Groton PFAS Briefing

Greg R. Fishbone, Vice-Chair, Board of Water Commissioners
January 4, 2020

PFAS are a group of man-made compounds, including some with toxic and potentially carcinogenic effects.

The BoWC requested exploratory testing of GWD water sources after concerning levels of PFAS were detected in the groundwater of nearby communities.

Although two GWD wells show trace levels of PFAS, all Groton Water sources remain in compliance with current and proposed regulatory standards.

Table of Contents

Intro and Disclaimer

PFAS are a group of man-made compounds with strong carbon-fluorine bonds. Since the 1950s, PFAS compounds have been used in non-stick cookware, water-repellent clothing, stain-resistant fabrics and carpets, cosmetics, firefighting foams, food packaging, and other products that resist grease, water, and oil.

In the decades since PFAS compounds first came into use, it's been noticed that some of them don't break down in the environment. These "forever chemicals" cycle through soil and water, into plants, into animals, and into humans. This trait is called persistence.

Some PFAS compounds get trapped in living tissues and blood serum. They can remain in the body for years, accumulating with each additional exposure, and passing through the placenta and breast milk from one generation to the next. This trait is called bioaccumulation.

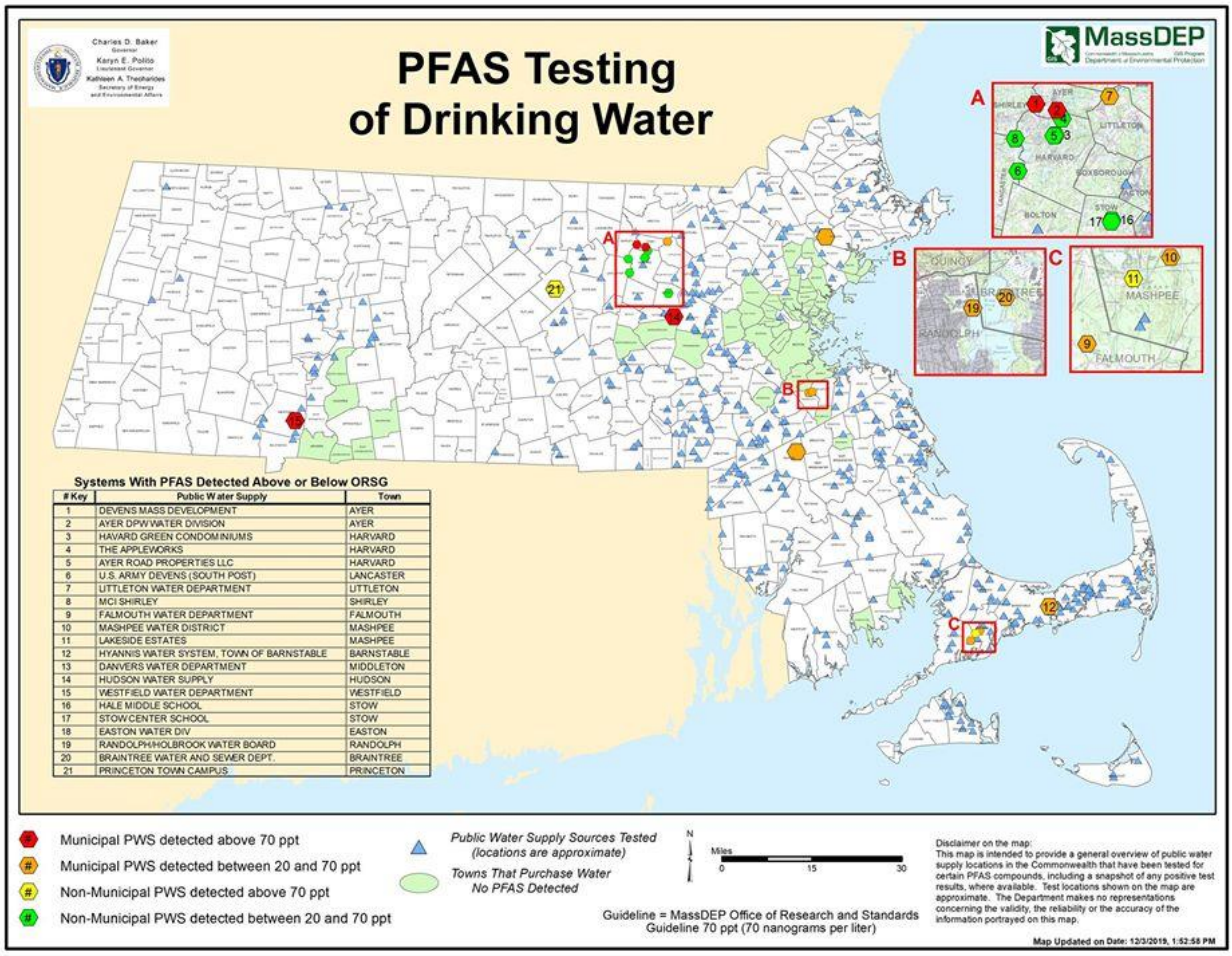
Some PFAS compounds have toxic effects and are potentially carcinogenic in humans[1].

