From:	Faye Yoshihara
To:	Benton Public Comment
Subject:	LU-24-027 - Coffin Butte Landfill Expansion CUP
Date:	Monday, June 30, 2025 4:40:52 PM
Attachments:	FINAL Clean Water Symposium Corvallis April 17 2025 simplified.pdf

Dear Planning Commissioners, I am writing in opposition to LU-24-027, the expansion of Coffin Butte Landfill CUP. The additional exhibits submitted by Republic Services and their consultants and most disturbingly, Benton County's Updated Staff Report continue to disregard neighbors' lived experience with noise, odor, visual blight and litter, all of which impact the character of our area. In addition, they minimize or dismiss the known and emerging public health concerns related to the toxic chemicals spewing, leaking and leaching from Coffin Butte landfill into our air, soil and water. PFAS are amongst these toxic chemicals.

I would like to bring your attention to testimony #1730, from Dr. Jennifer Field, Oregon State University professor in the Department of Environmental and Molecular Toxicology. She is recognized as a pioneer and national expert with over 30 years experience, including researching the occurrence and behavior of PFAS in landfill leachate and gas.

I am submitting as testimony, Dr. Field's slide presentation, for her keynote lecture "Advancing Environmental Forensics of Per- and Polyfluoroalkyl Substances" on April 17, 2025 for the Clean Water Symposium, hosted by Oregon State University. In this lecture she discusses the documented issues of PFAS, landfill leachate & gas emissions and wastewater treatment plants & effluents. Her research has documented the persistent nature of PFAS from landfill leachate, which is known to continue for 40 years.

Please deny the Conditional Use Permit for LU-24-207 for the health and safety of Benton County residents and all those who live downstream.

Thank you,
Faye Yoshihara
37461 Soap Creek Rd.
Corvallis, OR 97330

Oregon State University
College of Engineering

Advancing Environmental Forensics of Per- and Polyfluoroalkyl Substances

Clean Water Symposium
Oregon State University
April 17, 2025

Jennifer A. Field, Ph.D.
Department of Environmental and Molecular Toxicology

Oregon State University
College of Agricultural Sciences

Outline

- What makes PFAS special?
- PFAS uses
- Landfill leachate & gas emissions
- Wastewater treatment plants & effluents
- PFAS forensics
- Acknowledgments

Outline

Oregon State University
College of Agricultural Sciences

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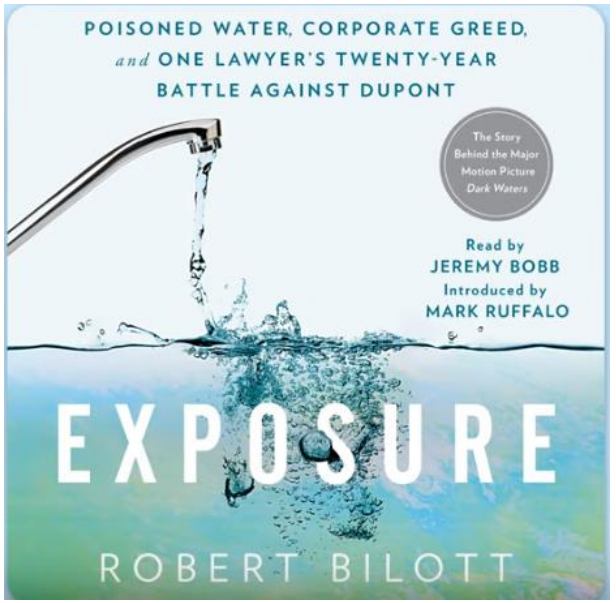
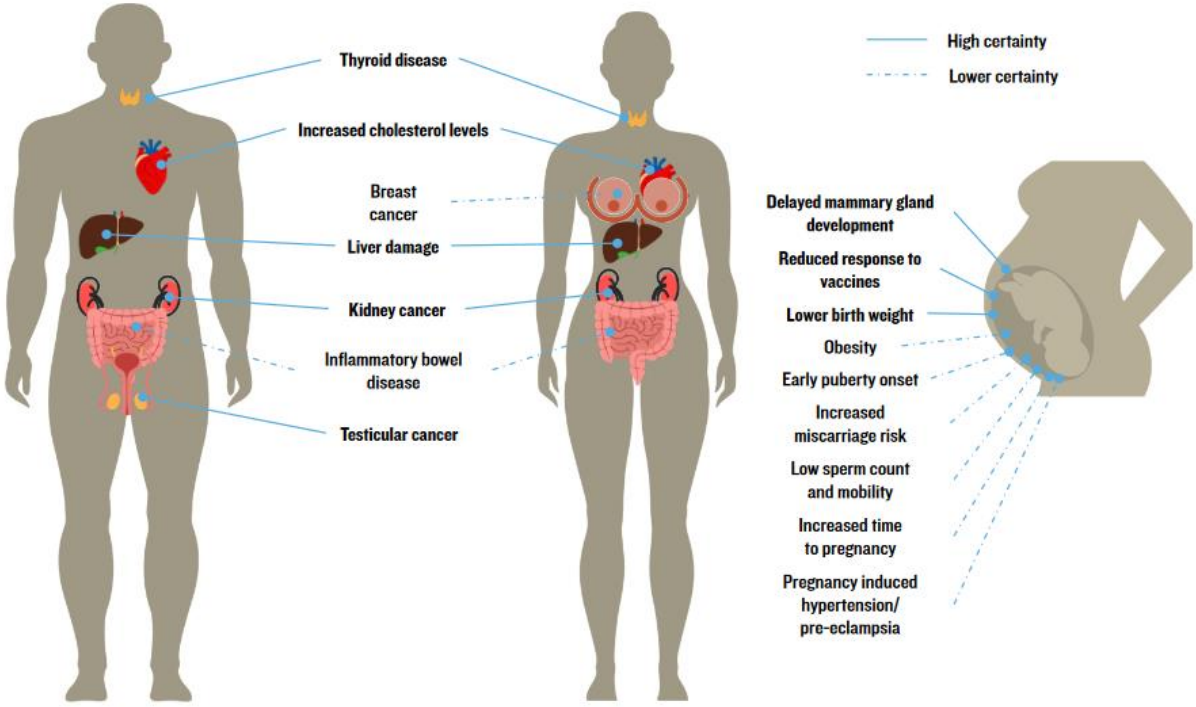
PFAS in the Press

- Household word around the world
- Local, national, international news media, movies, books



