PENNSYLVANIA AMERICAN WATER

GANNETT FLEMING | TRANSYSTEMS

A Dive into PFAS Pilot Studies

Removing PFAS from Four Surface Water Plants Throughout Pennsylvania

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Agenda

- Introduction
- Information about Facilities
- DEP Piloting Guidance
- Pilot Design
- Observations
- Lessons Learned

About American Water

Largest regulated water and wastewater company in the United States

- Founded in 1886, American Water (NYSE: AWK) has **served customers and communities for more than 135 years**.
- We serve a broad national footprint and maintain **a strong local presence**.
- We treat and deliver more than **one billion gallons of water daily**.
- We provide services to more than **14 million people with regulated operations in 14 states and on 18 military installations**.
- We **employ 6,700 talented professionals** who leverage their significant expertise and the company's national size and scale to achieve excellent outcomes for the benefit of customers, employees, investors and other stakeholders.

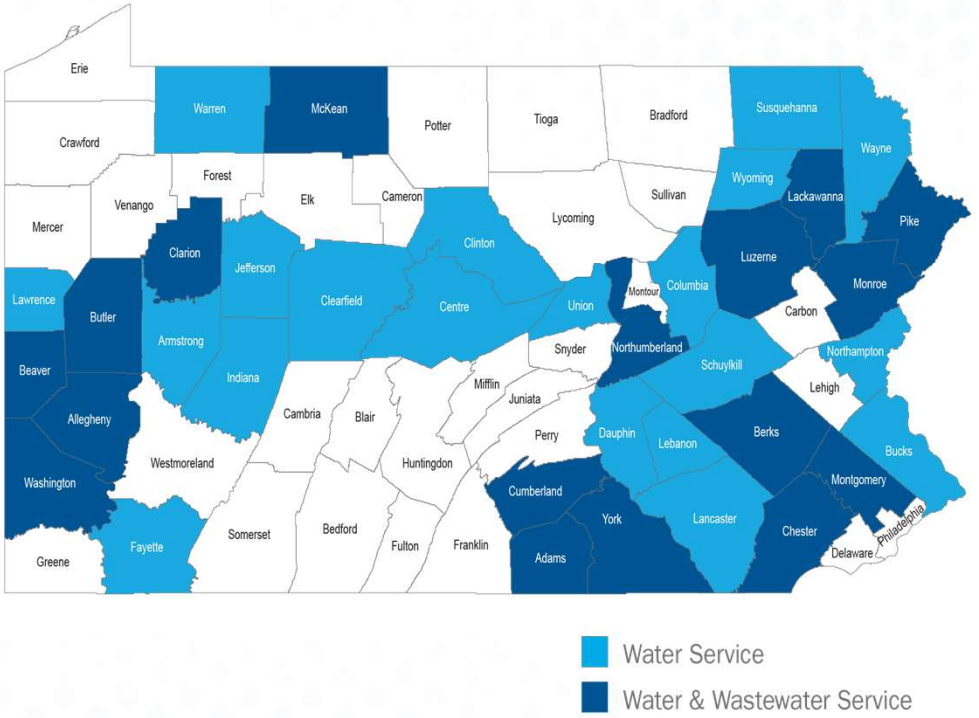
American Water corporate headquarters located in Camden, N.J.

About Pennsylvania American Water

Pennsylvania American Water is the largest regulated water and wastewater service provider in the Commonwealth.

Our approximately **1,170 employees** serve:

- Approx. **2.4 million people** in **418 communities** in **37 counties** (19% of the population)
- **687,600 water customers**
- **114,900 wastewater customers**



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Pennsylvania American Water Operations

Our assets at a glance:

- **37** water treatment plants
  (Average daily delivery: 192 MG)
- **27** wastewater treatment plants
  (Total daily capacity: 75 MG)
- **12,080** miles of transmission, distribution and collection mains and pipes
  (Water main: 10,380 miles / Wastewater main: 1,690 miles)
- **95** active groundwater wells
- **465** water and wastewater pumping stations
  (Water pump stations: 302 / Wastewater lift stations: 163)
- **292** treated water storage facilities
- **52** dams

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Background

Project Drivers

- EPA/DEP Regulations
- PFOA/PFOS near or above MCLs
- Media performance information is limited for surface water
- Evaluate full scale treatment alternatives to meeting U.S. EPA regulations
- DEP requires pilot testing
  - 9-month study or until breakthrough has occurred (whichever is longer)

Facilities Information

WTP	Location	Plant Capacity	Source
Silver Spring	South Central	8 MGD	Conodoguinet
Hershey	South Central	11 MGD	Swatara & Manada
Ellwood	Western	8 MGD	Connoquenessing & Beaver River
Norristown	Southeast	18 MGD	Schuylkill

Raw Water Quality

Parameter	Silver Spring	Hershey	Ellwood	Norristown
TOC, mg/L	1.4	1.4	3.8	2.9
Coagulant	Ferric	Ferric	Alum	Ferric
Hardness	190	112	171BR, 133CC	139 (Plant Eff)
Iron, mg/L	0.01	0.020	0.01	0.26
Manganese, mg/L	0.02	0.021	0.02	0.16
pH	7.7	7.4	7.2	7.8

Notes:

- The above numbers reflect average values
- BR – Beaver River, CC – Connoquenessing Creek

