Welcome to the Per- and Polyfluoroalkyl Substances (PFAS) Heartland Community Engagement

EPA Region 7- Leavenworth, Kansas
September 5, 2018
PFAS 101: Dr. Marc Mills, EPA Office of Research and Development

EPA Region 7- Leavenworth, Kansas
September 5, 2018
PFAS 101: An Introduction to PFAS and EPA research on PFAS

Presentation to “Per- and Polyfluoroalkyl Substances (PFAS) Heartland Community Engagement Meeting”

Marc A. Mills, Ph. D.
EPA Office of Research and Development
Per- and Polyfluoroalkyl Substances (PFAS)

A class of man-made chemicals
- **Chains** of carbon (C) atoms surrounded by fluorine (F) atoms, with different endings
- **Complicated chemistry** – thousands of different variations exist in commerce
- **Widely used** in industrial processes and in consumer products
- **Some** PFAS are known to be **PBT**:  
  - **Persistent** in the environment  
  - **Bioaccumulative** in organisms  
  - **Toxic** at relatively low (ppt) levels
Per- and Polyfluoroalkyl Substances (PFAS)

- Perfluorocarboxylic acids (ex. PFOA)
- Perfluorosulfonic acids (ex. PFOS)
- Fluorotelomer alcohol (ex. 8:2 FTOH)
- Perfluorophosphonic/phosphinic acids (ex. If R=OH then PFOPA, if R=C8 then perfluoroalkane then 8:8 PFPI)
- Perfluorosulfonamide (ex. FOSA)
- Perfluorinated cyclo sulphonates (ex. PFECHS)
- Perfluorosulfonamidoethanol (ex. N-ETFOSA)
- Fluorotelomer phosphate esters (ex. If R=OH then 8:2 monopAP, if R=8:2 FTO ester then 8:2 dipAP)
- Polyfluorinated ether carboxylates (ex. 4,8-dioxa-3H-perfluorononanoate)
- Polyfluorinated polymeric unit (ex. 1H,1H,2H,2H-perfluorodecyl acrylate)
- Polyfluorinated ether sulfonates (ex. Perfluoro [hexyl ethyl ether sulfonate]}

Slide courtesy of Mark Strynar referencing Lindstrom, Strynar and Libelo, 2011 ES&T
Thousands of Chemicals: More Than Just PFOA and PFOS

**PFAS**

**Non-polymers**

- **Perfluoroalkyl acids (PFAAs)**
  \[ C_nF_{2n+1}R \]
  - Perfluoroalkyl carboxylic acids (PFCAs)
  - Perfluoroalkane sulfonic acids (PFSAs)
  - Perfluoroalkyl phosphonic acids (PFPAs)
  - Perfluoroalkyl phosphinic acids (PFPIAs)

- **Perfluoroalkane sulfanyl fluoride (PASF)**
  \[ C_nF_{2n+1}SO_2F \]
  - PASF-based derivatives
    \[ C_nF_{2n+1}SO_2-R, R = NH, NHCH_2CH_2OH, \text{etc.} \]

- **Perfluoroalkyl iodides (PFAIs)**
  \[ C_nF_{2n+1}I \]
  - Fluorotelomer iodides (FTIs)
    \[ C_nF_{2n+1}CH_2CH_2I \]
  - FT-based derivatives
    \[ C_nF_{2n+1}CH_2CH_2-R, R = NH, NHCH_2CH_2OH, \text{etc.} \]

- **Per- and poly(perfluoro)alkyl ethers (PFPEs)-based derivatives**
  - Polyfluoroalkyl ether carboxylic acids

**Polymers**

- **Fluoropolymers**
  - Polytetrafluoroethylene (PTFE)
  - Polyvinylidene fluoride (PVDF)
  - Fluorinated ethylene propylene (FEP)
  - Perfluoroalkoxy polymer (PFA)
  - Others