Human Toxicology

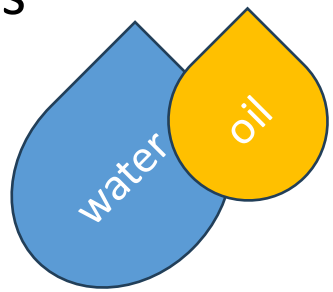


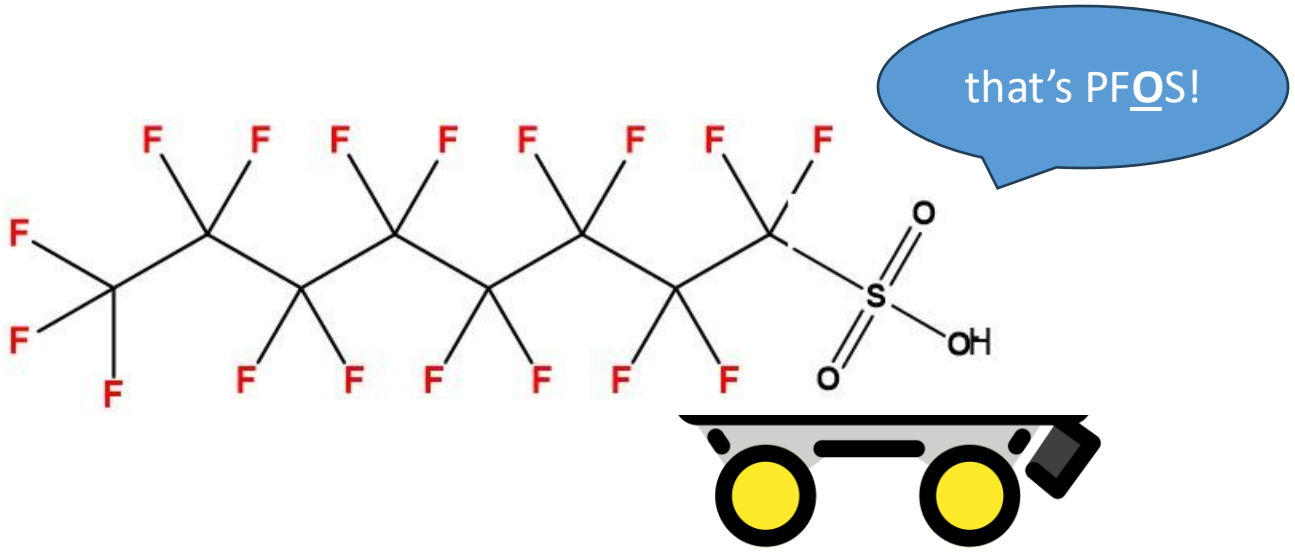
- PFAS half lives: days to years
- PFAS bind to protein
  - ➢ blood-rich tissues (liver, kidney, and blood)
- PFOA & PFOS have been shown to induce tumors in rodents and fish

Jamie DeWitt

PFAS Anatomy & Nomenclature

- (per)Fluorinated tail
  - ➢low van der Waal forces[1]
- 'R' group
  - ➢source of PFAS variety



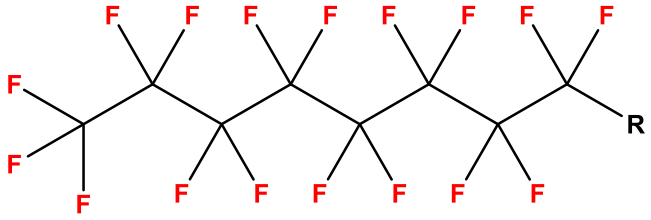


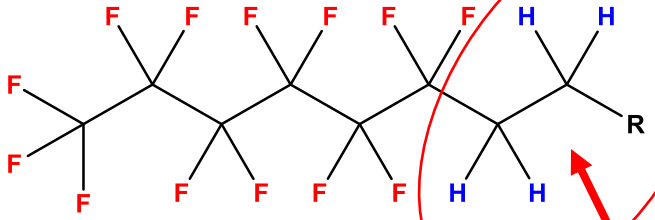
[1]Goss and Bonner 2006 J Phys Chem A

Elk photo: David J. Stang (Wikimedia Commons)

PFAS Anatomy & Nomenclature

- Perfluorinated vs. polyfluorinated…

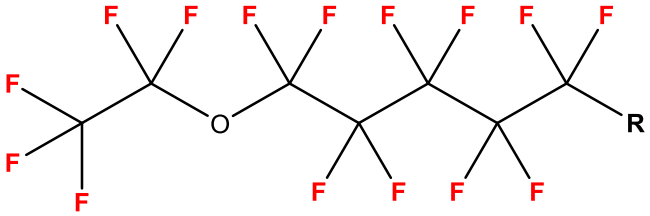


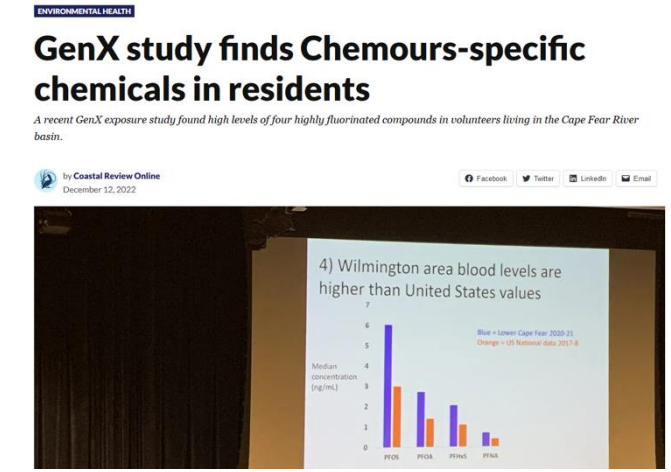


… a big difference to a mass spectrometer!!

'Weak spot'

- Similar function, avoid patents
- Adds a 'weak' spot…
- Slip in an oxygen….



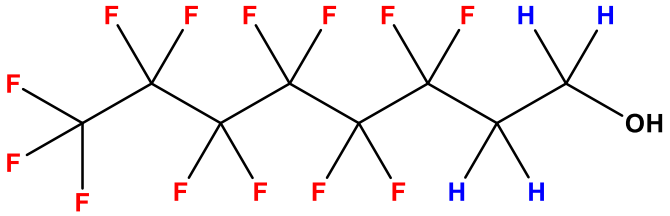


PFAS Anatomy & Nomenclature

- If a R group is neutral…
  - ➢higher vapor pressure → volatile!

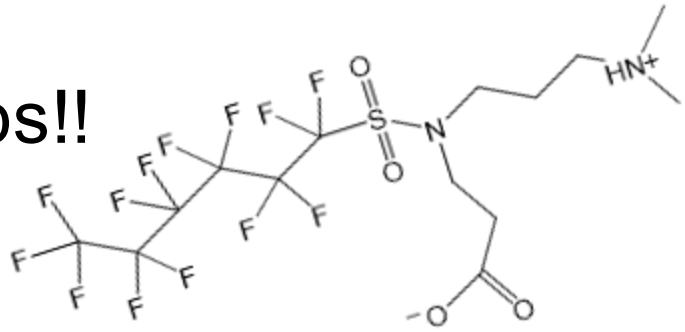
#1 PFAS in landfill gas

that's an FTOH



- Some really ~~wacky~~ R groups!!

zwitterionic

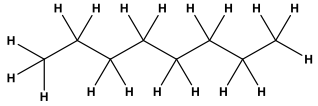


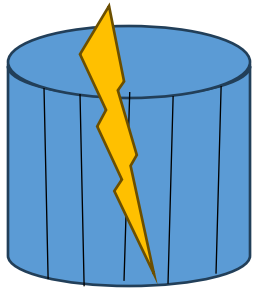
How PFAS are Made

- 3M electrofluorination chemistry
  - ➢Hydrocarbon feedstock
    - ✓biodegradable
  - ➢HF (handle me with care!!)
  - ➢Products = PFOS + a lot of by products
    - ✓not biodegradable

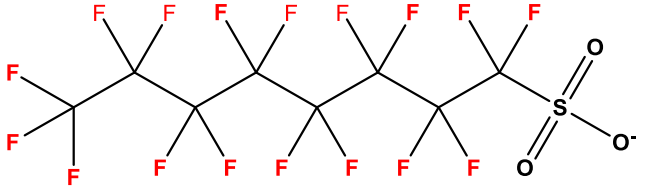
HF

$SOCl_2$





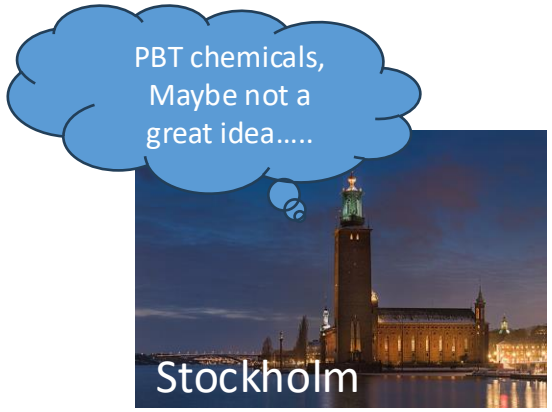
It's me again (PFOS)!



