WRCC Meeting Summary
July 26, 2023

Attendees:

Municipalities:
☒Kevin Hann, Chair, Hampstead
☒Jim Wieprecht, Vice Chair, Taneytown
☒John Dick, Westminster
☒Gary Dye, New Windsor
☐Delbert Green, Manchester
☒Mayor Perry Jones, Union Bridge
☐Rodney Kuhns, Manchester
☒Alex Perricone, Manchester
☒ Jim Roark, Hampstead
☒Kevin Rubenstein, Sykesville
☐Kevin Smeak, Taneytown
☒Dick Swanson, Mount Airy

CC LRM:
☐Brenda Dinne
☐Glenn Edwards
☒Chris Heyn, Director
☒Claire Hirt
☐Mary Lane
☐Byron Madigan
☐Kelly Martin
☒Denise Mathias
☒Zach Neal
☒Janet O'Meara
☐Ed Singer
☐Price Wagoner

Health Department:
☒Richard Brace

CCG Others:
☒Andy Watcher, CC DPW
☒Lydia Rogers, CC M&B
☒Bryan Bokey, CC DPW

Guest Speakers:
☒Phoebe Aron, Hazen
☒Jeremy Hise, Hazen

Others:
☒Joan White, City of Baltimore
☒Paul Sayan, City of Baltimore
☒Bill Felter, City of Baltimore

1. Opening Statement

Chair – Kevin Hann

Mr. Hann opened the meeting at 2:30 PM. He introduced Jim Roark, Acting Town Manager for Hampstead. All attendees introduced themselves.

Vice Chair – Jim Wieprecht

None.

2. Approval of Meeting Summary – June 28, 2023

Approval of the June meeting summary was discussed. No changes were made.

APPROVAL OF MINUTES: Motion was made by Alex Perricone and seconded by Dick Swanson to approve the June 28, 2023, meeting summary as written. Motion carried.

3. PFAS Implications for Municipalities – Phoebe Aron and Jeremy Hise, Hazen

- Phoebe Aron and Jeremy Hise with Hazen, the firm working on the Water Resources Element, presented an overview of the implications of PFAS (per-and polyfluoroalkyl substances) for the municipalities.
- EPA's proposed rule will set the maximum contaminant levels for PFOA and PFOS, the most common PFAS compounds, at 4 parts per trillion. The rule is expected to be final in early 2024.

- Since most of the water systems in the county tend to regularly rely on a high percentage of available capacity, taking any sources offline will impact available capacity.
- Hazen identified potential PFAS sources, which could include fire training facilities, fire stations, airports, landfills, and others. If a buffer were placed around these sources, some municipal wells would be considered at higher risk for PFAS contamination.
- PFAS treatment options in drinking water are limited, but there are opportunities for optimized implementation. Mitigation alternatives include well management, treatment at water treatment plants, and treatment at the source. Hazen discussed approaches for evaluating management and treatment options. The primary options include granular activated carbon (GAC), ion exchange, and reverse osmosis (RO)/nanofiltration. Hazen suggested benchmarking treatment conditions.
- Hazen also discussed how to determine cost of compliance with EPA's new rule and the associated timeline. Choice of treatment approach and costs vary depending on the option and the individual system. Hazen shared information on Peoples Water in Florida as a case study.

*Reference/**Attachment**: PFAS Workshop*

- *Carroll County WRCC: PFAS Implications for Municipalities*

4. Water Resources Element (WRE 2024) Update – Chris Heyn

- Task 1.2: Automation of Portions of Buildable Land Inventory model: Completion is anticipated for early September.
- Task 2: Groundwater Allocability: Hazen is working on technical memo and will provide a revise document soon.
- Task 3: Emerging Contaminants: Hazen will take any feedback provided at WRCC meeting regarding PFAS topic and incorporate to technical memo. The technical memo is expected in early August.
- Task 4: MDE TIPP Spreadsheet Comparison: Hazen is comparing the results of the MapShed model used previously for the TMDL implementation plans with the results of one of the watersheds using MDE's TMDL Implementation Progress and Planning tool. A technical memo will be provided in August.
- Task 5: Climate Change Impacts: Hazen is working on evaluating climate change impacts as they relate to water resources. A draft technical memo is due in August.
- Task 6: Update 2010 WRE Supporting Documents: Hazen will update the supporting documents used to prepare the 2010 WRE. This includes the capacity and demand information used to identify needs, challenges, and recommendations regarding shorter-term and long-term water supply and wastewater. Brenda Dinne is meeting with each municipality/system to review the completed workbooks, which now include demand information, prior to providing them to Hazen. The name of the workbooks has been changed to "Capacity & Demand" rather than "Capacity Management Plan" to help avoid confusion regarding the purpose of these workbooks. They are for planning purposes only and not intended to be submitted to MDE.

Reference/Attachment:

- *N/A*

5. Municipal Stormwater Projects Update – Janet O'Meara

Janet O'Meara provided an update on the municipal stormwater restoration projects.

*Reference/**Attachment:***

- *Municipal Project Status*

6. Other

- Water Conservation: Mr. Swanson shared that the Mayor of Mt. Airy is now posting videos on Facebook about water conservation.
- 20SW Facilities: Ms. Hirt reminded those who need to apply for a 20SW permit that the Notice of Intent (NOI) is due at the end of the month. If the Stormwater Pollution Prevention Plan (SWPPP) is not completed, it can be submitted separately.
- 2022 NPDES Annual Report: Ms. O'Meara stated that MDE's comments on the 2022 annual report were positive.
- 2023 NPDES Annual Report: Ms. Hirt indicated emails will go out next week or two for updating information.

7. Adjournment

The meeting adjourned at 3:56 PM. The next monthly meeting is scheduled for Wednesday, August 23, 2023, at 2:30 PM.

MEETING ADJOURNMENT: Motion was made by Mayor Perry Jones and seconded by Alex Perricone to adjourn the July 26, 2023, meeting. Motion carried.

Upcoming Meetings:

Regular Monthly Meeting – Wednesday, August 23, 2023

MUNICIPAL STORMWATER PROJECT STATUS

July 26, 2023

FUTURE PROJECTS:

Michael's Property (Hampstead) – Project is on hold until Town has obtained approval from property owners to move forward.

Meadow Ridge Basin 2 (Westminster) – Retrofit of existing facility to provide water quality through a surface sand filter. This site is adjacent to the pump station at the edge of the City limits. The County has begun sending out RFPs under the new term contract. We are expecting to send this one out within the next few months.

Hampstead Valley 2/3 (Hampstead) – Hampstead Valley facilities 2 and 3 will be retrofit as a stream restoration project to decommission Sycamore Drive as a roadway embankment. The design will include a stream restoration beginning immediately downstream of the proposed Hampstead Valley 1 facility and continue to Sycamore Drive.

CONCEPT DESIGN:

Hampstead Valley 1 (Hampstead) – Retrofit of existing detention basin to a surface sand filter. Site is located just south of Lower Beckleysville Road near a production well. CLSI is currently working on resubmitting a concept plan of a triple facility design. New Dam Safety requirements have gone into effect. These requirements include additional modeling, which may affect the current concept design.

Manchester East (Manchester) – We are looking into opportunities for a new stormwater facility north of Manchester Valley High School, adjacent to the pump station. We have awarded this project to CLSI. They are getting started with a design for a new surface sand filter and potential for drainage improvement at the upstream end of the stormdrain network.

New Windsor Wetland (New Windsor)- A new wetland facility is proposed adjacent to the Maryland Midland Railroad tracks and Dickenson Run. The proposed improvements include removing the existing inlet adjacent to the intersection of Water St and Church St, replacing it with a diversion structure that will route the 1-year storm discharges to the proposed wetland facility. We are working through the design with the engineer for a structure to balance the facility on both sides of the sewer main. A concept plan was submitted July 12th for review.

Public Safety Training Center (Westminster Well)- A retrofit for the Public Safety Training Center pond is in progress for the facility design and PFAS remediation. WRA is finalizing the concept plan for the surface sand filter this week. Tetra Tech will provide guidance for the PFAS remediation. A concept plan was submitted on July 13th for review.

PRELIMINARY DESIGN:

Hampstead Valley 4 (Hampstead) – A new surface sand filter and stream restoration project is proposed between Century Street and Downhill Trail. Culverts at Downhill Trail require realignment into the HOA parcel for dam breach approval. A preliminary submittal was reviewed by stormwater and sent back with comment.

Roberts Field Wet Facility (Hampstead) – Retrofit of wet pond to new hybrid wet pond/submerged gravel wetland. The recent concept submittal was approved with comments from the Town and Stormwater Management. Wallace Montgomery & Associates (WMA) is beginning the preliminary phase of design.

FINAL DESIGN:

CONSTRUCTION:

North Carroll Library (Hampstead) – As-built has been approved.

PLANNING PROJECTS:

Little Pipe Creek Restoration Opportunities – The County has executed the grant agreement with the National Fish and Wildlife Foundation (NFWF). CWP has developed an outline for identifying priority restoration areas, this is currently being reviewed internally. CWP and County staff went out together for an assessment of Little Pipe watershed in late June.

TREE PLANTING PROJECTS:

All the municipal plantings have completed their maintenance period and are now the responsibility of the municipalities. Please make sure that these areas are being mowed at least three (3) times per season.

Hazen

Carroll County WRCC: PFAS Implications for Municipalities

July 26, 2023

Agenda

- Introductions
- PFAS Regulatory Overview
- Potential PFAS Implications
- PFAS Mitigation and Treatment
- Determining Cost of Compliance and Case Study
- Q&A

Regulatory Review

Proposed PFAS Rule

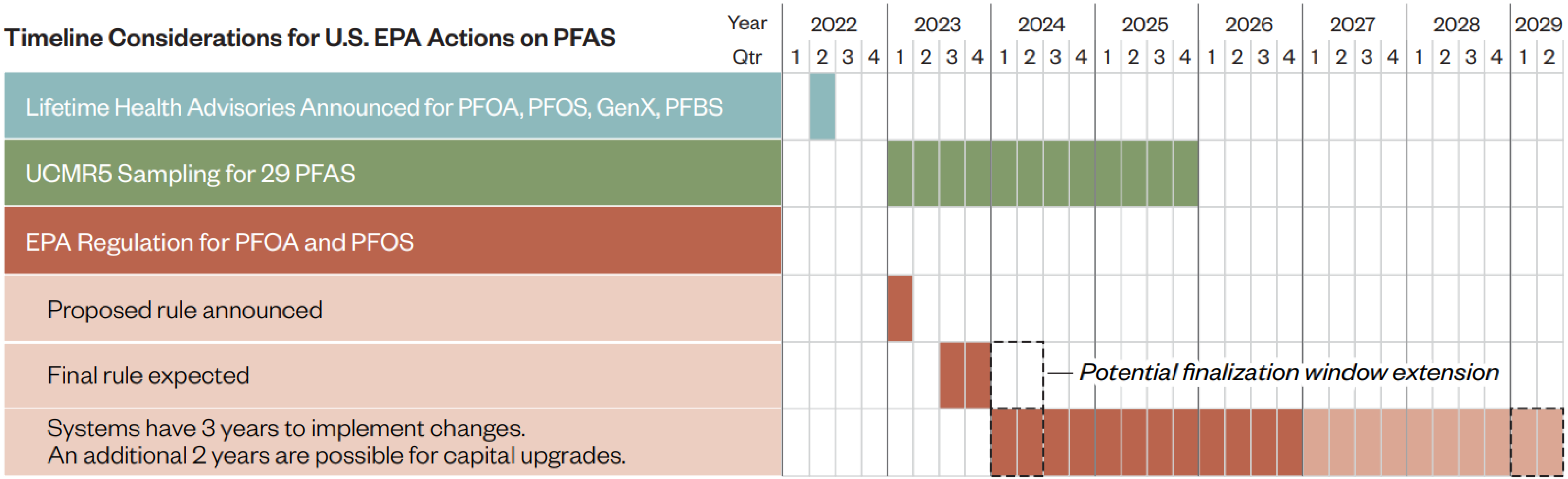
The proposed rule set MCLGs and MCLs for PFOA and PFOS, and took a risk-based approach to regulating 4 additional PFAS compounds:

- **PFNA**
- **PFHxS**
- **PFBS**
- **GenX**

Compound	Proposed MCLG	Proposed MCL (enforceable levels)
PFOA	Zero	4.0 parts per trillion (also expressed as ng/L)
PFOS	Zero	4.0 ppt
PFNA	1.0 (unitless) Hazard Index	1.0 (unitless) Hazard Index
PFHxS		
PFBS		
HFPO-DA *(GenX Chemicals)*		

$$PFAS\ Hazard\ Index\ MCL = \left[\frac{HFPO\text{-}DA_{water}}{10\frac{ng}{L}}\right] + \left[\frac{PFBS_{water}}{2{,}000\frac{ng}{L}}\right] + \left[\frac{PFNA_{water}}{10\frac{ng}{L}}\right] + \left[\frac{PFHxS_{water}}{9\frac{ng}{L}}\right]$$

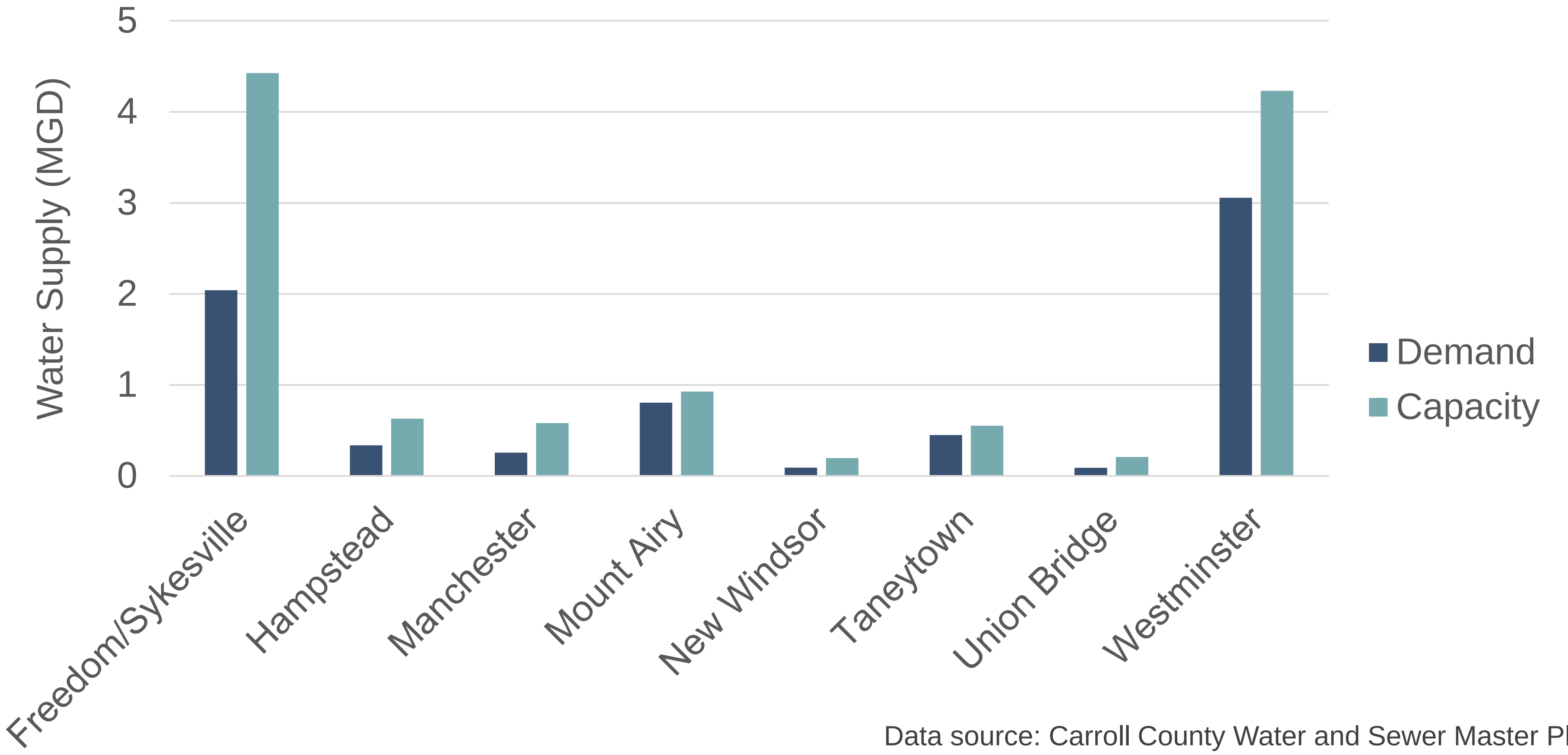
What is the Regulation Timeline?



Implications for Municipalities

Water Demand and Capacity

- Water supply capacity exceeds average daily demand for all County municipalities, but some regularly rely on all or nearly all the available capacity.

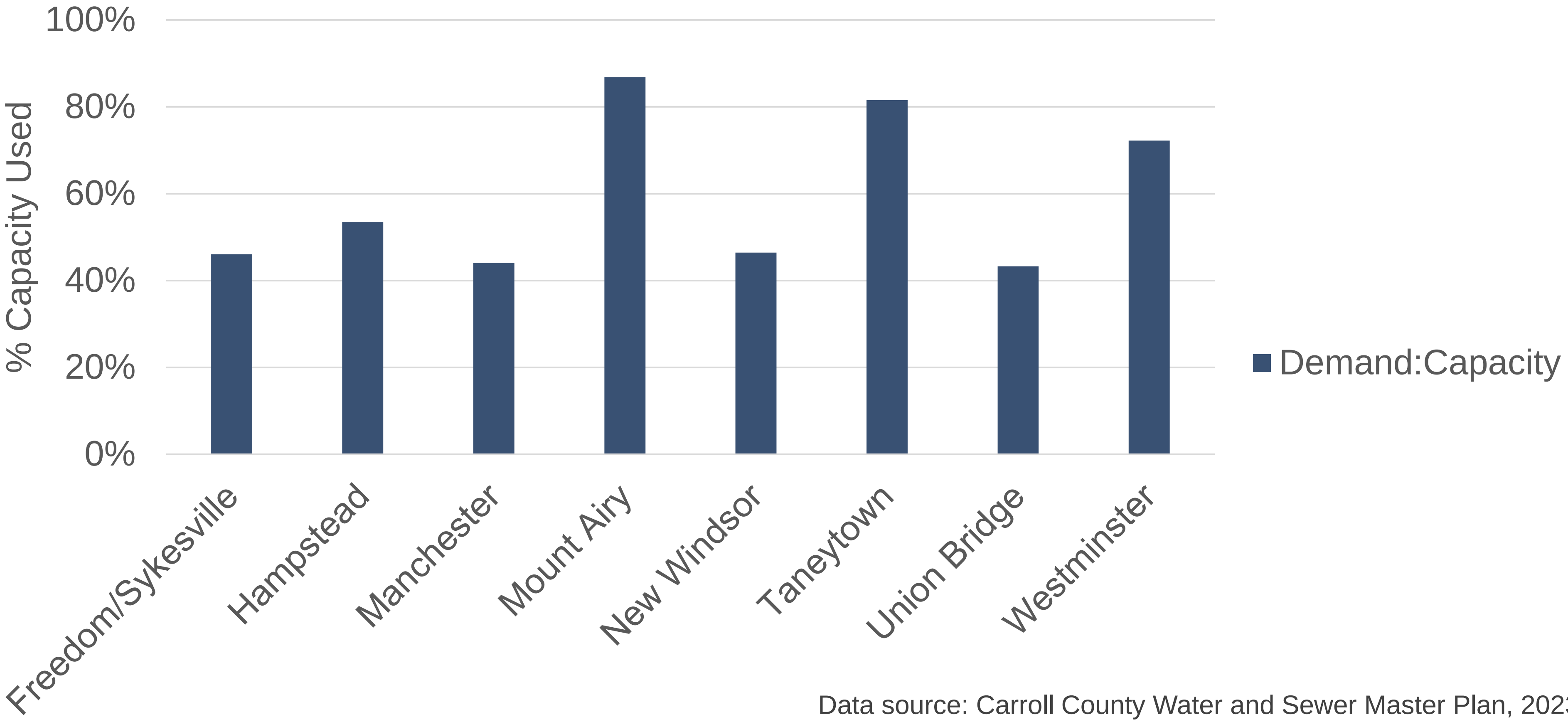


Data source: Carroll County Water and Sewer Master Plan, 2023 Triennial Update

Water Demand and Capacity

Percentage of Capacity Used

- Water supply capacity exceeds average daily demand for all County municipalities, but some regularly rely on all or nearly all the available capacity.

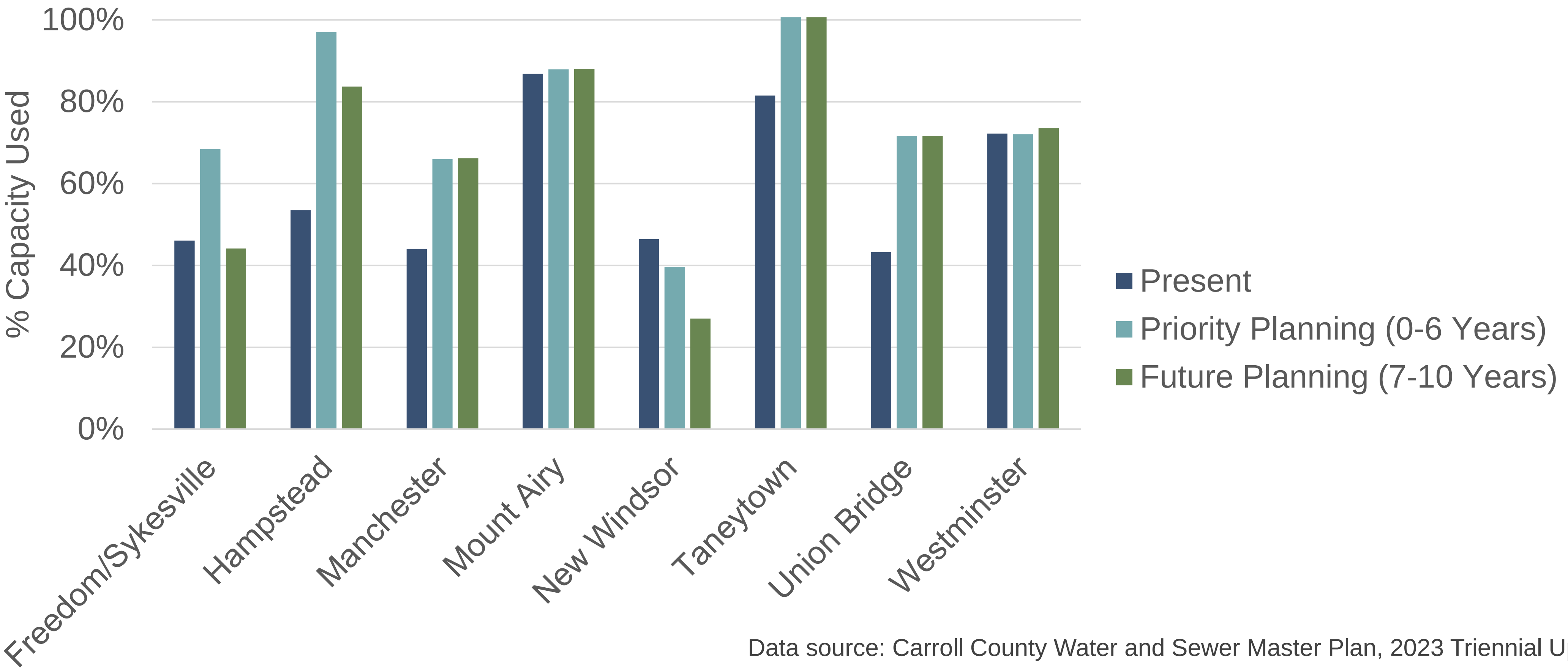


Data source: Carroll County Water and Sewer Master Plan, 2023 Triennial Update

Water Demand and Capacity

Projected Percentage of Capacity Used

- The percentage of water capacity used is expected to increase for most County municipalities over the next decade.