- **Side-chain fluorinated polymers**
  - Fluorinated (meth)acrylate polymers
  - Fluorinated urethane polymers
  - Fluorinated oxetane polymers
<table>
<thead>
<tr>
<th>Used in Homes, Businesses, &amp; Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Food contact surfaces such as cookware, pizza boxes, fast food wrappers, popcorn bags, etc.</td>
</tr>
<tr>
<td>• Polishes, waxes, and paints</td>
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<tr>
<td>• Stain repellants for carpets, clothing, upholstered furniture, etc.</td>
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<tr>
<td>• Cleaning products</td>
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<td>• Dust suppression for chrome plating</td>
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<tr>
<td>• Electronics manufacturing</td>
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<tr>
<td>• Oil and mining for enhanced recovery</td>
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<tr>
<td>• Performance chemicals such as hydraulic fluid, fuel additives, etc.</td>
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</tbody>
</table>
Sources of PFAS in the Environment

• Direct release of PFAS or PFAS products into the environment
  – Use of aqueous film forming foam (AFFF) in training and emergency response
  – Release from industrial facility

• Surfacing (chrome, paper, polymers) facilities

• Landfills and leachates from disposal of consumer and industrial products containing PFAS

• Wastewater treatment effluent and land application of biosolids
Reasons for Concern

- Known or suspected toxicity
- PFAS and/or breakdown products are persistent in the environment
- Bioaccumulation in biota vary greatly across chemicals and species
- Used by a variety of industries
- Found in a variety of consumer products
- Most people have been exposed to PFAS
Known Human Exposure Pathways

- Best documented source is **contaminated drinking water** near industrial production facilities or waste disposal e.g., Cottage Grove, Minnesota; Parkersburg, West Virginia; Dalton, Georgia; Decatur, Alabama; Arnsberg, Germany; Osaka, Japan Lindstrom et al. 2011, Environ. Sci. & Technol. (45) 8015 – 8021

- **Food** is also implicated in many studies, especially fish from contaminated waters, items contaminated by food packaging, and breast milk Fromme et al. 2009, Inter. J. Hyg. & Envr. Heath (212) 239-270; Mogensen et al. 2015, Environ. Sci. & Technol. (49) 10466 - 10473

- **House dust** may also be an important route of exposure – especially for children who ingest relatively higher levels of dust via hand-to-mouth activity Shoeib et al. 2011, Environ. Sci. & Technol. (45) 7999 - 8005

- **Workplace exposures** significant for some sectors: manufacturing or services making or directly using PFAS, apparel sales, waste treatment Nilsson et al. 2013 Environ. Sci.: Processes Impacts, 15, 814-822

SlideCourtesy of Andrew Lindstrom, US EPA
• Animal toxicity
  • Causes liver, immune system, developmental, endocrine, metabolic, and neurobehavioral toxicity.
  • PFOA and PFOS caused tumors in chronic rat studies.

• Human health effects associated with PFC(s) in the general population and/or communities with contaminated drinking water include:
  • ↑ cholesterol
  • ↑ uric acid
  • ↑ liver enzymes
  • ↓ birth weight
  • ↓ vaccine response
  • Thyroid disease
  • Osteoarthritis
  • Diabetes
  • Testicular and kidney cancer
  • Pregnancy-induced hypertension
  • Ulcerative colitis
  • Effects in young adulthood from prenatal exposures
    – Obesity in young women.
    – ↓ sperm count in young men.
Conceptual Model of PFAS F&T

Adapted from Davis et al. Chemosphere 67 (2007) 2011–2019
Current PFAS R&D Activities

- **Analytical Methods**
  - Establish validated methods for measuring PFAS in different environmental media

- **Human Health/Toxicity**
  - Develop standard toxicity values (RfD)
  - Apply computational toxicity for screening PFAS universe

- **Exposure**
  - Develop sampling methods to characterize sources and contaminated sites
  - Identify and estimate human exposure to PFAS from different sources

- **Treatment/Remediation**
  - Identify/evaluate methods to treat and remediate drinking water and contaminated sites

