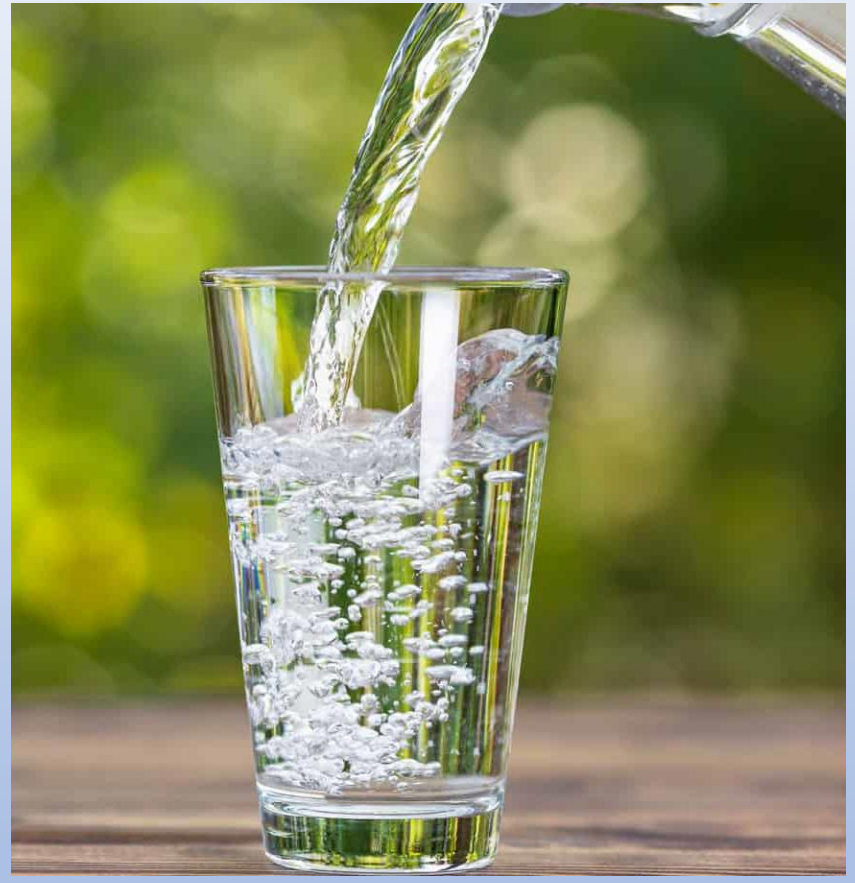


PFAS Chemicals in Duxbury Water: Understanding Health Risks & Solutions

January 23, 2024

7:00 PM

Jointly presented by The Town of Duxbury & Duxbury Safe Water Committee, Inc.

Meeting Agenda

Welcome/Introductions	Tanya Trevisan (Duxbury Safe Water Committee and Duxbury Water and Sewer Advisory Board)
Overview of PFAS and Health	Dr. Laurel Schaider (Silent Spring Institute)
Duxbury Water Supply Wells/ PFAS Sources and Town Meeting Warrant Articles	Fernando Guitart (Duxbury Selectboard)
Q & A	

Overview of PFAS and Health

Dr. Laurel Schaider
Silent Spring Institute

“Forever Chemicals” and your health: What do we know about PFAS and what are the concerns?

SILENT SPRING INSTITUTE
Researching the Environment and Women’s Health

Laurel Schaider, PhD
Senior Scientist
Silent Spring Institute

PFAS Chemicals and Duxbury Water – 1/23/24

SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

We are an independent, non-profit research organization dedicated to identifying the links between everyday chemicals and health, with a focus on women's health and breast cancer.

History

Founded by Massachusetts Breast Cancer Coalition in 1994.

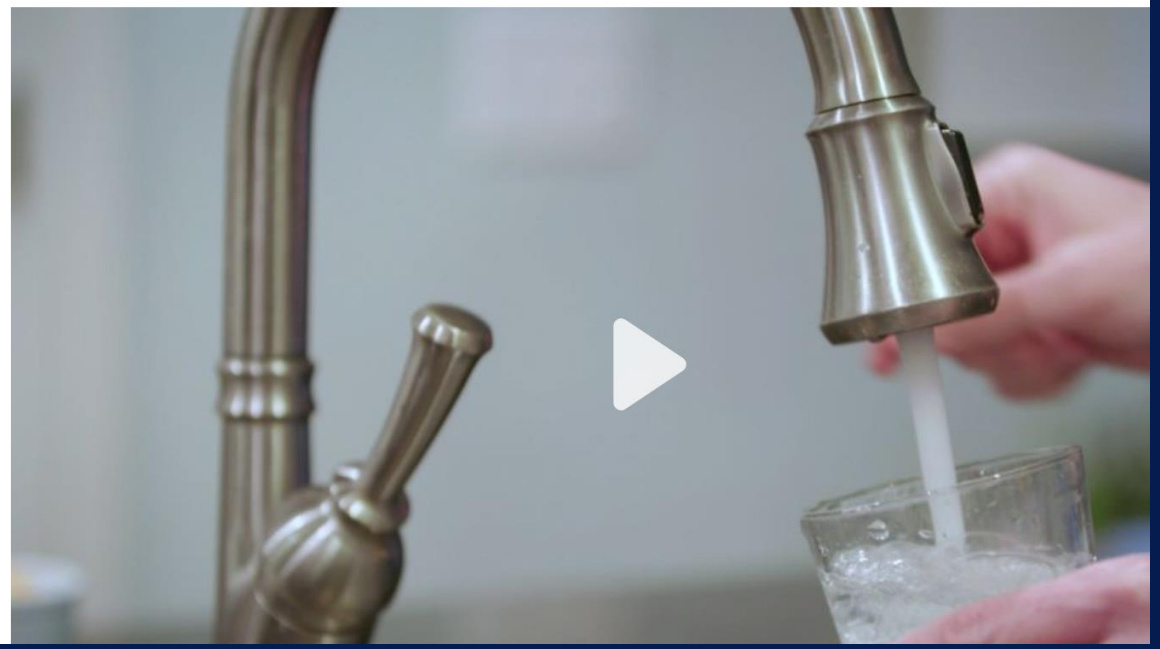
Now a leading scientific research organization on environmental causes of breast cancer.

"A lab of our own"

CNN health | Life, But Better | Fitness | Food | Sleep | Mindfulness | Relationships

Nearly half of the tap water in the US is contaminated with 'forever chemicals,' government study finds

By Jen Christensen, CNN
Updated 1:53 PM EDT, Thu July 6, 2023



Home // Local Coverage // Health

In 13 state parks, Mass. officials issue advisories for fish consumption due to PFAS

NEWS

Lawmakers hope to 'turn off tap' of PFAS forever chemicals in Mass.

Updated: Jun. 22, 2023, 5:12 a.m. | Published: Jun. 22, 2023, 5:01 a.m.

When organic is toxic: How a composting facility likely spread massive amounts of 'forever chemicals' across one town in Massachusetts

By David Abel Globe Staff, Updated July 6, 2022, 6:44 p.m.

Today's presentation

PFAS 101

EXPOSURES AND HEALTH

PFAS IN DRINKING WATER

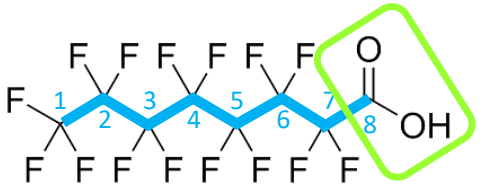
WHAT CAN YOU DO?

PFAS 101

PFAS 101
Per- and polyfluoroalkyl substances

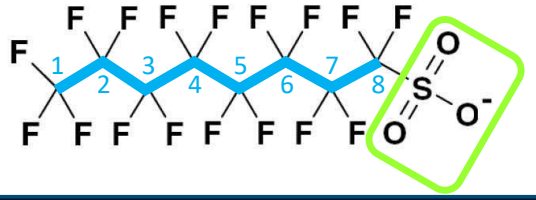
- Class of over 14,000 compounds
- "Forever chemicals" - resist degradation
- Mobile in environment
- Used in consumer products since 1950s
- Emerged as common drinking water pollutants around 2010-2015

PFOA ("C8")



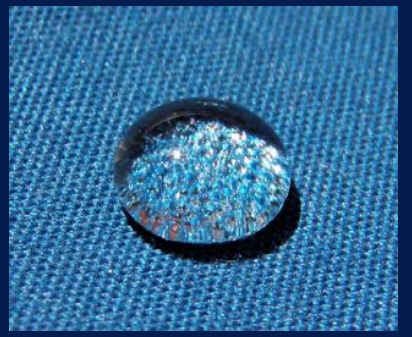
8 carbon chain

PFOS



PFAS are used in many everyday products

- Carpets & upholstery
- Waterproof apparel
- Non-stick cookware
- Waxes (floor, skis)
- Grease-proof food packaging
- Cosmetics
- Dental floss
- Paints



Silent Spring Institute studies

CNN
@CNN
Follow

2017

Researchers found fluorinated chemicals in one-third of the fast food packaging they tested, according to a report cnn.it/2jWU6Rw

NATIONAL GEOGRAPHIC

2019

SCIENCE

Fast food increases exposure to a 'forever chemical' called PFAS

Used in fast food packaging, the long-lasting chemicals can seep into food—and build up in our bodies.

USA TODAY

NATION

Oral-B Glide floss tied to potentially toxic PFAS chemicals, study suggests

Ryan W. Miller USA TODAY

Published 8:25 p.m. ET Jan. 9, 2019 | **Updated 7:15 p.m. ET Jan. 10, 2019**

2019

The Guardian

'Forever chemicals' found in nearly 60% of children's 'waterproof' or 'stain-resistant' textiles

A study found PFAS substances in clothing, pillow protectors, bedding and furniture, some labeled 'environmentally friendly'

2022

Toxic PFAS chemicals, which have been linked to cancer and a range of other health problems, have been found in children's products such as bedding. Photograph: Colorblind Images LLC/Getty Images

New York becomes third state to ban PFAS chemicals in food packaging

By News Desk on December 5, 2020

New York Gov. Andrew Cuomo has signed legislation that will help protect consumers from the harmful effects of a dangerous class of chemicals linked to serious health problems, according to Consumer Reports.

https://www.foodsafetynews.com/2020/12/new-york-becomes-third-state-to-ban-pfas-chemicals-in-food-packaging/

The New York State Senate

JUSTIFICATION:

The chemicals PFOA and PFOS have come under scrutiny in New York over the last several years due to water contamination cases. While existing federal and state efforts to regulate PFOA and PFOS are critical, there is a troubling gap in these efforts. PFOA and PFOS are part of a class of man-made chemicals called PFAS, or perfluoroalkyl and polyfluoroalkyl chemicals. Regulations on PFOA and PFOS do not address less common chemicals in the PFAS family that could pose similar and unknown human health impacts, not to mention the potential for new PFAS chemicals to be developed in the future. This bill ban PFAS chemicals in food packaging containers used in New York. Chemicals that are similar in chemical makeup to chemicals we know to be harmful should not be automatically approved for use, because it is likely they also lead to harmful health impacts. Rather, we should utilize a precautionary principle and prohibit the use of all PFAS chemicals in food packaging.

...

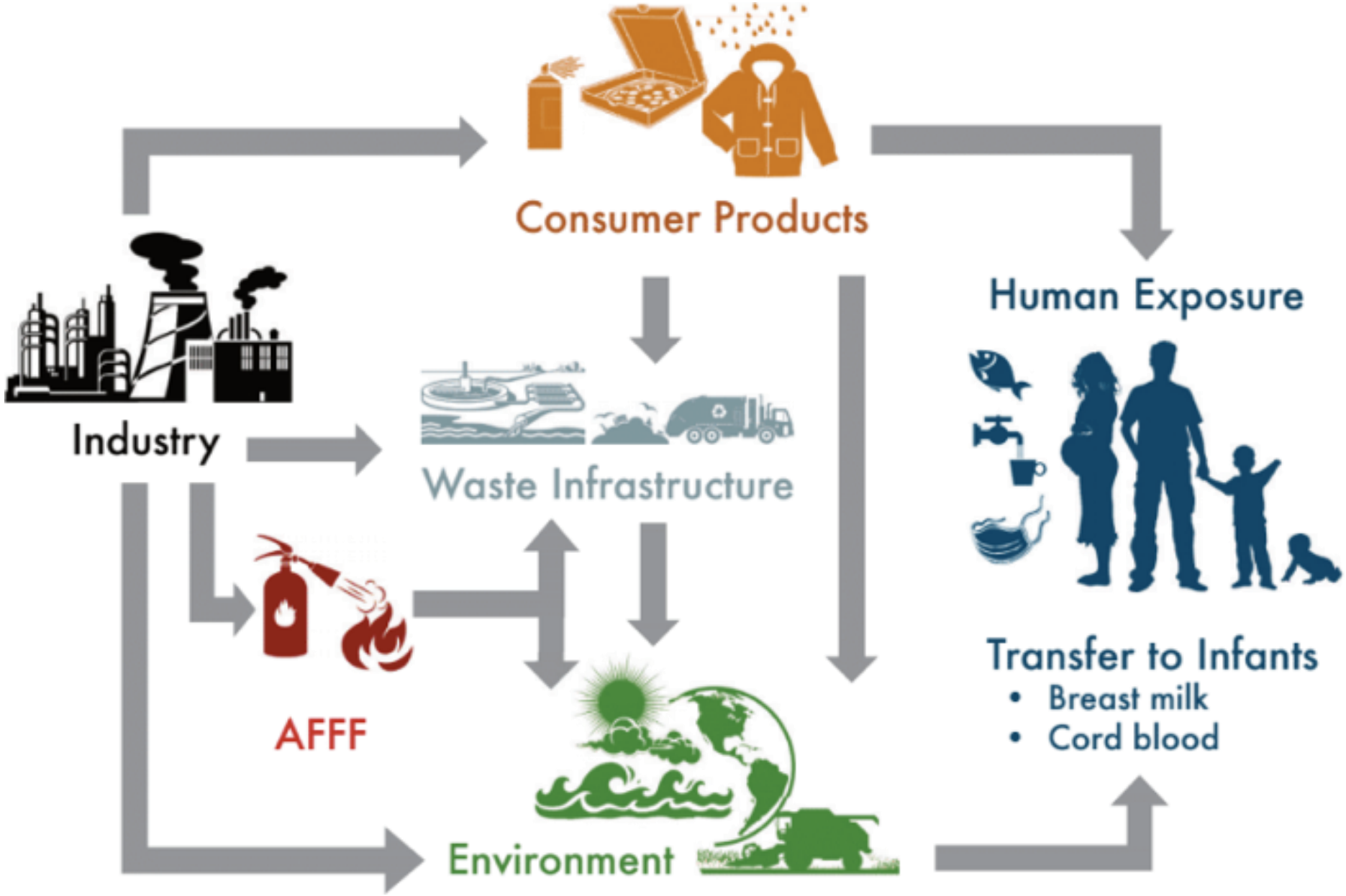
Food packaging is a key place to look for PFAS chemicals, as they often include non-stick components to repel grease. PFAS chemicals in food packaging can enter a human's bloodstream by leaching into food that is consumed, as well as find its way into the environment through disposal.

https://www.nysenate.gov/legislation/bills/2019/s8817

A study published in February 2017 (Silent Spring Institute et. al., Environ. Sci. Technol. Lett., 2017, 4 (3), pp 105-111) looked at 400 samples of food packaging from fast food restaurants in the United States. It found that PFAS chemicals were found in 46% of food contact papers and 20% of paperboard samples, including a breakdown of 56% of dessert and bread wrappers, 38% of sandwich and burger wrappers, and 20% of paperboard.

