PFAS Treatment Method Optimization for a Large Public Water Utility

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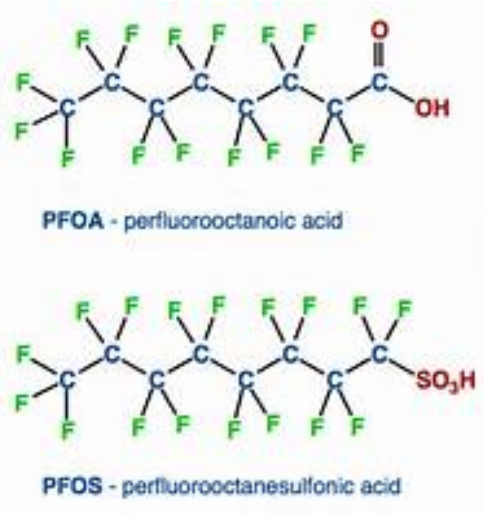
Weston & Sampson℠

PFAS Background

- Per- and Poly- Fluoroalkyl Substances are used in making fluoropolymer coatings
- Environmental Persistence
  - Resistant to:
    - Oil and Grease
    - Staining
    - Water
    - Heat
- Bioaccumulation
  - <1 week to 10 years
  - “Long” chain vs “short” chain



PFAS Background

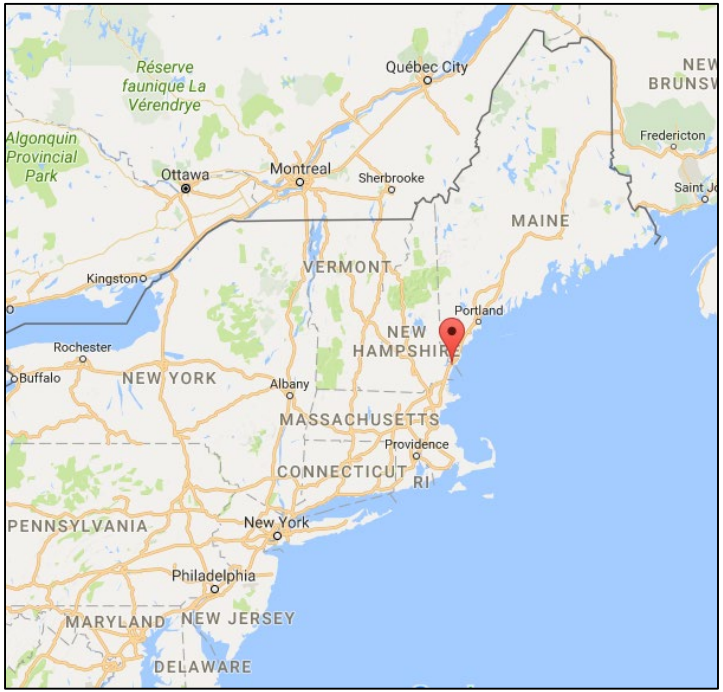
So where is it? (In high concentrations)

- Airports
- Air Force Bases
- Naval Facilities
- Fire Fighting Academies
- Manufacturing Facilities

Changing Drinking Water Standards

- 2009 – Initial USEPA pHA
  - PFOA – 400 ng/L
  - PFOS – 200 ng/L
- 2016 – Revised USEPA lifetime health advisory
  - PFOA + PFOS (Combined) – 70 ng/L
- Individual States
  - New Jersey – 13/14 ng/L (individual compounds)
  - Vermont – 20 ng/L (combined five compounds)
  - Connecticut/Massachusetts – 70 ng/L (combined five compounds)
  - New Hampshire – 38 ng/L (PFOA), 70 ng/L (PFOS), 85 ng/L (PFHxS), 23 ng/L (PFNA)
- Affected communities pushing for 1 ng/L limit
  - Based on long term exposure to PFAS

Case Study: Former Pease Air Force Base



- Portsmouth, NH
- Shut down in 1991
- Airport with split use between commercial flights and Air National Guard
- Expanding office space with some light industrial, college buildings, golf course, restaurants, day care centers

Previous Ground Water Contamination

- VOCs plumes (TCE/PCE) found around Haven Well
- A WTP constructed in the mid 1980's to treat for VOCs
- 1990 site remediation started under CERCLA
- Due to low demand (base closure) and steadily improving GW quality, WTP never activated, equipment removed in 2013

Pease Well Is Shut Down After Unregulated Contaminant Discovered

By SAM EVANS-BROWN • MAY 22, 2014

Tweet Share Google+ Email

May 2014

Article published May 22, 2014

Contaminated well shut down at Pease Tradeport

PORTSMOUTH — A well that serves the Pease International Tradeport has been shut down after testing positive for a chemical contaminant, according to the state Department of Environmental Services.