Project Approach

- Test at least two GAC
- Test at least one resin
- Test at least one alternate media (Cetco Fluorosorbs)
- 9-month duration
- Goal to have 80% breakthrough in approximately 6 months
- Provide information needed for full scale design of a PFAS treatment system

Selected Media

	Silver Spring	Hershey	Ellwood	Norristown
GAC1	Calgon Filtrasorb 400	Calgon Filtrasorb 400	Calgon Filtrasorb 400	Calgon Filtrasorb 400
GAC2	Evoqua Ultracarb 1240LD	Evoqua Ultracarb 1240LD	Evoqua Ultracarb 1240LD	Evoqua Ultracarb 1240LD
IX1	Calgon Calres 2301	Calgon Calres 2301	Calgon Calres 2301	Calgon Calres 2301
IX2	Dupont PSR2 Plus	Dupont PSR2 Plus	Dupont PSR2 Plus	Dupont PSR2 Plus
IX3/ Alternate	Purolite PFA694EBF	Lanxess Lewatit TP 108 DW	Cetco Fluorosorb 400	Lanxess Lewatit TP 108 DW
Alternate	Cetco Fluorosorb 200	Cetco Fluorosorb 200	Cetco Fluorosorb 200	Cetco Fluorosorb 200

Permitting

DEP Guidance

Media Selection

- Test at least three media
- Consider water quality:
  - PFAS
  - Anions, TDS
  - Metals
  - VOCs, SOCs, NOM
  - Turbidity
  - Hardness, alkalinity, pH, temperature
  - Emerging contaminants
  - Pre-treatment chemicals

PADEP Guidance: PFAS Pilot Sizing

Ion Exchange Resin

- Minimum 3-inch diameter
- EBCT >= 2.5 minutes
- HLR <=12 gpm/sf
- Media Depth >= 3 ft

GAC

- Minimum 3-inch diameter
- EBCT >= 10 minutes
- HLR <=6 gpm/sf
- Media Depth >= 3 ft
- Initial backwash
- 30% expansion

Pilot Design & Operation

Pilot System Design Example

Parameter	Full-Scale Concept		Pilot System	
	GAC	IX Resins/ Fluorosorb	GAC	IX Resins/ Fluorosorb
Vessel Dia. (ft.)	12	12	0.33	0.33
Bed Depth (ft.)	12.4	4.1	6 (3/column)	2.5
Bed Volume (cf)	1,400	460	0.26 x 2	0.22
Flow Rate (gpm)	7,640	7,640	0.84	1.2
HLR (gpm/sf)	9.65	13.5	9.65	13.5
EBCT (min)	9.6	2.25	2.3 x 2	1.4
Total Bed Volumes / 6 mos.			56,500	190,000