PFAS EXPOSURES and HEALTH EFFECTS

How are we exposed to PFAS?

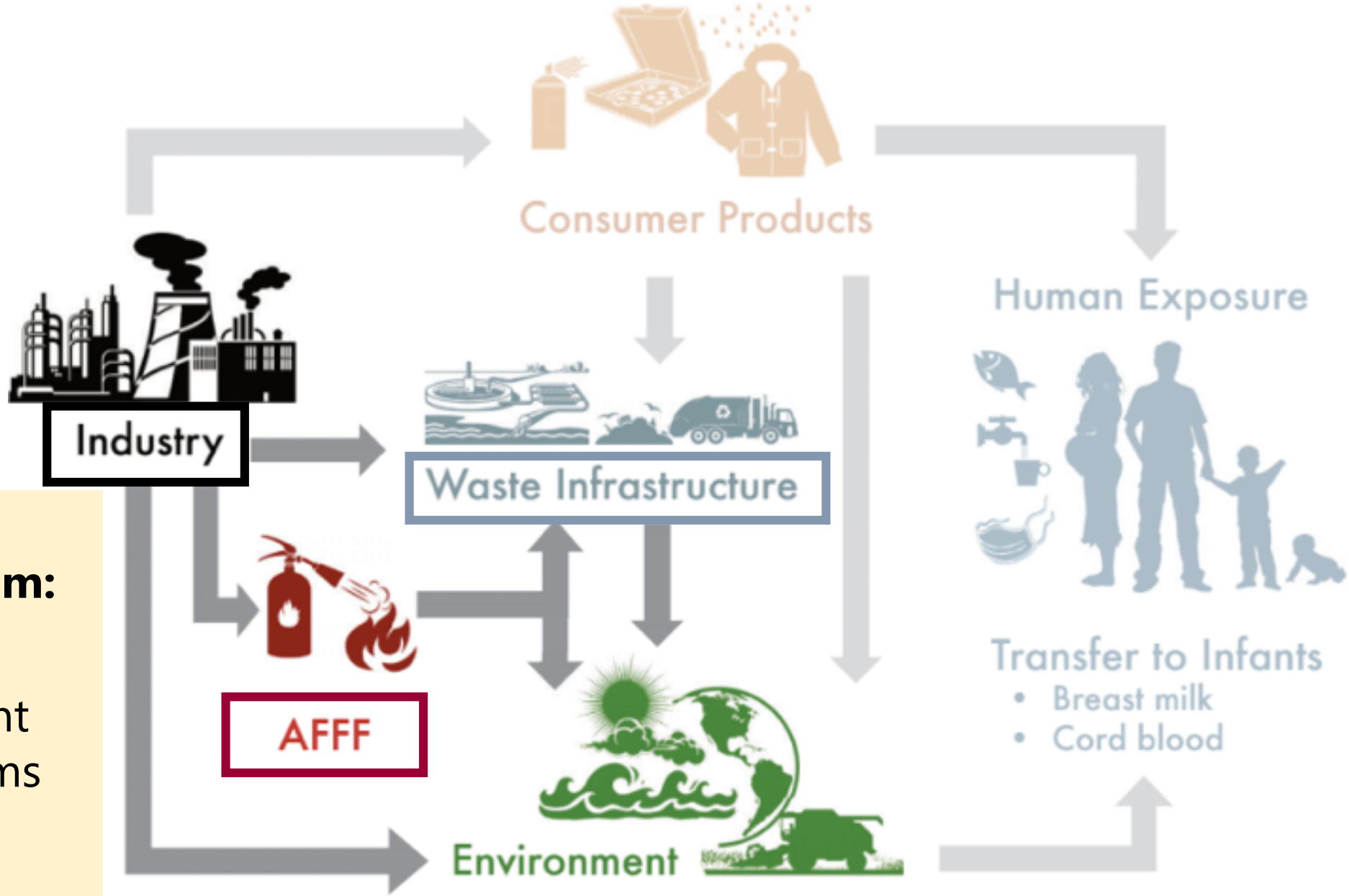


EM Sunderland et al. 2018. JESEE. 29:131-147.

How are we exposed to PFAS?

Environmental contamination from:

- Industry
- Sewage treatment and septic systems
- Landfills
- Firefighting foam



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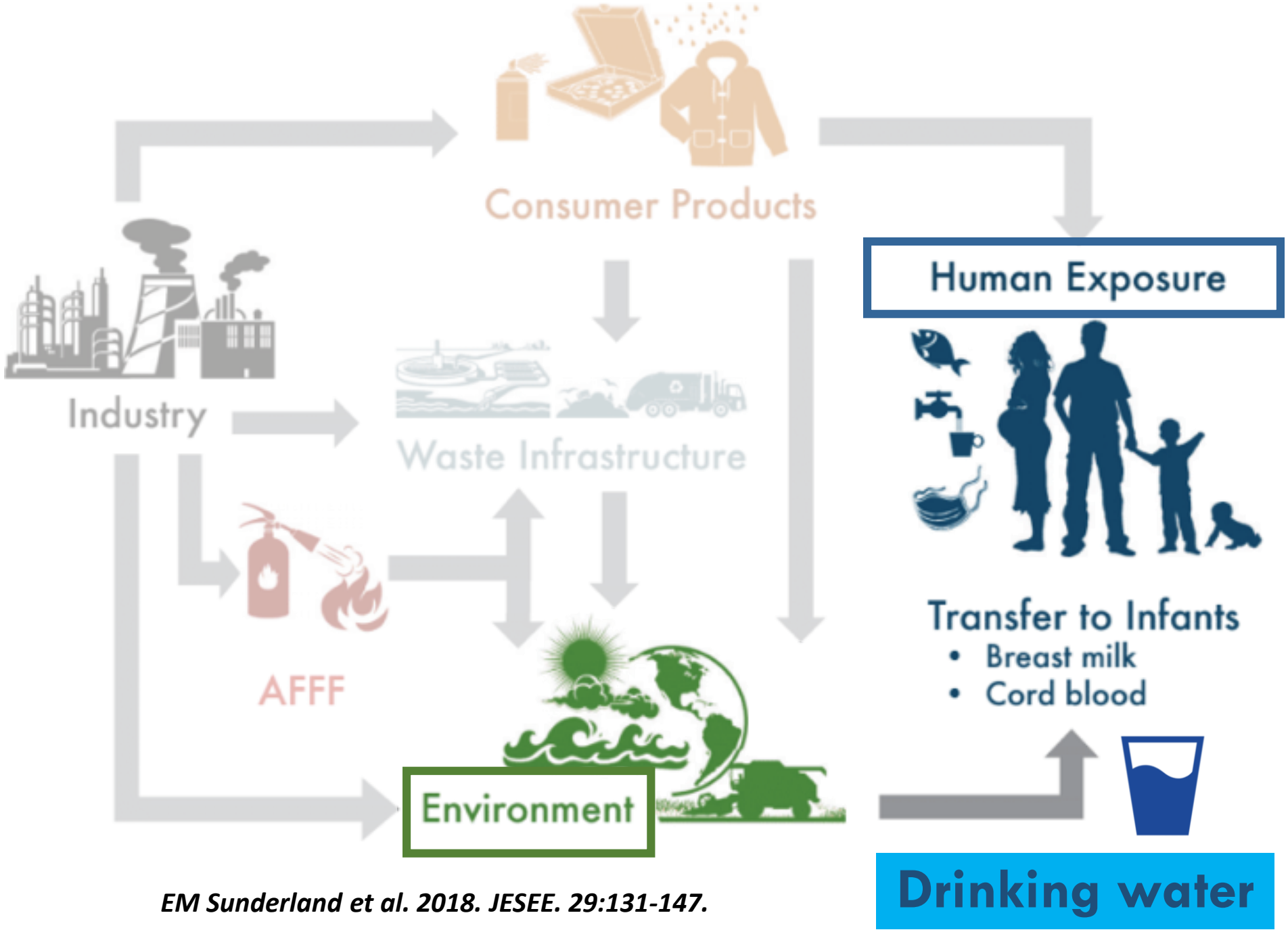
How are we exposed to PFAS?



