Emerging Contaminants: Per- and Polyfluoralkyl Substances (PFAS) Global Regulatory Status and Drivers for Action

Shalene Thomas, Emerging Contaminant Program Manager

Agenda

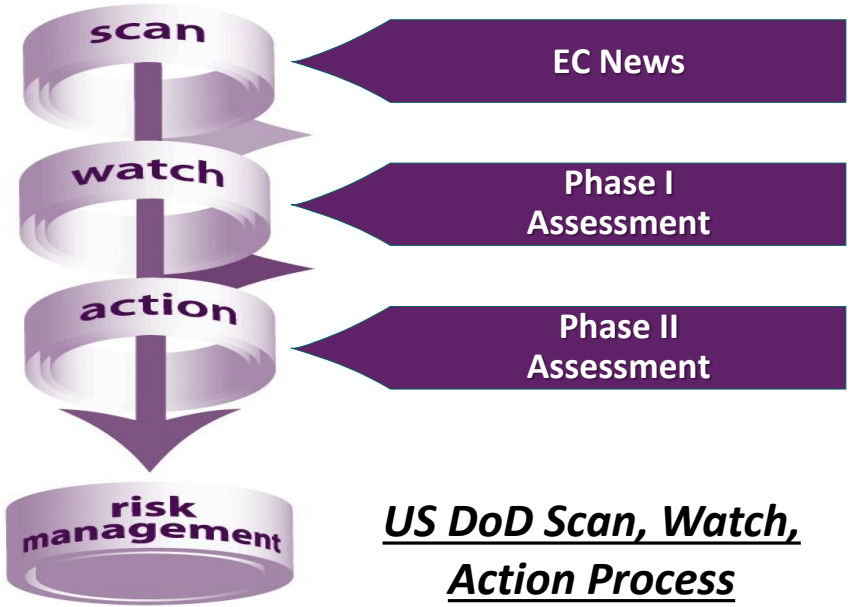
1. Emerging Contaminants
   - What are they?
   - Why the concern?
2. PFAS and the US Regulatory Timeline
3. PFAS and the Global Regulatory Framework
4. Trends and Managing/Mitigating Future Liability

Emerging Contaminants- What are they? Why the concern?

What is an emerging contaminant?

US DoD and EPA definitions generally state:

1. Presents potential unacceptable risk
2. Has no published standard
3. New science, detection, or exposure pathway available[1,2, 3]



US DoD Scan, Watch, Action Process

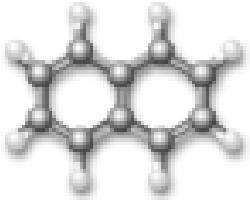
[1]DoD Instruction 4715.18, *Emerging Contaminants,* June 11, 2009. DUSD (I&E) is Deputy Under Secretary of Defense for Installation and Environment

[2]EPA Federal Facilities Restoration and Reuse Office: http://www.epa.gov/fedfac/documents/emerging_contaminants.htm#additional_ec

[3] http://toxics.usgs.gov/regional/emc/

List of Emerging Contaminants

US Department of Defense Emerging Contaminants



Naphthalene

Be

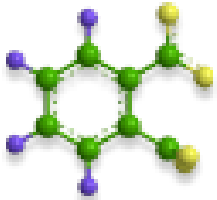
Beryllium

Cr^{6+}

Hexavalent Chromium (HC)

SF_6

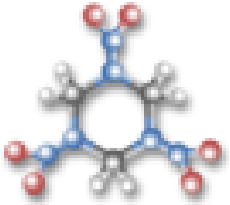
Sulfur Hexafluoride (SF_6)



Phthalate

Pb

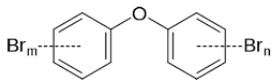
Lead



RDX

US EPA Office of Water Contaminants of Emerging Concern

- Pharmaceuticals and Personal Care Products
- Polybrominated diphenyl ethers (PBDEs)
- PFOS and PFOA



PBDEs

PFOA - perfluorooctanoic acid

PFOS - perfluorooctanesulfonic acid

US Federal and State EC Programs

Safe Drinking Water Act (SDWA)

Unregulated Contaminant Monitoring Rule (UCMR)

Center for Disease Control and Prevention (CDC)

National Health and Nutrition Examination Survey (NHANES)

State Biomonitoring Cooperative Agreement

Seven States with Specific Risk Management Programs Addressing Emerging Contaminants

WA, AZ, MN, NY, ME, VT

A Moving Target; Why the concern?