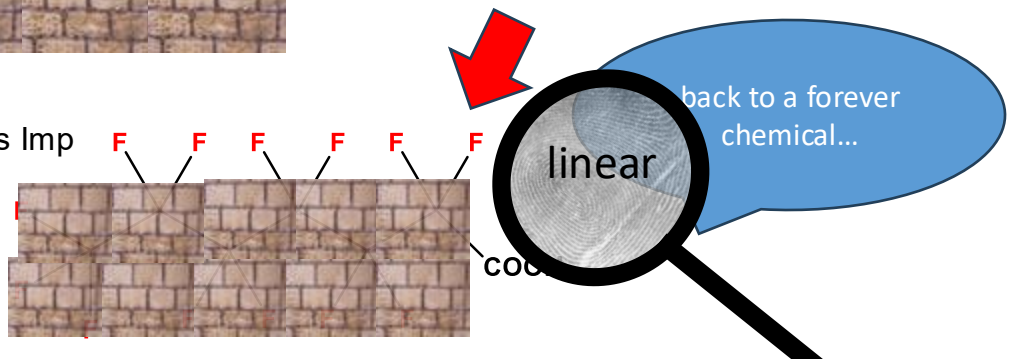
Elk photo: David J. Stang (Wikimedia Commons)

PFAS as 'Forever Chemicals'

- Microbes can't use perfluorinated PFAS for carbon or energy
  - puts the 'P' in Persistent Bioaccumulative and Toxic criteria (Stockholm Convention)
  - persistence alone basis for regulation[1]



- Polyfluorinated 'spacer' + R (C, N, P, S)



[1]Cousins et all. 2019 Environ Sci Process Imp

Precursors to Persistent PFAS

Interstate Technology and Regulatory Council – a valuable resource!

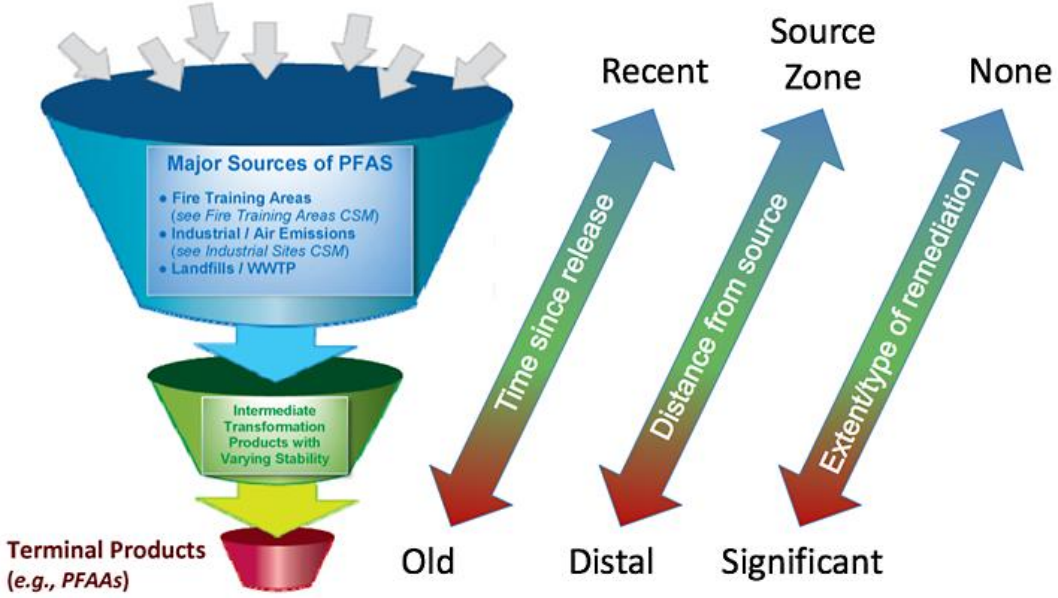


Figure 5-4. Illustration of precursor transformation resulting in the formation of PFAAs.

Source: L. Trozzolo, TRC, and C. Higgins, Colorado School of Mines. Used with permission and based on This Photo by Unknown Author is licensed under CC BY-SA.

https://pfas-1.itrcweb.org/5-environmental-fate-and-transport-processes/#5_1

Outline

Oregon State University
College of Agricultural Sciences

- What makes PFAS special?
- PFAS uses
- Landfill leachate & gas emissions
- Wastewater treatment plants & effluents
- PFAS forensics
- Acknowledgments

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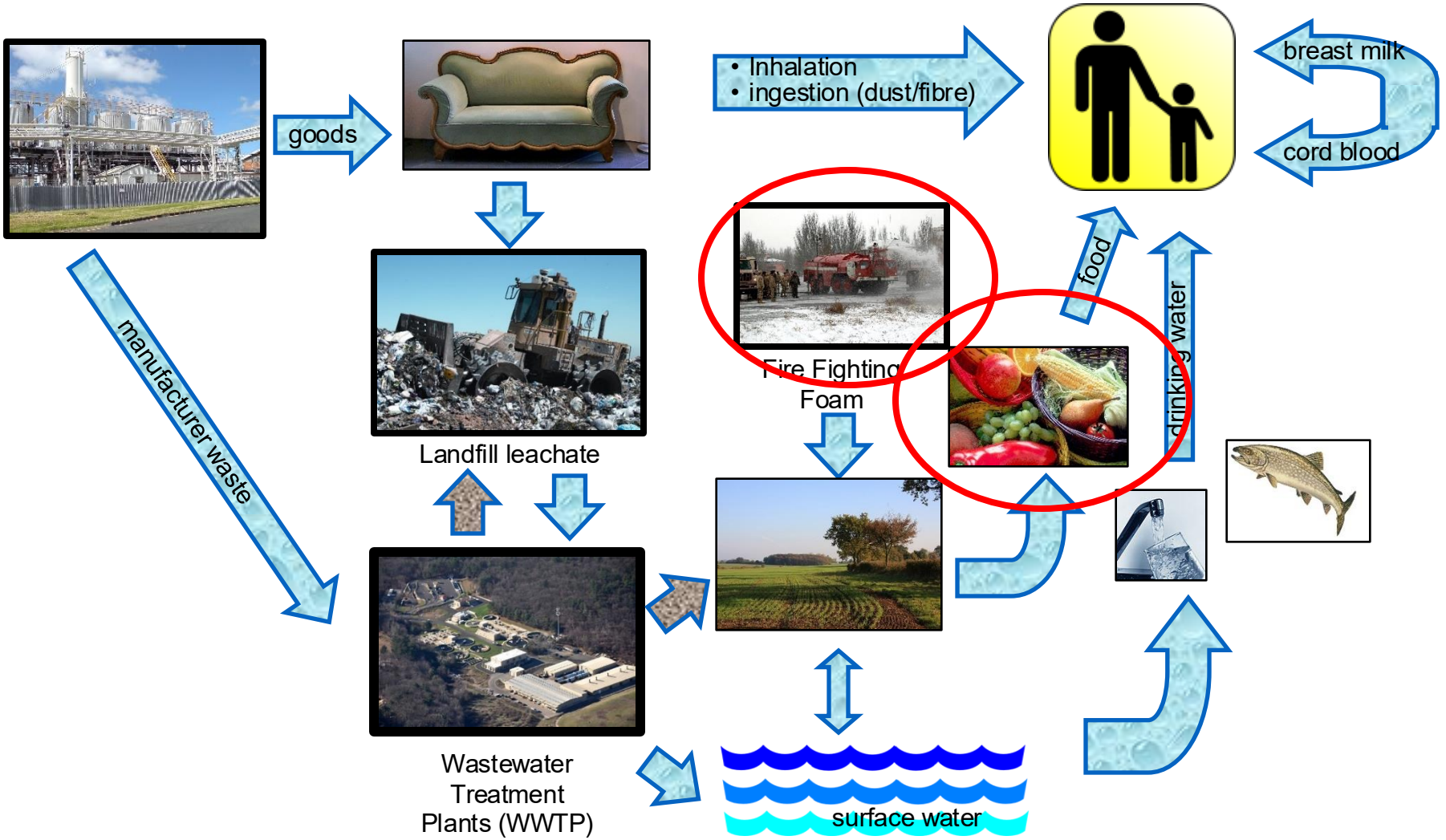
PFAS Uses & Routes of Exposure



