USEPA's Toxic Release Inventory (TRI): A Tool to Identify Possible Per-and polyfluoroalkyl substances (PFAS) Hot-Spots

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2023 Toxics Release Inventory (TRI) National Conference
Session - TRI: Identifying Potential Health Impacts (part 1)
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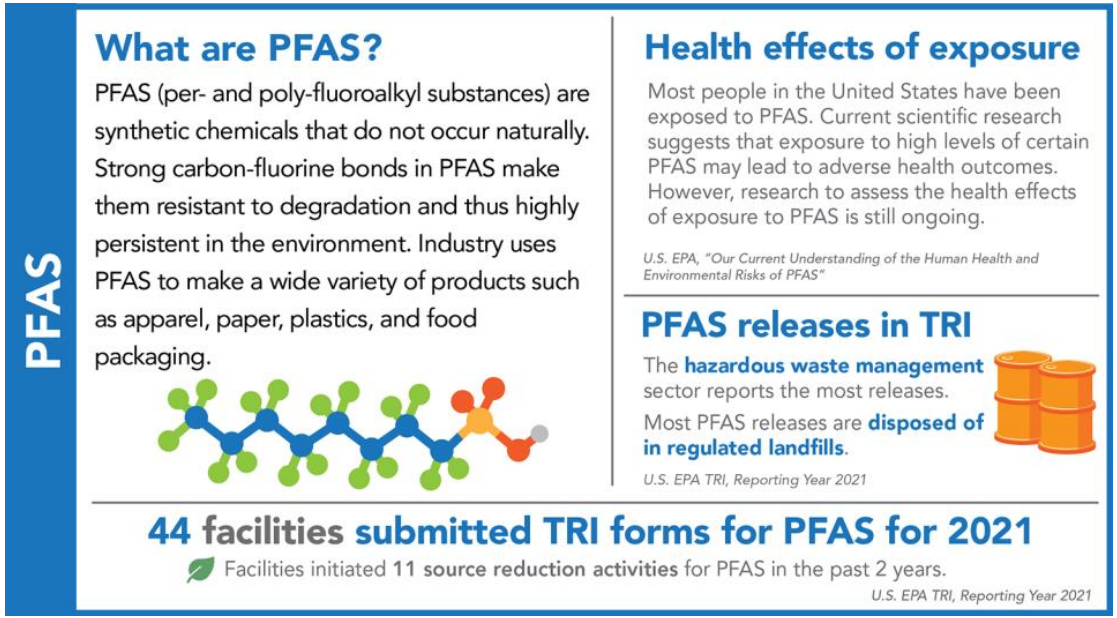
Superfund Research Center

Pigman College of Engineering
University of Kentucky

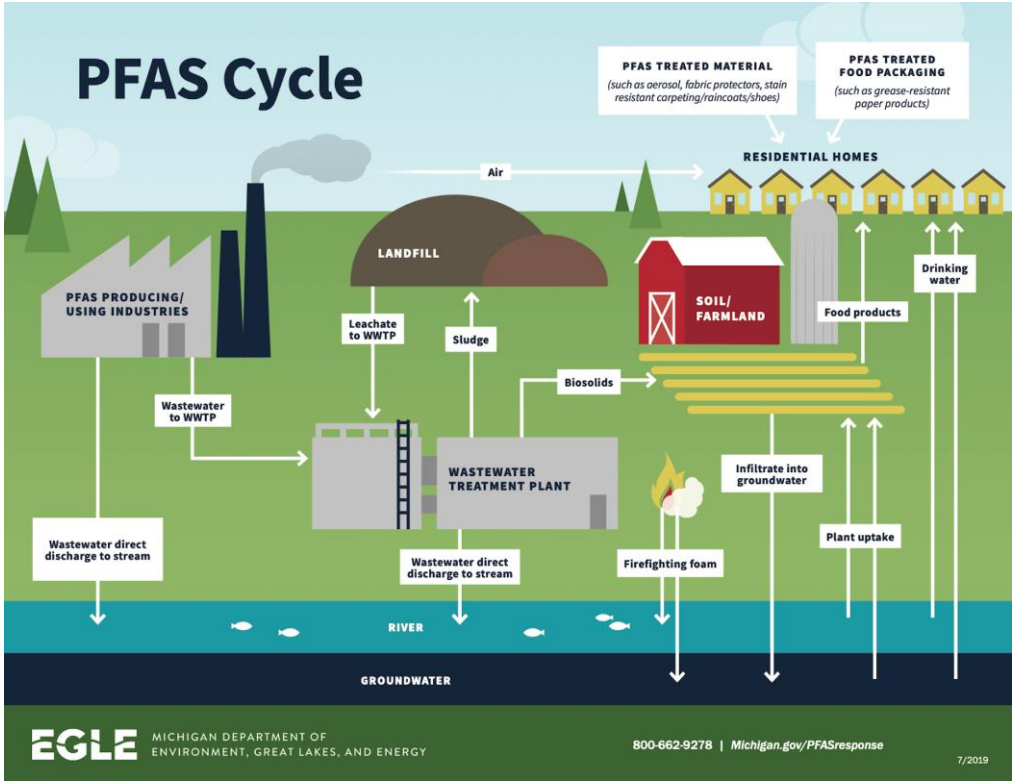
Overview

- Background
- Methods
- Results
- Next Steps



What Are PFAS?

- Class of heterogeneous fluorinated compounds
- Unique physiochemical properties
- Widely used in consumer and industrial applications
- Associated with adverse health effects including increased risk of certain cancers and dyslipidemia
  - (NASEM Report, 2022)



Where do PFAS end up?