Persistent, Bioaccumulative, Toxic

Use and Contamination is Widespread

Regulatory and Legal Actions Rising

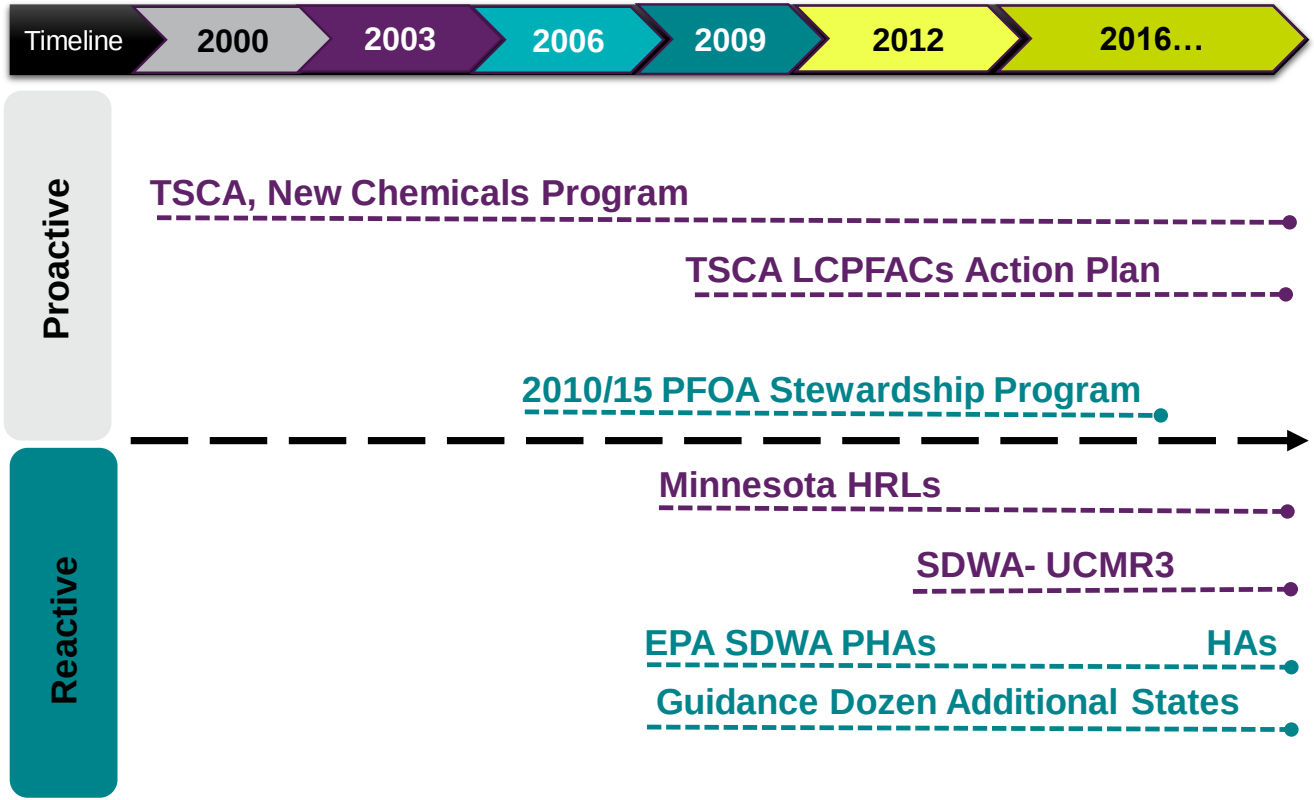
Risk Review, Management, Mitigation

Manage and Mitigate Risk; Why are ECs Different?

Classic Contaminants	Emerging Contaminants
► IRIS toxicology data available	► Often no peer-reviewed toxicology data available or risks unknown
► Science used to evaluate risk and exposure is “Accepted”	► Science used to evaluate risk and exposure is “Evolving”
► Analytical methods are tested and verified	► Analytical methods are in development, not commercially available
► Remedial options are available	► Remedial options not generally commercially available
► PUBLISHED AND ACCEPTED CRITERIA	► NO CRITERIA OR VARIABLE CRITERIA

