Discovering and Treating PFAS while Decommissioning a Power Plant

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Agenda

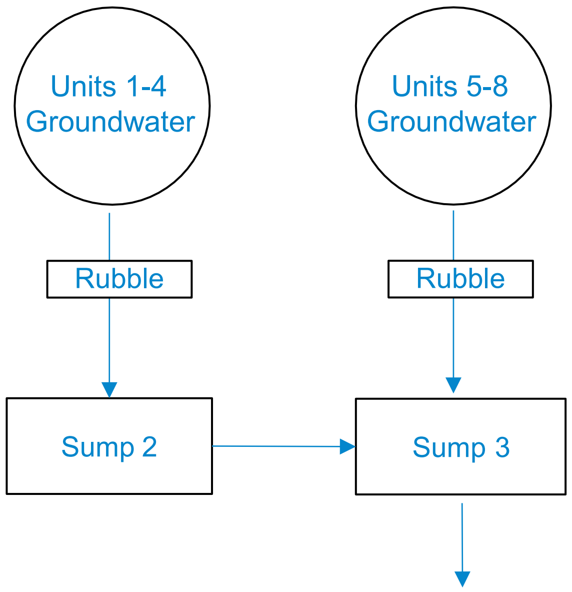
- Background
- PFAS Treatment System Design
- Operational Challenges During Decommissioning
- Treatment Summary and Estimated Costs
- Summary of Wisdom Gained

Background

- Power plant in process of being decommissioned
- Basement elevation 10-12’ lower than nearby major water body
- Water needed to be removed from basement during decommissioning
- Discovered PFAS in basement water while sampling
- Source of PFAS unknown, but water needed to be removed during decommissioning (anticipated 2-3 months), and needed to be treated
- Fast turn, because decommissioning was occurring

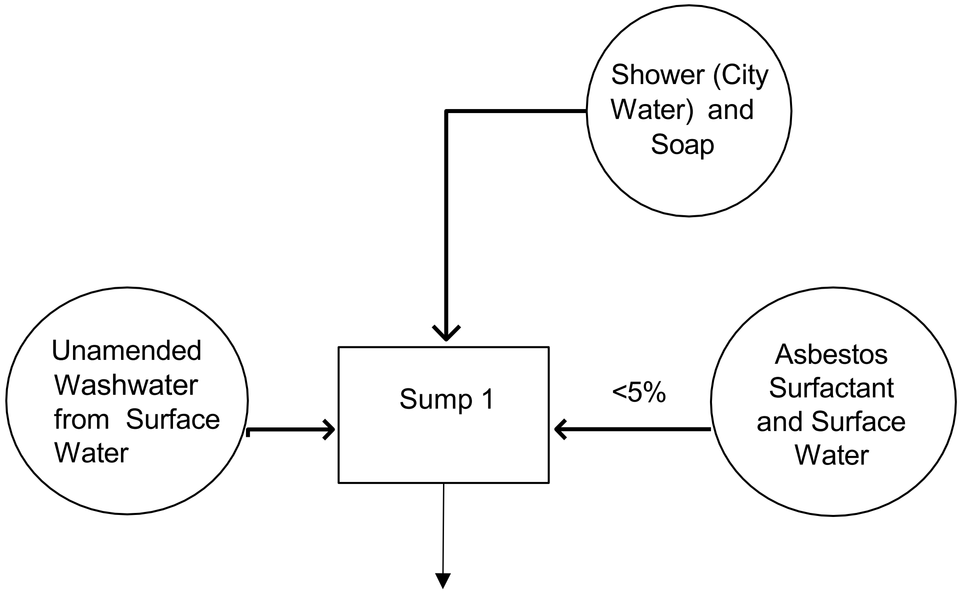
Water Balance

Power Plant Sump Water



- Batch process (not continuous)
- 40,000 gpd average, range of 15k to 150k gpd
- 300,000 gallons per foot of basement
- PFAS – four analytes detected, PFOS exceeded water quality values (14 ppt vs 11 ppt)
- pH: 9.6