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Local and Federal Legislative Delegation

March 18, 2015 - Senator Shaheen addresses Pease PFC contamination to U.S. Air Force

2016 – Governor (now Senator) Hassan meets with Testing for Pease representatives

Technical Response Team Forms

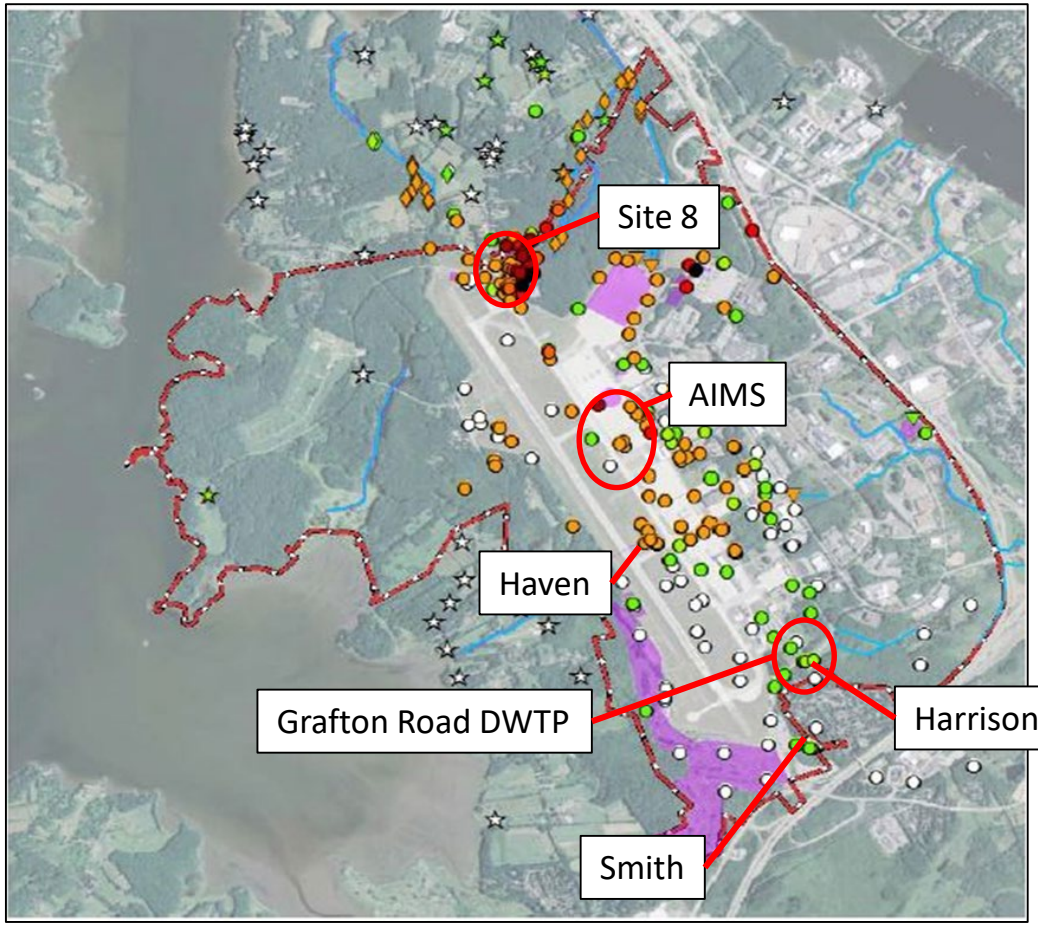
- **Weekly meetings (initially) either in-person or via teleconference:**
- City of Portsmouth Staff
  - City consultants
- Pease Development Authority
- Environmental Protection Agency
- New Hampshire Department of Environmental Services
  - Waste Division
  - Drinking Water and Groundwater Bureau
- Air Force Civil Engineering
  - Air Force Consultants
- New Hampshire Health and Human Services
- Agency for Toxic Substances and Disease Registry (ATSDR)
- Others, depending on topic

Public Involvement:

- Presentations to Portsmouth City Council
- Haven Well Community Advisory Board
  - 14 public meetings in 2014
- Blood Testing
  - March 31st, 2015 – Public Meeting where NHHS Announces Protocol for Pease Blood Testing
  - Three public meetings announcing blood test results
- ATSDR Community Assistance Panel
  - Formed in 2016 to address long-term health concerns
- Pease Restoration Advisory Board
  - Reestablished in 2016

Former Pease Air Force Base

- Three treatment systems
  - Site 8 (remediation)
  - AIMS (remediation)
  - Grafton Road (drinking water)

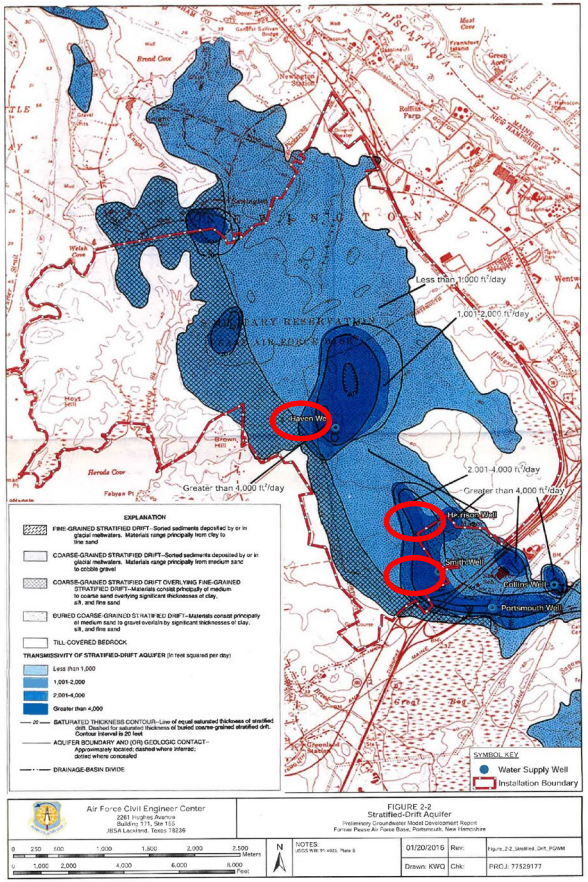


Drinking Water Sources

Initial Haven Well sample came back at 2.5 µg/L

Well	Flow Rate (gpm)	PFOA+PFOS (µg/L)
Harrison	286	0.029
Smith	343	0.012
Haven	534	1.495

Average PFOA+PFOS concentrations, Harrison and Smith: 2016-2017, Haven: 2016



Drinking Water Technologies

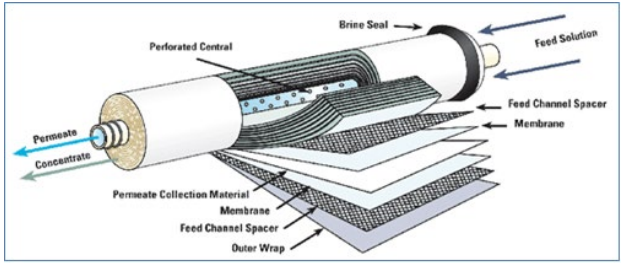
- Granular Activated Carbon
  - Advantages – cost effective, several systems in use, PFAS can be transported offsite for destruction
  - Disadvantages – may be costly to changeout for short chain breakthrough

Drinking Water Technologies

- Ion Exchange Resins
  - Advantages – custom designed treatment, long service life, smaller vessels required
  - Disadvantages – expensive if single use, new technology with limited data

Drinking Water Technologies

- Membranes



  - Advantages – near 100% removals

  - Disadvantages – waste stream, high capital and O&M costs, expertise required to operate system

