


PFAS EXPLAINED: The growing crisis of 'forever chemicals'

July 24, 2019 [Maven](#) [Best of the Notebook](#), [Meetings](#)

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that includes PFOA, PFOS and GenX chemicals. Since the 1940s, PFAS have been manufactured and used in a variety of industries around the globe, including in the United States. PFOA and PFOS have been the most extensively produced and studied of these chemicals. Both are very persistent in the environment and in the human body. Exposure to certain PFAS can lead to adverse human health effects.

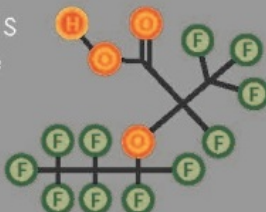
PFOA & PFOS

U.S. manufacturers voluntarily phased out PFOA and PFOS, two specific PFAS chemicals.



GenX Chemicals

GenX chemicals are a replacement for PFOA.



PFAS are a group of chemicals that have become ubiquitous in consumer goods – and the environment. What are they and what can be done about them?

PFAS, or poly- and perfluoroalkyl substances have received a lot of attention in the media recently. Initially notorious for contaminating drinking water sources as a result of industrial releases and use of firefighting foam, PFAS are also used in a wide variety of consumer products. PFAS can easily move through soil into groundwater aquifers and contaminate drinking water sources. Since PFAS are not known to breakdown in the environment, they have been dubbed in the media as the 'forever chemicals'.

The widespread contamination of PFAS and its cousin, PFOA, have resulted in a flurry of legislation at the federal level, with about 30 different bills to address the problem in various ways. About a year ago, the state of California issued notification and response levels, which they are looking to revise in the coming months.

At the July meeting of Metropolitan's Engineering and Operations Committee, Dr. Mic

Stewart, Director of Water Quality, gave the following overview of PFAS, including how humans are exposed, health effects, their occurrence in California, monitoring, and treatment.

It's important to point out that PFAS have not been detected in Metropolitan's water supplies, but it is a complex and fast moving issue that does affect some Metropolitan member agencies.

WHAT ARE PER- AND POLYFLUOROALKYL SUBSTANCES? (PFAS)

Chemically speaking, the term 'alkyl' refers to the fact that they are a carbon chain-based substance; 'fluoro' means that there are fluorine atoms attached to the carbon atoms, and 'per' and 'poly' refer to the degree to which the fluorine atoms are attached to the carbon atoms.

History and Use of PFAS

“Better Things For Better Living...Through Chemistry”
[DuPont advertising slogan (1935)]



https://commons.wikimedia.org/wiki/File:Happy_Pan_Poster.jpg

PFAS ¹	Development Time Period							
	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
PTFE	Invented	Non-Stick Coatings			Waterproof Fabrics			
PFOS		Initial Production	Stain & Water Resistant Products	Firefighting foam				U.S. Reduction of PFOS, PFOA, PFNA (and other select PFAS ²)
PFOA		Initial Production		Protective Coatings				

Adapted from Interstate Technology Regulatory Council

First developed in the 1940s, PFAS are a broad class of manufactured chemicals that are widely used to make products that resist heat, oils, grease, stains, and water. There are close to 5000 different PFAS on the global market today. Some of the common products that have PFAS include Teflon coated cookware, carpets, clothing, paper packaging for food, and fire retardants; there are many more.

PFAS are extremely stable, primarily due to the very strong carbon-fluorene bond. They have become ubiquitous in the environment and can be found in soil, air, surface water, groundwater, wastewater, plant effluent, sewage sludge, and landfills.

One of the early PFAS-based products was polytetrafluoroethylene or PTFE; it was invented in late 1930s and the more common

name for that is Teflon. Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS) soon followed, and were used in stain and water resistance products, firefighting foam, and protective coatings. PFOA and PFOS are the most common PFAS found in the United States.

