

Meeting PFAS Compliance with Existing Infrastructure: Pilot Testing Conversion of Anthracite Gravity Filters to GAC

Mark Titcomb, PE

Hunter Martin, PE

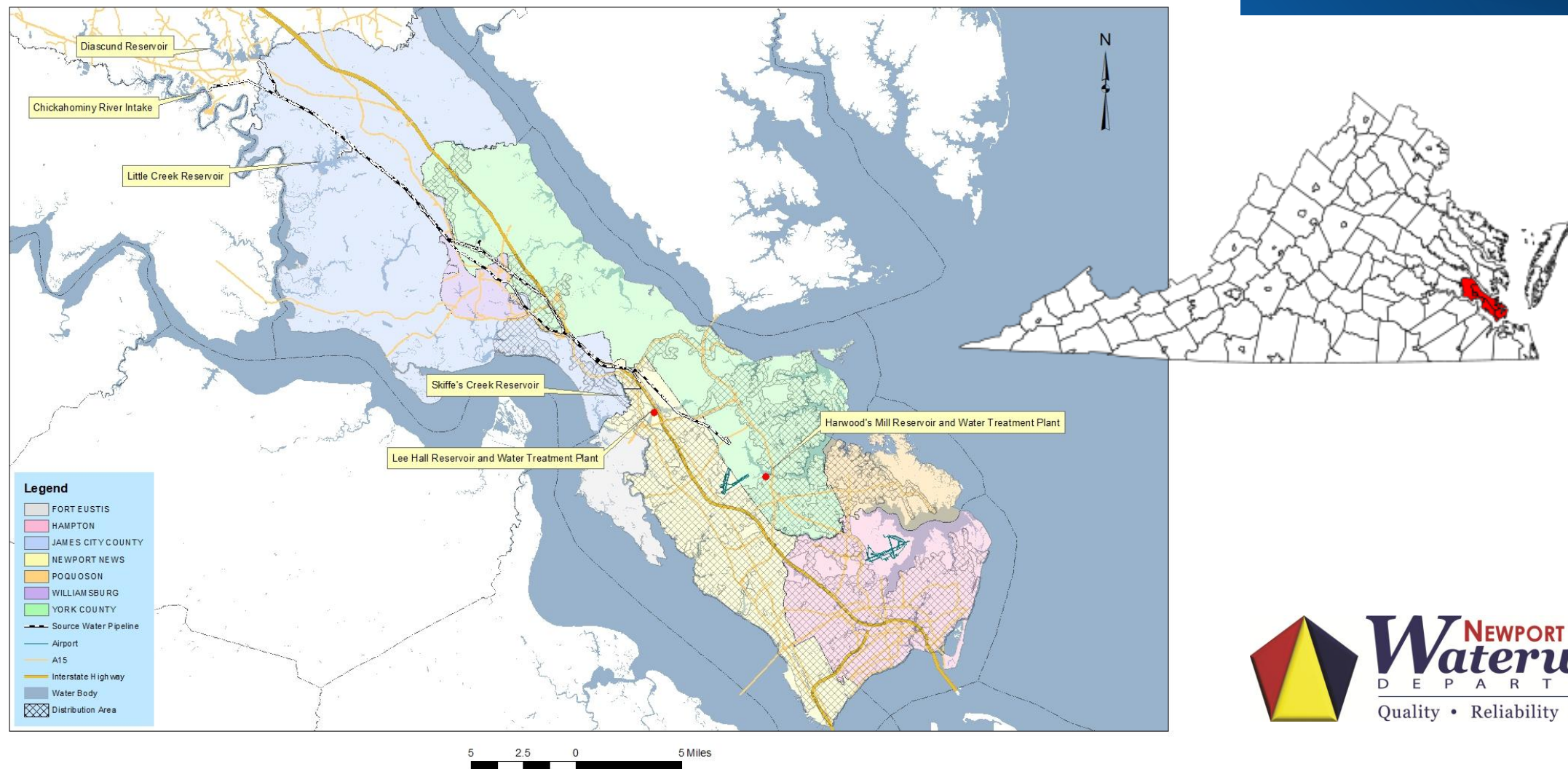


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Waterworks
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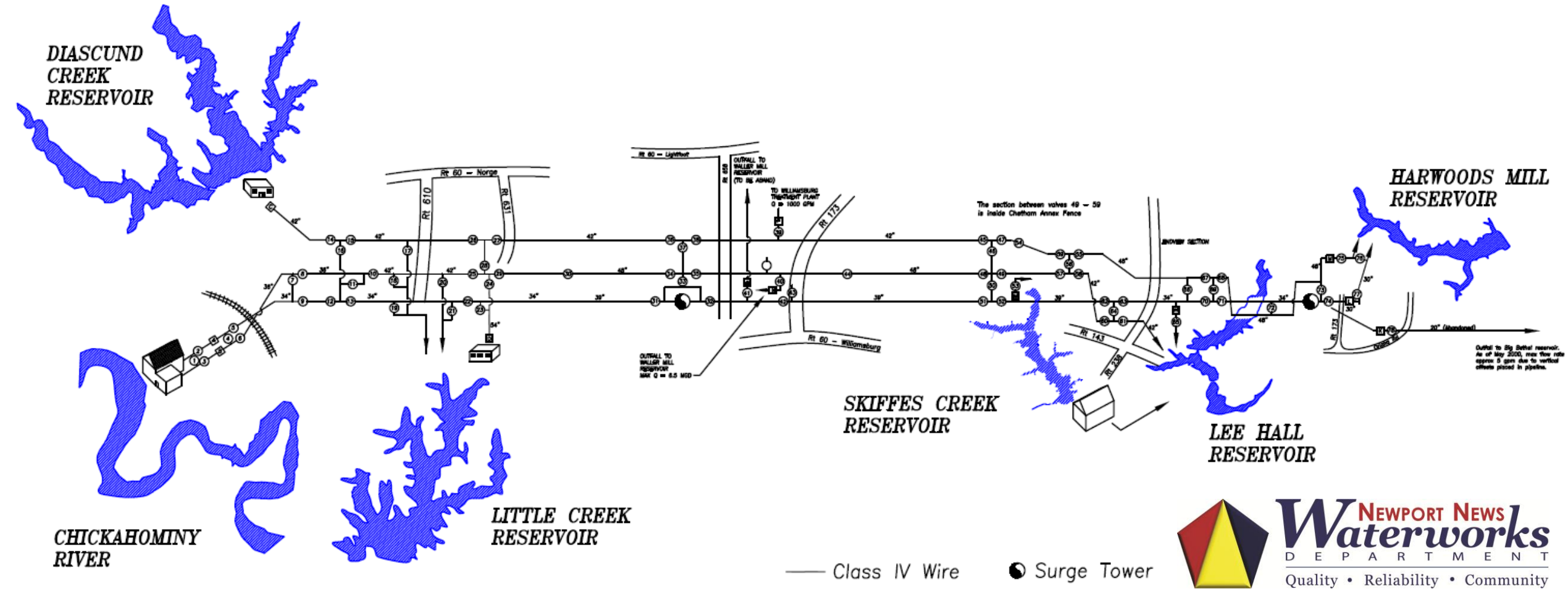
Agenda

- 1 NNWW System Overview / Existing PFAS Summary
- 2 Raw Water Sampling and Overview
- 3 Filter-Adsorber Concept
- 4 Pilot Testing
- 5 Lessons Learned / Next Steps

