



REGFORM
REGULATORY ENVIRONMENTAL
GROUP FOR MISSOURI

PFAS

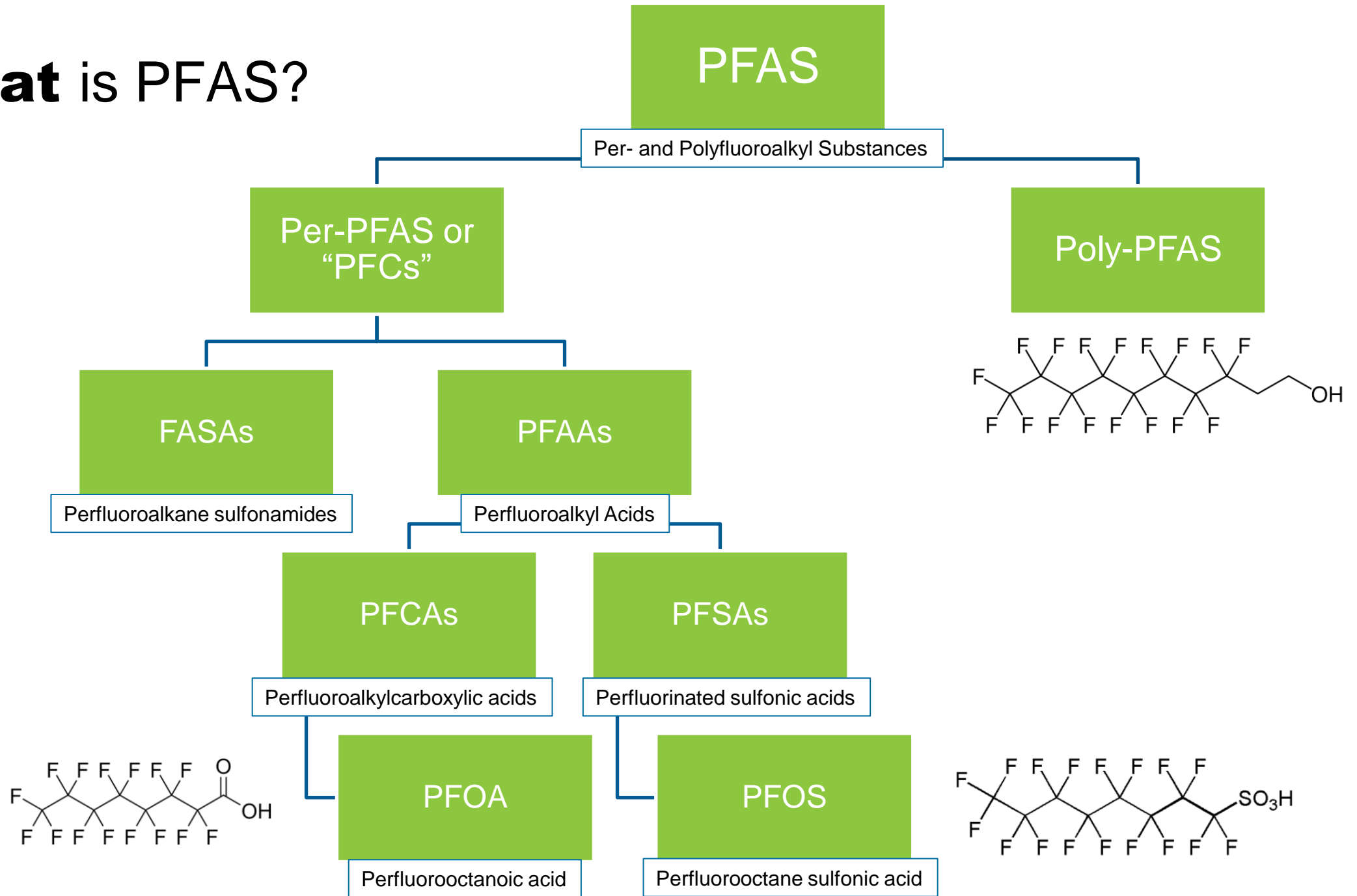
Water Treatment Challenges

Tina Liu, P.E.
Kristen Jenkins, P.E.

Missouri Water Seminar
September 12, 2018



What is PFAS?



What is PFAS?



Firefighting
Foams



Metal Plating



Textiles



Electronics



Photography



Paper
Coatings



Paints



Hydraulic
Fluids

PFAS exposure may:

Affect development in children

Lower pregnancy chance

Interfere with hormones

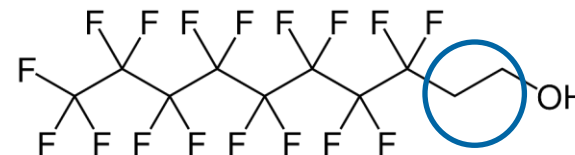
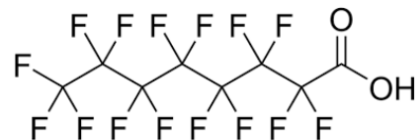
Increase cholesterol levels