Source: https://www.stantec.com/en/services/pfas/per-and-polyfluoroalkylated-substances-infographic

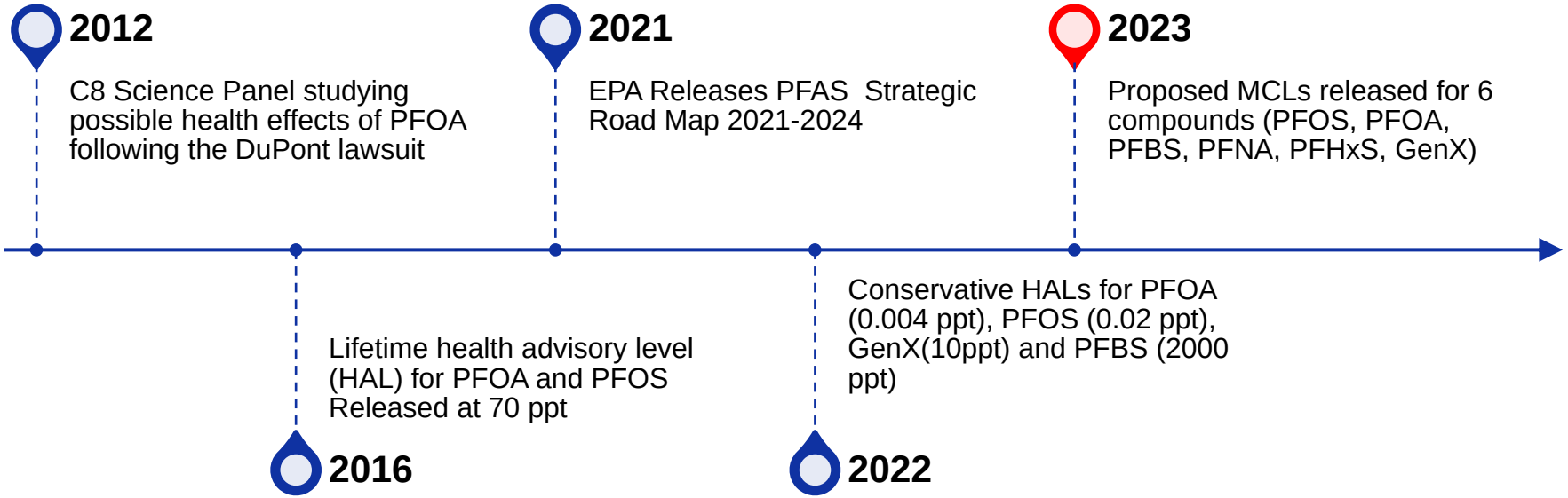
Direct PFAS Users and Sources

- Industries
- Military Installations and airports
- Agriculture
- Landfills
- Water and Wastewater Treatment

