PFAS EXPOSURES: INSIGHTS FROM ENVIRONMENTAL DATA

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August 22, 2018

Biomonitoring California Scientific Guidance Panel Meeting

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Overview

- Major environmental point sources of PFASs
- Types of PFAS environmental data available
- Drivers for environmental data collection
- Identifying new PFAS impacts and exposures
  - Methods
  - Conceptual site models and source pathway receptor linkages
- Data collection considerations
- Take home messages

Major Locations of PFAS Point Source Contamination

- Primary Manufacturing
- Secondary Manufacturing (Application of PFASs to other products)
- Military Fire Training and Crash Sites
- Airports

Approximate Order of Importance

Relative Order of Importance Less Understood

- Municipal Fire Training Sites
- Refineries
- Large Rail Yards
- Metal Plating Facilities
- Wastewater treatment plants
- Landfills

Major Locations of PFAS Point Source Contamination

- Primary Manufacturing
  - GenX in North Carolina (current)
  - PFOS, PFOA in Alabama, Minnesota (historical)
  - PFOA in West Virginia/Ohio (historical)
- Secondary Manufacturing (Application of PFASs to other products)
  - PFNA in New Jersey
  - PFOS and PFOA in New England, Michigan
  - Misc. PFASs associated with furniture, carpet (Southeastern U.S.) and outdoor apparel industries
- Military Fire Training and Crash Sites, Airports, and Metal Plating - Nationwide
- Refineries (importance not well understood)
  - Possible sources in CA, TX

Potential PFAS Sources in California

- Military fire training and crash sites
- Secondary manufacturing
- Airports
- Refineries
- Metal plating
- General consumer product use
  - Wastewater treatment plant discharges may concentrate these

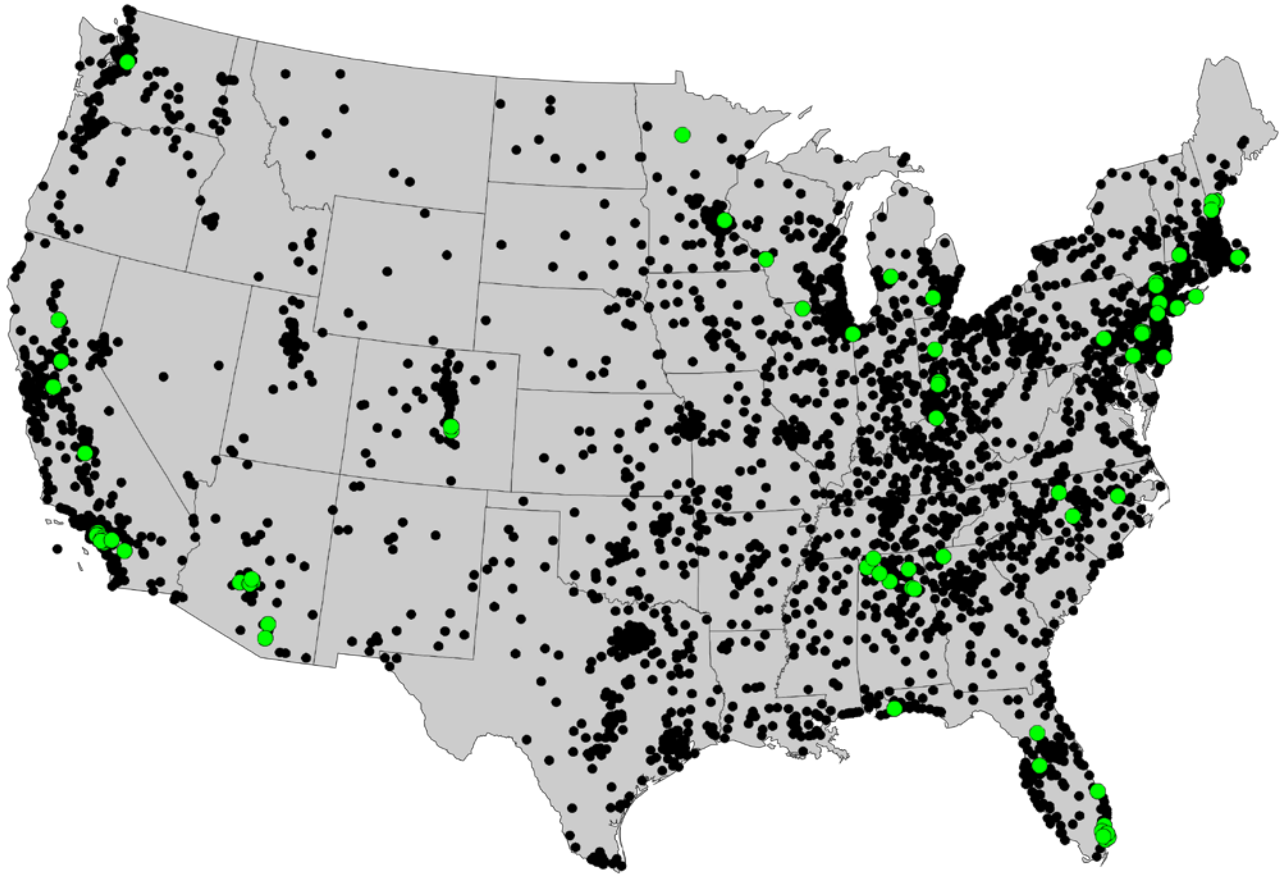
Most environmental data is on perfluoroalkyl sulfonates and carboxylates

