2026 Spring Biosolids Symposium

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Biosolids Planning for Potential Impacts of PFAS

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Wisconsin Wastewater Operators Association

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Presentation Outline

- Contaminants of Emerging Concern (CECs)
- PFAS Basics
- PFAS in Biosolids – Trends
- Regulatory Status
- Technology Status
- Planning Implications and Approach

EPA's CEC List (2022)

- Biennial reviews of sewage sludge standards
- Additional potential CECs:
  - Nanomaterials (microplastics)
  - Pharmaceuticals and personal care products
    - Some endocrine disruptors
  - Brominated:
    - Flame retardants (PDBEs)
    - Polybrominated biphenyls (PBBs)
- 1,4-Dioxane
- DNT (Dinitrotoluene)
- TNT (2,4,6-Trinitrotoluene)
- NDMA (N_Nitroso-dimethylamine)
- Perchlorate

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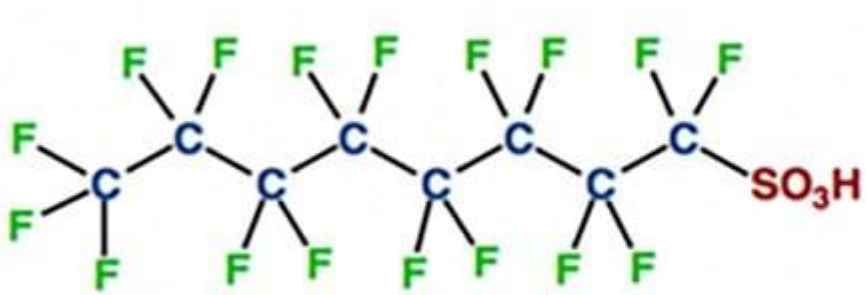
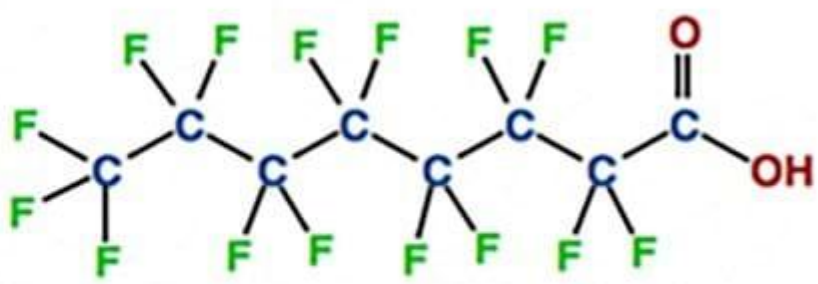
PFAS Basics

PFAS = PFOS + PFOA + Derivatives

- Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are part of a large group of lab-made chemicals known as perfluoroalkyl and polyfluoroalkyl substances (PFAS)



PFOS - perfluorooctanesulfonic acid



PFOA - perfluorooctanoic acid

Source: Markes International

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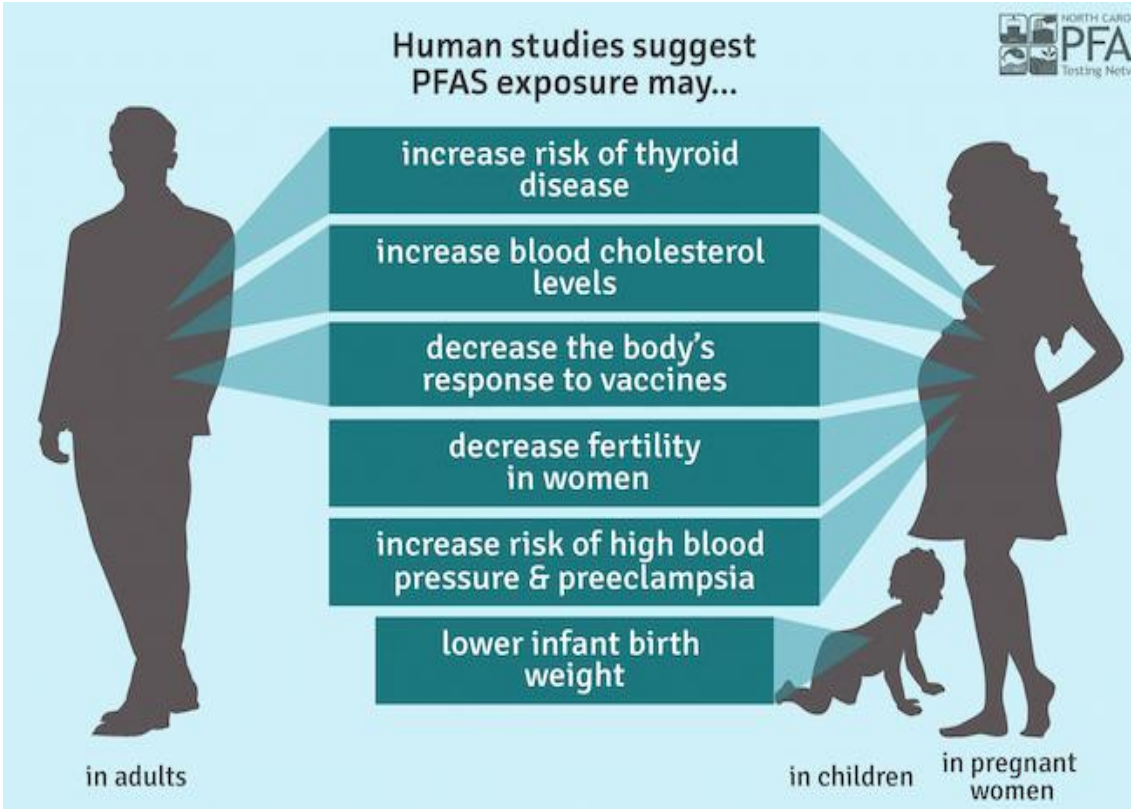
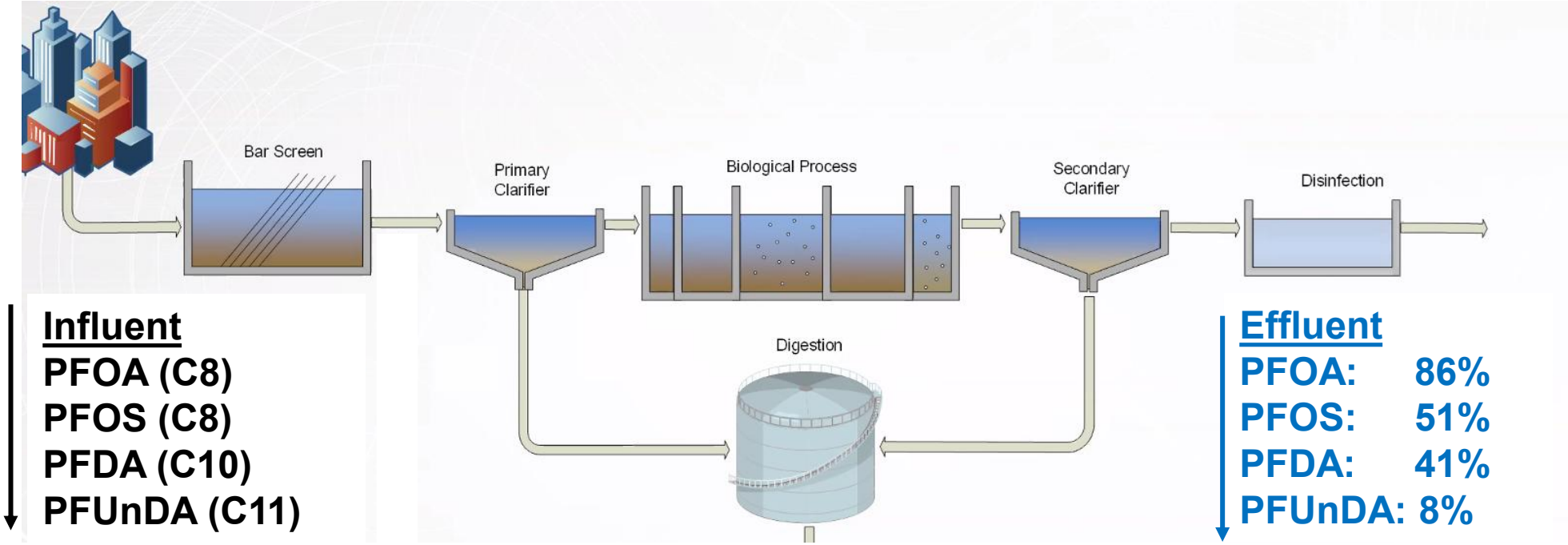
PFAS Are Useful Chemicals Associated With Many Health Concerns