- **Technical Assistance to Regions, States, Tribes**
**Problem:** Lack of standardized/validated analytical methods for measuring PFAS

**Action:** Develop and validate analytical methods for detecting, quantifying PFAS in water, air, and solids

**Results:**
- Testing current drinking water method for 6 additional PFAS (20 total, including GenX)
- Developing and testing method for 24 PFAS in surface water, ground water, and solids
- Initial development of method for air emission sampling and analysis
- Continued development of non-targeted methods to discover unknown PFAS

**Impact:** Stakeholders will have reliable analytical methods to test for known and new PFAS in water, solids, and air
Research: Exposure

- **Problem**: Lack of knowledge on sources, site-specific concentrations, and exposure
- **Action**: Develop and test methods to characterize PFAS sources and exposures
- **Results**:  
  - Developing exposure models for identifying, quantifying PFAS exposure pathways and relative source contribution  
  - Developing and evaluating sampling and site characterization approaches to identify sources and extent of contamination.
- **Impact**: Stakeholders will be able to assess potential PFAS sources and exposures, and identify key exposure pathways for risk management
Ohio River, Air Transport

- Ohio State student studying PFAS in Ohio River and adjacent watershed
- Collaborated on sampling, analysis
- Found PFAS upstream from source
- Similar findings around facilities in NH, NJ, NC
- Implication of air as PFAS F&T pathway from industrial stacks
Problem: Lack of toxicity values for many PFAS compounds

Action:
- Literature review of published toxicity data for 31 PFAS
- Conduct assessments, fill gaps through computational toxicology

Results:
- Literature review complete, ~21 PFAS with some in vivo data to support assessment
- Toxicity assessment underway for GenX, PFBS
- Computational assays underway for 75 PFAS representative of PFAS chemical space

Impact: Stakeholders will have PFAS toxicity values to support risk management decisions and risk communication
Problem: Need water treatment technology performance and cost for PFAS removal

Action:

- Review PFAS performance data from available sources (industry, DoD, academia, international)
- Test commercially available granular activated carbons (GACs) and ion exchange (IE) resins for effectiveness over a range of PFAS under different water quality conditions
- Evaluate a range of system sizes – large full-scale utility options to home treatment systems

Results:

- Update EPA’s Drinking Water Treatability Database, a public database for treatment performance data for regulated and unregulated contaminants
- Use state-of-the-science models to extrapolate existing treatment studies to other conditions

Impact: Utilities will be able to identify cost effective treatment strategies for removing PFAS from drinking water
In early 2000s, scientists documented PFOA and PFOS in Cape Fear River downstream from chemical plant.

Returned in 2012, found new unknown PFAS compounds.

Eventually identified GenX, Naphion byproducts, others.

State of NC worked with plant to identify, halt flows, significant reduction in river concentration, ongoing monitoring.
Research: Contaminated Site Remediation

- **Problem**: PFAS-contaminated sites require remediation and clean up to protect human health and the environment

- **Action**:
  - Characterize sources of PFAS such as fire training and emergency response sites, manufacturing facilities, production facilities, disposal sites
  - Evaluate treatment technologies for remediating PFAS-impacted soils, waters, and sediments
  - Generate performance and cost data with collaborators to develop models and provide tools to determine optimal treatment choices

- **Results**: Tools, data and guidance regarding cost, efficacy, and implementation for remedy selection and performance monitoring

- **Impact**: Responsible officials will know how to reduce risk of PFAS exposure and effects at contaminated sites, and to repurpose sites for beneficial use
Problem: Lack of knowledge regarding end-of-life management (e.g. landfills, incineration) of PFAS-containing consumer and industrial products

Action:

- Characterize various end-of-life disposal streams (e.g. municipal, industrial, manufacturing, landfills, incinerators, recycled waste streams) contributing PFAS to the environment
- Evaluate efficacy of current and advanced waste management technologies (e.g. landfilling, thermal treatment, composting, stabilization) to manage PFAS at end-of-life disposal
- Evaluate performance and cost data with collaborators to manage these materials and manage PFAS releases to the environment