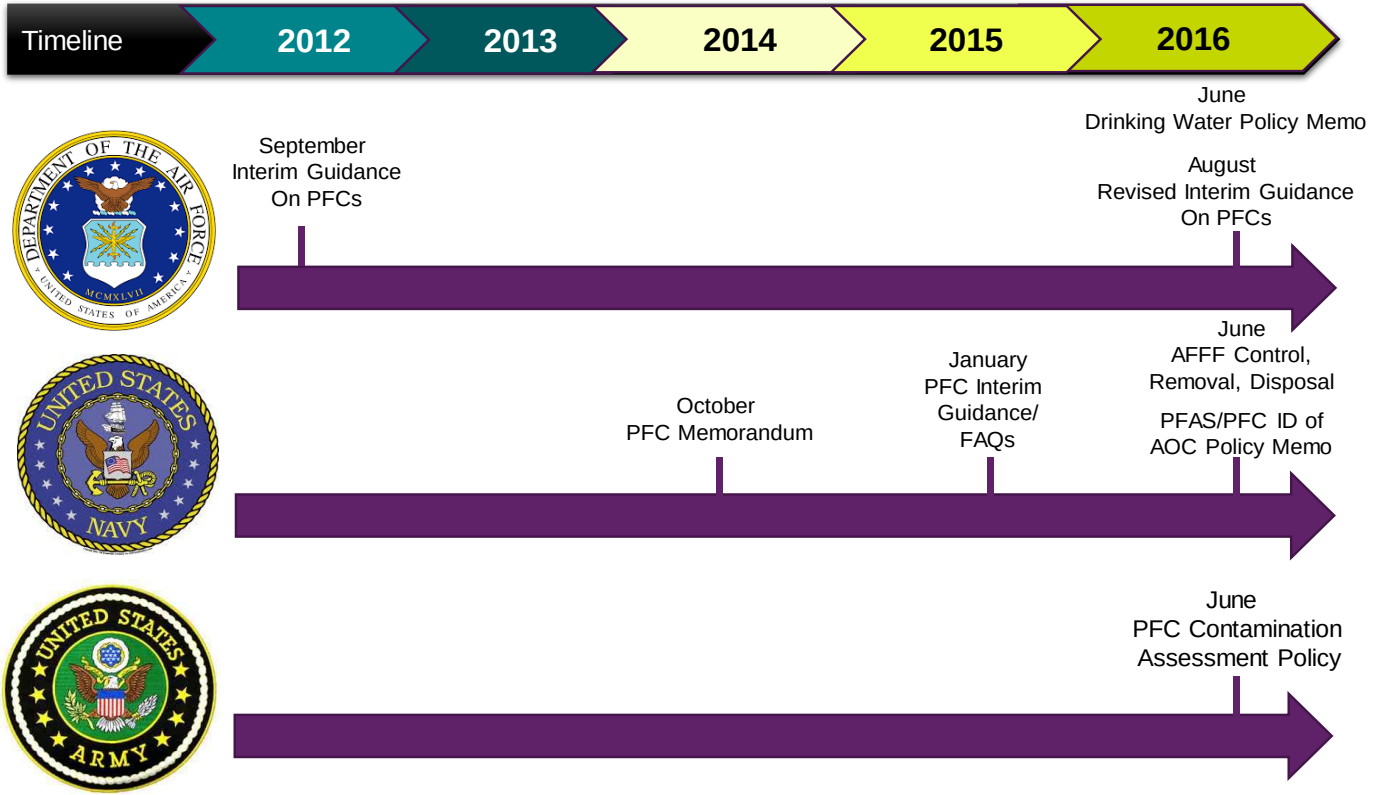
PFAS and the US Regulatory Timeline

Timeline: US Regulatory Drivers



TSCA= Toxic Substance Control Act
LCPFACS =long-chain perfluoroalkyl carboxylate
HRL = Health Risk Limit
SDWA = Safe Drinking Water Act
UCMR = Unregulated Contaminant Monitoring Rule
PHA = Provisional Health Advisory

Timeline: US DoD Policy Drivers



Timeline: Social Drivers

- August 9th Release (2016)
- Implies 664 Military PFAS Sources
- Academic Article published same day as press release in NPR, Washington Post, etc.
- Emphasizes social drivers influencing actions

Environmental Science & Technology Letters

Letter

pubs.acs.org/journal/estlcu

Detection of Poly- and Perfluoroalkyl Substances (PFASs) in U.S. Drinking Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants

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[†,‡]

[†]Harvard T. H. Chan School of Public Health, Boston, Massachusetts 02215, United States

[‡]Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge, Massachusetts 02138, United States