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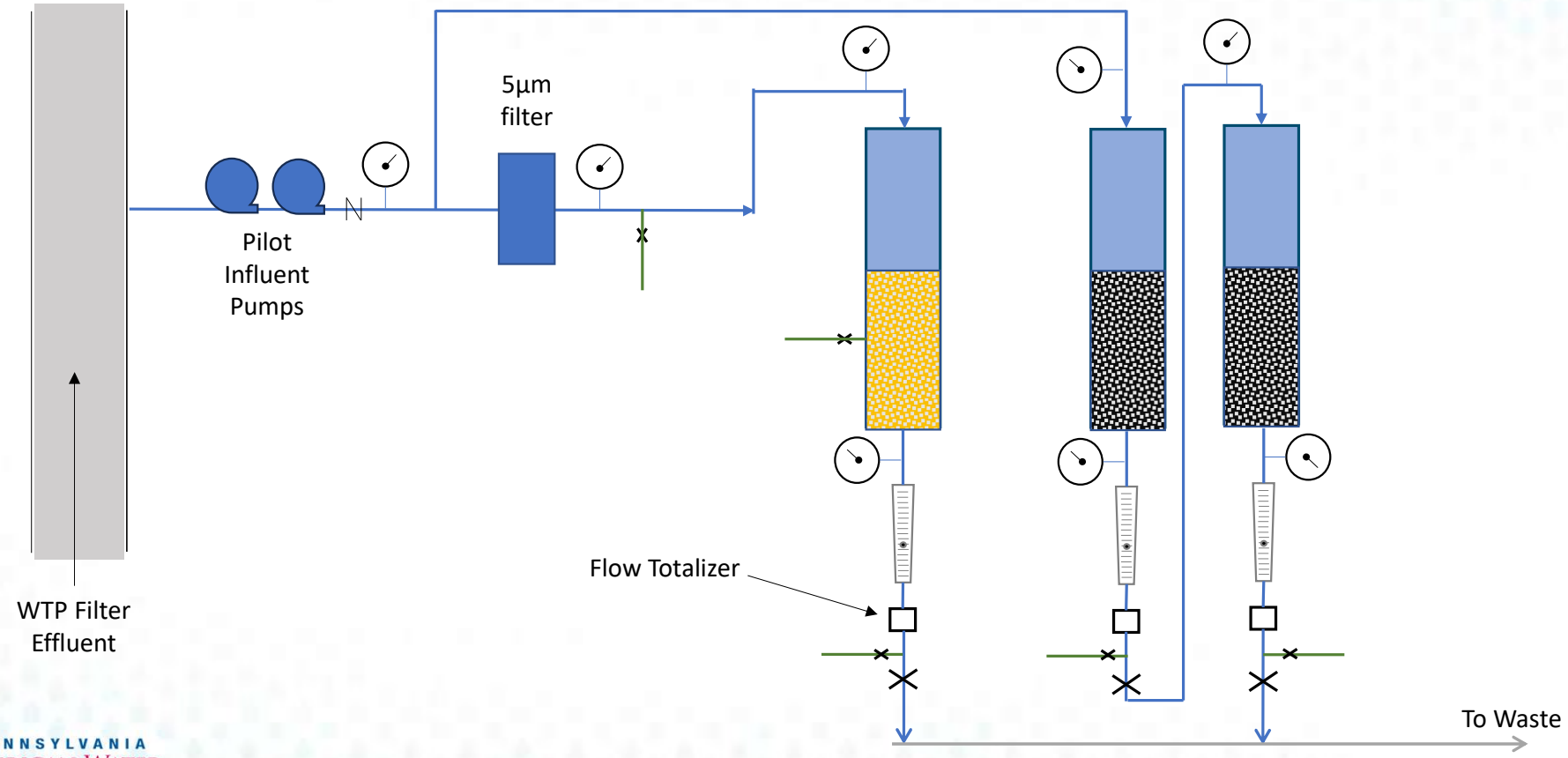
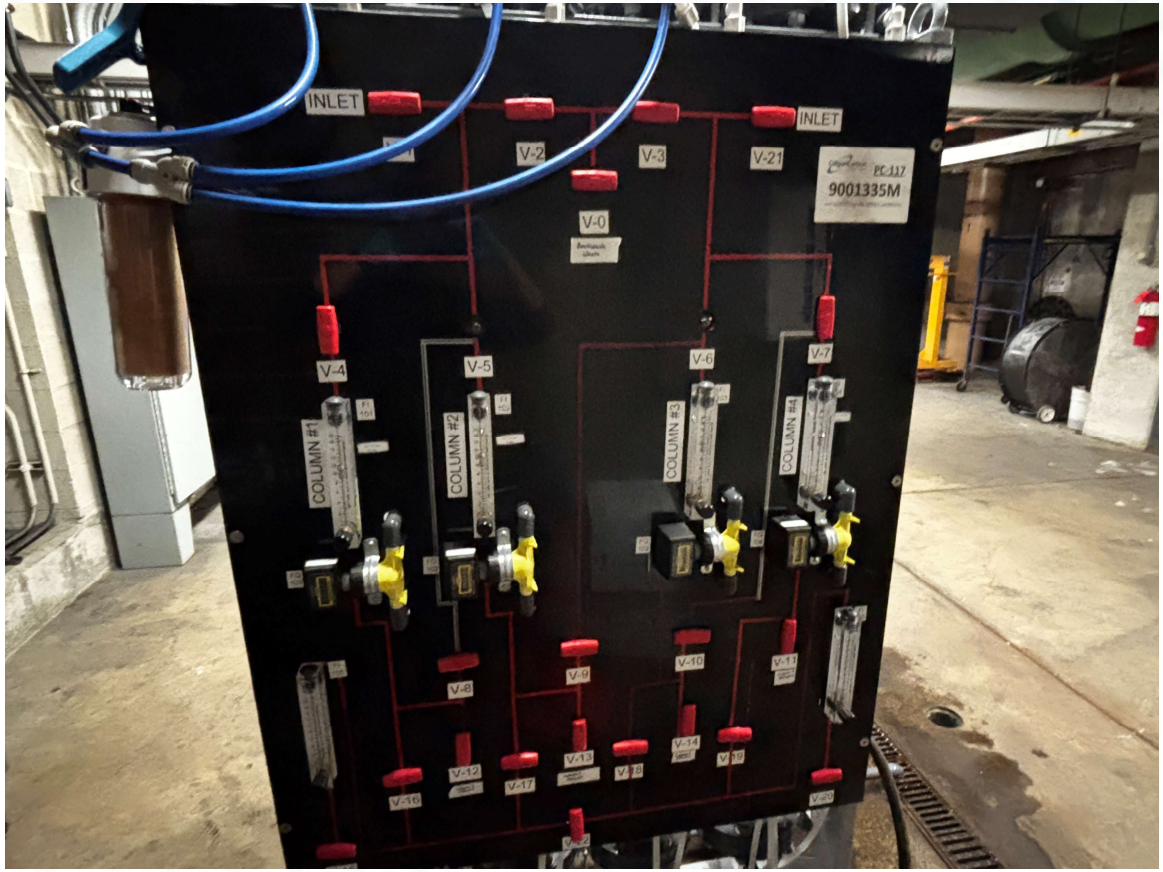
Example Schematic