HEALTH EFFECTS OF EXPOSURE



These substances can bioaccumulate in humans and wildlife. Early testing found that 95% of the people who were tested for PFAS tested positive. This led to a voluntary phase-out of the two products that started in 2000, which in turn led to declines by about 60 to 80%. Exposure continues due to presence in products from some companies not participating in the voluntary phase-out and from products that are imported from other countries.

The Science Advisory Board to USEPA and World Health Organization considers PFOAs a likely human carcinogen; PFOS is also considered a human carcinogen. Adverse health effects associated with PFOA or PFOS include high cholesterol levels, ulcerative colitis, thyroid disease, different types of cancers, decreased vaccination response, and liver damage. Dr. Stewart also noted that there is little

information on other PFAS compounds which are likely also of health concern.

FEDERAL AND STATE ACTIONS ON PFOA AND PFAS

In 2016, the US EPA established a drinking water health advisory of 70 nanograms per liter; nanograms per liter is equivalent to parts per trillion. Dr. Stewart said to put that in context, it would be like filling the Rose Bowl full of water and adding a few drops, so even though it's occurring at extremely low levels, it still can have adverse health effects.

The health advisory is based upon the concentration of PFOA and PFOS. *"The way they do the health effect studies, in essence what they are saying is if you consume water containing 70 parts per trillion or greater over your lifetime, the lifetime is 70 years, in their calculations, you might subject to some adverse health effects,"* said Dr. Stewart. *"When they do their health effects modeling, they look at the most sensitive populations to set these numbers, and it's usually for infants, pregnant women, and people who might be immune-compromised."*

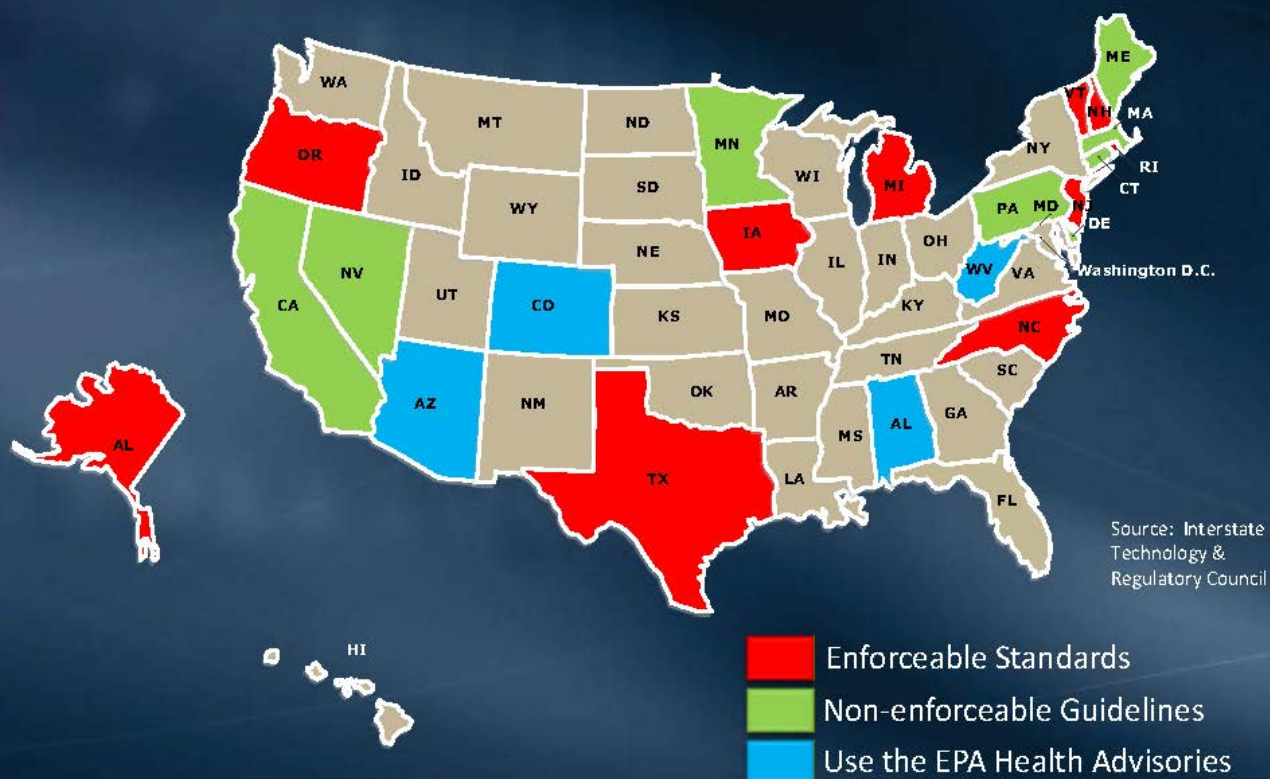
But health advisories are not drinking water standards, he pointed out. *"They aren't enforceable standards; they are really guidance that the EPA gives to water utilities across the country so they can take necessary action to assess contamination, inform consumers, and limit exposure."*