The two best studied PFAS compounds, PFOA and PFOS, are toxic in quantities measured in parts per trillion. These molecules are practically indestructible when released into the environment. They remain in the human body for years after each exposure. They are extremely soluble in water, and can travel fast and far in streams and groundwater.

Similarly constructed PFAS compounds are expected to share most or all of these traits. A few that resemble PFOA and PFOS have also come under scrutiny, but these represent only the best studied and most worrisome tip of an iceberg consisting of over 4,700 other PFAS compounds[2].

Over 99% of Americans already have PFAS compounds circulating in their blood at levels that are probably causing physiological effects. These levels and their detrimental effects can be reduced by eliminating further PFAS exposures. Consumer products and foods represent the largest source of exposure for most people, but contaminated drinking water can add exposures as well.

With concerning levels of PFAS compounds in a cluster of drinking water systems on Groton's southern doorstep, it's especially vital for Groton residents to keep an eye on what's coming out of our public and private wells.



Researching this topic has been a trip down the rabbit's hole for me. Some aspects of PFAS presented information denser than I could wade through. Other areas remained wispy and speculative despite my best efforts. There will continue to be updates, including some prompted by your questions, comments, and concerns.

> *This briefing has not been vetted or approved by state or federal agencies, or by the Groton Water Department, nor does it represent the Board of Water Commissioners as a whole. Views, opinions, speculation, and any inadvertent mistakes are entirely my own. Consume at your own risk.*

This briefing is meant to be informative, and does not propose or support any particular local action. Let me know what you think, and thanks for reading!

--Greg R. Fishbone, Water Commissioner

Latest Updates:

Groton Water Testing

In October 2019, the Board of Water Commissioners requested exploratory testing of Groton Water Department water sources after concerning levels of PFAS were detected in the groundwater of nearby communities. Two PFAS compounds at Baddacook Well and one PFAS compound at Whitney Well #1 were detected at levels near the lowest reporting limits of the testing equipment. Although these two GWD wells show trace levels of PFAS, they remain in compliance with all current and proposed regulatory standards.

New MassDEP Regulations

In December 2019, the final draft of a proposed PFAS standard for drinking water was released by MassDEP, and is expected to be enacted in 2020.

- If enacted as currently proposed, the new regulation would lower the current PFAS limit from 70 to 20 ppt. Baddacook Well and Whitney Well #1 have tested at below 5 and below 3 ppt respectively.
- If enacted as currently proposed, the new regulation would increase the number of regulated PFAS compounds from five to six. The GWD wells have been screened for all six of these PFAS compounds plus twelve others.
- If enacted as currently proposed, the new regulation would initiate a schedule of mandatory testing for public and private water systems. In Groton, this would include water systems at Groton-Dunstable Regional High School, the Grotonwood Camp, and the Still Meadow development.
- For systems of its size, mandatory testing of GWD water sources would be scheduled to start in 2021. Groton's exploratory testing represents about a two-year head start on gathering local information.

Status of PFAS Regulation

Protecting the public from the threat of PFAS is a fast-evolving process.

Federal Actions:

In 2016, the U.S. EPA issued a Lifetime Health Advisory (LHA) for two PFAS compounds, PFOS and PFOA, in any combination that adds to over 70 parts per trillion. This health advisory is not enforceable on its own, but serves as guidance to states in their enforcement regulations.

Because PFAS contamination has been identified in hundreds of current and former military sites, the U.S. Congress debated PFAS regulation as part of the 2019 National Defense Authorization Act. The final version of the Act included provisions:

- To require better reporting on PFAS releases into the environment,
- To require additional disclosure of industrial and commercial uses of PFAS, and
- To provide funding for continued research and investigation.

Not included in the final version were proposals:

- To designate PFAS compounds as “hazardous substances,”
- To give the EPA authority to order the cleanup of PFAS-contaminated sites,
- To provide clean water to PFAS-contaminated farms,
- To expedite the transition to PFAS-free firefighting foams, and
- To establish new federal drinking water standards.