Results: Provide technologies, data and tools to manage these end of use streams

Impact: Responsible officials will be able to manage effectively end-of-life disposal of PFAS-containing products
Technical Assistance for States, Tribes and Communities

Problem: State, tribes and communities sometimes lack full capabilities for managing PFAS risk

Action:
• Make EPA technical staff available to consult on PFAS issues
• Utilize applied research at impacted sites to develop new research solutions while also providing technical support to site managers
• Summarize reoccurring or common support requests to share lessons learned from technical support activities

Results: Many examples of past and ongoing technical assistance
• Cape Fear River, NC – Significant reductions in PFAS in source and finished drinking water
• Manchester, NH – Collaboration on air and water sampling
• Newport, RI – Review and support to DOD PFAS sampling at Naval Station Newport

Impact: Enable states, tribes and communities to ‘take action on PFAS’
• Known contamination from AFFF use at (former) Wurtsmith AFB, Michigan

• Impacting local DW wells, recreational lake, eventually Lake Huron

• Instances of foam reforming on lake surfaces
Practical Methods to Analyze and Treat Emerging Contaminants (PFAS) in Solid Waste, Landfills, Wastewater/Leachates, Soils, and Groundwater to Protect Human Health and the Environment

U.S. Environmental Protection Agency
National Center for Environmental Research
Science to Achieve Results (STAR) Program

Solicitation Opening Date: August 17, 2018
Solicitation Closing Date: October 2, 2018
Key Knowledge Gaps

Release
- Surrounding Environmental Media

Leachate
- Wastewater Treatment Plant (WWTP)

Transformation
Mitigation
Treatment
Containment
EPA PFAS Data and Tools

Links to data and tools that include information related to PFAS and are available on EPA’s website:


Interstate Technology Regulatory Council (ITRC)
Outstanding set of PFAS overview primers on variety of topics – naming conventions, history and use, regulations, fate and transport, remediation, etc. (English and Spanish)
https://pfas-1.itrcweb.org/
Increased specificity and confidence in the type of supporting data used (e.g., health, occurrence, treatment) is needed at each stage.
Public Water Systems by State with One or More UCMR3 Samples above Health Advisory for PFOA/PFOS
Stakeholder Perspectives: Dianne Barton, National Tribal Toxics Council Chair

EPA Region 7- Leavenworth, Kansas
September 5, 2018
Leavenworth PFAS Community Engagement – 9/5/18

Unique Risks to Tribal Resources and People

Dianne Barton - National Tribal Toxics Council
National Tribal Toxics Council

• An EPA Tribal Partnership Group started in 2012 with Office of Pollution Prevention and Toxics (OPPT).

• Advocate for tribal scenarios for Toxic Substances and Control Act (TSCA) chemical risk evaluations
NTTC Members

- Russell Hepfer
  Lower Elwha Klallam Tribe
  EPA Region 10

- Doug Stevens (Ex-O)
  Salish Kootenai College
  EPA Region 8

- Jolene Keplin
  Turtle Mountain Band of Chippewa Indians
  EPA Region 8

- Fred Corey
  Aroostook Band of Micmacs
  EPA Region 1

- Rebecca Stevens
  Coeur d’Alene Tribe
  EPA Region 10

- Kelly Wright
  Shoshone Bannock Tribes
  EPA Region 10

- Susan Hanson
  Shoshone Bannock Tribes
  EPA Region 10

- Jubin Cheruvilil (Ex-O)
  Michigan State University
  EPA Region 5

- Shavonne Smith
  Shinnecock Indian Nation
  EPA Region 2

- Dianne Barton
  Columbia River Inter-Tribal Fish Commission
  EPA Region 10

- Clifford Buseko
  Elko Band Council
  EPA Region 9

- Rick Dullois
  Seneca-Cayuga Nation
  EPA Region 6

- HJ Howerton (Ex-O)
  BIA Central Office
  EPA Region 3

- Sharni Veno
  Houlton Band of Maliseet Indians
  EPA Region 1

- Gary Hay
  Chickaloon Village Traditional Council
  EPA Region 10

- Suzanne Fluharty
  Yurok Tribe
  EPA Region 9

- Laurie Suter
  Tohono O’odham Nation
  EPA Region 9

- Lynn Zender and Kristin K’erit
  Zender Environmental Health and Research Group

3
Concerns with Perfluorinated Compounds

• Because of our lifeways, Tribes are more impacted by environmental toxics than any other group in the U.S.

