Study	City of Boise PFAS Information	Boise is conducting a citywide audit to identify PFAS sources, as well as testing for PFAS at wastewater treatment facilities and in their drinking water distribution system.

Contact Information:

Tyler Fortunati, REHS Drinking Water Bureau Chief: Idaho DEQ	Tyler.Fortunati@deq.idaho.gov

Kansas

Kansas's Primary Reponses to PFAS include:

- Developing a list of potential sources of PFAS contamination;
- Prioritizing sites to test for contamination; and
- Partnering with other agencies and organizations.

Developing a list of potential sources of PFAS contamination

Kansas Department of Health and Environment (KDHE), Bureau of Environmental Remediation, and Bureau of Water are conducting a joint investigation into PFAS contamination. They have created a statewide inventory which is available online (see in the Additional Documents table below). The state inventory was developed using NAICS and SIC codes and over 9,000 potential PFAS sources have been identified.

Prioritizing sites to test for contamination

With 9,000 potential sources of PFAS contamination identified, KDHE is working to prioritize sites and create a monitoring and testing plan. From this plan they will develop an approach to address clean-up of source contamination and drinking water with PFAS contamination.

Partnering with other agencies and organizations

KDHE has partnered with many other state and federal agencies as well as NGOs as they develop their PFAS monitoring plan. These organizations include U.S. EPA, DOD, Kansas Rural Water Association (KRWA), ATSDR, and various county health departments.

Additional Documents:

Category	Document	Description
State Website	PFAS Guidance	PFAS guidance information can be found on KDHE's website. The website contains helpful links to additional information about PFAS on U.S. EPA's website.
Government Report	Statewide Inventory Report	The inventory report from the KDHE's investigation is available online here. The investigation identified over 9,000 facilities that have produced, used, or stored PFAS. This will be the base for their prioritization plan. The report also includes information on the SIC and NAICS codes used to identify potential sources.

Contact Information:

Cathy Tucker-Vogel Section Chief of Public Water Supply Section: KDHE	cathy.tucker-vogel@ks.gov

Kentucky

Kentucky's Primary Reponses to PFAS include:

- Conducting statewide sampling of finished drinking water;
- Limiting the use of AFFF; and
- Developing a strategy for identifying exposure pathways.

Conducting statewide sampling of finished drinking water

The Kentucky Department for Environmental Protection (KY DEP) Division of Water conducted a sampling study of PWSs in 2019. They collected samples from 81 community public drinking water treatment plants, representing 74 public drinking water systems. Sampling sites were chosen to represent surface water and groundwater sources, a breadth of influence by urban and rural land-use, and varying sizes of populations served. Samples were analyzed for PFBS, PFHpA, PFHxS, PFNA, PFOS, PFOA, ADONA, and HFPO-DA. They did not identify any that were at or above the U.S. EPA lifetime health advisory for PFAS and PFOA.

Limiting the use of AFFF

In 2019, the Kentucky state legislature passed KRS 227.395, which prohibits the use of any Class B firefighting foam that contains PFAS chemicals for training or testing purposes. AFFF is still allowed to be manufactured and used in emergency firefighting operations.

Developing a strategy for identifying exposure pathways

The Kentucky Energy and Environment Cabinet is in the final phases of developing a strategy to identify and monitor potential exposures and exposure pathways. The approach taken will be a phased look at points of exposure and exposure pathways, as well as any sources that may contribute to them. It will address PFAS in specific industry sectors. More information may be available at a later date from the state contacts listed below.

Additional Documents:

Category	Document	Description
Government Report	Evaluation of Kentucky Community Drinking Water for PFAS	Kentucky conducted a sampling study to identify PFAS in PWSs. Finished water was collected from 81 PWSs across the state to understand the extent of contamination. This report explains the methodology for choosing sites to test, testing procedures, and remediation actions. PFAS was found in some samples but all tested sites were under the U.S. EPA health advisory level of 70 ppt.
State Regulation	KRS 227.395 Class B firefighting foam	KRS 227.395, passed by the Kentucky state legislature in 2019, prohibits the use of AFFF that contains PFAS for training or testing purposes.
Government Action	Press Release: Statewide Testing of PFAS	This is a sample press release issued by KY DEP about their PFAS sampling report. It summarizes the results of their statewide sampling for the public.

Contact Information:

Alicia Jacobs Drinking Water Branch Manager: Kentucky Division of Water	Alicia.Jacobs@ky.gov 502-782-6987
Carey Johnson Assistant Director: Kentucky Division of Water	Carey.Johnson@ky.gov 502-782-6990

Maine

Maine's Primary Reponses to PFAS include:

- Developing a list of priority sites and testing for potential PFAS contamination;
- Developing a plan for if PFAS contamination is found; and
- Partnering with other agencies and states.

Developing a list of priority sites and testing for potential PFAS contamination

The Maine Center for Disease Control (MCDC) has used Maine Department of Environmental Protection's (MDEP) Environmental and Groundwater Analysis Database (EGAD) to develop a list of potential sources and contaminated source waters from PFAS. They located water systems near potential sources and in 2017, tested seventeen water systems. In 2019, they tested another nineteen water systems. Preliminary results range from not detectable to 70.6 ppt; all PFAS test results are available online (see in the Additional Documents table below).

Developing a plan for if PFAS contamination is found

MCDC's action level is based on U.S. EPA's heath-based advisory of 70 ppt for PFOS and PFOA. If PFOS or PFOA contamination is found, MCDC will recommend a confirmatory sampling round. If concentrations of 70 ppt or greater combined PFOS and PFOA are confirmed, MCDC may recommend treatment or switching to another source water. MCDC will also provide technical and financial assistance if needed through the Drinking Water State Revolving Fund (DWSRF).

Partnering with other agencies and states

Maine's Governor created a Task Force to address PFAS contamination. This task force has reviewed available data on known sources and impacts from PFAS, reviewed an inventory of AFFF, identified gaps in knowledge and educational opportunities, and examined disposal and treatment options. The Task Force prepared a summary report to the Governor outlining how the state can manage PFAS impacts.

MCDC partners with MDEP for much of its work on PFAS within the state. They also share information with ASDWA. Lastly, MCDC works with other states and drinking water administrators within EPA Region 1 to identify and address PFAS in the region.

Additional Documents:

Category	Document	Description
State Website	PFAS Guidance	This website holds information on MDEP's actions on PFAS. The website includes helpful links to their GIS map, wastewater cleanup plans, and laboratory recommendation.
Sampling Results	PFAS Data	All PFAS test results from MDEP are available at this link. This data was extracted from the Environmental Geographic Analysis Database.
Map	PFAS Mapper	MDEP created a GIS PFAS map used to locate sources of contamination. MCDC used this map to create a list of potential contamination sources and contaminated source waters.

Category	Document	Description
Government Action	Governor's Task Force on PFAS	Executive Order 5 FY 19/20 created the "Governor's Task Force on the Threats of PFAS Contamination to Public Health and the Environment." Links to the executive order, draft report, and recordings of the task force's meetings can be found here.
Case Study	Former Naval Air Station Brunswick	Due to potential PFAS contamination in groundwater around the former Naval Air Station (NAS) Brunswick, the Navy has requested to test water quality in the surrounding regions. Firefighting foams that contain PFAS were used on the NAS. PFAS was previously found in the Eastern Plume area, therefore, additional testing is being requested.

Contact Information:

Michael Abbott Program Director: MCDC Drinking Water Program	michael.abbott@maine.gov
MDEP PFAS Contact	pfas.dep@maine.gov
Governor's Task Force Contact	PFASTaskforce@maine.gov

Maryland

Maryland's Primary Reponses to PFAS include:

- Developing a GIS map of potential sources of contamination;
- Establishing a state-wide sampling plan; and
- Communicating information on PFAS in Maryland to the public.

Developing a GIS map of potential sources of contamination

Maryland Department of Environment (MDE) is in the process of developing a GIS map of all potential sources of PFAS contamination in Maryland. It is scheduled to be finalized by March 2020. Once they develop the map and see the extent of contamination, MDE will create a plan to test private wells and PWS source waters. In the interim, MDE has encouraged PWSs to voluntarily test their raw water source and finished drinking water for PFAS. This will help inform MDE of PFAS contamination while the map is being developed. If a PWS finds PFAS in their drinking water, they will be required to notify the public. MDE will work with the system to address the contamination.