Source: pnellas.gov



Source: techtarget.com

Impact of Molecular Size On Fate of PFAS Through WWTP



Increasing # of Carbon atoms (chain length)

Influent
PFOA (C8)
PFOS (C8)
PFDA (C10)
PFUnDA (C11)

Effluent
PFOA: 86%
PFOS: 51%
PFDA: 41%
PFUnDA: 8%

Solids
PFOA: 11%
PFOS: 48%
PFDA: 59%
PFUnDA: 92%

Source: Adopted from Chemosphere. Avanti, O., et al.

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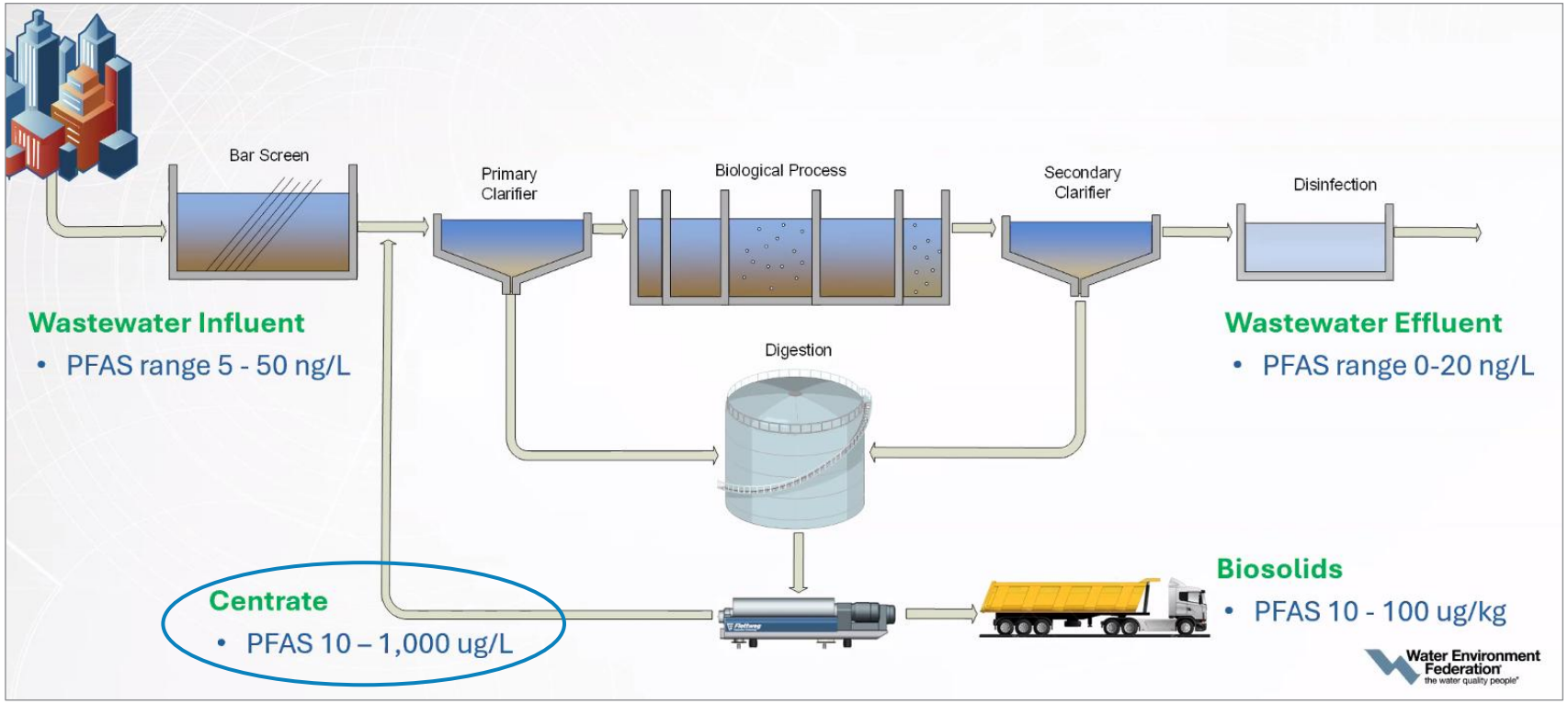
Additional Thoughts on PFAS Fate

- Potential for PFAS treatment?
  - 3 orders of magnitude higher than influent/effluent
  - 1 to 2 orders of magnitude higher than sludge



Source: WEF PFAS Webinar, 5/29/2025 (Pima County Data)

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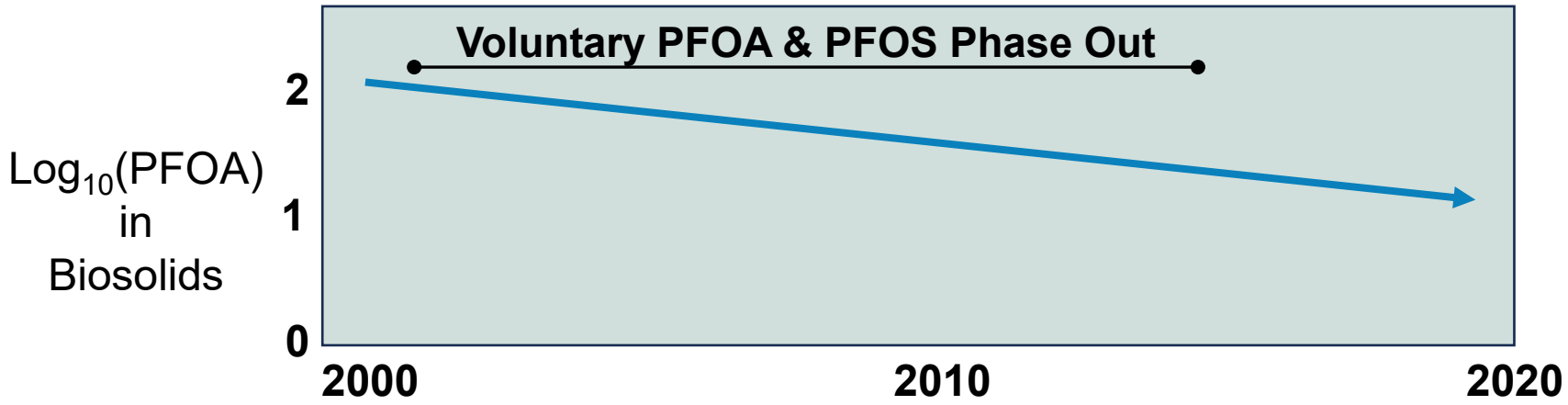
PFAS in Biosolids – Trends

- By 2002, the primary U.S. manufacturer of PFOS voluntarily phased out production of PFOS
- In 2006, 8 major companies in the PFAS industry voluntarily agreed to phase out production of PFOA and PFOA-related chemicals by 2015
- Concern still remains:
  - Limited number of ongoing uses of PFOA-related chemicals
  - Still available in existing stocks and from companies not participating in the PFOA Stewardship Program
  - Exposure could occur via goods imported from countries where PFOS and PFOA are still used



Source: Adopted from ES&T Water; Thompson, K.A., et al.