At the start of 2020, there are still no enforceable regulations in the works for PFAS compounds in drinking water at the national level.

Massachusetts Actions:

In 2018, MassDEP issued an Office of Research and Standards Guideline (ORSG) for five PFAS compounds in any combination that adds up to over 70 ppt. Community water systems are required to comply with the ORSG if concerning levels of toxic PFAS compounds are detected, but no testing requirements were established.

In 2019, MassDEP initiated the process to establish a Maximum Containment Level (MCL) for six PFAS compounds in any combination that adds to over 20 ppt. If approved, regular testing and reporting will be instituted, and and standards would be enforceable against community water systems and non-community systems alike, including those associated with schools, hospitals, factories, and restaurants.

MassDEP reviewed a group of ten PFAS compounds for potential regulation. Three are not included in U.S. EPA's 537.1 testing protocol for PFAS, making it impossible for water systems to currently detect. Another was deemed by MassDEP as somewhat less worrisome than the others. The six remaining compounds in the group are PFOS, PFOA, PFHpA, PFNA, PFHxS, and PFDA.

	PFCAs	PFSAs
6-Atom Carbon Chain	PFHxA	PFHxS
7-Atom Carbon Chain	PFHpA	PFHpS
8-Atom Carbon Chain	PFOA	PFOS
9-Atom Carbon Chain	PFNA	PFNS
10-Atom Carbon Chain	PFDA	PFDS
Well Studied: Toxic, Persistent, and Bioaccumulative		
Not Well Studied: Probably Toxic, Persistent, and Bioaccumulative		
Not Well Studied: Probably Not Toxic, Persistent, and Bioaccumulative		
Not Included in USEPA 537.1 Testing		

Speculation on Future Regulation:

- Great pressure has been placed on the U.S. EPA to regulate PFAS compounds in drinking water at the national level. Progress has been slow, so far leaving enforcement up to the states. If a national standard were to be passed, it would have to be reconciled with state regulations and would represent a new floor on which future state regulation could be built.
- In December 2019, U.S. EPA introduced a new testing method that increases the number of detectable PFAS compounds from 18 to 29. Other methods under review would include even more compounds. An expanded

range of testing methods would enable the regulation of additional PFAS compounds, including some in the group that MassDEP has already expressed an interest in.

- Ongoing studies may either confirm or disprove the suspected toxicity levels and persistence of currently less well-studied compounds, providing a scientific basis for their inclusion in or exclusion from future regulation.
- The regulatory practice of peer states may cause additional PFAS compounds to come under review in Massachusetts as well. These currently include GenX (subject to regulation in North Carolina), PFBS (subject to regulation in Minnesota), and PFHxA (under consideration in Michigan).
- MassDEP's current approach is to regulate similarly toxic, pervasive, and bioaccumulative PFAS compounds by adding their levels together. In the future, less toxic or bioaccumulative PFAS compounds may be regulated separately at higher levels.
- Some of the PFAS compounds that do break down in the environment may form other PFAS compounds in the process, including PFOA, PFOS, and closely related compounds. These precursor compounds may also come under scrutiny for regulation.
- The currently proposed MassDEP regulation is based solely on toxicity, and doesn't account for carcinogenicity. MassDEP has already suggested that emerging data on the cancer-promoting effects of PFOA and PFOS could support a future guidance level of **ZERO** for some PFAS compounds in drinking water.

Can MassDEP Guidelines Go Lower than 20 ppt?

From MassDEP's "Technical Review Summary" Dated 13 Dec 2019, p.4:

> *The cancer data is concerning to MassDEP, because some carcinogens can present a degree of risk at any exposure level. To account for this potential risk, MCL goals (MCLGs) of zero have been established for some chemicals and may ultimately be warranted for certain PFAS. MCLGs are guidance values rather than standards and are levels of a contaminant in drinking water at or below which there is no known or expected risk to health. At this time, however, the level of cancer risk posed by these compounds is unclear. Until the cancer data on these compounds is better understood, MassDEP will move ahead with the drinking water values based on non-cancer effects. MassDEP ORS will follow and assess research in this area to determine if future revisions to the drinking water values are needed.*

If a future MassDEP standard established a guidance level of zero, the trace levels found at the Baddacook and Whitney Wells would no longer be in compliance.

Affected Groton Residents

The Town of Groton is divided between two watersheds, the Nashua River Watershed on the western side of town, and the Merrimack River Watershed on the eastern side of town. Known PFAS sites close to the town's southern border lie within the Nashua River Watershed.