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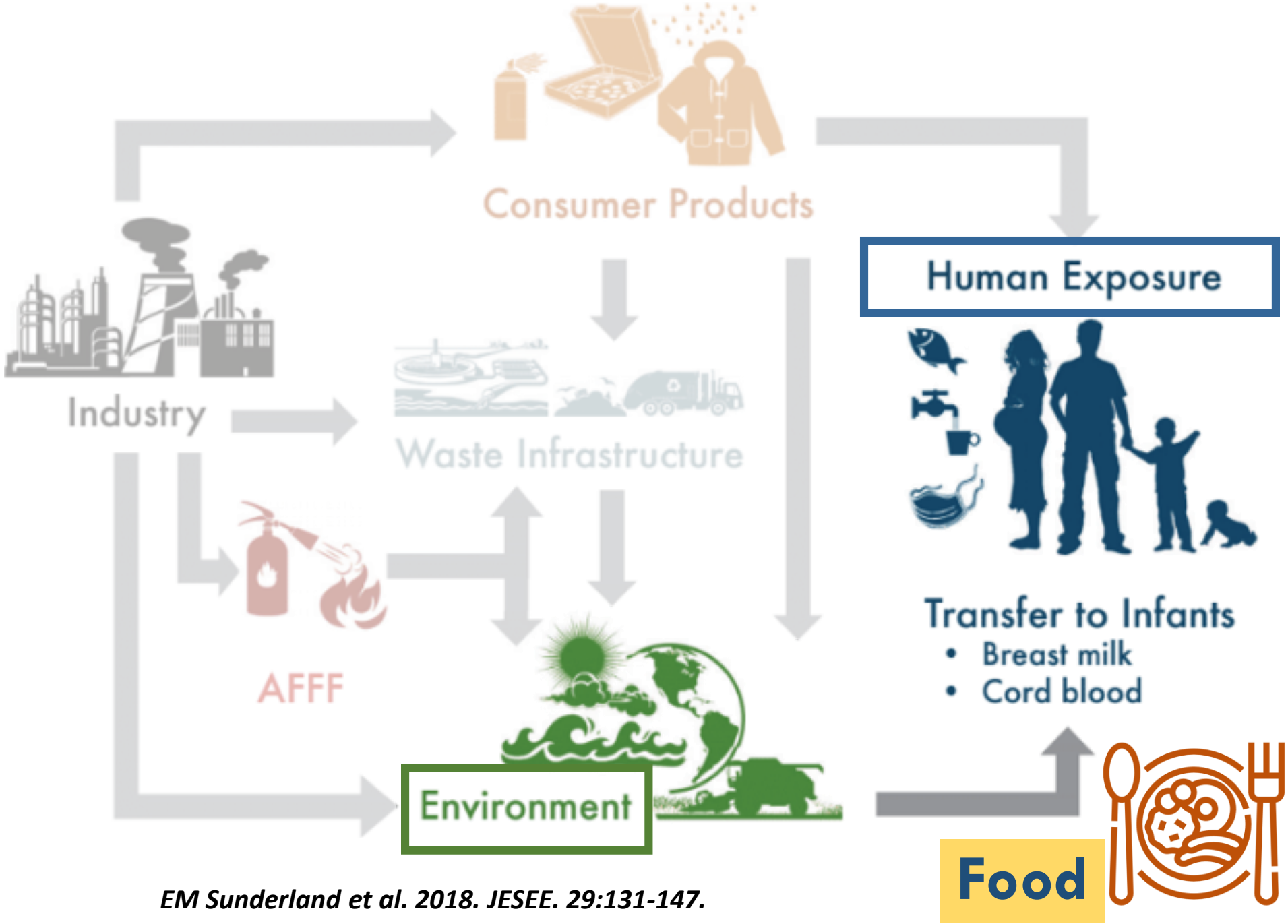
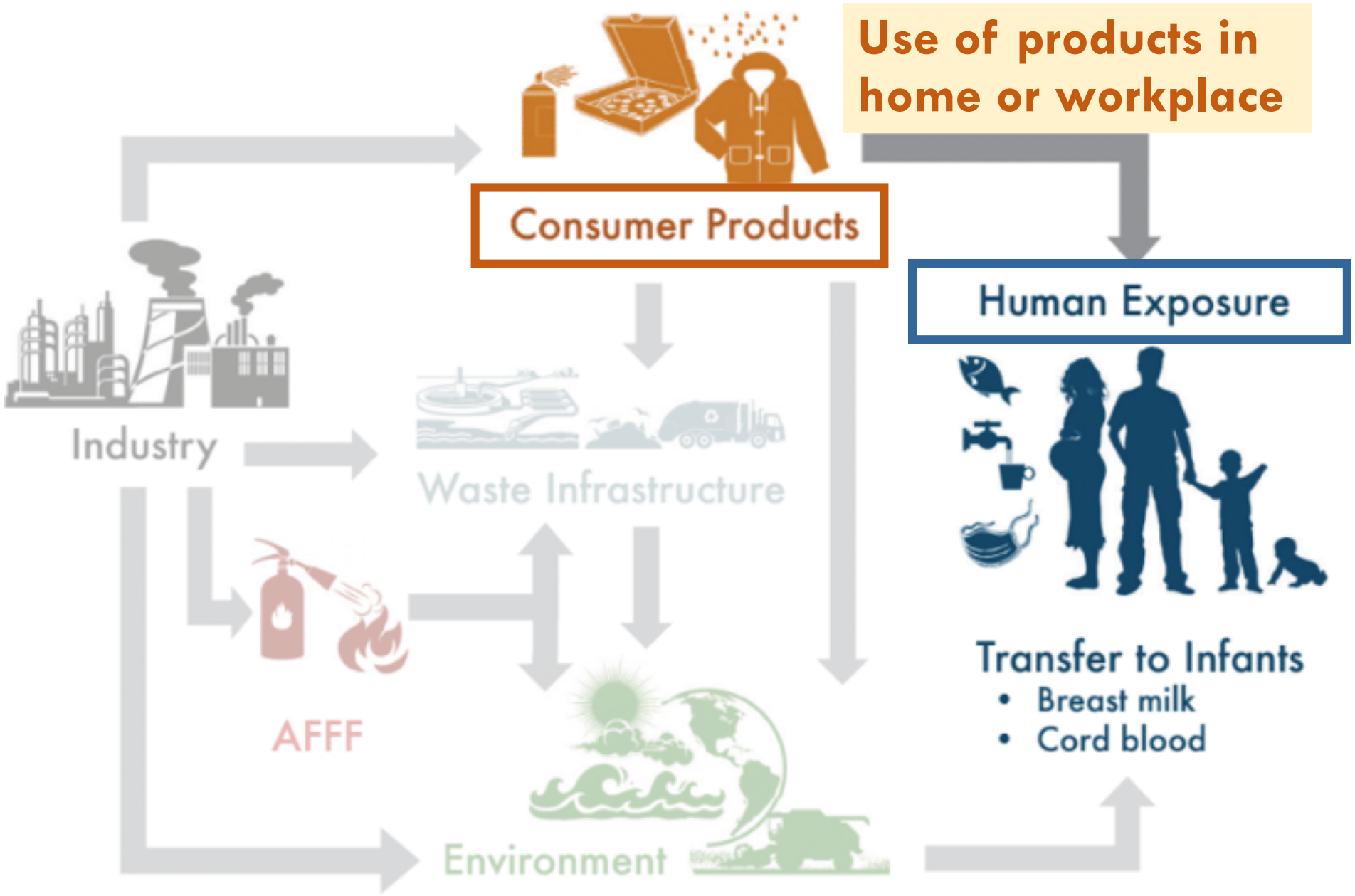
How are we exposed to PFAS?



EM Sunderland et al. 2018. JESEE. 29:131-147.

How are we exposed to PFAS?



EM Sunderland et al. 2018. JESEE. 29:131-147.

PFAS exposures are widespread

- **PFAS found in blood of over 99% of US residents** (CDC)

- **Some PFAS are long-lived in the human body**
  - Long-chain PFAS: years
  - Some newer PFAS: weeks to months
  - Many PFAS: not yet studied

- **Who has higher levels?**
  - Workers (PFAS-related industries, firefighters)
  - Older people typically have higher levels than younger people
  - Men typically have higher levels than women

A Calafat et al. 2007. EHP. 115: 1596-1602. HP Susmann et al. 2019. EHP. 127: 107003.
Y Li et al. 2022. Environ Int. 163: 107198. Y Xu et al. 2020. EHP. 128: 077004.

Exposures to PFAS have been associated with many harmful health effects

- Increased cholesterol & risk of obesity
- Immune system suppression, including suppressed vaccine response
- Changes in thyroid hormone levels
- Reproductive effects (preeclampsia, decreased fertility)
- Developmental effects (decreases in birth weight, changes in bone density)
- Impaired mammary gland development
- Cancer (kidney, testicular, prostate)

***EPA**: www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas*
***EFSA**: https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2020.6223*

Exposures to PFAS have been associated with many harmful health effects

- Increased cholesterol & risk of obesity

"Not only do we all have PFAS in our bodies, but we also know that PFAS affects almost every organ system."

Dr. Linda Birnbaum
Former Director of NIEHS
(quoted in *The Hill)*

***EPA**: www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas*
***EFSA**: https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2020.6223*

Infants and children have higher exposures to PFAS & other toxic chemicals

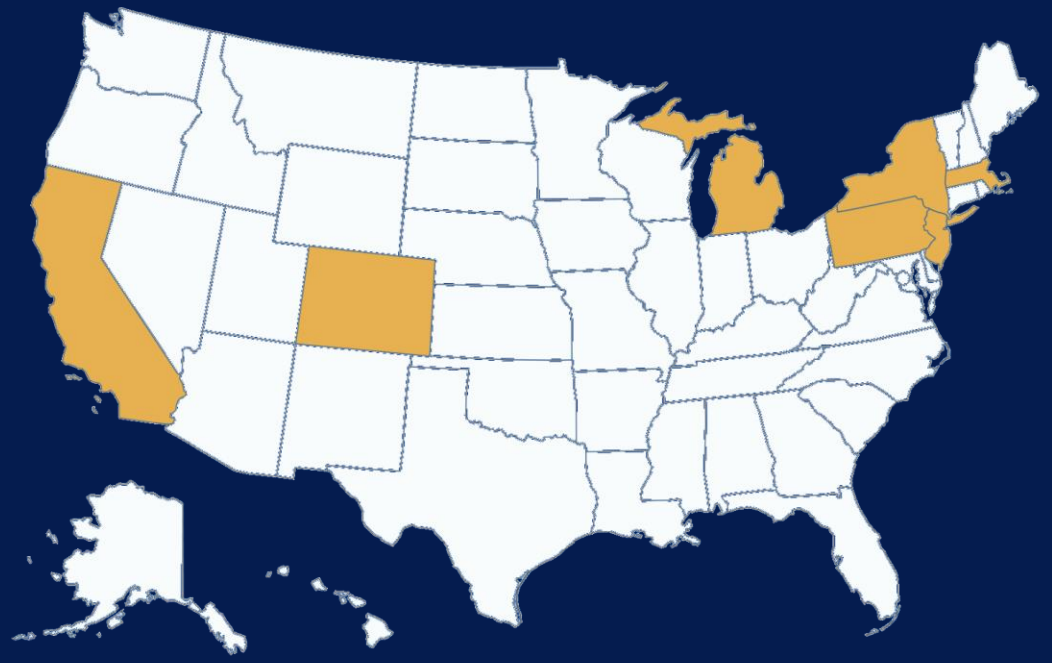
- Children drink more water, eat more food, and breathe more air per unit body weight
- Higher ingestion through hand-to-mouth, mouthing, chewing, and hand-object behaviors
- PFAS can be transferred through the placenta and via breastfeeding

Y Wu et al. 2020. Chemosphere. 251:126771.
AO De Silva et al. 2021. Environ. Toxicol. Chem. 40:631–657.

CDC PFAS Multi-site Health Study

- Funded by **CDC's** Agency for Toxic Substances and Disease Registry (**ATSDR**)
- Includes communities in 7 states with PFAS contamination of drinking water
- Goal: Improve our understanding of PFAS-related health effects

Includes communities in 7 states



Massachusetts PFAS & Your Health Study in Hyannis and Ayer

Research partners

Silent Spring Institute (lead)
Harvard School of Public Health
Eastern Research Group

Local partners

Mass. Breast Cancer Coalition
People of Ayer Concerned about the Environment (PACE)

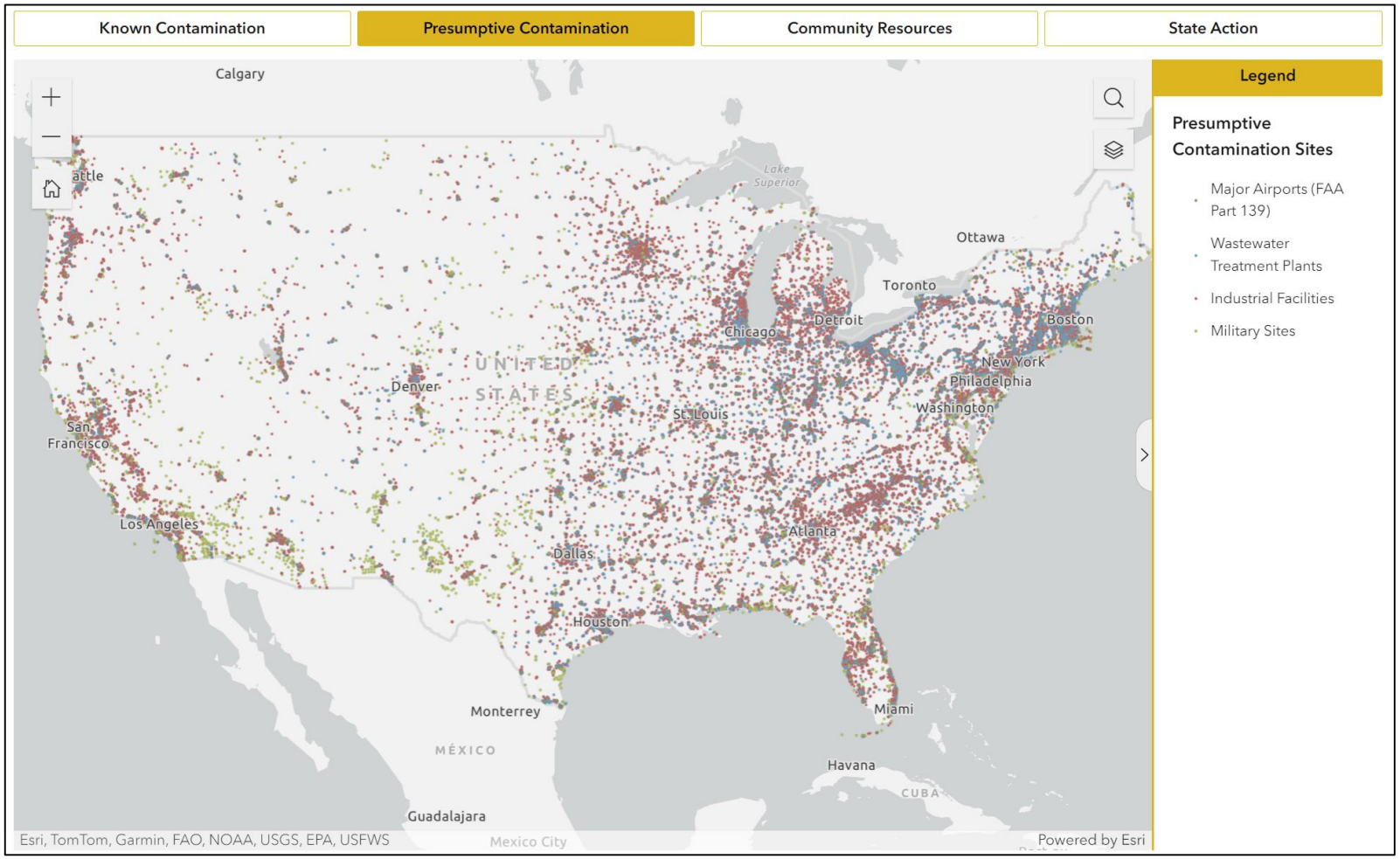
Massachusetts PFAS & Your Health Study in Hyannis and Ayer

- **Study enrollment:**
  700 adults and 100 children (4-17)
- **Study components:**
  1. Blood draw
  2. Questionnaire
  3. Neurobehavioral tests (children only)
- **Data collection ended 9/30/23**

PFAS and DRINKING WATER

Estimated 200 million Americans have PFAS in tap water (EWG 2022)

Thousands of known and likely contamination sites



PFAS-REACH
PFAS Research, Education, and Action for Community Health

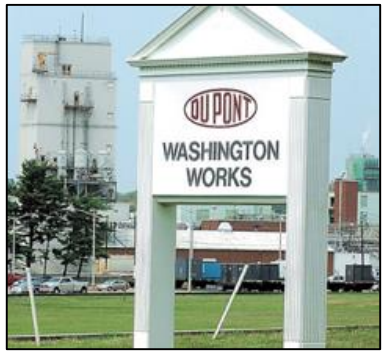
PFAS Project Lab
Northeastern University

SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

https://pfas-exchange.org/connecting-communities/

How do PFAS get into water?