Existing Facility

GAC Piloting – Harrison and Smith

Purpose – monitor GAC effects on pH

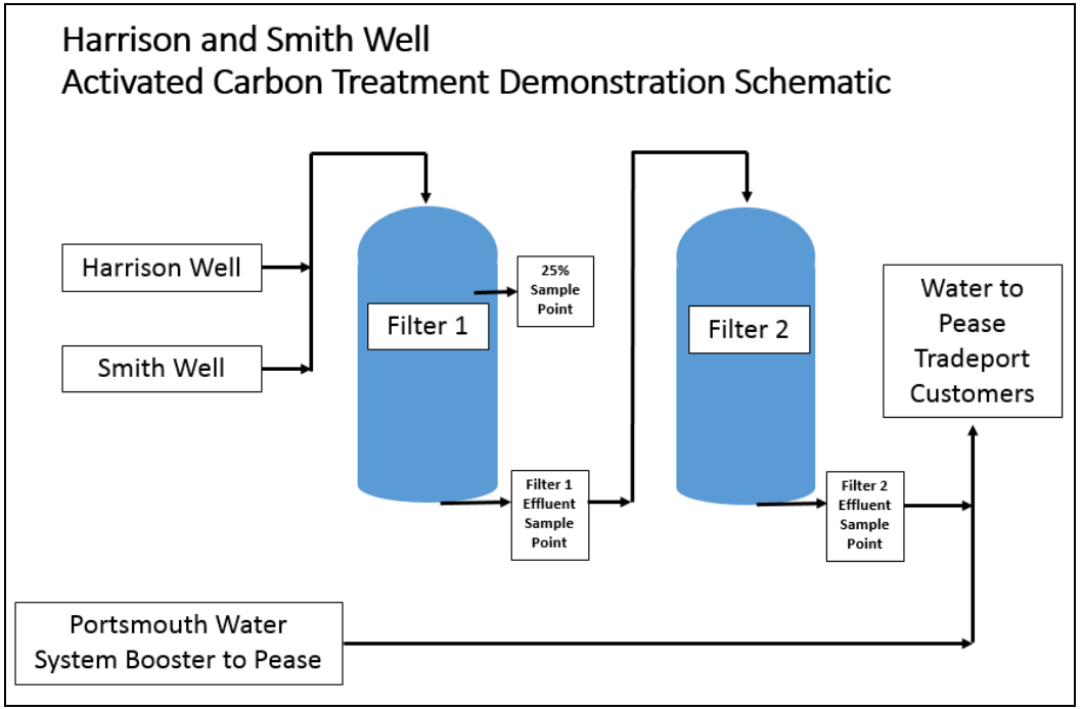
- Potential issues with orthophosphate effectiveness

Demonstration Study

Purpose

- Test GAC effectiveness on Pease (Harrison and Smith) water
- Buy time
  - Test new media
  - Further research
  - Continue negotiations

Demonstration Filter Schematic



GAC Filter Installation

Demonstration Filter Results

- 26 months of operation, ~344,000,000 gallons treated (65,530 BV)
  - GAC works well for low levels of PFOA/PFOS
- Media in PV2 replaced March 2018, All media replaced in November 2018
- Last sampling event before changeout (November 2, 2018):
  - PFOA at 75% sample port of PV1
  - PFHpA at 75% sample port of PV1
  - PFHxS at 100% sample port of PV1
  - PFHxA at 25% sample port of PV2
  - PFBA at 100% sample port of PV2
- Low concentrations result in inconsistent results (particularly PFBA)