Decommissioning Process Water



- Batch process
- 5,500 – 11,000 gpd
- PFAS: four analytes detected, no exceedances
- pH: <9

Treatment Objectives

- Needed to be operating quickly
- Adaptive for a range of flows and constituents
    - Batch process
- Meet all regulatory criteria
    - PFOS: 11 ppt
    - PFOA: 420 ppt
    - $6.5 < pH < 9$
- Flexible for decommissioning changes

Concurrent Options Evaluation and PFAS Bench Tests

- Barr evaluated multiple options for PFAS:
  - Ion exchange
  - Foam fractionation
  - Reverse osmosis
  - Carbon
- Since carbon was most likely given the timeframe, contacted a vendor to conduct bench study while we evaluated further
- Geochemical modeling for pH: bench testing of aeration
- Carbon treatment bench study errors

PFAS Treatment Design Considerations

Treatment Criteria

- Understanding water quality is critical
- Long chain (PFOA and PFOS) vs short chain

Empty bed contact time

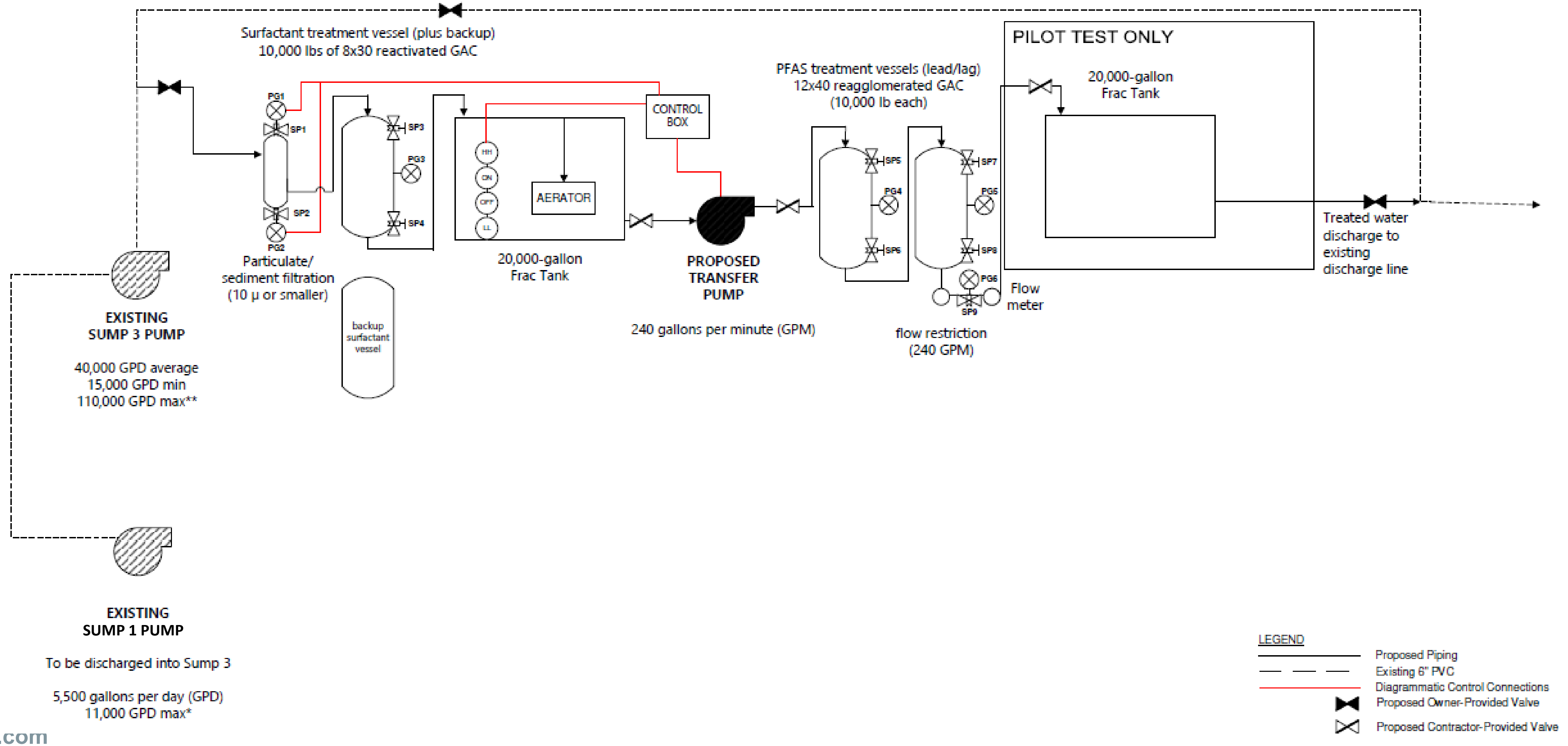
- Used to size vessels and estimate carbon usage
- Desire to use existing pumps