In February of 2019, the EPA released a [PFAS Action Plan](#), which has a number of elements. The plan calls for continued research and improving methods of detection. Dr. Stewart noted that by listing these chemicals, it gives the EPA some flexibility in terms of manufacturing levels of PFAS. *"If you want to protect public health, probably the most important step is not to have it produced commercially to begin with,"* he said.

Dr. Stewart noted that the EPA has signaled its intent to move forward with developing drinking water-related regulations for PFOA

and PFOS, but they may be considering other PFAS in the future.

States with Standards and Drinking Water Guidelines for PFAS in the United States



In a national survey of the occurrence of PFAS in the country that was conducted in 2012 and 2013, 36 states reported detections of either PFOS or PFOA. About 5000 utilities did the survey and at one point, 3% of those reported levels of PFOA or PFOS above the health advisory.

He presented a slide showing the states that have set standards and drinking water guidelines, noting that this issue is emerging so

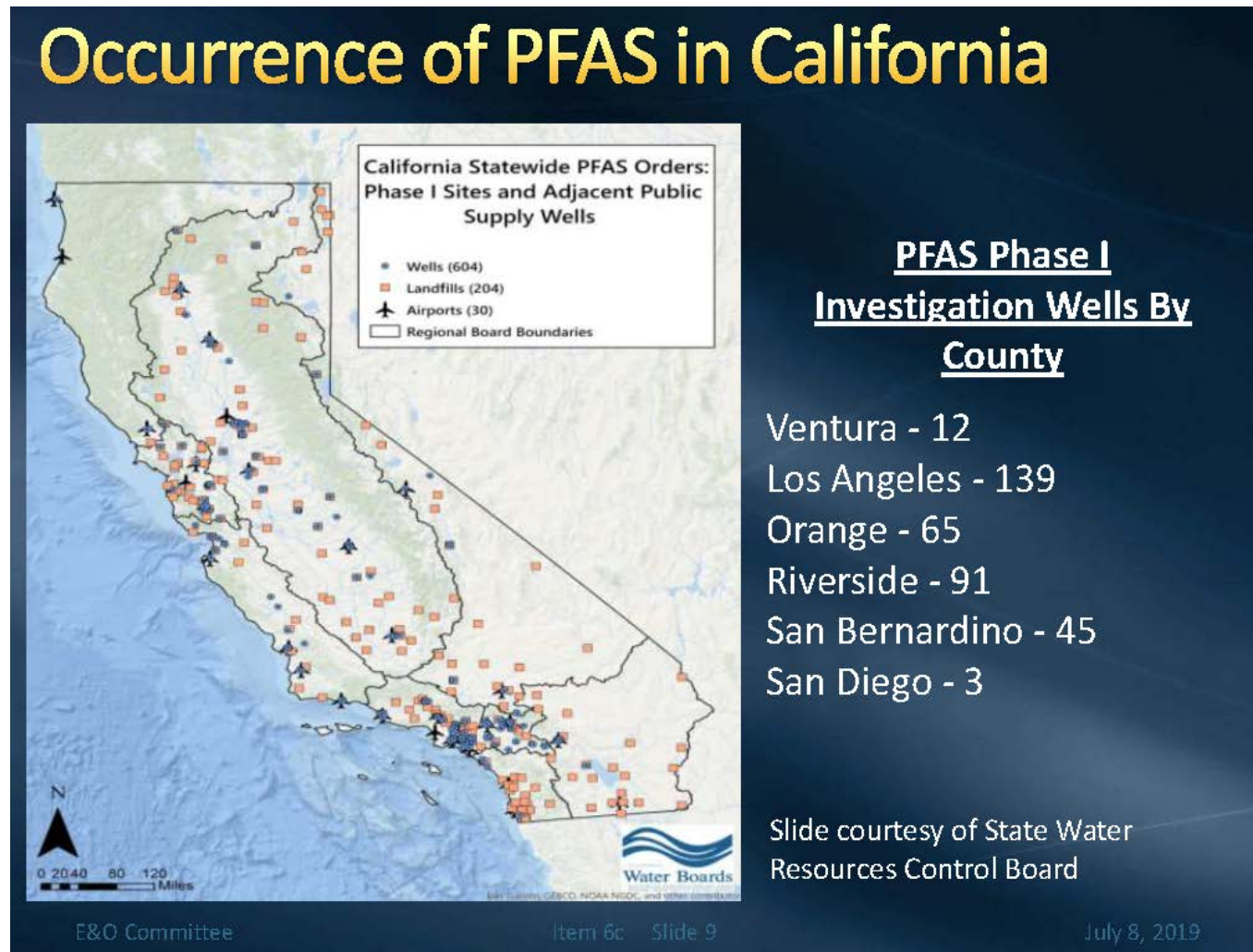
quickly that states are rapidly changing guidelines and standards every day of the week.