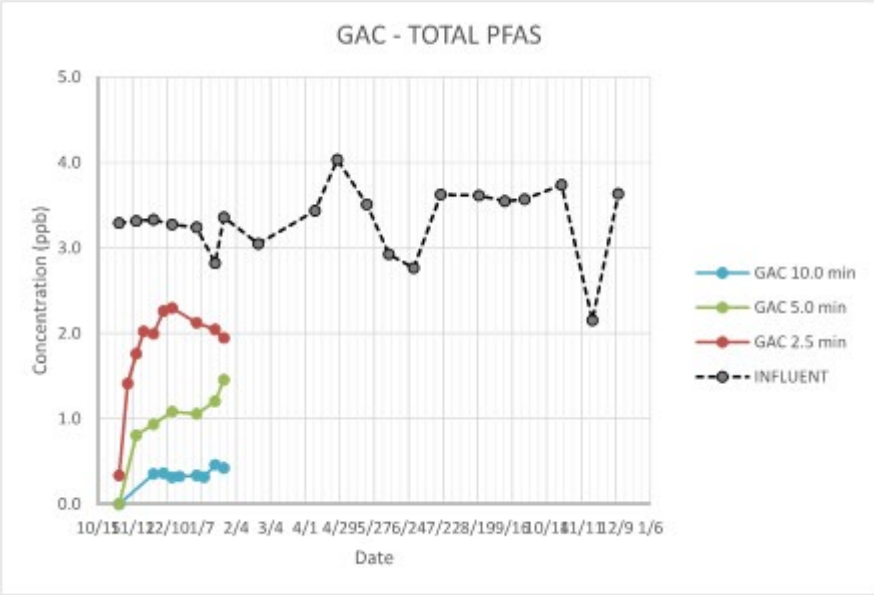
Objectives of Haven Well Pilot Test

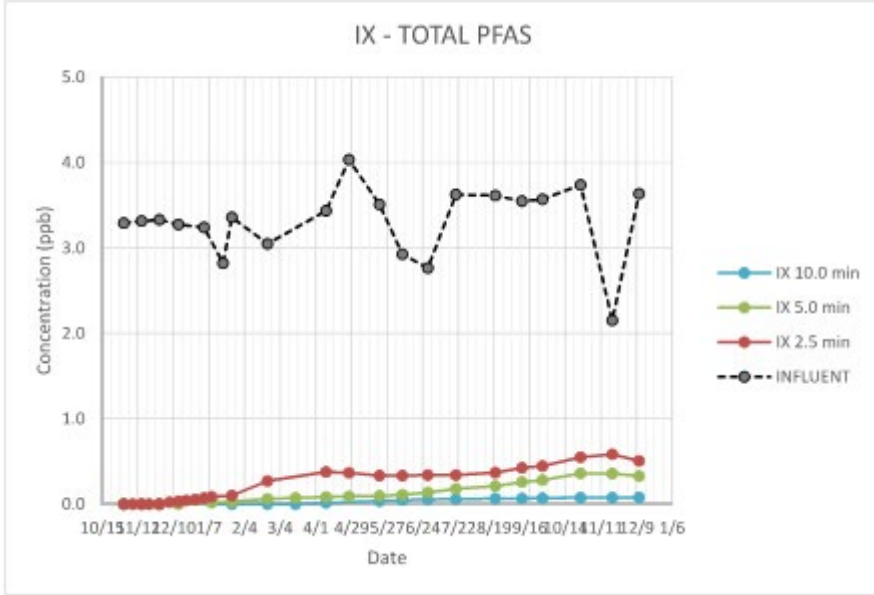
- Uncertain if GAC would perform well for significantly higher levels of PFAS.
- Compare the ability of media to remove PFAS from the Haven Well
  - IX Resin = ECT's SORBIX LC1
  - GAC = Calgon's F400
- Confirm design parameters and system sizing to be used in the preparation of the full-scale treatment system technology evaluation.
- Select PFAS-removal technology for full-scale implementation based on lifecycle cost comparison and risk

Haven Pilot Setup

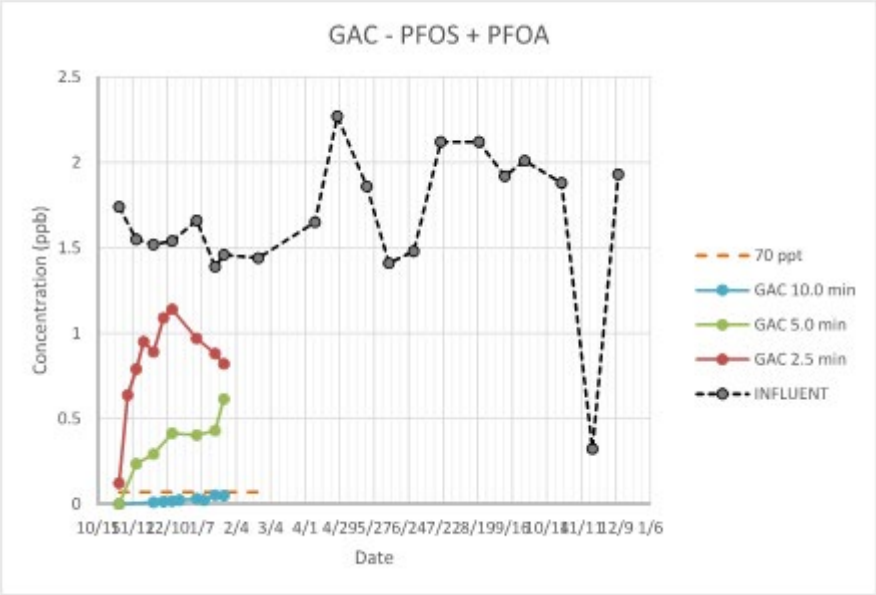
- Fabricated dual sided pilot skid for side-by-side testing: IX Resin vs. GAC
  - Each side:
    - Design flowrate of 112 gpd
    - 4 columns in series, 2.5-min EBCT each
    - 1.25-inch column diameter
    - 30-inch media bed height
- Sampled & analyzed for 23 PFAS compounds out of each column