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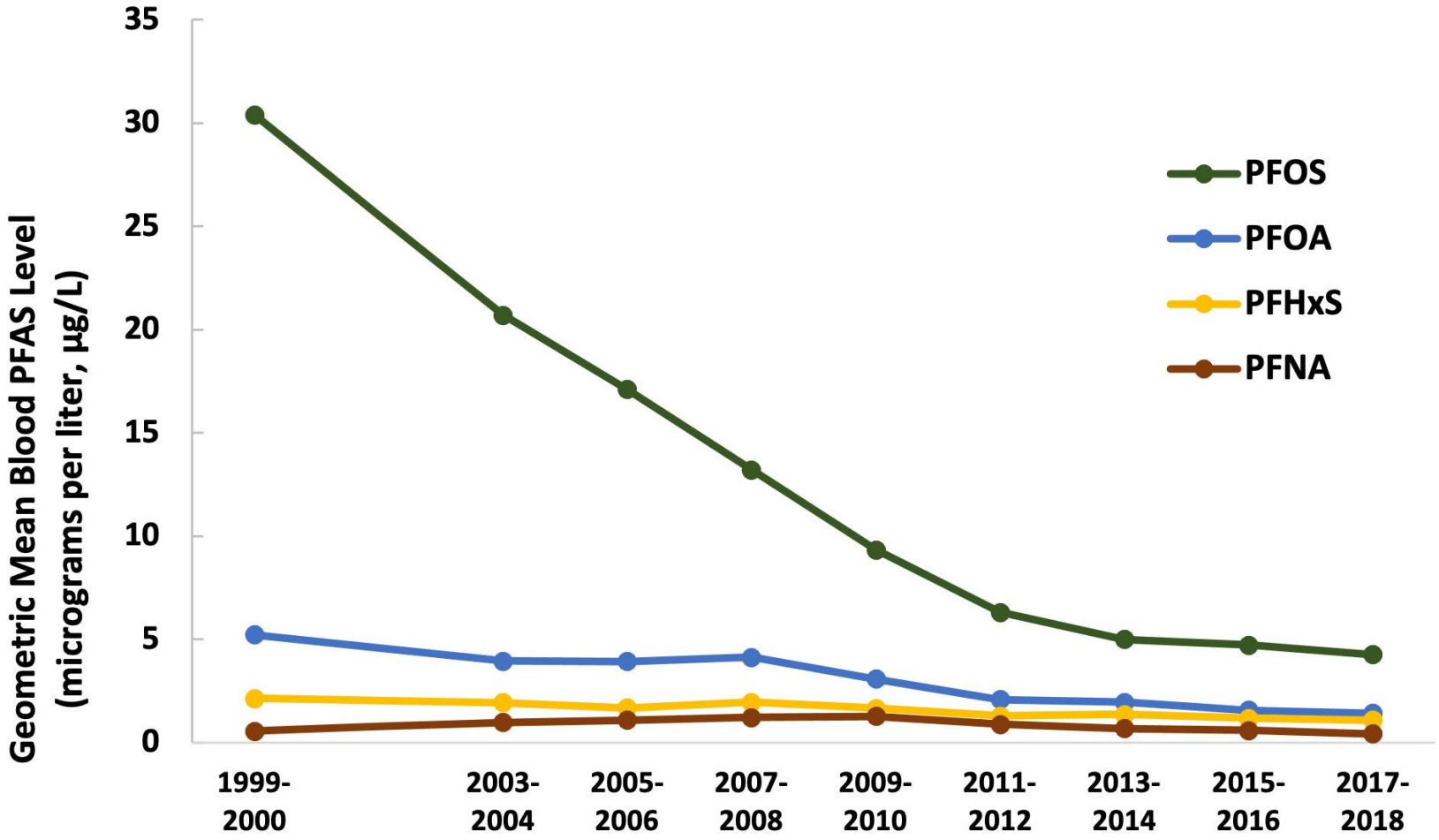
PFAS Trends – Human Exposure



Source: National Health and Nutrition Examination Survey (NHANES)

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PFAS Trends – Source Reduction Effect on Industrial Impacted WWTPs

WWTP Effluent

WWTP	Highest Effluent PFOS (ppt)	Recent Effluent PFOS (ppt)	PFOS Reduction
#50	540	3.6	99%
#14	360	4.7	99%
#57	2,000	7.2	99%
#54	240	6.5	93%
#92	4,800	3.9	99%

Source: Data presented at Texas Water 2025

Biosolids

WWTP	2017 PFOS (ppb)	2023 PFOS (ppb)	PFOS Reduction
#50	983	14	99%
#14	1,060	27	97%
#57	1,680	23	99%
#54	387	63	84%
#92	2,150	17	99%

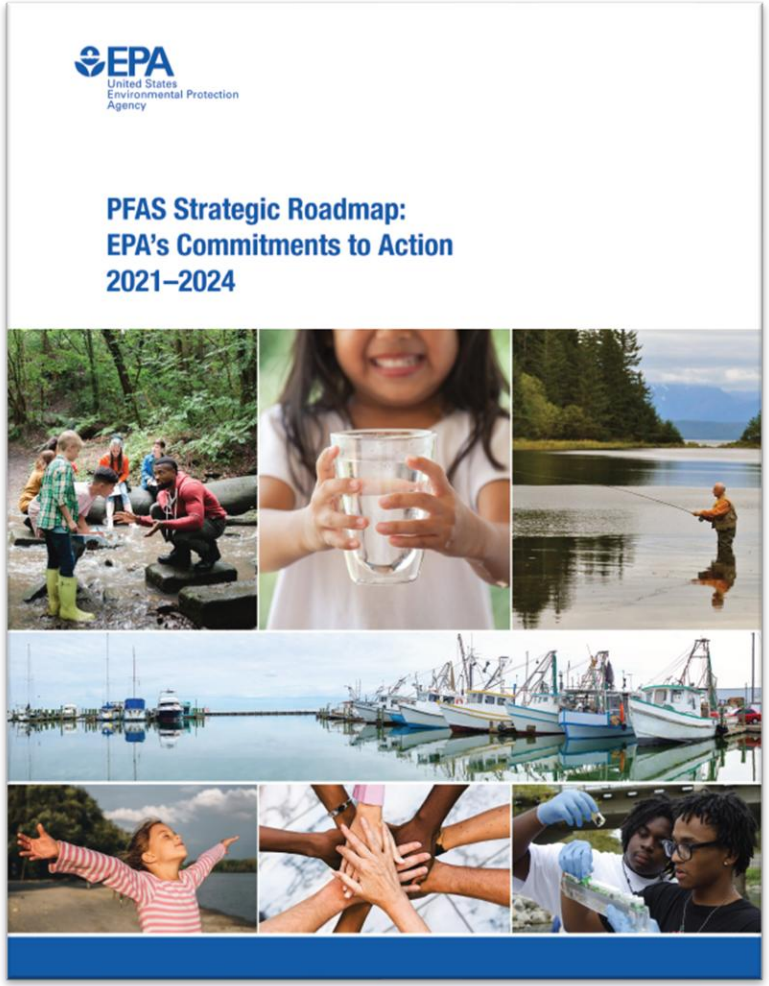
Source: Data presented at Texas Water 2025

Regulatory Status of PFAS

- Federal
- Wisconsin
- Other states

Federal PFAS Rulemaking – Former Administration

- **Released October 18, 2021**
- Sources were the focus
- Built out within existing regulatory framework



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Federal PFAS Regulatory Framework Shift With Federal Administration

Enforcement and Guidance (2024)	Enforcement and Guidance (2025)
• **Max Contaminant Levels** • CERLA – Haz. Substance • Toxicity Release Inventory • **Effluent Limitation Guidelines** • **NPDES** • More	• Executive order to pause new regs • ELG development paused • Reduce # of PFAS on MCL list • Extended drinking water compliance by 2 years

Anticipated Outcome: States lead new regulatory efforts

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EPA Draft Sewage Sludge Risk Assessment for PFOA/PFOS (January 2025)

Application Rates for Exposure Scenarios

Scenario	Concentration of PFOA or PFOS	Application Rate	Number of Applications	Human Exposure Duration
Farm – pasture-raised livestock	1 part per billion (ppb)	10 dry metric tons (DMT) per hectare (ha)	Once annually for 40 years	10 years – cancer 1 year – noncancer
Farm – food crops (fruits and vegetables)	1 ppb	10 DMT/ha	Once annually for 40 years	10 years – cancer 1 year – noncancer
Land reclamation sites	1 ppb	50 DMT/ha	One application only	10 years – cancer 1 year – noncancer
Sewage sludge surface disposal sites (sewage monofills)	1 ppb	Flow rate 4×10^{-6} m^3/sec	Disposal site operating for 50 years	10 years – cancer 1 year – noncancer

Estimated risks scale linearly with the starting concentration of PFOA or PFOS in sewage sludge, assuming all other factors are held constant. As such, sewage sludge containing ten times more PFOA or PFOS (i.e., 10 ppb) would yield risk estimates that are ten times greater than those presented in the draft risk assessment.