Groton Water Customers:

Customers of the **Groton Water Department** **(GWD)** receive their drinking water from two wells at Whitney and one well at Baddacook, both within the Merrimack River Watershed. In October 2019, Groton's Board of Water Commissioners requested exploratory testing for all three GWD wells. Trace amounts of PFAS were found in two wells in amounts near the lower limits of the testing instruments. All three wells remain in compliance with current and proposed regulatory limits for PFAS.

Results:

- Baddacook: PFOA at 2.73 ppt + PFOS at 2.04 ppt = 4.77 ppt total PFAS detected.
- Whitney Well #1: PFOA at 2.44 ppt = 2.44 ppt total PFAS detected.
- Whitney Well #2: **No PFAS detected**.

Notes:

- The above tests have reporting limits that range from **1.82 to 1.89 ppt** for each PFAS compound. Values below the reporting limit are deemed unreliable and are reported as "not detected."
- Values above the reporting limit are accurate within a range of plus or minus 30%.
- The current MassDEP ORSG for five PFAS is a combined 70 ppt. Proposed regulations would lower that number to a combined **20 ppt** for six PFAS. The GWD results are several times lower than that.

West Groton Water Customers:

Customers of the West Groton Water Supply District should contact the WGWSD for information about the potential for PFAS in their water supply. There is no connection between the GWD and WGWSD water systems.

Non-Community Water Systems

If proposed regulations go into effect in Massachusetts as expected, they will be enforceable against non-community systems like those associated with schools, hospitals, factories, and restaurants. In Groton, this would include Groton-Dunstable Regional High School, the Grotonwood Camp, and the Still Meadow development. A schedule of testing for PFAS would begin in 2021.

Residents with Private Wells:

MassDEP advises:

> *If your well is located within one to two miles of a known source of PFAS or to other water supplies where PFAS has been detected, you may wish to consider sampling your water source. Sources of PFAS may include airfields, fire training areas, certain manufacturing facilities, and some waste disposal sites. Your local health department may have information on historical or potential sources of PFAS, or other PFAS impacted water supplies, that may be in proximity to your private well.*
>
> *Because PFAS have been widely used in consumer products, it is possible that some septic systems may also be a source of PFAS to ground water.*

See the "Potential Sources of PFAS in Groton" section below for specific areas of concern and MassDEP's "PFAS in Private Wells FAQ" for information on testing.

PFAS vs. Manganese

Because Groton has become familiar with the issue of manganese in drinking water, it may be useful to compare the nature of that threat with the nature of PFAS compounds.

- Manganese is a single element. PFAS is a class of a few thousand different molecular compounds, each of which must be separately studied and evaluated;
- Manganese is beneficial to health in small quantities. PFAS compounds are not healthy or beneficial in even trace amounts. For toxic PFAS compounds, the only safe level is zero.
- When compared with manganese, PFAS compounds can be toxic at much lower levels. Action levels in Massachusetts are 300,000 ppt for Manganese versus 70 (and soon to be 20) ppt of several combined PFAS compounds. (1 ppt = 1 part per trillion = 1 ng/L)
- For manganese, the greatest concern is with acute exposure by infants with underdeveloped digestive systems. By six to twelve months of age, children will have developed the ability to regulate their manganese levels, and will retain this ability throughout their lives. For PFAS, the concern is with people of all ages. Human bodies never develop a natural mechanism for processing toxic PFAS compounds or for regulating PFAS levels.
- For manganese, MassDEP advises that there is no particular danger to breastfeeding infants and that pregnant individuals should consult their health care provider about manganese intake. For toxic PFAS compounds, pregnant women, infants, and breastfeeding mothers are populations of heightened concern because of greater relative water consumption.
- For manganese, there is a special concern with drinking water because manganese is absorbed more readily from liquids than from solid foods. For toxic PFAS compounds, the concern with contaminated drinking water comes in addition to concerns over PFAS compound exposure from contaminated foods, food and beverage containers, consumer products, and contaminated household dust.
- Because manganese precipitates into a solid form, levels have been found to decrease in a water system between the source and customer faucets. There is no information available about the variation of PFAS levels within a water distribution system.
- Unlike manganese, in addition to issues of toxicity, some PFAS compounds are suspected carcinogens.

- While remediation is mandated for manganese at the levels currently registered at the Whitney Wells, no action is required for the known PFAS levels at any Groton water source.

