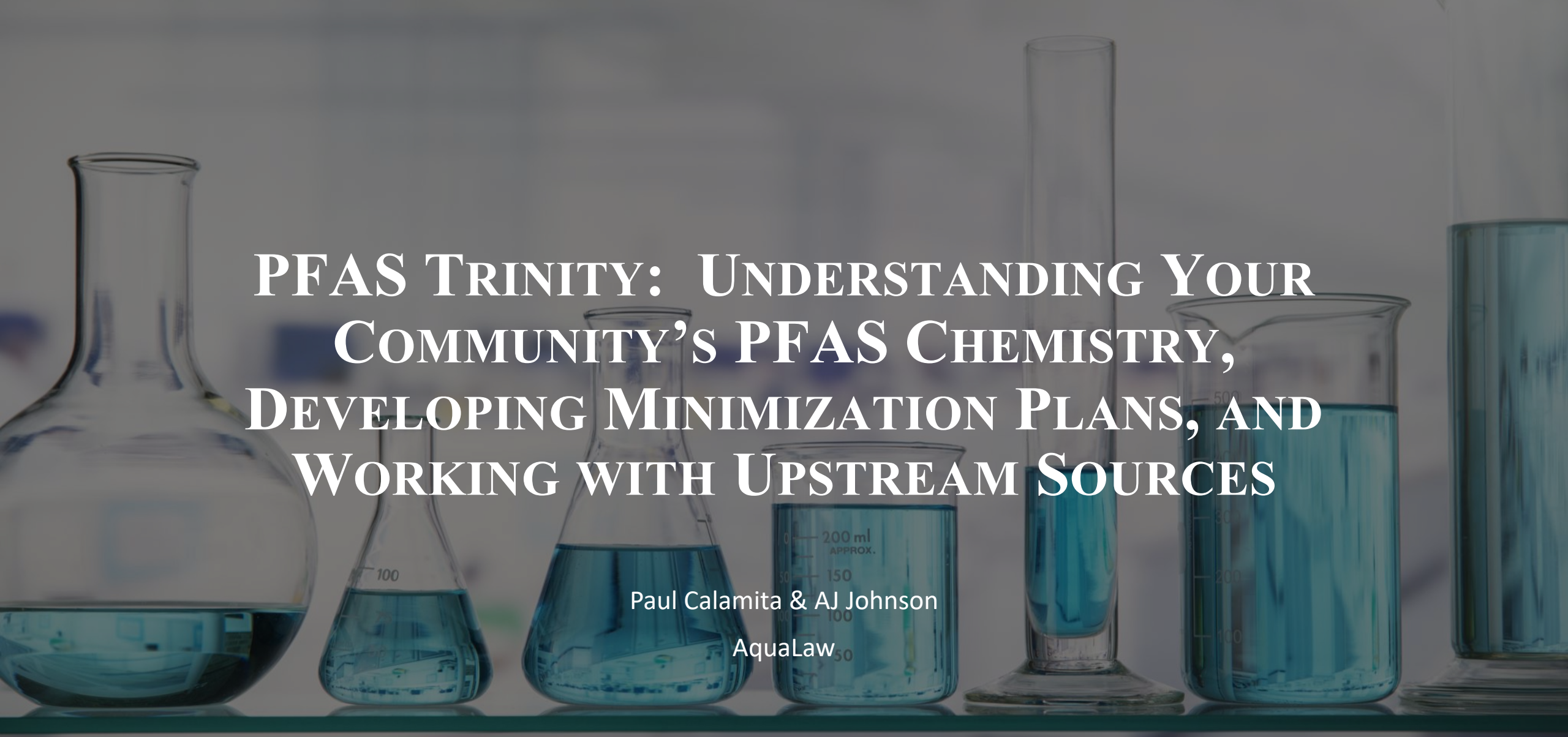

PFAS Trinity: Understanding Your Community's PFAS Chemistry, Developing Minimization Plans, and Working with Upstream Sources

