Geosyntec consultants

PFAS: SCIENCE, ENGINEERING, AND PUBLIC POLICY

DRWW General Membership Meeting

Feb. 16, 2023

Adrienne Nemura
734.476.0357
anemura@Geosyntec.com

OVERVIEW

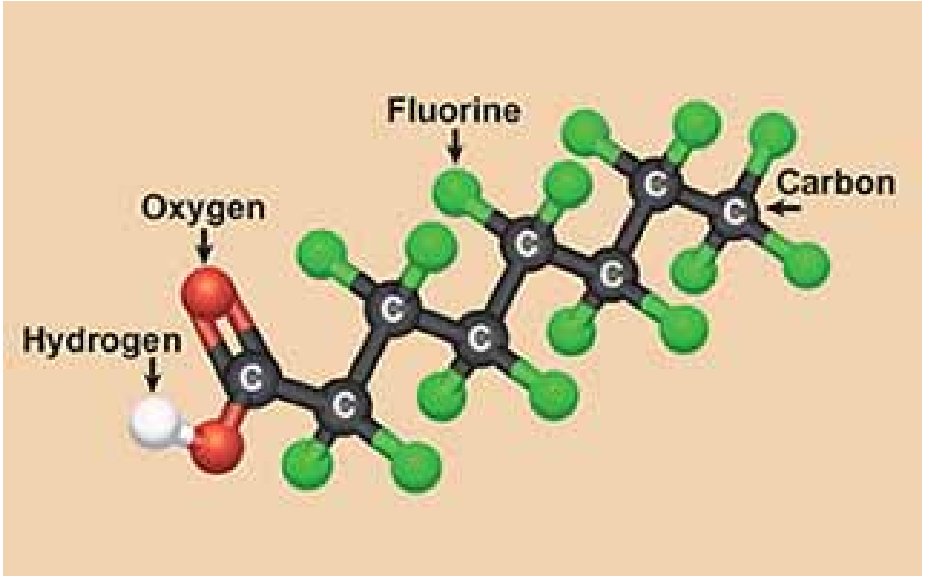
History & Background

PFAS Health Effects & Criteria

Sampling & Laboratory Techniques

Treatment Challenges

Regulatory Actions



https://www.niehs.nih.gov/health/topics/agents/pfc/index.cfm

Geosyntec consultants

HISTORY & BACKGROUND

PER- AND POLYFLUOROALKYL SUBSTANCES

Group of manufactured chemicals

- One of strongest bonds (carbon-fluorine) in organic chemistry
- Resistant to fire, degradation

Used in industry & consumer products since 1940s – polymers, surfactants, lubricants, etc.

Ambiguous and conflicting definitions

- EPA's master list has 12,000*
- Includes other fluorinated organic compounds (pesticides, pharmaceuticals , veterinary drugs)**
  - Lipitor, Prozac, Flonase, Pavloxid

* https://comptox.epa.gov/dashboard/chemical-lists/pfasmaster

** Fluorinated Compounds (mass.gov)

PERFLUOROOCTANOIC ACID (PFOA)

- Keeps coatings like Teflon from clumping
- Animal and human health impacts studied since the 1960s
- 1998 call to corporate attorney by his grandmother's neighbor about his cattle in Parkersburg, WV*
- Required a 2000 Court Order to obtain studies
- Epidemiological study of 70,000 people (exposed for decades) links to diseases
- Dupont ceases production and use of PFOA in 2013

http://www.nytimes.com/2016/01/10/magazine/the-lawyer-who-became-duponts-worst-nightmare.html?_r=0

* https://www.chicagotribune.com/news/environment/ct-pfas-history-20220710-iqrm53d4qrdt3dzbxr5exvvfli-htmlstory.html

PERFLUOROOCTANESULFONIC ACID (PFOS)

Key ingredient in Scotchguard

PFOS and PFOA used to make aqueous film forming foam (AFFF)

3M had documented adverse effects in animals in 1970s – did not pursue findings of PFAS in breast milk of animals or elevated rates of prostate cancer in factory workers

2002 – Minnesota Pollution Control Agency

- Requests MDH develop Health Based Values* for PFOA (700 ng/L) and PFOS (100 ng/L)
- Extensive investigation at 3M Cottage Grove manufacturing facility in Twin Cities

2018 - State settles with 3M for $850M

Chemical	Revised Minnesota HBV (ng/L)	Year
PFOA	35	2017
PFOS	15	2019
PFHxS	47	2019
PFHxA	200	2021
PFBS	100	2022
PFBA	7	2022

* Lifetime drinking water source

History of MDH Activities - Per- and Polyfluoroalkyl Substances (PFAS) - MN Dept. of Health (state.mn.us)

New Hollywood film ‘Dark Waters’ highlights the shocking reality of PFAS pollution

February 4, 2020 By Eleanor Hawke

Dark Waters is the most important American film in a decade, although it squanders an opportunity to fully portray PFAS* contamination as the nationwide human health epidemic it has become. The film leaves out half of the story and that involves the military’s role.