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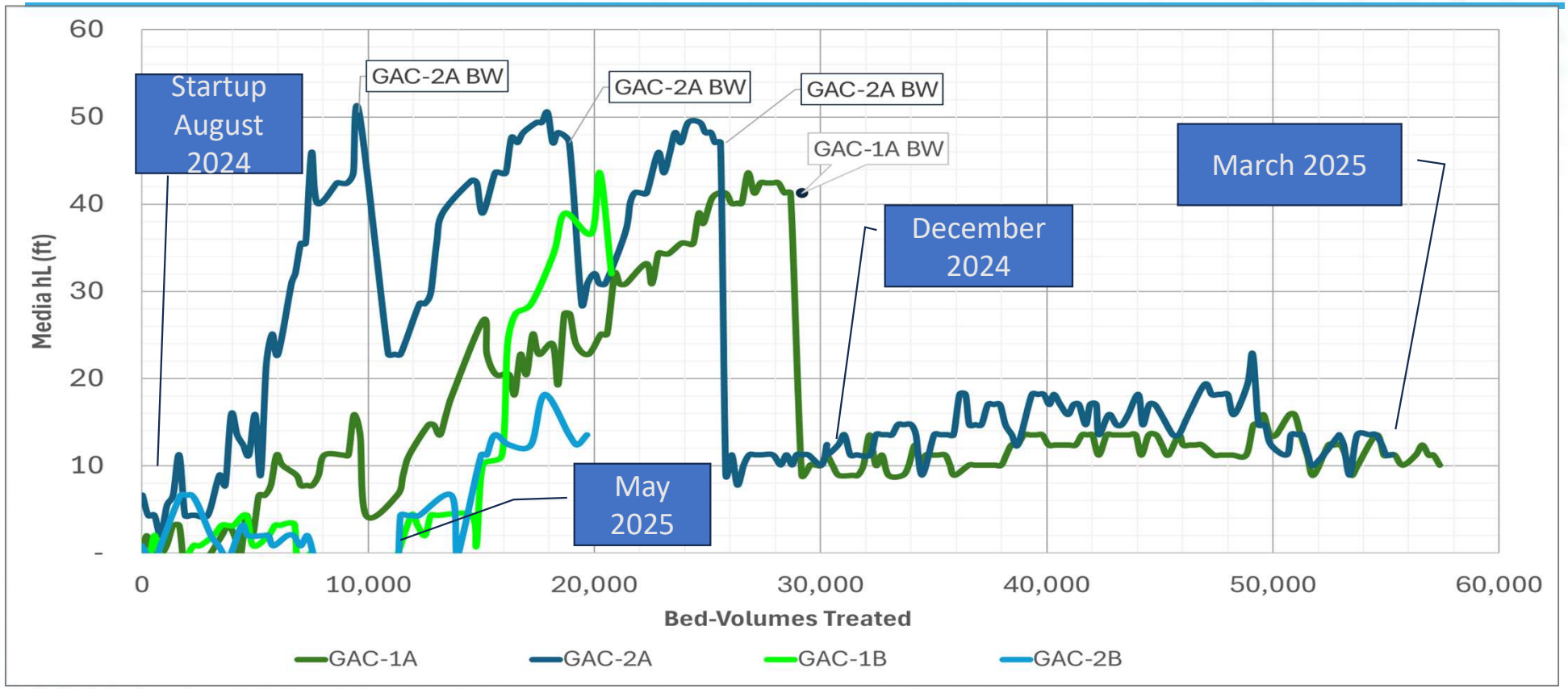
Pilot Operation

- Pressure – each column influent/effluent
  - Headloss calculations
- Flow Rate
  - Controlled by downstream rotometer for each column
  - Adjust rotomoter as needed to maintain target flow
    - *Backwashing required when headloss rises > 30 to 35 ft +/-
- Total Flow
  - Record daily
  - Use to calculate bed volume treated
    - *BVs = flow treated (gal) / bed volume (gal)
- Pre-Filtration
  - 5-micron filter used upstream of IX Resins to remove solids
  - Not required for GAC and Fluorosorb
  - Replace as headloss increases
- Sampling – Influent, Mid-point, and Effluent

Monitoring

Parameter	Why?
PFAS	Monitor load on media. Monitor breakthrough. Regulatory compliance.
Anions (Nitrate, Sulfate, Chloride)	Media impact on treated water quality. Impact of anions on performance (resins).
Total organic carbon (TOC)	Media impact on treated water quality. TOC impacts performance (esp. GAC)
pH, Alkalinity	Initial changes to effluent quality. Can impact adsorption performance.
Fe, Mn, Al	Potential for media fouling.
Turbidity	Potential for media fouling, headloss accumulation
Free chlorine	Resins are sensitive to oxidants