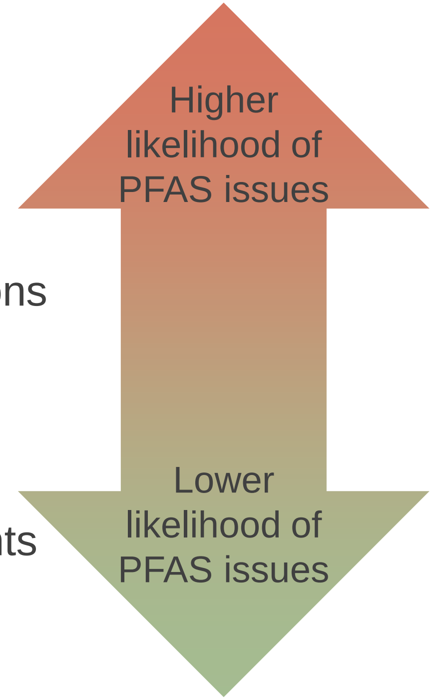


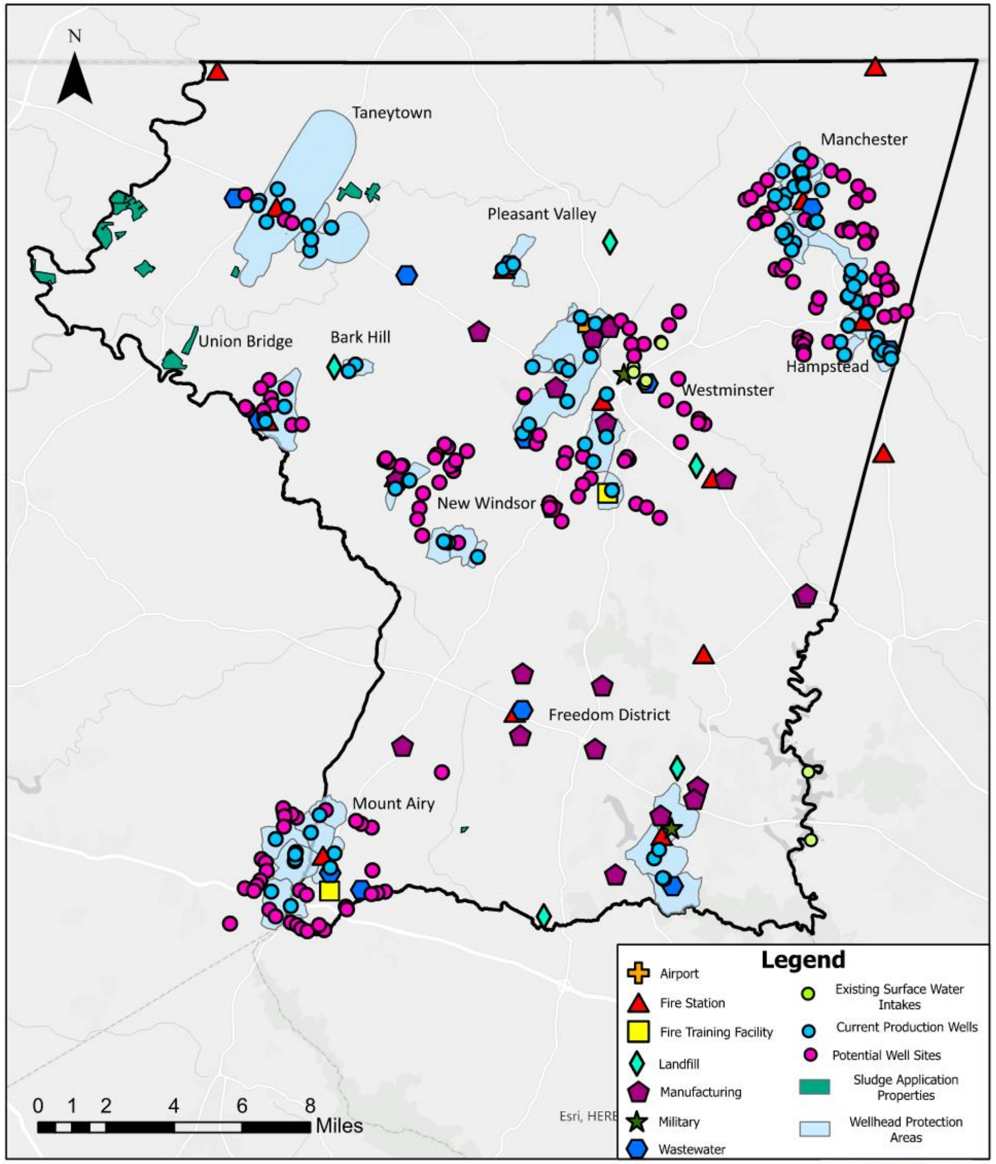
Data source: Carroll County Water and Sewer Master Plan, 2023 Triennial Update

Potential PFAS Sources

Potential PFAS sources in the County include:

- Fire training facilities
- Fire stations
- Airports
- Military sites and installations
- Landfills
- Manufacturing facilities
- Wastewater treatment plants





Hazen

Carroll County Emerging Contaminants: Potential PFAS Sources

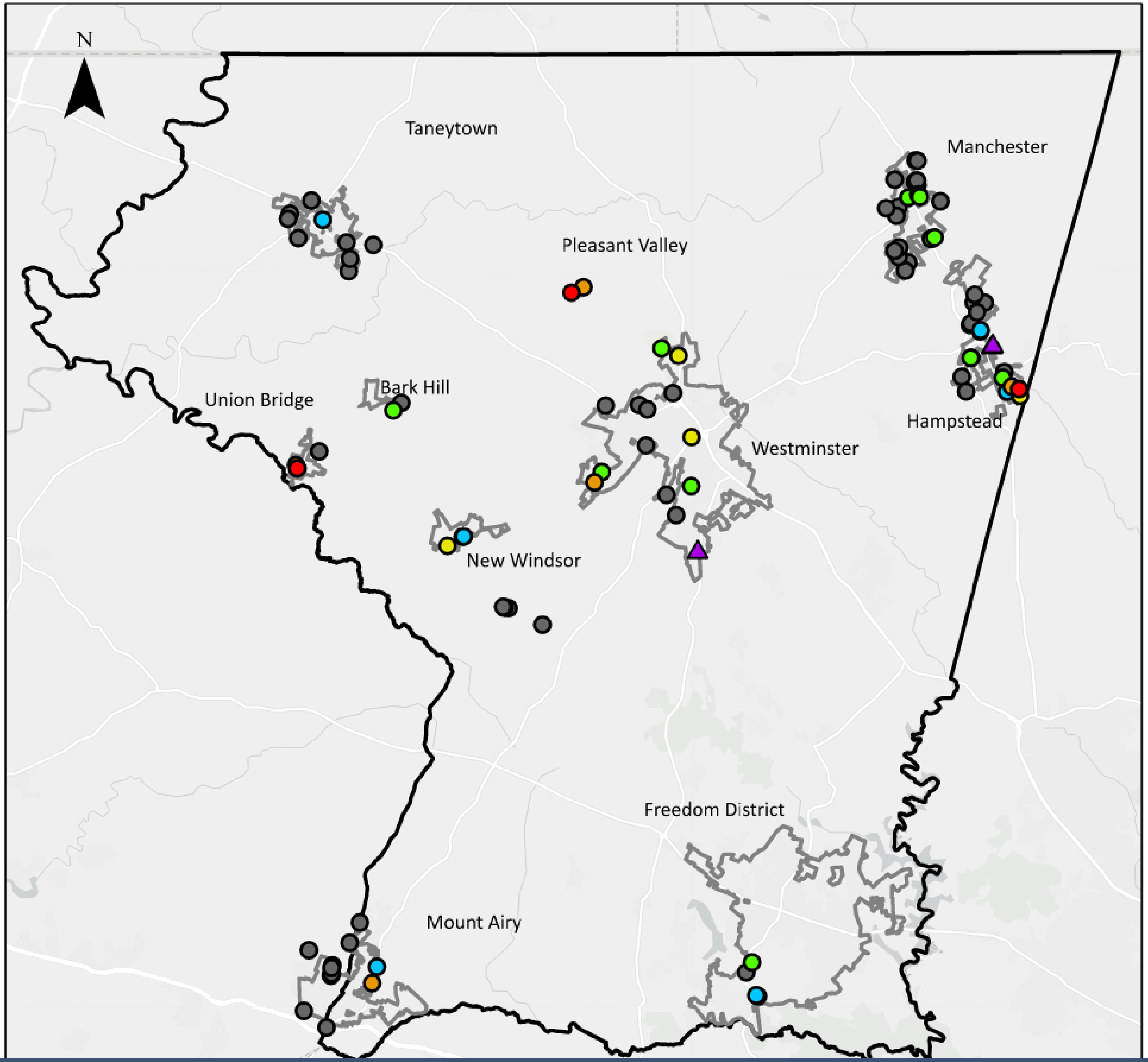
Likelihood of PFAS Issues

Proximity of Potential PFAS Sources to Production Wells

- Spatial buffer analysis to identify production wells that are more likely that others to have PFAS issues
- Buffers increase from 500 feet radius to more than 2,500 feet radius
- Results can help prioritize monitoring and identify wells and municipalities that may be affected by PFAS contamination

