POETs for PFAS: Lessons Learned and Emerging Concerns from Monitoring >10,000 Private Drinking Water Wells

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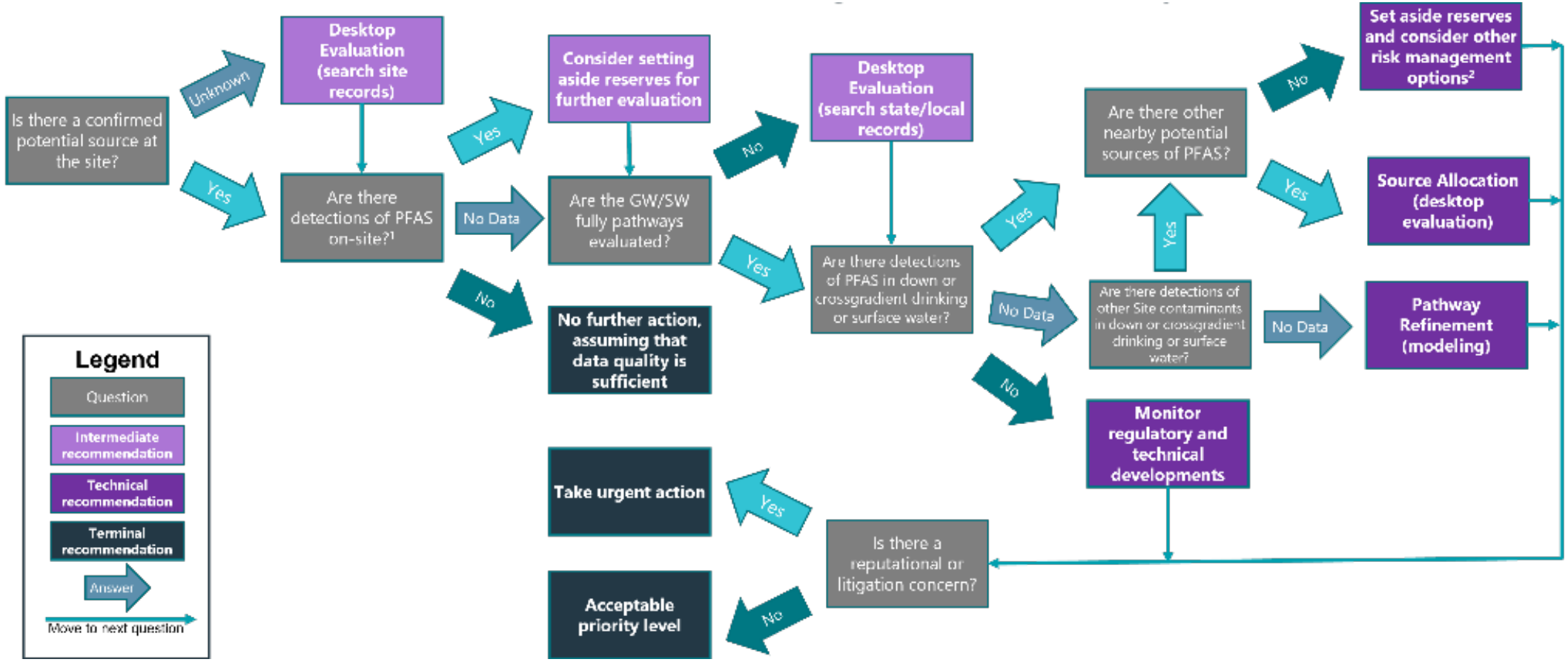
Outline

- Focus, Limitations & Scenarios
- Background & Initial Response Actions
- Pre-design Monitoring & System Design
- O&M, Performance Monitoring & Transit
- Summary – Lessons Learned
- Q&A