Headloss



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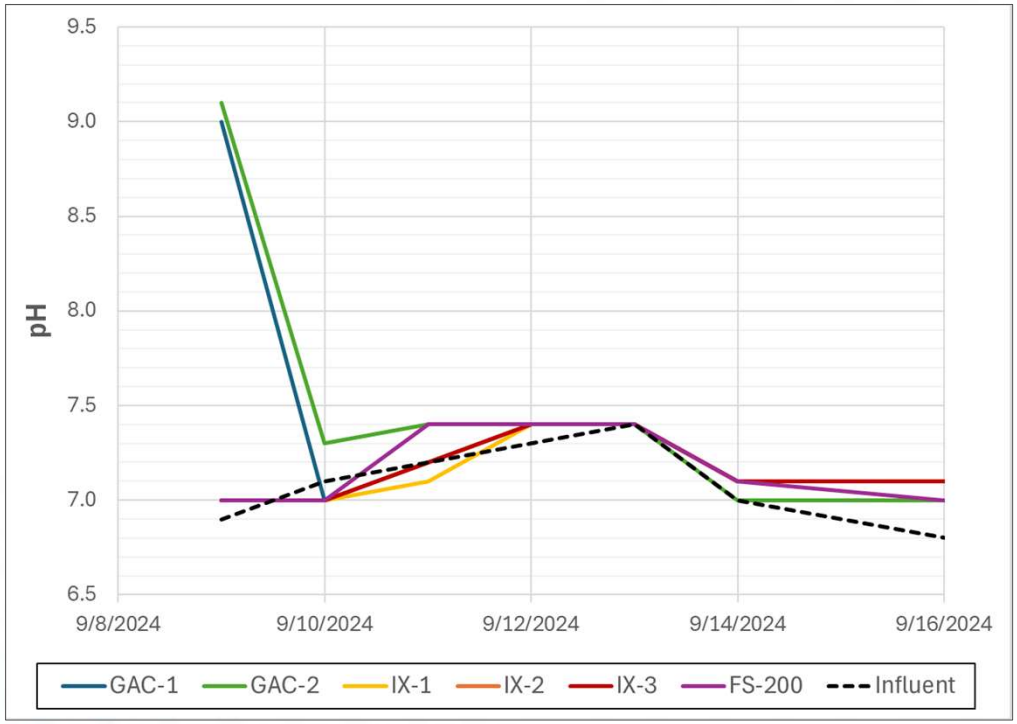
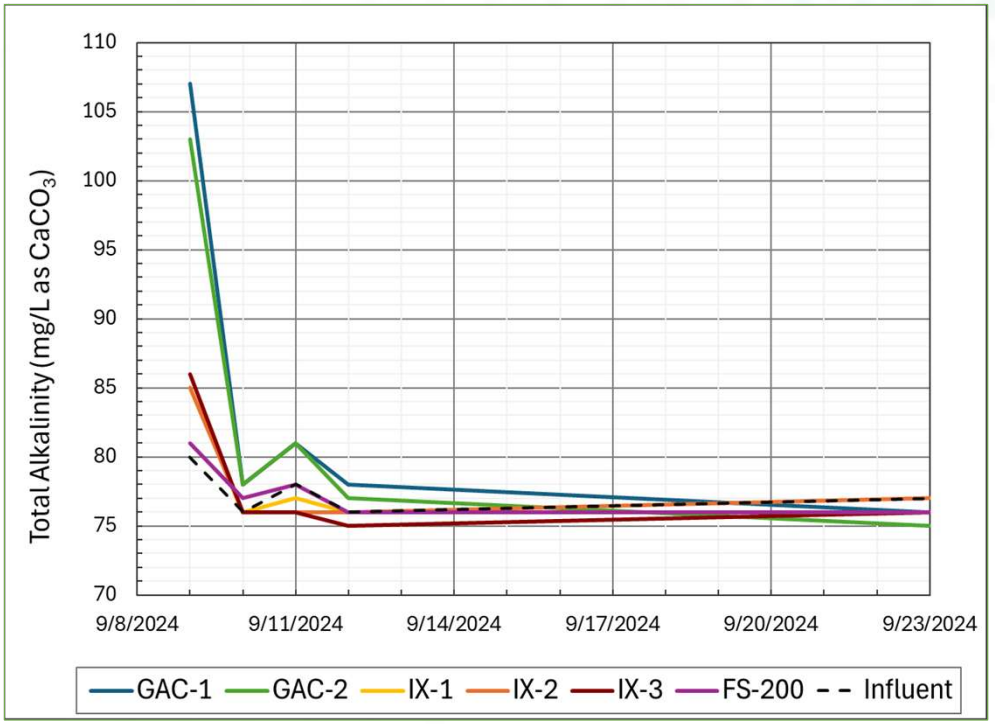
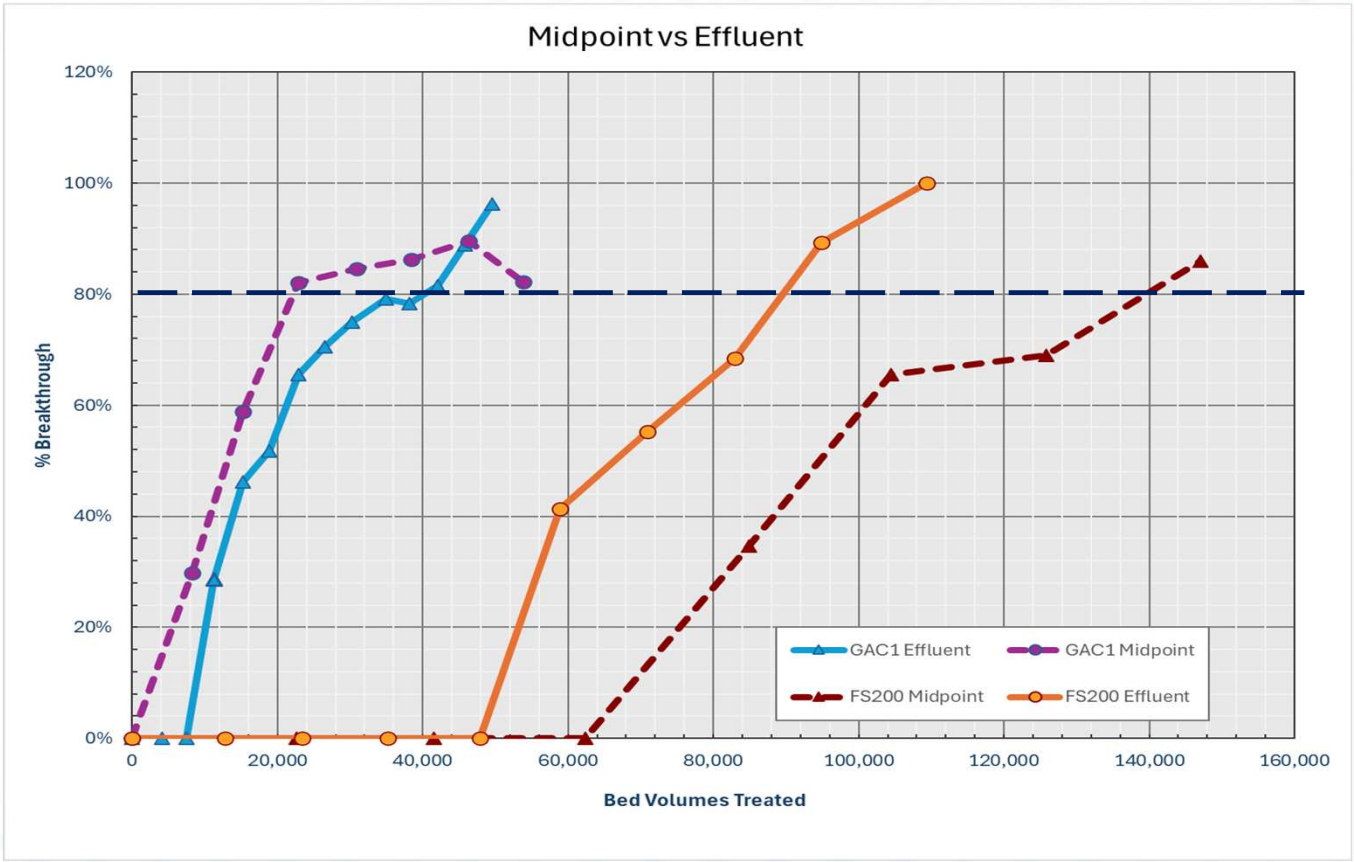
GAC vs IX Startup Stabilization Period





