



Managing Uncertainties in PFAS Sampling Design Stemming from Site Identification Unknowns

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### PFAS – Sources, Pathways, and Exposure

### Sources:

- Manufacturing sites for or using PFAS
- Aqueous film-forming foam (AFFF) use areas
- Chrome platers
- Landfills
- Municipal wastewater discharges

### **Pathways:**

- Ground deposition
- Percolation from soil to groundwater
- Groundwater discharge to surface water bodies
- Landfill leachate or wastewater discharge to surface water body
- Biological contact with surface water and sediment
- Plant uptake



### **Receptors:**

- Residents
- Drinking water users
- Consumers of farm products
- Construction workers
- Recreational users
- Ecological receptors



Persistent, bioaccumulative, and toxic substances



Significantly mobile in water



Regulations vary, tend to be very conservative



Toxicity studies are limited



Thousands of compounds, some very prevalent



Drinking water sources often impacted

### Conceptual Site Model – Providing a Framework



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**Uncertainties in PFAS Investigations** 

Where and what was released? What was the volume?

- PFAS release areas are relatively easy to locate for:
  - Known manufacturers of PFAS or PFAS goods
  - Fixed discharge locations from landfills, surface drainage
  - Fixed fire training areas
- PFAS release areas are less well understood for:
  - Impromptu fire training
  - Accidental or incidental releases of fire-fighting foam

- Michigan Environment, Great Lakes, Energy (EGLE) early PFAS mover
- EGLE initiated drinking water sampling in community; National Guard Bureau (NGB) coordinated on-site
- Identified pathway and receptors—but not source areas

Objective: develop a robust conceptual site model (CSM) to support response under US Department of Defense environmental remediation program





PFAS IDENTIFY. RESOLVE. Areas of Interest (AOIs) identified from historic resources, interviews, and judgment during Preliminary Assessment





- Performed Site Investigation to determine presence/absence of PFOS and PFOA
  - Biased sampling
  - Limited scope
  - Screened against DOD action levels
  - Retained AOIs; refined sources
- Substantial unknowns at end of SI
  - Extent of source areas
  - Distribution in groundwater
  - Fate and transport pathways



### Remedial Investigation - First mobilization

- Expanded data gathering including soil source areas
- Standard sample turn around times
- Noted data gaps
- Developed more comprehensive subsurface model using Environmental Sequence Stratigraphy
- Identified downgradient data gaps





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### Case Study – Military Airfield

**Remedial Investigation - second mobilization** 

- Adaptive field sampling
- In-field laboratory
- Improved subsurface model again using ESS
- Discovery of 11 additional source areas that would have been missed in a traditional approach

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- Careful assessment of all potential source areas and pathways is fundamental to Conceptual Site Model
  - Many historical use records are deficient or missing
  - Reliance on common sense and personal recollections is imperfect
  - Early site identification should be all inclusive
- Field sleuthing is essential
  - Synthesize all possible data inputs
  - Look for non-traditional pathways
- Employ statistical methods whenever resources are limited
- Continual CSM improvement is rooted in phased approaches with flexibility in resourcing and collective team strategizing

# **Questions?**



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