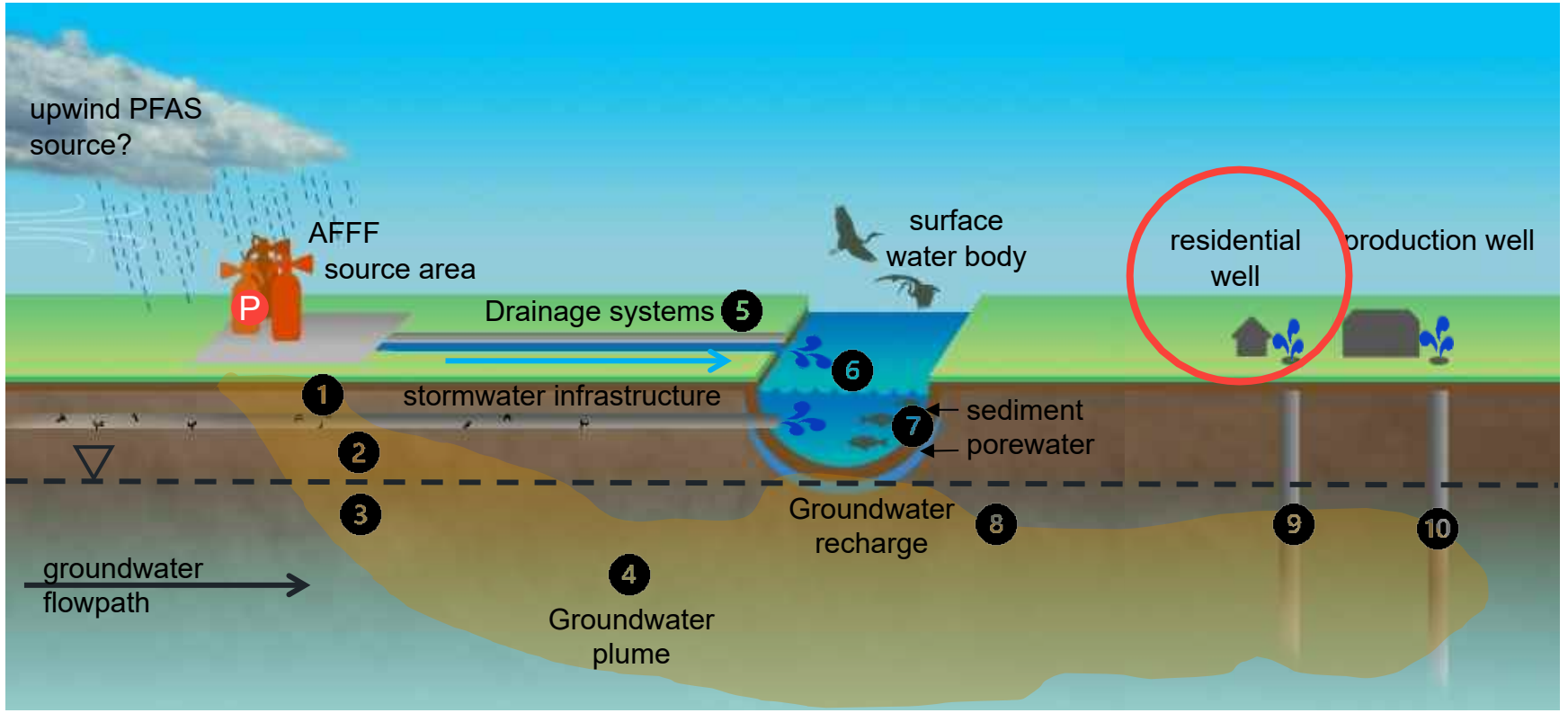
Focus and Limitations

- **Focus**
  - Portfolio PFAS POET Management
  - Proactive vs. Reactive Mgmt. & Consequences
  - Practical Considerations
  - Will not be a Big Data Dump
  - Identify Difficult Decision Pts. & Implications
  - Cover initial threat to successful POET mgmt.
- **Limitations**
  - Confidential Clients
  - Previous/Ongoing Litigation
  - Trigger new Litigation?
  - Geographic Considerations