Observations

Midpoint and Effluent Breakthrough



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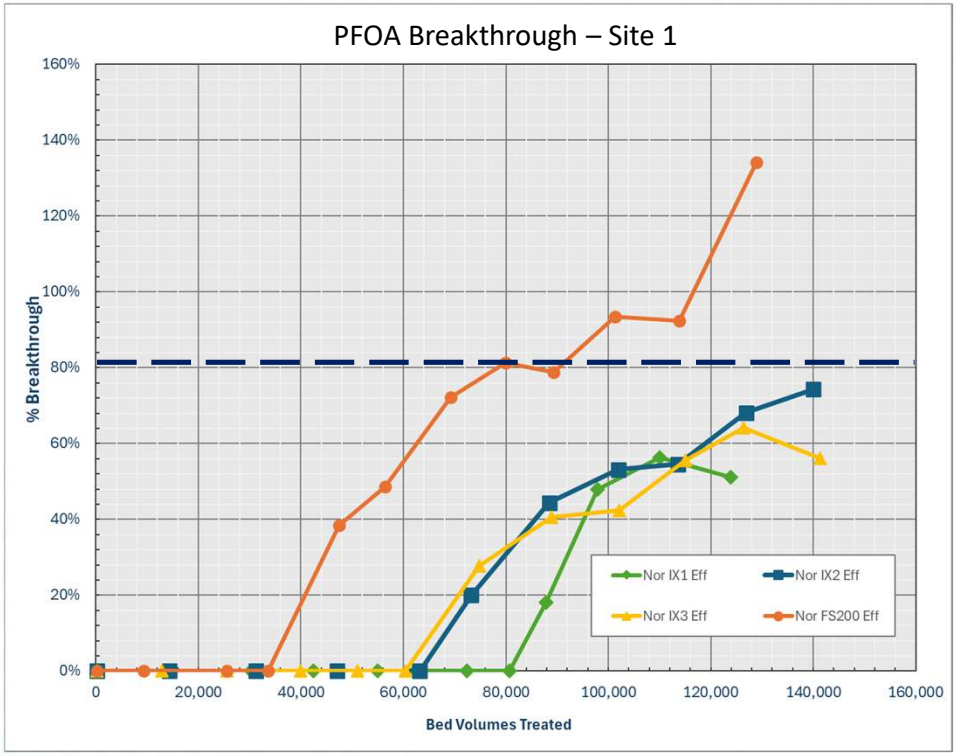
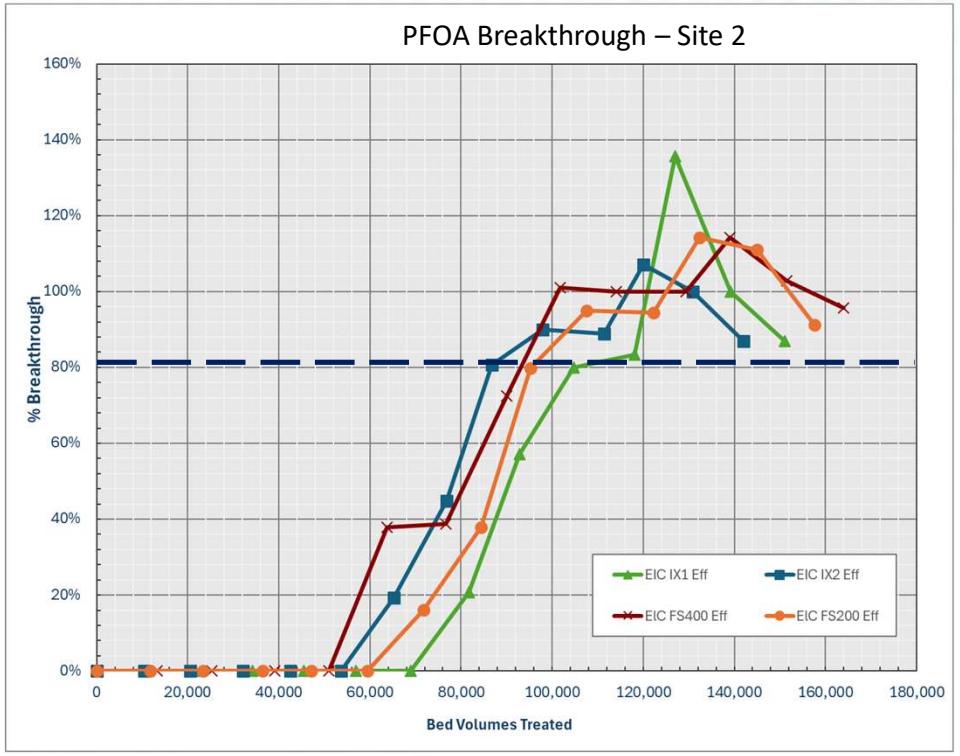
Source Water Effects on Breakthrough