- Aqueous film-forming foam (AFFF)
- Fluoropolymer production facilities
- Other industries
- Wastewater treatment plants
- Septic systems
- Landfills
- Land-applied sludge



EPA has not established enforceable drinking water standards

May 2016	Non-enforceable Lifetime Health Advisory: **70 ppt** (parts per trillion) for (PFOS and PFOA)
June 2022	Updated advisories: **0.004 ppt** (PFOA) and **0.020 ppt** (PFOS) (>1000x lower!) 10 ppt (GenX) and 2,000 ppt (PFBS)
March 2023	Draft standards: **4 ppt** (PFOA) and **4 ppt** (PFOS) plus limit on sum of 4 others
End of 2023	Finalized standards for PFOS and PFOA *** PLANNED ***

Massachusetts Standard
MCL = Maximum Contaminant Level

- Adopted October 2020
- Among the strictest regulations in the U.S.
- 20 parts per trillion for "**PFAS6**"

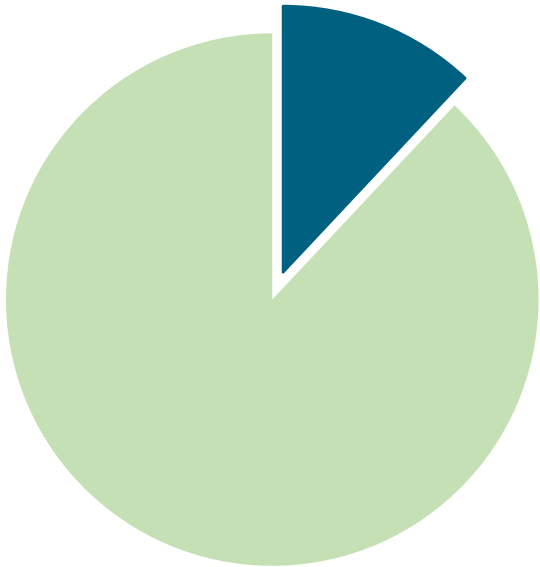
    PFAS6: total amount of 6 common PFAS

    PFHpA, PFOA, PFNA, PFDA, PFHxS, PFOS

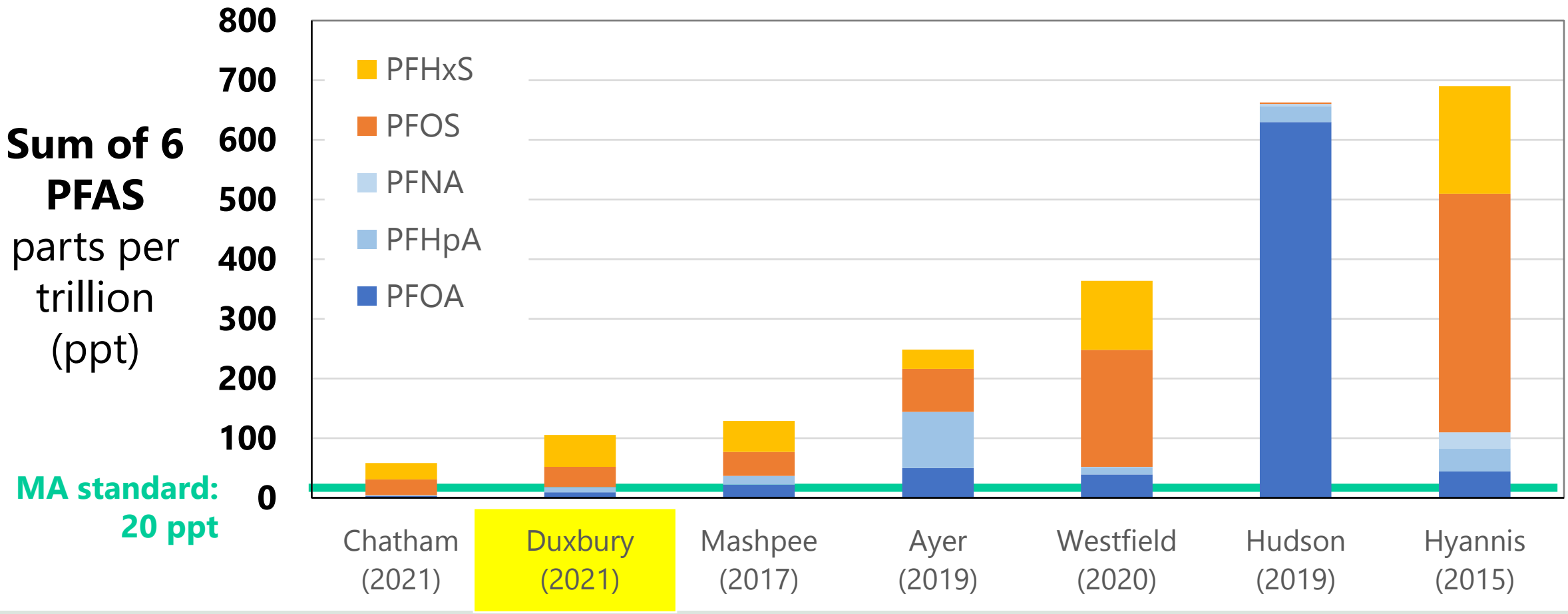
PFAS have been found in many MA public water supplies

- 1,417 public water systems must test for PFAS in MA
- 170 public water systems found PFAS6 above 20 ppt at least once
  - Many are municipal water supplies
  - Some serve schools, condos, municipal buildings, and other institutions

14% of public water supplies have exceeded state standard



Maximum measured PFAS concentrations in MA public water supplies



Results for individual wells, not tap water samples

How do I know if my water has PFAS?

Call your water supply

- Ask for results of recent PFAS testing

Consult your water supply's Consumer Confidence Report

- Available from your water supplier or online

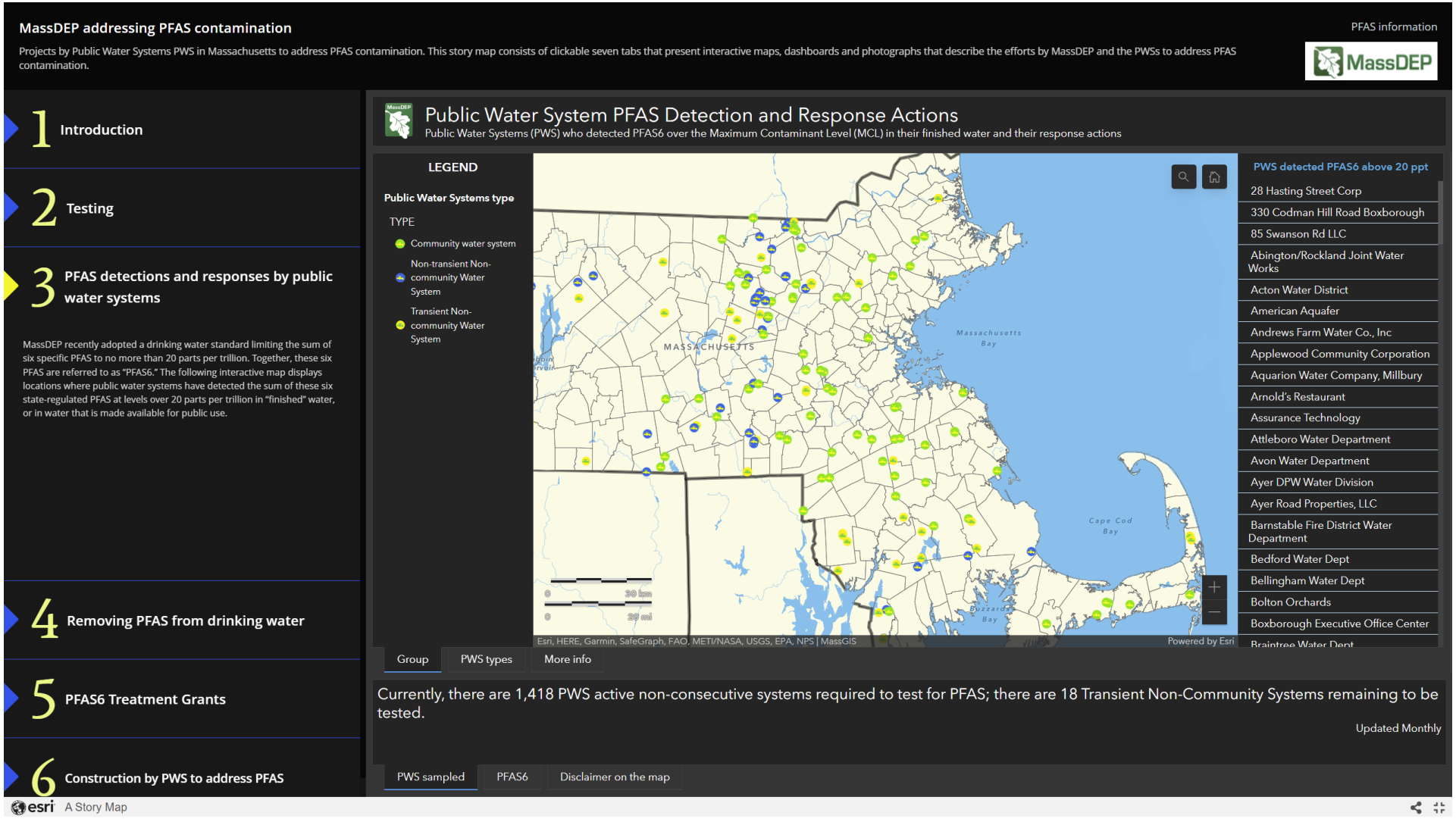
Search the Mass. EEA data portal

- https://eeaonline.eea.state.ma.us/portal#!/search/drinking-water

Search EWG's Tap Water Database

- https://www.ewg.org/tapwater/

PFAS information on MassDEP website



[Scan to see this page on DEP website]

MassDEP addressing PFAS contamination

Projects by Public Water Systems PWS in Massachusetts to address PFAS contamination. This story map consis
and photographs that describe the efforts by MassDEP and the PWSs to address PFAS contamination.

Duxbury

PFAS information

MassDEP

2 Testing

3 PFAS detections and responses by public water systems

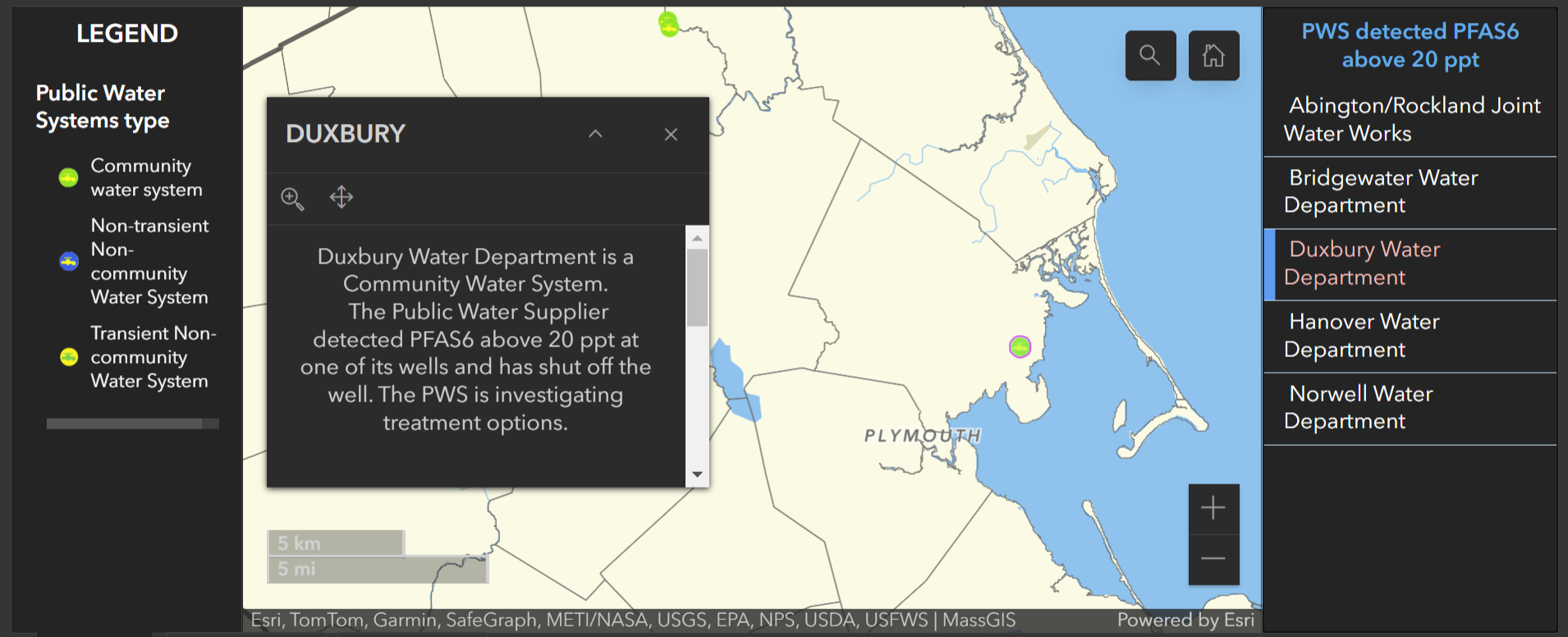
MassDEP recently adopted a drinking water standard limiting the sum of six specific PFAS to no more than 20 parts per trillion. Together, these six PFAS are referred to as "PFAS6." The following interactive map displays locations where public water systems have detected the sum of these six state-regulated PFAS at levels over 20 parts per trillion in "finished" water, or in water that is made available for public use.

4 Removing PFAS from drinking water

5 PFAS6 Treatment Grants

Public Water System PFAS Detection and Response Actions

Public Water Systems (PWS) who detected PFAS6 over the Maximum Contaminant Level (MCL) in their finished water and their response actions



Group | PWS types | More info

There are 1,417 active non-consecutive Public Water Suppliers that were required to test for PFAS.