Distance to Closest PFAS Source

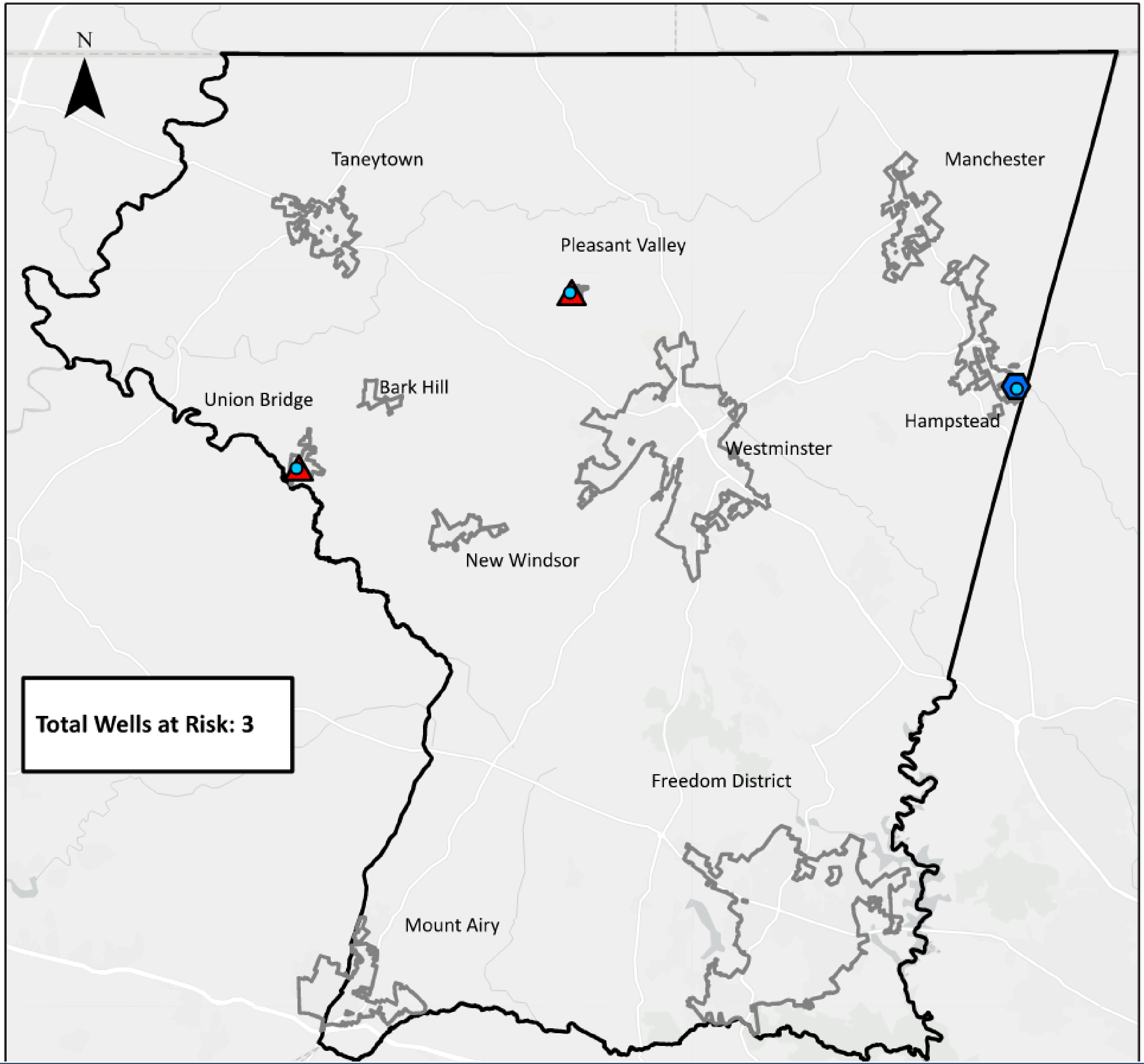
- Within 500 ft
- Within 1000 ft
- Within 1500 ft
- Within 2000 ft
- Within 2500 ft
- Greater than 2500 ft
- Well Offline due to PFAS



Likelihood of PFAS Issues

500 ft radius

Municipality	Well Name	PFAS Source Type
Pleasant Valley	Fire Station	Fire Station
Hampstead	PW-26	Wastewater
Union Bridge	PW-3	Fire Station



Production Wells
Well Online

PFAS Source
Fire Station
Wastewater

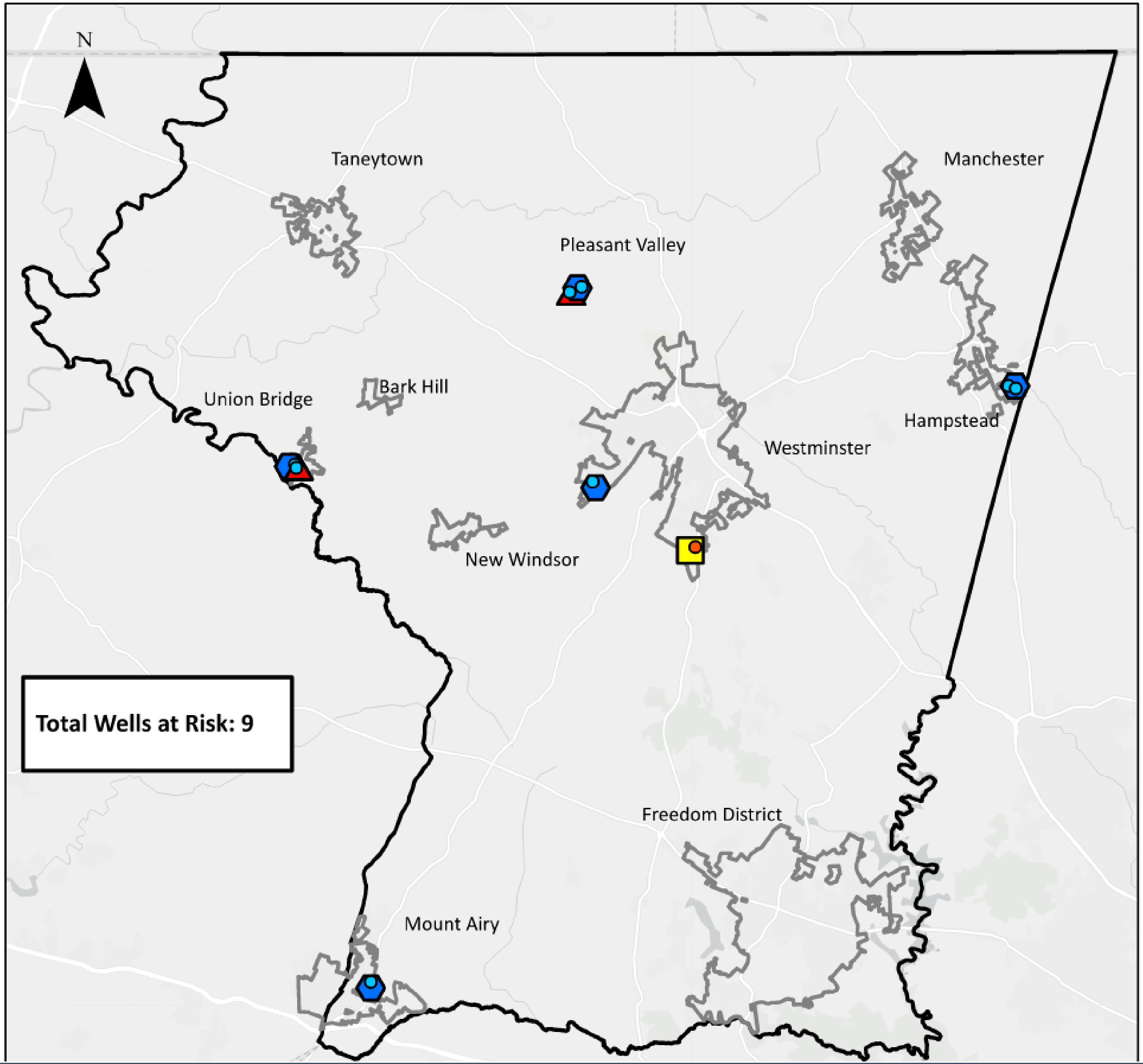
Likelihood of PFAS Issues

1,000 ft radius

Municipality	Well Name	PFAS Source Type
Union Bridge	PW-1	Fire Station, Wastewater
Pleasant Valley	PW-1A	Wastewater
Hampstead	PW-23	Wastewater
Union Bridge	PW-3	Wastewater
Mount Airy	PW-6	Wastewater
Westminster	PW-8 (Vo-Tech)	Fire Training Facility

Production Wells
- Well Online
- Offline due to PFAS

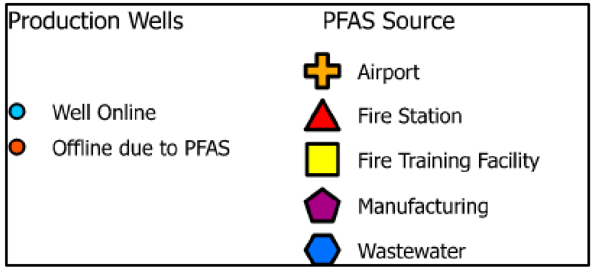
PFAS Source
- Fire Station
- Fire Training Facility
- Wastewater

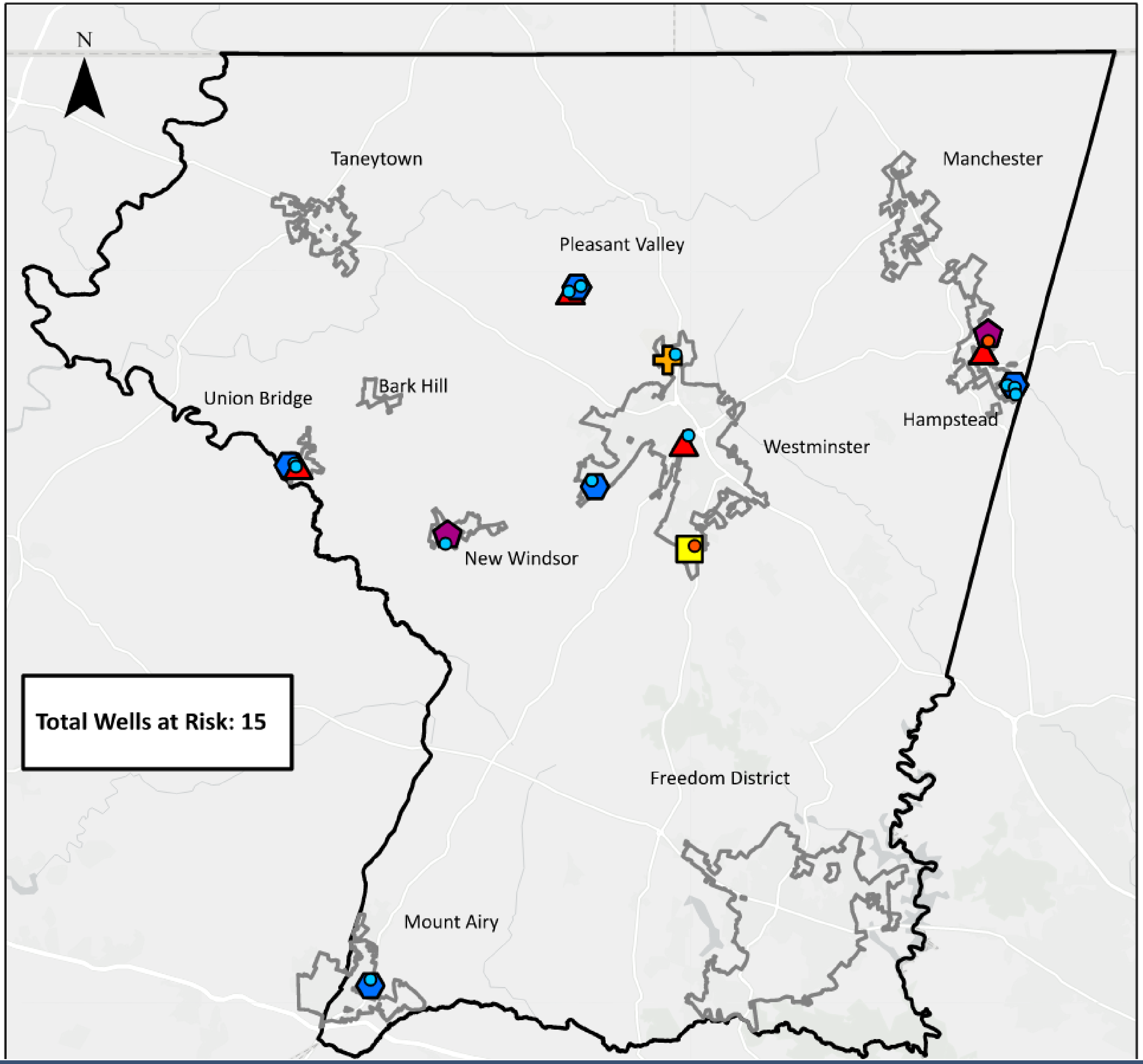


Likelihood of PFAS Issues

1,500 ft radius

Municipality	Well Name	PFAS Source Type
Westminster	Koontz Creamery	Fire Station
Hampstead	PW-24	Fire Station, Manufacturing
Hampstead	PW-25	Fire Station, Manufacturing
Hampstead	PW-27	Wastewater
Westminster	PW-4 (Air Bus. Cent.)	Airport
New Windsor	Roops Meadow Spring	Manufacturing