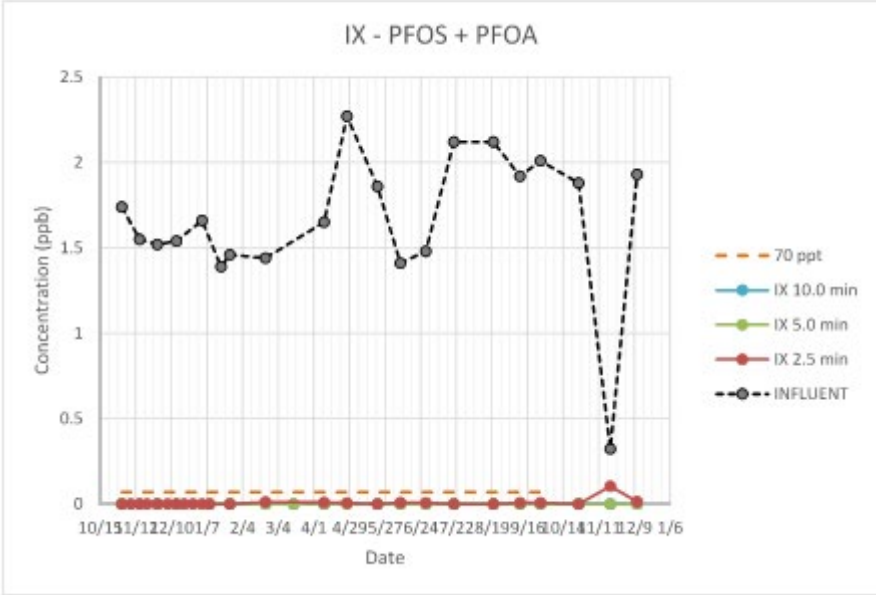
Haven Pilot Results



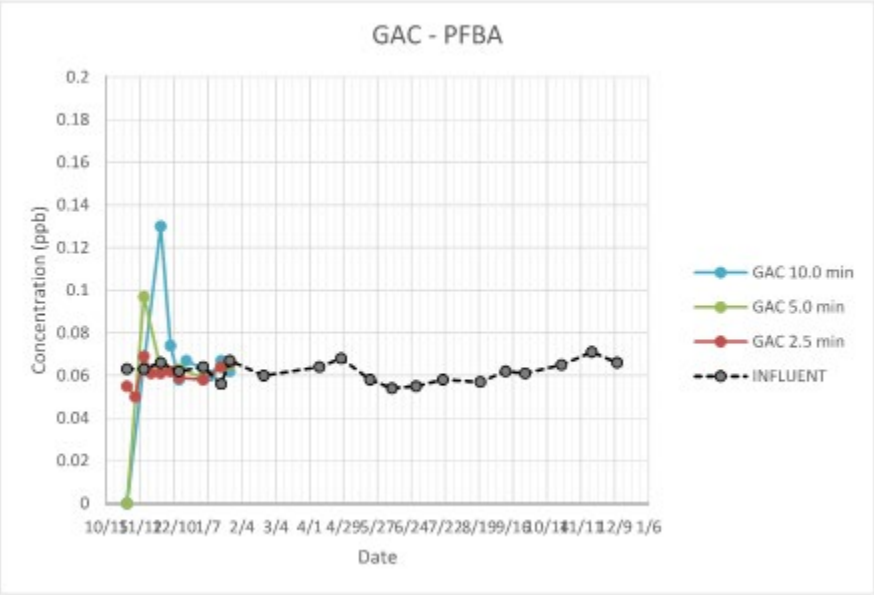


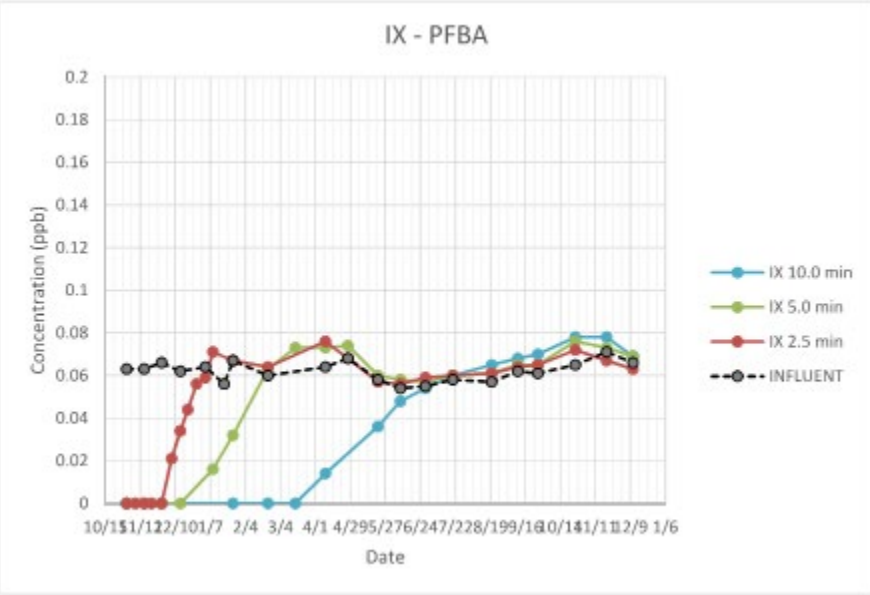
Haven Pilot Results





Haven Pilot Results





Haven Pilot Conclusions