Potential Sources of PFAS in Groton

Trace amounts of PFAS compounds have been found at Baddacook Well and at one of the two Whitney Wells. The source of this contamination is currently unknown and may never be known for certain. Potential sources of PFAS in Groton include:

Firefighting Foams:

- Firefighting foams that contain PFOS were discontinued in 2002. However, the pre-2003 foams have a long shelf-life and remain stockpiled on military bases and in civilian fire departments. PFAS compounds from past usage of these foams will remain in the environment, potentially for centuries.
- Some post-2003 foams, still in widespread use, contain a blend of less well-studied PFAS compounds, some of which can break down into PFOA and similar compounds.
- PFAS-free firefighting foams are available. Best practice for transitioning from PFAS to non-PFAS foam includes the decontamination of any firefighting apparatus exposed to PFAS compounds.
- **In Groton,** the PFAS levels of current firefighting foam stocks are currently unknown, and past usage of firefighting foams containing PFAS has not been assessed. Exposure to toxic PFAS compounds in firefighting foams and turnout gear would present an ongoing occupational hazard for Fire Department personnel.

The Retired Airstrip at Fort Devens:

- The U.S. Department of Defense has identified hundreds of current and former military sites that are known to have PFAS contamination related to the use of firefighting foams, including the retired airstrip at Fort Devens.

- **At Fort Devens,** a cleanup of PFAS substances is underway. Until the cleanup is completed, additional PFAS compounds may leak into the environment, and existing contaminants will continue to migrate through the groundwater toward drinking water sources of surrounding communities, possibly including southern parts of Groton within the Nashua River Watershed.

Wastewater and Sewage:

- Traditional sewage treatment is not effective at removing PFAS compounds, which are released with treated water back into the environment. Because PFAS compounds have been widely used in consumer products, it is possible that some septic systems may also be a source of PFAS compounds to ground water.
- Institutions with well water and septic systems have been known to experience PFAS contamination when PFAS-based cleaning products are washed down the drains, migrating from the septic field to the well.
- **In Groton,** the regional high school in an example of an institution that has both septic and a private well. It's unknown whether PFAS-based cleaning products, floor waxes, or carpet and fabric treatments have been used at the high school, and whether the wells have ever been tested for PFAS contamination. Under a proposed MassDEP regulation, mandatory testing for PFAS compounds in the high school well water will begin in 2021.

Bio-Solid Fertilizer:

- In December 2019, a *Boston Globe* report identified fertilizer made by the MWRA from a recycled sludge of treated sewage as yet another source of PFAS in the environment, potentially contaminating soil, crops, animal feed, and the drinking water in agricultural areas.
- **In Groton,** it's not currently known how extensively contaminated fertilizer may have been used at area farms.

Airborne Emissions and Rainfall:

- Airborne PFAS compounds have been detected around industrial sites.

- A 2019 study from the National Atmospheric Deposition Program (NADP) based at the University of Wisconsin-Madison looked at rainwater samples, detecting PFAS compounds in the rainfall over parts of the United States including Massachusetts.
- **In Groton,** until upwind emissions are better regulated, we can expect traces of PFAS compounds in some of the rainwater that fills our surface water and recharges our public and private wells.

Consumer Products:

- PFAS-treated paper, carpets, fabrics, and other products can degrade over time, creating PFAS-contaminated household dust. Teflon-treated cookware also degrades over time, potentially releasing contaminants into food.
- PFAS-treated products disposed of in landfills can cause PFAS compounds to leach into the soil and groundwater.
- **In Groton,** one potential source of environmental PFAS is from the food wrappers, old carpeting, fabrics, cosmetics, and other consumer products buried in the capped landfill at the transfer station on Cow Brook Pond Road. It's unknown whether the transfer station soils, surface water runoff, and surrounding groundwater have ever been tested for PFAS contamination.

Industrial Sites:

- **In Groton,** the former Conductorlab site on Main Street was a manufacturer of printed circuit boards. While PFAS-based anti-fuming agents were used in the electroplating and semiconductor industries at the time this plant was active, the use of PFAS compounds at this particular site is unconfirmed. It's likewise unknown whether the Conductorlab site soils, surface water runoff, and surrounding groundwater have ever been tested for PFAS contamination.
- **In West Groton,** Hollingsworth & Vose is a manufacturer of specialty paper products and paper-based filters. While PFAS-based treatments have historically been used within the paper industry, the use of PFAS compounds at this particular site is unconfirmed. It's likewise unknown whether the H&V site soils, surface water runoff, and surrounding groundwater have ever been tested for PFAS contamination.