Potential PFAS Implications on Growth and Development

Known PFAS Contamination

- Three wells currently offline due to PFAS are close to fire stations or fire training facilities

Municipality	Well Name	Potential PFAS Source	Buffer Distance (ft)
Hampstead	PW-24	Fire Station	1,500
Hampstead	PW-25	Fire Station	1,500
Westminster	PW-8 (Vo-Tech)	Fire Training Facility	1,000

Potential PFAS Implications on Growth and Development

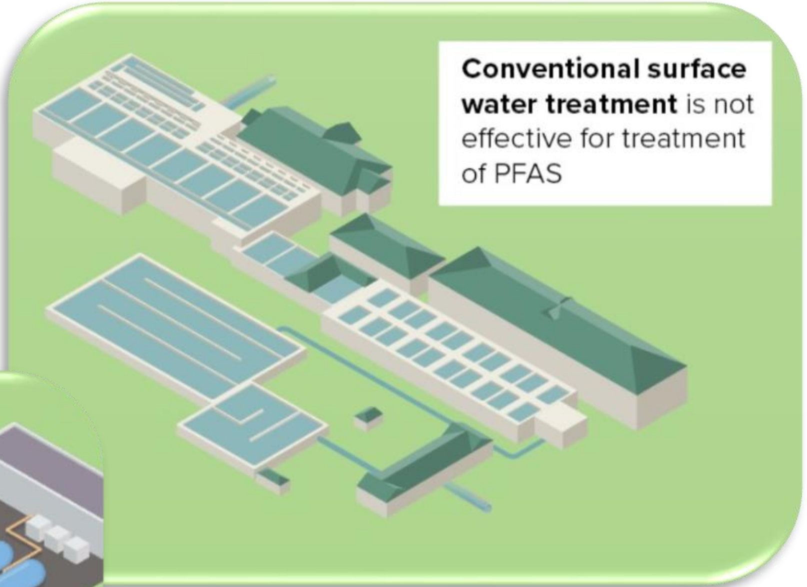
Potential PFAS Contamination from Fire Stations

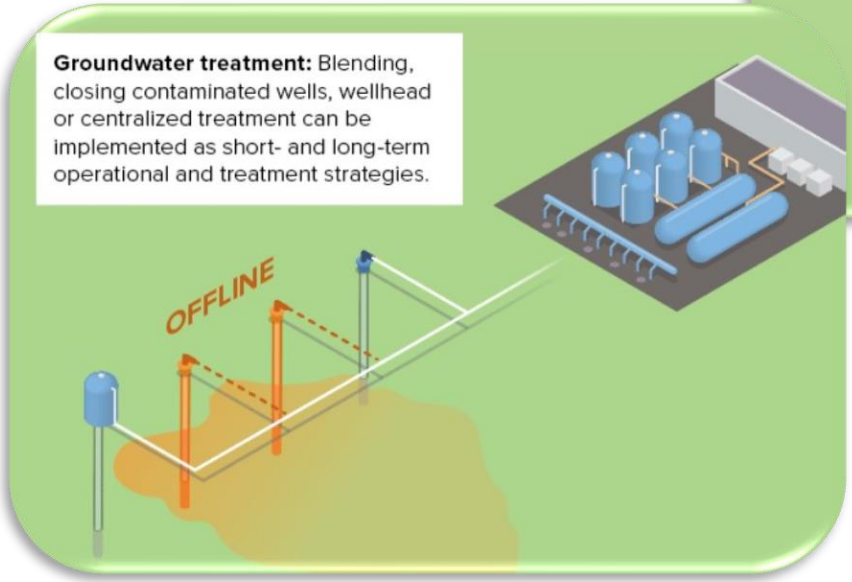
Municipality	Well Name	Buffer Distance (ft)	% of Average Daily Use	Notes
Hampstead	PW-28, PW-29	2,500	45%	Determined from permitted daily use
Manchester	Holland Dr. Well	2,500	5%	
	Walnut St. Spring	2,500	15%	Determined from Walnut St. spring storage capacity
	Walnut St. Well	2,500	2%	
Mount Airy	PW-5	2,000	19%	Well Field 5 & 6
New Windsor	Roops Meadow Spring	2,000	80%	Dennings Well, Main Spring, Roops Meadow Spring
Pleasant Valley	Fire Station	500	-	Pumping data unavailable
Taneytown	PW-8	2,000	8%	
Union Bridge	PW-1	1,000	24%	
	PW-3	500	18%	Not in use
Westminster	Koontz Creamery (stream augmentation)	1,500	-	Stream augmentation

Mitigation Options

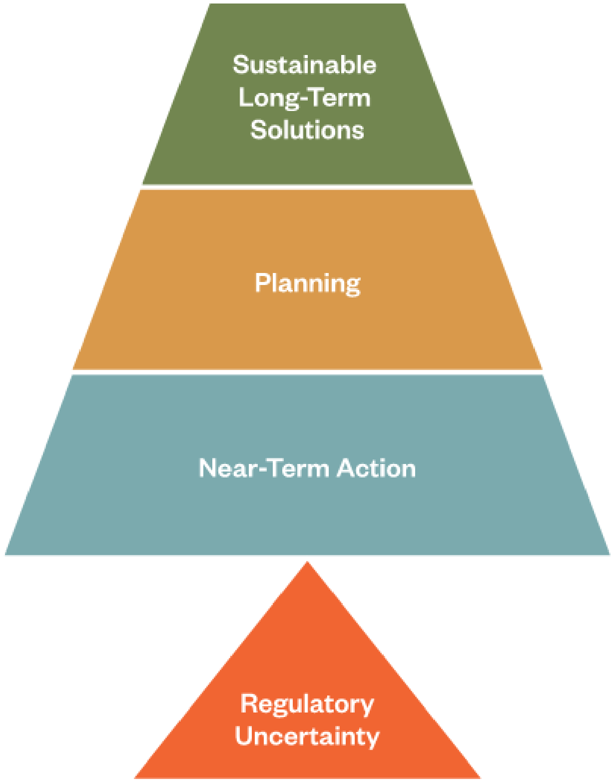
PFAS Treatment Options in Drinking Water