Establishing a state-wide sampling plan

As part of their risk-based, scientific approach to detecting, evaluating, and minimizing the impacts of PFAS in Maryland, MDE is in the process of developing a multi-phase, statewide sampling plan. The plan will be used to prioritize and organize sampling efforts across the state by considering the proximity of a water source to potential sources of PFAS and its geological setting. Once the risks of PFAS are better understood, MDE can communicate and manage those risks.

Communicating information on PFAS in Maryland to the public

MDE published its own PFAS webpage in December 2019. The page outlines basic information about PFAS, a memo update sent to PWSs and health departments, sampling results, and information on other agency and state initiatives. MDE is currently working with EPA Region III, other state agencies, and across all branches of MDE (including Air, Water, and Land Administration) to get a complete picture of the potential contamination.

Additional Documents:

Category	Document	Description
Case Study	Nike Sites Initiative	MDE released this document to inform citizens of contamination near a military base. This Nike Sites Initiative worked to identify where PFAS was used and where groundwater may be contaminated.
State Website	PFAS in Maryland	MDE publishes information on PFAS for the public on this webpage. They link to ongoing initiatives in other states, in addition to documenting their work in Maryland.

Contact Information:

Saeid Kasraei Water Supply Administrator: MDE	saeid.kasraei@maryland.gov

Massachusetts

Massachusetts's Primary Reponses to PFAS include:

- Drafting a Maximum Contaminant Level (MCL) for drinking water;
- Conducting and funding ongoing testing for existing PFAS contamination; and
- Cleaning up contaminated sites.

Drafting a Maximum Contaminant Level (MCL) for drinking water

On December 27, 2019, the Massachusetts Department of Environmental Protection (MassDEP) issued proposed revisions to drinking water regulations to establish an MCL. The draft regulations established a drinking water standard of 20 ng/L for the sum of six PFAS (PFOS, PFOA, PFHxS, PFNA, PFHpA, and PFDA).

PWSs in Massachusetts include: 526 community water systems (CWSs), 252 non-transient non-community water systems (NTNCs), and 865 transient non-community water systems (TNCs). This proposed MCL will apply to all PWSs. CWSs and NTNCs will be required to meet all requirements for testing, public notification, ongoing monitoring, and corrective actions. TNCs will be required to collect one sample and submit the test results to MassDEP. If this sample merits additional follow up, required actions would be determined on a system-by-system basis.

Conducting and funding ongoing testing for existing PFAS contamination

During UCMR 3, 158 large PWSs and 13 small PWSs were tested for PFAS. Nine of the PWSs' source water tested above the U.S. EPA lifetime health advisory level. Potential sources of PFAS were airfields where firefighting foams were used, fire-fighting training areas, and one PFAS manufacturer. Groundwater testing is ongoing. PWSs where PFAS was found were dealt with on a case-by-case basis; MassDEP either recommended treatment, blending, or switching source water based on each utility's circumstances.

In 2020, state funding will be available for all PWSs to test their finished water for PFAS. MassDEP is currently contracting with laboratories to do the analysis of the samples. Limited sampling of private wells will also be done to assess statewide occurrence of PFAS in groundwater. Additionally, a limited number of grants will be available in 2020 for PWSs to design treatment systems to remove PFAS from their water. The Drinking Water State Revolving Loan Fund (DWSRF) will be offering zero percent interest loans to PWSs for the construction of treatment facilities.

Cleaning up contaminated sites

The MassDEP Bureau of Waste Site Cleanup has been actively involved in investigating sources of PFAS contamination and identifying potentially responsible parties. The Massachusetts Contingency Plan (MCP) regulations were amended to require cleanup of contaminated sites found during testing. MassDEP is working to reduce future exposure to PFAS contamination with this cleanup effort.

Additional Documents:

Category	Link	Description
State Website	PFAS in Massachusetts	General information, fact sheets, guidance on sampling, approved laboratories, PWSs PFAS sources, testing results, and bottled water tested for PFAS are all found at this website.
Government Action	Draft MCL regulations	Here is more detailed information regarding the proposed revisions to the drinking water regulations to establish an MCL of 20 ng/L for the sum of six specific PFAS.
Government Action	AFFF Take-Back Program	MassDEP launched a legacy AFFF firefighting foam collection and destruction program in 2018. MassDEP coordinated with the MA Department of Fire Services (DFS) to contact fire departments, organize the collection, and disposal of stockpiled foams. They worked with a hazardous waste cleanup contractor to inspect the integrity of AFFF containers and safely transport them to a fuel incineration facility. The program continues to be highly successful.
Government Action	MA Contingency Plan (MCP): PFAS Revisions	MassDEP revised the state's MCP to include PFAS. The regulations specify PFAS cleanup standards and notification criteria for soil and groundwater as well as toxicity values for use in site-specific risk assessments.

Contact Information:

Drinking Water Program	Program.Director-DWP@mass.gov 617-292-5770

Michigan

Michigan's Primary Reponses to PFAS include:

- Creating the Governor's PFAS Action Response Team;
- Creating the MPART website; and
- Developing PFAS drinking water standards.

Creating the Governor's PFAS Action Response Team

In 2017, the Michigan PFAS Action Response Team (MPART) was created through the Governor's executive directive, to investigate and identify sources of PFAS in Michigan and to protect our drinking water and public health.

In February 2019, Governor Gretchen Whitmer signed Executive Order 2019-3, officially classifying MPART as an enduring body. This assured that MPART would continue this mission, work to protect Michigan's environmental resources, increase transparency, and establish clear standards to ensure accountability.

MPART is made up of personnel from seven member agencies within Michigan's state government including Department of Environment, Great Lakes, and Energy (EGLE), Department of Health and Human Services (MDHHS), Department of Natural Resources (DNR), Department of Agriculture and Rural Development (MDARD), Department of Transportation (MDOT), Department of Military and Veteran Affairs (DMVA), and Department of Licensing and Regulatory Affairs (LARA).

MPART provides recommendations to the directors of each member agency, and coordinates efforts between these departments. MPART also provides regular reports to the governor on ongoing PFAS-related efforts.

Creating the MPART website

The MPART website was created to serve as a central resource: a place to share up-to-date details and results from the many ongoing efforts across the MPART work groups, member agency teams, and geographical regions of our state.

The website also serves as a point of reference for MPART's official events and communication, including meeting agendas and minutes, press releases, presentations, official reports, educational materials, event announcements, and public meeting notices.

This interagency effort has generated a significant amount of testing and investigatory data. The MPART website is home to many tools designed to make these materials available to the public, specific to each initiative.

Statewide Public Water Supply Testing: Beginning in April 2018, EGLE's statewide public drinking water survey tested for PFAS in public drinking water supplies that serve approximately 75 percent of Michigan's residents. Over 2,500 supplies have been tested and this voluntary sampling initiative continues. Testing results for all public water sampling initiatives are shared through the Drinking Water section of the MPART website.

Site Investigations: In 2018, EGLE Remediation and Redevelopment Division (RRD) established 70 ppt for PFOS and PFOA as the cleanup criteria for groundwater used as drinking water. Using this threshold as a guide, and considering additional factors, sites across Michigan are identified and classified by MPART for investigation. These efforts have proven invaluable in the identification of potential sources for PFAS in Michigan's source waters.

Over 70 sites have been identified and their locations can be found on the Michigan PFAS Sites Interactive Map, found on the Investigations section of the MPART website. Also listed are PFAS areas of interest, which are defined as places where an investigation is underway and the EGLE RRD cleanup criteria has not been exceeded.

Watershed Investigations: Several of Michigan's watersheds have been identified as areas of interest related to PFAS. These investigation areas are designated based on numerous factors, including PFAS surveys for surface water and fish, the presence of PFAS foam, and sampling from wastewater screening programs. Currently, six watersheds in Michigan have been designated for investigation. Information on these can be found on the Investigations section of the website.

Studies and Research: Studies and research are underway under the guidance of MPART and its member agencies related to biosolids, landfill leachate, PFAS in soil, PFAS fate and transport, PFAS treatment technologies, and laboratory analytical methods. Details on this work can be found on the website.

Development of PFAS drinking water standards

In March 2019, Governor Gretchen Whitmer announced that Michigan would establish drinking water standards for PFAS to protect human health and the environment. A Science Advisory Work Group was established within MPART to review available data from around the nation to determine health values for PFAS in drinking water.

These numbers served as a starting point for EGLE in their development of draft MCLs for PFAS in drinking water. In November 2019, the formal rulemaking process began with a goal of adopting final MCLs in April 2020. This rule promulgation schedule is consistent with the state's priority toward the public health and commitment to protecting the state's valuable drinking water resources from this group of emerging contaminants.