Wisconsin PFAS Regulatory Status

- No enforceable state or federal PFAS limits exist yet for biosolids (land-applied sludge)
- DNR offers voluntary PFAS testing of sewage sludge/biosolids at wastewater treatment facilities - but testing is not mandatory
- The DNR has adopted an Interim Strategy for Land Application of Biosolids/Industrial Sludges with advisory thresholds and recommended response actions (not binding limits)
- Under that interim strategy:
  - Suggested action levels begin around 20 µg/kg (ppb) in biosolids
  - The DNR may decline to approve land application when PFOA + PFOS exceed

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Source: Wisconsin DNR, October 2025

Other States' PFAS Regulatory Status – Biosolids

State	PFOA (ppb)	PFOS (ppb)	Notes
Colorado	N/A	50	Implement source control
New York	20	20	If either > 20 ppb; state can disallow land application
Michigan	20		20-100 ppb restricted; >100 ppb cannot be land applied
Wisconsin	20		20-150 ppb restricted; >150 ppb cannot be land applied
Minnesota	20	20	20-125 ppb restricted; >125 ppb cannot be land applied
Vermont	1.6	3.4	Essentially meet background concentrations

Wisconsin – PFOS and PFOA Surface Water Quality Regulations

- PFAS Surface Water Quality Criteria (effective August 1, 2022)
- PFOS = 8 ng/L (= effluent limit; bioaccumulative)
- PFOA = 20 ng/L (public drinking water sources)
  = 95 ng/L (all other waters/incidental ingestion);
  - Stream dilution allowed

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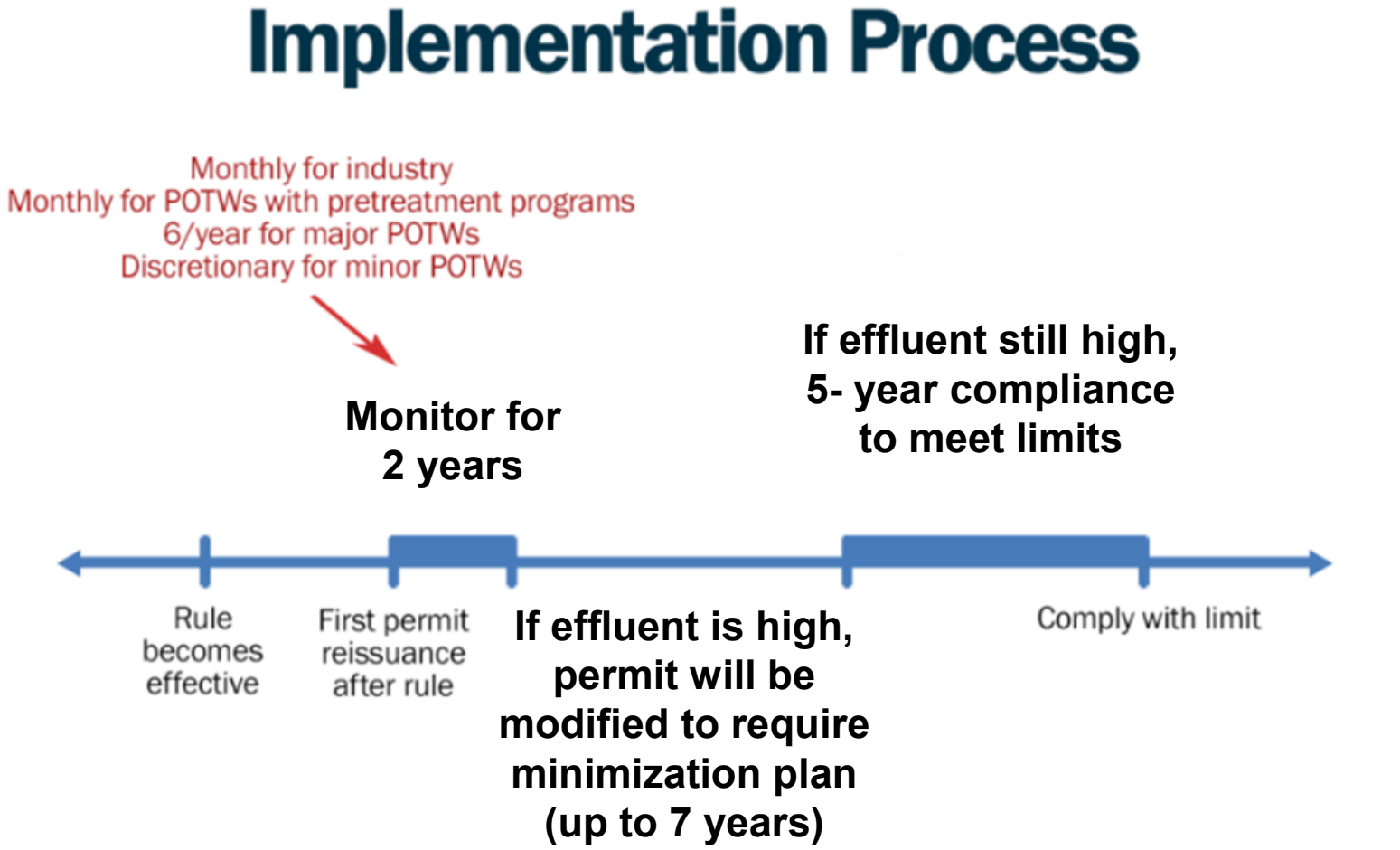
Source: https://dnr.wisconsin.gov/topic/PFAS/WaterQuality.html#rule