Types of carbon

- Reagglomerated vs reactivated
- Cost

Backup carbon vessels on site

Full Scale Pilot Design



Changing Conditions During Decommissioning – Particulates

Challenge:

- Very high TSS – 30% of basement backfilled
- Included concrete dust
- Bag filters changeouts very frequent

Solution

- Moved frac tanks to beginning of treatment train to act as settling tank
- Added second bag filter – 25 um and 10 um

Changing Conditions During Decommissioning – pH

Challenge:

- Basement backfilling included concrete and concrete dust
- pH above 12 within a month
- Treatment no longer possible with aeration
- Acid addition not possible due to regulatory requirements

Solution:

- Evaluate other options

Changing Conditions During Decommissioning – pH

- Passive (peat moss)
  - Use in either in line treatment or placed into basement water
  - Bench tests showed pH reduction achievable
  - 20 cy peat could treat 140,000 gallons of water
  - 75 tons of peat placed in basement would reduce pH by 1 standard unit
- Active (carbon dioxide)
  - Tested in full scale system and it worked well
  - Switched to fine bubble diffusers

Changing Conditions During Decommissioning – Extended Duration

Challenge:

- Initial timeframe planned for 2-3 months in summer
- Decommissioning delays
- Extended into winter

Solution:

- Winterize system
- Construct structure

Other Challenges

Asbestos abatement

- Breach of containment
- Asbestos water flowed into Sump 1 and pumped into treatment system
- Asbestos testing and carbon replacement
- Frac tank cleaning

End of project frac tank cleaning

- Scaling from caustic environment and particulates
- 10,000 psi power washer
- Mobile treatment system

Treatment System Summary

- ~26,000,000 gallons treated
- pH successfully reduced without acid addition
- Used 50,920 pounds of carbon that was incinerated
    - Two changeouts of sacrificial vessel, one changeout of lead vessel
- Approximate cost for 16 months of operation including winterization: $2,200,000 ($0.08/gallon)
- No exceedances of water quality effluent criteria