Additional Documents:

Category	Document	Description
State Website	MPART Website	This website gives an overview of the PFAS Action Response Team's work on PFAS. It has useful information such as public meetings, PFAS sites, watershed investigations, sampling guidance, and videos. This website is useful for citizens, PWS operators, and laboratories to get detailed information on PFAS.
Government Action	EGLE Community Water Supply Rule Promulgation	This website gives a summary of new rules promulgated or proposed for public water supplies under the provisions of the Michigan Safe Drinking Water Act, including the current rules project.

Contact Information:

Eric Oswald Director: Drinking Water and Environmental Health Division, EGLE	oswalde1@michigan.gov 517-284-6524

Minnesota

Minnesota's Primary Reponses to PFAS include:

- Setting health-based values and health risk limits for PFAS;
- Testing for PFAS; and
- Developing a list of potential PFAS sources and contaminated waters.

Setting health-based values and health risk limits for PFAS

The Minnesota Department of Health (MDH) and Minnesota Pollution Control Agency (MPCA) are creating a program to address PFAS contamination. MDH set health-based values (HBVs) and/or health risk limits (HRLs) for PFBS (2,000 ppt), PFBA (7,000 ppt), PFOS (15 ppt), PFOA (35 ppt), and PFHxS (47 ppt). An HBV is the concentration that is likely to pose little to no risk to human health. HRLs are HBVs that are adopted into rule. They both meet the same data requirements.

Testing for PFAS

MDH and MPCA address and test for PFAS contamination from production and manufacturing facilities, waste disposal and WWTPs, and firefighting foams (e.g., AFFF).

AFFF Usage Sites: In 2008, MPCA surveyed fire departments, airports, refineries, and other potential AFFF users. The MPCA, in consultation with MDH, identified facilities that used AFFF repeatedly and were located nearby PWS wells that may be at risk for contamination based on proximity and hydrologic conditions (i.e., gradient, depth, and soil types).

In 2009, MDH tested 17 community and 16 noncommunity public wells near AFFF sites. Seven tested below the health-based guidance and no PFAS were detected in the other wells. To follow up on these tests, ending in 2011, MPCA tested soil, surface water, groundwater, and sediment near 13 AFFF sites. These sites were prioritized by their potential to release PFAS to the environment, which was determined by type of foam used, frequency of training, environmental setting, and presence of nearby PWSs sources. Most tested low but some had high levels of PFAS; however, these sites weren't near PWSs and didn't pose a large risk. Detailed results from all of these tests are available online (see in the Additional Documents table below).

Nearby PWSs: When PFAS is found in PWSs, they continue sampling to get an annual average. If this annual average is higher than the health-based levels, MDH sends a letter to the owner with recommendations of how to reduce PFAS. However, this is not an enforcement letter, it is up to the owner to notify customers. MDH continues testing if the levels are close to the health-based values and if the concentrations are lower, they test less frequently.

Nearby Private Wells: The Twin Cities eastern metropolitan (East Metro) area had PFAS in their drinking water at levels higher than the general U.S. population; this is largely due to contamination from historic industrial waste disposal activities. Citizens within the East Metro area can request that MDH sample their private drinking water wells. A map is available online for citizens to see if they are in this contaminated area. More details on the map and East Metro sites are available online (see in the Additional Documents table below).

Developing a list of potential PFAS sources and contaminated waters

MPCA is working to develop a list of additional potential sources of PFAS contamination. MPCA is using numerous data sources to develop this comprehensive list, including:

- U.S. EPA PFAS Usage List;
- State Program Evaluations (New Hampshire and Vermont);
- USA Business database;
- NAICS database;
- Mergent Intellect NAICS database (to cross-reference information); and
- Made in Minnesota database.

MPCA will develop a sampling plan in 2020. A communications plan will be finalized by MPCA and MDH prior to sampling activities.

Additional Documents:

Category	Document	Description
State Website	PFAS Website	This website is the homepage for the PFAS program at MDH. It provides quick guidance on PFAS for citizens.
Fact Sheet	PFAS Guidance	MDH created a guidance document for citizens to understand the impact of PFAS on their water, health, and environment. It also explains the various health-based guidance values.
Map	PFAS Map	If citizens are within the East Metro sampling area where PFAS contamination has been found, they can request sampling of their private well. Citizens can see if they are within this area on this map.
Drinking Water Standards	Water Levels Guidance	This human health-based water guidance table explains the levels of PFAS in groundwater.
Sampling Results	AFFF Drinking Water Testing Results	In 2009, MDH tested PWSs that could potentially be contaminated by PFAS in the drinking water. All sites tested below the health-based exposure limits.
Sampling Results	AFFF Multiple Media Testing Results	Ending in 2011, MPCA tested multiple medias near 13 AFFF sites that were previously identified in 2009. Details on prioritization, testing, and follow up for all sites are included.
Laboratory Certification Programs	Laboratory Certification Standards	Laboratories must follow this criterion to be certified to test for PFAS. This guidance follows the MN Environmental Laboratory Accreditation Program (ELAP).
Case Study	East Metro Sites	Cottage Grove, Woodbury, Lake Elmo, Oakdale, and Washington County Landfill are all within the East Metro Sites that have found PFAS contamination due to industry contamination. Biomonitoring has been completed in 2008, 2010, and 2014 to watch PFAS levels in effected individuals.
Case Study	City of Cottage Grove ("3M Cottage Grove Facility" drop down menu)	In 2017, Cottage Grove had PFOS and PFOA levels higher than the MDH guidance levels for eight of their 11 wells. They installed granular activated carbon (GAC) treatments in two of the contaminated wells to ensure the city could provide enough safe water to all citizens.

Category	Document	Description
Case Study	City of Oakdale ("Oakdale Disposal Site" drop down menu)	Since 2006, Oakdale has been treating two wells that had high levels of PFAS due to industrial waste from a 3M disposal site. In 2010, 3M built another well that was outside of the area contaminated by PFAS. 3M also funded inputting GAC filters in effected wells.

Contact Information:

Lucas Martin Principal Engineer: MDH	lucas.martin@state.mn.us
Andri Dahlmeier Site Remediation: MPCA	andri.dahlmeier@state.mn.us

Missouri

Missouri's Primary Reponses to PFAS include:

- Testing at select PWSs;
- Creating a plan for if PFAS contamination is self-reported by a PWS; and
- Addressing known PFAS contamination.

Testing at select PWSs

As part of UCMR3, the Missouri Department of Natural Resources (MDNR) contracted testing for PWSs greater than 10,000 in population. These systems greater than 10,000 in population, along with a subset of smaller PWSs selected and funded by EPA, analyzed for PFOA and PFOS under UCMR3. MDNR identified no detections for these compounds during this sampling event. Following this effort, in 2016 and 2017, MDNR contracted with the Missouri University of Science and Technology (S&T) to perform targeted sampling of water systems near potential PFAS sources. Missouri S&T tested raw and finished drinking water from 15 systems during this study. Most of the samples collected were non-detect at <0.2 ppt for PFOA and PFOS. No single result was greater than 2 ppt. Detailed occurrence data from UCMR3 is available online at: https://www.epa.gov/dwucmr. Additional resources may be available from the state contact (see below). The MDNR Environmental Remediation Program is also coordinating with EPA on a potential project to develop an inventory of possible sources of PFAS contamination in Missouri for testing in the future.

Creating a plan for if PFAS contamination is self-reported by a PWS

MDNR is waiting for U.S. EPA to develop an MCL before requiring additional testing of PFAS, but they have developed a plan for addressing self-reported contamination from PWSs. If a system self-reports PFAS in drinking water higher than the U.S. EPA lifetime health advisory level (70 ppt), MDNR will first request additional samples to confirm the results. MDNR will also coordinate this issue with the Missouri Department of Health and Senior Services (MDHSS). Next, MDNR will work with the PWS to ensure the system notifies the public about the contamination. Lastly, MDNR will work with the PWS to provide an alternative drinking water source below the health advisory level or to institute other actions to mitigate the situation.

Addressing known PFAS contamination

Missouri is providing review of cleanups when impacted sites report PFAS detections. For example, the Department's Brownfield Voluntary Cleanup Program is providing oversight to the remediation of a release that resulted in the impact of a noncommunity water system's groundwater supply. The impacted water system shut down the contaminated well and switched to a nearby PWS. The cleanup of the contamination at the site is ongoing.

Additional Documents:

Category	Document	Description
State Website	Public Drinking Water Branch	This website is MDNR's homepage for the Public Drinking Water Branch.