• Primary focus of efforts on PFAS are on drinking water supplies
Focus on drinking water exposures.
DoD has identified 24 drinking water systems, where DoD is the water supplier, which tested above the LHA.

- DoD is following the EPA advisory recommended actions to include taking wells off line and providing alternative drinking water.
- These actions break the exposure pathway.

Groundwater Sampling

- DoD follows a comprehensive approach to identify installations where DoD stored and/or used AFFF and suspect a release is impacting drinking water.
  - As of August 2017, DoD identified 401 active and BRAC installations in the United States with at least one area where there is a known or suspected release of PFOS/PFOA.
- DoD is following the CERCLA process to address these suspected releases:
  - First step is to identify the source(s) of a known or suspected release.
  - Then identify if there is an exposure through drinking water.
  - If there is exposure, DoD priority is to cut off drinking water exposure.
  - Once exposure pathway is broken, the site is prioritized and will follow the CERCLA process to fully investigate the release and determine the appropriate cleanup actions based on risk.
- The DoD Components are conducting additional investigations, which include sampling groundwater.
PFAS in Plant and Animal Food Sources

Chen et al., 2018, Concentrations of perfluoroalkyl substances in foods and the dietary exposure among Taiwan general population and pregnant women.

European Food Safety Authority, 2016, Results of the monitoring of perfluoroalkylated substances in food in the period 2000 - 2009.

Figure 7: Frequency of results above the LOD or LOQ for the individual PFASs across food groups (n = 24,240).
PFAS Concentration in Freshwater Fish Fillet – Washington Ecology

Figure 4. PFAS Concentrations of Freshwater Fish Fillet Samples by Site (ng/g ww).

Results below quantitation limits were excluded from figure.

DOH SL = Department of Health Screening Level (applies to PFOS only).
LSS = largescale sucker; SMB = smallmouth bass; CCP = common carp; WAL = walleye;
RBT = rainbow trout; LMB = largemouth bass; YP = yellow perch; PEA = peamouth.

Tribal Consumption 175 grams/day
Washington Ecology monitoring results show decreases between 2008-2016 in WWTP and surface waters.

Figure 7. T-PFAAs Concentration (yellow bars).
White bars indicate PFAAs were not detected. Note the different Y axes for South Fork Palouse R. and West Medical Lk.

Figure 8. T-PFAA Concentrations in WWTP Effluent Collected in 2008 (grey bars) and 2016 (orange bars).
Washington Ecology monitoring results indicate that PFAS concentrations can persist in fish tissue and top level predators.
Typical Conceptual Model of Exposure to Contaminants in the Environment

Looks Outdoorsy

Actually Suburban/Recreational Exposures
RESOURCES VARIED AND NOT LINKED TO HOME ADDRESS

CULTURAL ACTIVITIES MAY INCREASE BOTH DIRECT AND INDIRECT EXPOSURES

- MONTANE RESOURCES
- FOREST RESOURCES
- RIPARIAN RESOURCES
- RIVERINE RESOURCES
- WETLANDS RESOURCES
- DESERT RESOURCES
- MARINE RESOURCES

Air and Dust Inhalation

Direct Soil Exposure

Sweat Lodge & Ceremonies

GAME MEAT

Game

Garden Produce

DIRECT SOIL EXPOSURE

Irrigation

Surface Water Use

AQUATIC FOODS - reptiles, fish, and shellfish

Harvesting, Processing

Marine Resources Harvesting, Processing, and Foods - shellfish, fish, and marine mammals

Sediment Exposure

Pottery

Gathered Foods

Weaving, Basketry

Harvesting & Processing

Weaving, Basketry, Pottery, and Ceremonies

Smoke Inhalation

Non-standard housing, seasonal camping, springs & ground water

Seafood, fish, and shellfish

Harper & Harris 2006 (with modifications by NTTC 2018)
Understanding Tribal Exposure to Toxics

• Delivered to EPA Administrators in 2015 and 2018.