Health Concerns

PFOA and PFOS are the most-studied of the PFAS compounds, but there is still much research to be done. Studies so far have been done on industrial plant workers exposed to occupational levels of the compounds, consumers exposed to contaminated water supplies, and experimental animals. Although results suggest several possible and probable effects that PFAS compounds may have on human health, many factors are at play, and we can't say for sure that any given individual's specific health problems were caused by or made worse by exposure to PFAS compounds.

PFAS Compounds as Endocrine Obstructors

Some PFAS compounds are known or suspected to bind to the hormone receptors of human cells. This may cause hormonal responses to be improperly triggered or blocked, affecting fertility and reproduction, neurodevelopment, the neruoendocrine system, obesity, and diabetes. Some studies suggest that prenatal exposure can have effects that last a lifetime. Endocrine obstructors may also promote hormone-sensitive cancers.

PFAS Compounds as Immunity Suppressants

Some PFAS compounds are known or suspected to suppress human immune functions. They may promote asthma, allergies, infections, and a decreased resistance to diseases. Some studies link PFAS compounds to autoimmune disorders including ulcerative colitis. They may also reduce the effectiveness of vaccines by tamping down the production of antibodies in response to vaccination.

PFAS Compound Effects on Liver Functioning

Some PFAS compounds are known or suspected have an effect on the liver. They have been shown to cause hepatic steatosis in rodents. In humans, they may contribute to obesity, insulin resistance, high cholesterol, and high blood pressure.

PFAS Compound Effects on Thyroid Functioning

Some PFAS compounds are known or suspected to have an effect on the thyroid. They may interfere with metabolism, lipid homeostasis, growth and neurodevelopment, and the proper regulation of the respiratory, cardiovascular, nervous, and reproductive systems. Effects on brain development may promote instances of ADHD, autism, and cognitive disorders. Effects on metabolism may lead to weight gain, fatigue, and other symptoms.

PFAS Compounds as Potential Carcinogens

Some PFAS compounds are suspected to increase the risk of kidney, bladder, testicular, and prostate cancers. The International Agency for Research on Cancer (IARC) issued a July 2016 monograph concluding that "[PFOA] is possibly carcinogenic to humans (Group 2B)." The agents in IARC's Group 2B may show sufficient evidence of carcinogenicity in experimental animals but limited or inadequate evidence of carcinogenicity in humans. Ongoing studies should provide additional data for future consideration.

A PFAS Timeline

- ***1947 to 1949:*** The Minnesota Mining and Manufacturing Company begins producing PFOA and PFOS. A search begins for commercial applications of these exciting new molecules. Today, the company is known as 3M.
- ***1951:*** DuPont begins use of PFOA as a surfactant in Teflon products. Teflon had been discovered in 1938 and was initially used primarily as a valve lubricant. PFOA was what finally allowed an otherwise non-stick coating to stick to a pan. Today's Teflon is manufactured by the DuPont spin-off company, Chemours.
- ***1952:*** 3M formulates Scotchgard using PFOS, with commercial sales beginning in 1956. Today, 3M markets a refomulated Scotchgard using a less well-studied PFAS compound.
- ***1963:*** U.S. Navy scientists began to work with 3M to develop PFAS-based Aqueous Film Forming Foams (AFFF). The U.S. military begins use of PFAS-based foam for suppression of chemical and petroleum fires.
- ***July 1967:*** In the wake of the USS Forrestal fire off the coast of North Vietnam, the U.S. Navy makes it mandatory for all of its vessels to carry PFAS-based

firefighting foam, and increases usage at U.S. military bases and airstrips. The ensuing PFAS contamination would become yet another legacy of the Vietnam War.