US Water Criteria

Concentration (ug/L, ppb)	PFOA	PFOS	
US EPA			
USEPA	0.07	0.07	1
	0.4***	0.4***	2
US by State			
Alaska (AK)*	0.40	0.40	2
Connecticut (CT)	0.07	0.07	2
Delaware (DE)	0.07	0.07	2
Iowa (IA)*	0.07	0.07	2
Maine (ME)	0.07	0.07	1
	0.13	0.56	2
	0.05	1.2	3
Michigan (MI)*	0.42	0.011	4
	0.07	0.07	2
Minnesota (MN)**	0.035	0.027	2
Nevada (NV)			1
New Hampshire (NH)*	0.07	0.07	2
New Jersey (NJ)	0.014**		1
North Carolina (NC)*	2		2
Oregon (OR)*	24	300	4
Texas (TX)*	0.29	0.56	2
Vermont (VT)*	0.02	0.02	1/2

NOTES

1= drinking water
2= groundwater
3= recreational water
4= surface water

* = Promulgated rule (AK, IA, MI, NH, NC, OR, TX, VT)
** = Promulgation anticipated, proposed or recommended (MN, NJ)
***= Calculated using the EPA RSL calculator

OTHER NOTABLES

- 70% of the states adopted criteria within the last 2 yrs
- Several states have adopted criteria for other PFAS
  - CT, DE, MN, NV, NJ, OR, and TX
- CERCLA 5-Year reviews serving as Site “Re-Openers”
- Administrative Orders from EPA despite promulgated rule
- States have adopted Emergency Rules
- Site Clean-Up Goals vary broadly

Basis of Derivation

PFOA

	EPA	Vermont	Texas	North Carolina	Minnesota
Criteria (ug/L)	0.07	0.02	0.29	1	0.035
Input factors					
Critical Effect	Developmental	Developmental	Developmental	Inreased liver weight	Developmental
Study	Lau et al. 2006	Lau et al. 2006	Macon et al. 2011	Butenhoff et al. 2002	Lau et al. 2006
Species	Mice	Mice	Mice	Monkey	Mice
Dose-Response	LOAEL	LOAEL	LOAEL	BMD	LOAEL
Total Uncertainty Factor	90,000	90,000	90,000	900	81,000
Receptor	Lactating Woman	Infant (1- yr)	Child (0-6 yrs)	Adult	Infant exposure via breastmilk for 1 year, from mother chronically exposed via water, followed by lifetime of exposure via drinking water
Relative Source Contribution	0.2	0.2	Not applied	0.2	0.5

LOAEL = Lowest observable adverse effect
BMD = Benchmark does method

PFAS and the Global Regulatory Framework

International Water Criteria

Concentration (ug/L, ppb)		PFOA	PFOS	
International				
Australia	health-based	0.56	0.07	1
	health-based	5.6	0.7	2
Canada	screening value	0.2	0.6	1
Denmark	screening value	0.1	0.1	1
Germany	health-based	0.3	0.3	1
	administrative	0.1	0.1	1
Italy	health-based	0.5		1
	screening value	0.1		3
Netherlands	health-based		0.53	1
	administrative		0.0053	1
Sweden	health-based		0.09	1
	administrative	0.09	0.09	1
UK	health-based	10	0.3	1
	admin. Level 1	0.3	0.3	1
	admin. Level 2	10	1.0	1
	admin. Level 3	90	9	1

NOTES

1= drinking water
2= recreational water
3= freshwater

OTHER NOTABLES

- Most countries adopted criteria earlier than US (2006-2014)
- Several countries have adopted criteria for other PFAS
  - Australia, Canada, Denmark, Italy, Sweden
- Substantial variability across countries
- Several countries are re-evaluating criteria
- Stockholm convention has been a primary driver

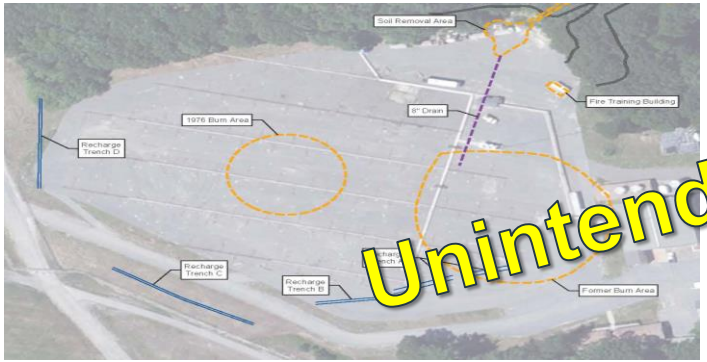
Trends and Managing/Mitigating Future Liability