• Requests that EPA institutionalize a process to consider tribal exposure in risk assessments.

• Tribes are a sensitive subpopulation for environmental exposures.
Cultural Practices for Harvesting Food Resources
• Net Pulling
• Fish Processing
Continued Close Relationship to the Environment

• Harvesting Wapato, Acorns, Clams, Nettles

Coeur d'Alene Tribe

Yurok Tribe
• Sand-bar Willow Harvesting
• Tule Harvesting

• Roots and Berries
• Weaving Plants and Bark
• Multi-generational cultural practices
Growing up S’Klallam
Surveys document higher than average consumption of fish by tribal people.

“The rates of tribal members consumption across gender, age groups, persons who live on versus off-reservation, fish consumers only, seasons, nursing mothers, fishers, and non-fishers range from 6 to 11 times higher than the national estimate used by USEPA.”

(quote from CRITFC, 1994)
Solid Waste Disposal Issues

All the chemicals in the smoke!

Burning Waste at Class III Landfills

March 2017

Old Burn Unit

constructed out of local materials. Important design aspects that need
consideration include ease of emptying the ash and size of unit based on population
needs. Units should include spark arrestors, provide good air flow, and keep
fuel levels constant. Ace. Locally-constructed burn units are generally
more affordable than commercially made units; however, they have a much lower life
expectancy.

Table 9

<table>
<thead>
<tr>
<th>Class</th>
<th>Compound</th>
<th>Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCs (1)</td>
<td>1,3-Butadiene</td>
<td>141.25</td>
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<tr>
<td></td>
<td>2-Butanone</td>
<td>38.75</td>
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<tr>
<td></td>
<td>Benzene</td>
<td>979.75</td>
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<tr>
<td></td>
<td>Chloroethane</td>
<td>163.25</td>
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<tr>
<td></td>
<td>Ethylbenzene</td>
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<td></td>
<td>m,p-Xylene</td>
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<td>p-Xylene</td>
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<td></td>
<td>Styrene</td>
<td>16.25</td>
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<tr>
<td></td>
<td>Toluene</td>
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Table 9 (continued)

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<tr>
<th>Class</th>
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<tr>
<td>Carbonyls (1)</td>
<td>Acetaldehyde</td>
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<td>Acetone*</td>
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<td></td>
<td>Acrolein</td>
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<td></td>
<td>Benzaldehyde</td>
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<td>Crotonaldehyde</td>
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<td>Formaldehyde</td>
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<td>Isovaleraldehyde</td>
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<td></td>
<td>m-Tolualdehyde</td>
<td>5.85</td>
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<tr>
<td></td>
<td>Propionaldehyde</td>
<td>112.60</td>
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Total PCDDs/Fs and PCBs (2)

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<tr>
<th>Emissions</th>
</tr>
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<tbody>
<tr>
<td>5.80 × 10^-3</td>
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<tr>
<td>7.68 × 10^-3</td>
</tr>
<tr>
<td>1.26 × 10^-2</td>
</tr>
<tr>
<td>1.34 × 10^-2</td>
</tr>
</tbody>
</table>

Source. (1) Ref. [34]. (2) Ref. [37].
* Compound of interest not on HAP list.
Indian Country & Existing Health Disparities

**AMERICAN INDIAN & ALASKA NATIVE HEALTH DISPARITIES: CHILDREN**

Compared to non-Hispanic white children, American Indian and Alaska Native children are more likely to suffer from the following:

- **infant mortality** 55% more likely to die as an infant
- **SIDS** x2 as likely to die of SIDS
- **obesity** 90% more likely to be obese as a preschooler
- **depression** x2 as likely to attempt suicide as a high-schooler

**How do we reduce racial and ethnic health disparities?**
We must work together to improve our health care system to make it high-quality, comprehensive, affordable, and accessible for everyone.
High-End of General Population Exposure is not Protective of a Sensitive Subpopulation

• 2010 Exposure Assessment of PBDE
  – “unusually high exposures at the high end of the general population” – susceptible sub-population
  – 95th percentile 291 ng/g versus mean 31 ng/g in adults – “even the highest dust concentrations might not be able to explain”
  – “suggests the possibility that there are other exposures not identified in this assessment”

Tribal lifestyles are not just the extreme tail of a general population exposure range
State Fish Consumption Advisories for PFAS

New Jersey issues first advisories for consumption of fish containing PFAS chemicals
State scientists recommend health limits for 12 species

Fish advisories issued for Michigan lakes, river impacted by PFAS contamination
There is a need for exposure assessments of PFAS that specifically considers tribal lifeways and resources in order to protect all sensitive subpopulations.
RESOURCES VARIED AND NOT LINKED TO HOME ADDRESS

CULTURAL ACTIVITIES MAY INCREASE BOTH DIRECT AND INDIRECT EXPOSURES

- MONTANE RESOURCES
- FOREST RESOURCES
- RIPARIAN RESOURCES
- RIVERINE RESOURCES
- WETLANDS RESOURCES
- DESERT RESOURCES
- MARINE RESOURCES

GAME

AIR AND DUST INHALATION

SWEAT LODGE & CEREMONIES

GAME MEAT

GARDEN PRODUCE

GAME

DIRECT SOIL EXPOSURE

IRRIGATION

SURFACE WATER USE

SEDIMENT EXPOSURE

AQUATIC FOODS - reptiles, fish and shellfish

MARINE RESOURCES HARVESTING, PROCESSING AND FOODS - shellfish, fish, & marine mammals

WEAVING, BASKETRY HARVESTING & PROCESSING

Pottery

GATHERED FOODS

NON-STANDARD HOUSING, SEASONAL CAMPING SPRINGS & GROUND WATER

SWEET LODGE & CEREMONIES

HARVESTING & PROCESSING

Harper & Harris 2006 (with modifications by NTTC 2018)
Stakeholder Perspectives: Dr. Bill Cibulas, Acting Director, Division of Toxicology and Human Health Sciences, Agency for Toxic Substances and Disease Registry

EPA Region 7- Leavenworth, Kansas
September 5, 2018
ATSDR National PFAS Activities
September 5, 2018

Bill Cibulas, PHD, MS
Acting Director
Division of Toxicology and Human Health Sciences
Perfluoroalkyls Toxicological Profile (ToxProfile)

- Released for public comment on June 20, 2018
  - Considered draft until finalized following public comment period
- What’s new in this ToxProfile
  - Updates minimal risk level values for PFOA and PFOS
  - Sets new minimal risk level values for PFHxS and PFNA
- Minimal risk level values
  - Estimate of the amount of a chemical a person can eat, drink, breathe each day without detectable risk to health
  - Developed for health effects other than cancer
  - Derived for different exposure periods: acute, intermediate, and chronic
  - Used as screening tool to help identify exposures that could be potentially hazardous to human health
New Opportunities

  - Statistically-based PFAS biomonitoring exposure assessments (EAs) at no less than 8 current or former DOD sites (short term – completed within two years)
    - 10 million dollars for FY2018
    - EAs will include measurement of PFAS in serum and urine, as well as limited environmental (dust and tap water) sampling
  - Multi-site PFAS health study (long term – completed over next 5-7 years)
    - 10 million dollars anticipated for FY2019 for this effort, with possibility of additional funds in subsequent years
    - Study design will be informed by data from PFAS EAs
Multi-Site PFAS Health Study