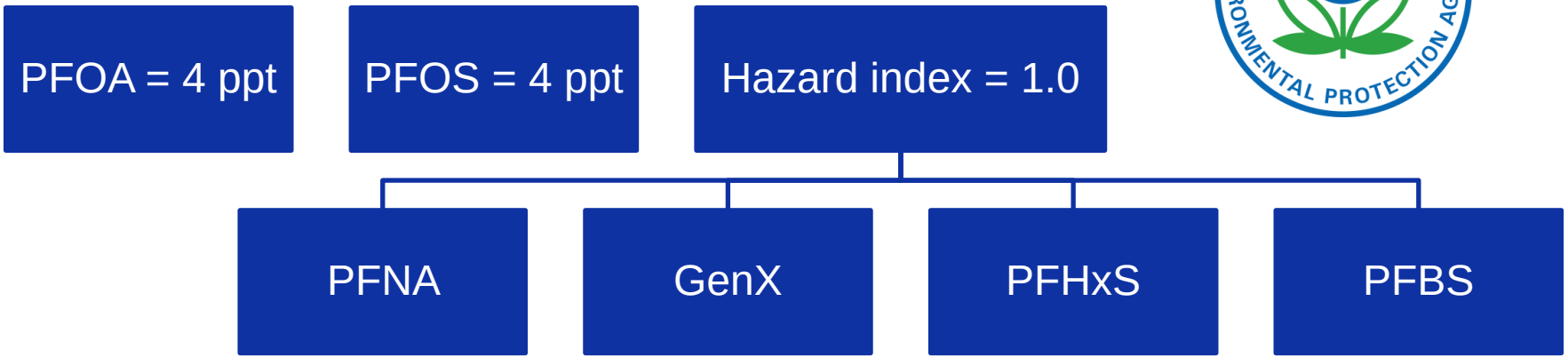
Indirect PFAS Users

- Consumers
- Dry Cleaners

Regulatory History

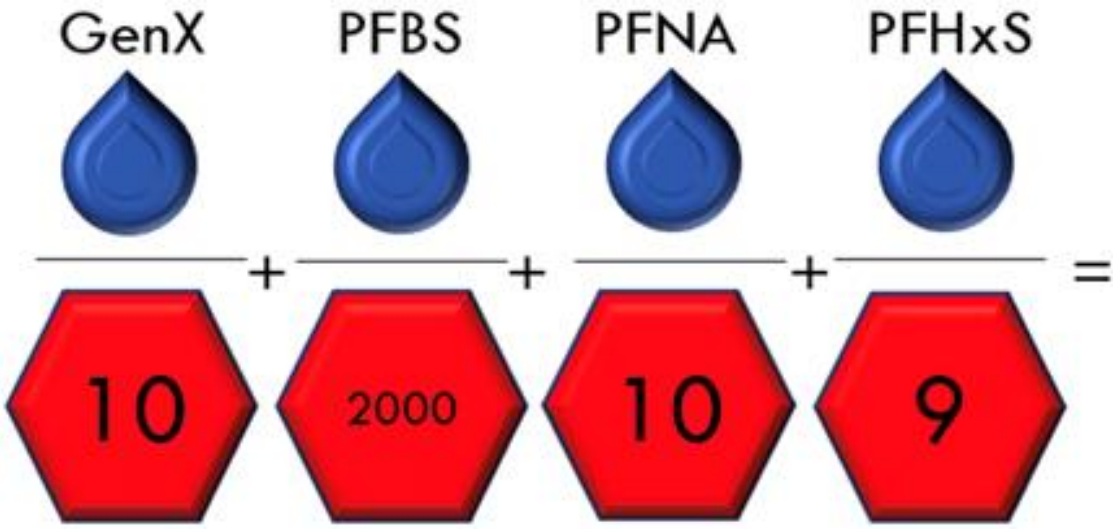


EPA 2023 Proposed Maximum Contaminant Levels (MCLs)



Hazard Index is an EPA tool used to understand health risk from chemical mixtures

Hazard Index (HI)



USEPA, 2023

Hazard Index

The HI considers toxicity of individual chemicals

Kentucky Data

Drinking Water

KDEP sampled 81 Public Water Systems

2019

Source Water

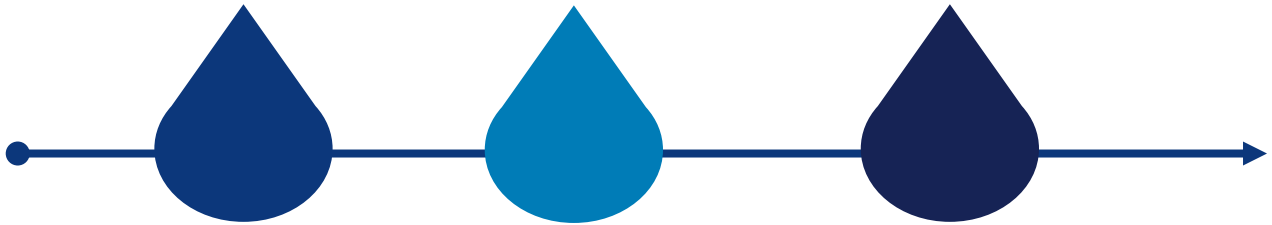
40 Surface Water locations across the commonwealth

2021

Drinking Water Part 2

Additional 113 PWS not included in previous study

2023



Most frequently detected PFAS: **PFOS**

15 of 194 systems exceed proposed MCLs

72 of 194 systems contained at least 1 of the 6 PFAS included in proposed drinking water regulations

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PFAS

What are PFAS?

PFAS (per- and poly-fluoroalkyl substances) are synthetic chemicals that do not occur naturally. Strong carbon-fluorine bonds in PFAS make them resistant to degradation and thus highly persistent in the environment. Industry uses PFAS to make a wide variety of products such as apparel, paper, plastics, and food packaging.

Health effects of exposure

Most people in the United States have been exposed to PFAS. Current scientific research suggests that exposure to high levels of certain PFAS may lead to adverse health outcomes. However, research to assess the health effects of exposure to PFAS is still ongoing.

U.S. EPA, "Our Current Understanding of the Human Health and Environmental Risks of PFAS"

PFAS releases in TRI

The **hazardous waste management** sector reports the most releases.

Most PFAS releases are **disposed of in regulated landfills**.