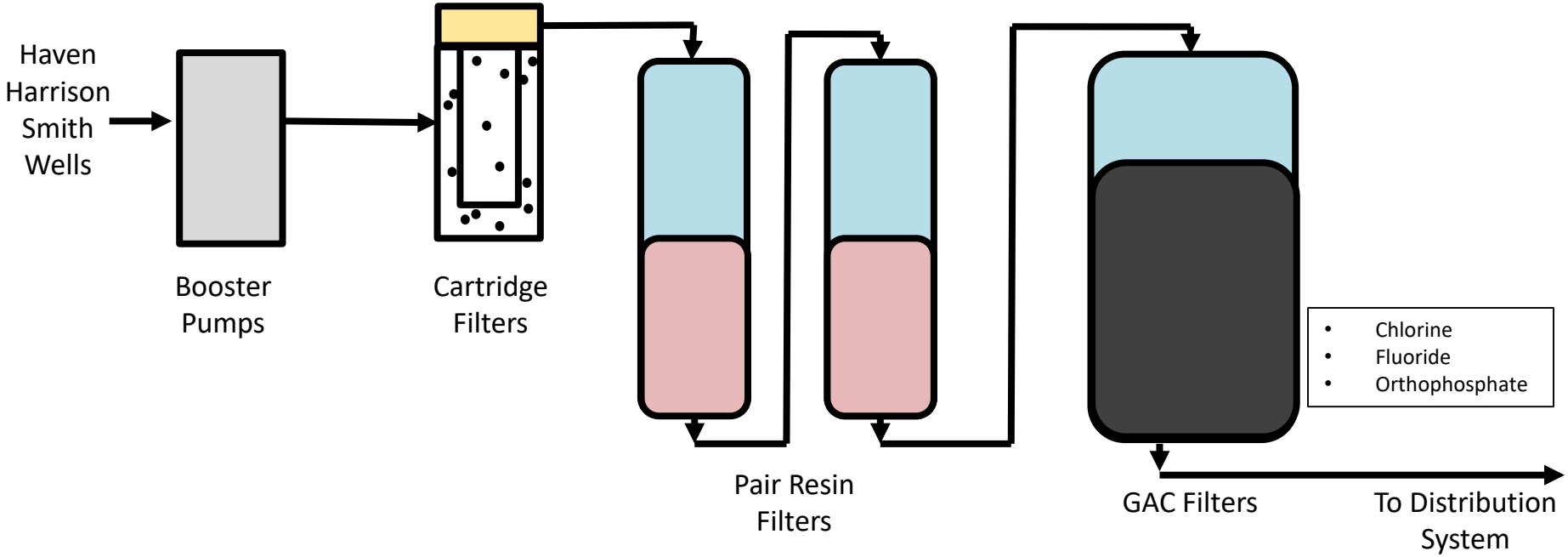
- Resin significantly outperforms GAC when raw water PFAS concentrations are high
- Resin removed short chain compounds better than GAC
- As regulations move PFAS limits lower, the advantages of resin over GAC goes up