FREE PRESS
SPEAKING TRUTH TO POWER SINCE 1970

A new Hollywood film ‘Dark Waters’ highlights **the dire reality of pollution from harmful PFAS chemicals** and the urgent need for strong, protective legislation to protect human health and the environment.

‘The Devil We Know’: Film Review | Sundance 2018

Stephanie Soechtig's doc 'The Devil We Know' shows how 3M and DuPont have made billions by exposing us to toxic chemicals.

The Hollywood Reporter

THE DEVIL WE KNOW

2018, Documentary, 1h 35m

100% TOMATOMETER
7 Reviews

89% AUDIENCE SCORE
100+ Ratings

Geosyntec consultants

PFAS HEALTH EFFECTS & CRITERIA

PFAS SCIENCE IS "FULL OF UNCERTAINTIES AND INCONSISTENT INTERPRETATIONS BY SCIENTISTS"

PFOA may be associated with kidney and testicular cancer

PFOS and PFOA may be associated with

- Increased cholesterol
- Decreased vaccine response for children
- Kidney disease

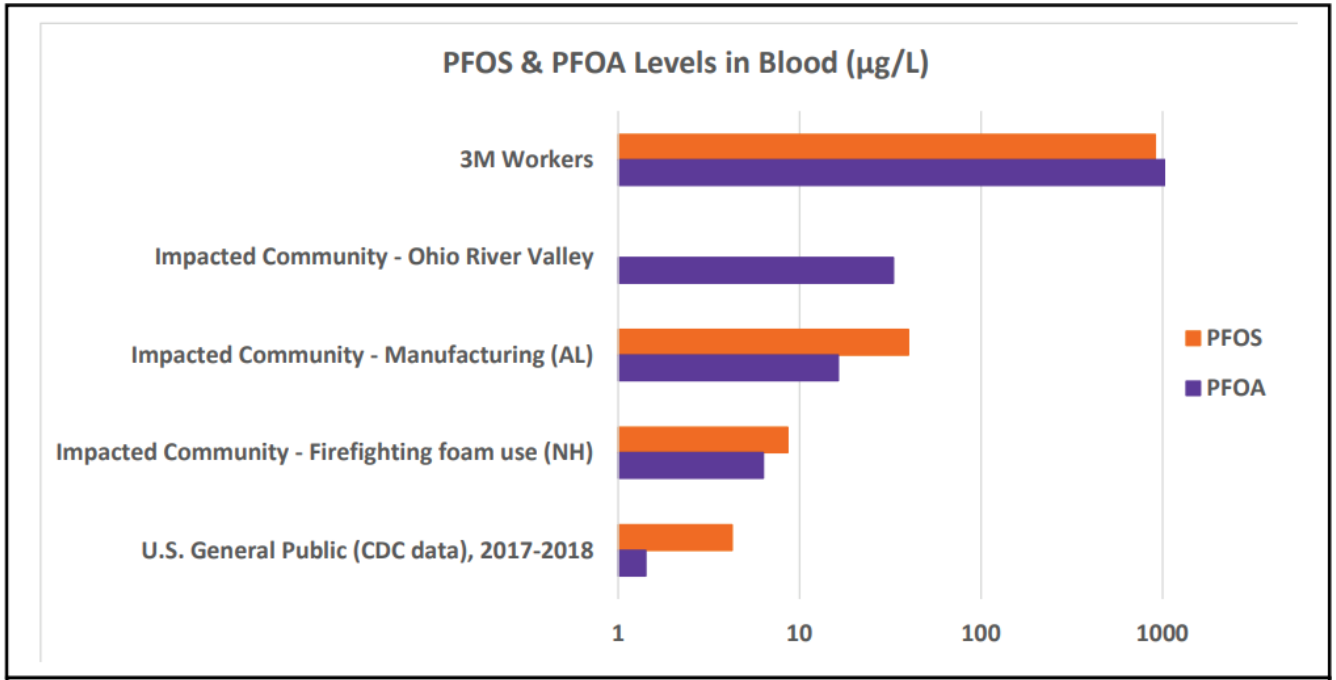
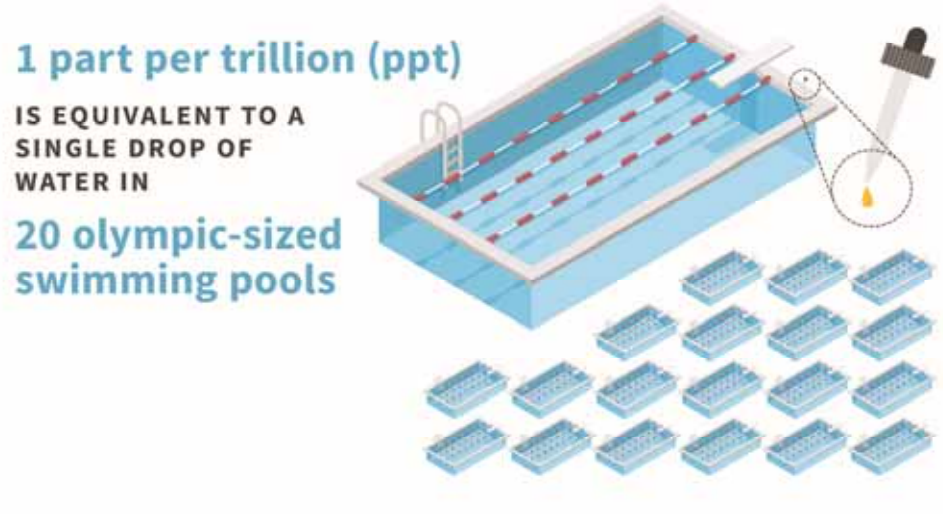