Wisconsin's PFAS Surface Water Quality Regulations



Source: https://dnr.wisconsin.gov/topic/PFAS/WaterQuality.html#rule

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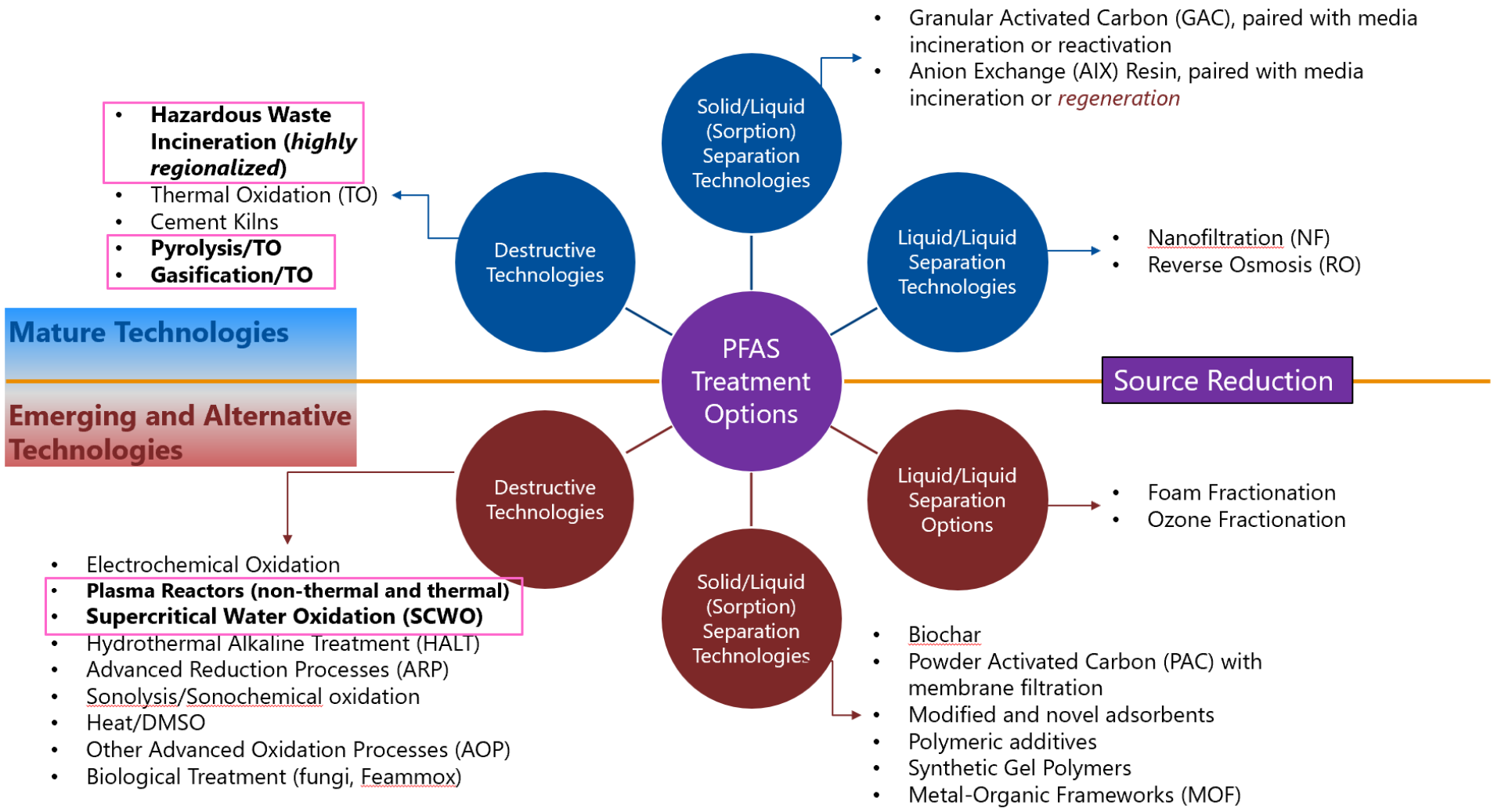
Technology Status



Source: Barr Engineering

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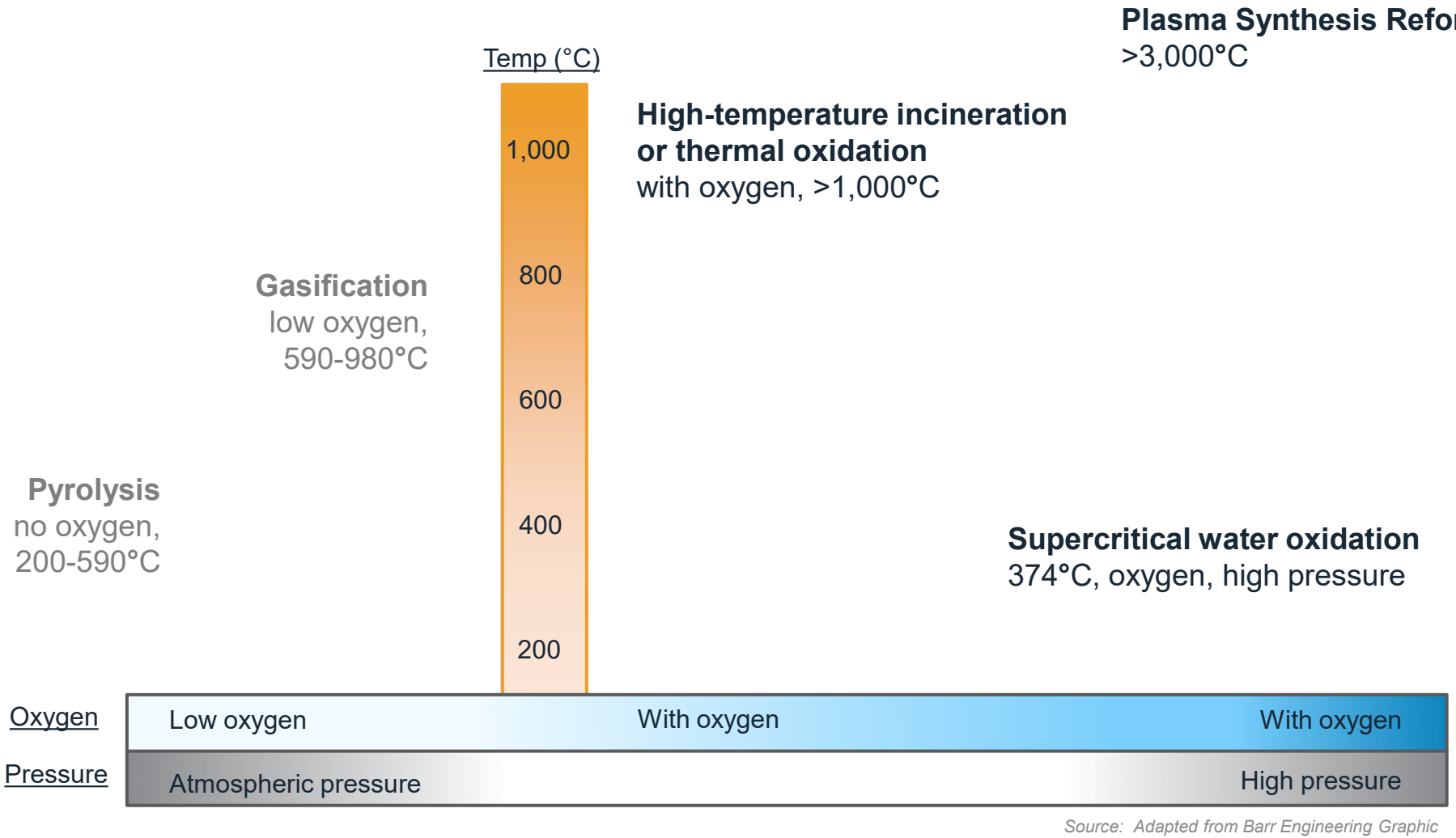
PFAS Destruction Technologies for Biosolids