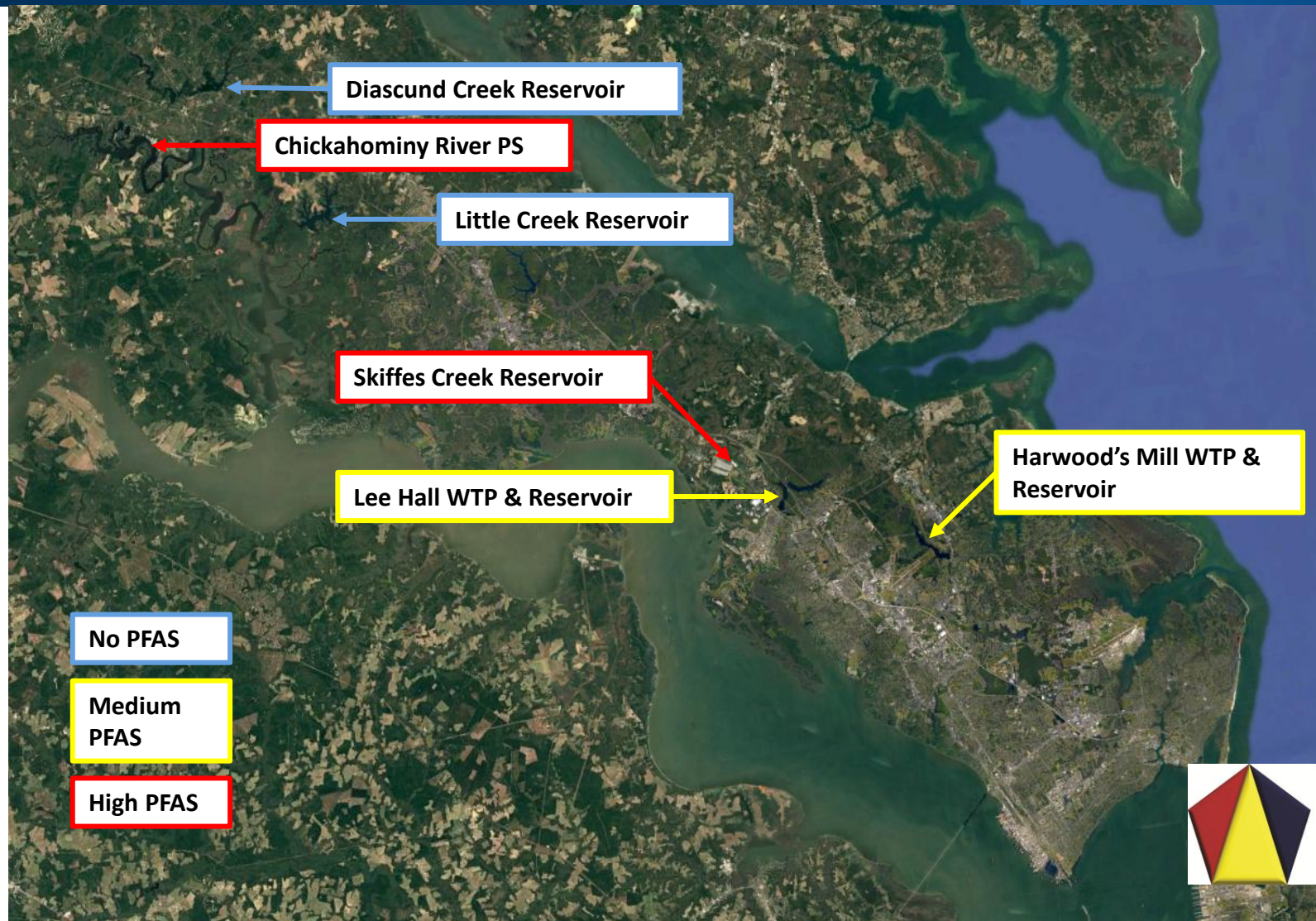
NNWW System Overview



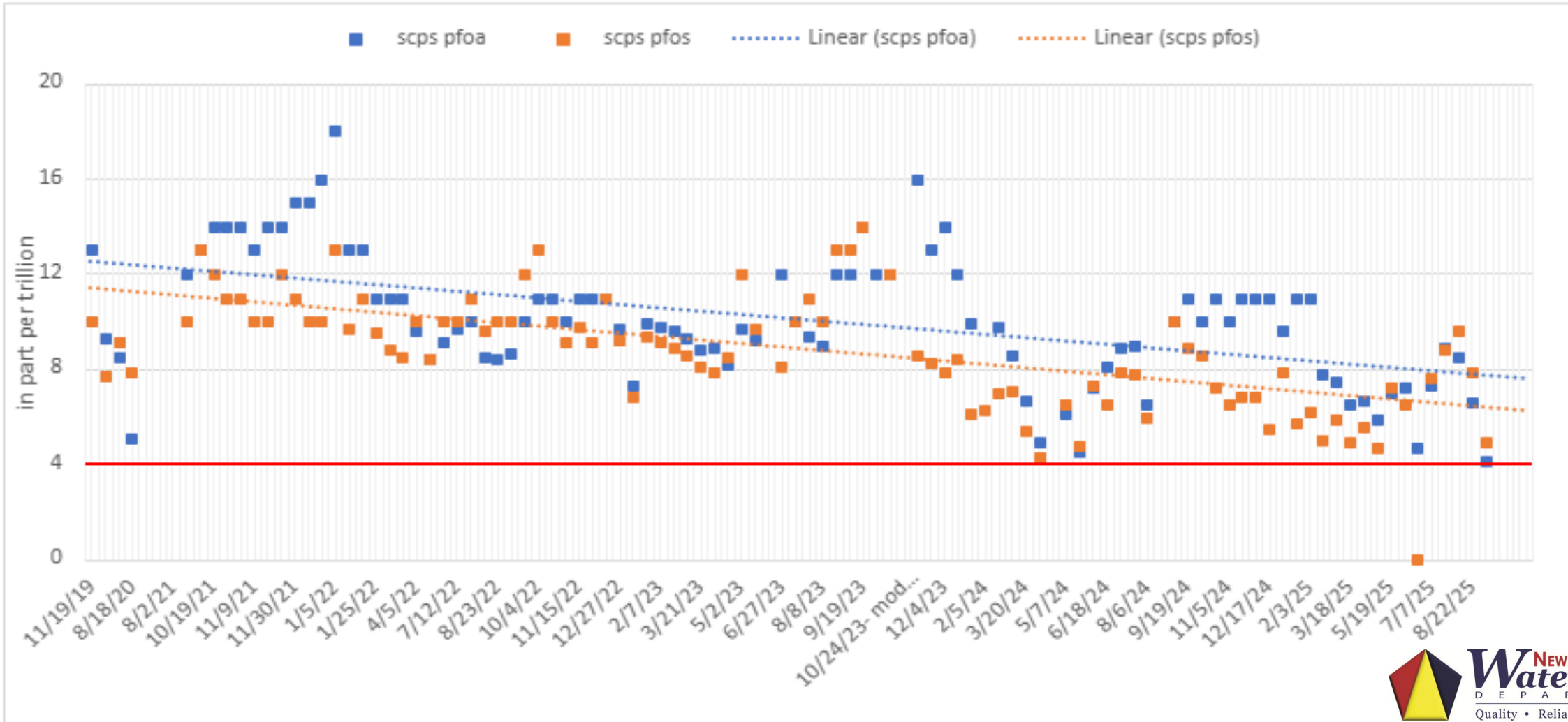
NNWW Raw Water Pumping Schematic



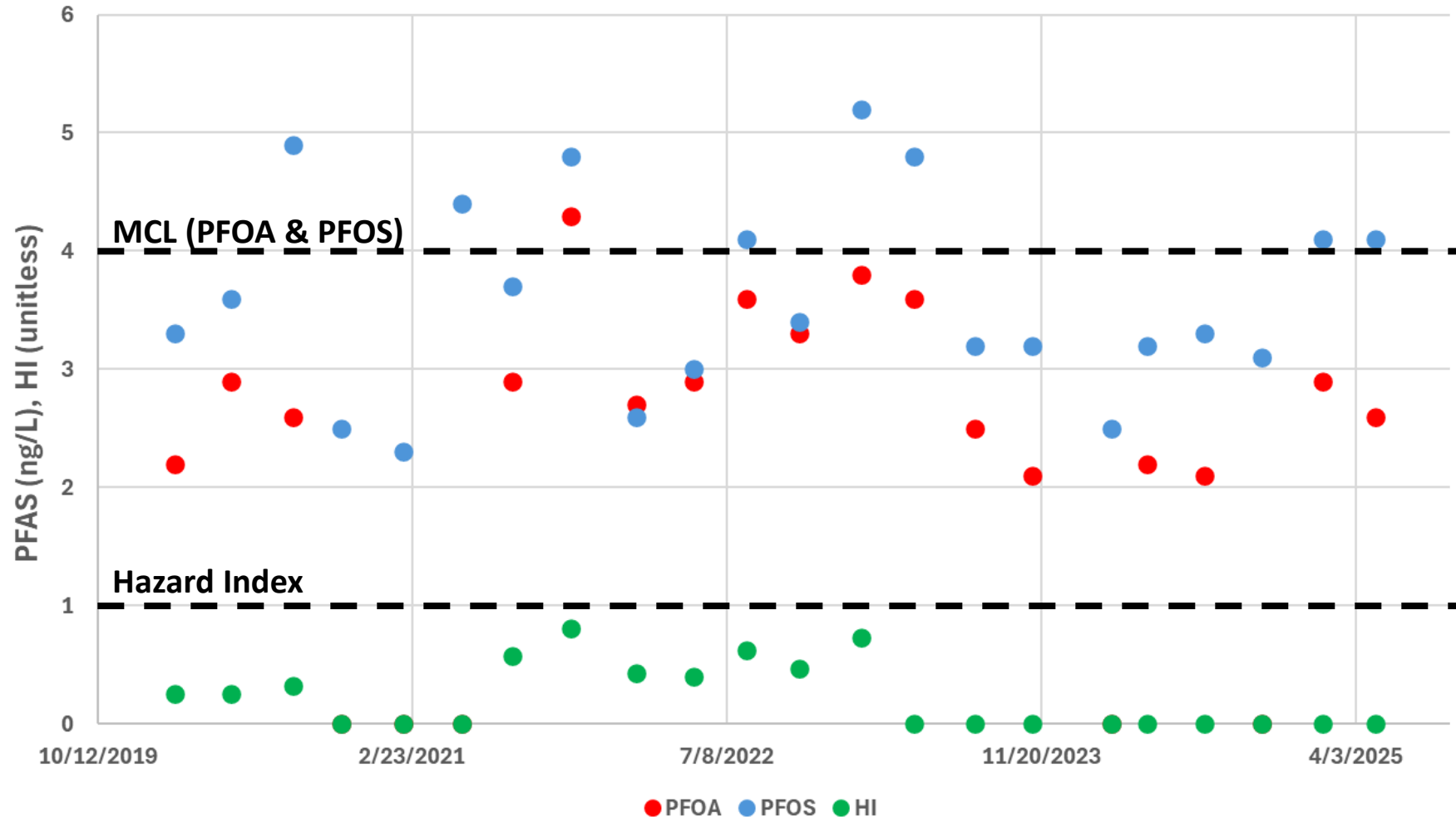
So where is PFAS within our system?



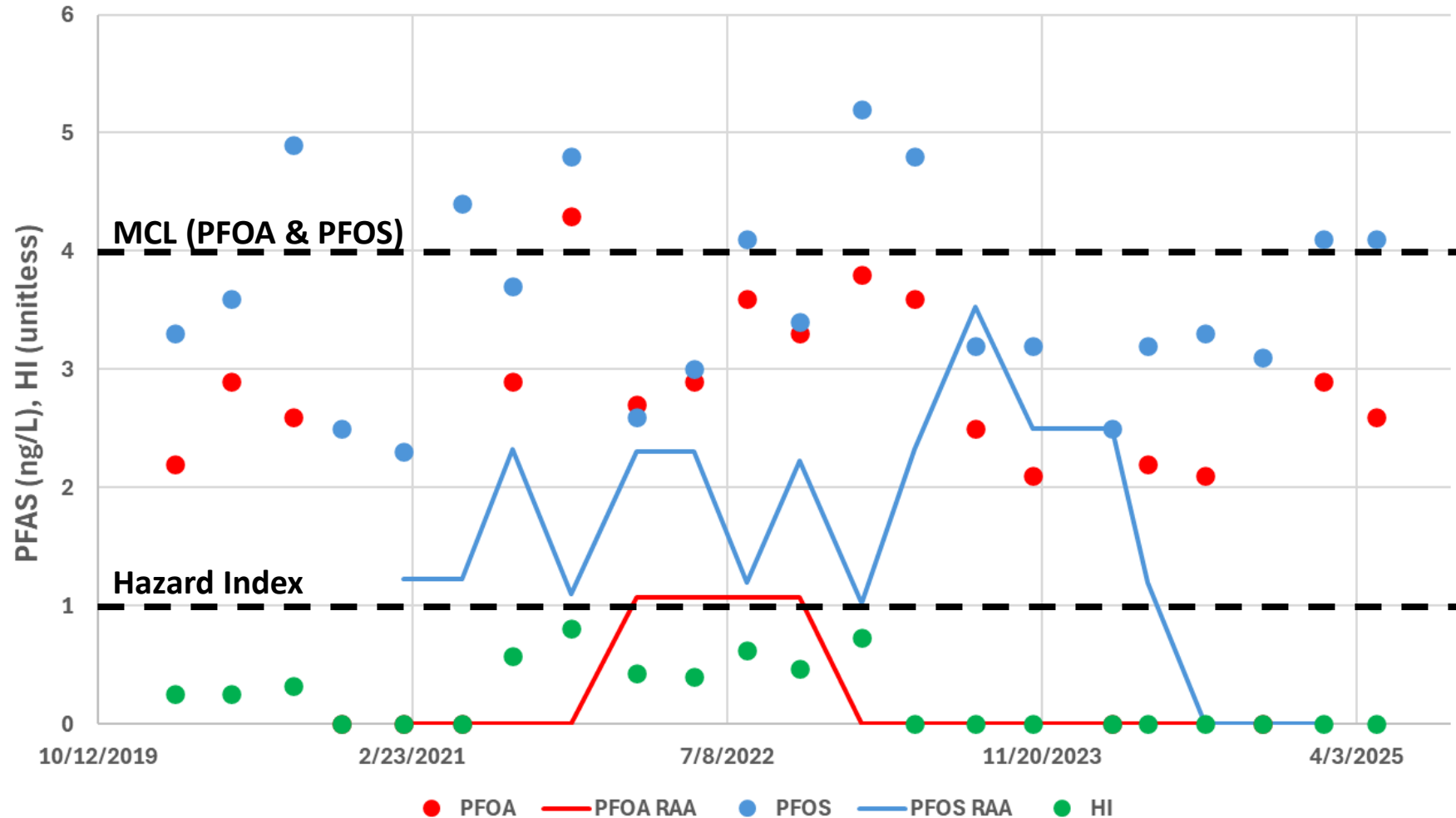
Five Years of PFAS Sampling



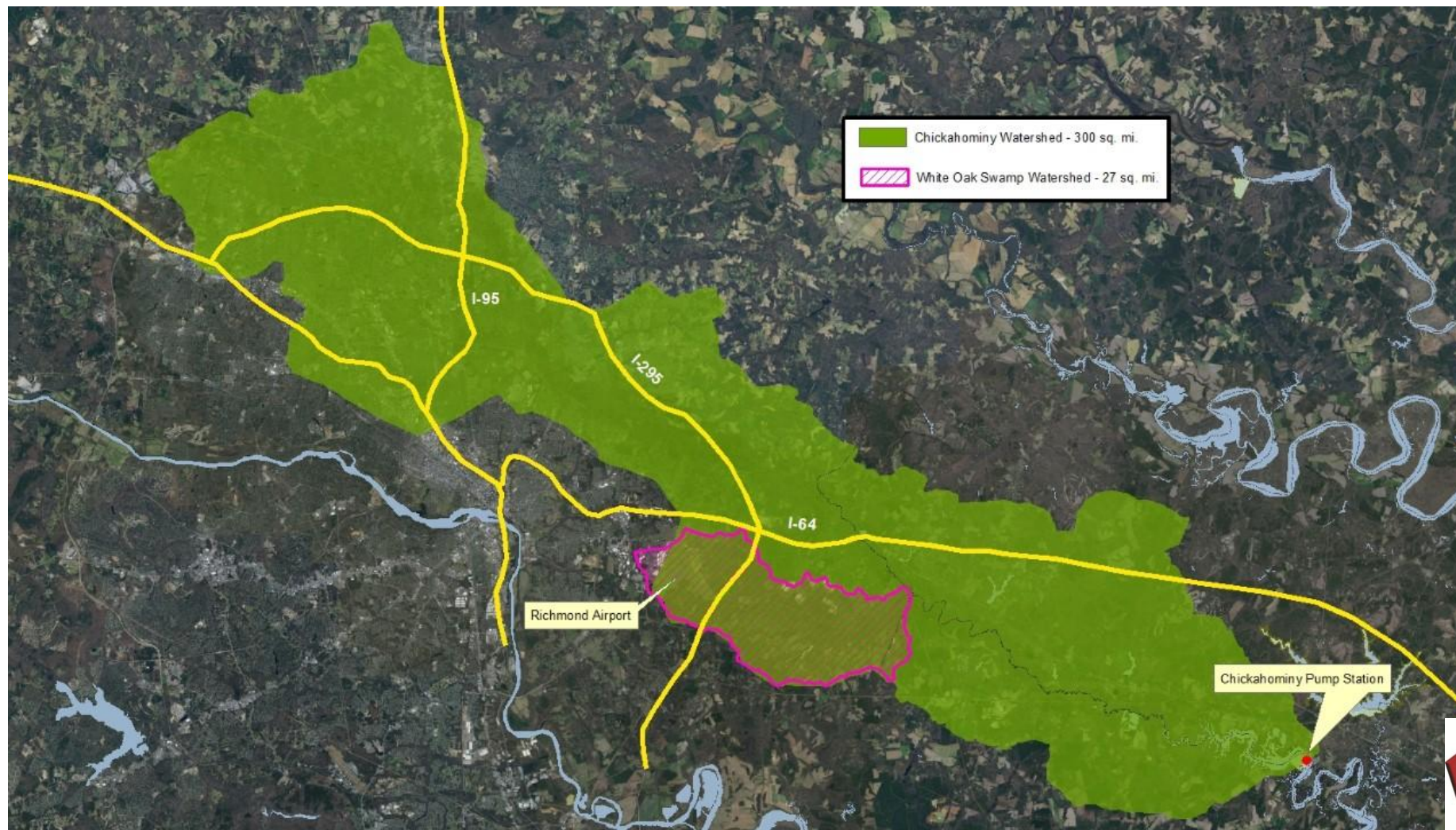
What does this PFAS look like at the Terminal Reservoirs?



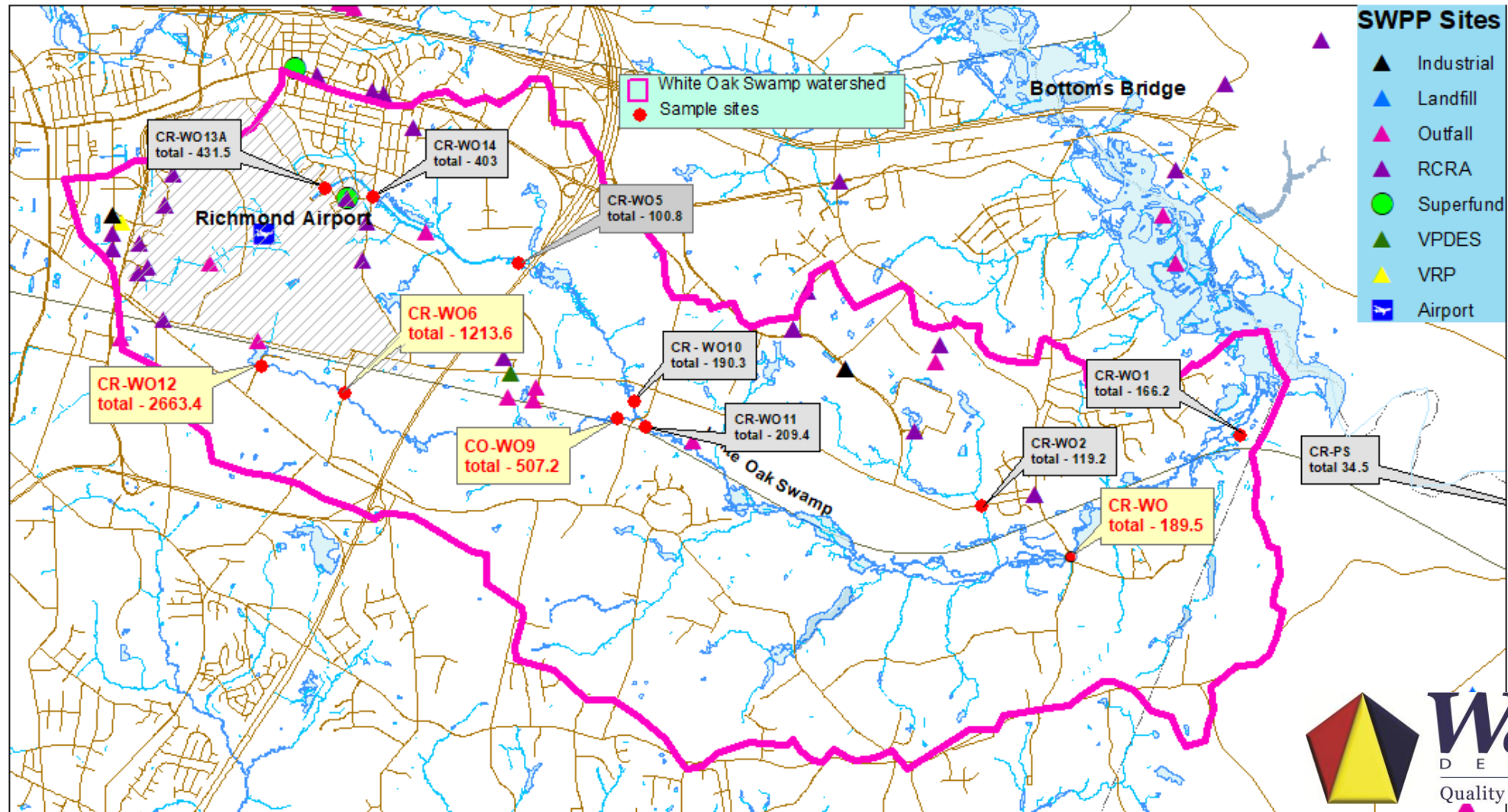
What does this PFAS look like at the Terminal Reservoirs?