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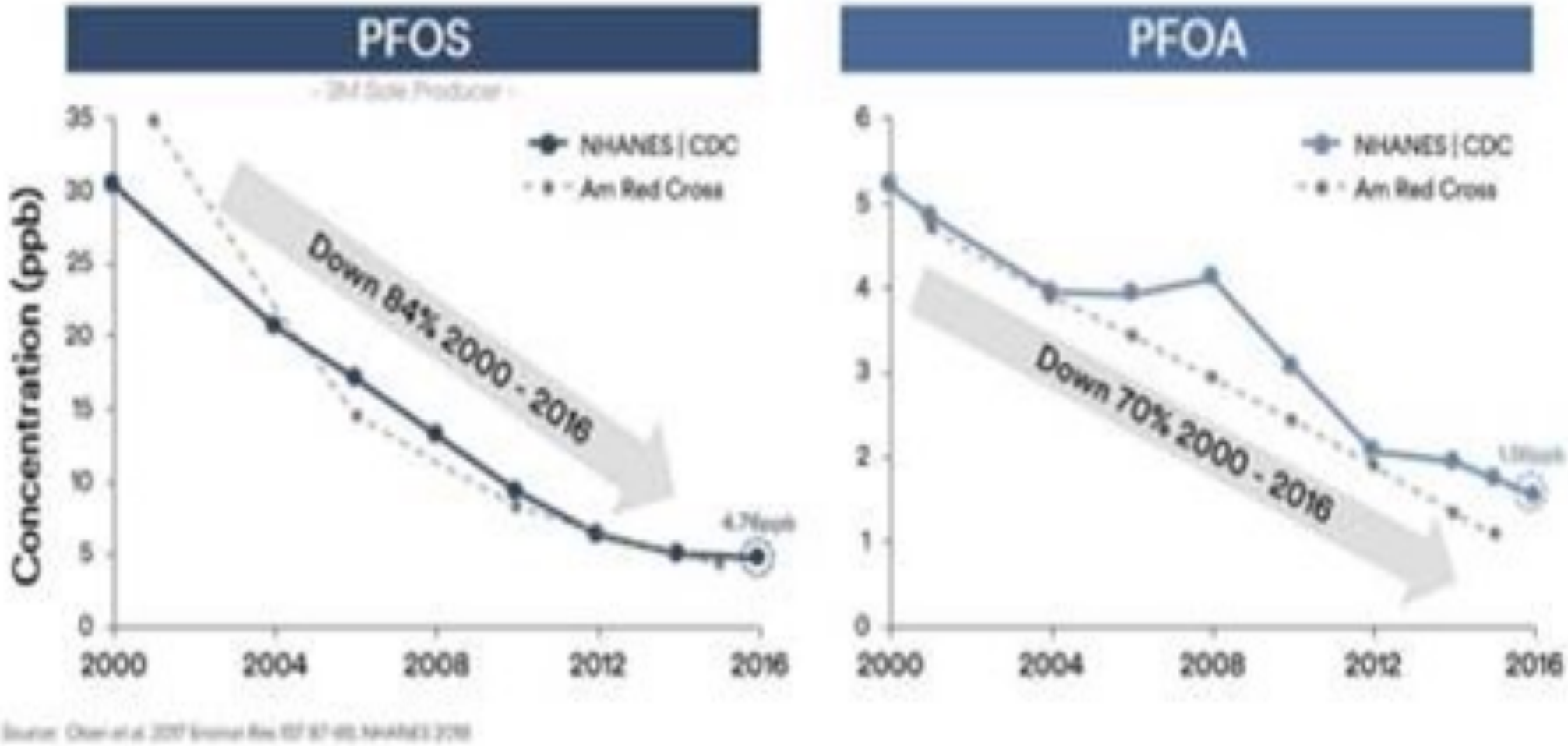
Background on PFAS Issues

- Unprecedented public health and environmental challenge
- Truly ubiquitous
- Affects all of us
  - Our blood levels
  - Should drop even more dramatically going forward
  - Phase out
  - Litigation/regulation/legislation
- NB: some products (military/medical) still require PFAS chemicals

Health and Environmental Science

Trends of PFOS and PFOA Serum Concentrations in US General Population



PFOS and PFOA average blood levels have been declining since 3M exit

PFAS Background

- Legacy contamination will likely make PFAS a continuing challenge for water utilities
- We know very little about PFAS chemicals
- We have actual human long-term studies
  - Health-related clusters?