Applicable Scenarios – Prioritizing Sites w/ Decision Trees

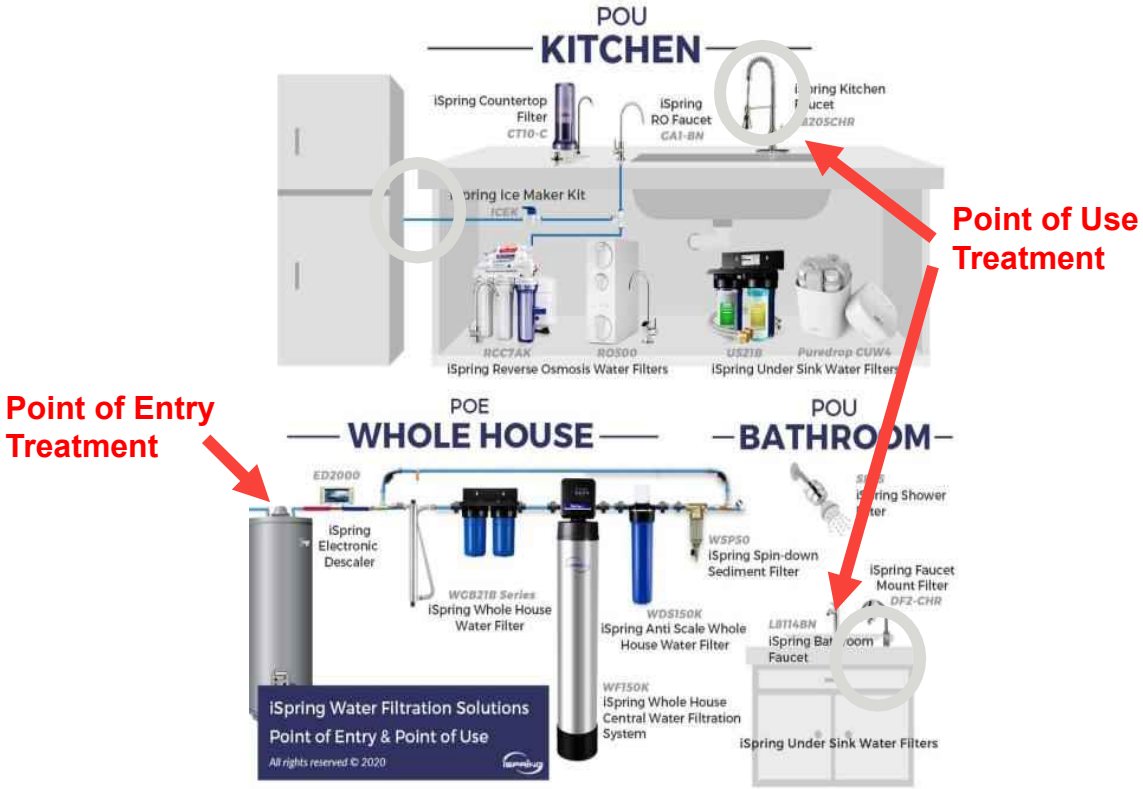


Applicable PFAS Treatment Scenarios



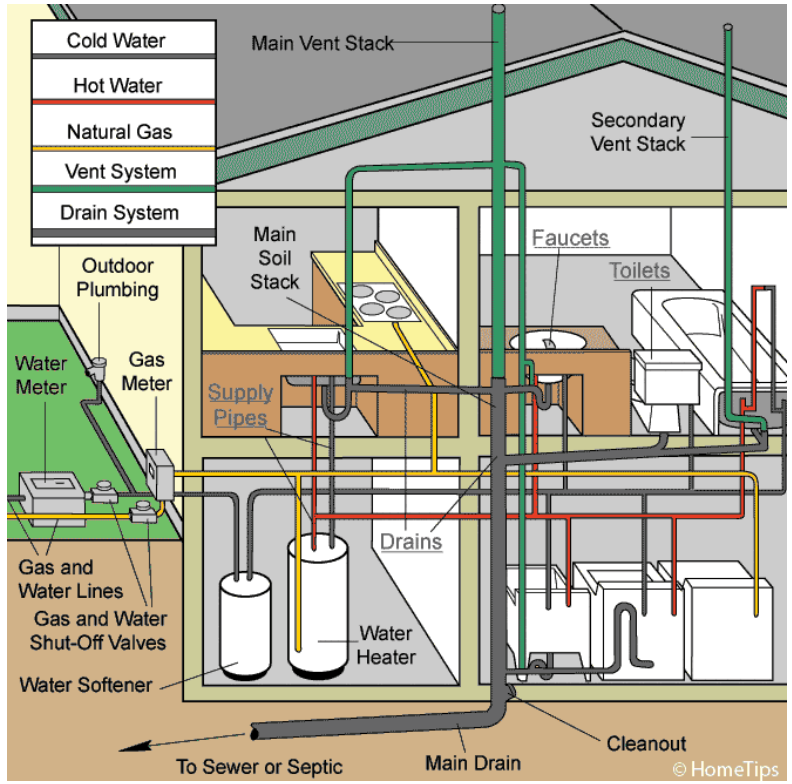
1. Surface soil
2. Subsurface soil
3. Source area groundwater (GW)
4. Dissolved GW plume
5. Surface water drainage systems
6. Surface water (SW)
7. Sediment
8.
9. Residential well
10. Production well
- P PFAS products (e.g., AFFF)