- Methods readily available at commercial laboratories (drinking water, groundwater, soil; fish at select laboratories)
- More toxicity data has been collected on these types of PFASs (esp. PFOS and PFOA), leading to the development of standards and guideline values in drinking water
- State and federal requirements for sampling have focused on these compounds
- MeFOSAA and EtFOSAA (USEPA Method 537; stain resistance); FOSA; 6:2 FtS, 8:2 FtS (firefighting foams, other industries); and GenX compounds (PFOA replacement) also measured in some locations
- Peer reviewed literature contains a wider variety of compounds reported in environmental media but methods are not standardized

Drinking water exceedances drive many PFAS environmental data collection efforts

- Exposure to PFASs above a regulatory threshold in drinking water is documented and an environmental investigation follows to determine sources
- UCMR3 data – primarily large scale drinking water systems
  - Primarily groundwater sourced systems had PFOS+PFOA above 70 ppt
- Small-scale private wells may have some of the highest PFAS levels
- Private citizens have led some drinking water testing efforts: Hoosick Falls, NY; student project in Sweden
- Many environmental PFAS investigations at military installations with known PFAS releases from firefighting foams have focused on pathways to drinking water

US EPA UCMR3 Survey Revealed PFAS-Contaminated Drinking Water



- PFOS, PFOA, PFHxS, PFNA, PFHpA, PFBS measured – reporting limits from 10 ppt to 70 ppt
- ~60 water utilities (green dots) with PFOS and/or PFOA detections above the 70 ppt PFOS+PFOA US EPA Health Advisory Level (HAL)
- Approximately 25% of impacted water supplies above HAL were surface water sourced (75% groundwater sourced)

Data from US EPA Unregulated Contaminant Monitoring Rule 3 (UCMR3 2013-2015)

One or more PFAS detected in ~ 2% of public water supplies

Non-drinking water exposures

- Fish consumption
  - Some “do not eat” fish consumption advisories have been issued
- Crops
- Airborne exposure
- Soil ingestion
- Note: USEPA Health Advisory for PFOS/PFOA assumes drinking water is 20% relative source contribution

Michigan issues PFAS ‘Do Not Eat’ Fish consumption advisory

August 4, 2018

MDHHS

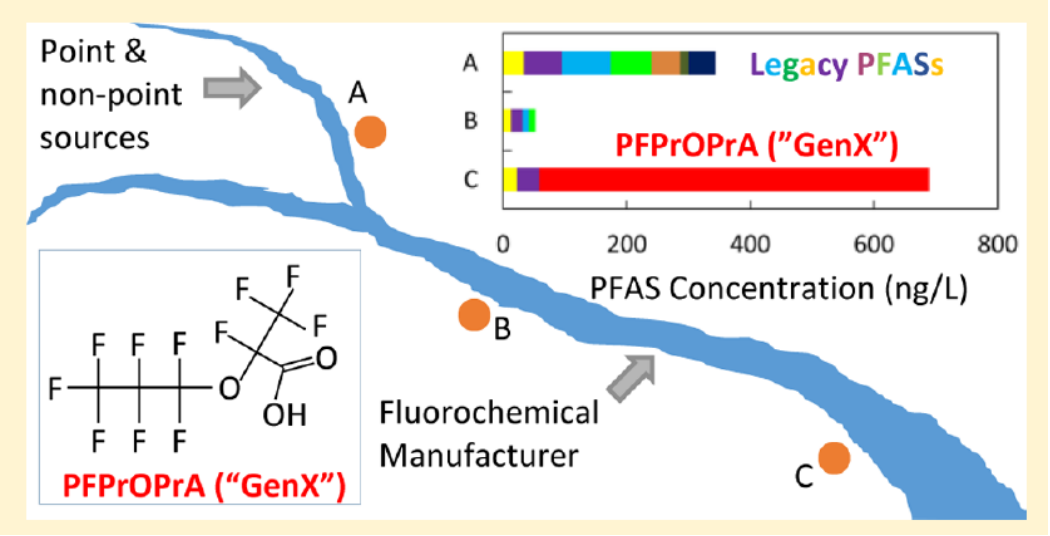
By PRESS RELEASE | Posted: Sat 3:04 PM, Aug 04, 2018 | Updated: Sat 3:14 PM, Aug 04, 2018