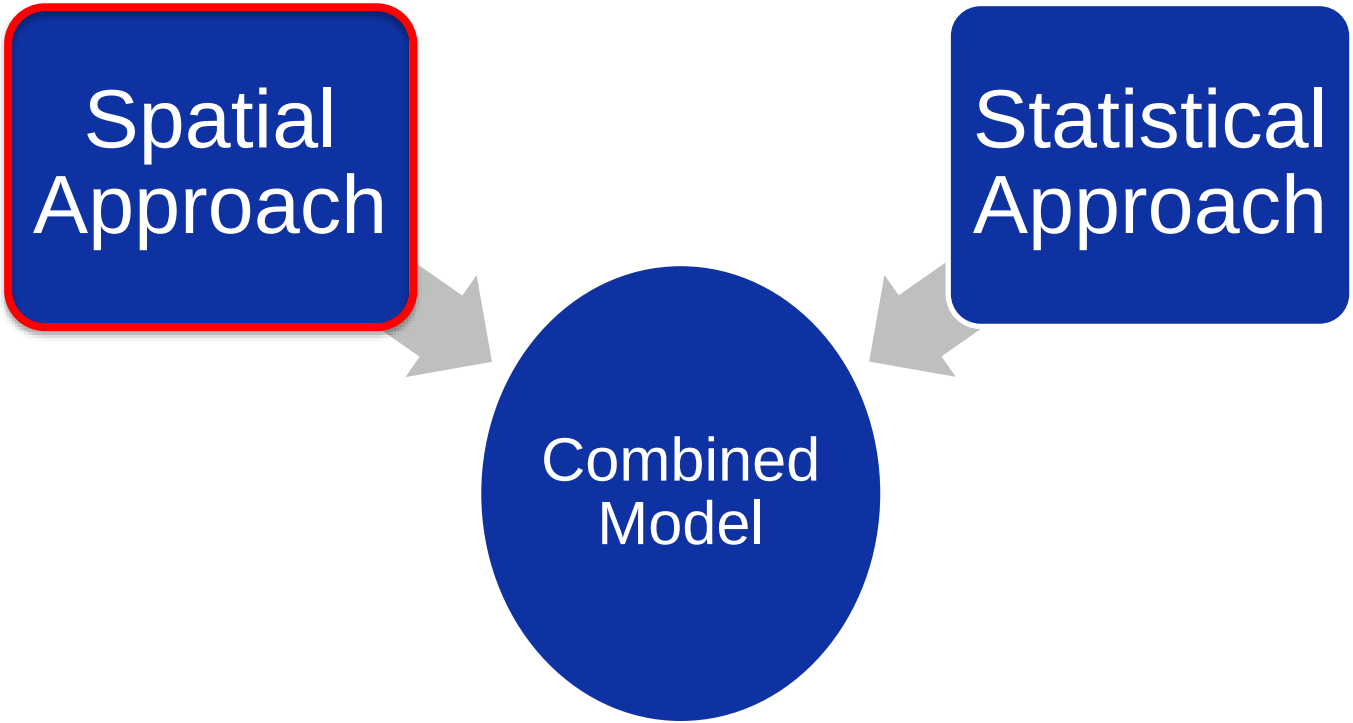
U.S. EPA TRI, Reporting Year 2021

44 facilities submitted TRI forms for PFAS for 2021

Facilities initiated **11 source reduction activities** for PFAS in the past 2 years.

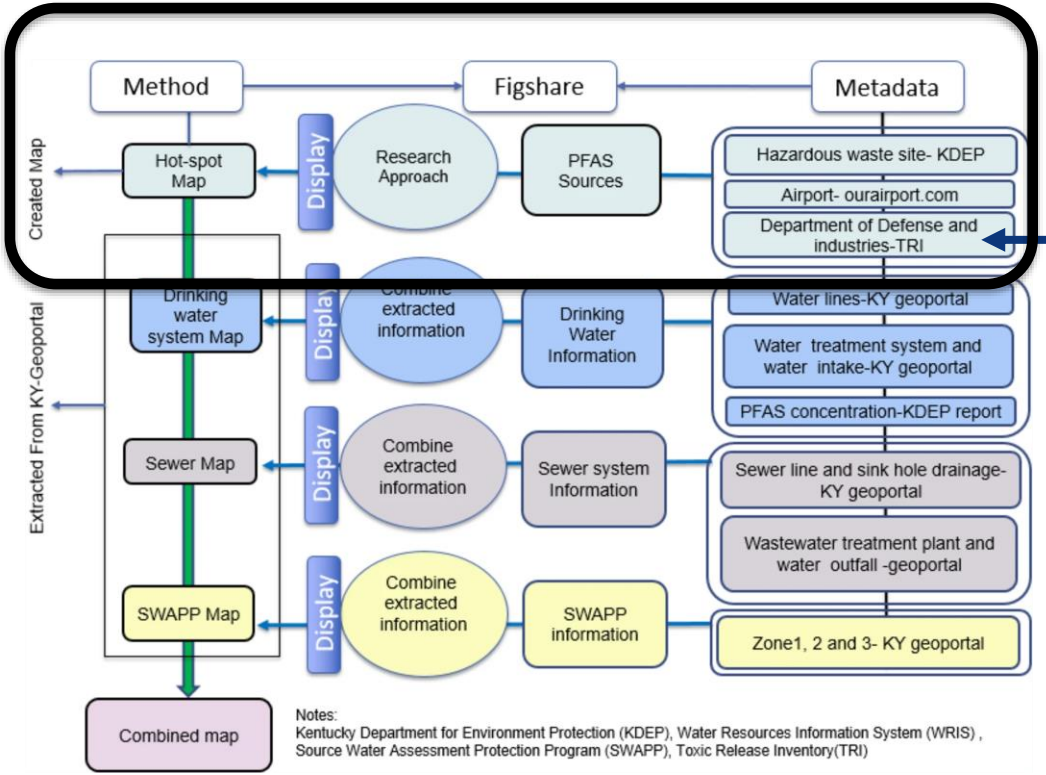
U.S. EPA TRI, Reporting Year 2021

Methods



Methods

Identify potential PFAS users and Hazardous Waste Sites → Assign Indicator Sore → Generate Heat Map based on findings



See Publication: *Ojha et al.,* Identifying and sharing per-and polyfluoroalkyl substances hot-spot areas and exposures in drinking water.
Scientific Data, (2023) 10:388.