Background – POET vs. POUT



Point of Use Treatment

Point of Entry Treatment



Water Line vs. Well Supply Graphic

- Dramatic **increase** in **Fluoro-surfactant use** – components contributing PFAS?
- PFAS can potentially **stick/adsorb** to many system components
- Component contribution or sticking means **PFAS still present** after

Initial Response Actions – Threat of Impact to Drinking Water

Even before Sampling:

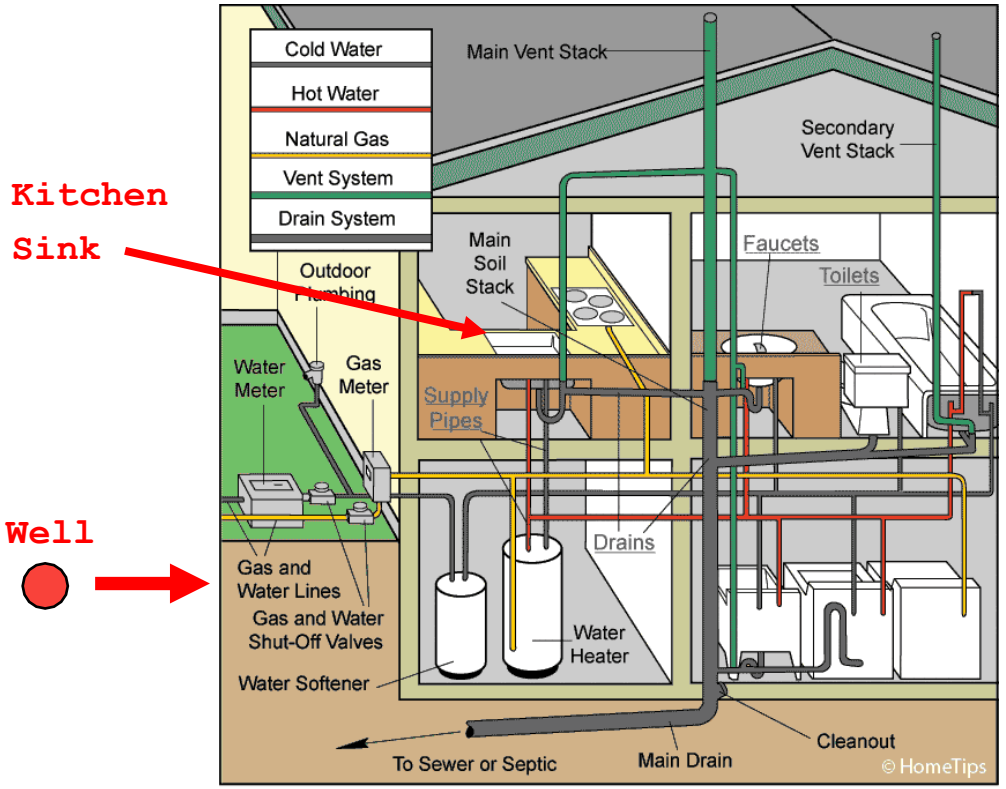
- **Notify Legal and Public Relations**
- Follow Portfolio Level Decision Tree or develop one and **initiate offsite source survey**
- Conduct offsite drinking water well survey using all available resources, including door to door if warranted.
- Prepare to offer **Bottled Water at first contact!**
- Contact potentially Affected Parties (APs)
- Get legal permission to access property to sample.

Sampling & Analysis

- Identify any/all regulatory requirements
- Consider anticipated **future requirements**
- Include all Method analytes
- Consider any forensic analysis driven by Offsite Sources
- Samples should be collected directly from the well, consider sampling at the hot and cold-water taps (*e.g.*, kitchen sink)

Sampling Scenarios and Sequencing

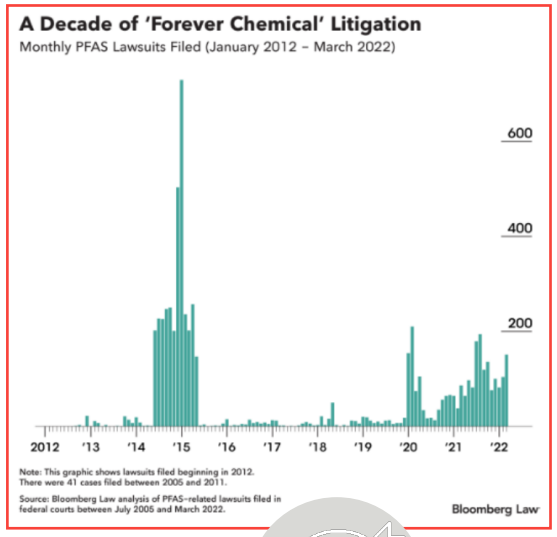
1. No PFAS detected in well, **no need to sample kitchen sink**
   - If required to sample kitchen sink and PFAS detected then component leaching is the suspected source
2. Concentrations **similar** in well and at kitchen sink
   - No sticking or component contribution
3. Concentrations in Kitchen sink **higher**, an indication of:
   - component leaching if before POET
   - installation
   - Sticking, component leaching or both after POET installation