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So now, let's get personal…

and yes……

…even toilet paper

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Robel et al. 2017 ES&T; Timshina et al. 2021 Chemosphere;Thompson et al. 2023 ES&T Lett;Ye et al. 2024 ES&T

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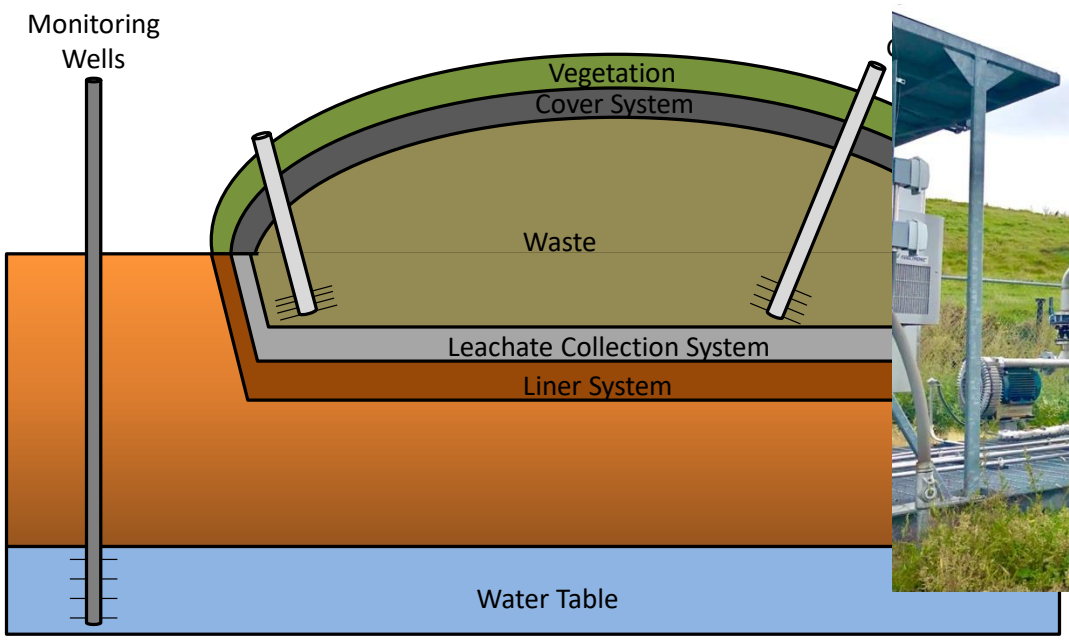
Ideal Landfill

- Engineered system: isolate waste from environment

Mort Barlaz

…Real Landfills



Florentino de la Cruz

Oregon State University
College of Engineering

US National Survey of Landfill Leachate

- 17 municipal solid waste landfills
- 41 Cells (1–6 cells/landfill)
- 1–3 samples per cell

	TOC (mg/L)	Conductivity (mS)
Leachate	7.5 – 22,000	1.2–18 ($SeaH_2O$=55)
WWTP effluent	15	0.9

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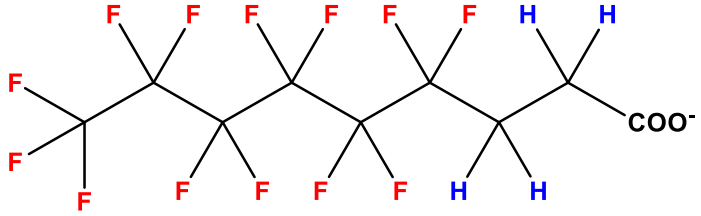
U.S. Survey

Precursors



Product = 5:3 FTCA

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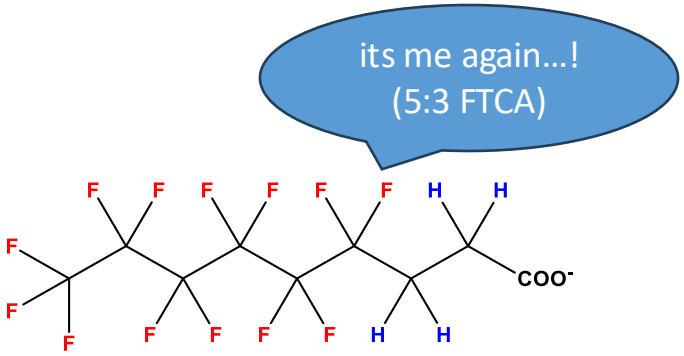
Zhang 2013; Liu and Avendano 2013

Landfill Leachate

- No such thing as a 'blank' landfill leachate (they all contain PFAS)[1-3]
- 2nd most concentrated (ug/L) PFAS
  - No.1: AFFF groundwater (μg/L-mg/L)
  - No. 3: WWTP effluent (ng/L)
  - much higher than EPA MCLs (4-10 ng/L)
- Short-chain PFAS most abundant regardless of refuse/cell age (*leach*ate)
- Transformation products, some unique (diagnostic) to landfills
- Long residence time (decades)
- PFAS leach for 40 yr



Landfills are long-term PFAS sources

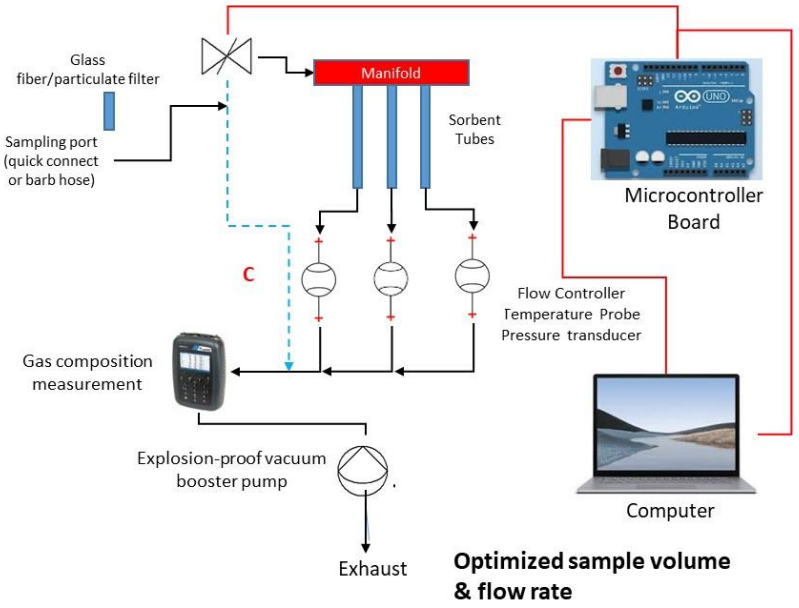
Where does all that leachate go?