Contact Information:

David Lamb Public Drinking Water Branch Chief: MDNR	david.lamb@dnr.mo.gov
Eric Medlock Chemical Monitoring Coordinator Public Drinking Water Branch: MDNR	eric.medlock@dnr.mo.gov 573-522-5028

Montana

Montana's primary responses to PFAS include:

- Setting water quality standards;
- Working to develop a potential PFAS site list; and
- Investigating known contamination sites.

Setting Water Quality Standards

The Montana Department of Environmental Quality (DEQ) set numeric water quality standards for PFOS and PFOA in groundwater. The sum of the concentrations of the two chemicals is not to exceed 70 ppt. Additionally, the state's environmental requirements, criteria, and limitations provide that concentrations of PFAS compounds other than PFOS or PFOA must not exceed levels that render the waters harmful, detrimental, or injurious to beneficial uses.

Developing a PFAS Site List

The Montana DEQ has developed a PFAS working group and is coordinating with other state agencies and local governments to develop a potential PFAS site list. This list will include locations where PFAS may have been stored, used, disposed of, or otherwise released to the environment. The DEQ is also exploring possible funding sources to expand their sampling near identified or potential PFAS sites.

Investigating Known Contamination Sites

Montana DEQ conducted sampling for PFAS at PWSs under UCMR3. They found that none of the chemicals tested above the method reporting limit. PFAS has been detected at levels above the groundwater criteria at four military sites in the state. Two of these sites also had PFAS above screening levels in soil and surface water. Further investigation of these sites is ongoing.

Additional Documents:

Category	Document	Description
Drinking Water Standards	Circular DEQ-7 Montana Numeric Water Quality Standards	This department circular sets the criteria for both PFOS and PFOA at 70 ppt. Additionally, the sum of the concentrations of the two compounds (PFOS + PFOA) must not exceed 70 ppt.
Case Study	PFAS Sites of Concern	This webpage contains site summaries and full site inspection reports of four military installations with PFAS levels elevated above the groundwater criteria.
State Website	Montana DEQ PFAS Program Website	This website summarizes Montana DEQ's work on PFAS. It is useful for citizens to get reliable information on PFAS in MT.

Contact Information:

Terri Mavencamp Cleanup, Protection, and Redevelopment Section Supervisor: MT DEQ	tmavencamp2@mt.gov 406-444-5595
Eric Sivers Source Water Protection Section Supervisor: MT DEQ	esivers@mt.gov 406-444-0471

New Hampshire

New Hampshire's primary responses to PFAS include:

- Adopting MCLs for PFAS;
- Identifying possible sources of contamination; and
- Informing the public about PFAS.

Adopting MCLs for PFAS

In 2019, the New Hampshire Department of Environmental Services (NHDES) established drinking water MCLs and Ambient Groundwater Quality Standards (AGQSs) for four PFAS:

- PFHxS – 18 ppt
- PFNA – 11 ppt
- PFOS – 15 ppt
- PFOA – 12 ppt

These standards are significantly lower than the U.S. EPA lifetime health advisory level of 70 ppt. The NHDES also established water quality standards and procedures for wastewater discharges to groundwater that contain PFAS. PWSs are now required to sample and test quarterly for these four PFAS chemicals. Once a violation of a standard has been confirmed, which is based on the average of four samples collected quarterly during the first year, PWSs must notify their customers and develop a plan to address the violation. The New Hampshire state legislature also enacted Senate Bill 309-FN, which requires NHDES to develop a plan and a budget for adopting surface water quality standards for the same PFAS contaminants. NHDES has submitted a plan and a budget to the legislature for their consideration.

Identifying possible sources of contamination

NHDES used SIC and NAICS codes to identify sites that may have been a source of PFAS contamination, as well as vulnerable source waters. NHDES is working with one plastics manufacturer in particular to delineate the extent of groundwater contamination caused by their factory. They are requiring the manufacturer to provide bottled water to affected well owners. NHDES has also distributed letters and surveys to fire departments, requesting information on their past use of firefighting foams. NHDES is currently assessing the feasibility of offering a stockpiled foam take-back program.

Informing the public about PFAS

NHDES has consistently been transparent about the presence of PFAS in New Hampshire, as well as their efforts to identify and contain it. All data collected as part of the development and ongoing implementation of the MCL are available through the NHDES PFAS Investigation website (see in the Additional Documents table below). These test results are also displayed through an online map that allows users to view all sample collection sites in the state. New Hampshire holds regular public meetings where NHDES updates the public on PFAS research and current efforts. All materials, including the presentation slides, are available on the NHDES PFAS website. These include factsheets for well owners on testing their water for PFAS and installing home filtration systems. NHDES also tested bottled

water brands commonly sold in New Hampshire for PFAS and made results available online. Total PFAS was detected at levels above the MCL in five of 36 samples.

Additional Documents:

Category	Document	Description
State Website	NH PFAS Investigation	This is the main NHDES PFAS webpage, with links to all of their ongoing work in addressing PFAS in New Hampshire, including sample test results, public presentations, and correspondences with stakeholders.
Drinking Water Standards	PFAS MCL and AGQS Standards	Here are the drinking water MCL and AGQS that NHDES has set for PFOA, PFOS, PFHxS, and PFNA. They range from 11 to 18 ppt.
State Regulation	Senate Bill 309-FN	This bill regulates groundwater pollution and requires NHDES to develop surface water quality standards for PFOS, PFOA, PFNA, and PFHxS.
Fact Sheet	In-Home Water Filtration Options	This guidance page provides useful information to homeowners on options for installing GAC or reverse osmosis filters in their homes. It covers both point-of-use and point-of-entry filtration systems.
Laboratory Certification Programs	Laboratory Testing Guidelines for PFAS for Private and Public Drinking Water Supplies	These guidelines outline the reporting limits, analytical methods, and analytes required when sampling for PFAS. It also includes a list of laboratories around the U.S. which NHDES has accredited to test for PFAS.
Fact Sheet	Answer to FAQs: PFAS MCLs	This public information document provides answers to frequently asked questions about PFAS, water safety, and the MCL-setting process. It covers topics that states should consider when addressing the needs of the public.
Map	NHDES PFAS Sampling	This link brings you to an interactive map of all the PFAS water quality data available in the NHDES Environmental Monitoring Database. The map allows users to view each sample site and see the concentrations of PFOA, PFOS, PFHxS, PFNA, and total PFAS that were detected in each sample. It allows users to filter by groundwater samples, surface water samples, sites screening for PFAS, and other sample types.
Fact Sheet	PFAS Sample Collection Guidance	This document provides tips and important considerations for sampling wells for PFAS, including a list of items that should not be present during sampling due to the risk of cross contamination.
Government Action	Class B Firefighting Foam Request for Information	This is a letter sent to municipalities and fire departments requesting information on where Class B foams have been used in the past and when they will be used in the future. This also includes an informational guide and report on firefighting foam best practices.

Category	Document	Description
Government Action	Letter to Fire Departments	This is a letter to fire departments recommending that they voluntarily test any on-site water supply wells for PFAS. The letter was sent with the NHDES Laboratory Testing Guidelines (see above) attached.
Sampling Results	Bottled Water Testing Results	NHDES tested 36 different bottled water products commonly sold in New Hampshire for PFAS. The results are broken down by brand, source water, treatment, and PFAS analytes tested.

Contact Information:

Brandon Kernen Manager: Hydrology and Conservation, New Hampshire Department of Environmental Services	Brandon.Kernen@des.nh.gov

North Carolina

North Carolina's Primary Reponses to PFAS include:

- Creating a health goal for GenX;
- Investigating a known contamination site; and
- Sampling drinking water and groundwater for PFAS.

Creating a health goal for GenX

The North Carolina Department of Health and Human Services (DHHS) has set a health screening goal of 140 ppt for GenX, the trade name for the chemical perfluoro-2-propoxypropanoic acid. This goal applies to the most vulnerable population, bottle-fed infants. A health goal is a non-regulatory, non-enforceable level of contamination below which no adverse health effects would be expected over a lifetime of exposure.

Investigating a known contamination site

The North Carolina Department of Environmental Quality (DEQ) and DHHS together began investigating GenX contamination in the Cape Fear River in 2017. After sampling confirmed the presence of GenX, the state worked with the Chemours manufacturing facility to stop the release of the chemical and provide bottled water to those with wells that were affected by the contamination. Extensive multi-media PFAS testing has continued in the area surrounding the facility.