PFAS Regulatory Trends

- **Analyte consideration**
  - Primary focus PFOS and PFOA at the Federal level
  - PFBS -EPA RSL published criteria
  - Assume PFHxS, PFNA, PFBS, PFBA will follow
  - Reporting branched and linear isomers separately
- **Additive Trends**
  - New HAs consider PFOS+PFOA. Assume this trend will continue
  - Other countries are already implementing this approach
- **Expanded Media Focus**
  - Stormwater as potential secondary source.
  - Biota – driven by risk perceptions (e.g. POTW/biosolids, crops,etc.)
  - Air – translocation evident but poorly understood.
- **Proactive Regulatory, Sector, or Market Actions Globally**

Managing and Mitigating Liability

- **Active Remediation Considerations**
  - Oxidation of precursors
  - Soil excavation
  - Reinjection
- **Construction/Demolition**
  - Soil management
  - Air translocation
  - Dewatering considerations



Unintended Consequences

[4] McGuire, M. E., et al. (2014). Evidence of remediation-induced alteration of subsurface poly- and perfluoroalkyl substance distribution at a former firefighter training area. Environmental Science & Technology, 48(12), 6644-6652

Sampled Media	# of samples	PFOS Frequency of Detects	PFOS Median / Maximum (ppb)	PFOA Frequency of Detects	PFOA Median / Maximum (ppb)
Soil samples	1562	59.70%	32.4 / 108,000	44.60%	2.60 / 1,450
Groundwater samples	1363	74.50%	0.050 / 7150	66.30%	0.05 / 3,820

Managing and Mitigating Liability

- Wastewater and Management
  - Water treatment, containment, reuse/discharge
  - Biosolids management/ reuse
- Water reuse
  - ✓ Source?
  - ✓ Construction (compaction, dust suppression)
  - ✓ Irrigation (grounds, golf course)

Unintended Consequences

[5] Xindi C. Hu et al. Detection of Poly- and Perfluoroalkyl Substances (PFASs) in the U.S. Drinking Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants, Environmental Science and Technology Letters (August 2016), 3, 344-350, DOI: 10.1021/asc.astlett.6b00260

[6] U.S. Environmental Protection Agency FACT SHEET, Perfluorochemical (PFC) Contaminationof Biosolids Near Decatur, Alabama, March 2011

[7] http://www.afcec.af.mil/News/Article-Display/Article/466187/air-force-earth-day-2013-emphasis-on-water-conservation

Managing and Mitigating Liability

- Stormwater
  - >95% detection across samples collected
  - Non-point source contribution
  - Management via
    - ✓ passive treatment
    - ✓ collection and treatment
    - ✓ retention

- Investigation-Derived Waste (IDW) Management
  - Currently being maintained on property
  - Staged until later date
  - Liabilities minimized by storing on-site
  - Some disposal facilities refusing to accept.

- AFFF Interim Best Management Practices
  - Consider entire life cycle
  - Procurement
  - Management of wastewater during testing and flushing
  - Disposal practices

Unintended Consequences

Sampled Media	# of samples	PFOS Frequency of Detects	PFOS Median / Maximum (ppb)	PFOA Frequency of Detects	PFOA Median / Maximum (ppb)
Stormwater samples	80	96.30%	0.140 / 3.70	67.50%	0.040 / 0.940

PFAS Regulatory Status and Prognosis

The “take-home messages”…

1. **Keep one eye open- the PFAS regulatory framework is evolving quickly**

2. **Science is not always driving decisions**

3. **Evaluate and manage liabilities proactively to avoid unintended consequences**

Where to find us

Upcoming Conferences

- AEHS, Amherst MA- Oct 16-19
- SETAC Annual Conference, Minneapolis MN- Nov 16-18
- Battelle Chlorinated Conference, Palm Springs, CA –April 8-12

Industry Publications

- NGWA: Groundwater and PFAS: State of Knowledge and Practice- due out Fall 2017
- ITRC: PFAS Fact Sheets- 6 in total before the end of 2017
- Podcast: Understanding Emerging Contaminants and Regulatory Matters (https://itunes.apple.com/us/podcast/civil-engineering-podcast/id993416182?mt=2)
- Woodard, S. et al. 2017. Ion exchange resin for PFAS removal and pilot test comparison to GAC. Remediation 2017; 27:19-27.

Questions?

Shalene Thomas
Emerging Contaminant Program Manager
shalene.thomas@woodplc.com
(612) 252-3697

Thank you to collaborators:
Dave Woodward, Nathan Hagelin -Wood