Twenty Year Present Worth Analysis
Grafton Road Drinking Water Treatment Plant

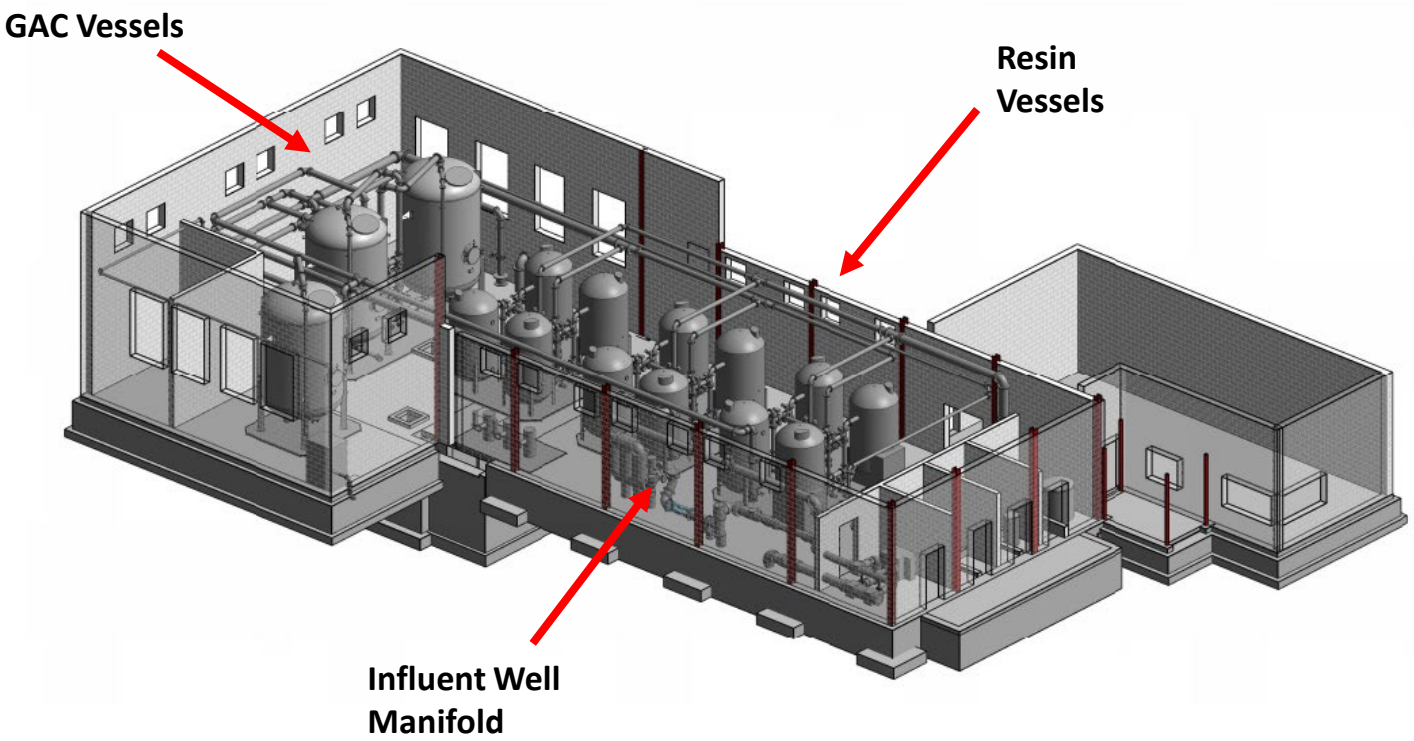
Treatment Option	Construction Cost		Operations Costs		Present Worth Cost (20 year, 4%)
	Vessels and Media	Credits*	Annual Media Cost	Increase Electrical Cost Due to Additional Headloss	
GAC Only Treatment	$2,140,000	-	$304,000	-	$6,271,000
Resin in Parallel and GAC in Series	$2,430,000	-	$91,300	$2,000	$3,698,000
Resin in Series and GAC in Parallel	$2,000,500	$(910,000)	$99,300	$8,000	$3,173,000

* Credits associated with reduction in building footprint and elimination of backwash supply and recycle tanks.

Grafton Road Water Facility Process Schematic
New Treatment System



Proposed Final Layout



Current Rendering – Grafton Road Water Treatment Facility

National Assessment of Municipal Treatment

GAC Filtration

- Ann Arbor, MI
- Aqua America, PA
- Barnstable, MA
- Hoosick Falls, NY
- Issaquah, WA
- Little Hocking, OH
- Merrimack Village District, NH
- New Castle, DE
- Newburgh, NY
- Oakdale, MN
- Portsmouth, NH (temporary filters)
- Suffolk County Water Authority, NY
- Westfield, MA

Resin Filtration

- Horsham, PA (with carbon)
- Portsmouth, NH (with carbon)
- Widefield WSD, CO (resin only)

Membrane Filtration

- West Morgan – East Lawrence, AL (expressed interest)