Huset et al. 2011 Chemosphere; Allred et al. 2014; J Chrom A; Lang et al. ES&T 2017; Chen et al. 2024 Waste Manage
Image: Nick Allen - Own work, CC BY-SA 4.0, https://upload.wikimedia.org/wikipedia/commons/4/4b/Landfill_compactor.jpg

Landfill Gas Sampling

- 30 sites throughout the US
- Annual precipitation (arid to wet)
- Waste Types
  - ➢ municipal, construction, demolition, ash, biosolids
- Disposal: 1950s – recent
- Waste Decomposition State
  - ➢ fresh (< 5 yr) to old (> 10 yr)

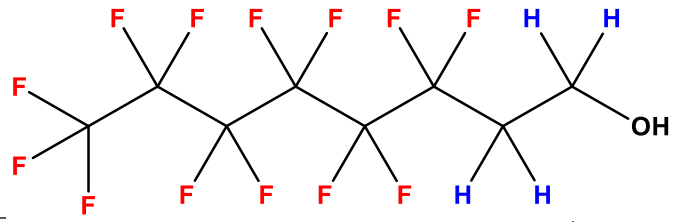
Main Header

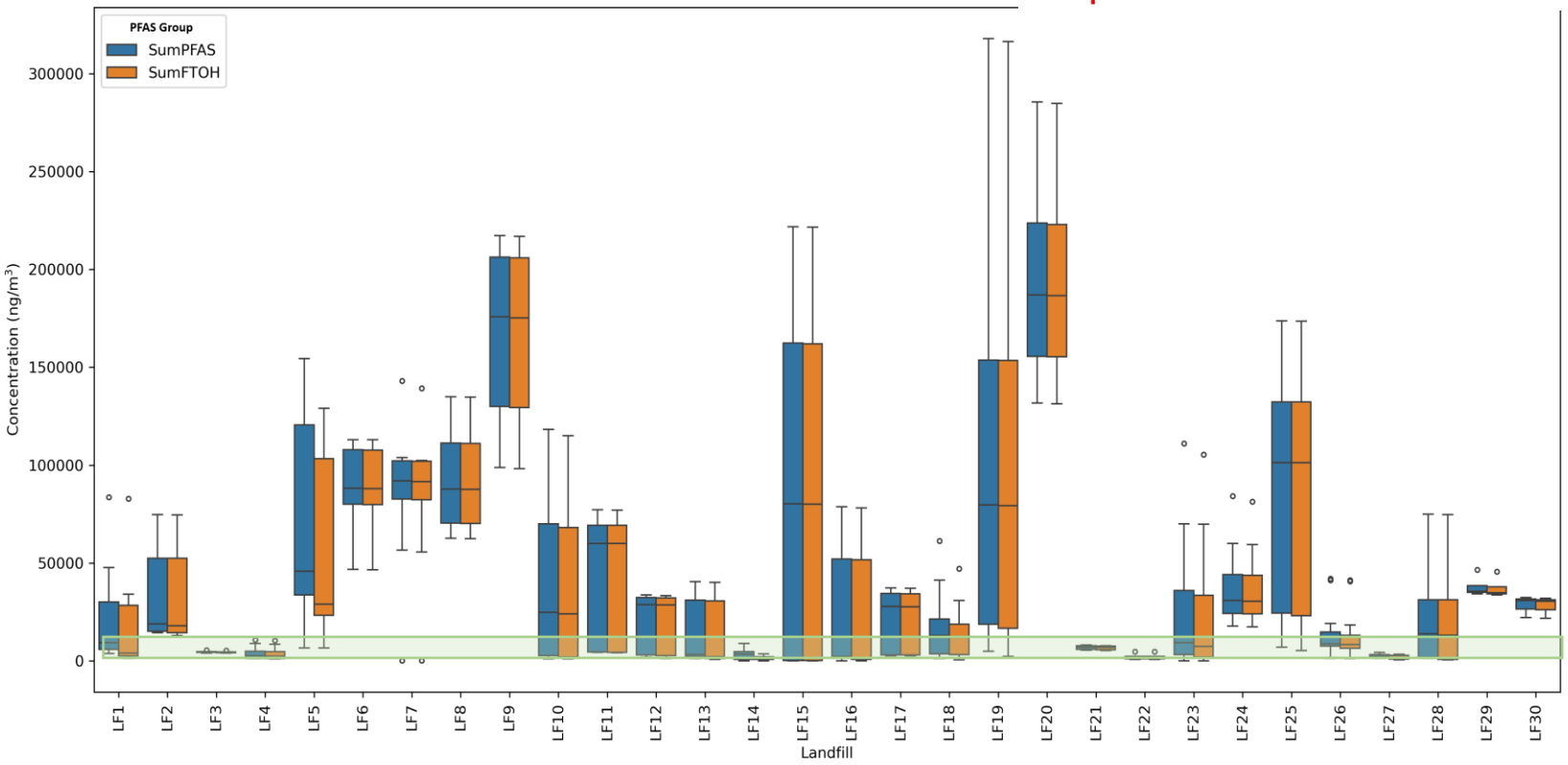


PFAS in Landfill Gas

I'm volatile

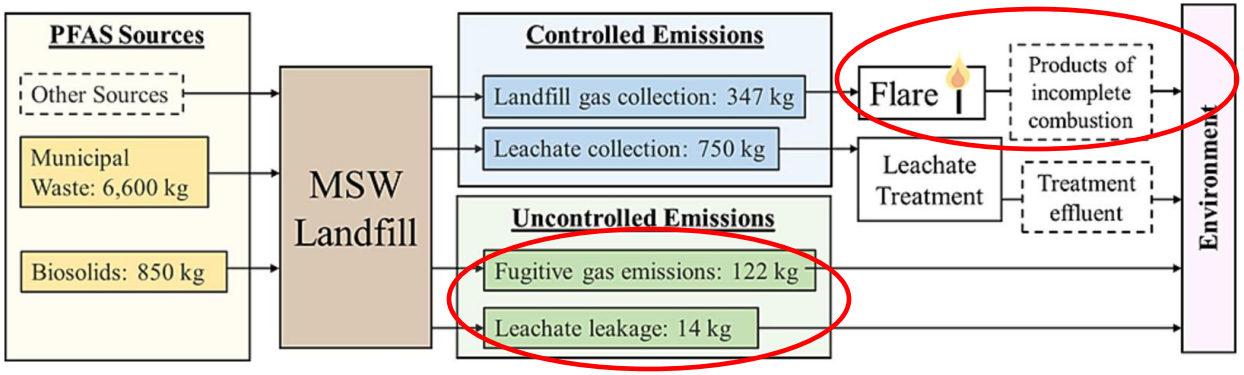
- FTOHs - major PFAS
- Orders of magnitude above ambient air
- FTOHs degrade to PFOA