Enormous uncertainty - levels of concern

EPA	2009	2016	2022	2023
PFOA	400		0.004	4 (proposed)
		70 comb.		
PFOS	200		0.02	4 (proposed)

WHO/Other Health Agencies – Higher Levels

- After EPA's HALs, WHO found:
  - "significant uncertainties and absence of consensus" over critical PFAS health endpoints
  - Set a provisional guideline that limits PFOA and PFOS to a higher value of 100 ppt in drinking water and 500 ppt for all other measurable PFAS.
  - In Australia, the drinking water PFOA guideline is 560 ppt.
- Dramatically different ranges from the leading public health organizations.

PFAS Background

- No approved testing methods
- Draft/unapproved methods can only measure 40-50 out of many thousands of PFAS chemicals
- Lab capacity
- Lab cost

PFAS Background

- Federal regulatory process is cumbersome and glacial even without these PFAS-specific challenges.
- Some states have stepped into the void
- Lacking any regulatory foundation, public utilities have been left to fend for themselves to ensure safe drinking water and to minimize PFAS chemicals in their wastewater systems.

PFAS Background

There will be successor chemicals

- We still want the incredible products and product attributes that PFAS chemicals bring
- EC groundhog day time loop?
- Break loop with EC barrier technology at WTP?

Thoughts About PFAS Sampling

- PFAS sampling still in its infancy.
- No significant field contamination
  - Despite ubiquitousness
  - No field blanks for non-regulatory testing?
- No approved methods
- Draft/Experimental methods have been impressive
  - Consistent and logical results

PFAS Sampling

Holding time is helpful

- 28-days refrigerated
- No rush to labs and for analytical work to begin
- Allows 24-hour or longer composites
- Better information for same price

PFAS Testing

- Targeted Testing
- Non-targeted testing
  - TOP
  - AOF/EOF, etc.

Recommended PFAS Sampling for Public Utilities and Communities

- Defer or characterize PFAS levels?

- AL recommends full characterization and making results publicly available.

- Less PFAS is better
  - For those downstream
  - For your ratepayers
  - For your biosolids

PFAS Sampling for Your Community

- Must characterize to reduce
- Lots of low-hanging PFAS reductions
- Reasonably prudent minimization steps
- You will expect the same from upstream sources

What to Sample

- Water Plant
- Private wells near usual suspect facilities
- Wastewater Plant

Drinking Water Sampling.

- Full characterization
  - Targeted
  - Non-targeted (source water)

- Critical to determine:
  - If you need an EC barrier
  - What type
  - Which ECs need to be controlled
  - Life-cycle costs
  - Control of upstream sources may matter

Well Sampling

Consider private wells near usual suspect PFAS hot spots

- Landfills, military bases, fire training centers, PFAS manufacturing facilities, industries with AFFF fire suppression systems that were tested frequently, etc.

- We think some testing of downgradient wells (at the landfill) or adjacent private wells is a prudent step to ensure we don't have any isolated PFAS hot spots. We know that private well contamination has been found around some of these types of facilities around the country.