PFAS Screening



PFAS Screening



PFAS Sources

NEWPORT NEWS

Victims of deadly plane crash at Newport News-Williamsburg International Airport identified

by: [Courtney Ingalls](#), [Julius Ayo](#), [Michelle](#)

Posted: Oct 6, 2022 / 03:33 PM EDT

Updated: Oct 7, 2022 / 09:18 PM EDT

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NEWPORT NEWS, Va. (WAVY) – A small plane crash at Newport News-Williamsburg International Airport confirmed.



PFAS Sources



Source Water PFAS Overview

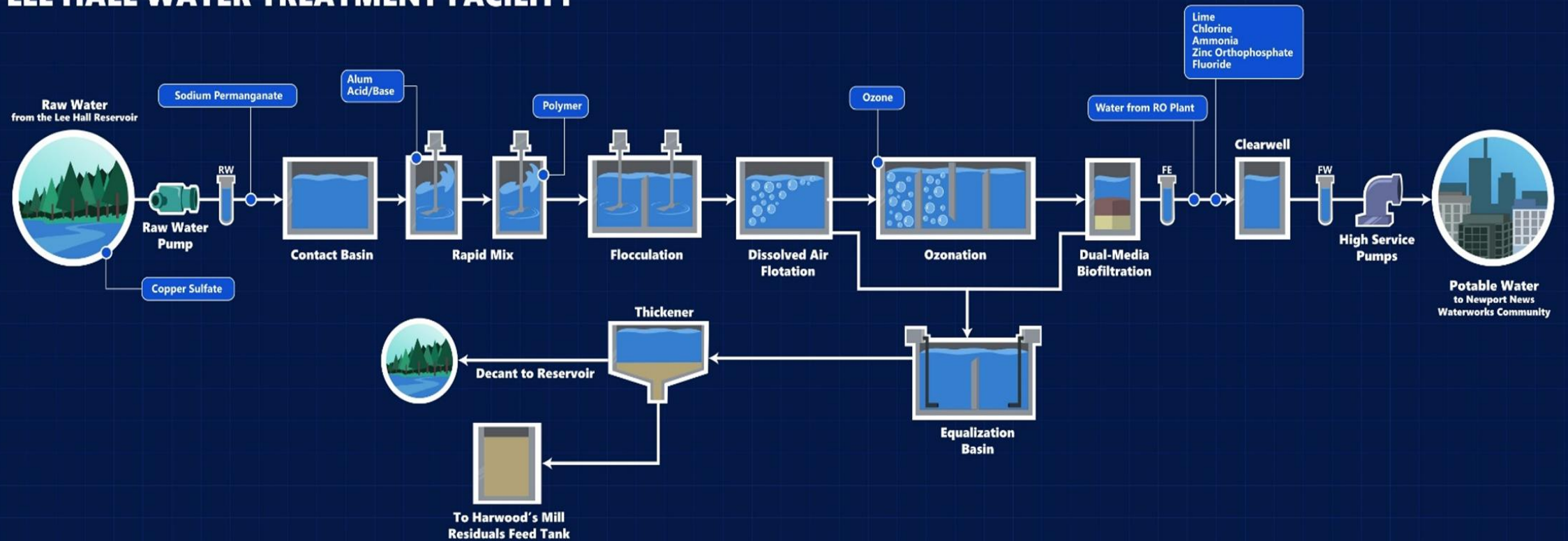
Water Source	PFAS Present?	Identified Sources	Remediation Options
Chickahominy River	Yes	Richmond Airport	Minimal Source Remediation options
Diascund Creek Reservoir	No	-	-
Little Creek Reservoir	No	-	-
Skiffe's Creek Reservoir	Yes	Yorktown Naval Weapons Station?	Cease pumping
Harwood's Mill Reservoir	Yes	NN/W Airport, Remote Reservoirs	Minimal Source remediation options, install treatment
Lee Hall Reservoir	Yes	Fire Training BMP, Remote Reservoirs	Remediate BMP, install treatment

PFAS Plan

- Where we have control over property, perform raw water remediation to reduce loading of PFAS into terminal reservoirs
 - Fire Training Center BMP that feeds into Lee Hall Reservoir
- Try to work with property owners to encourage remediation of their sites
 - Richmond Airport, Newport News/Williamsburg Airport
- Install treatment at Lee Hall WTP where it is more feasible
- Continuously monitor PFAS during operation and direct PFAS-sources to Lee Hall where we have treatment

Lee Hall WTP

LEE HALL WATER TREATMENT FACILITY



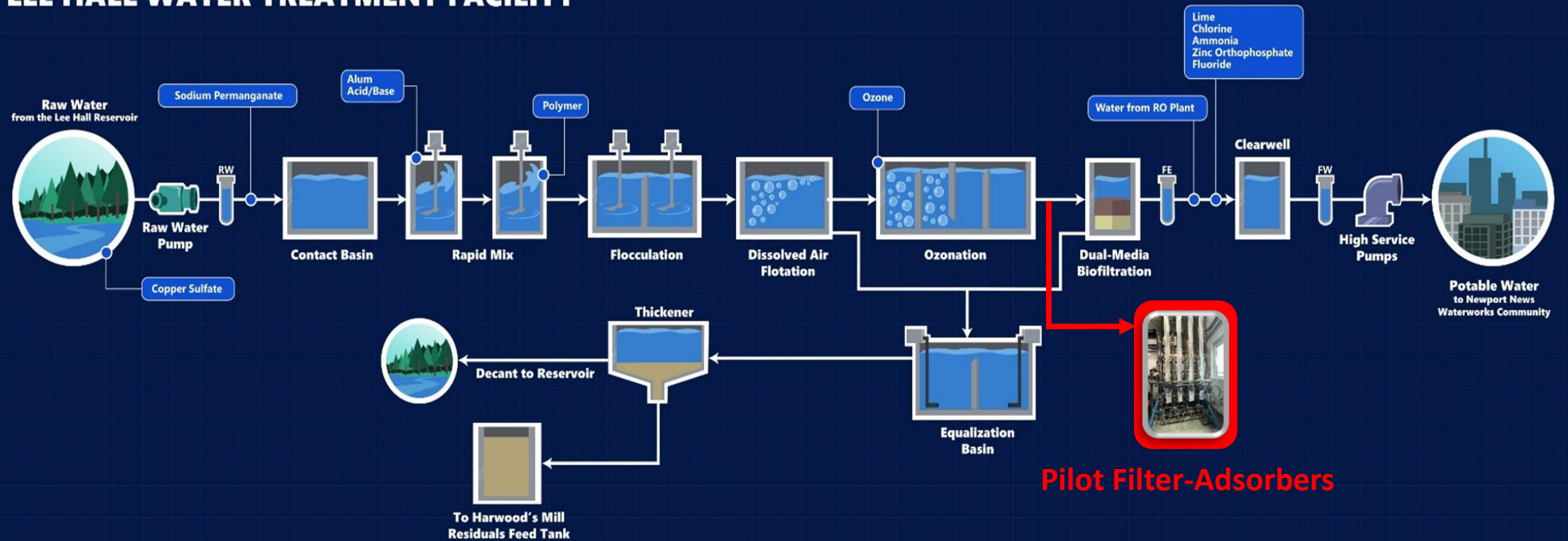
Treatment Technology Evaluation

Alternative	Capital Cost	O&M Cost (\$/year)	Life Cycle Cost
GAC Pressure Vessels	\$78M	\$5.1M	\$220M
IX Pressure Vessels	\$56M	\$6.3M	\$236M
Post-Filter GAC Contactor	\$58M	\$4.8M	\$194M
Filter-Adsorber GAC Contactor	\$11M	\$3.5M	\$112M

Filter-Adsorber concept will save the City **~\$80M** over the next 30 years!!

Lee Hall WTP

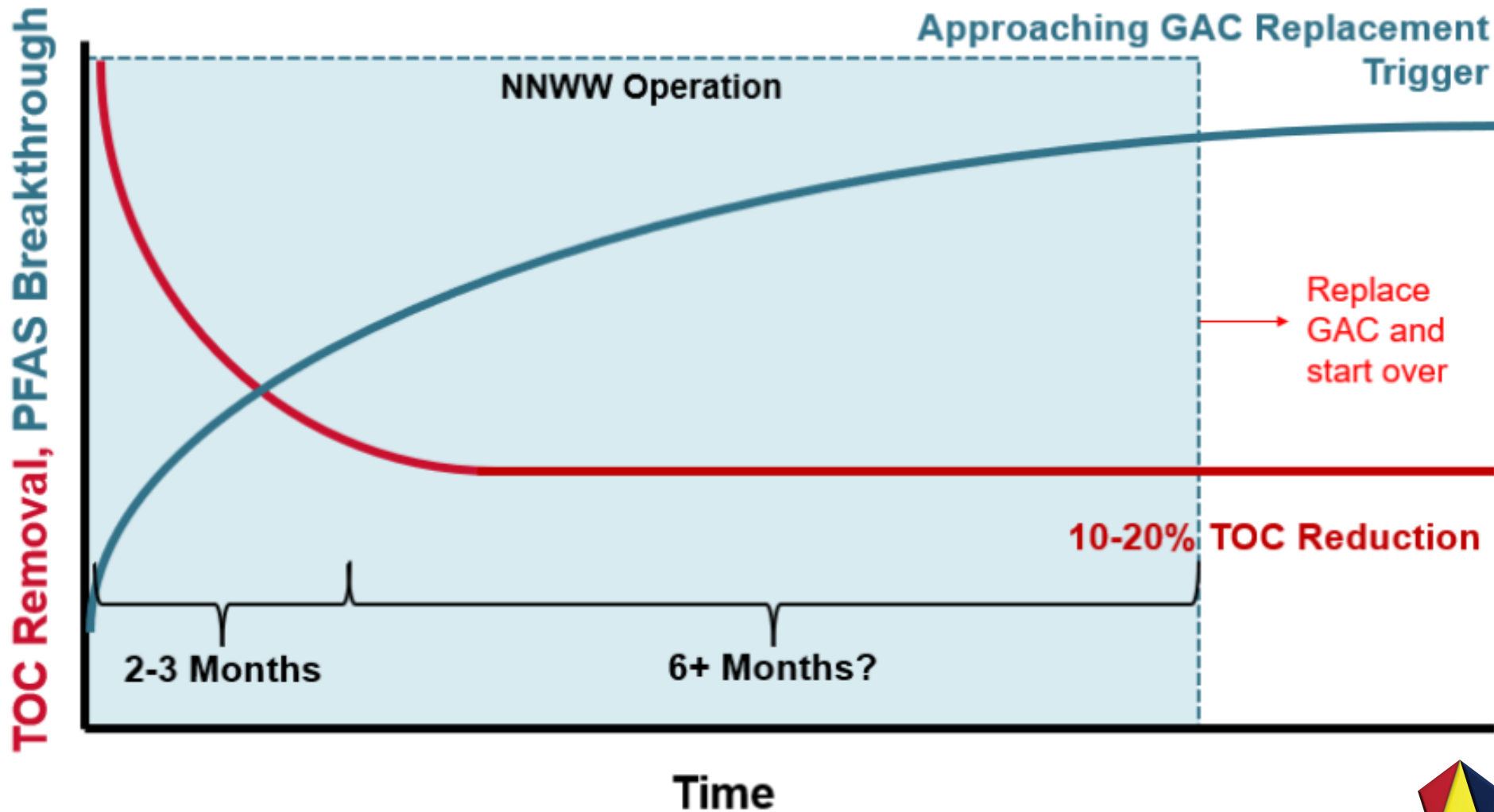
LEE HALL WATER TREATMENT FACILITY



Filter-Adsorber Concept

Benefits	Challenges
- Multi-Functionality • Filtration • Adsorption • Biological Treatment - Enhanced Contaminant Removal - Extended Organics Removal - Improved Biostability	- Competition for adsorption sites - Media Exhaustion - Frequent Media Replacement - Operational Challenges • Higher Headloss (for smaller media) • Backwashes disrupt mass transfer zone