Figure 3. Comparison of exposure to PFOS and PFOA between different groups of people. Data (log scale) adapted from ATSDR (https://www.atsdr.cdc.gov/pfas/health-effects/us-population.html).

https://wateradvisory.org/wp-content/uploads/2021/12/What-Do-Human-Studies-Tell-Us-About-the-Toxicity-of-PFAS.pdf



https://www.michigan.gov/-/media/Project/Websites/PFAS-Response/Images/PPT-Swimming-Pool.pdf?rev=5104c6f80cc74cf79fcb5e2add3c9088

If you were 31.8 million years old, 1 part per quadrillion (ppq) or a picogram per liter is equivalent to a blink.

CHANGING (AND LOW) TARGETS & CRITERIA

USEPA HAs
PFOA = 0.004
PFOS = 0.020
HFPO-DA = 10
PFBS = 2,000

Table is promulgated for drinking water

All concentrations are **ppt (or ng/L)**

State	PFOA	PFOS	PFHxS	PFHxA	PFBS	PFBA	PFNA	PFHpA	HFPO-DA
CA	10	40			5,000				
MA	20	20	20				20	20	
MI	8	16	51	400,000	420		6		370
MN	35	15	47	200	100	7			
NH	12	15	18				11		
NJ	14	13					13		
NY	10	10							
PA	14	18							
RI	20	20	20						
VT	20	20	20				20	20	
WA	10	15	65		345		9		

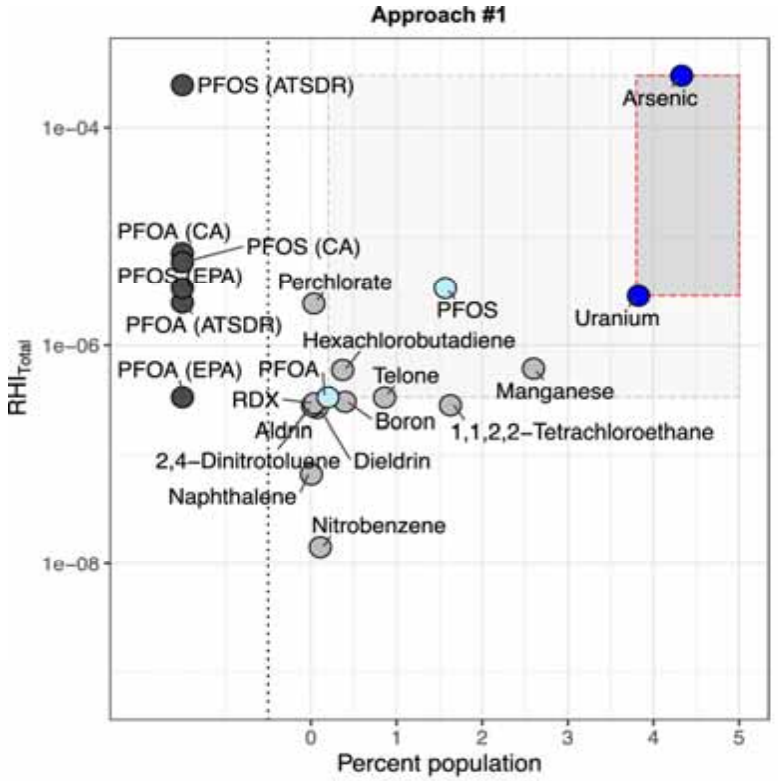
PFAS — Per- and Polyfluoroalkyl Substances (itrcweb.org)

