

PFAS INVESTIGATIONS AND IMMEDIATE RESPONSE ACTIONS

Former Municipal Fire Training Facility
Barnstable County, Massachusetts



REGENESIS

Presented By:

Paul Ruzala, P.E., Barnstable County

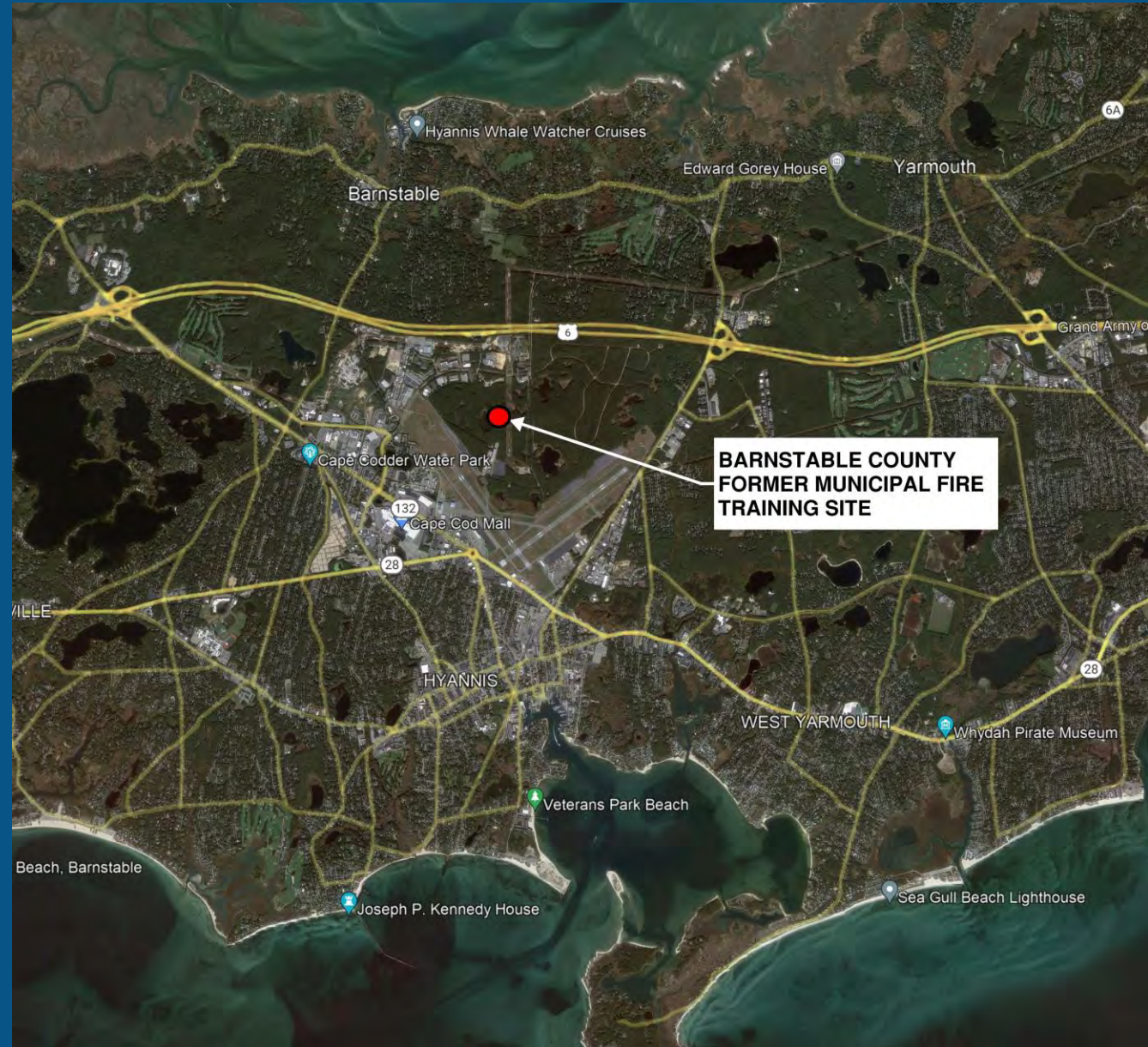
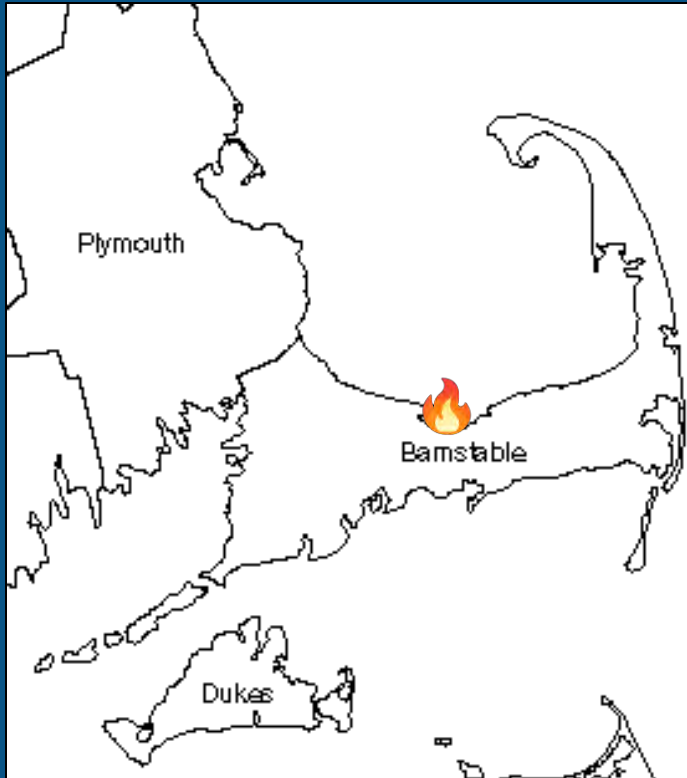
Jenn McKechnie, P.G., LSP, GZA GeoEnvironmental Inc.