Methods

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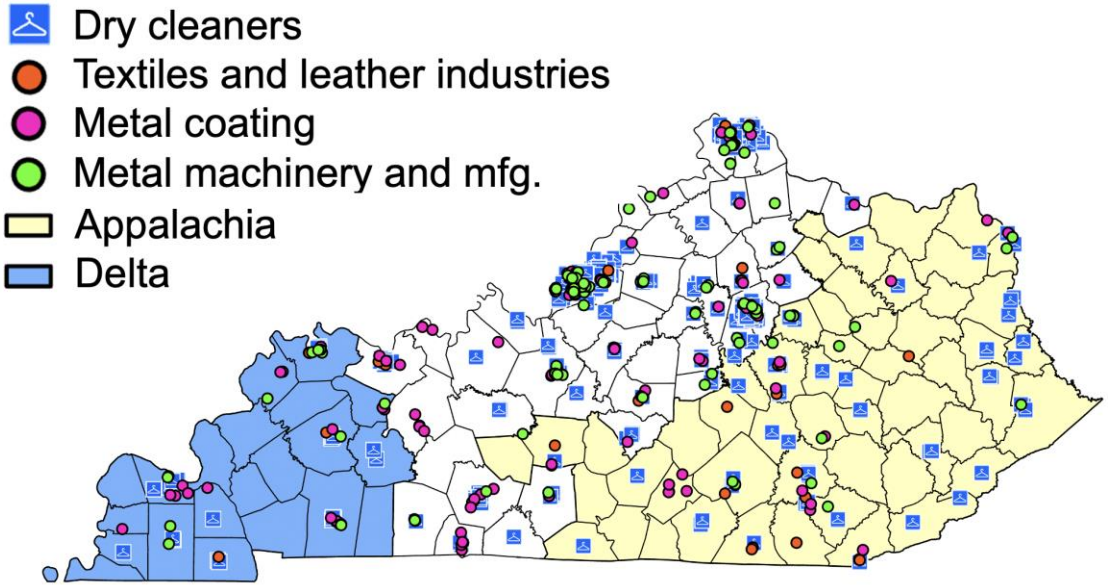


Methods

How did we use the TRI Database:

- Site-related information and toxic chemicals released to the atmosphere and water.
- Chemical releases assumed to increase the likelihood of nearby drinking water source becoming contaminated with PFAS.

Recently, 176 PFAS were added to the list of chemicals covered by TRI.

Why didn't you use PFAS releases from the TRI Database?

Not all industries that release PFAS are currently required to *report* PFAS releases.

TRI reporting requires that emissions are measured.

For Kentucky, the 2021 TRI data includes 750 pounds of PFAS released to air (from 1 location). 2 other locations are included in as PFAS reportable with 0 pounds released. No other PFAS releases are reported.

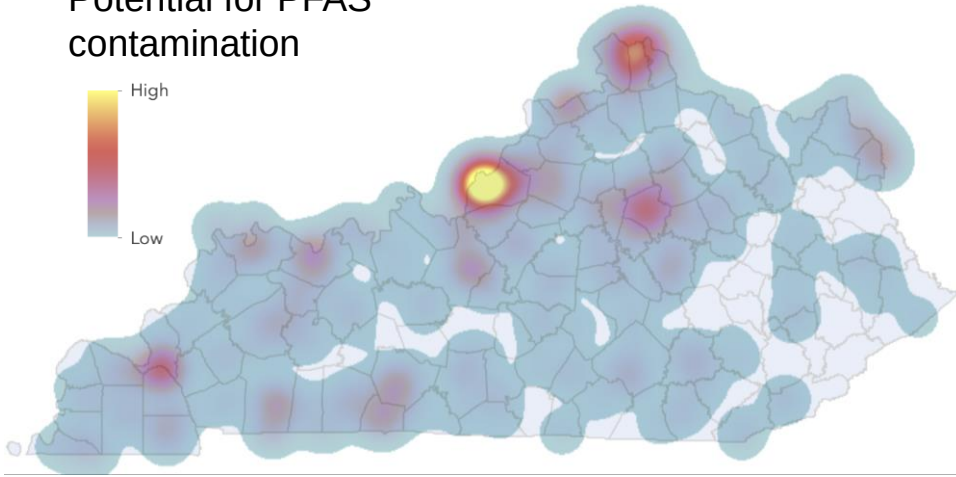
Background

Methods

Identify potential PFAS users and Hazardous Waste Sites → Assign Indicator Sore → Generate Heat Map based on findings