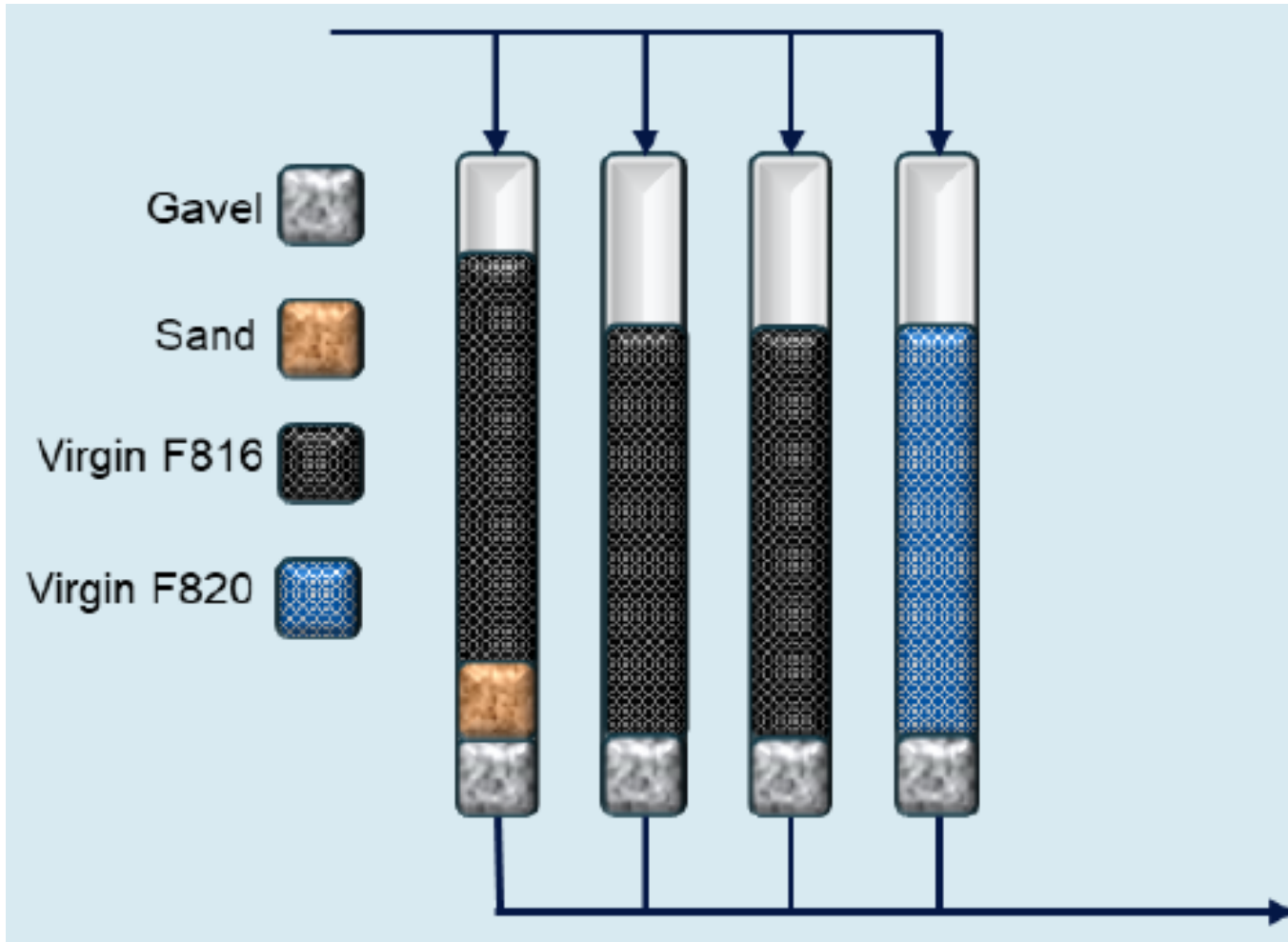
Filter-Adsorber Concept



PILOT TESTING PHASES

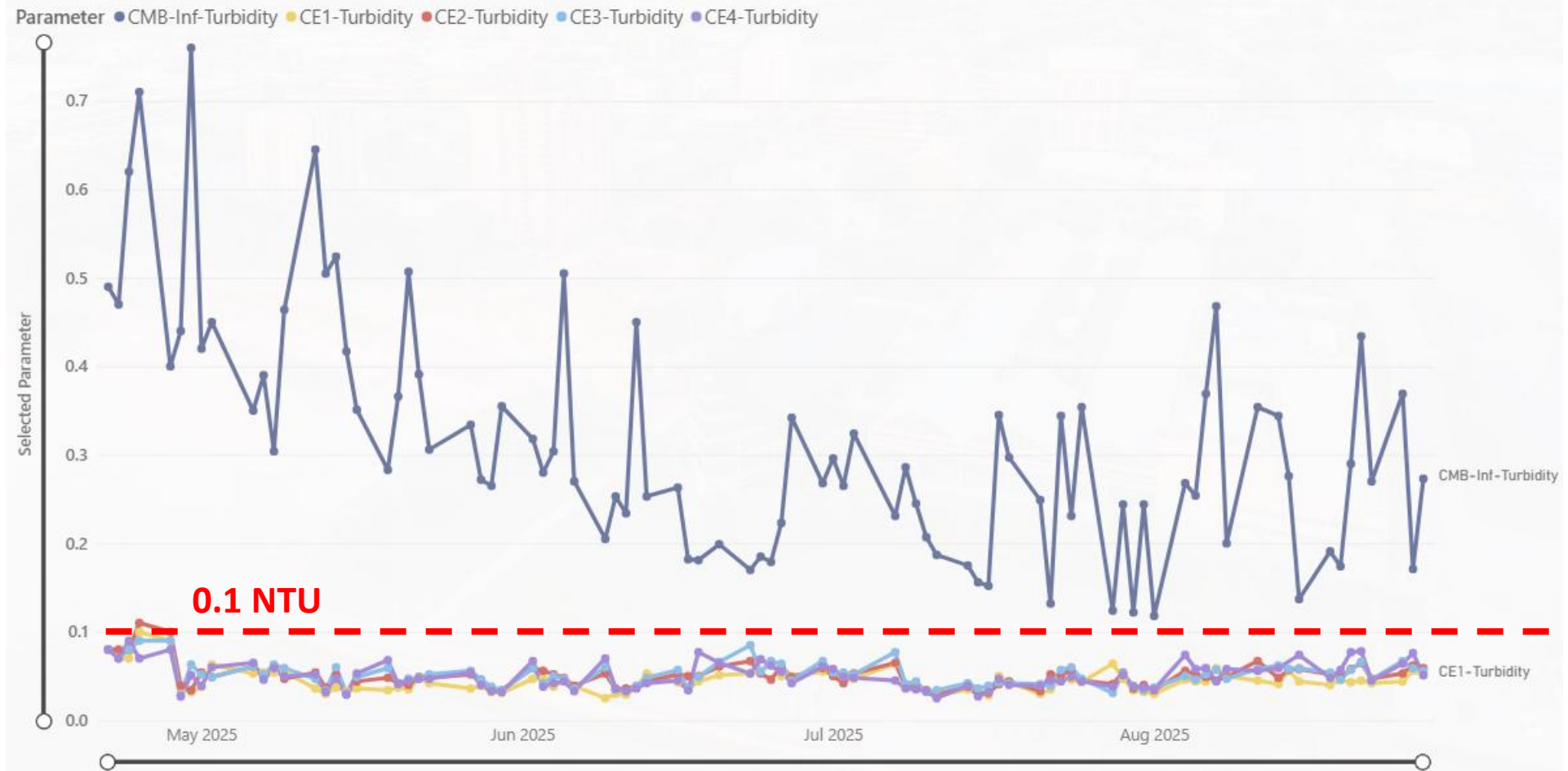


Pilot Column Media

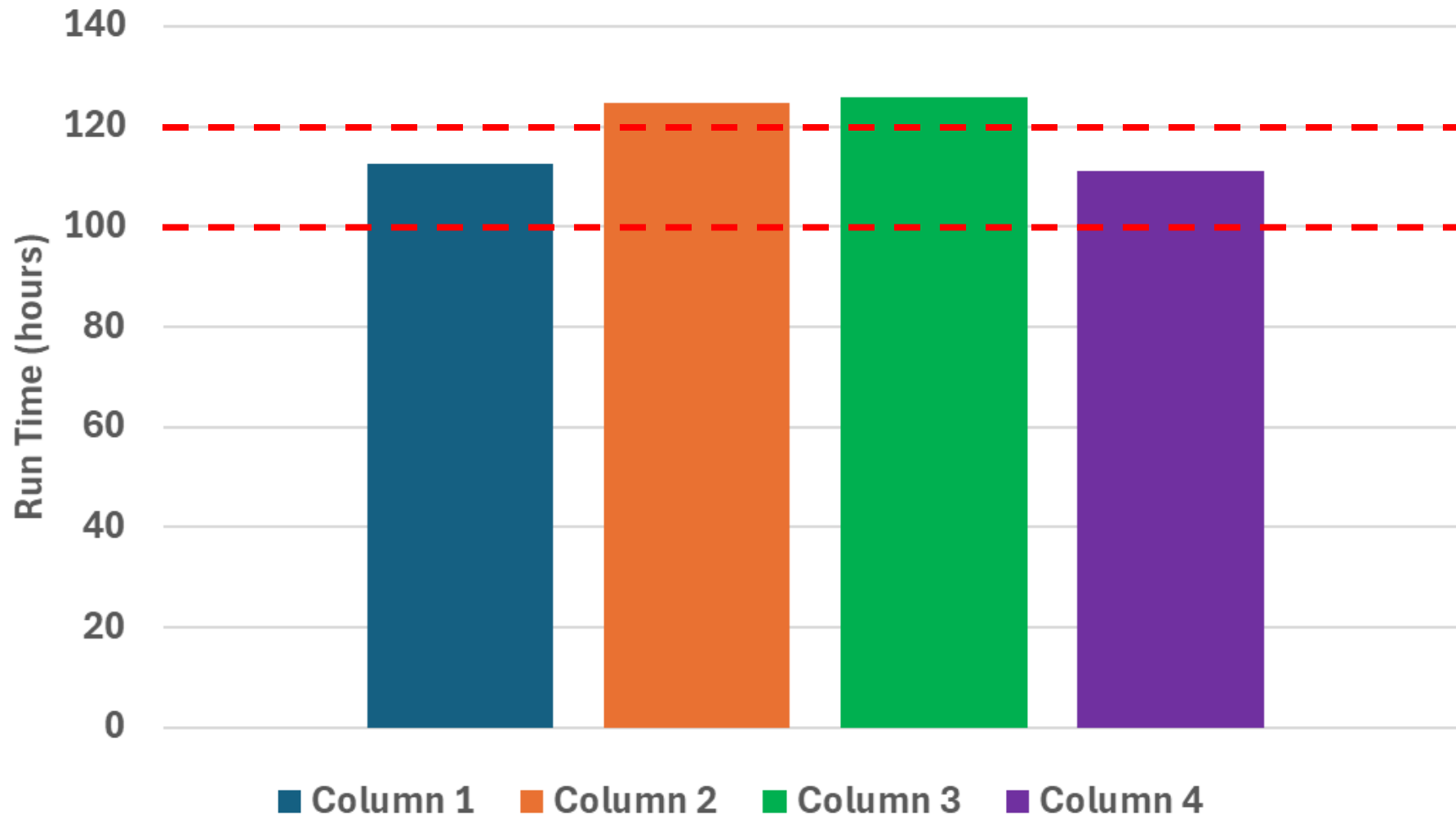


Parameters	Ex. LHWTP Media	F 816	F 820	F 400
Effective Size (mm)	1.4	1.4	1.1	0.65