Daniel Scanlon, GZA GeoEnvironmental Inc.

Ryan Moore, REGENESIS

Site Locus

- 155 South Flint Rock Road, Hyannis, MA





Former Municipal Fire Training Site History

- Utilized between 1959-2019 by all Cape Cod Fire Districts for critical and necessary life-saving training exercises
- Towns participated in education and essential training that they otherwise could not afford
- Utilized by 75+ Massachusetts Fire Departments “Over the Bridge”
- Utilized by others including:
 - Massachusetts Firefighting Academy
 - Steamship Authority
 - Pilgrim Nuclear
 - Otis Joint Base Cape Cod
 - Select Rhode Island Fire Departments





Municipal Fire Training Academy History

"Pit Fire" Demonstration 1959



Cape Cod Open House 1973





Former Municipal Fire Training Site - PFAS

PFAS FOAM USAGE

- Users trained with legacy AFFF (aqueous film forming foams) from 1959-2013+/- .
- Users provided their own AFFF (i.e., the County did not purchase foam and has no Site usage records).
- **PFAS detected in Mary Dunn Supply Wells in 2013.**
- Water training exercises ceased in 2019.

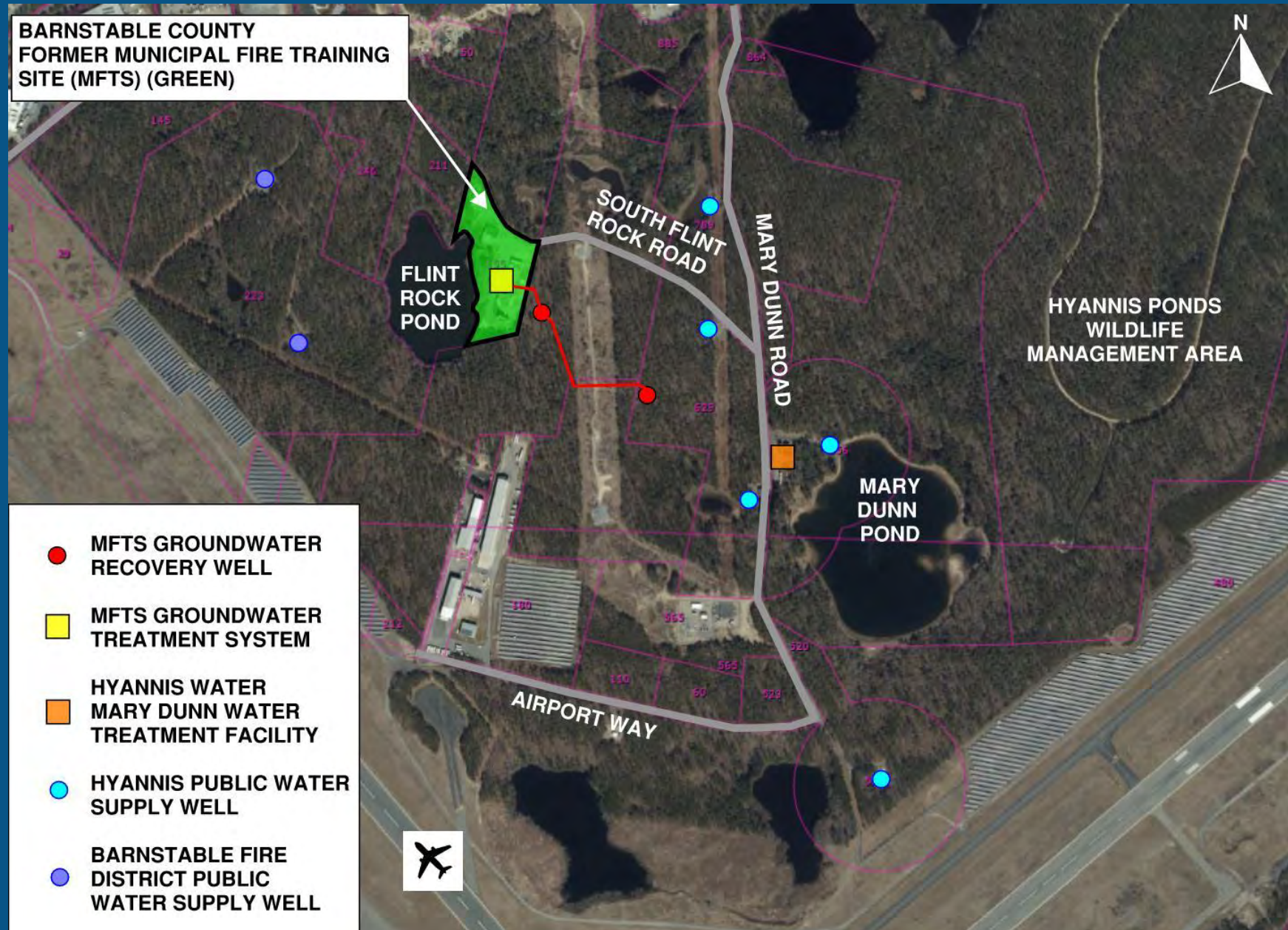
Throughout the site history of operation, the County, Municipalities and Fire Departments were unaware of the dangers of PFAS compounds in the AFFF.

Foam manufacturers marketed this project knowing the inherent dangers to both health and environment.



Site Layout

- Five Acre Property
- Hundreds of Acres Impacted
- Ten Water Supply Wells nearby
- Multiple Prior Environmental Impacts (chloroform, petroleum, perchlorate)
- Existing Pump & Treat Infrastructure
- SW, GW, and Sediment Impacts
- Legacy Response Actions





Municipal Fire Training Academy Remediation Milestones

July 2015

Groundwater Pump & Treatment System Online