"Some states have developed enforceable standards, others have just guidelines, and some just have deferred to the EPA health advisories."

Dr. Stewart noted that the numbers can vary dramatically from state to state. *"I've seen it at 13 parts per trillion in one state, to over 1000 in other states, so what this really says to me is it*

highlights the uncertainty and the interpretation of health effects data when setting guidelines."

PFAS IN CALIFORNIA



The map on the slide shows the occurrence of PFAS in California; it shows the sites that are known to contain PFAS as well as sites suspected to be a high risk for having them. This includes airports, because airports use foam in the firefighting activities and the foam or agent typically contains PFAS.

The column on the right are wells identified by the state as either having high levels of PFAS or

may have that based upon their proximity to airports or landfills and how many wells in each of the counties that would be subject to further testing.

In July of 2018, the State Water Board established notification levels for PFOA at 14 parts per trillion and PFOS at 13 parts per trillion. Similar to EPA's health advisories, notification levels are not

enforceable. Notification levels in California are health-based advisory levels for chemicals that don't have drinking water standards.

If the notification levels are exceeded, there are two statutory requirements: Wholesale water systems must notify governing bodies and water systems directly supplied with that drinking water; Retail water systems must notify governing body; and the State Water Board recommends but does not require that customers and consumers be notified.

Last year, the State Water Board also established a response level at 70 parts per trillion, which is the same level that EPA uses for their health advisory. A response level is the level at which the state recommends but does not require removal of drinking water from service. An agency can elect not to remove the water from service, but the State Board recommends If an agency elects not to remove the source, the that the agency notify local governing body; notify customers that the contaminant exceeds level at which State recommends removal and reason for continued use; issue a press release, and conduct regular sampling until contaminant drops below response level.

The State Water Board is expected to be changing their notification level soon, and the response levels will likely be modified later this fall.

The State Water Board is currently implementing a three phase program to study the extent of occurrence of PFAS throughout the state. The first phase is testing water wells near airports and landfills; phase 2 is testing near primary manufacturing facilities, and phase 3 is testing near secondary manufacturing sites and wastewater treatment plants. The sampling is starting this year and will begin with quarterly sampling for one year.