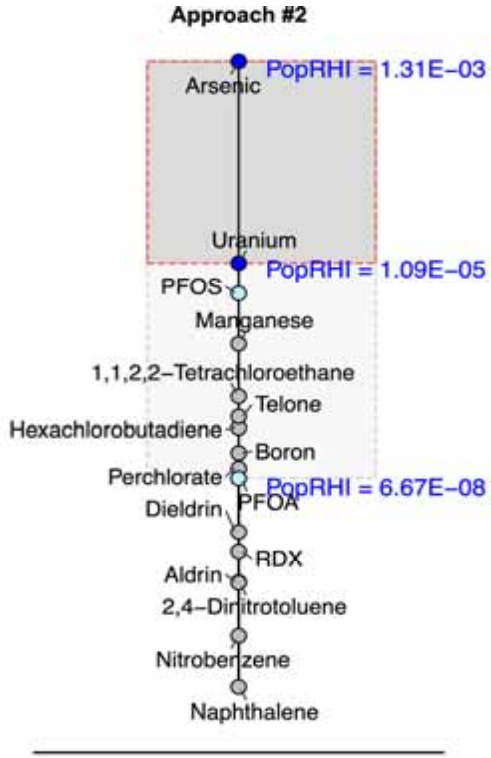
- THE US EPA LIFETIME DRINKING WATER HEALTH ADVISORIES FOR PFOS AND PFOA ARE OFTEN LOWER THAN THEIR RESPECTIVE LEVELS IN RAINWATER AND THE DANISH DRINKING WATER LIMIT VALUE FOR Σ4 PFAS IS ALSO OFTEN LOWER THAN THE LEVEL OF Σ4 PFAS IN RAINWATER
- THE EUROPEAN UNION (EU) ENVIRONMENTAL QUALITY STANDARD (EQS) FOR PFOS FOR FRESHWATERS IS OFTEN LOWER THAN LEVELS IN RAINWATER
- THE CYCLING OF PFAAs IN THE WORLD'S HYDROSPHERE MEANS THAT LEVELS OF PFAAs IN RAINWATER WILL BE PRACTICALLY IRREVERSIBLE

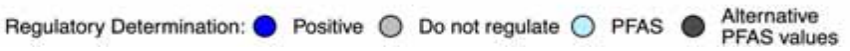
PFAS (ng/L)	USEPA HAs	Tibetan Rain	Antarctic Rain
PFOA	0.004	0.055	0.22
PFOS	0.020	0.005	0.106

Does regulating per- and polyfluoroalkyl substances represent a meaningful opportunity for health risk reduction?

If PFOA & PFOS were present in 100% of our drinking water systems, levels of 227 ng/L PFOS and 2295 ng/L PFOA would be needed to exceed the minimum threshold of percent population to justify "meaningful opportunity"







AWWA Water Science, Volume: 3, Issue: 5, First published: 14 September 2021, DOI: (10.1002/aws2.1240)

Calculations with PFOA and PFOS at 70 ng/L

Water & Health Advisory Council

[Chemical & Engineering News: Letter to the Editor of PFAS Drinking Water Advisories - Water & Health Advisory Council (wateradvisory.org)]

- Debate on study EPA relied on
- Advisories' credibility is doubtful
- Misdirecting drinking-water priorities and expenditure
- Serious peer review is essential

Everyone agrees that per- and polyfluoroalkyl substances (PFAS) are environmentally and biologically persistent and should be managed. Exposures occur from many sources, including household products and fabrics, some foods, and food contact containers. Their manufacture, uses, and exposures are being reduced by company and government agreements from the early 2000s. Human blood levels of PFOA and PFOS in the US are more than 70–85% less than they were in 1999. Some drinking waters are exposure sources, usually at low parts per trillion, especially some groundwaters, where they may persist for many years.

The EPA's calculations are based partly on a study in the Faeroe Islands with an inverse relationship between child blood levels and antibody titers for diphtheria and tetanus. There is debate on the study's applicability. Even if the finding is valid, the US Centers for Disease Control and Prevention's data show no relationship with cases in the US. Cases of diphtheria are extremely low. Vaccinations are very effective, so those health advisories are protecting against a nonexisting consequence at high cost.

The advisories' credibility is doubtful, and those unmeasurable numbers raise public concern and result in major expenditures in the over 150,000 public water systems in the US. They also misdirect drinking-water priorities and expenditures that should deal with decaying water distribution systems and water-related legionellosis, a deadly waterborne disease.

The EPA must reexamine its scientific risk assessments and provide a more credible scientific basis for its health advisories. Serious peer review is essential.

Geosyntec consultants

SAMPLING AND LABORATORY TECHNIQUES

SAMPLING TECHNIQUES

Avoid
- Clothes washed with fabric softener
- Clothes made or washed with stain resistant chemicals
- Certain insect repellents and sunscreens
- Certain personal care products
- Pre-wrapped food or snacks

Polypropylene (or HDPE)
Trizma® (pH 7) from qualified lab
Watch carpets & car interiors

Wash hands
Powderless nitrile gloves

Place bottles on PFAS-free surfaces (not the ground)

Bag samples in LDPE resealable storage bags

Decontamination
- Alconox, Liquinox, and Citranox
- PVC brush to remove particles
- Triple rinse with PFAS-free deionized water

"even the smallest cross-contamination could contribute to a false positive sample"
https://www.michigan.gov/pfasresponse/investigations/sampling-guidance

USEPA LABORATORY TECHNIQUES

USEPA Method 537 Revision 1.1 (SPE and LC/MS/MS)
- For 18 PFAS in finished drinking water samples