Water Quality Data - Turbidity



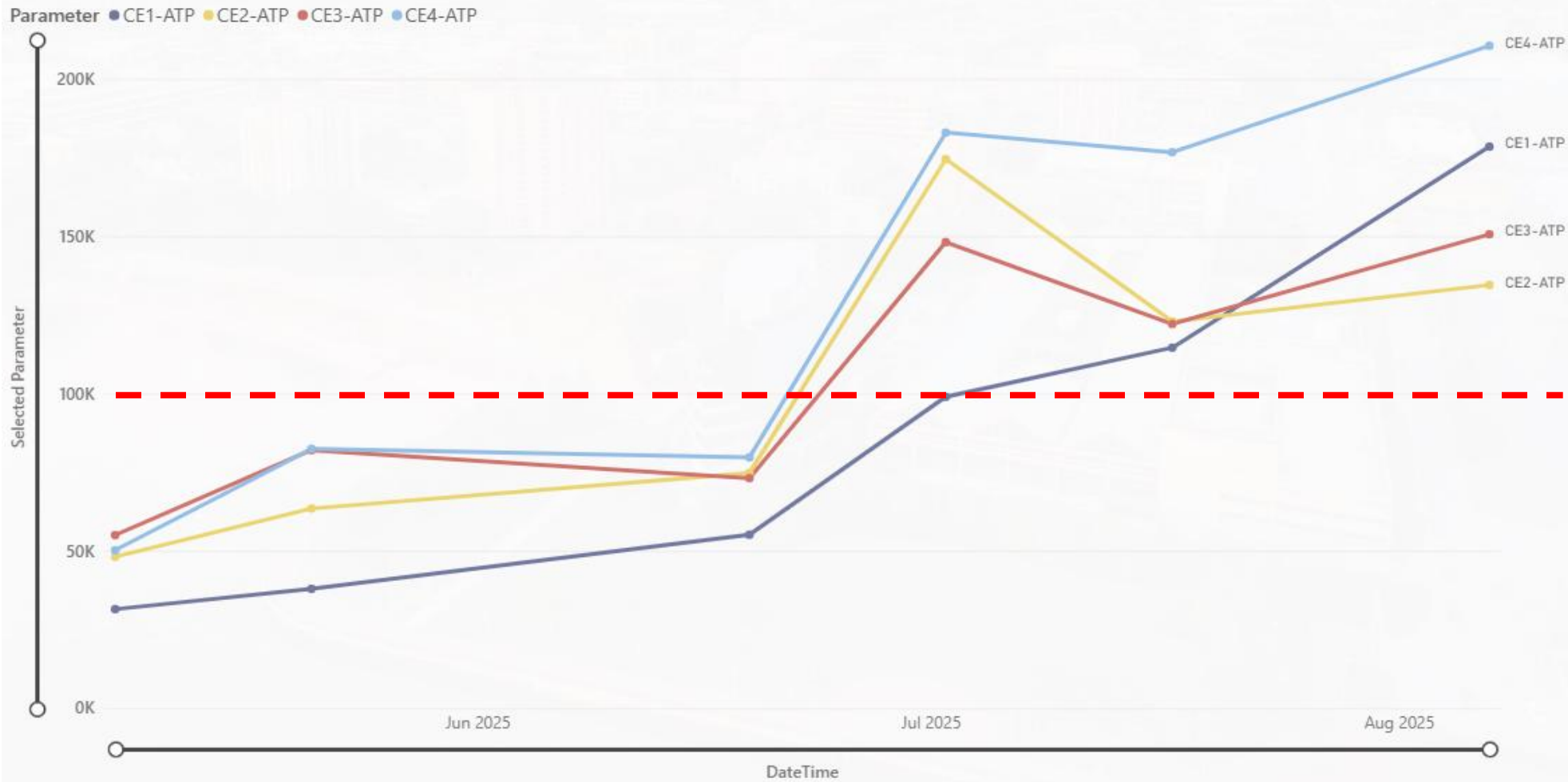
Water Quality Data – Run Time



Backwash Triggers	
Turbidity	0.1 NTU
Headloss	6-feet
Run Time	120 hours

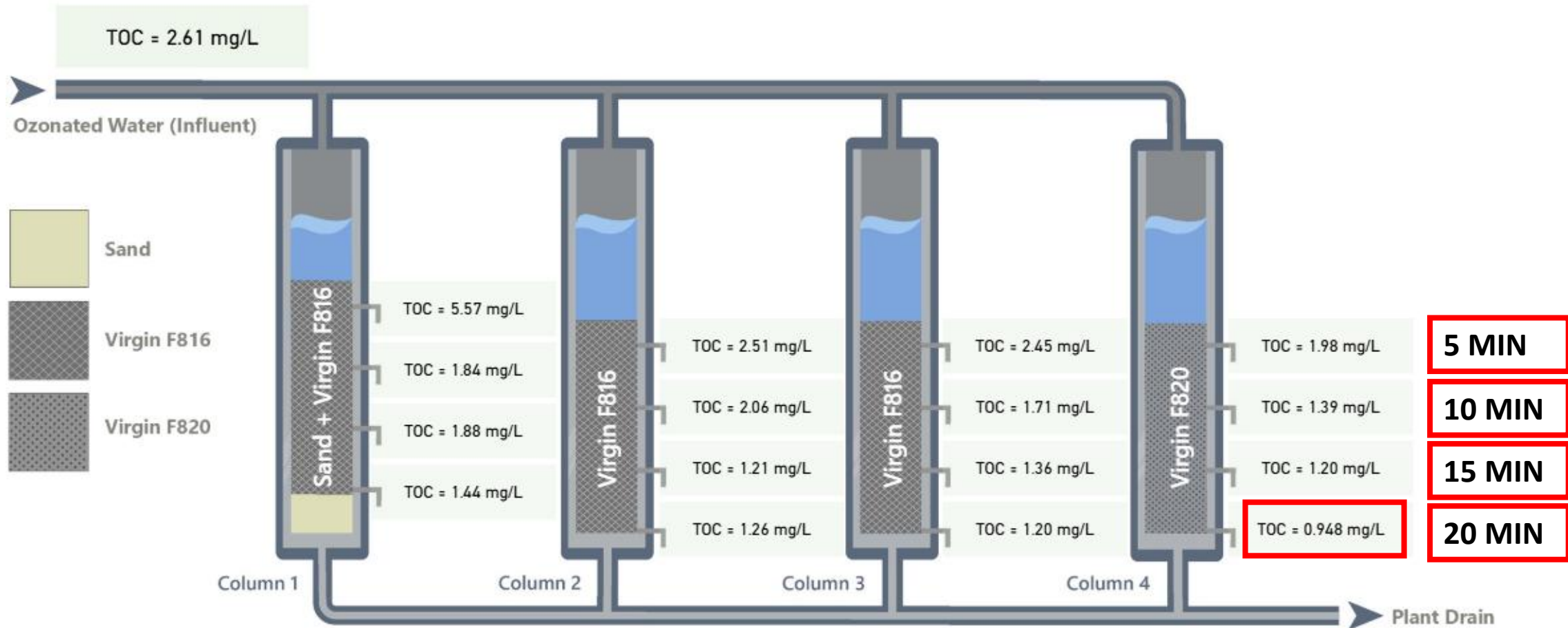
ATP Monitoring

ATP (ATP, RLU) for Phase 2 (Baseline Testing), from 4/24/25 to 8/18/25



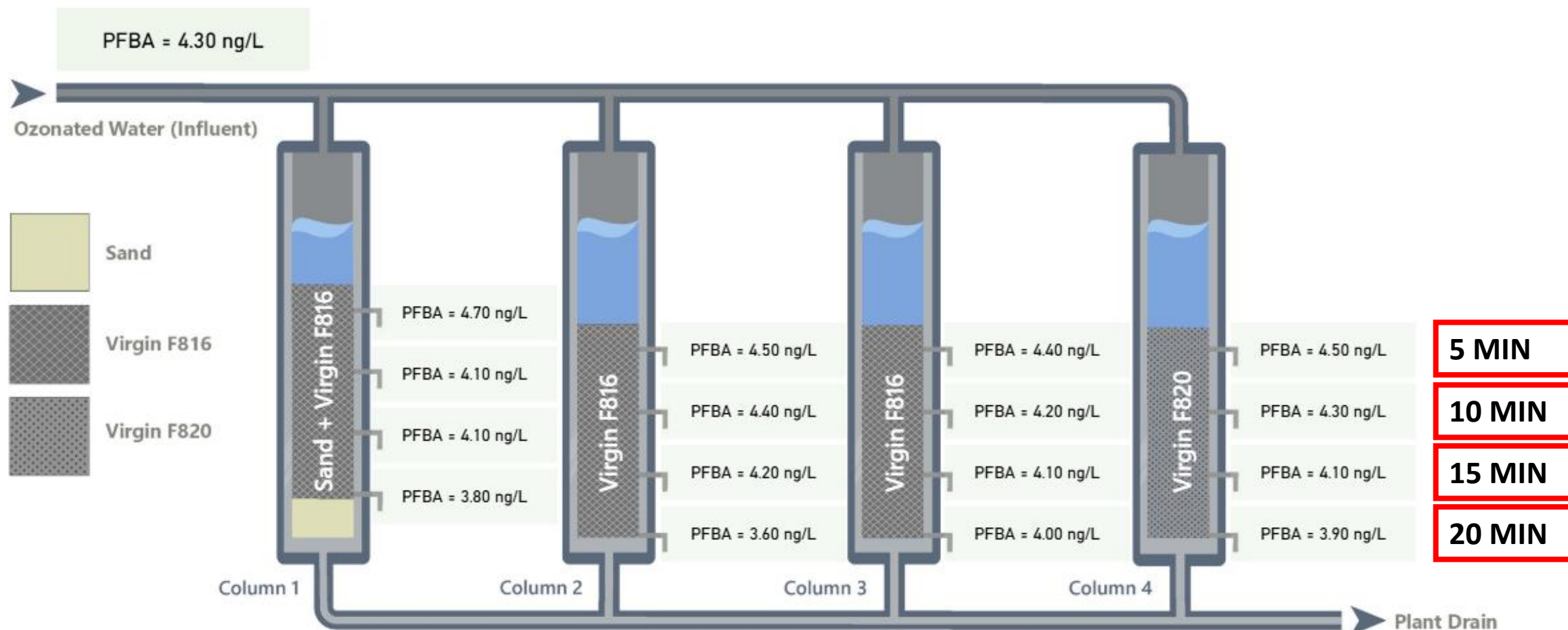
Water Quality Data - TOC

WEEK 16 DATA



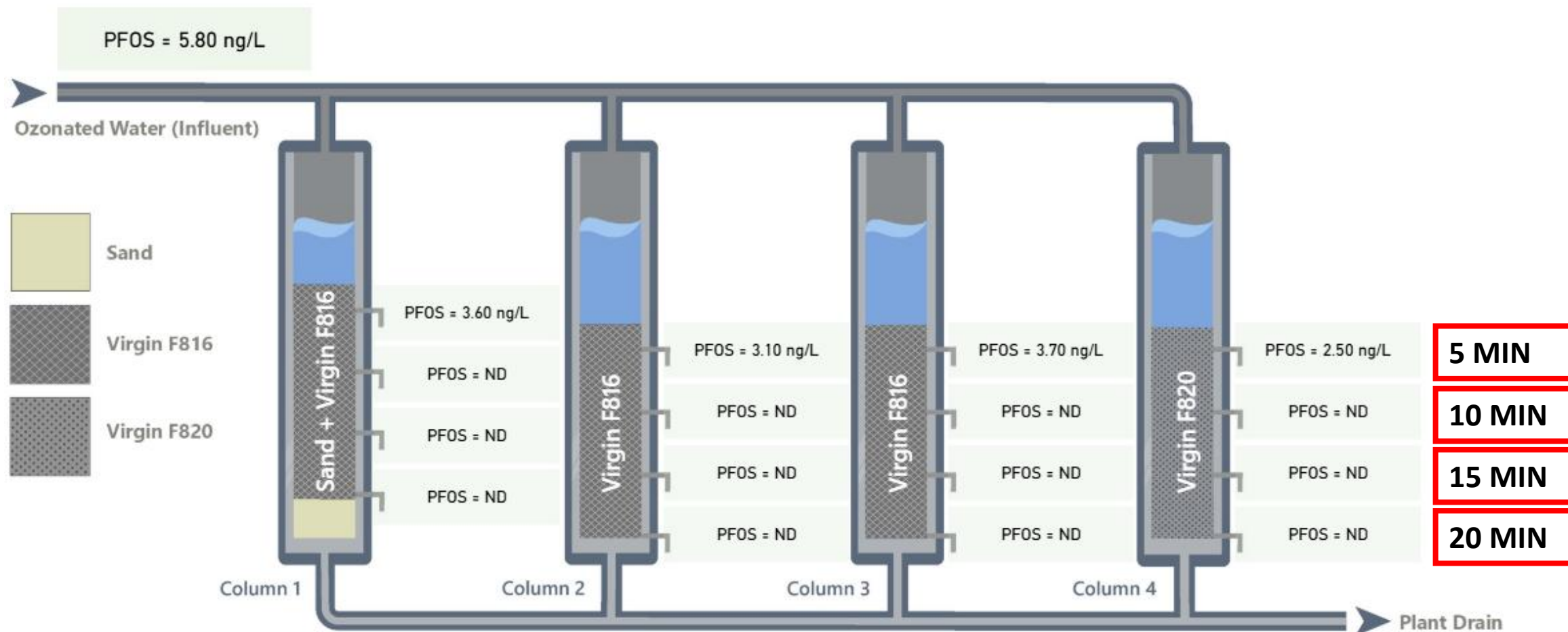
PFBA

WEEK 16 DATA



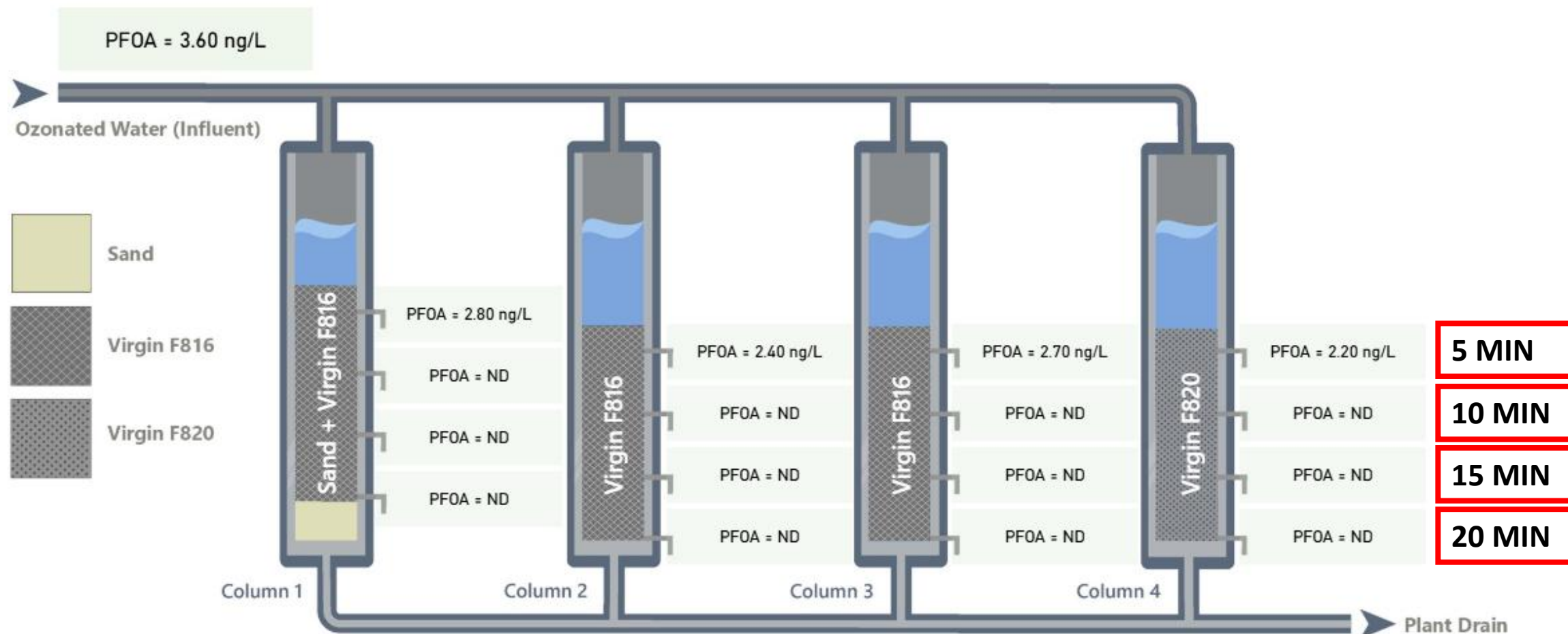
PFOS

WEEK 16 DATA



PFOA

WEEK 16 DATA



Pilot Study Observations to Date

- Good run times & particle removal
- High TOC removal
- Short chain PFAS breakthrough
- Some PFOA & PFOS breakthrough @ 5 min EBCT
- No PFOA & PFOS breakthrough in effluent
- Smaller F820 media performing well hydraulically

Lessons Learned / Important Considerations

- Spare pumps / equipment
- Considering pilot column under drain design early
- Backwash concept mimicking full scale
- Collaboration with Operations, NNWW engineering staff, HDR

Questions?