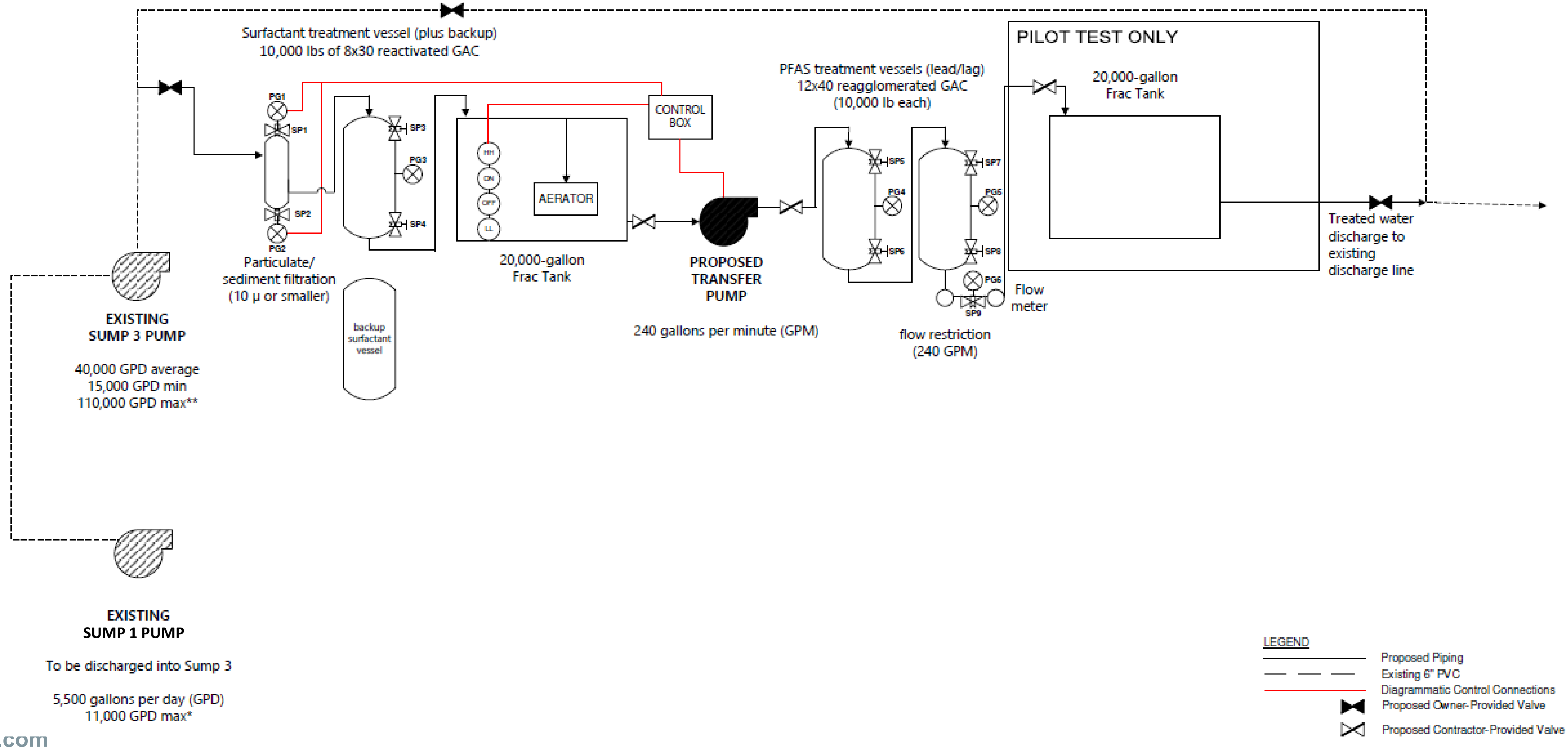
Influent Sampling Results Over Time

		Location	SP-1	SP-1	SP-1	SP-1	SP-1	SP-1	SP-1	SP-1	SP-1	SP-1	SP-1
		Date	April	June	August	September	October	January	February	April	June	July	August
Parameter	Units	Criteria											
PFOS	ng/l	11	**14**	7	**17**	10	**12**	**12**	10	6	7	7	8
PFOA	ng/l	420	19	17	58	37	42	43	24	17	23	16	25
pH	S.U.	6.5 to 9	**9.6**	**11.8**	**12.3**	**12.0**	**11.8**	**10.5**	**12.2**	**11.7**	**10.8**	**11.5**	**8.6**