Water Line vs. Well Supply Graphic

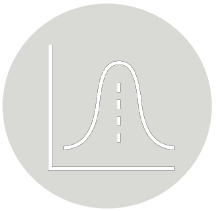
System Design – Triggers and Goals

- If state/local PFAS DW criteria exist **any exceedances should trigger treatment**
- No criteria – what concentration should trigger treatment?
- Should you **anticipate changes** in criteria and/or more PFAS analytes?
- Is a Below Detection Limit (**BDL**) goal **feasible** for all PFAS?
- What if you identified another nearby Source? Implications?
- But the need for Treatment could also be triggered by:
  - At-risk wells nearby
  - **Litigation avoidance**
  - Any detection of a regulated or unregulated PFAS
  - Concerns about seasonal data variability (*e.g.*, Treatment triggered at ½ of applicable criteria)
  - No State Criteria – default to Final Lifetime Health



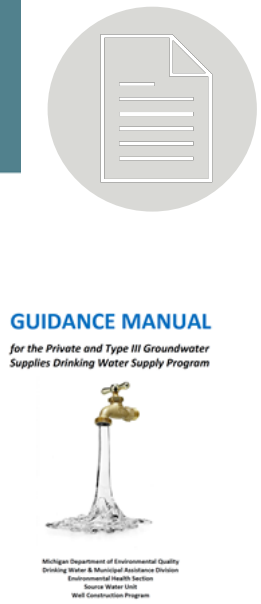
System Design – Pre-design Monitoring

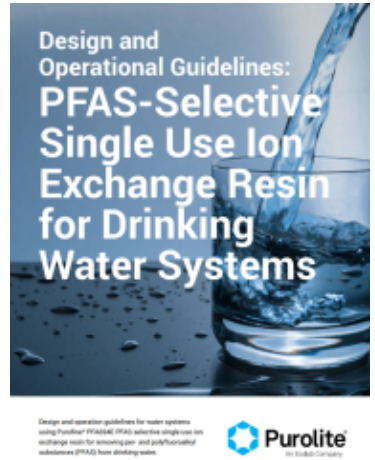
- All exceedances should be **confirmed** via resampling/analysis
- Disparities in the data should be **fully evaluated** with Lab
- **Resampling** provides opportunity for additional analysis in support of design:
  - For common treatment complications (*e.g.*, iron, TOC, manganese, etc.)
  - Additional analyses in all wells may be too costly and is likely unnecessary in all samples – by hydrogeologic zone
  - Select pre-design monitoring **parameters consistent with** target or preferred **treatment** option (*e.g.*, GAC vs. IX vs. RO)
  - Consider potential for co-contaminants that have not been analyzed (could cause premature break-through)



System Design – Guidance Manuals and Design Guides

- Great resources to consider – should **not** result in a **"cookie cutter"** design approach (Site-specific design considerations).
- State-specific requirements may exist through state **environmental or health agencies.**
- US **EPA Guidance** on PFAS Best Available Treatment (BAT) technologies.



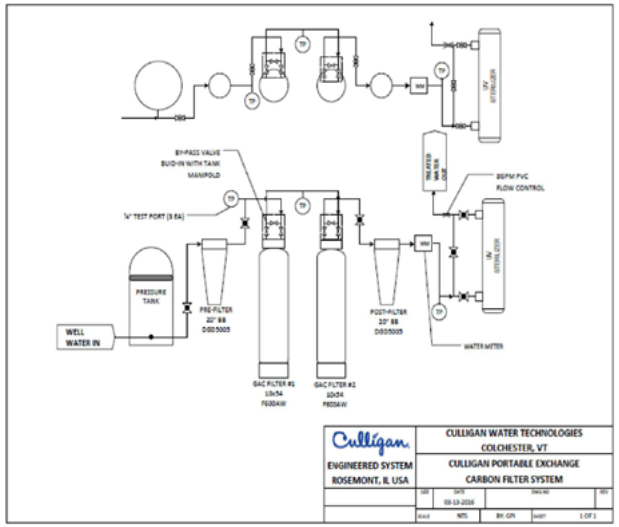


System Design – Point of Entry Treatment Systems (POETs)