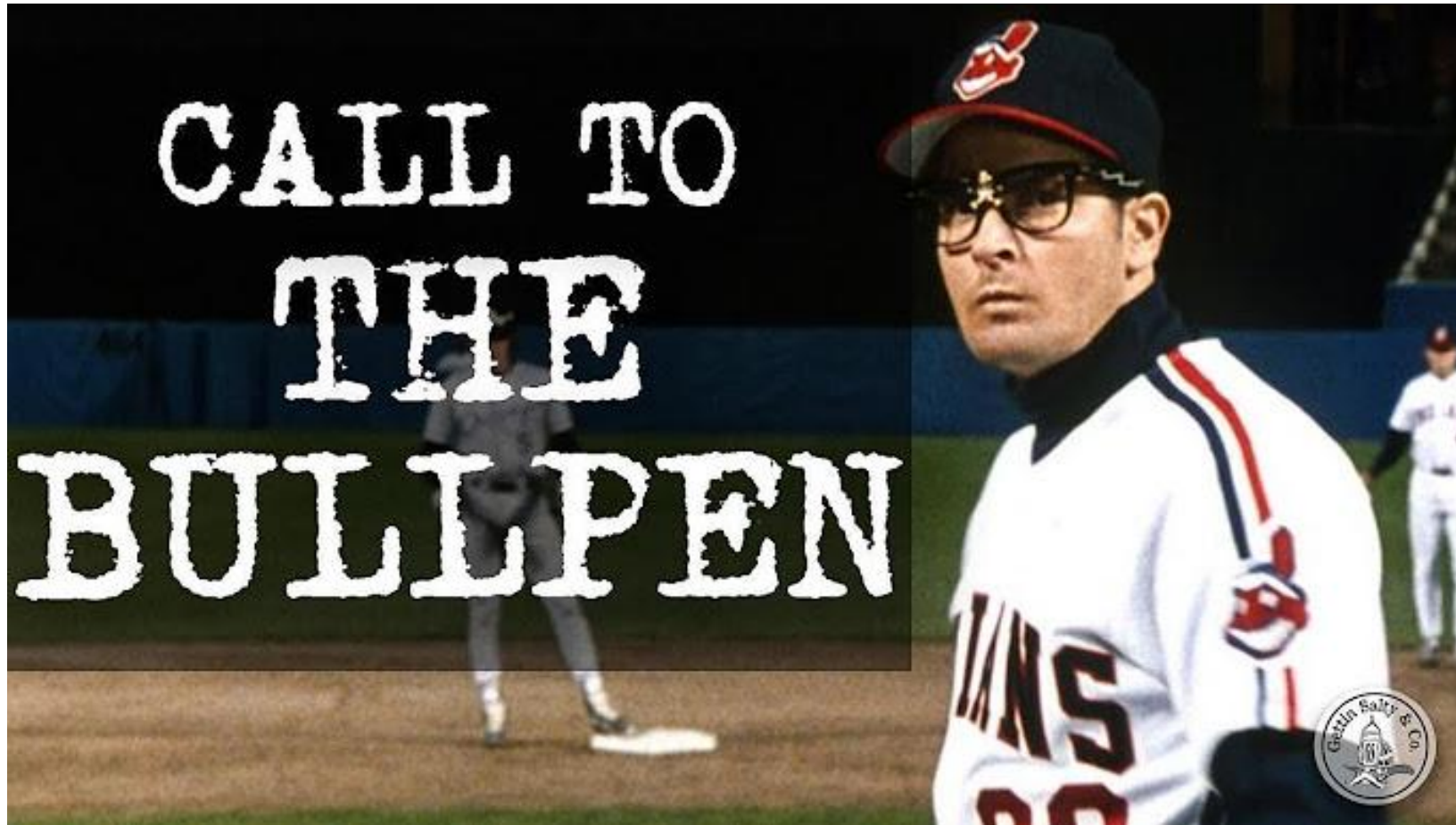
Mark Titcomb, PE
Chief of Process Reliability
mtitcomb@nnva.gov



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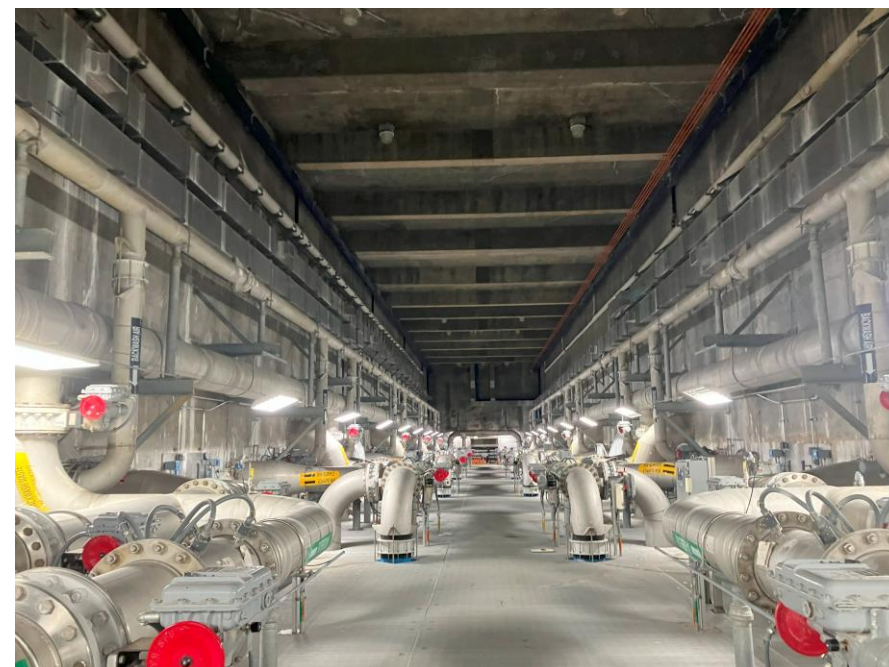


Bullpen



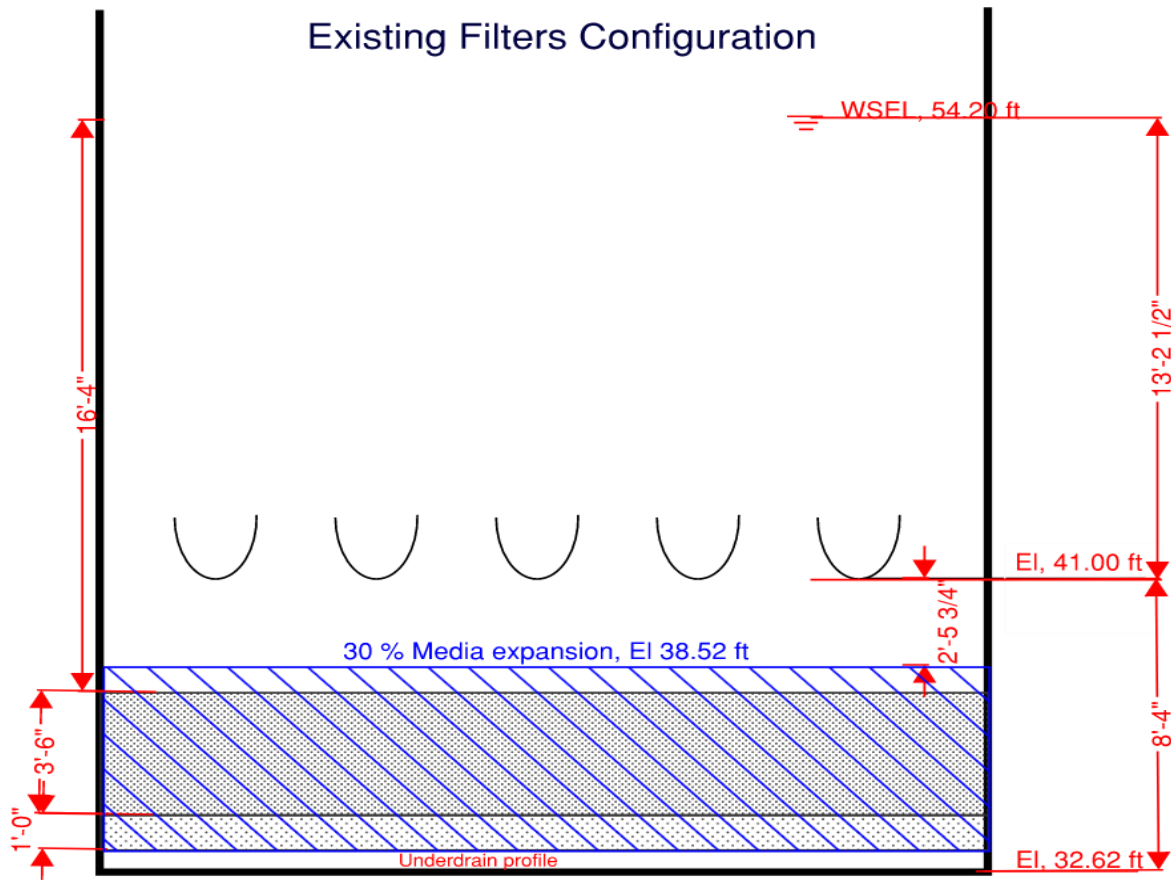
LH WTP Raw Water

Parameter	Minimum	Average	Maximum
Hardness, mg/L	33.7	57.9	75.5
pH	6.4	7.3	7.8
TOC, mg/L	4.8	5.7	6.8
Turbidity, NTU	1.5	2.1	3.6
Iron (Total), µg/L	101	247.8	580
Iron (Dissolved), µg/L	12.4	92.1	248
Manganese (Total), µg/L	16.25	39.2	82.3
Manganese (Dissolved), µg/L	1.0	4.9	12.7
PFOA, ng/L	2.0	3.1	6.0
PFOS, ng/L	2.6	4.4	8.9

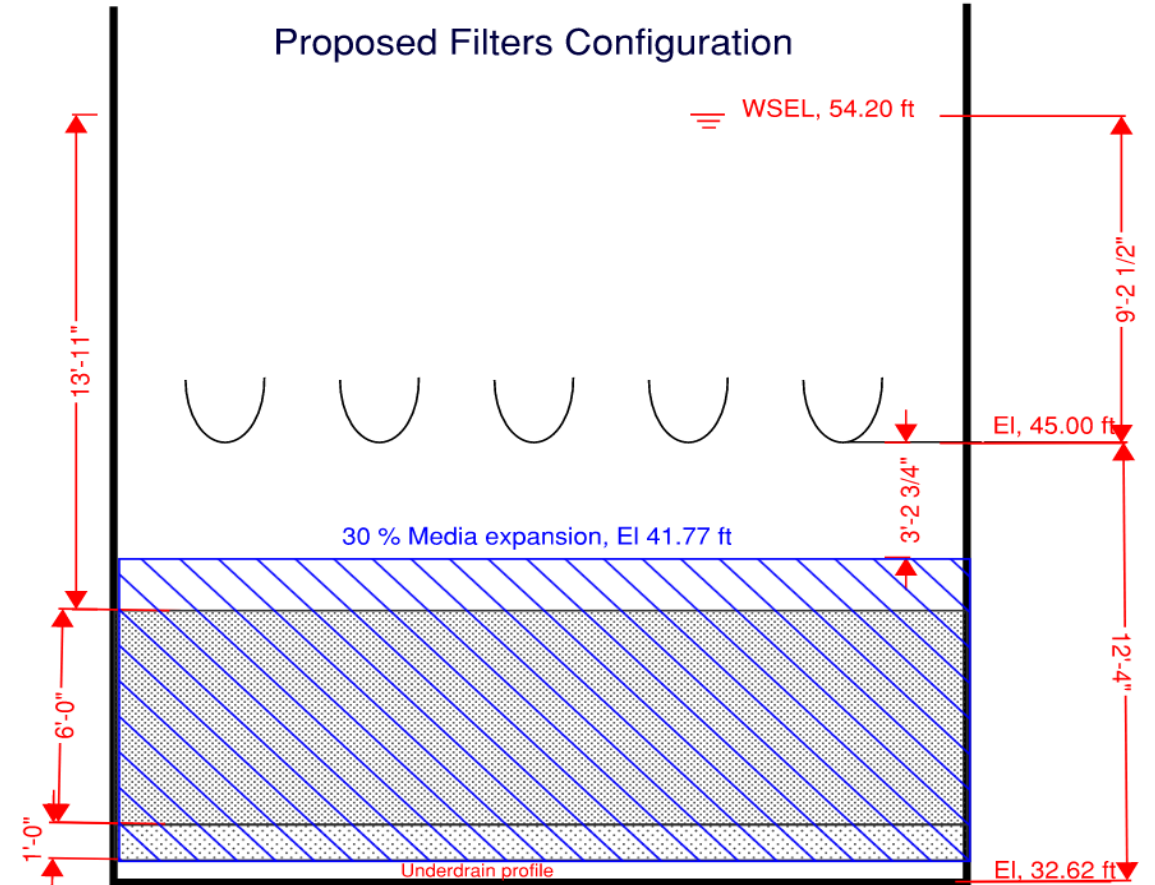


Filter-Adsorber Concept

Existing Filters Configuration



Proposed Filters Configuration



Pilot Rehab



Data Gathering

Parameter	Frequency
Turbidity (online)	Continuous
Headloss (online)	Continuous
Turbidity (grab)	Daily
pH	Daily
DO	Daily
UV254	Daily
Temperature	Daily
ATP	Bi-Weekly

Parameter	Frequency
Arsenic	Start-Up
Alkalinity	Weekly
Hardness	Weekly
Iron (Diss & Total)	Weekly
Manganese (Diss. & Total)	Weekly
TOC	Weekly
Inf. & Eff. PFAS (EPA 533)	Weekly
Depthwise PFAS & TOC	Monthly