USEPA Method 533 (Isotope Dilution Anion Exchange SPE and LC/MS/MS)
- Isotope dilution method targeting 25 “short-chain” PFAS in finished drinking water samples

USEPA Method 8327 (External Standard Calibration and MRM LC/MS/MS)
- Direct injection method for 24 analytes in groundwater, surface water and wastewater

Draft Method 1633 (3rd draft in Dec. 2022)
- Direct injection method for 40 PFAS in wastewater, surface water, groundwater, soil, biosolids, sediment, landfill leachate, and fish tissue (single lab validation)
- EPA and DoD collaborating with a multi-laboratory validation study
- EPA recommending for use in individual NPDES permits

https://www.epa.gov/water-research/pfas-analytical-methods-development-and-sampling-research

USEPA LABORATORY TECHNIQUES - TOTAL

Method 1621 (multi-laboratory validation ongoing)

- Adsorbable organofluorines in wastewater and surface waters

Total Organic Fluorine (TOF) – in development

- Total PFAS presence and absence

Total Organic Precursors (TOP) – under consideration

- Identify PFAS precursors that may transform to more persistent PFAS
- TOP methods are commercially available

32 accredited labs (including American Water Central Laboratory in Belleville, IL)

Geosyntec consultants

TREATMENT CHALLENGES

TREATMENT CHALLENGES

Relied upon technologies focus on PFAS removal, not destruction

- Granulated activated carbon (GAC)
- Ion exchange (IX)
- Reverse osmosis (RO)

Produce a concentrated residual stream that must be treated

- Hazardous waste landfill
- Incineration

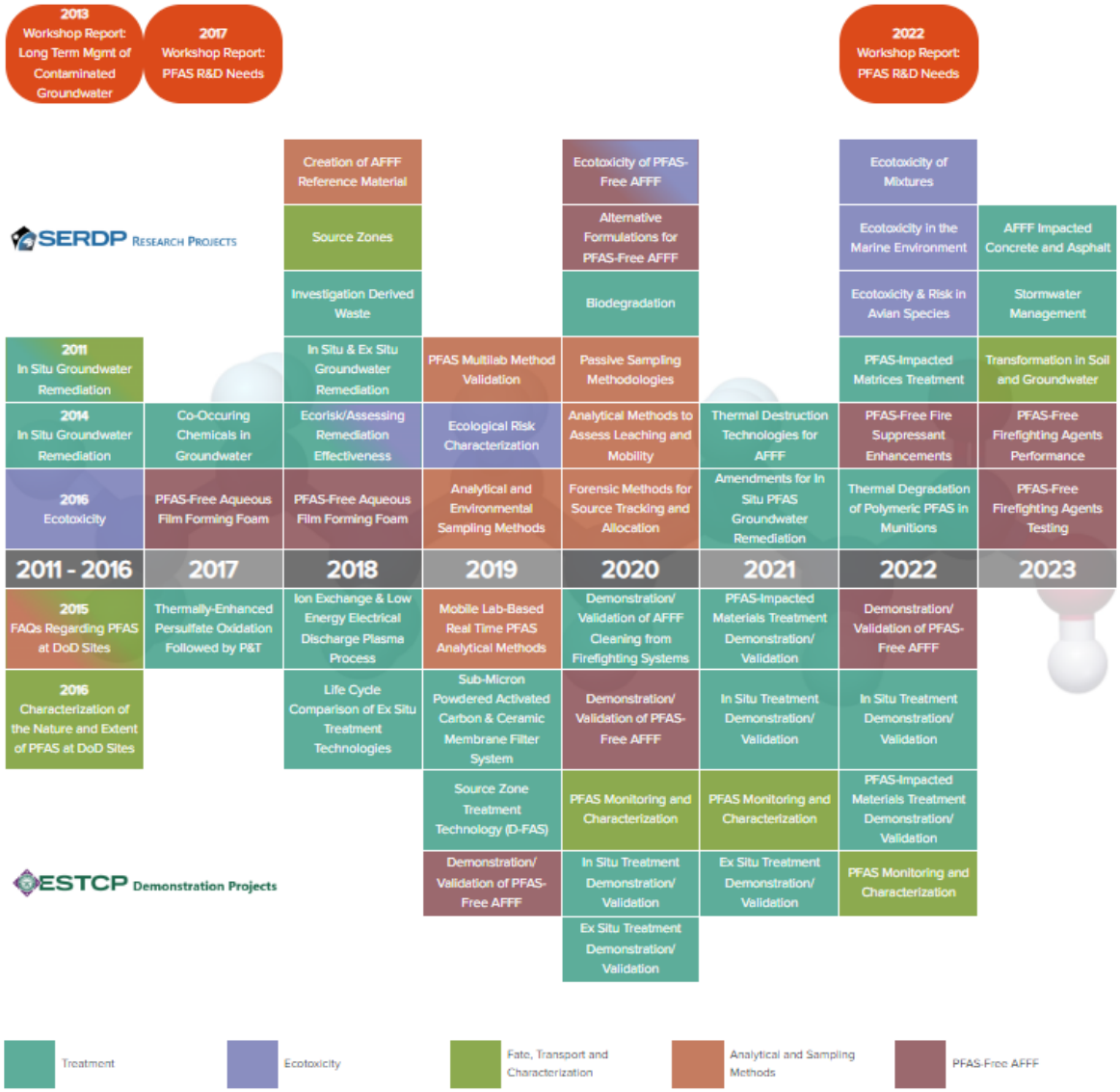
No demonstrated in situ treatment technologies