WHAT ABOUT METROPOLITAN SUPPLIES?

Dr. Stewart said that they collected samples in 2013, 2016, and 2017 and found neither PFOA or PFOS detected in source or treated waters. They also sampled this year, but the test results have not been received yet. He noted that Metropolitan does not perform PFAS analysis in their laboratory.

While Metropolitan doesn't have any detections of PFAS, he noted that some member agencies do have detections in their system and they are making plans to address that in their systems.

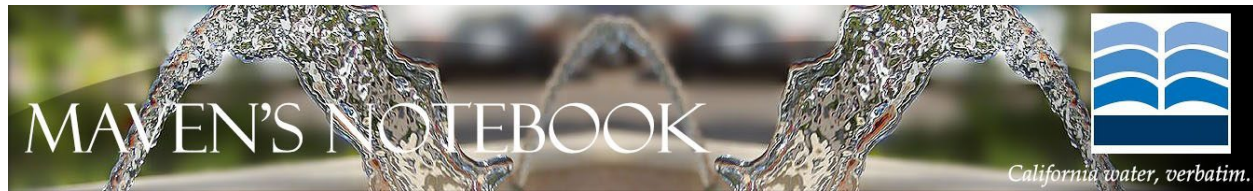
MONITORING AND ANALYTICAL ISSUES



Photo by Arielle Fragassi

Dr. Stewart noted that in terms of detecting PFAS, the methods still remain in the developmental phase as laboratories continue to improve the methods for detection. Out of the close to 5000 PFAS in existence, fourteen of them could be detected in 2009. In 2018, they could detect 18 PFAS and the detection limit was lower, so laboratory methods continue to improve.

Because of the prevalence of PFAS in the environment, it's very easy to contaminate the sample, so special collection procedures are required. *"They tell you that you shouldn't wear clothes that have been washed in fabric softeners or any new clothing, or use any lotions or*



sunscreen on your hands as that could contaminate the sample,” Dr. Stewart said. “It’s a pretty extensive list. If you stopped at the fast food place and had some French fries and that package and you had that little grease-resistant cover in there, in fact that could be enough to result in a false positive sample, so they are very particular and very prescriptive steps so you don’t contaminate your sample because your doing parts per trillion.”

TREATMENT TECHNOLOGIES

The common drinking water treatments such as those used at Metropolitan’s treatment plants is generally considered ineffective for removing PFAS; Dr. Stewart says it’s about 20 to 40% maximum according to the literature he’s seen. The EPA recognizes three major treatment regimes that they consider to be highly effective in removing PFAS: activated carbon (either powder or granular), ion exchange, and membrane separation such as reverse osmosis. The EPA considers these treatments to be effective at removing up to 98-99%. Reverse osmosis is the most effective.

Dr. Stewart said the cost for treatment is around of \$350-\$500 an acre-foot. He noted these are operational costs only, and don’t include capitalization, site preparation, media regeneration, or waste disposal, which could change the costs substantially.


ADDRESSING THE PROBLEM

At the federal level, there are about 60 bills addressing PFAS, not all of them dealing specifically with water. There is a lot of legislation at the state level as well. These bills focus on a wide range of issues, including detection, restrictions on use, drinking water standards testing, and waste incineration.

At the federal level, many of the drinking water-related bills have been consolidated into Senate Bill 1790; the legislation looks to set

drinking water standards within a couple years, add more monitoring for PFAS in the next round of unregulated contaminant monitoring, and to classify PFAS as a hazardous waste.

State PFAS Legislation



- AB 841 (Ting, D – San Francisco)
 - Requires the Office of Environmental Health Hazard Assessment (OEHHA) to adopt a work plan and identify potential risks to human health
- AB 756 (C. Garcia, D – Bell Gardens)
 - Requires water systems to monitor for PFAS
 - Creates a new notification procedure for PFAS, if response or notification levels are exceeded

EBO Committee Item 56 - State 28 July 8, 2019

At the state level, there are two bills currently. AB 841 would require the Office of Environmental Health Hazard Assessment, which is the office that looks at health effects and determines notification and response levels, to adopt a workplan to identify potential risks to human health. AB 756 is an extensive bill that requires water systems to monitor for PFAS and creates new notification procedures.