Source: Adapted from Barr Engineering Graphic

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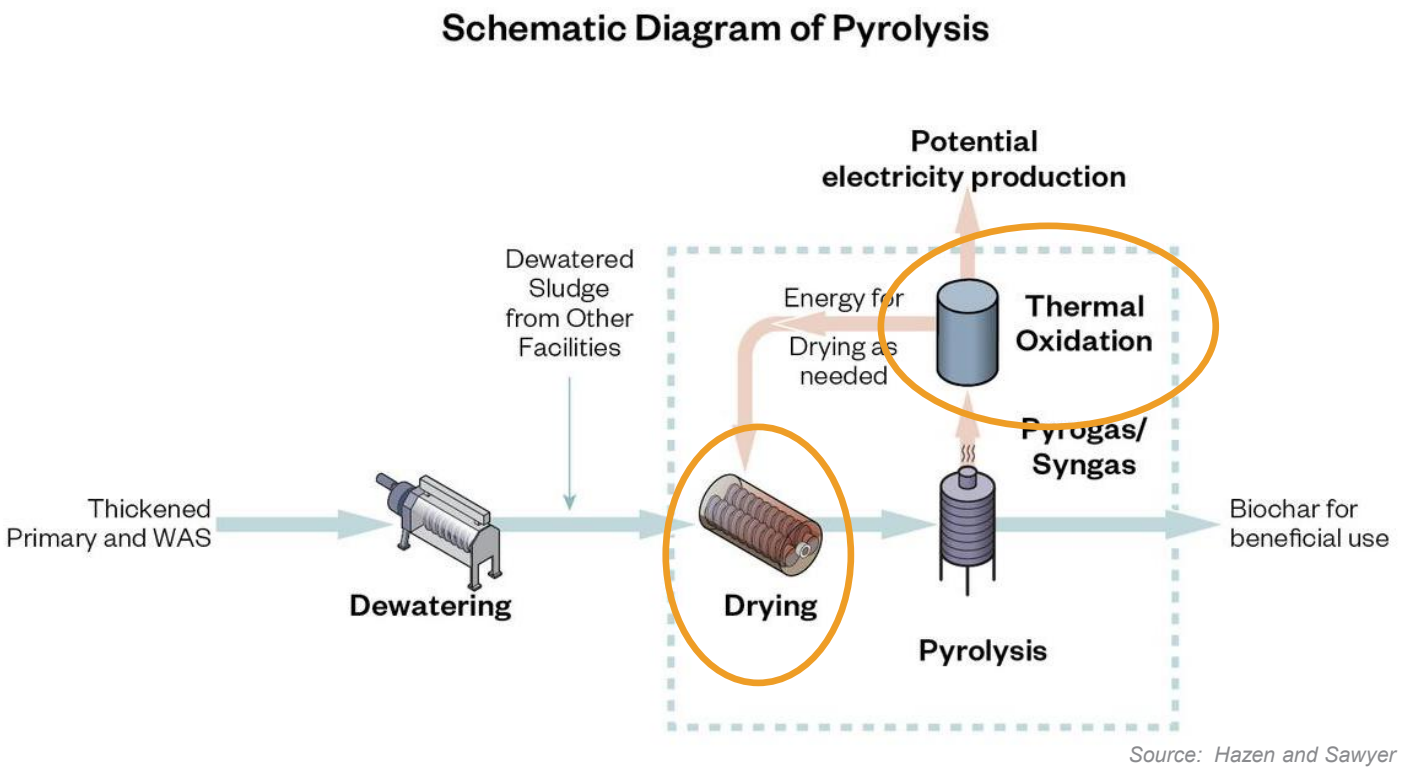
Pyrolysis/Gasification



Source: Hazen and Sawyer

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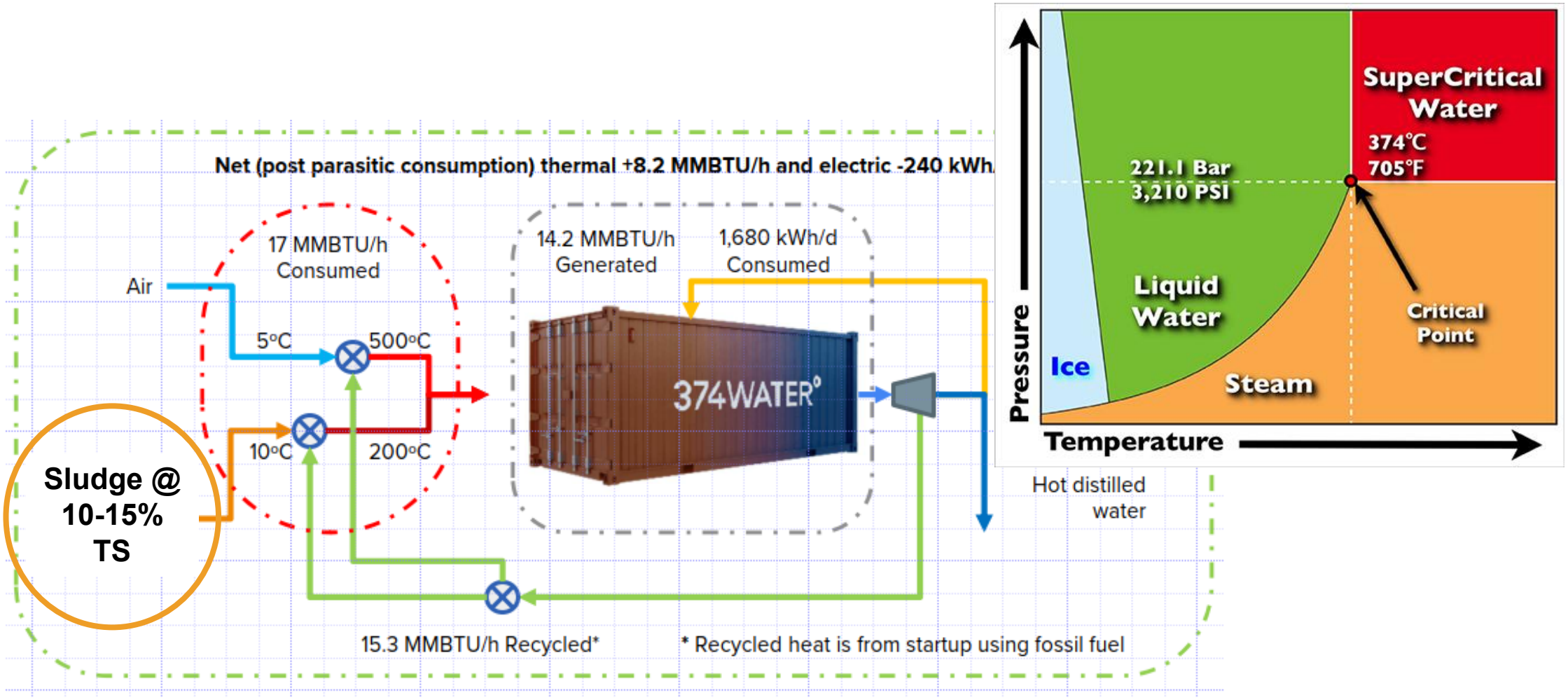
Supercritical Water Oxidation (SCWO)



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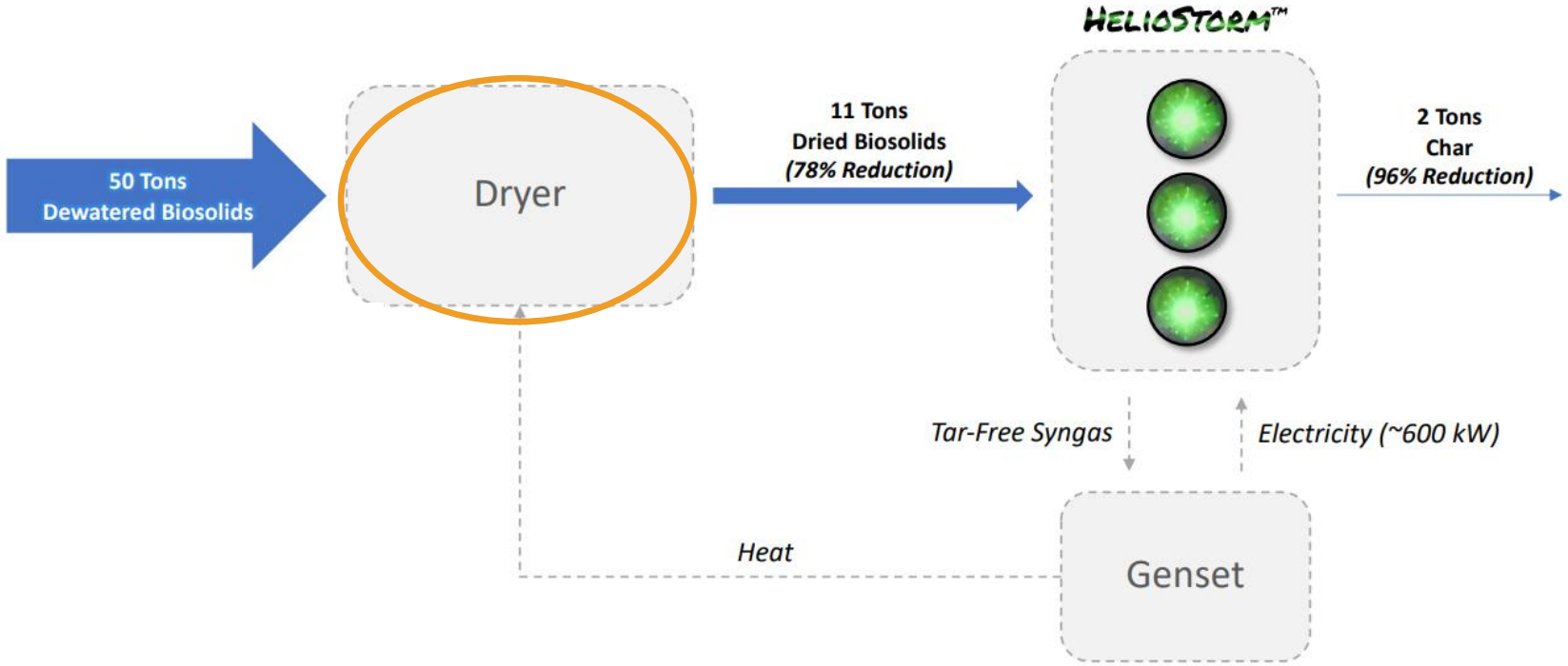
Plasma Synthesis Reactor (PSR)