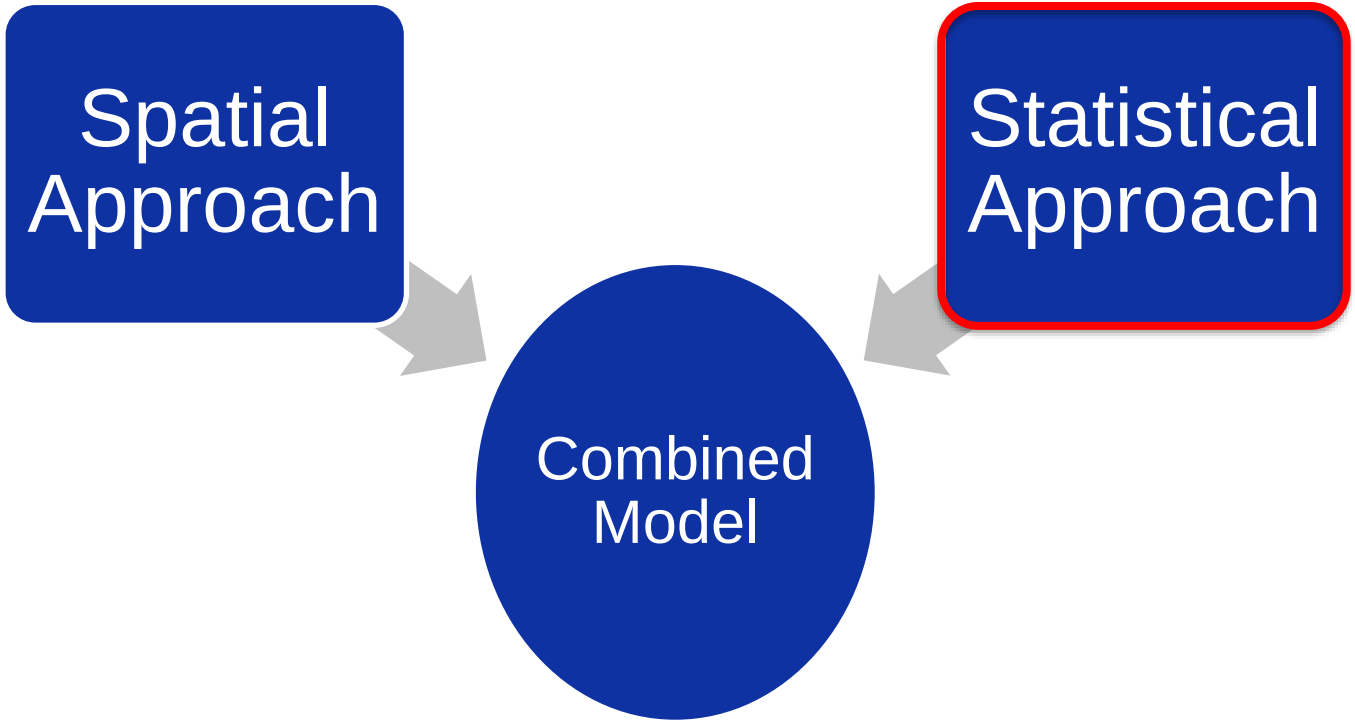
Indicator Score	Facility	Upper Magnitude	Source
100	Department of Defense	10,000µg/L (28 PFAS)	AFFF*
	Landfill	1,000 µg/L (13 PFAS)	Waste streams from landfills
	Chemical manufacturing Industries	1,000 µg/L (11 PFAS)	PFAS/ Fluoropolymer manufacturer and user
75	Airport	100 µg/L (28 PFAS)	AFFF*
	Fire Training Areas	100 µg/L (28 PFAS)	AFFF*
	Petroleum Refineries	10 µg/L (28 PFAS)	AFFF*
50	Textiles	10 µg/L (13 PFAS)	Fluoropolymer coating
	Furniture	10 µg/L (13 PFAS)	Fluoropolymer coating
	Paper	10 µg/L (13 PFAS)	Fluoropolymer coating
25	Rubber/Plastics	10 µg/L (13 PFAS)	Fluoropolymer coating
	Fire Station	Not Available	PFAS Foam
	Fabricated Metal	Not Available	Fluoropolymer coating

Potential for PFAS contamination



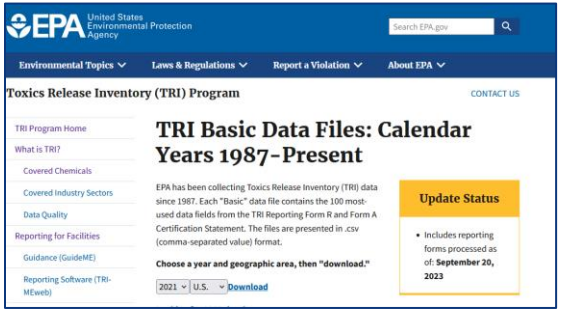
See Publication: *Ojha et al., "A geospatial and binomial logistic regression model to prioritize sampling for per- and polyfluorinated alkyl substances in public water systems*," **Integrated Environmental Assessment and Management:** (2022) 19(1): 163-174.

Methods



Methods

EPA TRI Data



$$\text{Risk(Air)} = \sum_{i=1}^{n} = \left(\frac{\text{Indicator Score(i)} \times \text{Amount Released to Air (i)}}{\text{Distance to PWS(i)}^2} \right)$$

$$\text{Risk(Surface Water)} = \sum_{i=1}^{n} = \left(\frac{\text{Indicator Score (i)} \times \text{Amount Released to Surface Water (i)}}{\text{Distance to PWS(i)}^2} \right)$$

$$\text{Risk(Ground Water)} = \sum_{i=1}^{n} = \left(\frac{\text{Indicator Score(i)} \times \text{Amount Released to Ground Water (i)}}{\text{Distance to PWS(i)}^2} \right)$$