Sampling drinking water and groundwater for PFAS

The North Carolina General Assembly directed the North Carolina Policy Collaboratory, a research consortium of the state's academic institutions, to sample for PFAS at all public water supply intakes and at public water supply wells for groundwater systems. The purpose of the testing is to establish a water quality baseline, to develop models that predict which private wells are most at risk of contamination, and to test PFAS removal technologies. Aside from this, DEQ sampled a number of drinking water reservoirs for PFAS in 2019 and plans to continue this effort in additional reservoirs in 2020. DEQ also requested 3-months of influent PFAS monitoring from NPDES pretreatment facilities in the Cape Fear River Basin to help evaluate potential source areas.

Additional Documents:

Category	Document	Description
State Website	GenX Investigation	This website details DEQ's work investigating GenX contamination in southeast North Carolina. This website contains information on drinking water sampling, groundwater contamination, and health-related resources.
State Report	North Carolina DHHS Risk Assessment for GenX	This document answers a series of frequently asked questions about DHHS's updated Risk Assessment for GenX.
State Website	North Carolina DEQ Water Resources	This website details DEQ's work regarding emerging compounds.

Category	Document	Description
State Website	North Carolina PFAS Testing Network	This website details the Collaboratory's work investigating PFAS contamination in North Carolina's drinking water supplies. The site contains progress reports, presentations, and additional resources.

Contact Information:

Rebecca Sadosky Drinking Water Protection Program Coordinator: North Carolina Department of Environmental Quality	rebecca.sadosky@ncdenr.gov

North Dakota

North Dakota's Primary Reponses to PFAS include:

- Developing a list of potential sources of PFAS and
- Testing possibly contaminated sites.

Developing a list of potential sources of PFAS

North Dakota Department of Environmental Quality (NDDEQ) has internally developed a list of potential sources of PFAS contamination. They looked at all potential sources such as air, water, soil, and industry. They used these potential sources of contamination to develop a list of potentially contaminated source waters.

Testing possibly contaminated sites

From the UCMR3, they tested the most likely PWSs that could have PFAS contamination. They looked at both surface and groundwater sources. NDDEQ did not, however, detect any contaminated samples as part of UCMR3. In 2018 they conducted a more comprehensive survey of PFAS in North Dakota. They collected samples at landfills, drinking water treatment plants, WWTPs, and groundwater sources located near fire training areas. Some of these samples did contain combined PFAS levels above the U.S. EPA lifetime health advisory level. Overall, this study identified data gaps and provided a baseline for future sampling. In 2020, sampling will focus on PWSs.

Additional Documents:

Category	Document	Description
State Website	Groundwater Protection Program	This website details the work that the NDDEQ does on groundwater protection.
Case Study	City of Williston	The City of Williston recently reported various leaks that cause release of PFAS into the groundwater. Further investigation is needed and may be pursued in the future.
Government Report	Statewide PFAS Survey	This report details the state's PFAS sampling efforts, including methodology and results. Concentrations above the EPA health advisory were detected at a variety of sites.

Contact Information:

David Bruschwein Director: Division of Municipal Facilities	dbruschw@nd.gov 701-328-5259

Northern Mariana Islands

Northern Mariana Islands' Primary Reponses to PFAS include:

- Developing a list of potential sources of PFAS contamination;
- Sampling for PFAS in surface and groundwater; and
- Taking precautionary steps to reduce contamination.

Developing a list of potential sources of PFAS contamination

The majority of the Commonwealth of the Northern Mariana Islands' (CNMI's) PFAS contamination is from using firefighting foams containing PFAS (e.g., AFFF) at military training facilities. To stop further contamination, these foams are no longer used during training.

Sampling for PFAS in surface and groundwater

The CNMI Bureau of Environmental and Coastal Quality (BECQ) tests drinking water tank entry point sites near military training areas that used firefighting foams on a quarterly basis. If PFAS is found in higher concentrations than the U.S. EPA lifetime health advisory level of 70 ppt for PFOS and PFOA, then nearby wells are individually tested on an annual basis. If the concentrations in these wells is higher than 70 ppt, they will be shut off to prevent further contamination. If finished water from a PWS tests higher than 70 ppt, a public notice will be sent out to affected customers.

Taking precautionary steps to reduce contamination

As a precaution, PWSs are blending their water to reduce the likelihood of high levels of PFAS. CNMI BECQ is also contacting producers of GAC filters in case treatment is necessary for at-risk PWSs.

Additional Documents:

Category	Document	Description
State Website	Safe Drinking Water Guidance	CNMI BECQ Safe Drinking Water Program's website provides an overview of all their actions to ensure safe drinking water.
Laboratory Certification Programs	Eurofins Laboratory	CNMI BECQ uses Eurofins Laboratory to test for PFAS in ground, surface, and drinking water.

Contact Information:

Travis Spaeth Safe Drinking Water Program Branch Manager: CNMI BEQ	travisspaeth@becq.gov.mp

Oregon

Oregon's Primary Reponses to PFAS include:

- Oversight and technical input for voluntary assessment of PFAS;
- PFAS reduction policies for consumer and business products; and
- Coordinating with other agencies and states.

Oversight and technical input for voluntary assessment of PFAS

The Oregon Health Authority (OHA) and Department of Environmental Quality (ODEQ) provide oversight and technical input for voluntary testing and assessments of soil, water, and wastewater for PFAS. This includes review of the UCMR 3 monitoring data for PFAS; assistance to individual PWSs and municipal WWTPs for reviewing sampling plans and interpreting results; and oversight of and consultation with landowners that are proactively assessing contaminated sites. When known PFAS contamination sites are identified, OHA evaluates nearby PWS susceptibility based on potential sources, well construction, and local hydrogeology. In addition, ODEQ's laboratory is developing PFAS analytical methods and expects to have those methods operational by the Winter 2020. The nature and extent of ODEQ's PFAS environmental monitoring will depend on available resources and directives from agency leadership, the Governor, or the Legislature.

PFAS reduction policies for consumer and business products

In the 2015 House Bill 478, PFOS was designated as a High Priority Chemical of Concern for Children's Health as part of the Toxic-Free Kids Act. Manufacturers must now report children's products (i.e., toys, car seats, and clothing) that contain high levels of PFOS. Manufacturers also must eventually remove the chemicals from a subset of products (e.g., products children could put in their mouths) or request a waiver.

In 2012, the Governor's Executive Order 12-05 was issued. This advanced Green Chemistry actions by the state government. This order mandated the Department of Administrative Services to work with the ODEQ to revise state purchasing policies and specifications to minimize the purchase of products with priority toxic chemicals, including PFAS. The intent of these actions is to increase market demand for lower toxicity products.

Oregon Senate Bill 737 required ODEQ to develop a priority persistent pollutant list for water quality. The list of 118 pollutants, including five PFAS, was developed with the help of a science advisory committee. Major WWTPs (with dry-weather design flow capacity of one million gallons a day or greater) were required to analyze effluent for PFAS twice in 2010 and develop reduction plans for PFAS if detected above initiation levels. No municipal wastewater results exceeded the PFAS initiation levels.

There are currently no state regulations related to PFAS for drinking or surface water standards, cleanup action levels, hazardous waste management, or air quality.

Coordinating with other agencies and states

Oregon has worked with federal agencies, state agencies, and NGOs to better understand exposure risks, develop cleanup requirements, and advance safe alternatives to PFAS-containing products. OHA and ODEQ are coordinating their work on wastewater and stormwater entities. The two agencies have a

bimonthly call with EPA Region 10, other states, DOD, USCG, and ATSDR within the region to understand PFAS concerns. In addition, DEQ and OHA participate in multiple PFAS workgroups convened by state environmental and health associations, including the Environmental Council of the States (ECOS), Association of State and Territorial Health Officials (ASTHO), and the Interstate Chemicals Clearinghouse (IC2). They also coordinate with NGOs such as Northwest Green Chemistry, which developed a roadmap for conducting alternatives assessments for PFAS in food packaging.