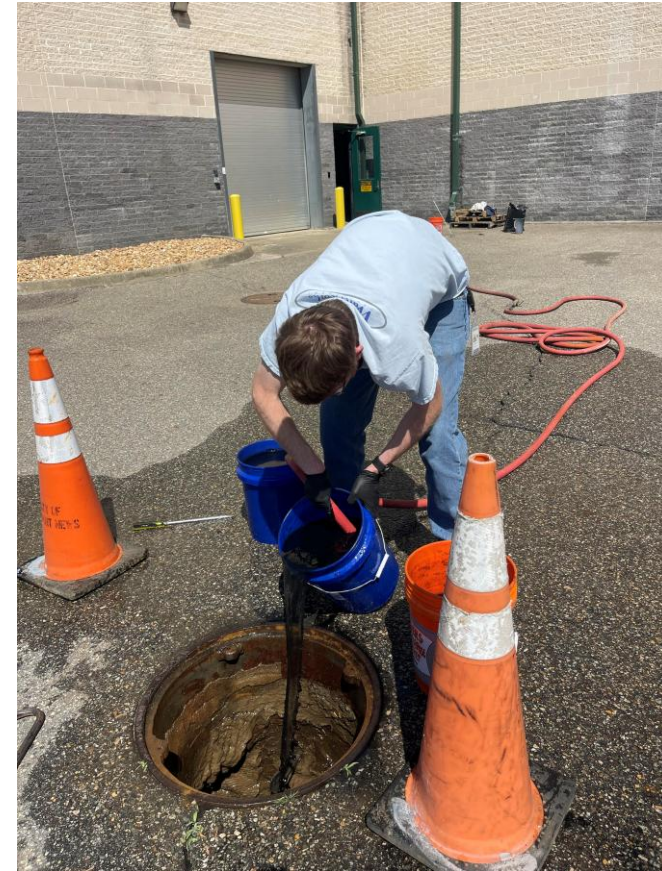
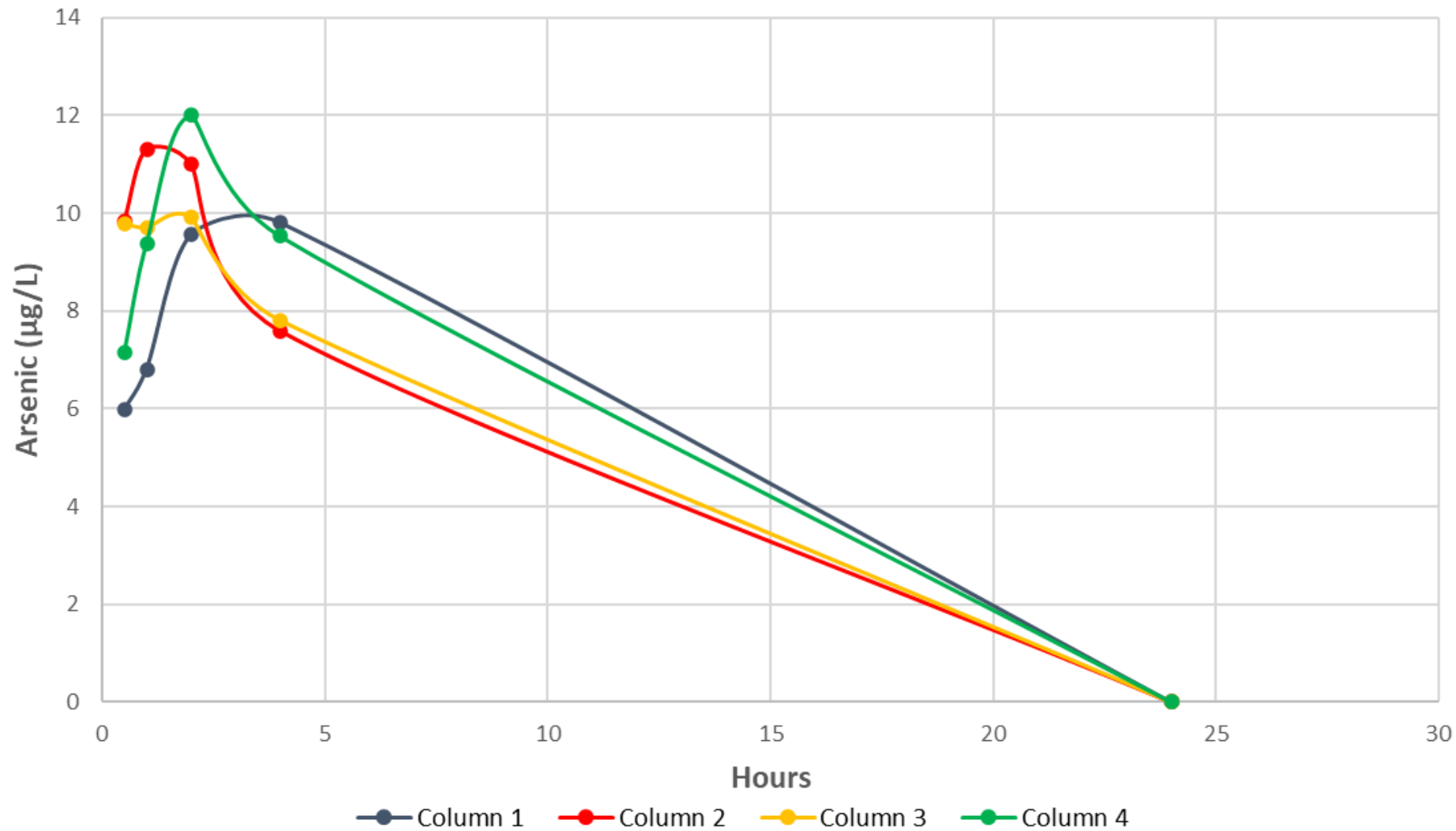
Pilot Study Objectives

- **Media Performance:** Evaluate various GAC media for PFAS removal and establish breakthrough curves.
- **Operational Duration:** Determine effective multi-function operation time for PFAS, TOC, turbidity, and inorganics removal, and estimate GAC changeout frequency.
- **Acclimation Period:** Identify biological acclimation and operational phases: adsorption-dominant, dual-function, and biofiltration-dominant.
- **Headloss Impact:** Analyze headloss accumulation patterns, backwashing frequency, and their effects on PFAS removal efficiency.
- **Filter Efficiency:** Assess performance under varying EBCTs and loading rates.
- **Seasonal Variations:** Investigate source water quality impacts on PFAS removal and additional benefits, such as reduced disinfection byproducts.

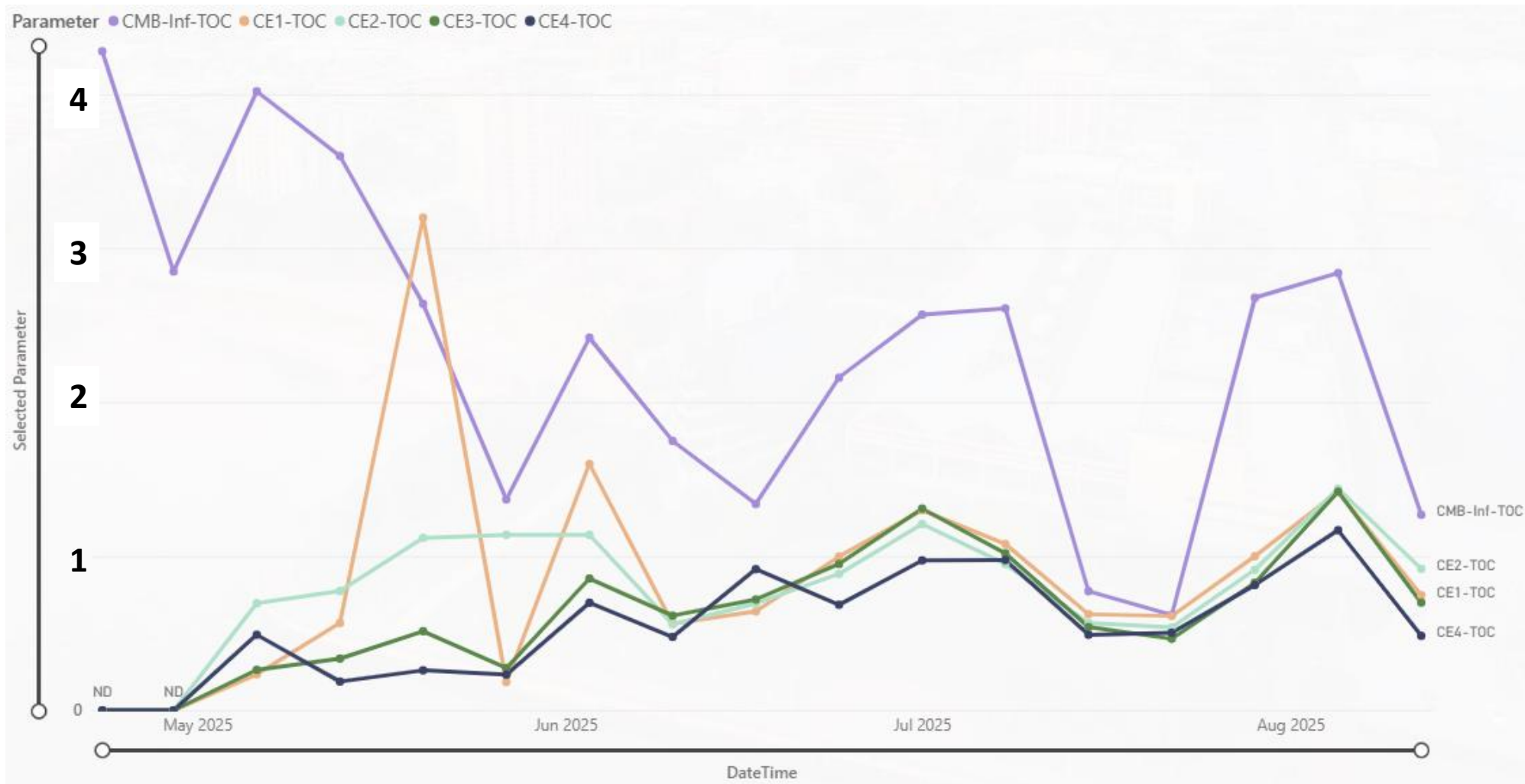
Anticipated Outcomes of Pilot Study

- **Validated Performance:** Provide defensible PFAS removal and water quality data (organics, inorganics) to support full-scale filter-adsorber integration.
- **Optimal EBCT:** Identify the best EBCT for the filter-adsorber concept, compatible with current or modified filter gallery structures.
- **Breakthrough Insights:** Develop PFAS and TOC breakthrough curves to estimate media replacement frequency.
- **Backwashing Strategy:** Determine the optimal backwashing approach to maintain adsorption, filtration, and biological activity with minimal disruption.