Affect immune system

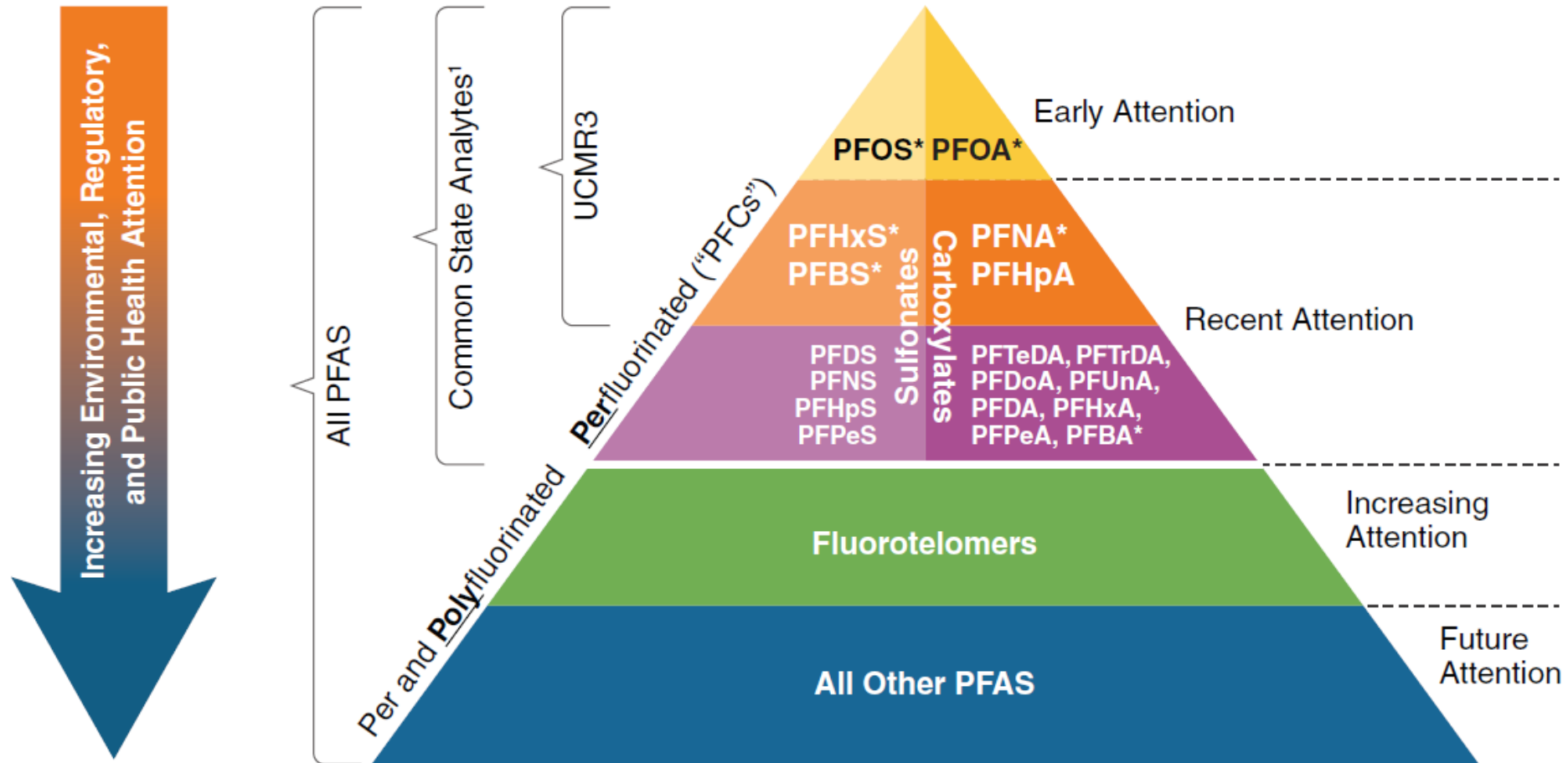
Increase risk of cancer

Per-PFAS versus Poly-PFAS

| Per-PFAS | Poly-PFAS |
|--------------------------------------|----------------------------------|
| Fully fluorinated | Not fully fluorinated |
| Strong C-F bond | Creates a “weak link” |
| Difficult to degrade | Can be transformed into Per-PFAS |
| High water solubility | Low water solubility |
| Low volatility | High volatility |
| Transported in surface & groundwater | Transported in atmosphere |



Emerging Awareness



*Common regulatory criteria or health advisories

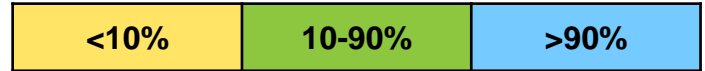
¹Sum of informal poll (NJ, NH, MN)

Thematic and not proportional.

Bottom of triangle indicates additional number of compounds; not a greater quantity by mass, concentration, or frequency of detection.