Source: Hartland Water Systems

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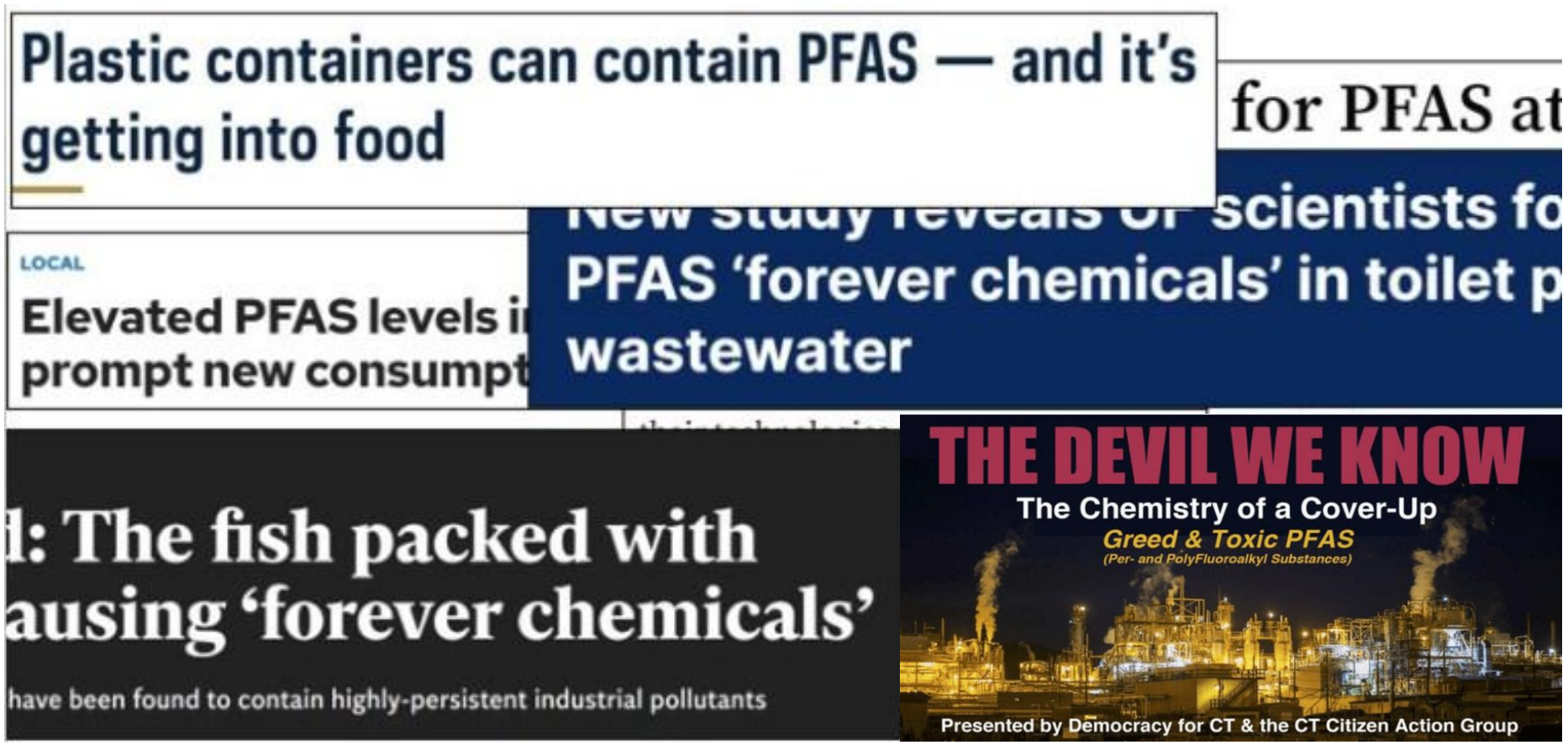
Planning Implications and Approach



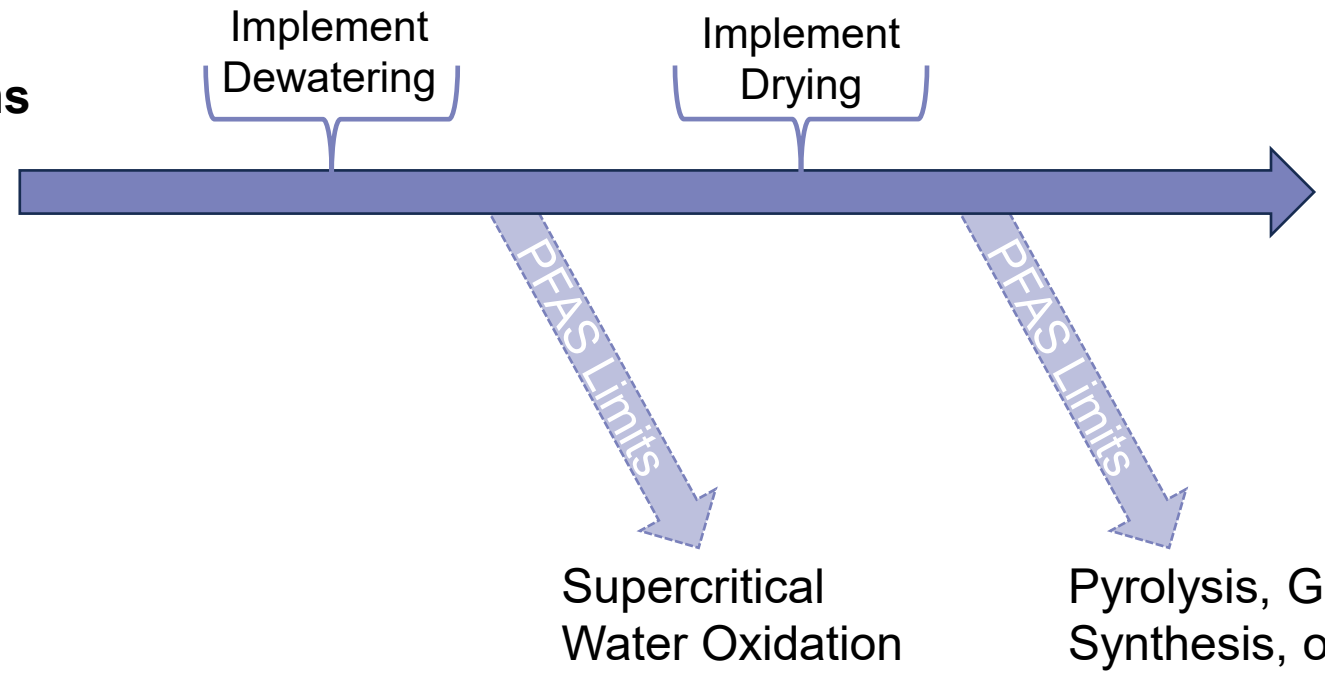
Land Application Limitations Could be a Reality – By Regulation or Perception