PWS sampled | PFAS6 | Disclaimer on the map

esri

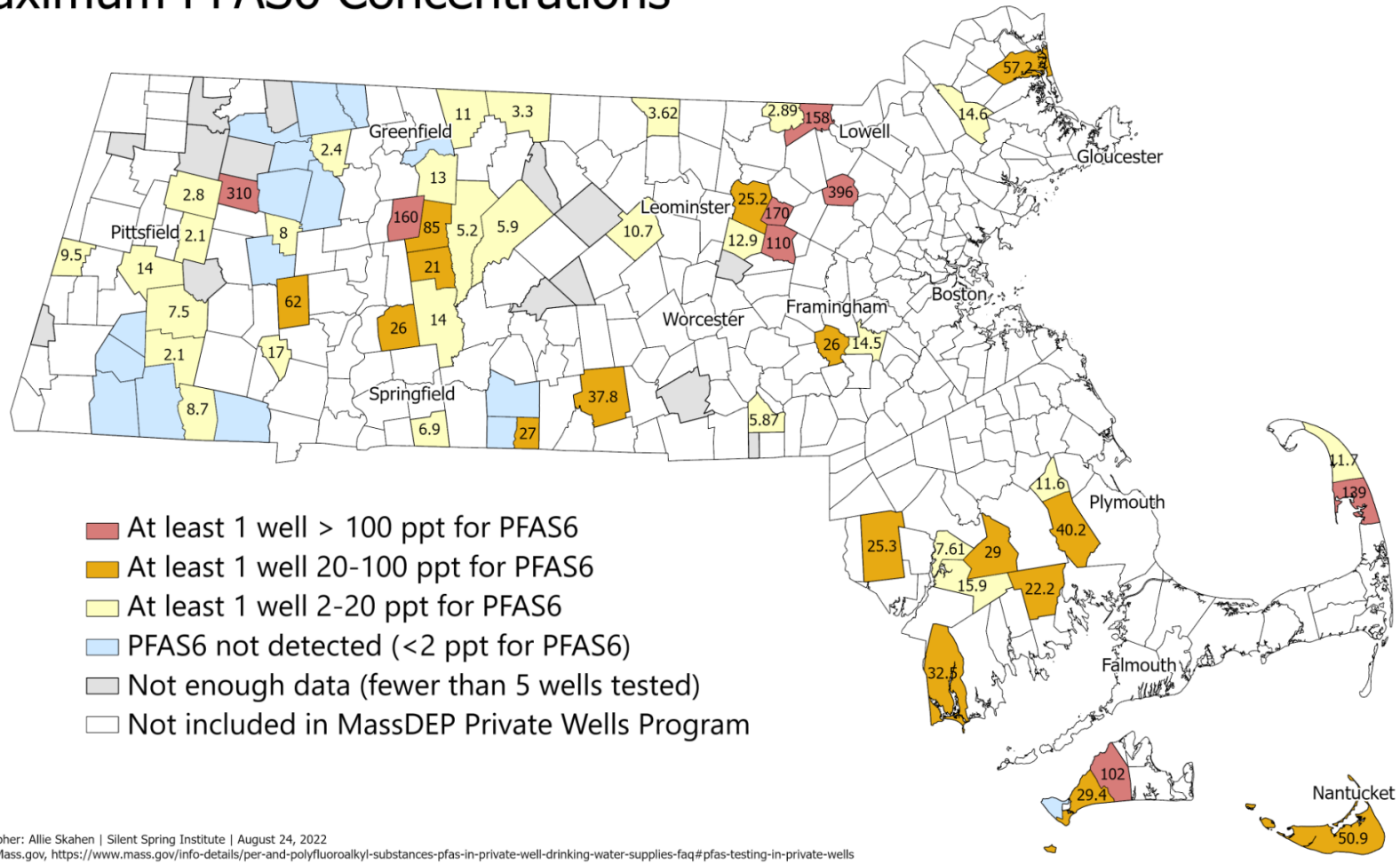
What about private wells?

500,000 people in Massachusetts have a private well

https://privatewells.silentspring.org

Private wells in towns throughout MA have been found to exceed MA standard

Maximum PFAS6 Concentrations



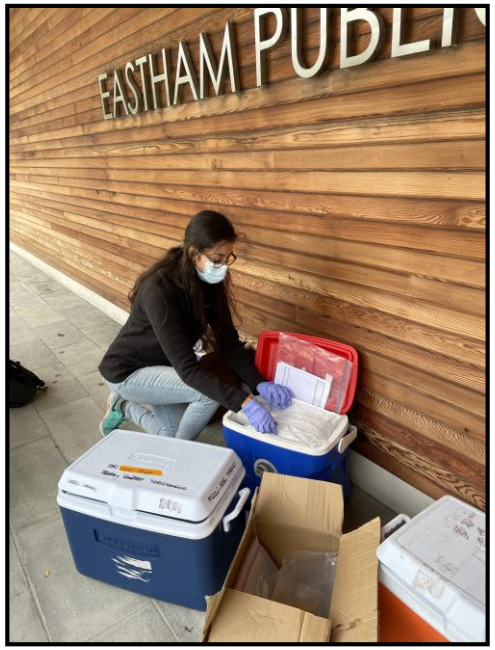
Cartographer: Allie Skahen | Silent Spring Institute | August 24, 2022
Source: Mass.gov, https://www.mass.gov/info-details/per-and-polyfluoroalkyl-substances-pfas-in-private-well-drinking-water-supplies-faq#pfas-testing-in-private-wells

STEEP
Sources, Transport, Exposure & Effects of PFASs
UNIVERSITY OF RHODE ISLAND SUPERFUND RESEARCH PROGRAM

STEEP private wells study

Research partners: Univ. of Rhode Island (lead), Harvard University, Silent Spring Institute

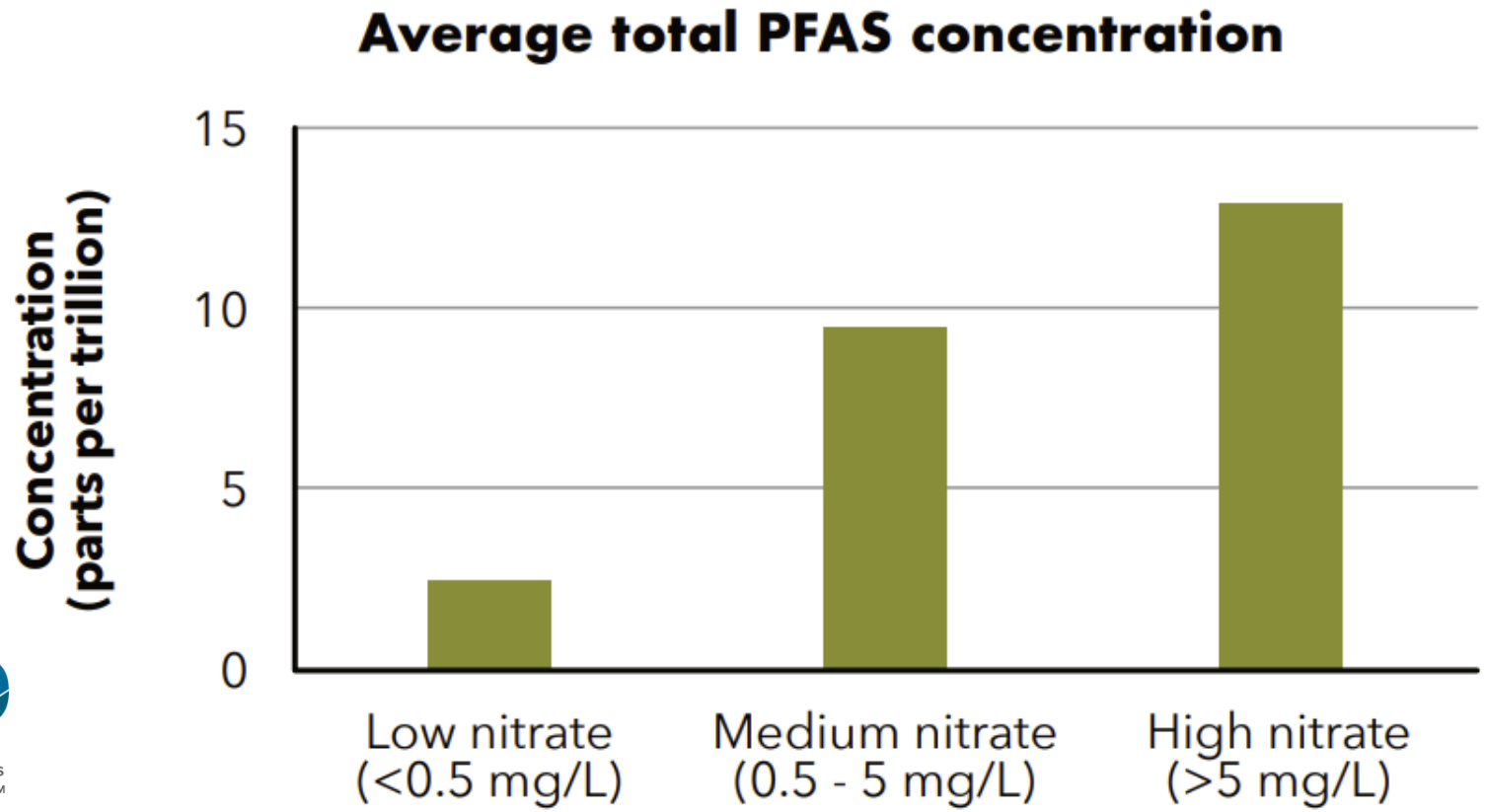
Local partners: Mass. Breast Cancer Coalition, Sierra Club Cape Cod Group, Mashpee Wampanoag Tribe



SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

https://web.uri.edu/steep/files/wellwater_prelim-findings_web-2.pdf

Private wells on Cape Cod with higher nitrate also had higher PFAS, consistent with septic systems as a source



STEEP
Sources, Transport, Exposure & Effects of PFASs
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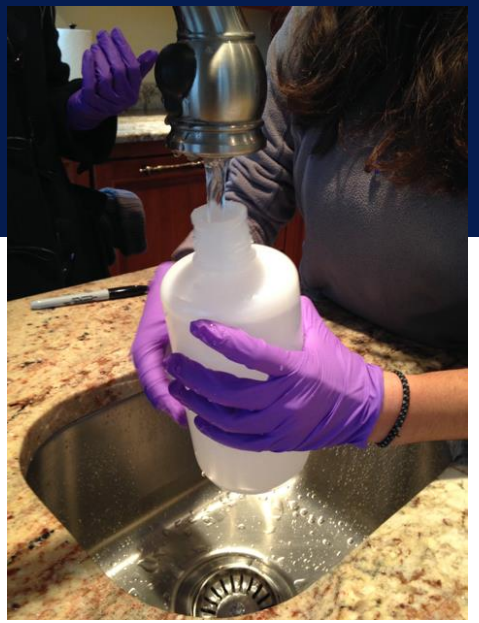
https://web.uri.edu/steep/files/wellwater_prelim-findings_web-2.pdf

PFAS water treatment options



- Activated carbon
  - Solid carbon block or filter pitcher
  - Very effective for PFOS, PFOA, and other long-chain PFAS
  - Short-chain PFAS not as well removed
- Reverse osmosis (RO)
  - Very effective for long-chain and short-chain PFAS
  - More expensive and generates stream of wastewater, can affect septic systems
- Look for filters that meet NSF P473 certification, and NSF/ANSI 53 standard for activated carbon filters and NSF/ANSI 58 standard for RO

Maintenance of systems is key for contaminant removal

Important areas for future PFAS research

- Toxicity of newer alternative PFAS
- Understanding exposures among firefighters and other workers
- Discovering extent of PFAS in plastics
- Evaluating exposures to PFAS from fish
- Developing drinking water treatment technologies and managing PFAS-containing waste

What can you do?

Tips for avoiding PFAS

- Select textiles without stain-resistance
- Avoid microwave popcorn
- Eat more fresh foods to avoid food packaging
- Filter your drinking water if PFAS are elevated
- **Ask yourself: Do I really need this product?**
- **Start with a change you're able to easily make**

Download
Silent Spring Institute's
Detox Me Smartphone app

Visit our website:
www.silentspring.org

PFAS Exchange online resource center
www.pfas-exchange.org

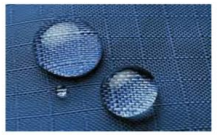
- Fact sheets
- Resources for Clinicians
- Blood and water data interpretation tool
- Connecting Communities map
- Interactive quiz

PFAS-REACH
PFAS Research, Education, and Action for Community Health

PFAS Exchange – Fact sheets
www.pfas-exchange.org

How to Reduce Your Exposure to PFAS

PFAS-REACH
PFAS Research, Education, and Action for Community Health


PFAS (per- and polyfluoroalkyl substances) are a class of chemicals that companies add to consumer products to make them nonstick, waterproof, and stain-resistant. They are found in carpets and upholstery, waterproof apparel, non-stick cookware, grease-proof food packaging, and even dental floss. They are also used in firefighting foams for putting out fuel fires.

Unfortunately, studies have linked these chemicals with a range of health problems including thyroid disease, cancer, high cholesterol, obesity, and effects on the immune system. Luckily, there are simple steps you can take to reduce your everyday exposure to PFAS and create a healthier environment for you and your loved ones.

In your personal life:

- ✓ Avoid stain-resistant carpets and upholstery, as well as stain-resistant treatments and waterproofing sprays.
- ✓ Avoid products with the ingredient PTFE or other "fluoro" ingredients listed on the label.
- ✓ Choose cookware made of cast iron, stainless steel, glass, or enamel instead of Teflon.
- ✓ Filter your drinking water with an activated carbon or reverse osmosis filtration system.
- ✓ Eat more fresh foods to avoid take-out containers and other food packaging.
- ✓ Avoid microwave popcorn and greasy foods wrapped in paper.
- ✓ Look for nylon or silk dental floss that is uncoated or coated in natural wax.