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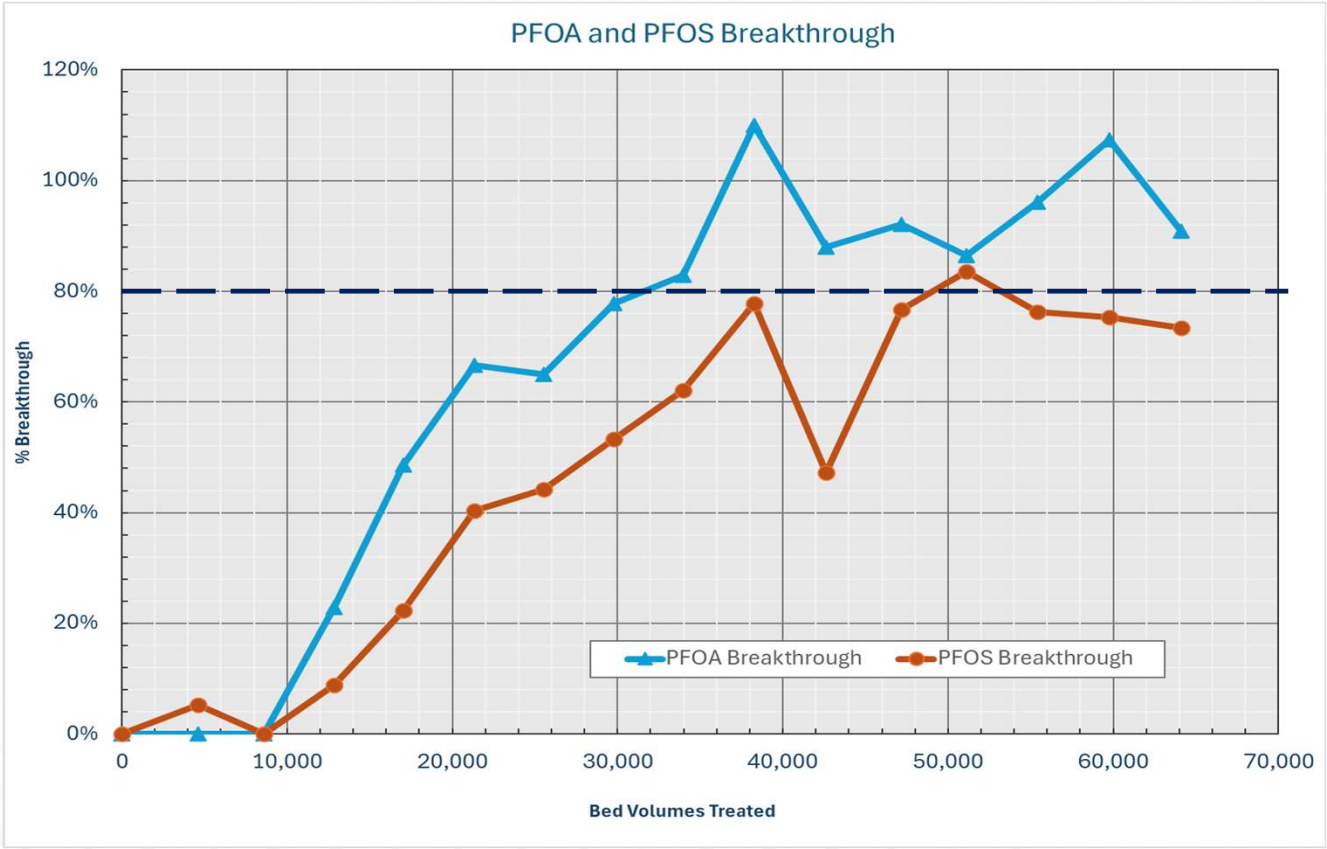
PFOA – Determines Bed Life