Additional Documents:

Category	Document	Abstract
State Website	OHA's Website on Emerging Contaminants in Drinking Water	OHA's website provides a quick overview of PFAS in relation to drinking water as well as resources for PWSs. It also provides links to the results of UCMR 3 PFAS monitoring in Oregon.
State Website	ODEQ's Website on PFAS	ODEQ's website provides an overview of PFAS compounds, detection locations, methods for evaluating risk, and regulations.
Fact Sheet	ODEQ-OHA Fact Sheet on PFAS	This fact sheet on PFAS gives background information on PFAS and human exposure. It also has an overview of current regulations from the federal and state government.
Government Action	Senate Bill 478	This bill required manufactures of children's product to report if there are high levels of PFAS in their products. They will have to remove these chemicals or request a waiver.
Government Action	Executive Order 12-05	To reduce purchasing of products with harmful chemicals in them, this executive order works to minimize state purchasing of products containing PFOS. See part C and D of the Green Chemistry Innovation Initiative for specific actions on PFAS.
Government Action	Senate Bill 737	PFAS was listed as a priority persistent pollutant, which required major WWTPs to monitor effluent for PFAS in 2010. It also required these WWTPs to create reduction plans for PFAS and other pollutants.
Government Report	Northwest Business and Environment Conference Presentation	This presentation summarizes PFAS in Oregon. It covers government regulation, PWSs drinking water programs, known contamination, and future efforts.

Contact Information:

Gregg Baird Emerging Contaminants Specialist: OHA, Drinking Water Services	gregg.c.baird@state.or.us

Pennsylvania

Pennsylvania's primary responses to PFAS include:

- Coordination across the state government;
- Creation of a state sampling plan;
- Creation of a PFAS toxicology services contract; and
- Ongoing responses to known contamination.

Coordination across state government

In September 2018, Governor Tom Wolf created a PFAS Action Team that includes the departments of Environmental Protection (DEP), Health (DOH), Military and Veteran Affairs, Community and Economic Development, Transportation, and Agriculture, as well as the State Fire Commissioner. Governor Wolf has also put pressure on the U.S. EPA and the Pennsylvania congressional delegation, urging them to form a more comprehensive response to PFAS and to vote in favor of federal bills addressing PFAS, respectively.

Creation of a state sampling plan

The PA DEP developed a one-year sampling plan to identify and test priority PWSs across the state. They used GIS layers containing information on geologic formations, HUC-12 watersheds, and the locations of potential sources of contamination (including military bases, fire training schools, manufacturing facilities, etc.) to identify a target subset of about 500 high risk PWSs. These are all within a ½ mile of a possible contamination site. PA DEP also created a control group list of about 300 PWSs that are located in forested watersheds and more than five miles away from a potential source of contamination. Sampling will be conducted over one year and will include approximately 360 high risk PWS samples and 40 control group samples. Pennsylvania's state drinking water regulations allow the DEP to require increased monitoring and the issuance of Tier 2 public notifications for unregulated contaminants above a known health advisory level, including PFAS; high levels are also reported to the Environmental Cleanup Program. Pennsylvania is accrediting laboratories to test for PFAS using EPA Methods 537 version 1.1 and 537.1.

Creation of a PFAS toxicology services contract

The PA DEP entered into a toxicology services contract with Drexel University to provide technical evaluation and consultation regarding environmental exposures of health concern from PFAS. The contractor will review and evaluate human health effects and toxicology data, epidemiological studies, and reports, including information from U.S. EPA, ATSDR, FDA and other states. The contractor will collaborate with PA DEP and DOH to prepare a final report with an assessment of how and why the various agency values are different, and recommendations for toxicity values and draft MCLs for PFAS in drinking water.

Ongoing responses to known contamination

Pennsylvania currently relies on the U.S. EPA's health advisory limits (HALs) to determine when corrective actions are required. Investigations are ongoing at 22 sites across the state. In response to these efforts, as well as the state's PFAS plan more broadly, Pennsylvania has held public meetings and

published informational materials. They have also reached out to other states, including New Jersey and Michigan.

Additional Documents:

Category	Document	Description
State Website	PFAS: What They Are	Main PA DEP PFAS Program webpage.
Government Action	PFAS Action Team Members and Mission	Governor Wolf's executive order establishing the PFAS Action Team. The order lists the functions and members of a state-level interagency team for addressing PFAS, which can serve as a model for other states.
Government Action	Letter to EPA	Governor Wolf's letters to EPA Administrator Andrew Wheeler and the PA congressional delegation. The letters highlight several federal actions for which states and PWSs can lobby and serve as an example that other state executive leaders can follow.
Government Action	Letter to PA congressional delegates	
State Plan	Sampling Plan	PFAS Sampling Plan Phase 1: Plan to Prioritize Sampling of PWS 2019 – 2020. The plan details the GIS layers and method by which PA identified a list of PWSs at high risk of PFAS contamination.
State Plan	PA Safe Drinking Water	PA Safe Drinking Water regulations. See Sections 109.4, 109.302, and 109.409 for information on the statutory basis by which PA requires PWSs to monitor for unregulated contaminants and issue Tier 2 public notices.
State Plan	Unregulated Contaminants Guidance	Health Effects and Risk Management Guidance document (2003). Provides information and guidance to state staff on responding to contamination incidents. Does not address PFAS directly.
State Plan	Laboratory Accreditation	Detailed information on Pennsylvania's laboratory accreditation program, including applications, testing, and procedures. Useful model for states that do not already have an accreditation program.
Government Report	Addendum two to Cancer Data Review	Addendum two to the August 2016 Cancer Data Review: Selected Zip Codes of Warminster, Warrington, and Horsham, Pennsylvania (May 2018). This report summarizes a PA Department of Health study, including their methodology for geocoding cancer cases and analyzing their correlation with PFAS exposure.
Government Report	PFAS Exposure Assessment Technical Toolkit (PEATT) Pilot Project & PEATT Project presentation slides	PEATT Pilot Project PFAS Testing in the Warrington, Warminster, and Horsham areas. This report provides detailed information on a Department of Health study of blood PFAS levels in people living in an area where PFAS had been detected above the HAL in a public supply well. Includes sampling method and results. The presentation slides summarize the project.

Contact Information:

PA DEP Office of Water	RA-epcontactus@pa.gov
Lisa Daniels Director: DEP Bureau of Safe Drinking Water	ldaniels@pa.gov

Rhode Island

Rhode Island's Primary Reponses to PFAS include:

- Creating a map of potential PFAS contamination sites and testing nearby wells;
- Providing guidance and requirements for PFAS contamination in drinking water; and
- Partnering with other organizations to identify and reduce PFAS contamination.

Creating a map of potential PFAS contamination sites and testing nearby wells

EPA Region 1 has provided a map (GIS layers) of all known PFAS contamination sites, including their NAICS codes. Rhode Island Department of Environmental Management (DEM) then added to this map using a facility database and GIS layers. The Rhode Island Department of Health (RIDOH) used GIS to identify all public wells near these sites.

In 2017 and 2019, RIDOH tested all public wells, licensed water bottler wells, and licensed child care facility wells within a mile radius of potential PFAS facilities and within a half mile of fire stations. They also tested all schools that have their own wells and all drinking water sources identified in UCMR3. Lastly, DEM tested private wells and monitoring wells near the public wells found to have elevated PFAS.

In this sampling study, Oakland Association was the only system with PFAS above the U.S. EPA heath-based advisory level (70 ppt). RIDOH provided engineering services funding and a State Revolving Fund (SRF) principal forgiveness loan to Oakland Association to consolidate with a neighboring CWS. In total, 87 water systems were tested as part of this study, which is the drinking water of approximately 87 percent of Rhode Islanders. More specifically, 97 percent of Rhode Islanders who get drinking water from PWSs, 100 percent of municipal water systems that serve populations more than 10,000 people, 49 percent of CWSs, 100 percent of schools that have their own public wells, and five licensed child care facilities served by private wells. Of these, 56 percent had no PFAS detections; 15 percent had PFAS levels higher than 20 ppt for the combined sum of PFOA, PFOS, PFHxS, PFHpA, and PFNA in one or more sources; and 2 percent had levels of PFOA and PFOS between 36 and 70 ppt in one or more sources.

Providing guidance and requirements for PFAS contamination in drinking water

RIDOH has developed a program specifically related to PFAS contamination. They provide guidance to citizens regarding exposure to PFAS through drinking water as well as environmental and health effects from PFAS. This guidance includes a website, sampling and results letters to PWSs, answers to frequently asked questions, public notice for water system consumers for a health advisory exceedance, letters to private wells owners when there is contamination in the vicinity, and sampling instructions. RIDOH also enforces statutory authority to protect public health.

Rhode Island DEM has a groundwater standard for water systems. This is based off of U.S. EPA's heath-based advisory level of 70 ppt for PFOA and PFOS for all GAA and GA groundwater (i.e., groundwater that presumably doesn't need treatment for drinking water). See this guidance for more specifics on GAA and GA classification.