LANSING, Mich. (WLUC) - The Michigan Department of Health and Human Services (MDHHS) has issued an emergency ‘Do Not Eat’ fish advisory for all fish between the Huron River at Milford (Oakland County) to the Huron River at Base Line and Portage

http://www.uppermichiganssource.com/content/news/Michigan-issues-PFAS-Do-Not-Eat-Fish-consumption-advisory-for-several-water-bodies-on-the-Huron-River-within-parts-of-Oakland-Livingston-and-Washtenaw-counties-490066641.html

Other drivers of environmental data collection

- Academic studies
- Known or suspected major PFAS releases
  - GenX in North Carolina
- Regulations around groundwater
  - Michigan Groundwater Surface Water Interface (GSI) criterion – 12 ppt PFOS
  - New Jersey interim specific groundwater criterion for PFNA – 10 ppt PFNA
  - New Hampshire Ambient Groundwater Quality standard (set at EPA HAL)



Sun et al. "Legacy and emerging perfluoroalkyl substances are important drinking water contaminants in the Cape Fear River Watershed of North Carolina." *Environmental Science & Technology Letters* 2016.

ARCADIS Design & Consultancy for natural and built assets

Identifying new PFAS impacts and exposures

Standard PFAS Analyses

- **US EPA Method 537: Analysis for selected PFASs in drinking water**
  - 12 perfluoroalkyl sulfonates and carboxylates and two precursors
- **Groundwater and soil methods**
  - Quality Systems Manual (QSM) 5.1 has guidelines for non-potable water and soil; new EPA methods are under development for these media
    - Same analytes as 537, plus compatible with others
  - Two published ASTM methods for non-potable water and soil; they conflict with the QSM 5.1 guidelines in certain places