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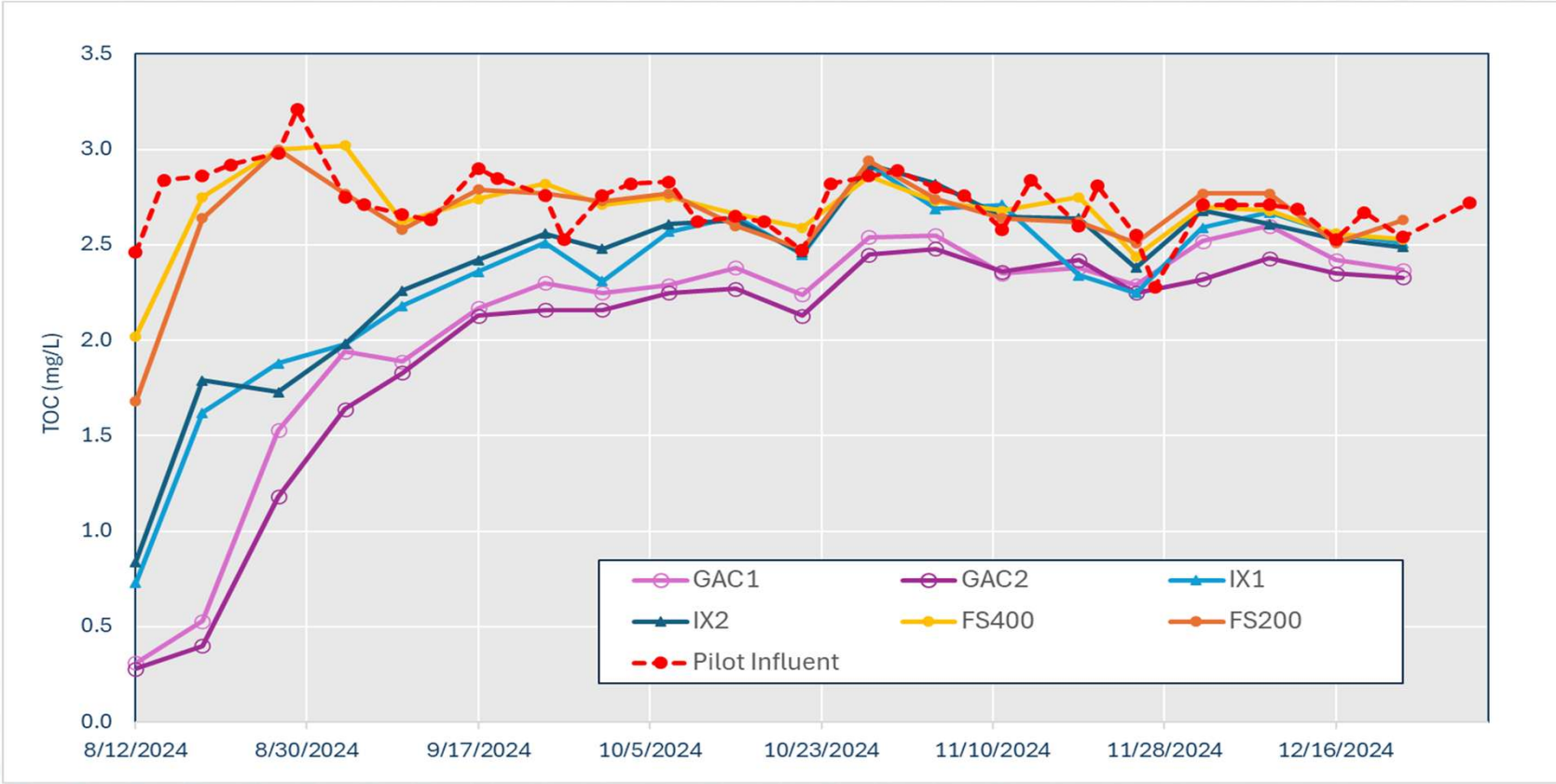
Performance Comparison – TOC Removal



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Takeaways

Lessons Learned – Pilot Setup and Installation

- Pilot supply headloss
- Pre-filtration
  - Nominal versus absolute
  - Replicate full scale implementation
  - Consider pre-filter and PFAS bed life
- Fouling and backwashing
- Pilot unit placement
  - Height constraints
  - Place in location that can get wet
  - Floor drain

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Lessons Learned – Full Scale Design

- Media selection
  - GAC selected
- Loading rates
  - Bed life
- Fouling considerations
  - Design maximum DP
  - Backwash and Waste Handling
- Initial Water Quality Changes
  - Waste Handling

	9.2 gpm/sf Design HLR	6.1 gpm/sf Design HLR
Number of Trains	12	18
Average HLR (gpm/sf)	5.9	3.9
Average EBCT (min)	16	24
Bed Life (days)	440	660
Bed Replacements/Year	10	10
Backwash Frequency (days/unit)	70	100
Backwashes per Year	96	60

Questions?