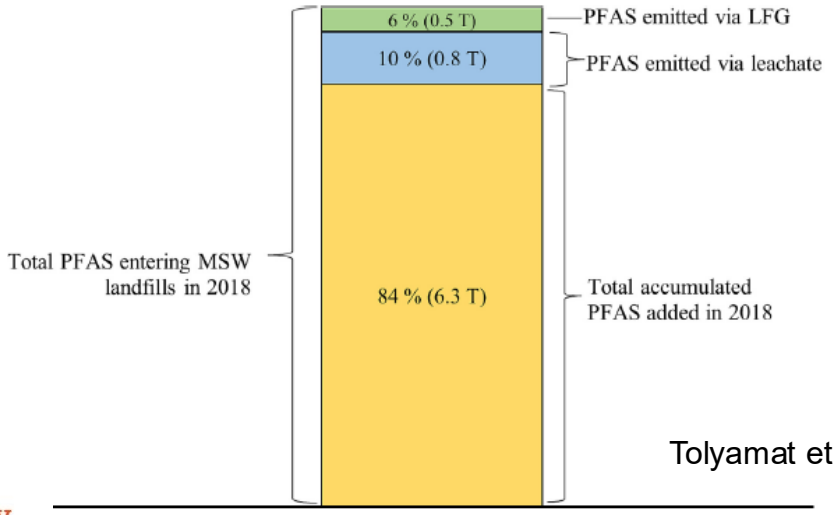




Titaley et al. 2023 ES&T Lett; Tian et al. 2018 ES&T; Weinberg et al. 2011 Atm Environ; Ahrens et al. 2010 ES&T

US Landfill Inventory





- 11% of emissions are uncontrolled
- few data on fate during flaring
- leachate and gas emissions (kg/yr) are equal

Tolyamat et al. 2023 Sci Tot Environ

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Model Landfill Reactors

Carpet & clothing (Lang et al 2016 ES&T)
Food packaging (Yi et al 2024 ES&T)
Mixed waste (Allred et al. ES&T 2015)

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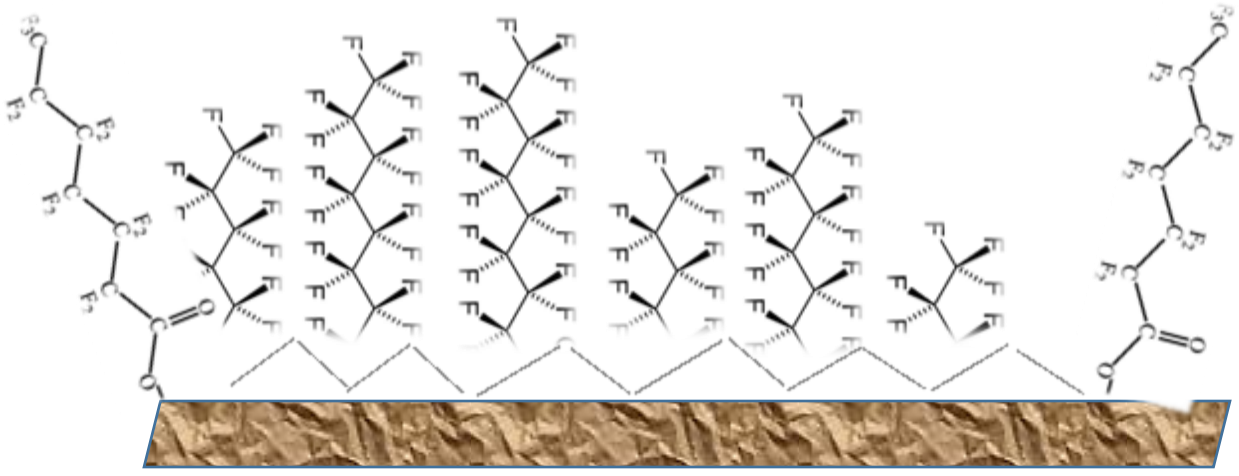
Reactor Studies

- Loss of unbound residuals
- Substrates (paper) degrade, further PFAS release



[1]Kim et al. 2015 ES&T;[2]Allred et al. 2015 ES&T;[3]Lang et al. 2016 ES&T

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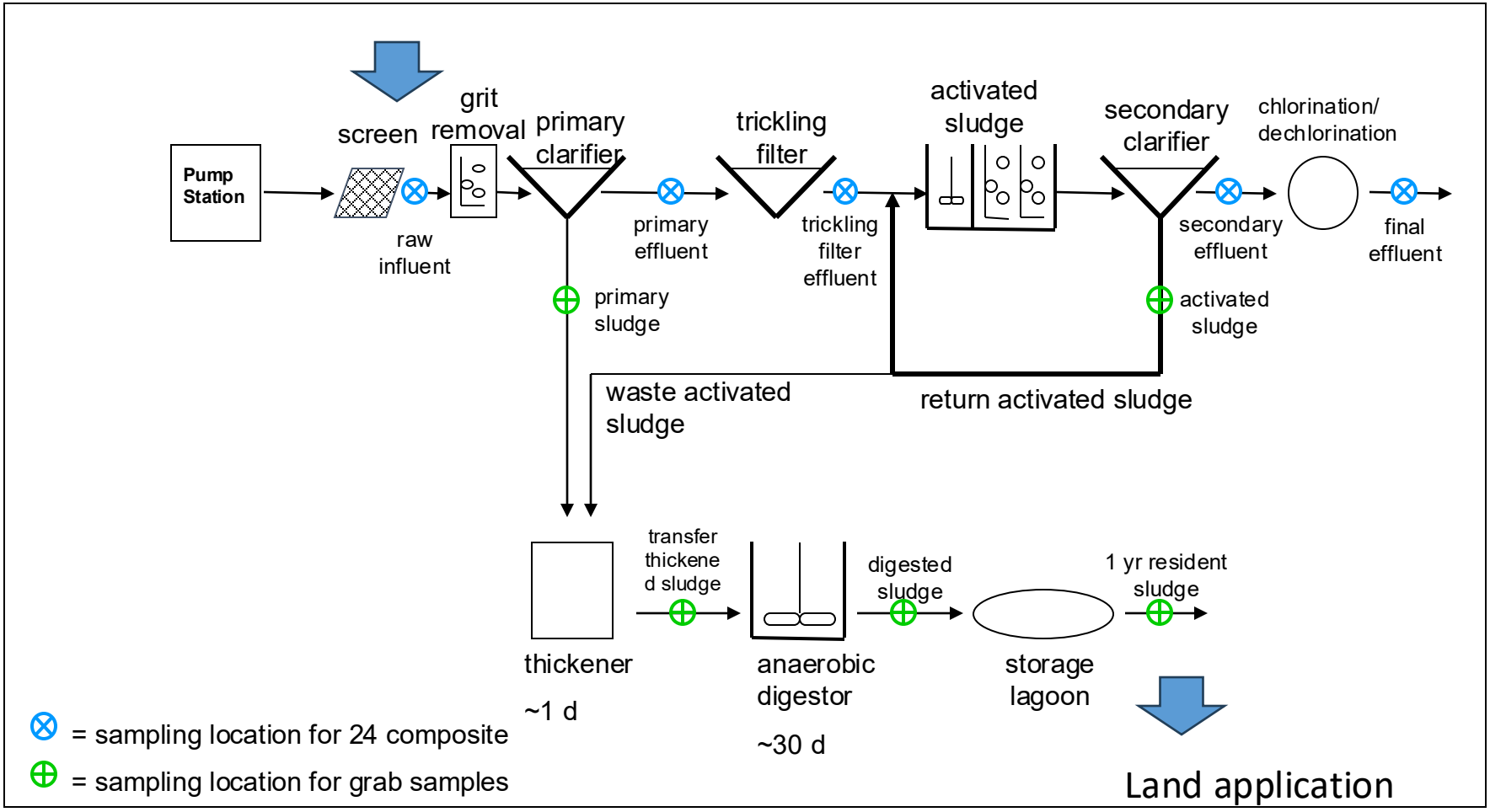
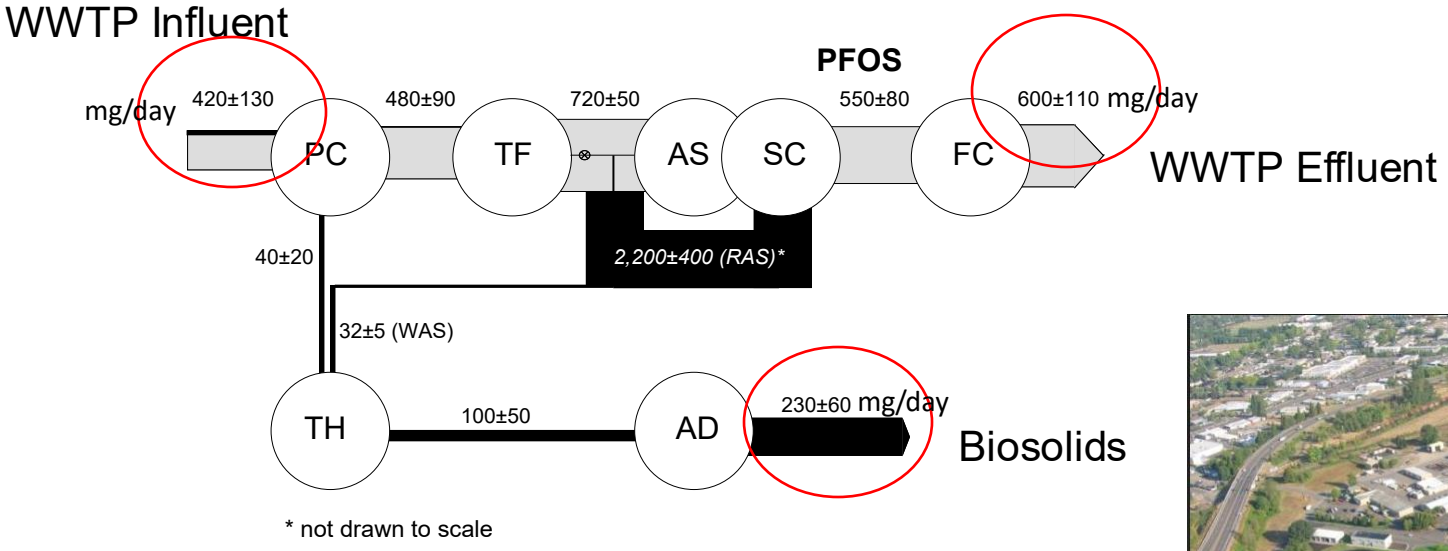
WWTP Mass Flow Study