In your community:

- ✓ Tell retailers and manufacturers you want products made without PFAS.
- ✓ Urge your local water utility to test for PFAS.
- ✓ Ask your state legislators to set up a statewide water and blood testing program.
- ✓ Encourage your state to follow the lead of other states in creating more health protective drinking water limits.
- ✓ Ask your elected officials to support restrictions on PFAS in consumer products and remediation of contaminated sites.
- ✓ Find out about local groups working to protect water quality by visiting:

www.pfas-exchange.org

NIH NIEHS PFAS-REACH is a five-year project funded by the National Institute of Environmental Health Sciences (NIEHS) under grant R01ES028311.

PFAS-REACH is led by Silent Spring Institute in collaboration with Northeastern University and Michigan State University. Community partners include Testing for Pease, Massachusetts Breast Cancer Coalition, and Toxics Action Center.

How Can PFAS Affect Your Health?

PFAS-REACH
PFAS Research, Education, and Action for Community Health

PFAS (per- and polyfluoroalkyl substances) are among the most ubiquitous synthetic chemicals in the world. Approximately 98 percent of Americans have PFAS in their bodies. People can be exposed to these chemicals in many different ways—through the water they drink, the products they use, the air they breathe, and the food they eat. During pregnancy, PFAS can pass from the mother to the fetus through the umbilical cord, and babies can be exposed through breast milk or formula made with contaminated water.

Their strong chemical bonds and unique structures make them very effective at repelling water and oil even at high temperatures. These same characteristics also make PFAS extremely persistent, meaning they don't break down in the environment. Even more concerning, some PFAS can remain in the body for years, and people continue to be exposed to the chemicals.

Because of their persistence and because exposures are so widespread, scientists are concerned about the potential health impacts. Most health studies have looked at PFOA and PFOS, the two most commonly found PFAS. However, new research suggests other types of PFAS have similar health effects.

Learn more: www.pfas-exchange.org

Although the science on health effects is still evolving, scientists are increasingly concerned about low-dose exposures, as they continue to find health effects at lower and lower levels. More research is needed on other PFAS chemicals, in particular ones that companies have developed to replace PFOA and PFOS. Because people are exposed to multiple PFAS from multiple sources, researchers are beginning to investigate the effects of mixtures of PFAS on human health.

Scientific studies have linked exposure to PFAS with:

Human studies

- High cholesterol
- Ulcerative colitis
- Cancer (testicular, kidney)
- Preeclampsia
- Liver damage
- Thyroid disease
- Decreased vaccine response
- Asthma
- Decreased fertility
- Lower birth weight

Animal studies

- Cancer (testicular, liver, pancreatic)
- Liver damage
- Delayed mammary gland development
- Developmental problems
- Effects on brain development
- Immune system effects
- Changes in cholesterol levels
- Changes in thyroid hormones
- Low birth weight

NIH NIEHS PFAS-REACH is a five-year project funded by the National Institute of Environmental Health Sciences (NIEHS) under grant R01ES028311.

PFAS-REACH is led by Silent Spring Institute in collaboration with Northeastern University and Michigan State University. Community partners include Testing for Pease, Massachusetts Breast Cancer Coalition, and Toxics Action Center.

PFAS: A Word About Drinking Water Guidelines

PFAS-REACH
PFAS Research, Education, and Action for Community Health

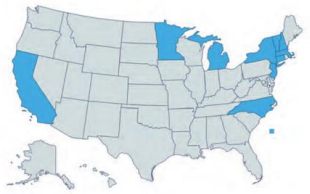
Are PFAS regulated in drinking water?

PFAS (per- and polyfluoroalkyl substances) are currently not regulated under the Safe Drinking Water Act. This means there are no federal drinking water standards and public water supplies do not have to test or treat their water for PFAS under federal law.

The U.S. Environmental Protection Agency (EPA) has set a non-enforceable health-based guideline level of 70 parts per trillion (ppt) for PFOA and PFOS, individually or combined.

However, many scientists and regulators believe this guideline is not protective enough of human health. As a result, some states have developed their own guideline levels for PFAS that are stricter than EPA's, and some have set, or are in the process of setting, enforceable standards.

Although guideline levels are not enforceable, meaning water utilities are not required to test or treat the water, they do offer some protection.



10 states with drinking water guidelines that are more restrictive than EPA's.

Why do guidelines vary?

Guideline levels are created when regulators, after reviewing the science, calculate a level of exposure below which health effects are not expected to occur. Regulators consider different types of evidence and factors when developing guideline levels:

- Studies linking exposure to PFAS with various health effects (for instance, effects on the immune system, liver, or mammary gland development).
- The impact on vulnerable populations such as infants or pregnant women.
- How much water people drink in a day.
- How much exposure likely comes from drinking water versus diet and consumer products.
- Molecular studies that show what happens to PFAS after the chemicals enter the body.

Although some variation is expected among the different state guideline levels, more recent guidelines are being set at similarly lower levels.

Learn more: www.pfas-exchange.org

NIH NIEHS PFAS-REACH is a five-year project funded by the National Institute of Environmental Health Sciences (NIEHS) under grant R01ES028311.

PFAS-REACH is led by Silent Spring Institute in collaboration with Northeastern University and Michigan State University. Community partners include Testing for Pease, Massachusetts Breast Cancer Coalition, and Toxics Action Center.

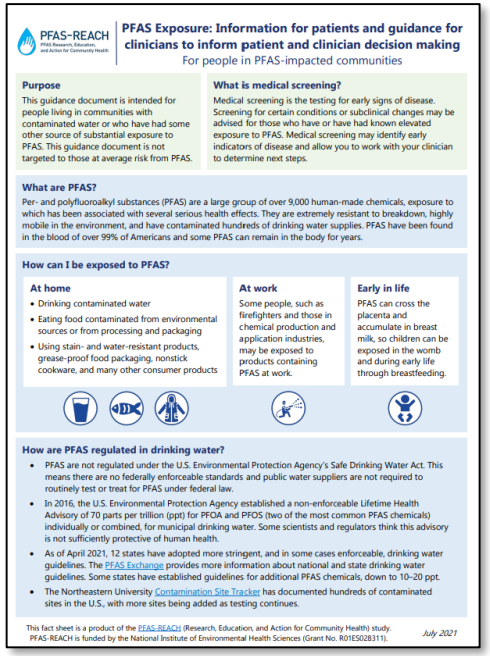
SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

www.pfas-exchange.org/resources

Medical screening guidance documents

- PFAS-REACH scientists and community leaders collaborated with physicians
- Based on concerns of affected community members
- 2 documents:
  - Overview and introduction to PFAS
  - Guidance for clinicians and patients on medical tests for health effects linked to PFAS exposures

For community members



PFAS-REACH

PFAS Exposure: Information for patients and guidance for clinicians to inform patient and clinician decision making

For people in PFAS-impacted communities

Purpose

This guidance document is intended for people living in communities with contaminated water or who have had some other source of substantial exposure to PFAS. This guidance document is not targeted to those at average risk from PFAS.

What is medical screening?

Medical screening is the testing for early signs of disease. Screening for certain conditions or subclinical changes may be advised for those who have or have had known elevated exposure to PFAS. Medical screening may identify early indicators of disease and allow you to work with your clinician to determine next steps.

What are PFAS?

Per- and polyfluoroalkyl substances (PFAS) are a large group of over 9,000 human-made chemicals, exposure to which has been associated with several serious health effects. They are extremely resistant to breakdown, highly mobile in the environment, and have contaminated hundreds of drinking water supplies. PFAS have been found in the blood of over 99% of Americans and some PFAS can remain in the body for years.

How can I be exposed to PFAS?

At home

- Drinking contaminated water
- Eating food contaminated from environmental sources or from processing and packaging
- Using stain- and water-resistant products, grease-proof food packaging, nonstick cookware, and many other consumer products

At work

Some people, such as firefighters and those in chemical production and application industries, may be exposed to products containing PFAS at work.

Early in life

PFAS can cross the placenta and accumulate in breast milk, so children can be exposed in the womb and during early life through breastfeeding.

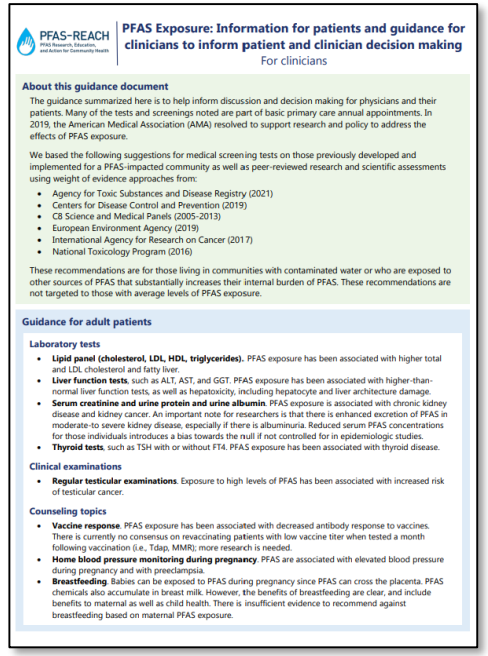
How are PFAS regulated in drinking water?

- PFAS are not regulated under the U.S. Environmental Protection Agency's Safe Drinking Water Act. This means there are no federally enforceable standards and public water suppliers are not required to routinely test or treat for PFAS under federal law.
- In 2016, the U.S. Environmental Protection Agency established a non-enforceable Lifetime Health Advisory of 70 parts per trillion (ppt) for PFOA and PFOS (two of the most common PFAS chemicals) individually or combined, for municipal drinking water. Some scientists and regulators think this advisory is not sufficiently protective of human health.
- As of April 2021, 12 states have adopted more stringent, and in some cases enforceable, drinking water guidelines. The PFAS Exchange provides more information about national and state drinking water guidelines. Some states have established guidelines for additional PFAS chemicals, down to 10–20 ppt.
- The Northeastern University Contamination Site Tracker has documented hundreds of contaminated sites in the U.S., with more sites being added as testing continues.

This fact sheet is a product of the PFAS-REACH (Research, Education, and Action for Community Health) study. PFAS-REACH is funded by the National Institute of Environmental Health Sciences (Grant No. R01ES028311).

July 2021

For medical professionals



PFAS-REACH

PFAS Exposure: Information for patients and guidance for clinicians to inform patient and clinician decision making

For clinicians

About this guidance document

The guidance summarized here is to help inform discussion and decision making for physicians and their patients. Many of the tests and screenings noted are part of basic primary care annual appointments. In 2019, the American Medical Association (AMA) resolved to support research and policy to address the effects of PFAS exposure.

We based the following suggestions for medical screening tests on those previously developed and implemented for a PFAS-impacted community as well as peer-reviewed research and scientific assessments using weight of evidence approaches from:

- Agency for Toxic Substances and Disease Registry (2021)
- Centers for Disease Control and Prevention (2019)
- C8 Science and Medical Panels (2005–2013)
- European Environment Agency (2019)
- International Agency for Research on Cancer (2017)
- National Toxicology Program (2016)

These recommendations are for those living in communities with contaminated water or who are exposed to other sources of PFAS that substantially increases their internal burden of PFAS. These recommendations are not targeted to those with average levels of PFAS exposure.

Guidance for adult patients

Laboratory tests

- **Lipid panel (cholesterol, LDL, HDL, triglycerides).** PFAS exposure has been associated with higher total and LDL cholesterol and fatty liver.
- **Liver function tests**, such as ALT, AST, and GGT. PFAS exposure has been associated with higher-than-normal liver function tests, as well as hepatoxicity, including hepatocyte and liver architecture damage.
- **Serum creatinine and urine protein and urine albumin**. PFAS exposure is associated with chronic kidney disease and kidney cancer. An important note for researchers is that there is enhanced excretion of PFAS in moderate-to severe kidney disease, especially if there is albuminuria. Reduced serum PFAS concentrations for those individuals introduces a bias towards the null if not controlled for in epidemiologic studies.
- **Thyroid tests**, such as TSH with or without FT4. PFAS exposure has been associated with thyroid disease.

Clinical examinations

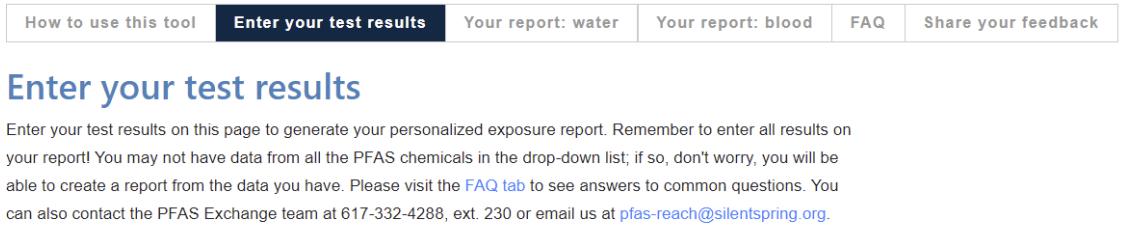
- **Regular testicular examinations**. Exposure to high levels of PFAS has been associated with increased risk of testicular cancer.