SUMMARY AND NEXT STEPS

Even though Metropolitan has not detected PFOS or PFOA in either treated or finished water, they will continue to monitor for PFAS. Staff will continue to support their member agencies as they assess the extent of occurrence in their service areas, and continue to track regulatory and legislative activities related to PFAS.

DISCUSSION HIGHLIGHTS

Director John Morris (San Marino) noted that there would be an impact on Metropolitan if the state tightens up the standards and member agencies have to take drinking water wells out



of service, they will turn to Metropolitan for their water supply.

Director Adan Ortega (Fullerton) called out Orange County Water District for mobilizing a few weeks ago when they learned that the State Water Board would be setting a new reporting limit. *"We got somewhat of a reprieve; there will be, I understand, a new notification level issued today, but the reporting level won't be revised until probably October. The San Gabriel Valley Water Association and the Watermaster went into full action as well and had legislators calling, so that was a good reprieve. There's two more cycles of testing; there's phase 2 that's going to be announced fairly soon, and then there will be a phase three that will include the wastewater agencies."*

Director Ortega then asked whether their groundwater storage accounts such as Semitropic and Arvin Edison had been tested. Dr. Stewart said they have requested DWR to ask those programs to start testing for this.

Director Ortega noted that if the higher reporting limit had kicked in, it would have meant \$50 million in additional imported water purchases by Orange County agencies, and an investment of over \$200 million in capital improvements with \$15 million in annual O&M, just in Orange.

Another director noted that it would have resulted in his agency having to take all of their wells out of service, making them 100% dependent on Met.

Another director asked what was the exposure risk from drinking water as opposed to the environment. What if you use an old pan to fry a sandwich? Is that more exposure risk than drinking water?

"When you look at the list of exposure routes, a lot of it is through food-based products because they

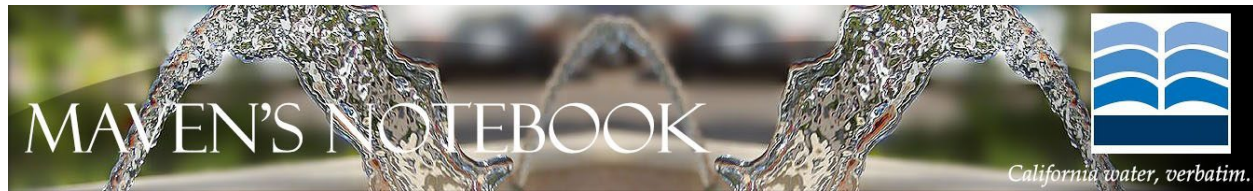
come in contact at some point with the paper wrappers and other things that have PFAS related to it, so exposure may be greater on food-related products and cooking utensils and other things you could come in contact with other than just drinking water," said Dr. Stewart.

Director Brett Barbre (Orange County) pointed out that there's a headline risk. *"A couple weeks ago, the Environmental Working Group came out with this explosive discussion of how there's this poison that's in the groundwater that's being served to you ... yeah, it's not an enforceable standard, but what they tell you now with the response level, if you don't comply with that response level, even though they haven't gone through the whole regulatory process to set the MCL, you have to explain to your customers why you're serving this water that they are telling you that you shouldn't, so it's the optics, it's the headline risk. We can argue all we want, hey you get more in chocolate cake than you do from your water, but that's not going to pass muster."*

Director Peterson asks if anything is done to eliminate PFAS in the environment.