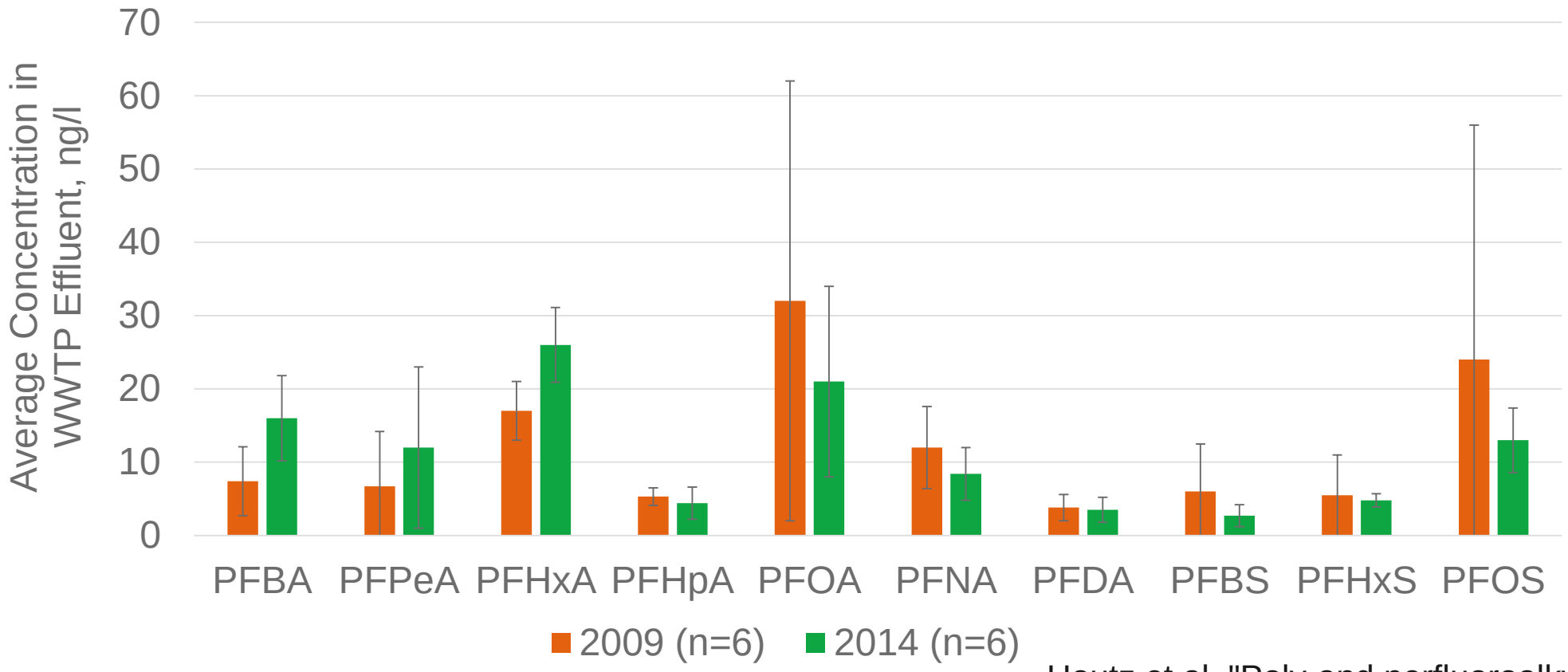
Additional PFAS Analytical Methods

Method	Matrices successfully demonstrated	Other potentially applicable matrices	Specificity for PFASs?	Provides information about PFAS chain lengths?
Total Oxidizable Precursor (TOP) Assay	Multiple environmental aqueous, soil, human blood	Extractable compounds from biota, commercial products	Yes	Yes
Extractable Organofluorine and Ion Chromatography	Multiple environmental aqueous, human blood	Extractable compounds from soil, biota, commercial products	No	No
Particle Induced Gamma Emission (PIGE) Spectroscopy	Commercial products	Water, Soil, Blood	No	No
High Resolution Mass Spectrometry	Multiple environmental aqueous	Extractable compounds from soil, biota, commercial products	Yes	Yes

Detecting new PFASs – Where to investigate?

- Domestic wastewater
  - Likely to reflect PFASs currently in use
  - Detection limits likely too high to identify non-point source impacts for many PFASs
- Discharge points of known or suspected sources
- Point of exposure or receptor

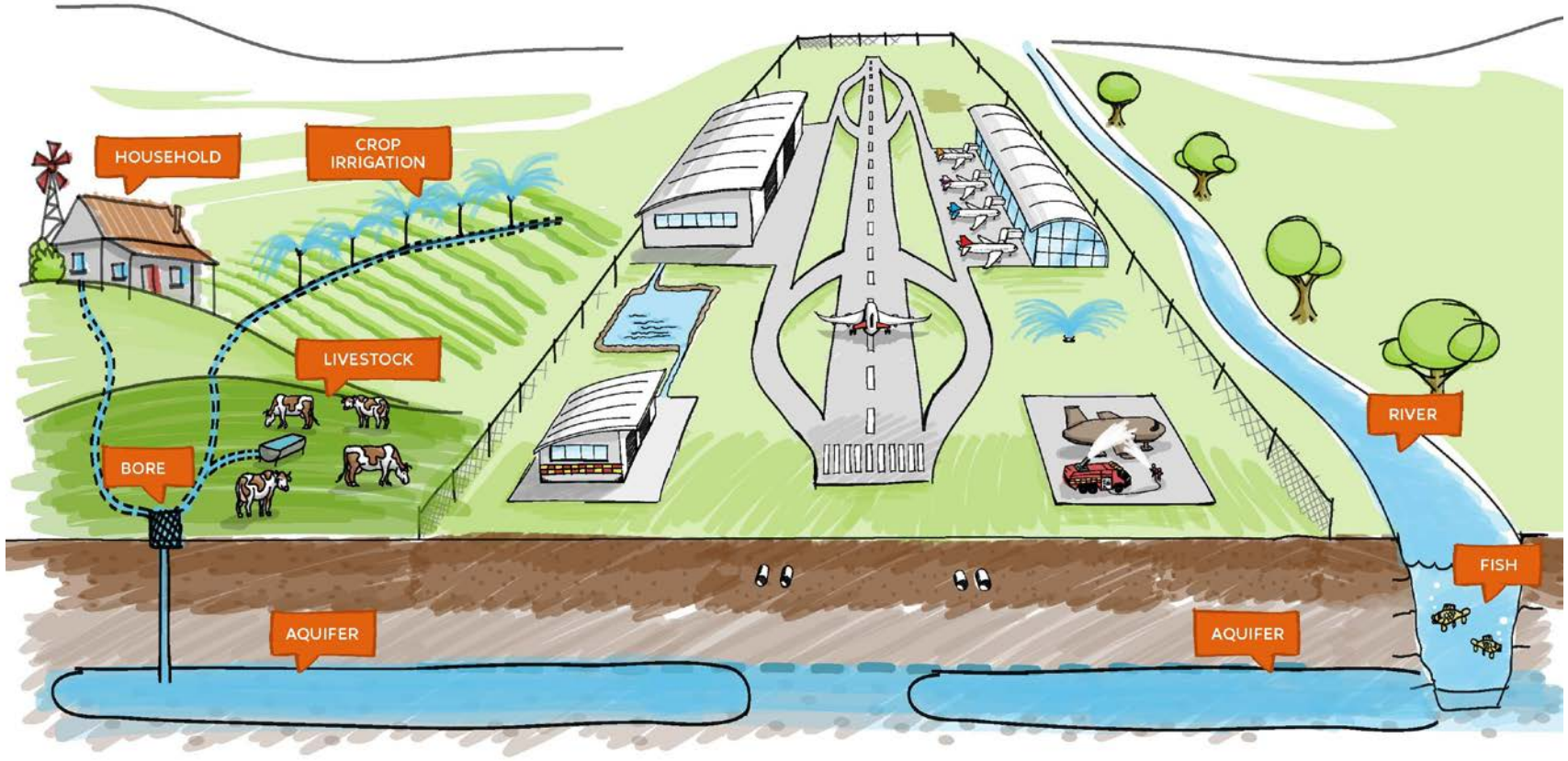
SF Bay Wastewater Effluent 2009 vs. 2014