- Have a backup plan – e.g., dewatering and landfilling
- Develop a high-level plan for implementing a treatment
- Wait to make major decisions
  - Dewatering
  - Drying
  - PFAS treatment

Planning Implications and Approach

- **Key:** Evaluate “off-ramps” to PFAS treatment and know when to take the off-ramp

Current Conditions
- Digestion
- Thickening
- Liquid Hauling



Example Future Conditions:
- Dried biosolids
- Class A/Class 1 solids

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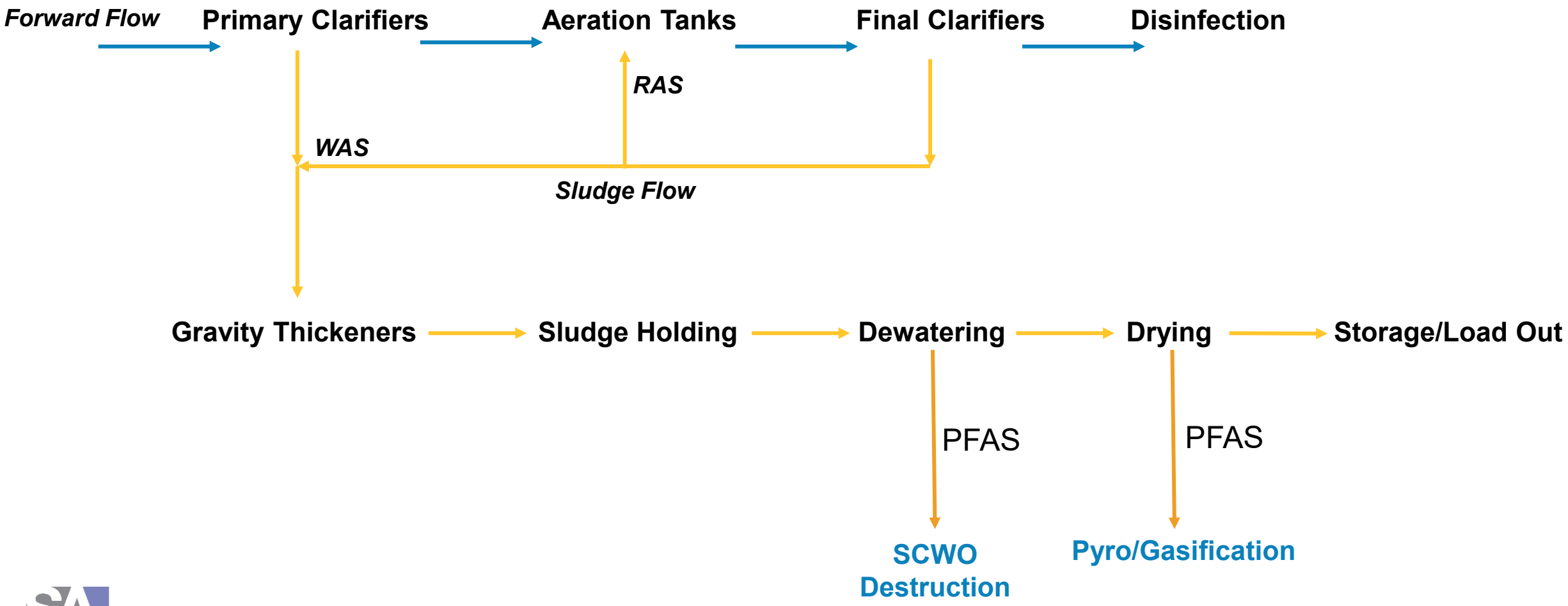
Example: PFAS Treatment at 10 MGD WWTP in Ohio



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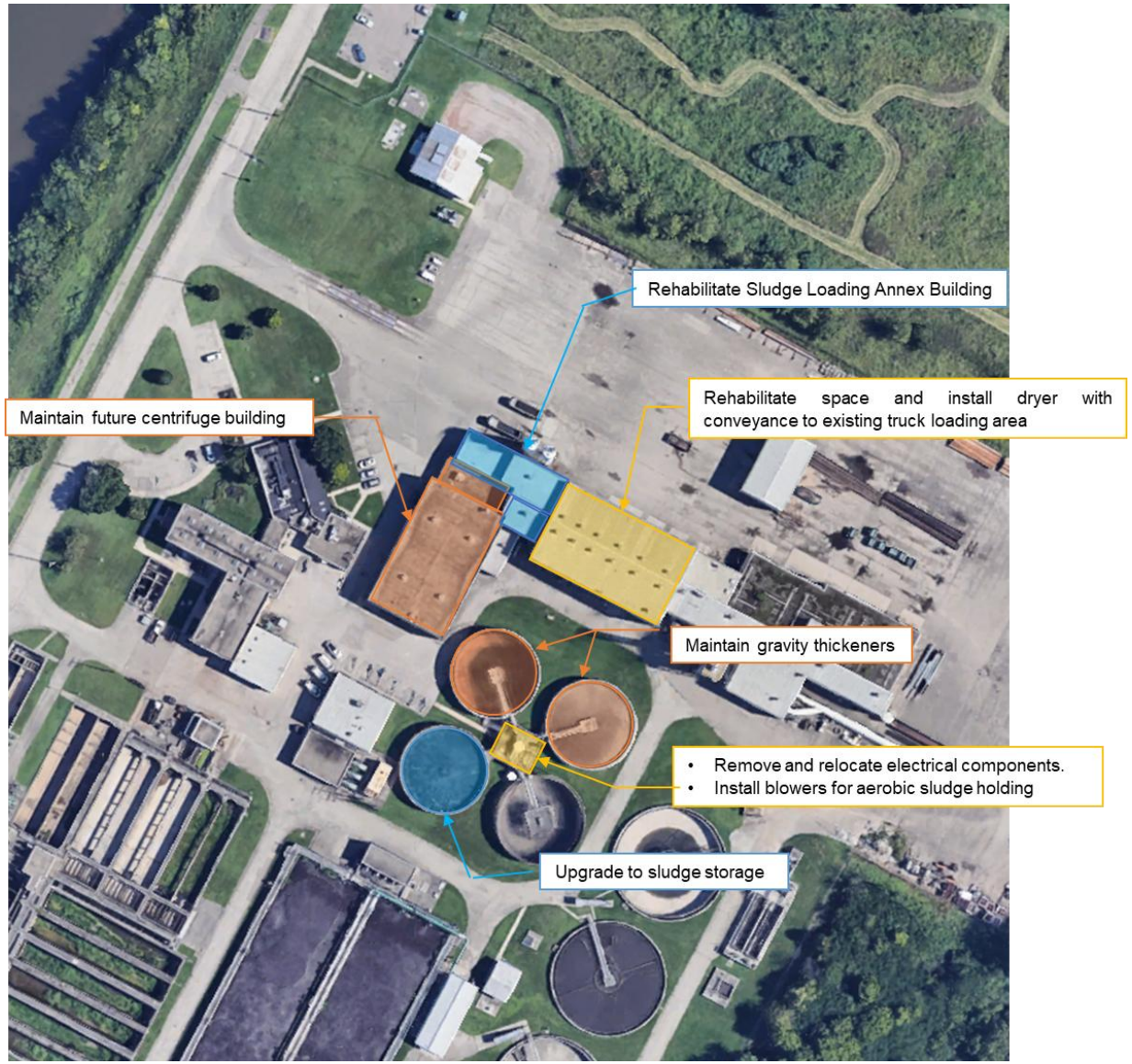
Example (Continued)

- Site planning
  - Review PFAS destruction technology layouts
  - Evaluate space needs
  - Reserve physical space
- High-level cost development
  - Significant unknowns
  - High contingencies
  - $30 to $60 million in this example
- Educate elected officials
  - “What if” budget impacts



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Summary

1. Public perception/acceptance is just as critical as regulatory driver
2. If you are conducting biosolids planning, consider including high-level PFAS impact analyses
3. Educate your elected officials

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Questions?

Source: © marish – vectorstock.com

Thank you for listening!

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