- ATSDR published feasibility assessment of possible future drinking water epidemiological studies at Pease, NH in November 2017
  - Pease International Tradeport is former Air Force base
    - In 2014, one of three wells that serve Pease showed elevated levels of PFOS
    - Level above provisional health advisory set by EPA
    - NH DHHS conducted human biomonitoring program (over 1,500 participants)
  - ATSDR reviewed epidemiological studies that evaluated health effects of PFAS exposures
  - Based on literature review and sample size calculations, report concluded that cross-sectional epidemiological studies of children and adults at only one site (e.g., Pease)
    - Feasible for some health endpoints (e.g., lipids, kidney function)
    - Insufficient sample size for other health endpoints (e.g., thyroid, liver and immune function, autoimmune diseases)
  - Highlighted need for multi-site study
Multi-Site PFAS Health Study

- Study communities impacted by PFAS-contaminated public drinking water supply wells and/or private wells
- Expected sample size: 8,000 total participants
  - 2,000 children
  - 6,000 adults
  - Based on review of scientific literature to study health outcomes of interest
- Cross-sectional study at multiple locations with separate evaluations of children (ages 4–17) and adults (ages ≥18)
- Site considerations
  - Documented past or present PFAS drinking water concentrations at the tap,
  - The magnitude of past or present PFAS concentrations at the tap,
  - Size of population exposed,
  - Amount of information available on the contaminated drinking water system or private wells, and
  - If biomonitoring for PFAS has previously occurred at the site.
## Multi-Site PFAS Health Study (cont.)

### Health Outcomes to be Studied

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Children</th>
<th>Adults</th>
<th>Outcome</th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipids</td>
<td>X</td>
<td>X</td>
<td>Neurobehavioral</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>X</td>
<td>X</td>
<td>Osteoarthritis/Osteoporosis</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Kidney function/Disease</td>
<td>X</td>
<td>X</td>
<td>Endometriosis</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Liver function/Disease</td>
<td>X</td>
<td>X</td>
<td>Immune function</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Thyroid</td>
<td>X</td>
<td>X</td>
<td>Vaccine response</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Sex hormones/maturation</td>
<td>X</td>
<td></td>
<td>Autoimmune disease</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Multi-Site PFAS Health Study (cont.)

- **Biomarkers to be studied**
  - Total cholesterol, low density lipoprotein, high density lipoprotein, total triglycerides
  - Uric acid, creatinine
  - Thyroxine (T4), T3, thyroid stimulating hormone (TSH)
  - Glucose, insulin, glycosylated hemoglobin (HbA1c), auto-antibodies (GAD-65 and IA-2), C-peptide, pro-insulin
  - Alanine transaminase (ALT), $\gamma$-glutamyltransferase (GGT), direct bilirubin, and cytokeratin-18 (CK-18)
  - Immunoglobulin G (IgG), IgA, IgE and IgM; (C reactive protein, and antinuclear antibodies (ANA) – adults; antibodies to measles, mumps, rubella, tetanus, and diphtheria – children)
  - Testosterone, estradiol, sex hormone-binding globulin (SHBG), follicle stimulating hormone, insulin-like growth factor
  - Cytokines and adipokines (e.g., IL-1$\beta$, IL-6, IL-8, MCP-1, TNF$\alpha$, leptin, adiponectin, resistin, PAI-1)
For more information, contact NCEH/ATSDR
1-800-CDC-INFO (232-4636)
Follow us on Twitter  @CDCEnvironment

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry.
EPA announced four actions the Agency will take following the Summit:

- EPA will initiate steps to evaluate the need for a maximum contaminant level (MCL) for PFOA and PFOS.
- EPA is beginning the necessary steps to propose designating PFOA and PFOS as “hazardous substances” through one of the available statutory mechanisms, including potentially CERCLA Section 102.
- EPA is currently developing groundwater cleanup recommendations for PFOA and PFOS at contaminated sites and will complete this task by fall of this year.
- EPA is taking action in close collaboration with our federal and state partners to develop toxicity values for GenX and PFBS by this summer.