RIDOH laid out these requirements for water systems during the 2017-2019 testing:

- If over 20 ppt for the sum of PFOA, PFOS, PFHxS, PFHpA, and PFNA are found, RIDOH will collect another sample as soon as possible.
- If over 35 ppt for the sum of PFOS and PFOA are found, the PWS is required to conduct three more quarters of monitoring.
- If over 70 ppt for the sum of PFOA and PFOS are found, they must release a do-not-drink notice in 24 hours and submit a corrective action plan in 60 days. RIDOH submits a press release, holds a community meeting, and provides neighboring private wells sampling guidance and information about PFAS. DEM performs an investigation, which includes sampling of neighboring wells and may provide bottled water.

Partnering with other organizations to reduce PFAS contamination

RIDOH has partnered with PWSs, local governments, university research programs, and other state agencies, such as DEM and the Department of Children, Youth and Families. Brown University helped significantly with the 2017 and 2019 water quality testing. RIDOH has met with a PFAS Drinking Water Technical Advisory Group since July 2019 to discuss the results of the sampling study and next steps.

Additional Documents:

Category	Document	Abstract
State Website	PFAS Contamination of Water	This website provides helpful guidance to citizens regarding PFAS in their drinking water. It covers environmental and health issues as well.
State Report	Rhode Island DOH 2017 Annual Report	This annual report contains a summary of the state's actions on PFAS. This includes the UCMR3 testing, 2017 small water system sampling, and Oakland Association's water system case study.
State Plan	Rhode Island DOH Testing for PFAS	This 2019 DOH press release stated they will begin testing 50 water systems and child care facilities wells within a half mile of the fire stations. This testing is an extension of previous testing in 2017.
Case Study	Oakland Association Water System Case Study	Oakland Association Water System in Burrillville, RI had elevated levels of PFAs in its drinking water. They provided bottled water and health guidance to customers, as well as guidance to private well owners for testing.

Contact Information:

Amy Parmenter Enforcement Manager/UCMR Manager: RIDOH	Amy.Parmenter@health.ri.gov

Utah

Utah's Primary Reponses to PFAS include:

- Assembling a workgroup to address PFAS contamination;
- Creating in-depth guidance to citizens on exposure to PFAS; and
- Testing for PFAS contamination.

Assembling a workgroup to address PFAS contamination

To address contamination, Utah Department of Environmental Quality (UDEQ) created a workgroup of experts on PFAS from many different disciplines. Members included representatives from UDEQ's Divisions of Water Quality, Environmental Response and Remediation, Waste Management and Radiation Control, Drinking Water, and Communications. In addition, there were representatives from the Utah Department of Health (UDOH) and the Bureau of Epidemiology.

This workgroup identified potential sources of PFAS, including areas that used PFAS-based firefighting foams at training facilities, military installations, and airports. UDEQ used NAICS codes and the known locations of AFFF discharge and waste disposal and treatment sites. There are no facilities in Utah that manufactured PFAS, so their efforts have primarily focused on identifying areas where firefighting foams were used or stored. Additional sources of PFAS will be identified in the future. They are prioritizing testing for contamination based on highest likelihood of human exposure. UDEQ has also created a phased sampling approach that is set to begin in January 2020. Additional resources may be available from the state contacts (see below).

Creating in-depth guidance to citizens on exposure to PFAS

UDEQ has many resources available to inform citizens about potential exposure to PFAS. There are several pages on UDEQ's website dedicated to exploring PFAS further, including pages on PFAS basics, health effects, and human exposure.

Testing for PFAS contamination

UDEQ tested for PFAS in drinking water in the UCMR3 and none of the sites had PFAS higher than the U.S. EPA lifetime health advisory level of 70 ppt for PFOS and PFOA combined.

Additional Documents:

Category	Document	Description
State Website	PFAS Website	UDEQ's website has lots of helpful information regarding PFAS contamination. They have links to websites on PFAS basics, sources of PFAS, human exposure to PFAS, and health effects of PFAS.
Government Action	PFAS Workgroup	UDEQ created a workgroup including many branches of UDEQ, UDOH, and Utah's Bureau of Epidemiology. The workgroup located potential sites of PFAS contamination. They are now in the process of sampling.

Contact Information:

David F. Hansen Environmental Scientist PFAS Coordinator: UDEQ	dfhansen@utah.gov
Ben Brown PFAS workgroup contact: UDEQ	brbrown@utah.gov

Vermont

Vermont's Primary Reponses to PFAS include:

- Identifying and regulating PFAS chemicals;
- Providing water for PFAS contaminated private wells; and
- Developing an MCL for five PFAS.

Identifying and regulating PFAS chemicals

The Vermont Department of Environmental Conservation (DEC) Waste Management and Prevention Division has sampled sites that may have PFAS contamination such as areas that used firefighting foams containing PFAS (e.g., AFFF), wire coating, electroplating, and car washing for potential PFAS contamination. The Groundwater Protection Rule was revised for PFAS Groundwater Enforcement Standards; these standards were then adopted into the regulations for contaminated sites remediation.

Providing water for PFAS contaminated private wells

For private wells that have been contaminated, Vermont DEC is expanding PWSs hydraulics to switch water from contaminated private wells to municipal sources. Contaminated wells have been closed.

Developing an MCL for five PFAS

The Vermont Water Supply Rule revisions are underway to incorporate an MCL of 20 ppt for the sum of five PFAS (PFOA, PFOS, PFHxS, PFNA, and PFHpA). Public hearings have taken place and the responsiveness summary is being written. It will be filed with the Secretary of State by February 1, 2020; if it is approved, it will become final 30 days later.

Additional Documents:

Category	Document	Description
State Website	Vermont DEC's PFAS Website	This website details Vermont DEC's actions on PFAS contamination. It has information on drinking water, investigation and cleanup, surface water contamination, maps and studies, and health information.
Government Action	Act 21 (S.49)	Act 21 requires PWSs to test for five PFAS chemicals (PFOA, PFOS, PFHxS, PFNA, and PFHpA). It also requires DEC to create an MCL by 2020 for the five PFAS, regulate PFAS in surface water, and implement a statewide investigation of PFAS contamination.
State Plan	Statewide Sampling Plan	This report details what is known about PFAS in Vermont, their testing methodology and rationale, and their next steps in statewide sampling of facilities where PFAS may be present.

Contact Information:

Ellen Parr Doering Drinking Water and Groundwater Protection Division: Vermont DEC	ellen.parrdoering@vermont.gov

Virginia

Virginia's Primary Reponses to PFAS include:

- Creating a PFAS Task Force;
- Developing a GIS map of potential sources of contamination;
- Creating a plan for if PFAS is found in drinking water; and
- Addressing current contamination.

Creating a PFAS Task Force

The Virginia Department of Health (VDH) has created an interdisciplinary PFAS task force to understand the extent and impact of PFAS on the Commonwealth's water resources and human health. Experts from various disciplines are part of this task force. This includes emergency preparedness staff, local health district administration, state toxicologist, state epidemiologist, drinking water experts, and technical experts from the Virginia Department of Environmental Quality.

Developing a GIS map of potential sources of contamination

The Virginia Department of Health (VDH) is in the process of developing GIS maps of potential sources of PFAS contamination. This map will be used to identify potential at-risk groundwater and surface water sources and inform next steps.

Creating a plan for if PFAS is found in drinking water

If PFAS is found, VDH first compares the level to U.S. EPA lifetime health advisory level of 70 ppt for PFOS and PFOA. They then contact the owner of the water system and the local health department to share their findings. They may also request additional voluntary sampling. If the levels are higher than the U.S. EPA's health advisory, they will also ask the water system to notify their customers and VDH provides technical guidance to reduce exposure.

Addressing current contamination

Virginia has five sites that have known PFAS contamination. Four of them are military installations and one is a commercial facility. The Naval Auxiliary Landing Field (NALF) Fentress; Naval Air Station (NAS) Oceana; Naval Support Activity (NSA) Hampton Roads, Northwest Annex, near Chesapeake, VA; and National Aeronautics and Space Administration (NASA Wallops Flight Center conducted onsite groundwater testing and found PFAS in their drinking water wells due to use of AFFF. Wells impacted by the use of AFFF were shut down and the sites are being monitored. The DuPont Spruance Plant in Richmond is the fifth site. The facility contaminated the groundwater; these wells, however, are not and were not previously used for drinking water. Site cleanup is being coordinated between DuPont, Region 3, and U.S. EPA. More details on all contaminated sites are available at the Case Study link below.

Additional Documents:

Category	Document	Description
State Website	VDH PFAS Guidance	VDH has created this website to provide guidance to citizens on PFAS. The website provides a helpful snapshot of PFAS in Virginia and also links to additional sites where citizens can learn more about PFAS.