PFAS Mass Flow

- When it come to PFAS…. what goes in …goes out[1]
- PFAS 'exported' to surface water & biosolids land applied



- Ineffective for removing PFAS
- Leachate dilution increases volume and mass requiring treatment

[1]Schultz et al. 2006 ES&T;
https://www.corvallisoregon.gov/publicworks/page/wastewater-treatment

A Recent Decision

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CORVALLIS Gazette-Times

Search Gazette-Times

E-edition News Obituaries Sports Opinion Puzzles Lifestyles Public Notices Jobs Wildfires 57° Sunny

ALERT FEATURED TOP STORY

Corvallis to stop accepting chemical soup from Coffin Butte Landfill

Ella Hutcherson Oct 24, 2024 Updated Apr 9, 2025 0

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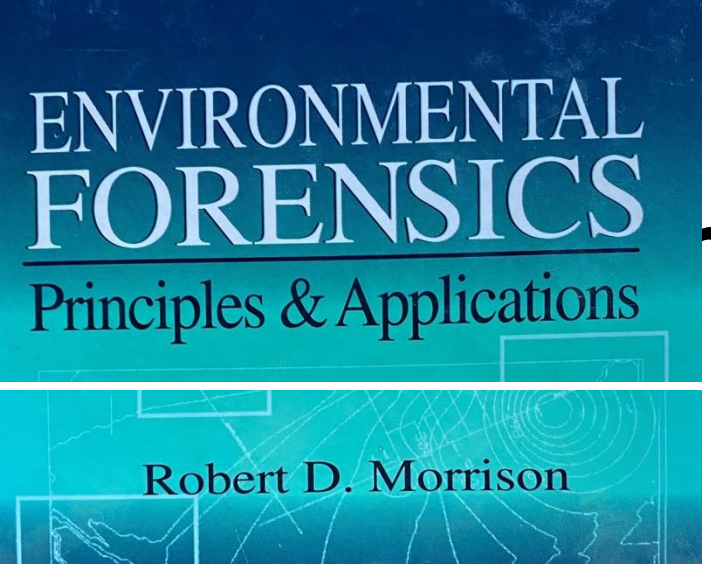

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ntal Science

Occurrence
Transformation
Transport

"Systematic evaluation of environmental information used in litigation"
Morrison 2000

Analysis of evidence
at crime scene

Forensics Science

Environmental Forensics

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Legal frameworks: seeking remedy or compensation

- cost allocation (who is responsible)?
- site investigation for property transfer
- insurance litigation –identify all responsible parties, equity of liability allocation
- toxic tort – probability of chemical exposure caused injury

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[1]Murphy, B.; Morrison, *Introduction to Environmental Forensics; Hester and Harrison 2008 Environmental Forensics; P*hoto Credit:Content Providers(s): CDC/ - This media comes from the Centers for Disease Control and Prevention's Public Health Image Library (PHIL), with identification number #1530;Mampato - Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=6532914

Sources & Fingerprinting

Goal: establish relationship between contaminant sources and impacted site

Diagnostic features:

- need fingerprinting of sources to identify diagnostic features with potential specificity
- *ideally* independent or resistant to weathering/aging and impacts of transport
- ultimately placed into context of mixing & dilution, combined with (bio)transformation and transport
- fingerprinting leads to….

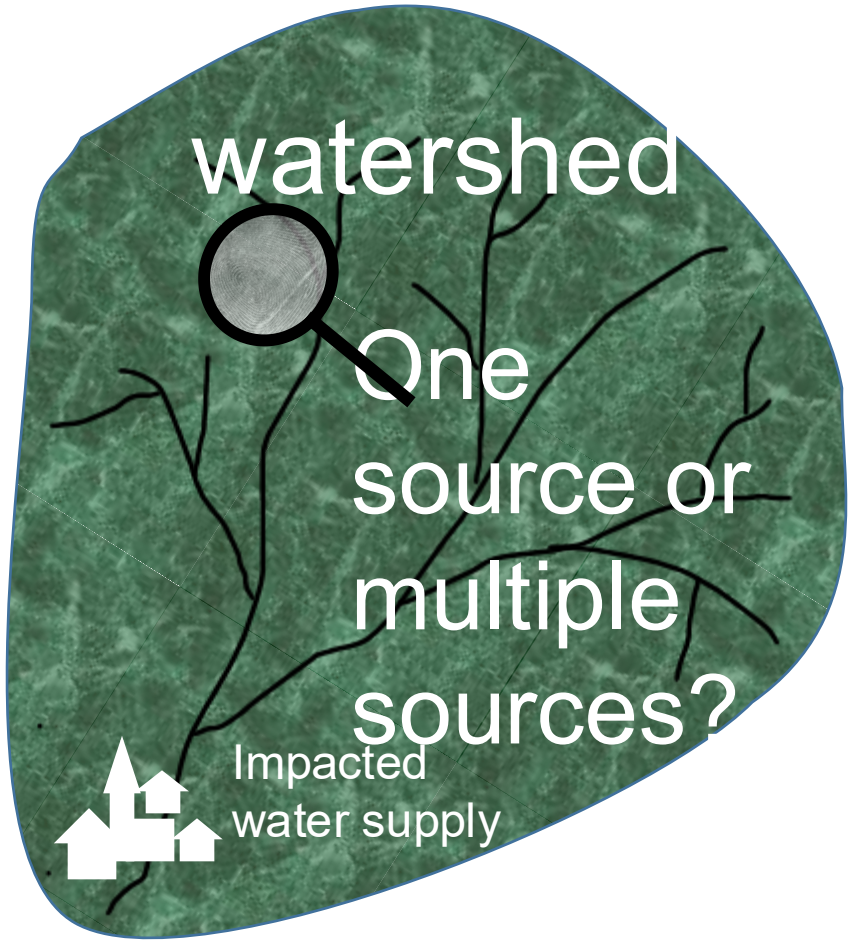
[1]*Hester and Harrison 2008 Environmental Forensics; Image credithttps://commons. wikimedia.org/wiki/File: Uncle_Sam_(pointing_finger).png; https://commons.wikimedia.org/wiki/File:Fingerprint_Whorl.jpg*