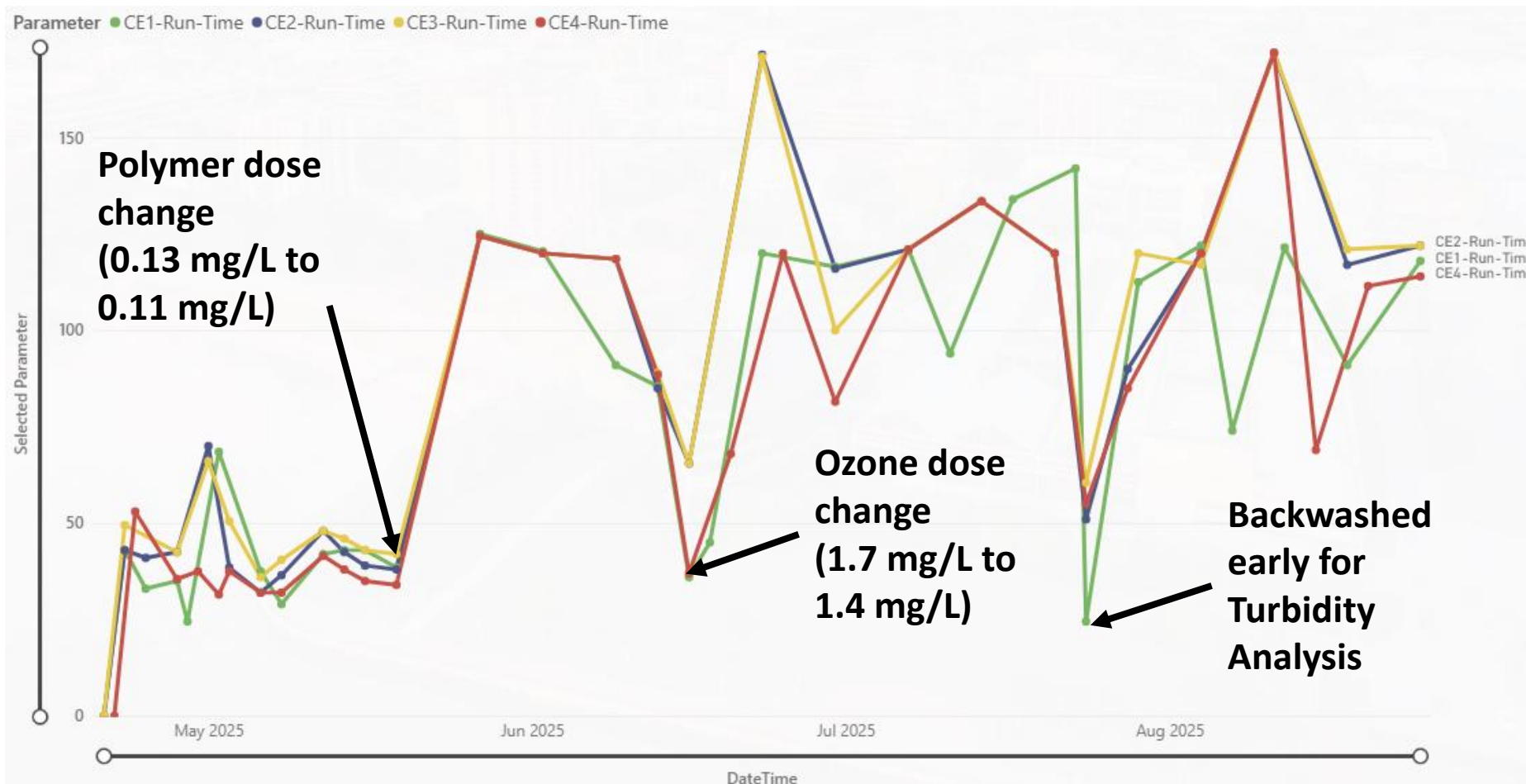
Arsenic During Start-Up



Water Quality Data - TOC



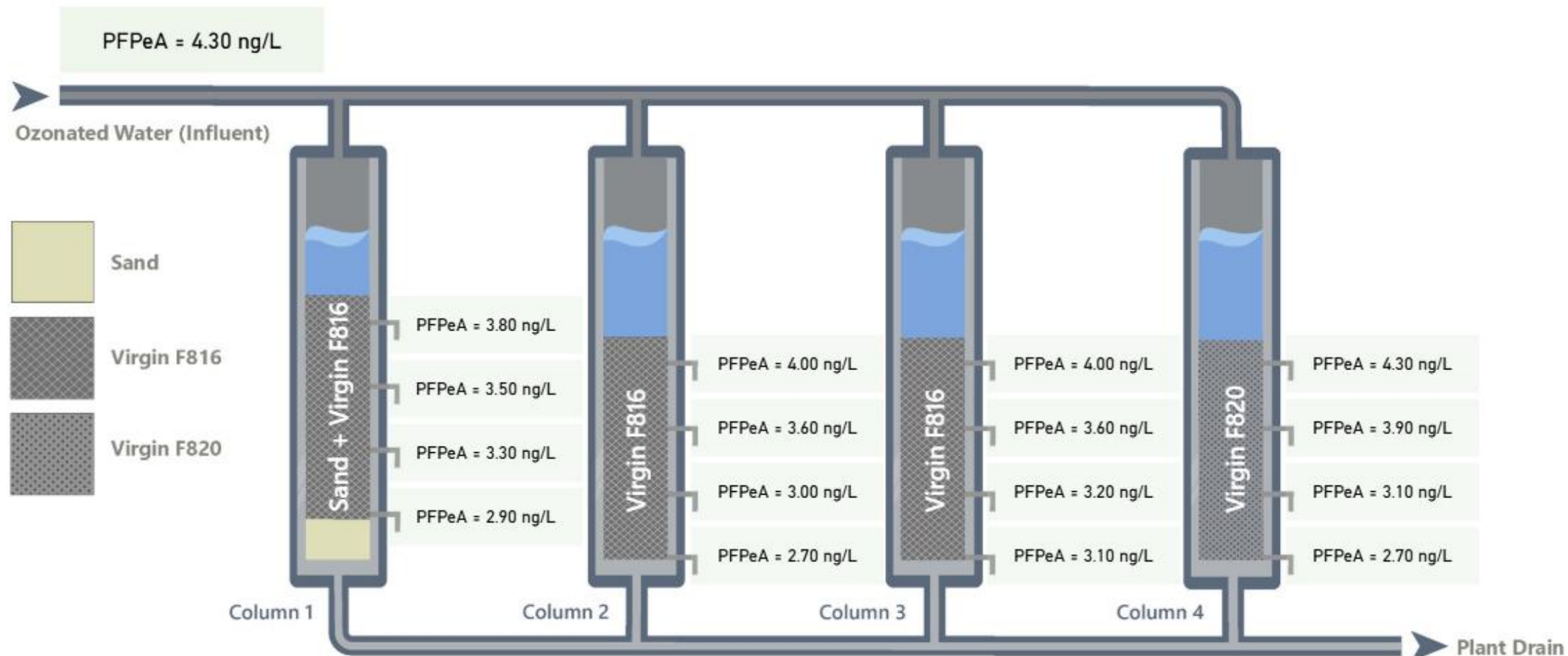
Water Quality Data – Run Time



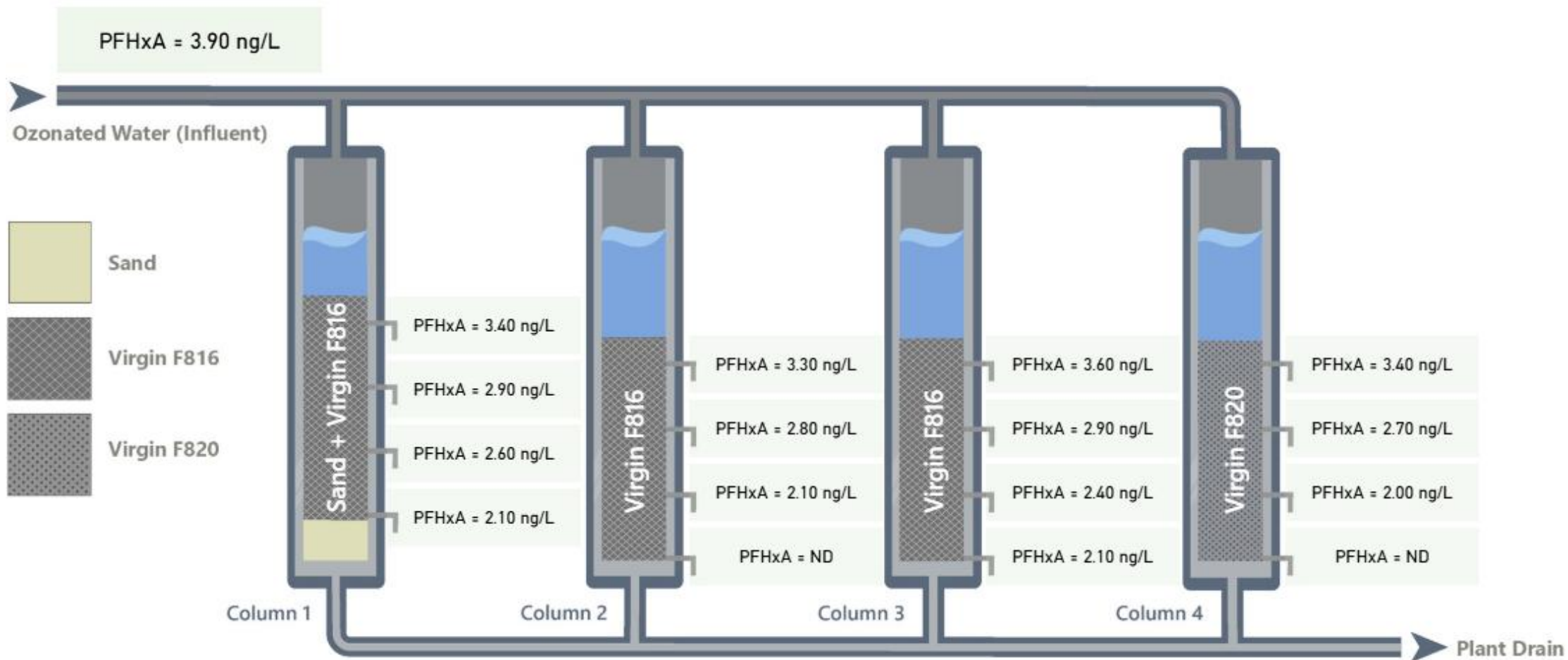
Column	Avg Run Time (hours)
1	104
2	120
3	121
4	106
LHWTP	

*Since 5/19/25

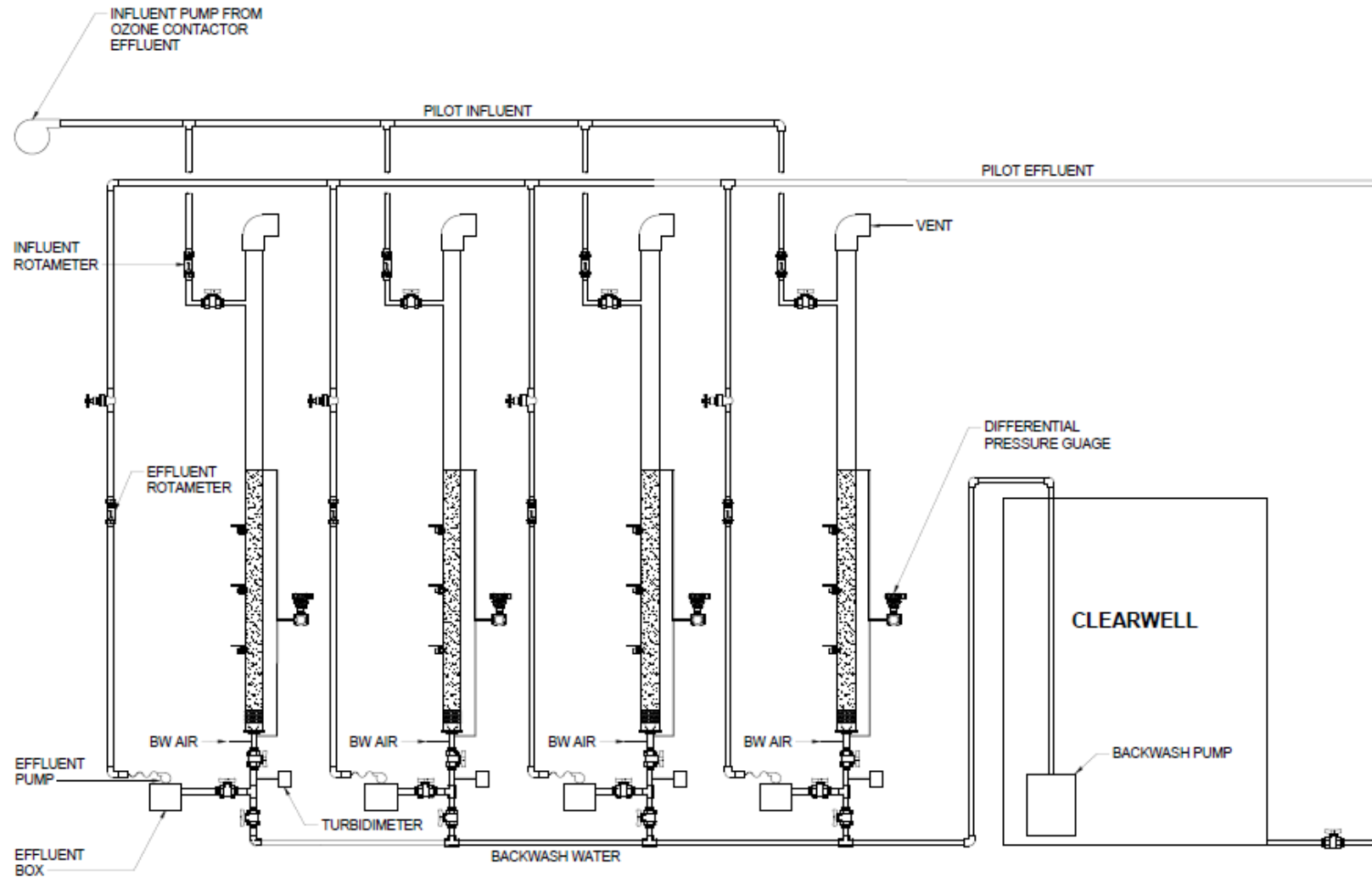
PFPeA



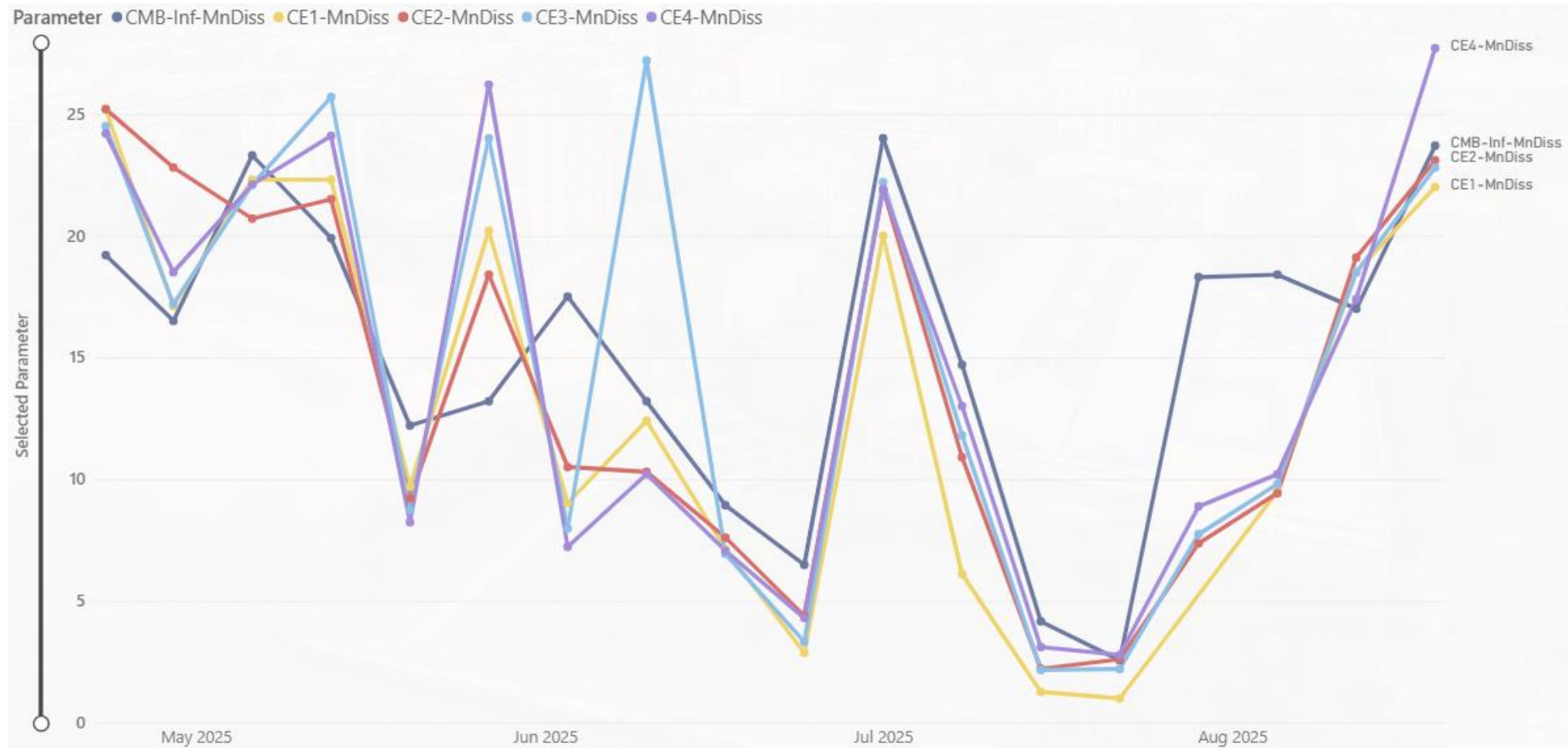
PFHxA



Pilot Plant Schematic



Water Quality Data - Manganese



Water Quality Data - Iron