Category	Document	Description
State Website	VDEQ PFAS Guidance	VDEQ has also created a guidance website on PFAS. It provides details on contaminated sites in Virginia, such as the Fentress Air Base and NAS Oceana.
Case Study	Fentress Air Base	This U.S. Naval Air Base has taken actions to test water in sites where there was a potential release of PFAS. This provides useful guidance on health impacts and action plans.
Case Study	NAS Oceana	Use of AFFF has led to PFAS groundwater contamination for 31 out of the 34 onsite wells that were tested. Four of the wells tested above the U.S. EPA health advisory level. No contamination was found in surrounding offsite wells. The Navy is requesting to test additional private wells to understand the full extent of the contamination.
Case Study	NSA Northwest Annex	The Naval Support Activity Hampton Roads, Northwest Annex near Chesapeake, VA has found PFAS in groundwater onsite. They are requesting to test additional private wells surrounding the compound.
Case Study	NASA Wallops Flight Center	Two of the three shallow and deep wells onsite are contaminated by PFAS above the U.S. EPA health advisory level. These wells have been shut down for drinking water. In 2017, the water was retested and NASA and the surrounding city, Chincoteague, didn't detect any PFAS. NASA is continuing to monitor the wells.
Case Study	DuPont Spruance Plant	The DuPont Spruance plant in Richmond contaminated surrounding soil and groundwater with PFAS. VDEQ determined future actions need to be taken to reduce exposure. Therefore, in 2018, they completed development of groundwater extraction and treatment systems.
Government Report	EPA Region 3 Report	This report details EPA Region 3's progress addressing legacy contamination. Many of these sites addressed had PFAS contamination.

Contact Information:

Robert Edelman Director of Division of Technical Services: VDH	robert.edelman@vdh.virginia.gov

Washington

Washington's Primary Reponses to PFAS include:

- Enacting legislation regulating PFAS;
- Developing drinking water rules addressing PFAS;
- Creating a list of PFAS contamination sources and nearby PWSs; and
- Partnering with other agencies.

Enacting legislation regulating PFAS

Washington has enacted two pieces of legislation restricting the use of PFAS. House Bill 2658 restricted the use of PFAS in food packaging and Senate Bill 6413 restricted the use of PFAS in firefighting foams. Food packaging and firefighting foams containing PFAS cannot be manufactured, sold, or distributed in the state of Washington. Both of these bills reduce exposure to PFAS. Further legislation to establish uniform monitoring, recordkeeping, reporting, and follow up actions for PFAS contamination is pending.

Developing drinking water rules addressing PFAS

Washington State Board of Health is in the rulemaking process to develop State Action Levels (SALs) for five perfluorinated compounds. The draft rules establish the monitoring framework for water systems to test for PFAS and the actions required when PFAS are detected in a public water supply source. The SALs are consistent with what many other states are also developing.

Creating a list of PFAS contamination sources and nearby PWSs

The Washington Department of Health (WDOH) and Washington Department of Ecology (WDOE) created a Chemical Action Plan to address contamination. They created a list of known sources of PFAS contamination such as firefighting training facilitates, military installations, and airports that use PFAS-based firefighting foams. They created a list of all PWSs within two miles of these facilities to prioritize monitoring under the proposed rulemaking.

Partnering with other agencies

WDOH has partnered with WDOE to develop and implement a lab certification program for PFAS testing. They have also partnered with the Armed Services to test water quality near facilities that used PFAS-based firefighting foams. WDOH also works with local municipalities as well as the governments of Michigan and New Hampshire to understand their actions on PFAS.

Additional Documents:

Category	Document	Description
State Website	PFAS Website	This website is a landing page for WDOH's work on PFAS contamination.
State Plan	Chemical Action Plan	WDOE's Chemical Action Plan details their plan to address PFAS contamination especially in areas that use PFAS-based firefighting foams.
Government Action	HB 2658	This bill restricts the use of PFAS in food packaging in Washington. Packaging made with PFAS cannot be manufactured, sold, or distributed in Washington.

Category	Document	Description
Government Action	SB 6413	This bill restricts the use of firefighting foams that contain PFAS. These foams cannot be manufactured, sold, or distributed in Washington.
Case Study	Airway Heights and Fairchild Air Force Base	After finding PFAS contamination on the Airway Heights and Fairchild Air Force Base, testing was conducted to understand the extent of contamination. Contaminated drinking water wells were decommissioned, and the public was notified.
State Regulation	PFAS Rulemaking	This webpage summarizes the state rulemaking activities pertaining to PFAS.

Contact Information:

Brian Walsh Policy and Rules Section Manager: WDOH	brian.walsh@doh.wa.gov 360-236-3102
Kara Stewart PFAS Chemical Action Plan Coordinator: WDOE	kara.steward@ecy.wa.gov 360-407-6250

Wisconsin

Wisconsin's Primary Reponses to PFAS include:

- Organizing a coordinated response to PFAS;
- Developing regulations and policies; and
- Sampling and investigating known contamination sites.

Organizing a coordinated response to PFAS

The Wisconsin Department of Natural Resources (WI DNR) has been given authority and specific directives to address PFAS via executive orders from the governor. They have established an interagency PFAS council designed to coordinate the government's PFAS prevention efforts, as well as a Technical Advisory Group of experts that meets regularly to share information and research. An internal workgroup at WI DNR is currently developing a GIS model and sampling plan for possible sources of contamination.

Developing regulations and policies

Senate Bill 302 requires WI DNR to create standards and monitoring requirements for PFAS. Wisconsin is currently proposing a state drinking water MCL for PFAS compounds. Under current state regulations, PFAS compounds also meet the definitions of a hazardous substance and environmental pollution.

The WI Department of Health recommends a groundwater standard of 20 ppt for PFOA and PFOS combined. If a PWS detects samples that exceed that standard, WI DNR requires the system to notify the public and remove the source from service if possible. They then recommend an ongoing sampling plan and work with the system to determine corrective actions.

Sampling and investigating known contamination sites

WI DNR has partnered with several water systems who are voluntarily sampling their sources for PFAS compounds. One municipality exceeded the 20 ppt standard (and the EPA lifetime health advisory level) and removed the well from service. Other systems have voluntarily taken wells out of service as sample results show the source water approaching recommended standards. WI DNR is actively involved in several ongoing PFAS investigations, the largest of which involves several manufacturing and waste treatment facilities in two neighboring cities.

Additional Documents:

Category	Document	Description
State Plan	Wisconsin Water Quality PFAS Initiative	This website details WDNR's actions on PFAS contamination in surface water, specifically (i) WWTPs PFAS screening; (ii) surface water and fish tissue sampling; and (iii) adoption of new surface water quality criteria.
Government Action	2019 Senate Bill 302	This 2019 Senate Bill 302 requires WDNR to create standards, monitoring requirements, and required responses if PFAS contamination is found in drinking water, groundwater, surface water, soil, or sediment.
State Website	WI PFAS Webpage	This is WDNR's main webpage on PFAS and provides information to the public on their PFAS projects.

Category	Document	Description
State Regulation	PFAS Rulemaking	This press release summarizes the proposed rules relating to PFAS currently in process of being finalized.
State Action	Governor's Executive Order #40	This Executive Order issued by the governor gives broad authority to WI DNR to investigate PFAS and develop regulatory standards, as well as to create an interagency PFAS Coordinating Council.
Test Results	Remediation and Redevelopment Program database	To view information on sites where PFAS contamination has been reported to the DNR, go to the Remediation and Redevelopment Program database. To find sites with PFAS contamination in the database, go to the "Advanced Search" tab, and under "Substances" search for "PFAS."
Laboratory Certification Programs	PFAS Laboratory Accreditation	This webpage contains the criteria laboratories must meet to become certified to analyze for PFAS.
State Action	Technical Advisory Group	Wisconsin's PFAS Technical Advisory Group meets regularly to share information about PFAS in the state.
State Action	WisPAC	The WisPAC, Wisconsin's PFAS Coordinating Council, is a state interagency council that meets regularly to discuss PFAS and coordinate the government's response.
Case Study	Marinette Case Study	This is Wisconsin's largest ongoing PFAS investigation, at several related sites in the Marinette and Peshtigo area. Manufacturing facilities and a WWTP are being investigated.

Contact Information:

Kyle Burton Director of Field Operations – Drinking Water and Groundwater Program: WI Department of Natural Resources	kyle.burton@wisconsin.gov (920) 662-5169

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