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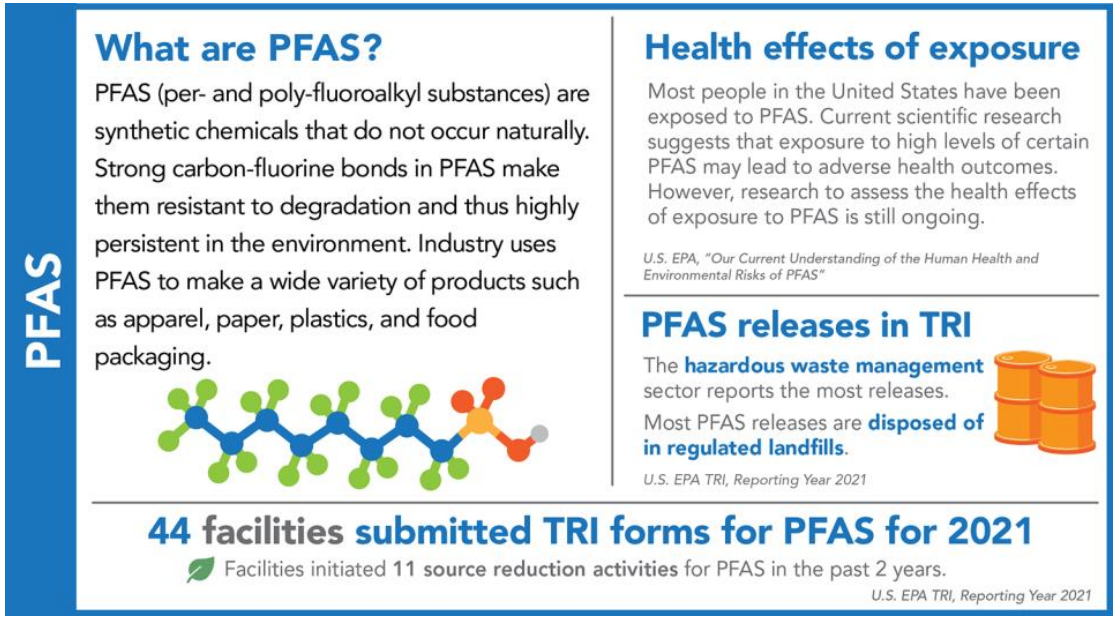
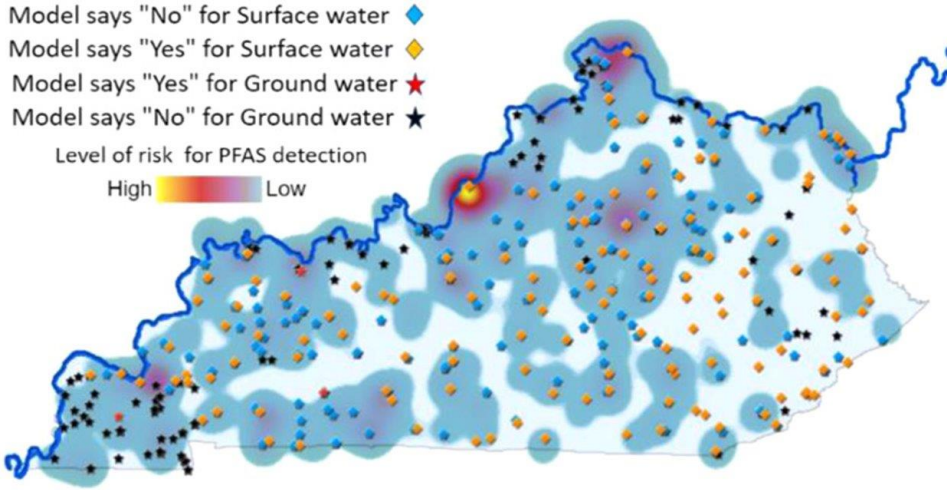


Diagnostic Tool

Results

See Publication: *Ojha et al., "A geospatial and binomial logistic regression model to prioritize sampling for per- and polyfluorinated alkyl substances in public water systems,"* **Integrated Environmental Assessment and Management:** (2022) 19(1): 163-174.

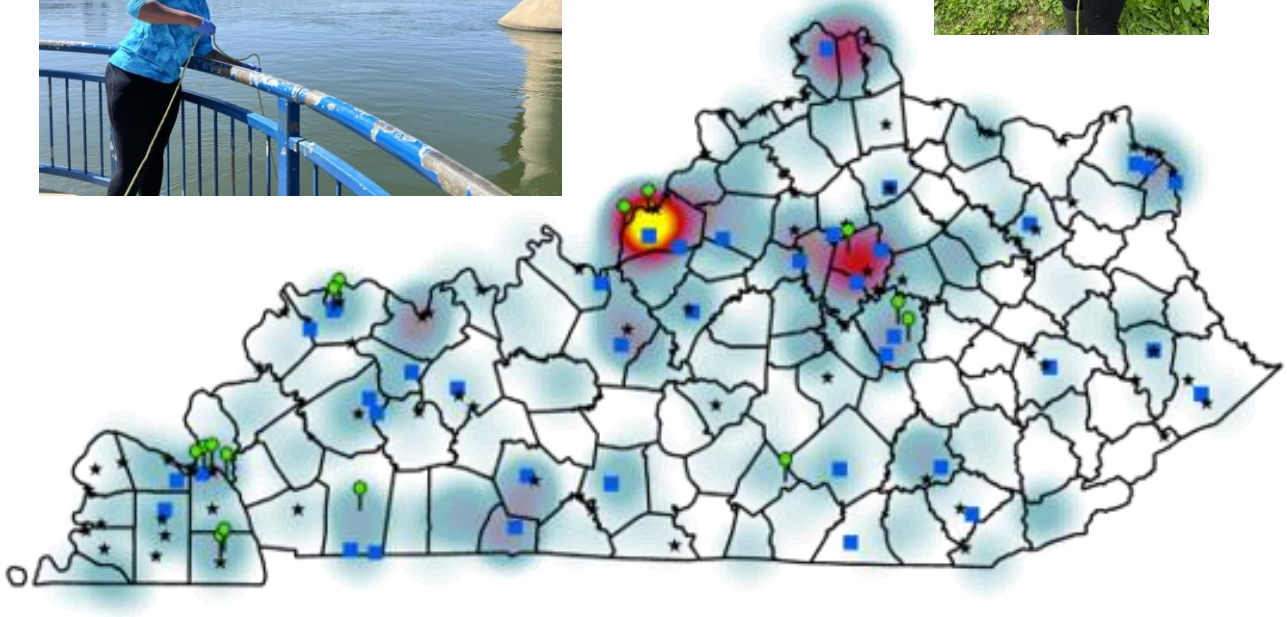


Source	Number	Sample – Y Model – Y	Sample – Y Model – N	Sample – N Model – Y	Sample – N Model – N	Model Accuracy
Total	75	32	5	12	23	0.76
GW Only	28	2	4	0	22	0.86
SW Only	47	30	1	13	3	0.70