*The wastewater treatment plants sampled in 2009 and 2016 are not identical (i.e., some plants sampled in 2009 were not sampled in 2014 and vice versa).

Houtz et al. "Poly-and perfluoroalkyl substances in wastewater: Significance of unknown precursors, manufacturing shifts, and likely AFFF impacts." *Water Research* 2016.

Conceptual Site Model: Source, Pathways, Receptors



Identification of PFASs of Concern: Investigate at Source or Receptor?

Identification of PFASs of Concern: Source

Pros of identification at ***source***

- Higher detections
- Potential to manage problem if one identified
- Identify compounds released vs. their transformation products

Cons of identification at ***source***

- Compounds may not result in exposure
- Fate and transport prediction/ modeling may be needed
- Multiple sources can impact one receptor

Identification of PFASs of Concern: Receptor

Pros of identification at ***receptor***

- Most reflective of current exposure
- Transformation products may be more important than the compounds released from an exposure point of view
- Screens out immobile compounds

Cons of identification at ***receptor***

- Compounds may not be present at high enough levels to detect
- Identification at receptor may not be predictive of future exposures for less mobile compounds

Considerations when collecting new data

- Identification of compounds without authentic analytical standards or measurement with non-standard methods may not stand up to public, regulatory or legal scrutiny
- If data is publicly available, collection of data for exploratory purposes may confuse an interested public requiring interpretation of the data's meaning
  - This has occurred with routinely measured PFASs such as PFBS
- For many PFASs, increasing mobility is associated with decreasing bioaccumulation
  - Compounds measured at receptor may be more mobile but cause less concern
  - Mobile PFASs are often more challenging to treat in drinking water

Take Home Messages

- California has some potential major PFAS point sources, but primary manufacturing does not appear to be one of them
- Most environmental data collected has focused on perfluoroalkyl sulfonates and carboxylates, and a few polyfluoroalkyl precursor compounds
- Drinking water PFAS exceedances drive most environmental sample collection efforts, and drinking water guideline values may inform which analytes are measured
- Data on novel/ more newly manufactured PFASs is best located in academic literature or from states with particular PFAS sources of concern
- There are a variety of methods that can be used to identify either total PFASs or individual compounds – investigation can occur at a suspected source or at a receptor

Thank you

The Interstate Technology and Regulatory Council's (ITRC) PFAS fact sheets and forthcoming technical guidance document are a great peer-reviewed resource for more information on specific PFAS topics.

https://pfas-1.itrcweb.org/

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