- ***1967:*** The FDA approves the use of PFOS and PFOA in food packaging. They would come to be used in fast-food packaging, pizza boxes, candy wrappers, and microwave popcorn bags.
- ***1968:*** Scientists begin to detect then-unidentified organofluorine substances in human blood serum.
- ***1970s and 1980s:*** Documents from this time demonstrate 3M's and DuPont's growing knowledge that PFAS compounds can be toxic, persistent, and bioaccumulative in humans. The detrimental health effects on factory workers and residents around PFAS manufacturing plants would eventually be revealed only through litigation.
- ***1976:*** As detection methods grow more sensitive, studies begin to suggest that the organofluorines in human blood could be PFOS and PFOA.
- ***1976:*** Congress passes the Toxic Substances Control Act (TSCA). As substances already in the stream of commerce, PFOS and PFOA are grandfathered in without any safety testing required.
- **1981:** DuPont transfers female workers from areas of its plant where PFOA was used after children with birth defects are born to the women.
- **1984:** DuPont's tests find PFOA in the drinking water of Little Hocking, Ohio, across the river from its Parkersburg, West Virginia, Teflon plant.
- ***1997:*** PFOA and PFOS are verified to exist in an alarming percentage of global blood-bank samples.
- ***1999:*** The U.S. EPA begins an investigation of PFOA and PFOS based on global distribution and reported toxicity.
- ***May 2000:*** 3M announces a voluntary phase-out of PFOS, PFHxS, and PFOA. The phase-out would be partially completed by the end of 2002, and entirely complete by 2008.
- ***2001:*** Attorney Robert Bilott files a federal class-action suit against DuPont for polluting the drinking water in and around its Parkersburg plant with PFOA. The suit exposes thousands of documents detailing what DuPont knew of the hazards of PFOA. Bilott's memoir would be adapted into the 2019 film, *Dark Waters*.
- ***2002:*** 3M partially completes its voluntary phase-out of PFOS, PFHxS, and PFOA manufacturing.
- ***2003:*** A reformulated Scotchgard is introduced, replacing PFOS with a related compound called PFBS. Other PFOS-based products would be similarly

reformulated. Information on the replacement PFAS compounds is limited, some are a proprietary blend, and many can not yet be detected in the environment by standard testing protocols.

- ***2003:*** Firefighting foams that degrade into PFOS are discontinued. However, the pre-2003 foams have a long shelf-life and remain stockpiled on military bases and in civilian fire departments. Many post-2003 foams, while PFOS-free, still often contain a blend of less well-studied PFAS compounds, some of which break down into PFOA and similar compounds in the environment.
- ***2003 to 2004:*** A study shows that 99.7% of Americans have detectable PFOA and PFOS in their blood serum (*Calafat et al.*, 2007).
- ***March 2006:*** Under the U.S. EPA's PFOA Stewardship Program, DuPont and other manufacturers agree to phase out PFOA and related compounds. The companies commit to a 95% reduction by 2010 and total elimination of U.S. manufacturing by the end of 2015. However, PFOA-based compounds and products would continue to be imported from other countries.
- ***May 2009:*** The U.N.'s Stockholm Convention determines PFOS to be a Persistent Organic Pollutant (POP). A determination on PFOA would be made in 2019, and on PFHxS in 2020 (expected).
- **2009:** DuPont replaces PFOA in its Teflon production process with a replacement PFAS called GenX, which is touted as having a more favorable toxicological profile than PFOA. However, testing shows detrimental effects of GenX in animals, while the effects in humans are as yet undetermined.
- ***2009***: U.S. EPA issues Provisional Health Advisory (PHA) for short-term health effects at 400 parts per trillion of PFOA and 200 parts per trillion of PFOS. PFAS compounds are scheduled for inclusion in the upcoming third round of the U.S. EPA's Unregulated Contaminant Monitoring Rule (UCMR3) program to collect data from public water systems.
- ***Between 2013 and 2015***: Through the UCMR3 program, initial testing is conducted at many drinking water sources nationwide. Concerning PFAS levels are detected across the country. In Massachusetts, concerning levsls are found in Hyannis and Westfield.
- ***2015:*** U.S. manufacturers complete the phase-out, started in 2006, of several related PFAS including PFOA, PFOS, PFNA, PFHxS, and PFHpA. However, in the meantime, PFAS production in China has increased to offset the reduction in U.S. output. China would not commit to reducing PFOS production until 2017.
- ***May 2016***: Based on data from UCMR3 and a review of then-current literature, the U.S. EPA issues a lifetime Health Advisory (HA) of 70 parts per trillion for the combination of PFOS and PFOA, in drinking water.