Model in Use

May 2023

- Sampled 13 surface water locations
- Used model to inform sample location decisions

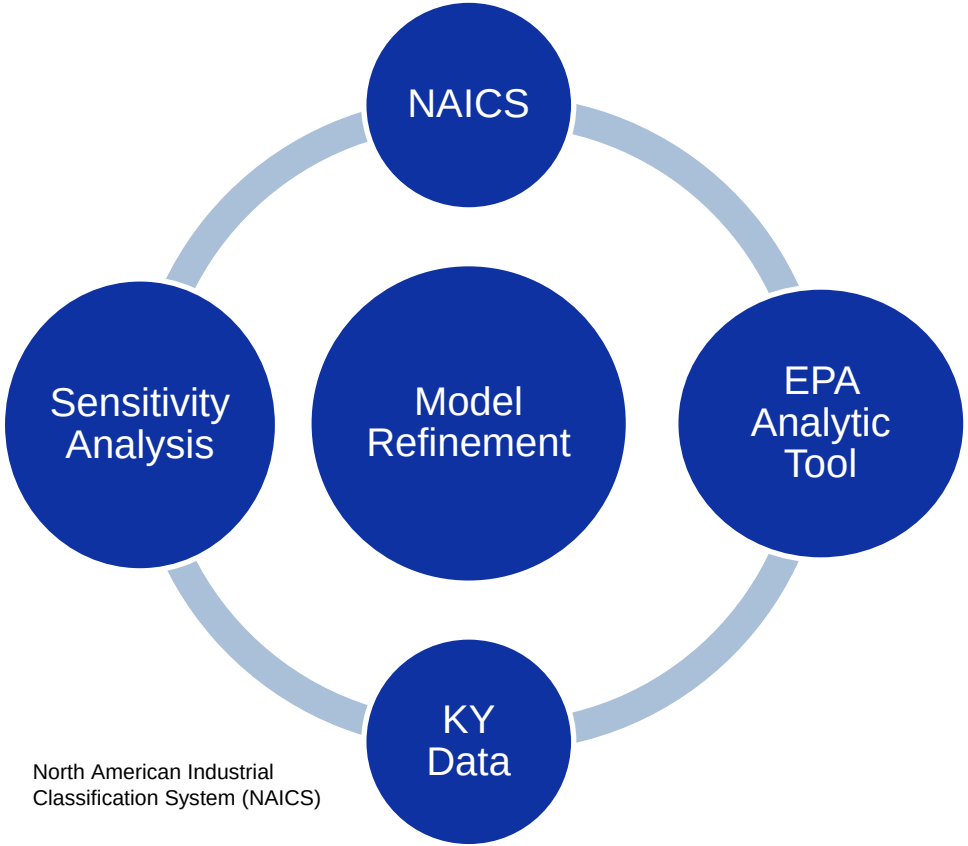


Model in Use

Graduate student (Ariel Robinson) conducted PFAS Analysis with Dr. Mark Strynar, USEPA

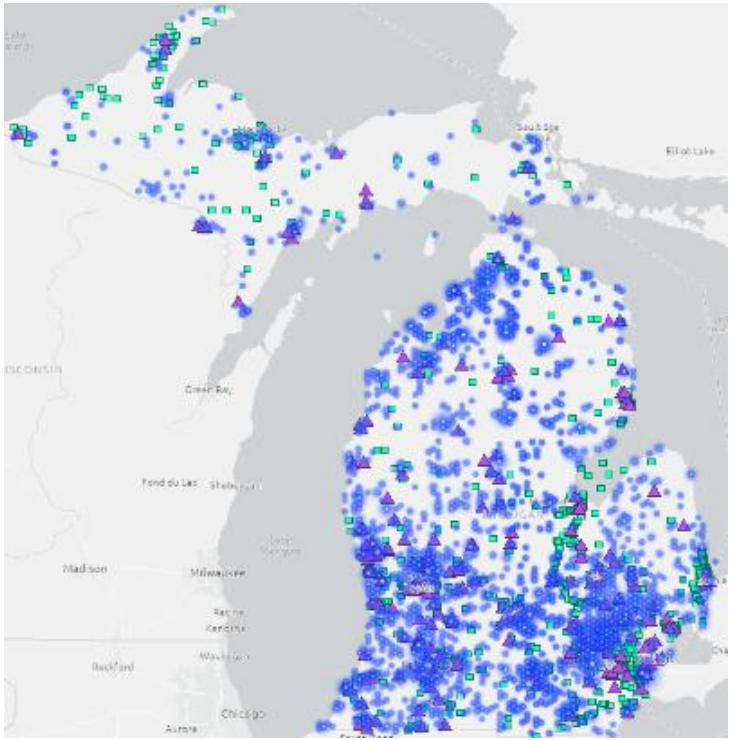
- Analyzed 10 PFAS Analytes
- Highest observed concentration, 67 ppt.
- Average detected concentration between, 5-10 ppt

Next Steps



North American Industrial Classification System (NAICS)

Refine the Kentucky model and apply the model to states with more extensive PFAS drinking water sampling and analysis data



Conclusions

Developed a model to prioritize PFAS sampling locations using TRI database

Validated the model with available data resulting in 76% accuracy

Used the model to inform sampling locations for a field study and shared with Kentucky parties

Acknowledgments

- University of Kentucky Superfund Research Center, Award Number P42ES007380.
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- Kentucky Department for Environmental Protection

Pennell Research Group

Superfund Research Center