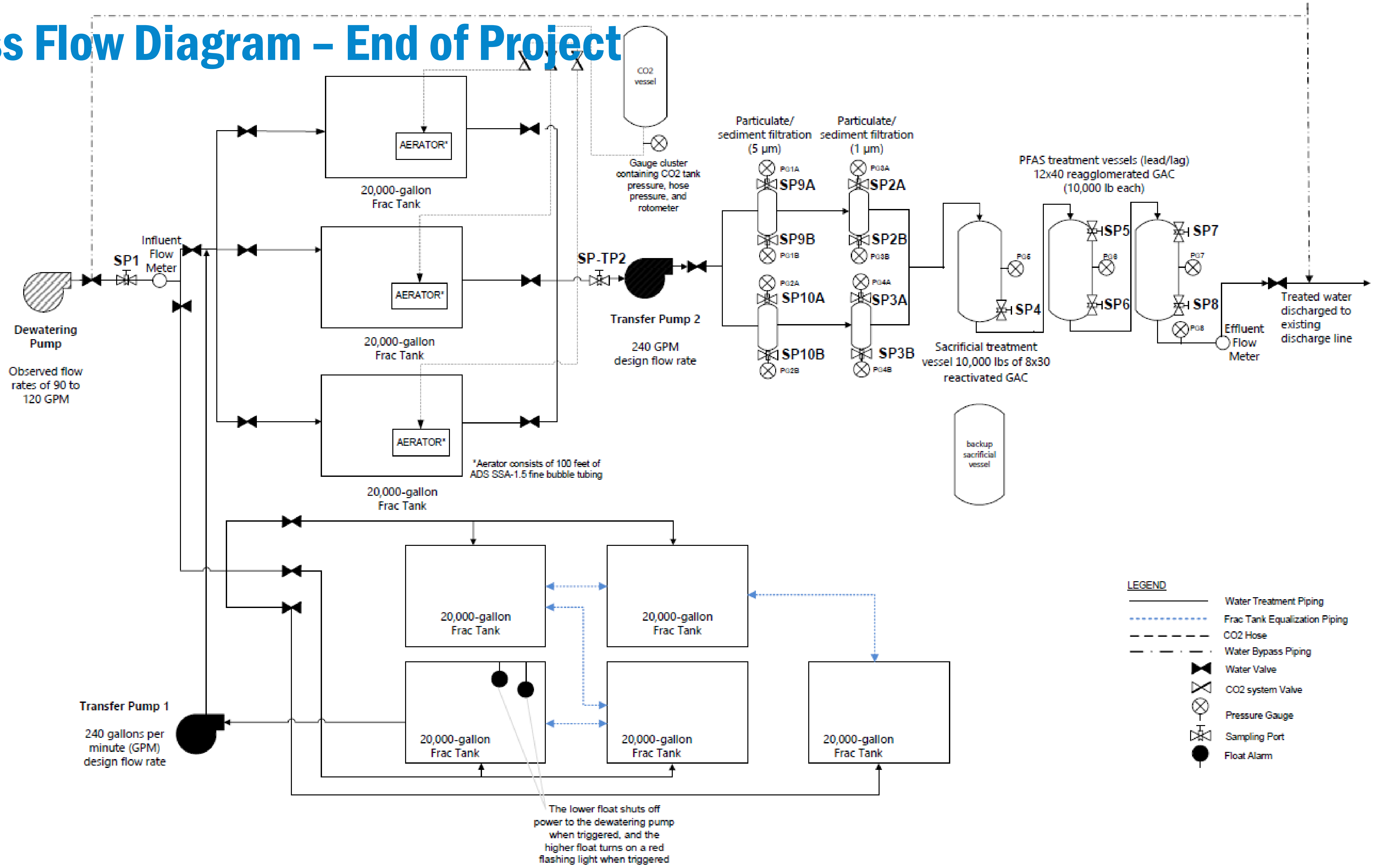
Wisdom Gained

- PFAS cross contamination can easily happen – our PFAS bench test was with reputable vendor and still had quality issues. Be meticulous.
- Assess all current and future incoming wastewater streams to the extent feasible, but be ready to change on the fly
- Sacrificial carbon vessel worked – removed TSS and hardness (and asbestos!) while protecting more expensive carbon for PFAS treatment
- If building dewatering must occur during decommissioning, consider alternative options to backfilling basement with construction debris until dewatering is not needed
- Be prepared to pivot – we had 10+ process flow diagrams from the numerous iterations due to changed conditions throughout construction

Full Scale Pilot Design - Comparison



Process Flow Diagram – End of Project



Thank you

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