- Example: HS dumpster

Wastewater Sampling

- Targeted and non-targeted sampling is essential.
- Multiday composite sample of your influent and effluent as well as a composite of your biosolids (targeted sampling).
- Chemical addition at either water or wastewater plants does not appear to be a PFA source
- Non-domestic user surveys (PFAS, 1,4-dioxane, etc.) (update your IWS)
- For non-industrially impacted POTWs, targeted results likely boring
- For others, maybe one or more SIUs contributing significant loads (including leachate)

Non-Domestic Users

Indirect dischargers have been aggressive and creative generally with voluntary reductions

- Product substitution
- Process changes (recapture/recycle PFAS-laden foam),
- Treat side-stream PFAS laden waste streams,
- Closed loop for certain processes high in PFAS (medical and military applications)
- Landfills have closed older cells (thereby reducing volume and PFAS concentrations in leachate), recycled leachate for irrigation, and are even contemplating underground injection for leachate.

Non-Domestic Users

Some waste streams high in PFAS or PFAS precursor chemicals may require treatment before being discharged to a sewer system or via stormwater outfalls.

SW from airport burn pits or other industrial property contaminated with PFAS

Non-Domestic Minimization

- Minimizing PFAS loadings is good for public water/wastewater utilities
- Also good for wastewater non-domestic users.
  - Good environmental stewards
  - Good community members
  - PFAS minimization plan is good for them
    - Ward off unreasonable or impractical regulatory demands
    - Lead to minimization of loadings and likely avoid further regulatory requirements (and litigation against) non-domestics
  - Living PFAS minimization plan for each non-domestic user with PFAS loadings that matter.
  - Protect downstream users
  - Enhance continued viability of effluent reuse and biosolids reuse programs.

Non-Domestic Minimization

- Similar minimization plans should be developed for hauled waste streams to your facilities that contain meaningful levels of PFAS and/or 1,4-Dioxane.

- Minimization plan approach is a bridge until use phase-out occurs and any environmental contamination attenuates or is remediated.

Non-Domestic User Minimization Plans

PFAS minimization plans should address the following issues:

- **Inventory** of all products used
  - **Certification of PFAS free**
  - **Updates on such certifications?**
- **Note what treatment used at other company-owned facilities?**
  - **National/regional/local**
- **Characterization** monitoring followed by **maintenance** monitoring.
- **PFAS Minimization Steps.**
- **New and Expanding Facilities Warrant Special Consideration.**

Applying PFAS Lessons Learned to Future Emerging Contaminants

- Historical approach to regulating environmental discharges is likely adequate to protect aquatic life but inadequate to protect public health.
- We can test growth, reproduction, and mortality on aquatic species, benthics, macroinvertebrates effectively.
- Human impacts are always more challenging
- PFAS-related litigation should motivate industries to disclose information about harmful effects of future emerging chemicals
- However, regulatory programs will never keep pace

Need to Modify NPDES Permit Applications

- NPDES permit applications only ask about 126 priority pollutants
  - We would not know what to say about EC results….

- POTW pretreatment personnel will have to do more.
- Updated IWS will be critical
- State/EPA permit applications need to ask for EC information
- Balanced with businesses' legitimate desire to protect confidential business information.

Multiple Benefits From the Identification of Your PFAS Chemistry

- Identifying your community's PFAS chemistry has four main benefits.
  - Allows you to minimize those loadings.
  - Gives design engineers critical information to ID cost-effective PFAS barrier technology
  - May allow you to reduce loadings (and your O&M costs) over time
  - May allow cost recovery from the manufacturers behind those sources.

Working With Upstream Sources

- Continuous dischargers
  - Direct dischargers
  - POTWs with indirect dischargers that matter
- Land runoff sources

Final Thoughts

- PFAS technology is expensive - both capital and O&M
  - 3,000-4,000 WTPs in the US may install such technology in 5-10 years.
  - Once that happens, it will effectively (if not politically) become the standard treatment expected at leading public water systems.
- There will always be Ecs
- EC barrier technology will become standard treatment at all major US WTPs
- WTP Water Sources
  - Previously, treatability, taste, odor, etc.
  - For now, PFAS levels may rise to top
- Regionalization warrants serious consideration given PFAS barrier technology costs (especially O&M)