- Key Design Considerations:
  - **Flow** rate
  - Influent **concentration**
  - Treatment **Goals** and Objectives
  - POET only vs. POET + POUT
  - Backwashing (*e.g.*, GAC) or reject requirements (*e.g.*, RO)
  - Available water pressure (*e.g.*, residential RO pressure limited)
- Influent, between, and effluent sample ports, **treatment confirmed at effluent**
- Key Considerations for Placement
  - **Direct from well** (best practice) vs. following existing equipment
  - Location/Space Availability and limitation

System Design – Point of Use Treatment Systems (POUTs)

- **Risks should drive placement** – Kitchen sink only, Bathrooms, Laundry Room, Livestock watering areas
- A **POUT** may be needed to remove adsorbed/residual PFAS in home **for an extended period**!
- Case Study
  - Residential well with **>1,000 PPT** PFOS, connected to wateline
  - PFOS still present at kitchen sink:
    - Hot-water tap – **~17% residual** remained
    - Cold-water tap – **~3% residual** remained
- **Higher** influent concentrations scenarios could require **additional measures** including:
  - Flushing the system
  - Replacing components (e.*g.*, glass-lined hot water tank)



System Design – Best Available Treatment Technologies

- GAC
  - Pros – Most available, longest/**most experience**
  - Cons – Lower capacity to remove short chain PFAS
- Single use IX
  - Pros – **> Adsorption Capacity & short chain removal**, smaller bed volume
  - Cons – still struggles w/ short chains, Sensitive to geochemistry, impart taste
- RO
  - Pros – Highest removal capacity
  - Cons – High reject rate, **limited disposal options**, highest O&M
- Site-specific conditions could warrant **any of these or combinations**
- Challenges and **anticipated changes** with PFAS disposal and destruction may influence media selection

Operations and Maintenance

- Commonly encountered problems include:
  - Sedimentation
  - Biofouling
  - Home RO system reliability
  - Biotransformation

- **Monitoring** costs can potentially **exceed disposal** costs
- Use of **NSF certified systems** could result in annual media replacement with limited to no performance monitoring
- **Tiered management** may be warranted (*i.e.*, more frequent monitoring and media replacement on higher concentration systems)
- All **costs** expected **to rise** in response to expected/pending federal regulations

Performance Monitoring – Response to Exceedances

- Effluent exceedance scenarios:
  - Erroneous laboratory data and mislabeling samples
  - Solids clogging
  - Biological transformation
  - Channeling thru media
  - Exhausted media
- **Respond conservatively**/document responses to every exceedance and all data irregularities
- **Effluent sample** at start-up or **changeout** most valuable but costly!
- New and **higher cost analytical methods** will increase performance monitoring costs
- Use of certified systems, sliding scale monitoring frequency, and annual media changeouts likely the **most cost effective**

Transition

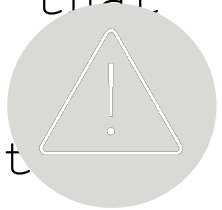
- After POET or water line installation
  - **Resample** at hot/cold water taps to assess PFAS sticking/desorption - still above treatment triggers?
    - Install POUT if concentrations exceed treatment triggers and suspend hot water use for ingestion pathway
    - Monitor POUT influent to determine when no longer required

- After water line installation
  - **Sample influent** to house for PFAS to detect or confirm PFAS in Municipal water
  - Abandon the supply well in accordance with local/state requirements

- At POET End of use - **remove system** if concentrations decline below treatment triggers
  - Don't let Affected Parties keep treatment systems

Summary – Lessons Learned

- Evaluate Site portfolios and sensitive receptors, **update CSM**
- Use consistent **Decision Tree** and be **proactive** on sites that pose threat to drinking water
- Conduct concurrent **offsite source evaluation** concurrent
- **Develop triggers and goals** and apply them consistently
- **Sample in sequence** that can identify sticking or component leaching and respond accordingly with treatment
- NSF Certified or equivalent systems provide benefits and should be considered but components **can still contribute PFAS**
- Emerging concerns about sticking and component contribution should be evaluated on **future and existing systems**, may require POUT for extended period – POET + POUT provides > protection



Thank You

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