Dr. Stewart noted that the EPA Action Plan has a number of steps that includes looking at manufacturing processes. *"The first step to limiting the amount that goes into the environment is to find out what the manufacturers are doing, so if they can register some of these compounds in the toxic registry, they can say, 'before you manufacture anything containing these, we need to be aware of it.' That's probably the most important step at the federal level is finding out who is manufacturing and what they are doing with this stuff. Some of the cleanup activities the EPA has is to focus in on that as well to find out where this stuff is at and what cleanup activities need to be engaged."*

Director Ortega added that it's his understanding that many forms of PFAS have



already been banned in the United States. *"When they've been monitoring for human impacts, they found that exposure levels are actually going down, but where we're vulnerable is that there are still many products*

that we import into the United States from countries that have not banned these substances that are still getting in."

PFAS WHAT YOU NEED TO KNOW

WHAT ARE PFAS CHEMICALS?

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that includes PFOA, PFOS and GenX chemicals. Since the 1940s, PFAS have been manufactured and used in a variety of industries around the globe, including in the United States. PFOA and PFOS have been the most extensively produced and studied of these chemicals. Both are very persistent in the environment and in the human body. Exposure to certain PFAS can lead to adverse human health effects.

PFOA & PFOS

U.S. manufacturers voluntarily phased out PFOA and PFOS, two specific PFAS chemicals.

GenX Chemicals

GenX chemicals are a replacement for PFOA.

WHAT EPA IS DOING

Some of the agency's work includes: development of additional toxicity values, analytical methods for additional PFAS and non-drinking water media as well as treatment options for PFAS in drinking water. EPA is also hosting a National Leadership Summit on PFAS in May 2018.

Established methods to measure 14 PFAS compounds in drinking water

Identified five treatment processes for PFOA and PFOS

Identified all PFAS chemicals that are legally available for production and use

Provided national monitoring data for 6 PFAS in drinking water

Issued drinking water health advisories (70 parts per trillion) for PFOA and PFOS in 2016

Provided support for 10 states with site-specific PFAS challenges and problems:
NC (Cape Fear River), MI, DE, WV, CO, NY (Hosick Falls), OH, NH, VT and NJ

Updated website to include tools and information so that states, tribes and local communities can understand, assess and address PFAS incidents and emergencies

HOW ARE WE EXPOSED TO PFAS?

PFAS include a large number of important chemicals that can be used in some food packaging and can make things grease- and stain-resistant. They are also used in firefighting foams and in a wide range of manufacturing practices. Unfortunately, some of these substances don't break down over time. That means they build up in the environment and in our bodies.

Drinking water can be a source of exposure in communities where these chemicals have contaminated water supplies. Such contamination is typically localized and associated with a specific facility, for example,

- an industrial facility where PFAS were produced or used to manufacture other products, or
- locations where firefighting foam was used such as oil refineries, airfields or other training facilities for firefighters

If you are concerned about the possibility of PFAS in your drinking water, contact your local water supplier and ask for more information about PFAS.

STAIN/GREASE REPELLENT

FIREFIGHTING FOAMS

INDUSTRIAL USES

HEALTH EFFECTS

There is evidence that exposure to PFAS can lead to adverse health outcomes in humans. If humans or animals ingest PFAS (by eating or drinking food or water that contain PFAS), the PFAS are absorbed and can accumulate in the body. PFAS stay in the human body for long periods of time. In some cases, the level of PFAS in the body can increase to the point where people can suffer from adverse health effects.

Studies indicate that high concentrations of PFOA and PFOS can cause reproductive and developmental, liver and kidney, and immunological effects in laboratory animals. Both chemicals have caused tumors in animal studies. The most consistent findings from human studies are increased cholesterol levels among exposed populations, with more limited findings related to:

- infant birth weights
- adverse effects on the immune system

- cancer (for PFOA)
- thyroid hormone effects (for PFOS)

WWW.EPA.GOV/PFAS SOURCE: U.S. EPA

FOR MORE INFORMATION ...

- [For the agenda, meeting materials, and webcast for the July meeting of Metropolitan's Engineering and Operations Committee, click here.](#)
- [For the State Water Resources Control Board's webpage on PFAS, click here.](#)
- [For the US EPA's page on PFAS, click here.](#)