PFAS Sources in Watersheds

Correlations: PFAS concentrations & sources

- number of military bases
- wastewater treatment plants
- municipal airports

[1]Hu et al. 2016 Environ Sci Technol Lett



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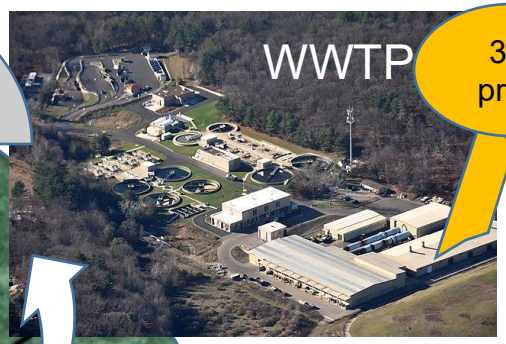
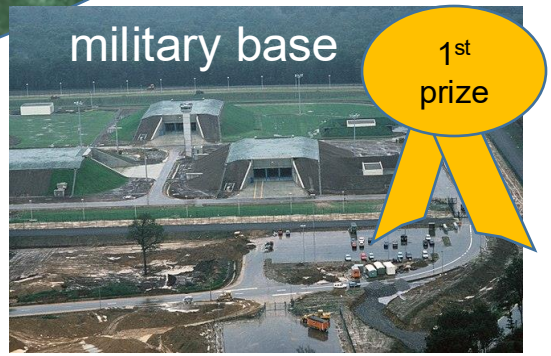
PFAS Sources in Watersheds



watershed



PFAS Source Data

- Separate studies
- Limited number of PFAS
- Different analytical methods
- Smaller/variable data sets
- Data not analyzed by same method or only traditional statistical approaches[1,2]

Gerrad Jones

Boris Droz

Challenge: compare data across methods, locations, time

[1]Benotti et al. 2020 Environ Forensics;[2]Kibbey et al. 2020 Chemosphere

PFAS Sources

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- AFFFs (1974-2021)
- AFFF-impacted groundwater (1988-2020)[1]
- Landfill leachate (1966-2013)[2,3]
- Biosolid-soil leachate (2008-2016)[4]
- Effluents
  - ✓WWTP (2019)[5]
  - ✓power generation (2021)
  - ✓pulp and paper mill (2021)[6]

[1]Backe et al. 2013 Environ Sci Technol;[2]Benskin et al. 2012 Environ Sci Technol;[3]Allred et al. Environ Sci Techno;[4]Sepulvado et al 2011 Environ Sci Technol;[5]Schultz et al. 2006 Environ Sci Technol

PFAS Source Fingerprinting

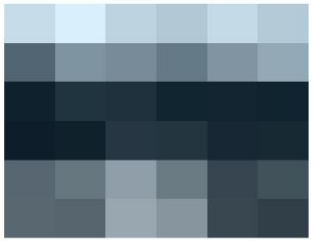
PFAS fingerprinting

- Target PFAS (EPA methods) common to many sources/processes
- Adding 'suspect' PFAS (no standard) adds information
- High resolution datasets contain *much more (100x)* information
- Multivariate statistical & machine learning workflows needed for better resolution & prioritization

Applications

➢ PFAS forensics & source apportionment

Target PFAS (EPA methods)



Target + Suspect PFAS

All 'features' increases resolution

Mt. Hood

Mt. Bachelor

Mt. St. Helens

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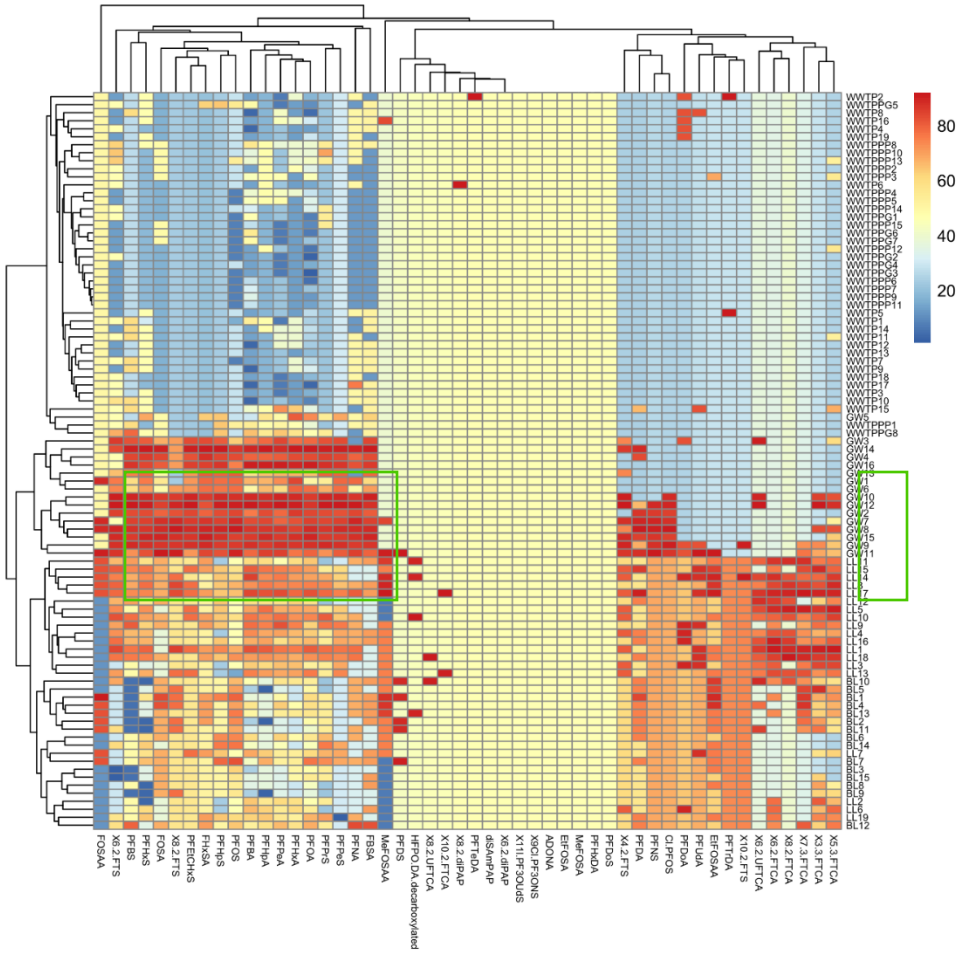
Mulitple Source Fingerprinting

Hierarchical Clustering Analysis



Principal Component Analysis

Joseph et al. Environ. Sci. Technol. 2023

Current work: adding *all features* in data set further increases ability to differentiate sources

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Conclusions

- PFAS are associated with innumerable materials and products
- Product use and disposal results in sources with unique fingerprints that enter the air and terrestrial environment
- Transport, transformation, metabolism alters signatures, next step in development of forensics tools for source apportionment

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Thank you!

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