Limited effective technologies…





But opportunities for optimized implementation

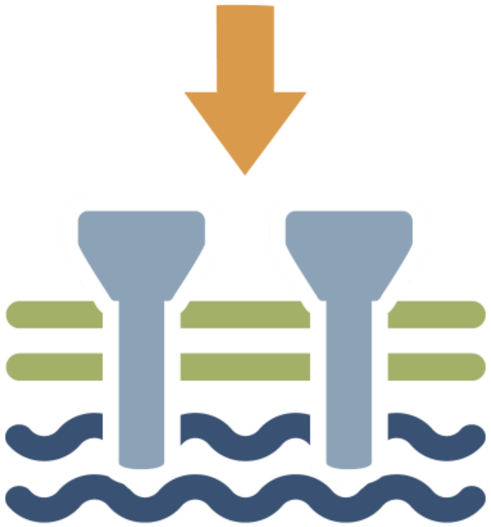


Mitigation alternatives

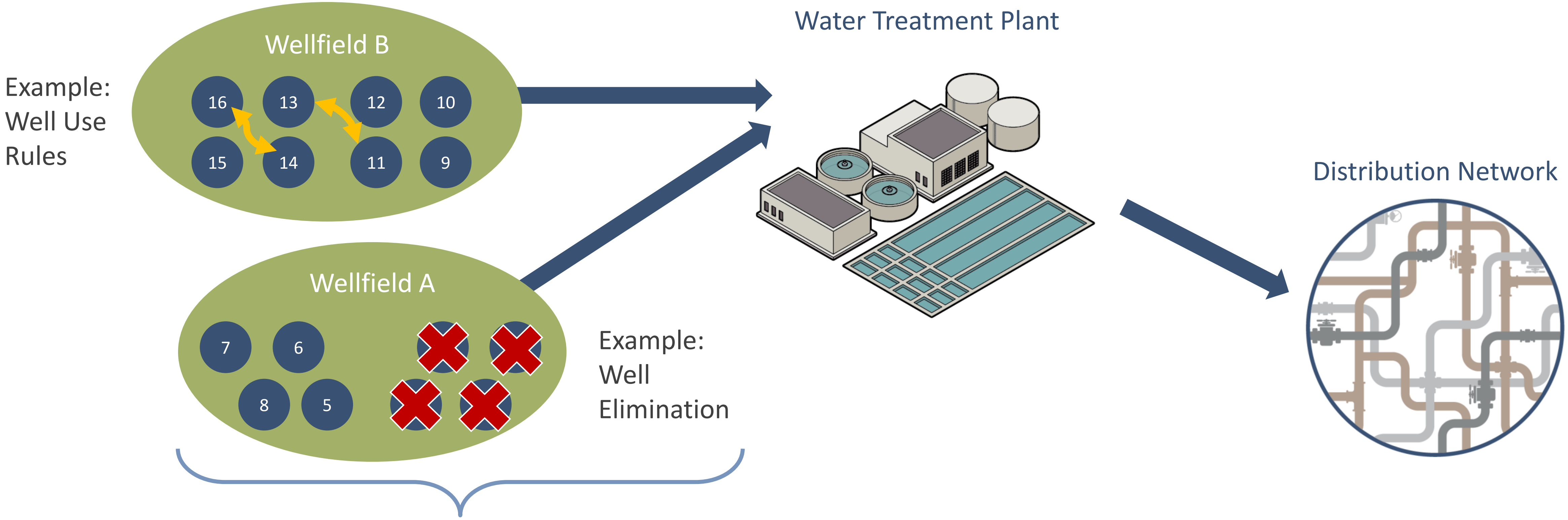
Well Management

Treatment at WTPs

Treatment at the Source



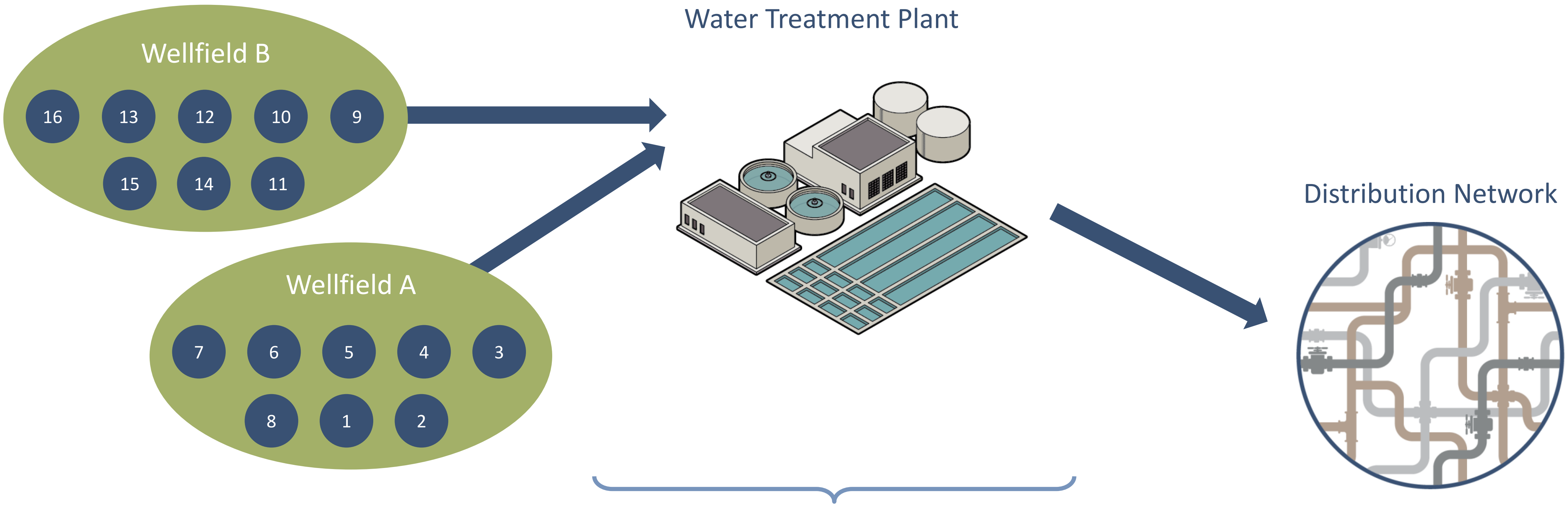
Approach For Evaluating Management and Treatment Options



Step 1: Can WELL MANAGEMENT achieve PFAS Targets

- Use Mass Balance Model of the Well Supply System to define impacts of well operations on observed concentrations at the WTPs
- Study effect of shutting down wells, minimizing use of wells, paired well operation, etc.

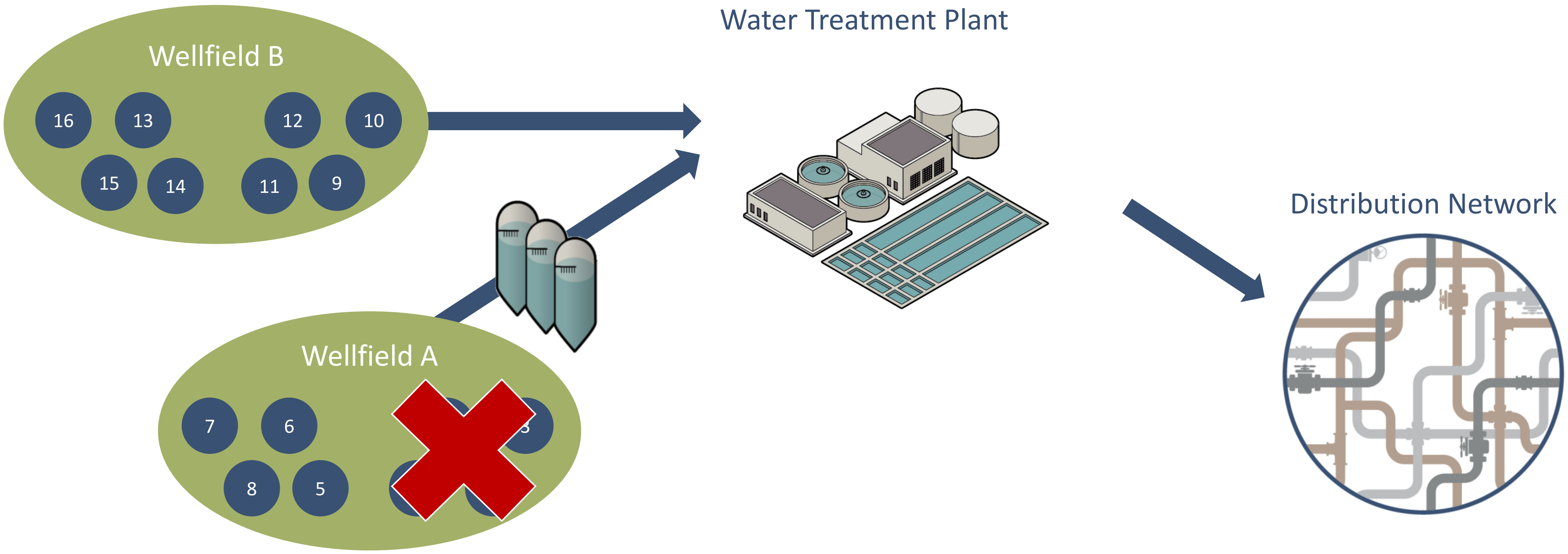
Approach For Evaluating Management and Treatment Options



Step 2: Understand impacts of WTP treatment on concentrations at WTP

- Is treatment at the WTPs capable of meeting PFAS targets?
    - PFOA, PFOS < 4 ppt (Draft MCL)
    - HI < 1

Approach For Evaluating Management and Treatment Options

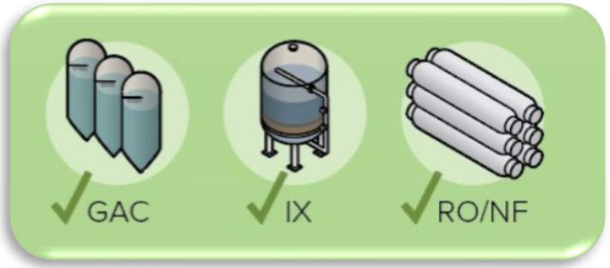


Step 3: Understand impacts of wellfield treatment on concentrations at WTP

- Is treatment at individual wells/wellfields capable of meeting PFAS targets?

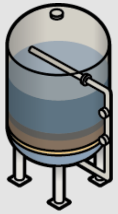
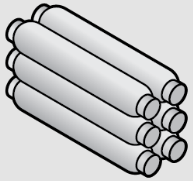
Currently Available Treatment Solutions to Address PFAS in Drinking Water

Even "Advanced" technologies comes up short sometimes



Technology	Benefits	Drawbacks
GAC	• Proven PFOA/PFAS removal • Removal of other chemicals (e.g., VOCs, EDCs, PPCPs) • DBP precursor reduction • Can be reactivated/reused	• Carbon replacement costs can be costly especially for short chains • Need to consider breakthrough time and regeneration cycles • Spent Material Disposal concerns (RCRA)
Ion Exchange	• Proven PFOA/PFAS removal • May be more effective for removal of some short chain PFASs	• Single use of resin cannot be regenerated • Competing ions may affect performance or require pre-treatment (TOC, Fe/Mn) • Limited removal of other contaminants • Spent Material Disposal concerns (RCRA)
Reverse Osmosis / Nanofiltration	• Removal of most PFAS • Removal of additional contaminants • DBP precursor reduction • Softening	• Brine management • Costly compared to other options

PFAS Treatment Approaches

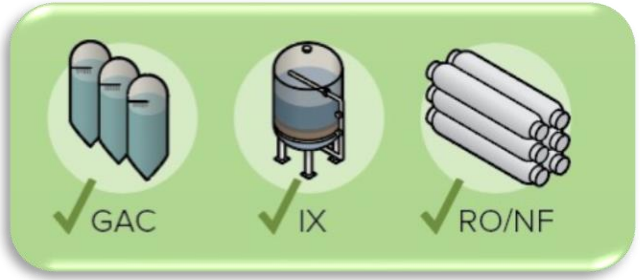
		Pros	Cons
	**Adsorption**	Ease of Implementation, Cost Effectiveness	Treatment Effectiveness Varies with WQ and PFAS
	**High Pressure Membranes**	Removal of Legacy & Next Generation PFAS	Cost and Concentrate Disposal
	**PFAS Destruction**	Complete Mineralization of PFAS	Cost and Maturity

PFAS Separation (Adsorption and High Pressure Membranes)

Summary of PFAS removals for various treatment processes

Removal <10%	Removal 10-90%	Removal > 90%

	M.W. (g/mol)	AER	COAG/ DAF	COAG/ FLOC/ SED/ G-or M-FIL	AIX	GAC	NF	RO	MnO4, O3, ClO2, Cl2, CLM, UV, UV-AOP
PFBA	214	Assumed	Assumed						
PFPeA	264								
PFHxA	314								
PFHpA	364								
PFOA	414								
PFNA	464		Unknown		Assumed	Assumed			
PFDA	514		Unknown		Assumed	Assumed			
PFBS	300								
PFHxS	400								
PFOS	500								
FOSA	499	Unknown	Unknown		Unknown	Assumed	Unknown	Assumed	Unknown
N-MeFOSAA	571	Assumed	Unknown		Assumed	Assumed	Assumed		Unknown
N-EtFOSAA	585		Unknown		Assumed	Assumed	Assumed		Unknown



Removal of PFAS from source waters depends on target, concentration, raw water quality and other variables (WaterRF 4322)

Benchmarking Treatment Conditions

Adsorption Systems

Adsorbent	Adsorber Configuration	EBCT (Total, min)	Flow Rate (MGD)	Spent Media Disposal	Interest Rate	Lifespan
GAC	Lead/Lag	20	1.5, 10	Off-Site Regeneration	5%	30 years
IX Resin	Lead/Lag	4	1.5, 10	Throwaway, Non-Hazardous		

Membrane Systems

Membrane	Flow Rate (MGD)	Background Water Quality	Flux (gfd)	Concentrate Disposal	Interest Rate	Lifespan
NF	1.5, 10	High/Low	19_{High} / 17_{Low}	Ocean Outfall/POTW	5%	30 years
RO	1.5, 10	High/Low	19_{High} / 17_{Low}	Ocean Outfall/POTW		
Constant flux operation contingent on background water quality selection						

Determining Cost of Compliance

How to determine Cost of Compliance?