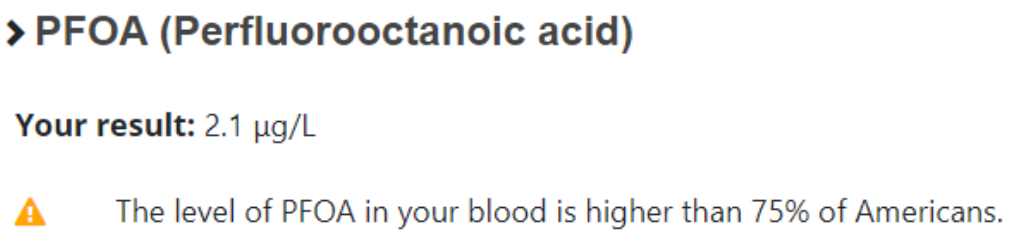
Counseling topics

- **Vaccine response**. PFAS exposure has been associated with decreased antibody response to vaccines. There is currently no consensus on revaccinating patients with low vaccine titer when tested a month following vaccination (i.e., Tdap, MMR); more research is needed.
- **Home blood pressure monitoring during pregnancy**. PFAS are associated with elevated blood pressure during pregnancy and with preeclampsia.
- **Breastfeeding**. Babies can be exposed to PFAS during pregnancy since PFAS can cross the placenta. PFAS chemicals also accumulate in breast milk. However, the benefits of breastfeeding are clear, and include benefits to maternal as well as child health. There is insufficient evidence to recommend against breastfeeding based on maternal PFAS exposure.

www.pfas-exchange.org/resources

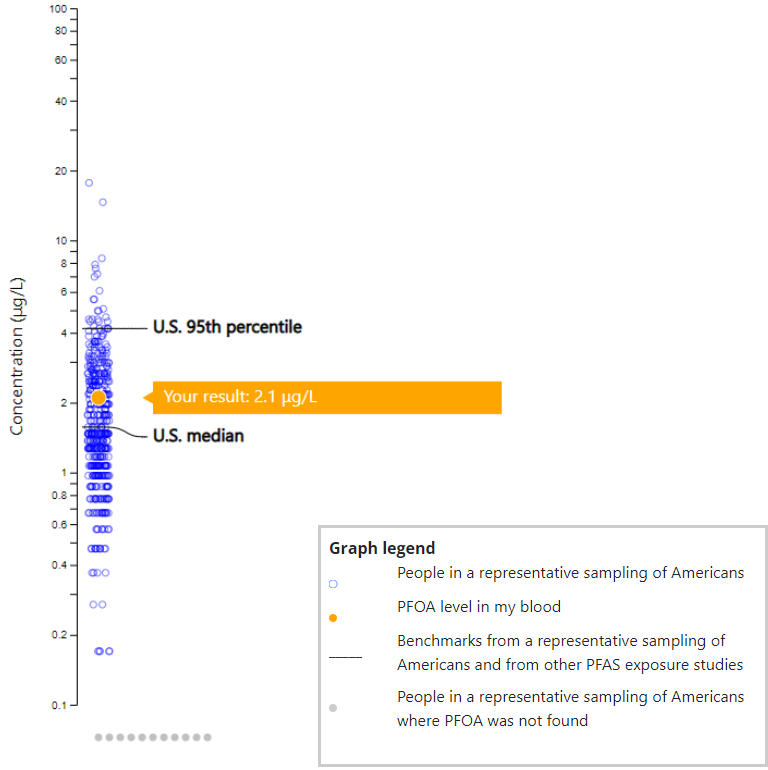
PFAS Exchange – What's My Exposure tool
www.pfas-exchange.org

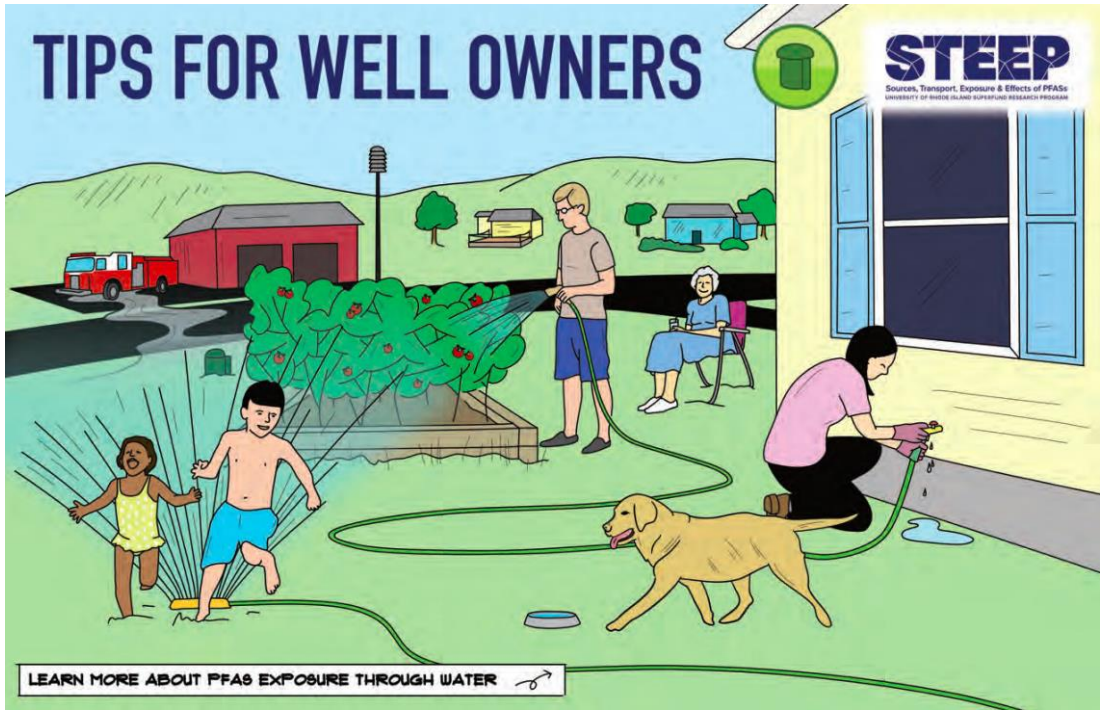




Features:

- Interface for entering drinking water and/or blood test results
- Results compared to benchmarks, standards, and comparison datasets in real-time
- Graphs and short text headlines
- Additional information on sources, health effects, and exposure reduction





URI STEEP's website has resources for a variety of audiences on PFAS, their health effects, and tips to minimize exposures

web.uri.edu/steep/resources

STEEP
Sources, Transport, Exposure & Effects of PFASs
UNIVERSITY OF RHODE ISLAND SUPERFUND RESEARCH PROGRAM

Ways to get involved!

- Let retailers know you want safer products

- Vote to support stricter chemical safety testing

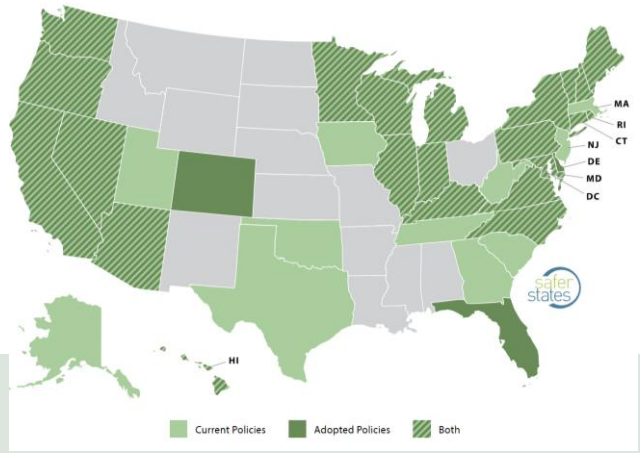
- Learn and share information about avoiding toxics

- Ask about procurement policies in your town and job

- Find out about local organizations and state legislation

How to get involved

- Groups advocating for PFAS legislation in MA:
  - MA Breast Cancer Coalition: mbcc.org/tag/pfas/
  - Clean Water Action: cleanwater.org/states/massachusetts
- Information about state-level policies and regulations:
  - Safer States: www.saferstates.com/toxic-chemicals/pfas/



Resources

- PFAS Exchange: www.pfas-exchange.org
- Silent Spring Institute: www.silentspring.org
- Northeastern University SSEHRI: www.pfasproject.com
- STEEP Superfund Research Program: web.uri.edu/steep
- Green Science Policy Institute: www.pfascentral.org
- National PFAS Contamination Coalition: www.pfasproject.net
- NC State University: https://superfund.ncsu.edu/pfas-hub

THANK YOU!

Laurel Schaider, PhD
Senior Scientist
Silent Spring Institute
schaider@silentspring.org

Duxbury Water Supply Wells/ PFAS Sources and Town Meeting Warrant Articles

Fernando Guitart
Duxbury Selectboard

Duxbury Water Supply

- 12 Municipal Wells
- 9 Water Treatment Facilities
- 126 miles of water mains for distribution
- Two above-ground storage tanks.

Captain's Hill Water Tank

DUXBURY SAFE WATER

Town of Duxbury Massachusetts

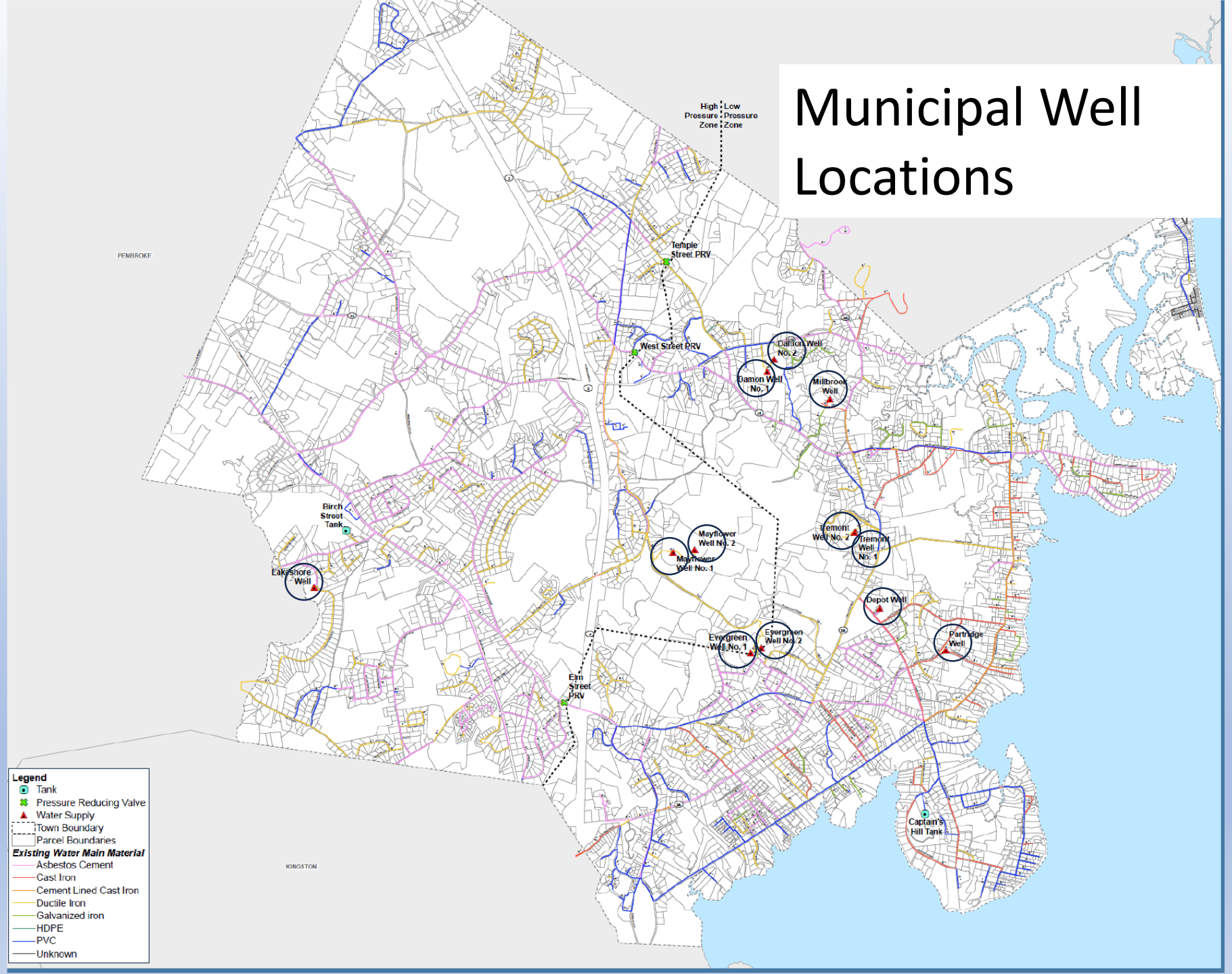
Duxbury Water Supply Overview

Treatment Facility	Location	Number of Wells	Permit Withdrawal Limit (Million Gallons/Day)
Evergreen	Evergreen Street	2	1.584
Tremont Wells	Hounds Ditch Lane	2	1.008
Damon Wells	Off Church Street	2	0.8
Mayflower Well No. 1	Mayflower Road	1	0.72
Mayflower Well No. 2	Mayflower Road	1	0.72
Lakeshore Drive Well	Lakeshore Drive	1	0.504
Milbrook Pond Well	Trement Street	1	0.5
Depot Street Well (off-line)	Depot Street	1	0.576
Partridge Street Well (off-line)	Partridge Street	1	0.346

DUXBURY SAFE WATER

Town of Duxbury Massachusetts

Municipal Well Locations



Current Conditions

- Two sources out of service
  - Depot Well inactive since 2014 due to high manganese levels, and
  - Partridge Well inactive since May 2021 due to high levels of per- and polyfluoroalkyl substances (PFAS)
- Duxbury has aging infrastructure in need of significant improvement

Mayflower Well No, 1 Pumping Station

Duxbury and PFAS Drinking Water Regulations

Current Regulations - October 2020 – Massachusetts amended Drinking Water Regulations

- Enforceable Maximum Contaminant Level (MCL) of 20 parts per trillion (ppt) for the total of 6 PFAS compounds

Partridge Well

- PFAS conc. > MCL – taken offline in 2021

DUXBURY SAFE WATER

Town of Duxbury Massachusetts

Duxbury and PFAS Drinking Water Regulations

- **Upcoming Federal Regulations**
  - Draft regs published March 2023
  - Enforceable MCLs for individual PFAS compounds PFOS and PFOA plus standards for four others
  - **Expected impacted sources: Partridge, Depot Street, Damon, Lakeshore, and Millbrook**
  - **Other sources close to MCL and may exceed in future**

Well	Exceedance of Proposed PFOS MCL (4 ng/L)	Exceedance of Proposed PFOA MCL (4 ng/L)
PARTRIDGE RD. GP WELL	33.5	9.44
DEPOT ST. GP WELL	3.6	10.4
MAYFLOWER WELL #1 AND #2	3.14	3.87
DAMON WELL #1 AND #2	3.95	4.49
EVERGREEN WELL#1 AND #2	2.27	2.29
LAKE SHORE DR. WELL	4.34	4.63
TREMONT WELL #1 AND #2	2.12	1.4
MILLBROOK POND WELL	3.25	4.2

PFOA and PFOS in Duxbury Well Water
(pink highlight exceeds proposed federal standard)

DUXBURY SAFE WATER

Town of Duxbury Massachusetts

What have we done in response to these new regulations and health concerns?