"An under-sink RO filter integrates with the plumbing under your kitchen sink to provide treated drinking water for you and your family. **The concentrated PFAS brine is discharged directly down the drain, so there is not waste to manage or dispose of.**"

TREATMENT OPPORTUNITIES

Next generation technologies

- Both in-situ and ex-situ approaches
- Primary focus
  - Treatment trains
  - PFAS destruction
- Significant R&D investments by the Department of Defense



Per- and Polyfluoroalkyl Substances & Aqueous Film-Forming Foam (serdp-estcp.org)

Geosyntec consultants

REGULATORY ACTIONS

NPDES PROGRAM – USEPA DEC. 5, 2022 MEMO

Quarterly monitoring for 40 PFAS

Best management practices (BMPs) - product substitution, reduction, or elimination of PFAS

BMPs to address firefighting foams for stormwater permits

Technology-based effluent limits (TBELs) based on best professional judgment

Water-quality based effluent limits (WQBELs) including numeric translation of narrative water quality standards

INDUSTRIAL DISCHARGERS (Effluent Limit Guidelines)

- OCPSF (Spr. 2024)
- Metal finishing
- Electroplating (Dec. 2024)
- Electric and electronic components
- Landfills (TBD)
- Pulp, paper, & paperboard (phasing out)
- Leather tanning & finishing
- Plastics molding & forming
- Textile mills (lack of data)
- Paint formulating
- Airports (phasing out)

NPDES PROGRAM – USEPA DEC. 5, 2022 MEMO

For POTWs:

Effluent, influent, and biosolids monitoring

Update industrial user inventories

Use BMPs and pollution prevention

Notify potentially affected public water systems of draft permits with PFAS-monitoring, BMPs, or other conditions

VARIETY OF STATE ACTIONS

Maine – statewide ban on biosolids application

Michigan – organized MPART – statewide sampling of influent, effluent, biosolids

- Led to “industrially impacted” approach
- Focus on source reduction and restricting biosolids application when necessary

California – statewide sampling of targeted industries

Illinois – initiating discussion with Illinois Association of Wastewater Agencies

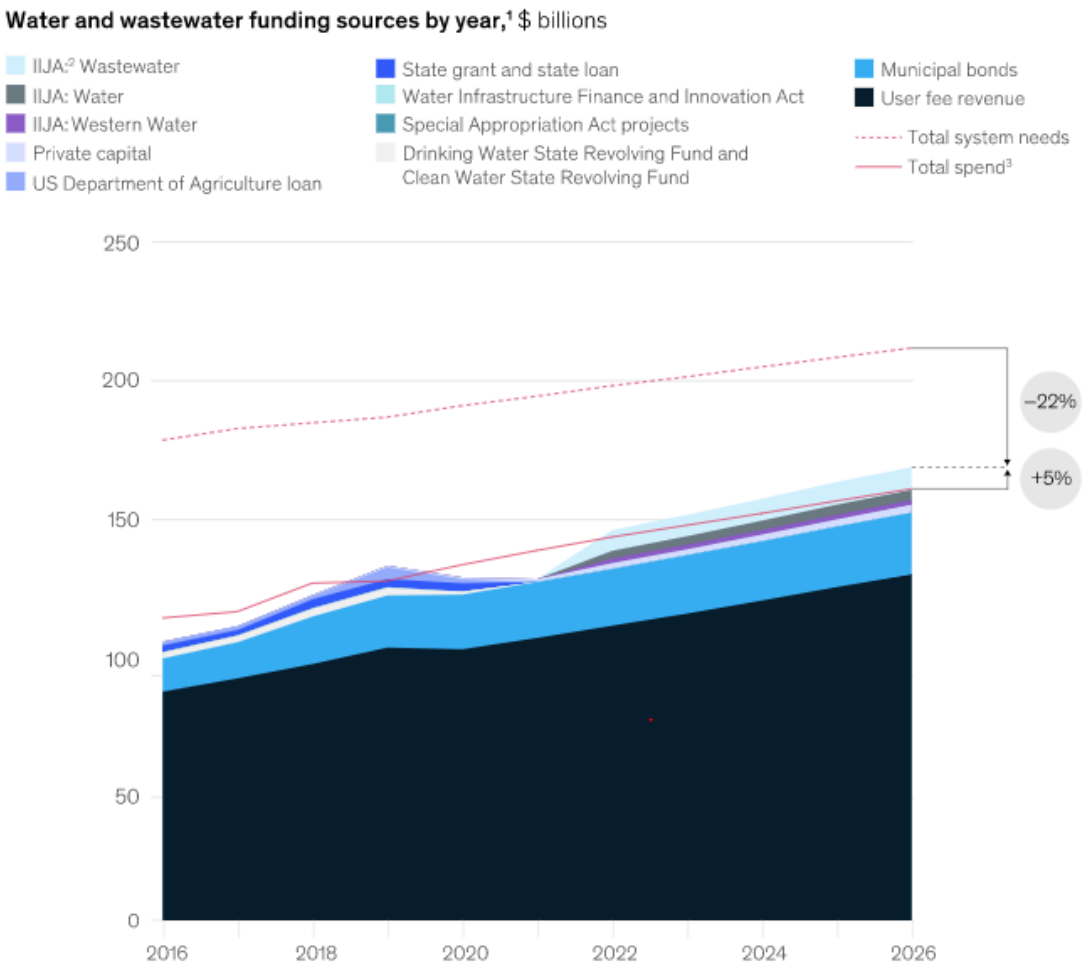
- Consideration of drafting model NPDES permit language
- Begin sampling of major municipal and industrial wastewater treatment plants