1. Understand the potential impacts of regulatory action (which compounds, which technologies, residuals?)

2. Understand feasibility and viability of treatment technologies (ie., IX resin is not suitable for gravity contactors)

3. Cost of compliance is a function of capital and operating and maintenance costs
   - Capital costs are escalating rapidly
   - O&M is critically important to cost of compliance
   - Media and residuals disposal costs are in flux

4. How to pay for the upgrades?

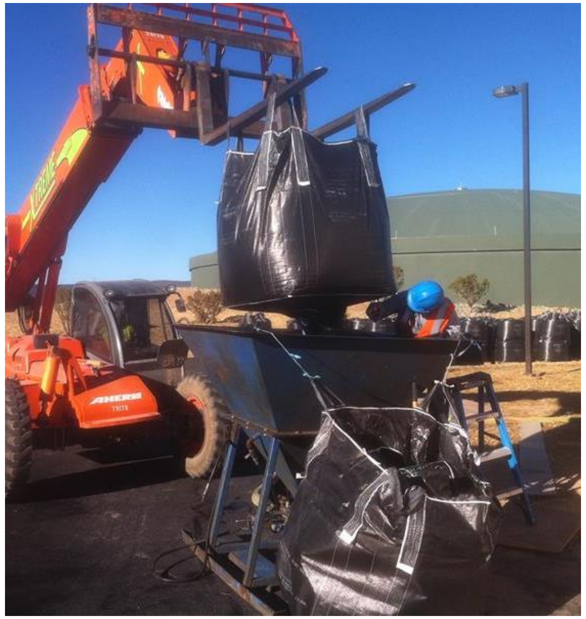
Cost Modeling Strategy

Today

Class V Cost Curves available

Class IV Estimates take a little longer, and may immediately be obsolete

Tomorrow

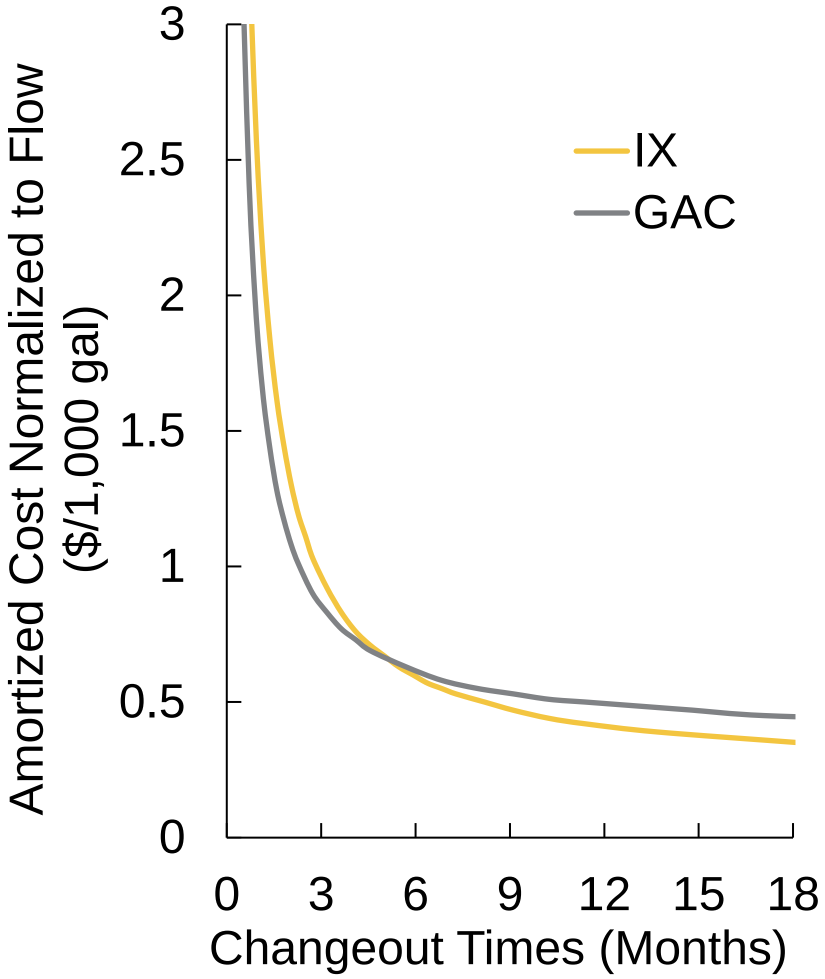


O&M is a function of:
- Media replacement (IX, GAC)
- Pumping Costs
- Brine / media disposal

The Future

The future can be impacted by:
- Short-chain PFAS regulations
- Cost Uncertainty
- Supply-chain issues
- Disposal of Media or Residuals

Cost of Adsorptive Treatment

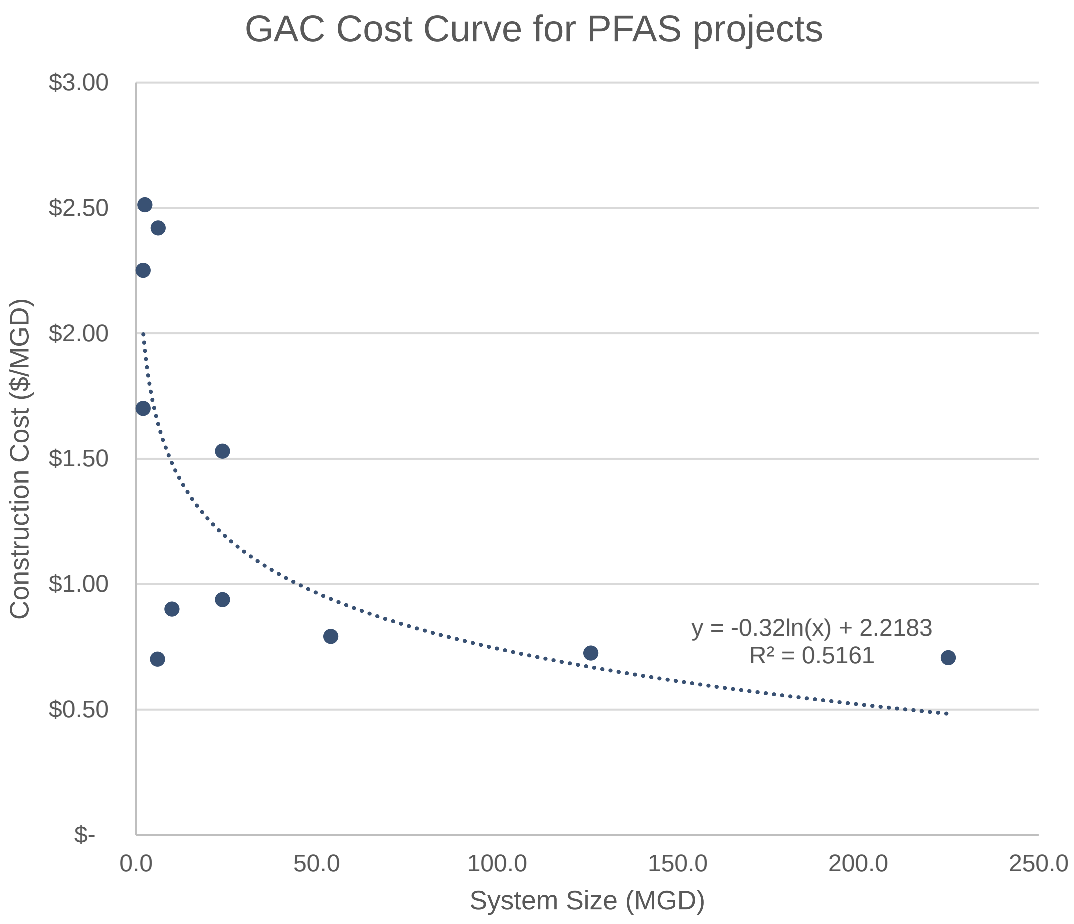


- IX and GAC cost curves look very similar.
- At changeout times exceeding 6 months, IX resin may become more cost effective.
- Cost curves can be adapted for a variety of operation conditions, adjustments of appropriate spent media disposal costs remains ongoing.

Adsorbent	Adsorber Configuration	EBCT (Total, min)	Flow Rate (MGD)	Spent Media Disposal
GAC	Lead/Lag	20	1.5	Off-Site Regeneration
IX resin	Lead/Lag	4	1.5	Throwaway, Non-Hazardous

Capital Cost Estimates Developed from Projects Around the Country

Today's Options



Additional Cost Modeling Tools to Expand capabilities

Working towards tomorrow's

Water Research Foundation Project 4913: Investigation of Treatment Alternatives for Short-chain PFAS

THE Water Research FOUNDATION

Hazen

NC STATE UNIVERSITY

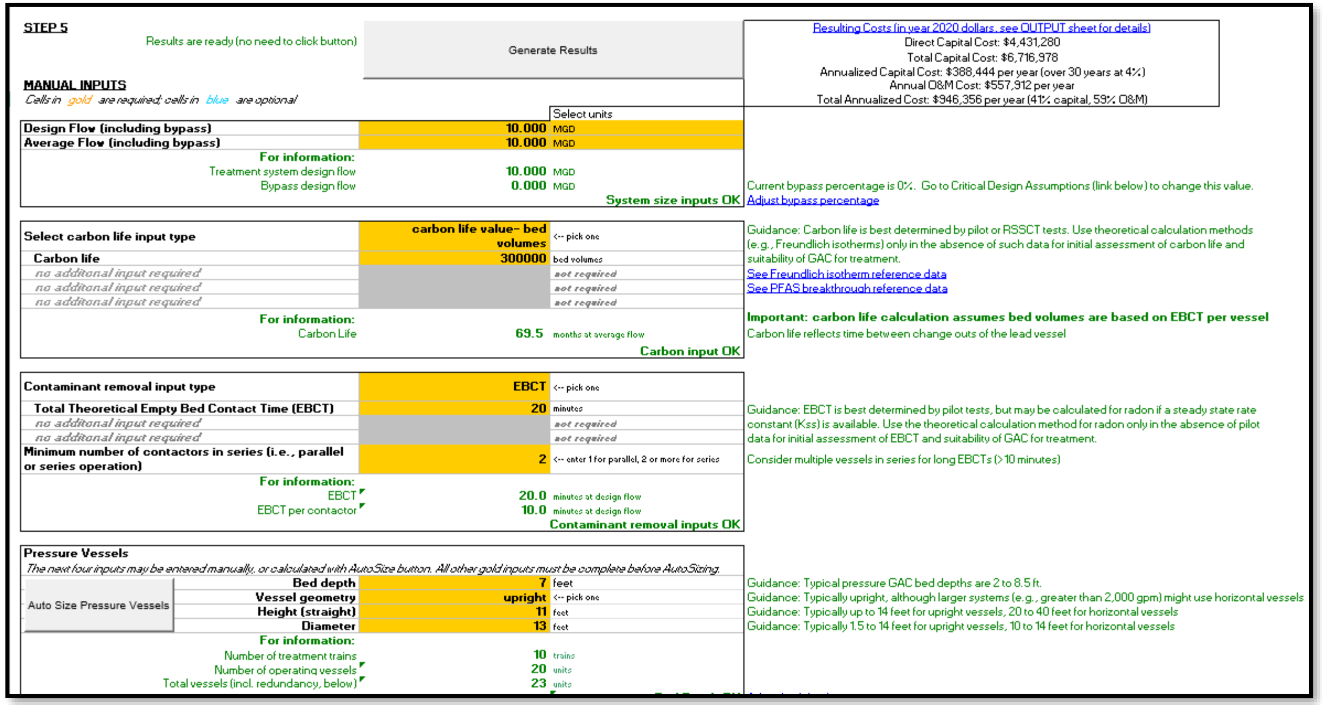
AMERICAN WATER

COLORADO SCHOOL OF MINES

CDM Smith listen. think. deliver.

CITY OF ANN ARBOR MICHIGAN

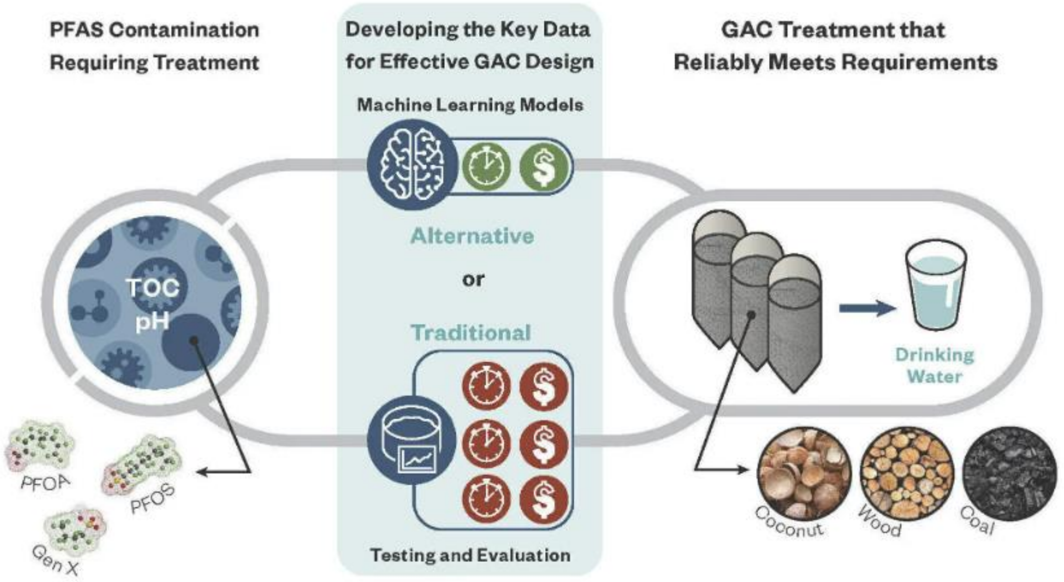
Work Breakdown Structure (WBS) Models Previously Developed by EPA



O&M Costs are crucial to understanding viability of treatment technology

Today's cost estimates

- IX models produce accurate cost estimates. GAC estimates were lacking.