- ***August 9, 2016:*** A study finds concerning levels of PFOS and PFOA in 194 out of 4,864 water supplies, with 75% of the detections confined to thirteen states, including Massachusetts. Firefighting foams are identified as a major contributor (*Hu, et al.*, 2016).
- ***2016***: The U.S. Army initiates the Superfund process to evaluate the PFAS levels in groundwater and in the municipal water supply wells for Devens and Ayer.
- ***June 2018***: MassDEP establishes an Office of Research and Standards Guideline (ORSG) level for drinking water. More protective than the U.S. EPA health advisory, the MassDEP guidelines also include PFNA, PFHxS, and PFHpA, cited for having similar chemical structures to PFOS and PFOA and a likelihood for exhibiting similar traits and toxicities. The ORSG level is 70 parts per trillion applied to the sum of all five compounds.
- ***August 2018***: A series of tests found PFAS in multiple drinking water sources in Ayer and Devens in excess of MassDEP's guidelines and U.S. EPA's advisory level.
- ***October 2018:*** In response to a petition sponsored by the Conservation Law Foundation and Toxics Action Center, MassDEP initiates a public response period on a potential PFAS water standard, or Maximum Containment Level (MCL).
- ***January 2019***: MassDEP announced its intention to develop a new drinking water standard, or Maximum Contaminant Level (MCL), for PFAS.
- ***May 2019:*** The U.N.'s Stockholm Convention determines PFOA to be a Persistent Organic Pollutant (POP).
- ***September 2019***: The Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) award $1 million to the Silent Spring Institute to cover the first year of a five-year study to look at PFAS exposures in Hyannis and Ayer. The goal of the study is to understand the relationship between PFAS exposure and health outcomes in differing populations, adding to scientific knowledge about PFAS exposure and associated health risks.
- ***October-December 2019:*** Congressional efforts are made to clean up legacy PFAS pollution with an amendment to the National Defense Authorization Act. Some funding is secured to study the issue, but Congress fails to designate PFAS as "hazardous chemicals," which would have kick-started clean-up activities at military installations where PFAS have been detected.
- ***December 2019:*** A *Boston Globe* report identifies fertilizer made by the MWRA from recycled sludge as yet another potential source of PFAS in the environment, potentially affecting drinking water in agricultural areas.

- ***December 2019:*** MassDEP publishes its final proposed regulation, set to take effect in 2020.
- ***October 2021:*** Under a proposed MassDEP regulation, small water systems like the Groton Water Department and West Groton Water Supply District are scheduled to begin regular testing for PFAS.
- ***By 2023,*** the NDAA requires the U.S. Department of Defense to no longer procure firefighting foams that contain PFAS.
- ***By 2024,*** the NDAA requires the U.S. Department of Defense to phase out the use of firefighting foams that contain PFAS.

References

U.S. HHS's Agency for Toxic Substances and Disease Registry
https://www.atsdr.cdc.gov/pfas/index.html

People of Ayer Concerned about the Environment (PACE)

Environmental Working Group
https://www.ewg.org/key-issues/toxics/nonstick-chemicals

United Nations' Stockholm Convention
http://chm.pops.int/

Silent Spring Institute
https://silentspring.org/

Former Fort Devens Environmental Restoration Program
https://ftdevens.org/public/framework/bannerhtml.aspx

Studies Cited

Calafat AM, Wong LY, Kuklenyik Z, Reidy JA, Needham LL (November 2007). "Polyfluoroalkyl chemicals in the U.S. population: data from the National Health and Nutrition Examination Survey (NHANES) 2003–2004 and comparisons with NHANES 1999–2000". *Environ. Health Perspect.* **115** (11): 1596–602.

Xindi C. Hu, David Q. Andrews, Andrew B. Lindstrom, Thomas A. Bruton, Laurel A. Schaider, Philippe Grandjean, Rainer Lohmann, Courtney C. Carignan, Arlene Blum, Simona A. Balan, Christopher P. Higgins, and Elsie M. Sunderland, "Detection of Poly- and Perfluoroalkyl Substances (PFASs) in U.S. Drinking

Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants" *Environmental Science & Technology Letters,* **2016 3** (10), 344-350.

Footnotes

How Many PFAS Compounds Are Out There?

[2] From the Organisation for Economic Co-operation and Development (OECD)'s "Summary Report on Updating the OECD 2007 List of Per- and Polyfluoroalkyl Substances (PFASs)" Dated 4 May 2018, p.6:

In total, ***4730*** *PFAS-related CAS numbers have been identified and manually categorised in this study, including several new groups of PFASs that fulfil the common definition of PFASs (i.e. they contain at least one perfluoroalkyl moiety) but have not yet been commonly regarded as PFASs. . . . [I]t should be noted that while this list is comprehensive, it is not an exhaustive list.*

U.S. EPA maintains a Master List of PFAS Substances, including those on the OECD list and other public lists:

[Accessed on 1 Jan 2020,] the consolidated list contains ***6330*** *PFAS CAS-name substances, with* ***5264*** *represented with a defined chemical structure. There is no precisely clear definition of what constitutes a PFAS substance given the inclusion of partially fluorinated substances, polymers, and ill-defined reaction products on these various lists. . . . This PFAS Master List will continue to expand as component lists grow.*

Many of these PFAS compounds are not currently used or manufactured within the United States. The U.S. EPA considers approximately **600** PFAS compounds to be "currently active in U.S. commerce."