"McKinsey analysis suggests that new PFAS requirements could lead to a threefold increase in PFAS-related annual capital spending between 2021 and 2025."

OTHER FUNDING NEEDS:

- Lead and copper rule
- Fixing water leaks
- Cybersecurity
- Combined sewer overflows
- Nutrients
- Climate resilience

A fivefold increase in federal funding would raise total funds in the industry by about 5 percent in the short term, but funding would still fall 22 percent short of the necessary capital.



https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/us-water-infrastructure-making-funding-count

THE ROANOKE TIMES
Monday, September 20, 2004

STEPHANIE KLEIN-DAVIS | The Roanoke Times

Mellisa Williamson, 35, a Bullitt Avenue resident, worries about the effect on her unborn child from the sound of jackhammers.

TRAFFIC: Official says wait for end result

Geosyntec consultants

EXTRA SLIDES

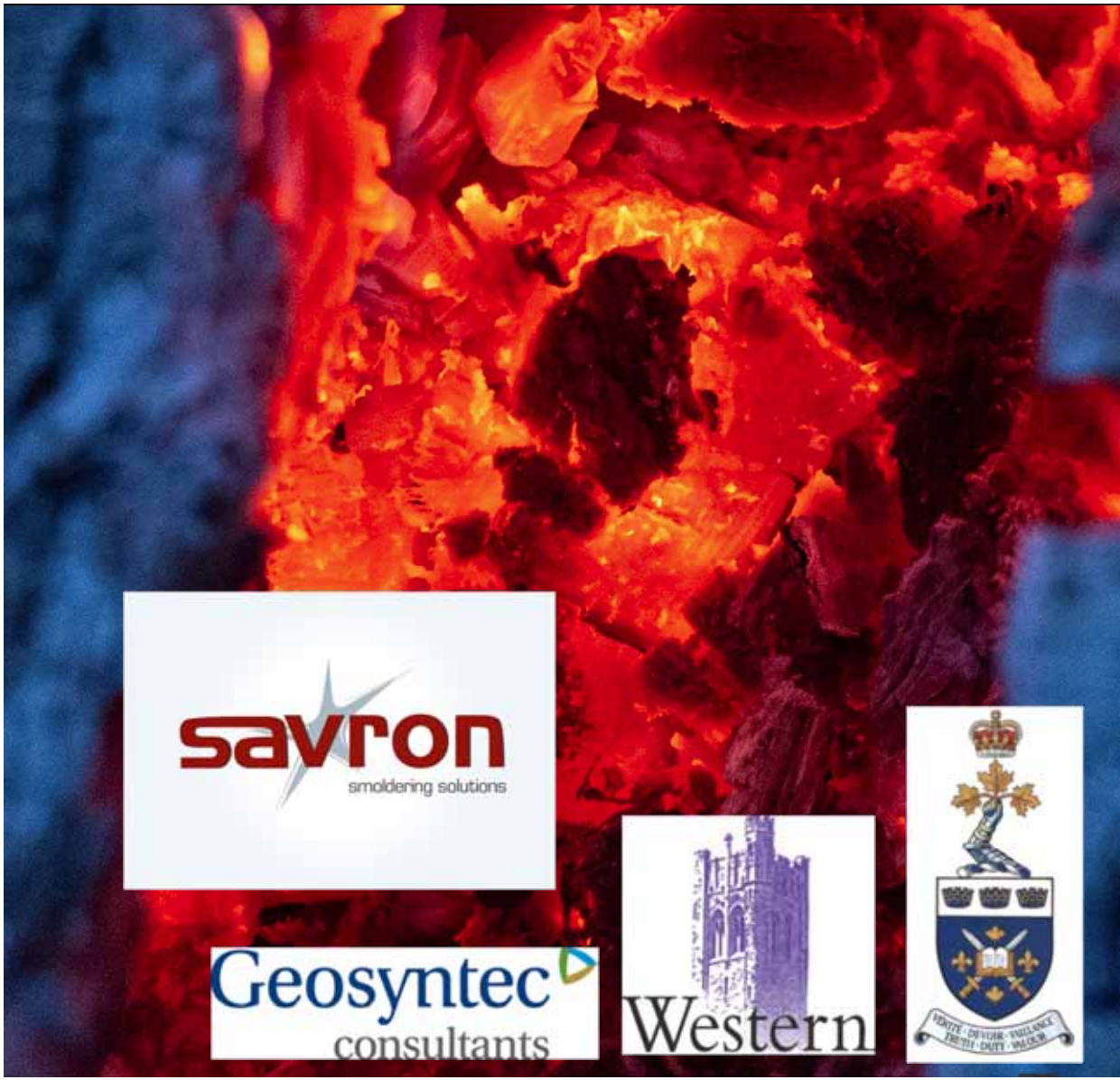
SMOLDERING

Low-cost / energy thermal technique to treat contaminated soils and media

- Temperatures > 700°C
- Use GAC to support

2021 SERDP PROJECT OF THE YEAR

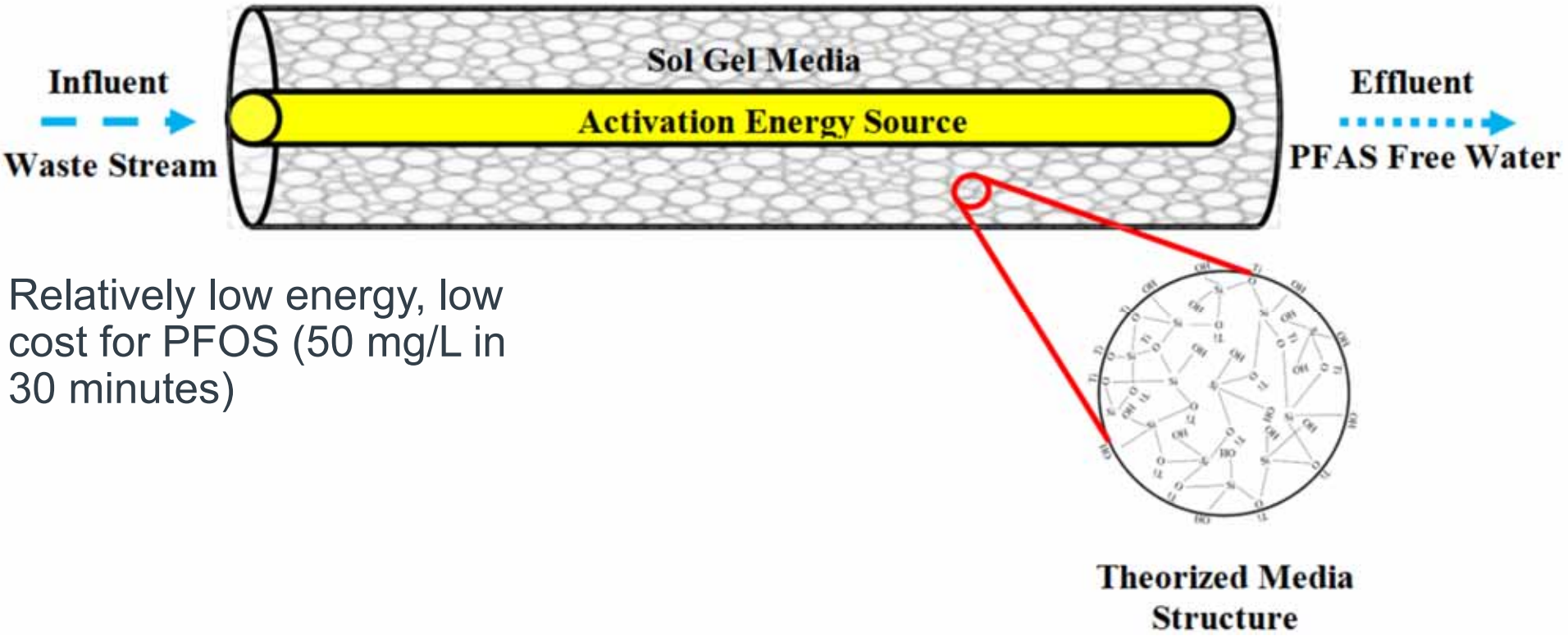
SERDP DOD • EPA • DOE



[Demonstration of Smoldering Combustion Treatment of PFAS-impacted Investigation-Derived Waste (serdp-estcp.org)]

[Innovations – Savron (savronsolutions.com)]

ULTRA-VIOLET ACTIVATION WITH STABLE PHOTOCATALYST



Relatively low energy, low cost for PFOS (50 mg/L in 30 minutes)