Instructions: Please provide as much information as possible in the table below.
Blue background data is critical for PFAS rating
Green background data will be assumed ND for PFAS rating
Do not Modify the Sheet as it will create errors when processing

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Information Requested for PFAS Treatment

Customer: | Date rated:
Project: | Sample:

Non-PFAS treatment goals

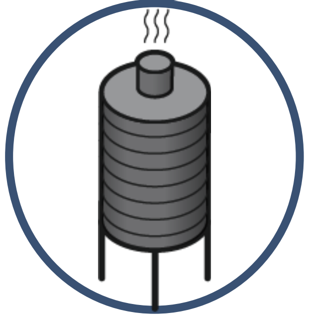
Ratings for BV based on resin volume in lead vessel with PFAS break as indicated below

Description	Units	Influent Water Min	Avg	Max	Non-PFAS treatment goals	PFAS Break measured ex LEAD Vessel at:	PFAS Break measured ex LAG Vessel at:
Operational Flow Rate	gpm						
Operational Schedule	hour/day						
Daily Volume (average)	Gallons						
Sulfate	mg/L (ppm)						
Nitrate (as N)	mg/L as N						
Nitrate (as NO3)	mg/L as NO3						
Alkalinity (as $CaCO_3$)	mg/L as CaCO3						
Chloride	mg/L (ppm)						
Fluoride	mg/L (ppm)						
Perchlorate	µg/L (ppb)				(e.g. < 4 ppb)		
Arsenate (As (V))	µg/L (ppb)						
Hexavalent chromium (chromate) Cr(VI)	µg/L (ppb)						
Uranium	µg/L (ppb)						
Calcium (as $CaCO_3$)	mg/L as CaCO3						
Magnesium (as $CaCO_3$)	mg/L as CaCO3						
Sodium	mg/L (ppm)						
Potassium	mg/L (ppm)						
Iron	mg/L (ppm)						
Manganese	mg/L (ppm)						

PFAS Spent Adsorbent Disposal

Costs and Availability Changing Rapidly

Landfilling:
- Subtitle D $50-$100 per ton
- Subtitle C $300-$500 per ton



Incineration:
- MSW Incinerator $200-$300 per ton
- HW Incinerator $1,200+ per ton

Electrochemical Oxidation, Super Critical Water Oxidation, Plasma, Hydrothermal Liquefaction, Others
- Costs not well developed

Case Study – Peoples Water in Florida - ~1.5 MGD Well

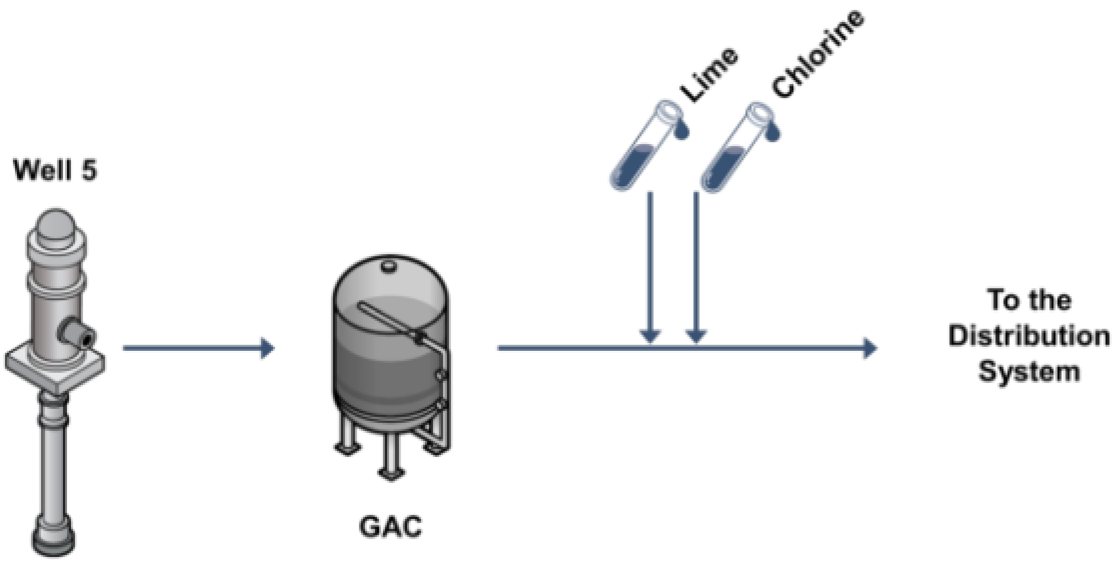


Figure 5-1: Proposed Well 5 GAC Process Flow Diagram

Table 5-2: Hazen and Calgon Projected GAC Replacement

Goal	Bed Volume to PFAS Breakthrough	GAC Changeout Frequency*
Calgon carbon Corporation Model	105,000	1.9 years
Hazen GAC Model	83,000	1.5 years

*: Changeout frequency is assumed to be based on continuous operation of Well 5 at 1,000 gpm.

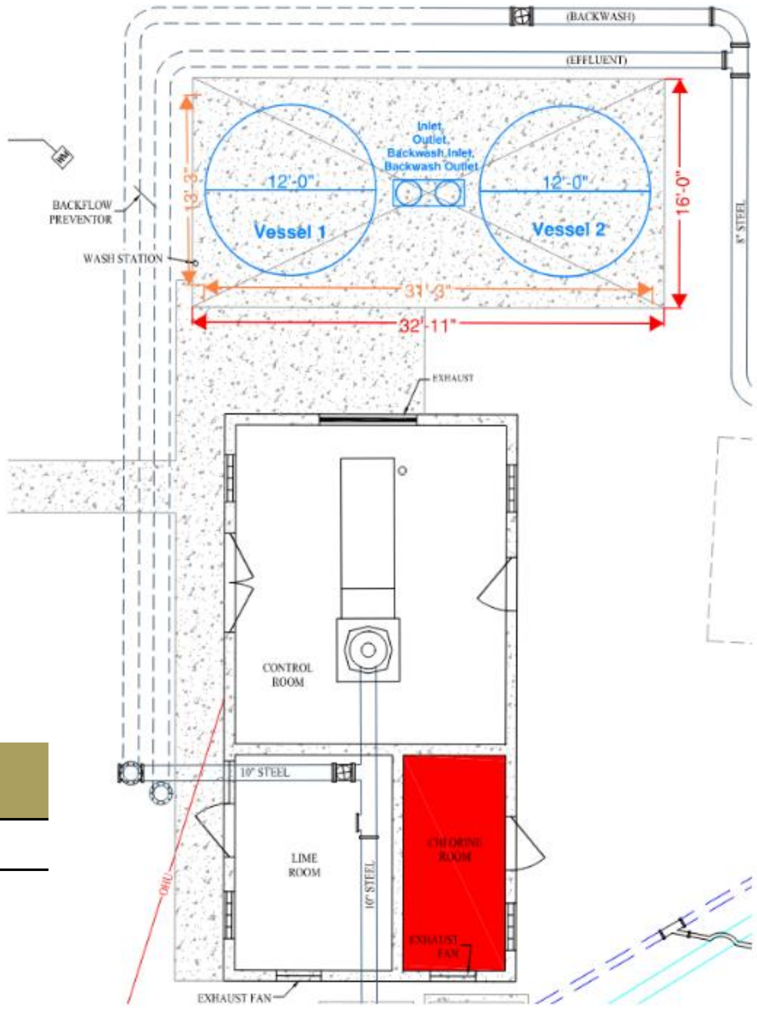


Figure 5-2: Well 5 Estimated Site Layout for GAC

Case Study – Peoples Water in Florida - ~1.5 MGD Well

Table 5-3: GAC Capital Cost Estimate

Description	Cost
General Conditions	$126,000
Civil/Site Work	$150,000
Mechanical*	$750,000
GAC Vessels	$600,000
GAC Media	$150,000
Structural	$150,000
Architectural	NA
HVAC/Plumbing	NA
Electrical	$105,000
Instrumentation & Controls	$105,000
Subtotal	**$1,386,000**
Design Contingency (30%)	$416,000
Contractor Overhead, Profit & Fee (25%)	$347,000
Escalation (at 3%-5% Annually)	$69,000
Bond and Insurance (3%)	$42,000
TOTAL	**$2,260,000**

*: Summation of GAC Vessels and GAC Media

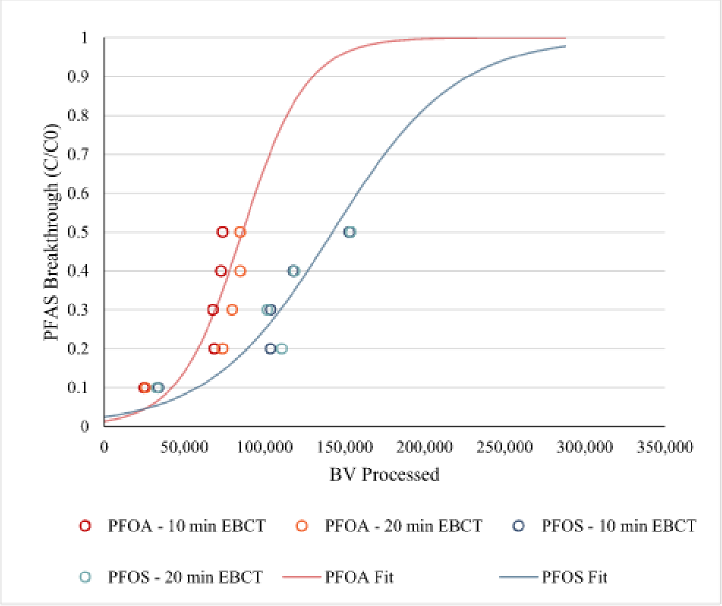


Figure 5-3: Hazen Predicted PWSC Well 5 GAC PFAS Breakthrough Versus Bed Volumes Processed.

Table 5-6: Calgon GAC Cost Comparison with Purolite AdEdge IX System

Cost Metric	GAC (Section 5.1)		IX (Section 5.2)	
	Low Estimate	High Estimate	Low Estimate	High Estimate
Capital Cost	$2,260,000		$2,281,200	
Annual O&M	$8,784.84	$109,836.49	$15,523.12	$153,419.61
Cost Per Gallon(per 1,000 gallons)	$0.21		$0.29	
Net Present Value *	$2,390,696.19	$3,894,089.63	$2,512,144.88	$4,563,696.38

*: 3% escalation, annualized over 20 years

Q&A