Evaluation of Water Treatment Systems



INCREASING SIZE

| | AER | COAG/DAF | COAG/ FLOC/SED/ G- or M-FIL | MnO ₄ , O ₃ , ClO ₂ , Cl ₂ , CLM, UV | AIX | GAC | NF | RO |
|-----------|-----|----------|-----------------------------------|--|-----|-----|----|----|
| PFBA | * | * | | | | | | |
| PFPeA | | | | | | | | |
| PFBS | | | | | | | | |
| PFHxA | | | | | | | | |
| PFHpA | | | | | | | | |
| PFHxS | | | | | | | | |
| PFOA | | | | | | | | |
| PFNA | | | | | * | * | | |
| FOSA | | | | | | * | | * |
| PFOS | | | | | | | | |
| PFDA | | | | | * | * | | |
| N-MeFOSAA | * | | | | * | * | * | |
| N-EtFOSAA | | | | | * | * | * | |



*Treatment performance is assumed based on PFAA size/charge and/or known removal data of shorter or longer chain homologues

Case Study – Groundwater Treatment

Evaluation of treatment alternatives for impacted groundwater

- Constituents requiring treatment:
 - Iron
 - Phosphorus
 - Mercury
 - PFAS
- Constituents potentially requiring pre-treatment:
 - Organic carbon (30-50 mg/L)
 - PFAS (total 1 µg/L)

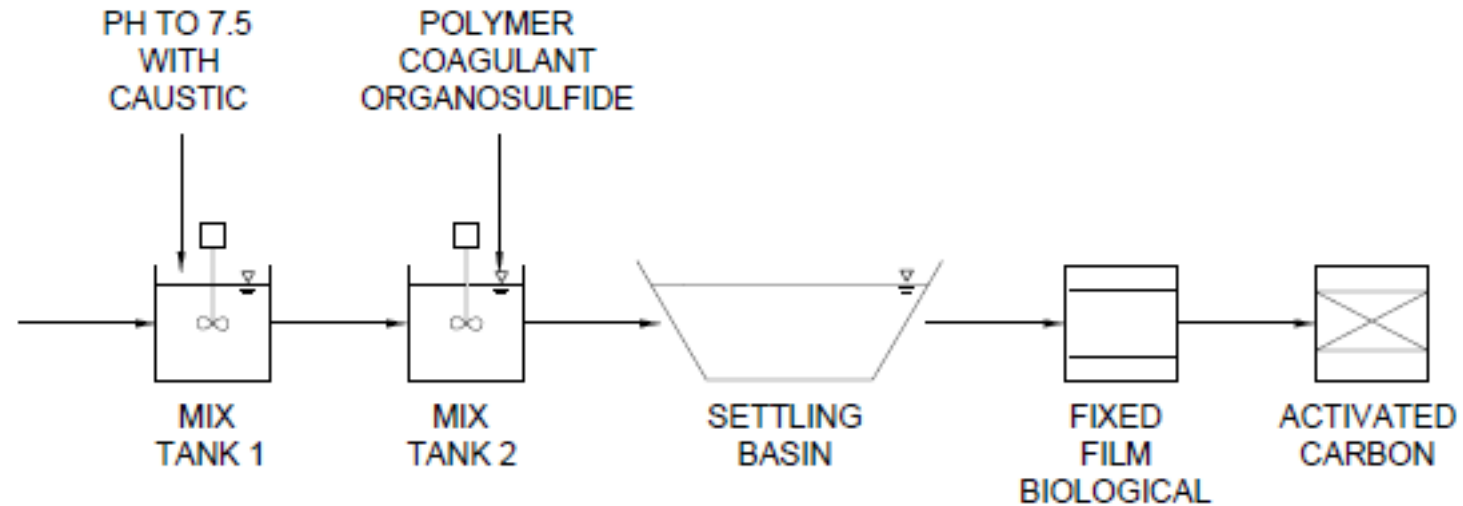
Removal of non-PFAS organics can drive treatment costs and significantly impact unit process selection

Case Study – Treatability Testing

Design considerations

- Activated carbon adsorption can vary depending on:
 - PFAS compounds present
 - Dissolved organic carbon
 - Water chemistry (pH, ionic strength)
- Currently performing laboratory tests to develop design and cost information
 - Iron precipitation and solids coagulation
 - Destruction of dissolved organic carbon
 - GAC adsorption rates of PFAS using rapid small column tests

Case Study – Treatment Alternative



| Mix Tank 1 | Mix Tank 2 | Settling Basin | Biox | Adsorption |
|------------|------------|----------------|-------------------------|-----------------|
| Fe precip | Hg precip | Solids removal | Organics reduction | PFAS adsorption |
| | | | NH ₃ removal | |
| | | | P removal | |

PFAS in the Spotlight

Sept 6 – U.S. House of Representatives congressional hearing

- Draft toxicology profile from June (Agency for Toxic Substances and Disease Registry)
- EPA hopes to release “national management plan” by end of this year

Sept 26 – Senate subcommittee hearing



REGFORM
REGULATORY ENVIRONMENTAL
GROUP FOR MISSOURI

Questions?

Tina Liu, P.E.

tina.liu@ghd.com

314-438-2802

11971 Westline Industrial Drive, Suite 101
St. Louis, Missouri 63146

Kristen Jenkins, P.E.

kristen.jenkins@ghd.com

678-280-2145

3075 Breckinridge Boulevard, Suite 470
Duluth, Georgia 30096





www.ghd.com