- Partridge Well shutdown as of April 2021
- Started investigation of PFAS sources
- Financing for Engineering Design for treatment of Partridge Well approved at Town Meeting in March 2023
- November 2023: Selectboard authorized PFAS Mitigation Working Group to develop a Response Action Plan to protect the water supply and public health in coordination with the Water and Sewer Advisory Board, the Board of Health, and the Water Department

DUXBURY SAFE WATER

Town of Duxbury Massachusetts

Ongoing Water System Infrastructure and Treatment Planning

- Water Quality Master Plan (Draft/Final 2023)
  - Pumping Station infrastructure, water treatment, and water main improvements
- PFAS Response Plan
  - Priorities and plan for treatment of municipal wells
  - Engineering designs and funding options
- Warrant Articles for funding of initial actions developed for March 2024 Town Meeting

DUXBURY SAFE WATER

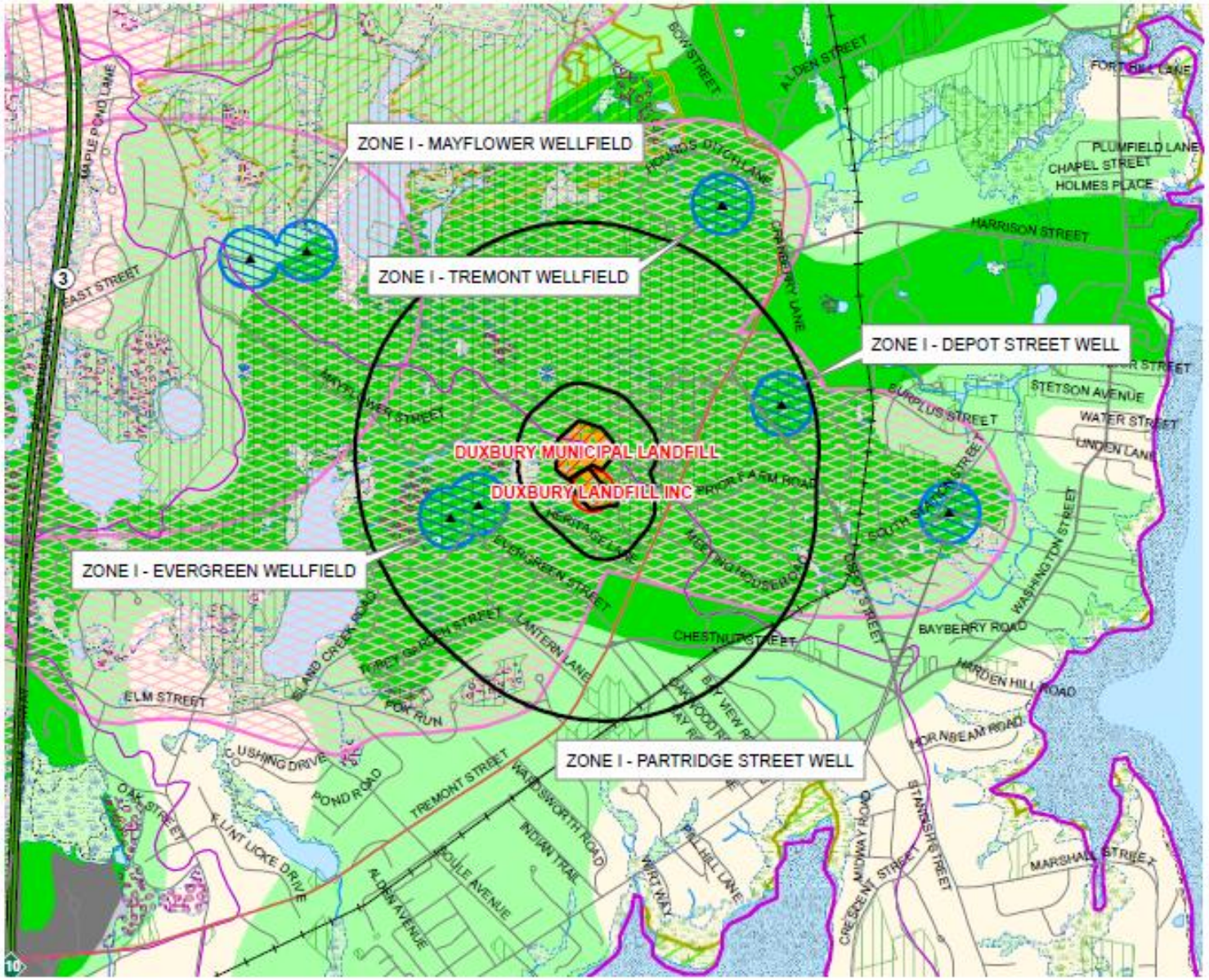
Town of Duxbury Massachusetts

PFAS Source Investigation-Ongoing

- Consultants Weston & Sampson investigating sources of PFAS including former Duxbury Landfill Inc./McNeil Dump and Duxbury Municipal Landfill
- The work has included
  - review of municipal records, reports, and historic documents;
  - test pit excavations to evaluate the extent of waste at the McNeil Dump;
  - installation and testing of groundwater monitoring wells;
  - groundwater modeling to evaluate PFAS plume migration and assess impacts to downgradient municipal wells; and
  - interim report in October 2022, and subsequent presentations to the Selectboard January 2023 and October 2023

DUXBURY SAFE WATER

Town of Duxbury Massachusetts



1,200 600 0 1,200 Feet

0.25 0.125 0 0.25 Miles

Data Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

NOTE: Radii shown are approximately 500-feet and 1/2-mile from edge of landfill.

Legend

Public Water Supplies
- Ground Water
- Surface Water
- Non-Community
- Railroads by Ownership

Transmission Lines
- Pipeline
- Pipeline Arbitrary
- Powerline
- Powerline Arbitrary
- Ski Lift/Tramway
- Substation
- Landing Strip/Airport
- Highway Exit Locations

All Roads

Road Classification
- Limited Access
- Multi-lane Hwy, not limited access
- Other Numbered Highway
- Major Road, Collector
- Minor Road

Non Potential Drinking Water Source Area
- High Yield
- Medium Yield

Aquifers
- High Yield
- Medium Yield
- Sole Source

MA Towns (from Survey Points)
- MA Towns (from Survey Points)

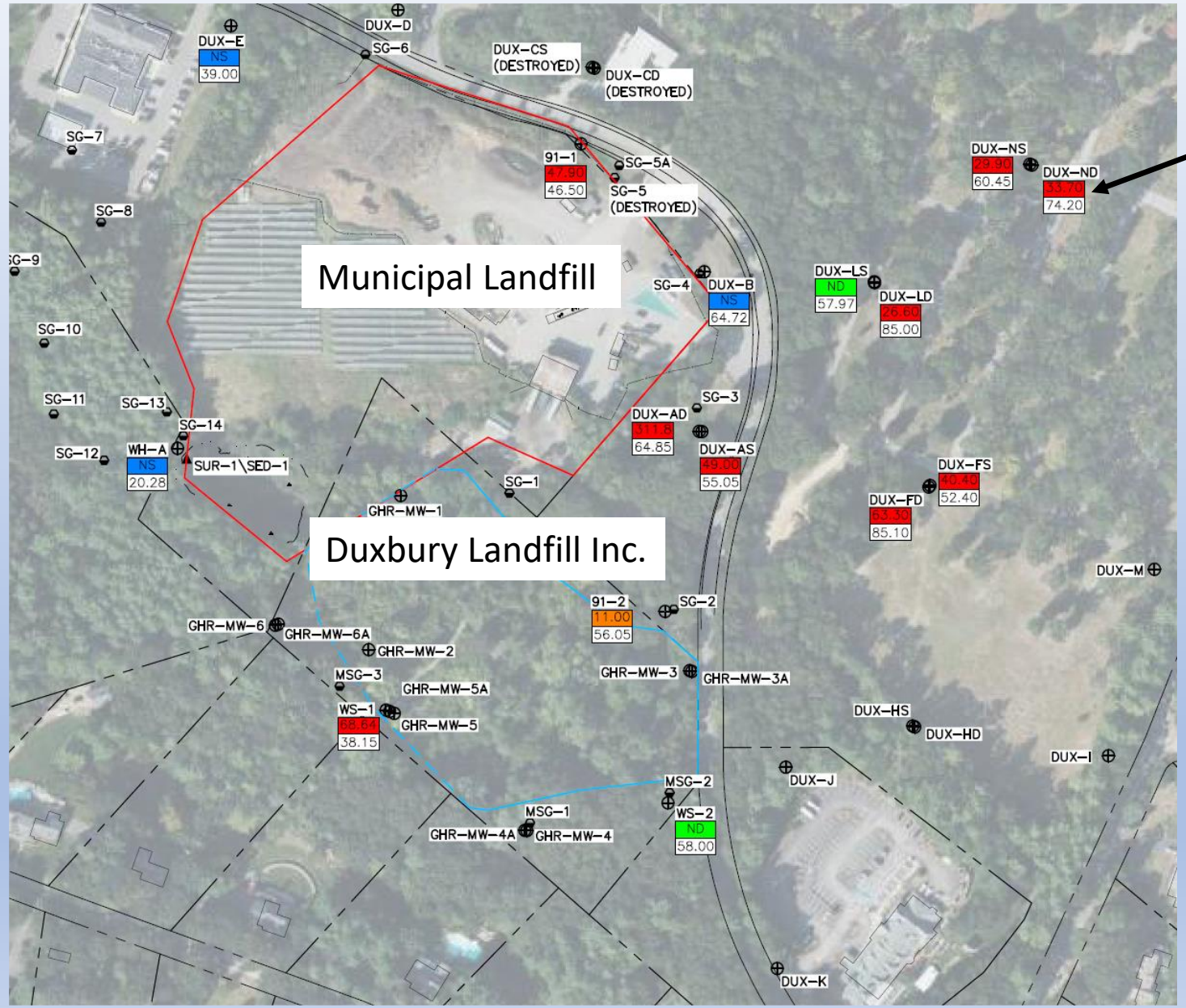
- Sub-basins
- Major Basins
- Landfills
- Dumping Grounds
- Protected Open Space
- ACECs
- Zone A
- IWPA
- DEP Zone Iis
- DEP Approved Zone
- Shoreline
- Hydrologic Connection
- Mean Low Water Line
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded marsh
- Cranberry Bog
- Salt Marsh
- Open Water
- Reservoir (with PWSID)
- Tidal Flats
- Beach/Dune
- NHESP Certified Vernal Pools
- NHESP Estimated Habitats of Rare Wildlife
- NHESP Priority Habitats of Rare Species

FIGURE 3
MCNEIL DUMP & DUXBURY MUNICIPAL LANDFILL
MAYFLOWER STREET
DUXBURY, MA

AREA RECEPTORS MAP

Weston & Sampson

PFAS Source Investigation



Monitoring Wells with PFAS6 Concentration (ppt) Red color > Current Massachusetts 20 ppt standard

PHOTOLOG
McNeil Dump Test Pit Activities, May 31, 2022
Duxbury, Massachusetts

15. Excavated debris from test pit TP-7.

DUXBURY SAFE WATER

Town of Duxbury Massachusetts

Other Potentially Significant PFAS Sources

- Residential and commercial septic systems (research has shown that effluent discharged from septic systems likely a major source of PFAS)
- Residue from fire fighting activities (AFFF foam PFAS) and cleaning of turn-out gear (gear contains PFAS)
- PFAS from fertilizers and topsoil products manufactured with biosolids (sewage sludge)
- Atmospheric deposition/rainwater

DUXBURY SAFE WATER

Town of Duxbury Massachusetts

What are our next steps?

- Partridge Preliminary Design – Recommendations due Q1 2024
- Town Meeting (March 9, 2024)
  - 1st Warrant Article – PFAS Prioritization Plan - $700 K
    - Select priority order of wells for PFAS mitigation
    - Confirm PFAS treatment method and plan other response actions to address water quality and physical plant challenges
  - 2nd Warrant Article – Proceed on Design & Permitting of 1st Priority Well-$1.0 M
- Infrastructure improvements and treatment costs have been roughly estimated at $75M - $100M
- Typical Timeline: Design to Construction Completion 2-2.5 years

DUXBURY SAFE WATER

Town of Duxbury Massachusetts

Questions?

For more information on Duxbury Safety Water

Donate to Duxbury Safe Water

Please consider donating to Duxbury Safe Water, Inc., to support our ongoing public education efforts about water quality and safety in Duxbury and across the Commonwealth.

Thank you!

Backup Slide: Treatment

PFAS Response - Removal With Granular Activated Carbon (GAC) Filters