January 2017

200 Tons of PFAS Impacted Soil Removed from Site



Municipal Fire Training Academy Remediation Milestones



**June 2017: Settlement with Town of Barnstable
For PFAS filtration on Mary Dunn Wells \$8.32 million**



December 2018: 4,000 square foot cap installed





Municipal Fire Training Academy Remediation Milestones

June 2019: Academy Closes



August 2021: Burn Building Demolition





Municipal Fire Training Academy Remediation Milestones

September 2021: Site Cap and Stormwater System Construction



October 2021: Site Cap Completed



2024 – County Awarded \$4m ARPA GRANT

- Award for Investigation and Remediation work
 - Requirement for funds to be:
 - obligated by **December 31, 2024**, and
 - expended by December 31, 2026
- Used to:
 - Reassess overall project approach;
 - Accelerate PFAS investigation / MCP efforts; and
 - Further stabilize the site via a PRB
- RFP for LSP Services Issued February 15, 2024
 - GZA selected April 11, 2024
- RFP for PRB issued November 27, 2024
 - Regenesi selected December 16, 2024



REQUEST FOR PROPOSALS (RFP)

BARNSTABLE COUNTY FORMER FIRE TRAINING ACADEMY PFAS RELEASE SITE
ENVIRONMENTAL ENGINEERING, PERMITTING, AND LICENSED SITE PROFESSIONAL SERVICES
(LSP)

Date: February 15, 2024

BARNSTABLE WATER POLLUTION CONTROL

CAPE COD GATEWAY AIRPORT

BFD Supply Wells

Flintrock Pond

Mary Dunn Supply Wells

Mary Dunn Pond

AIR-1 Sup

MAHER Supply Wells

Mill Creek Marsh

- Comingling with other sources
- Impacts of, and on, Water Supply Wells
- Increased Stakeholder Involvement:
 - Meetings with Community Leaders (Town, Airport, BFD, MassDEP, USGS, Sole-Source Consulting, Silent Spring, and others)
 - Information sharing and collaboration

GTA Known for excellence. Built on trust.

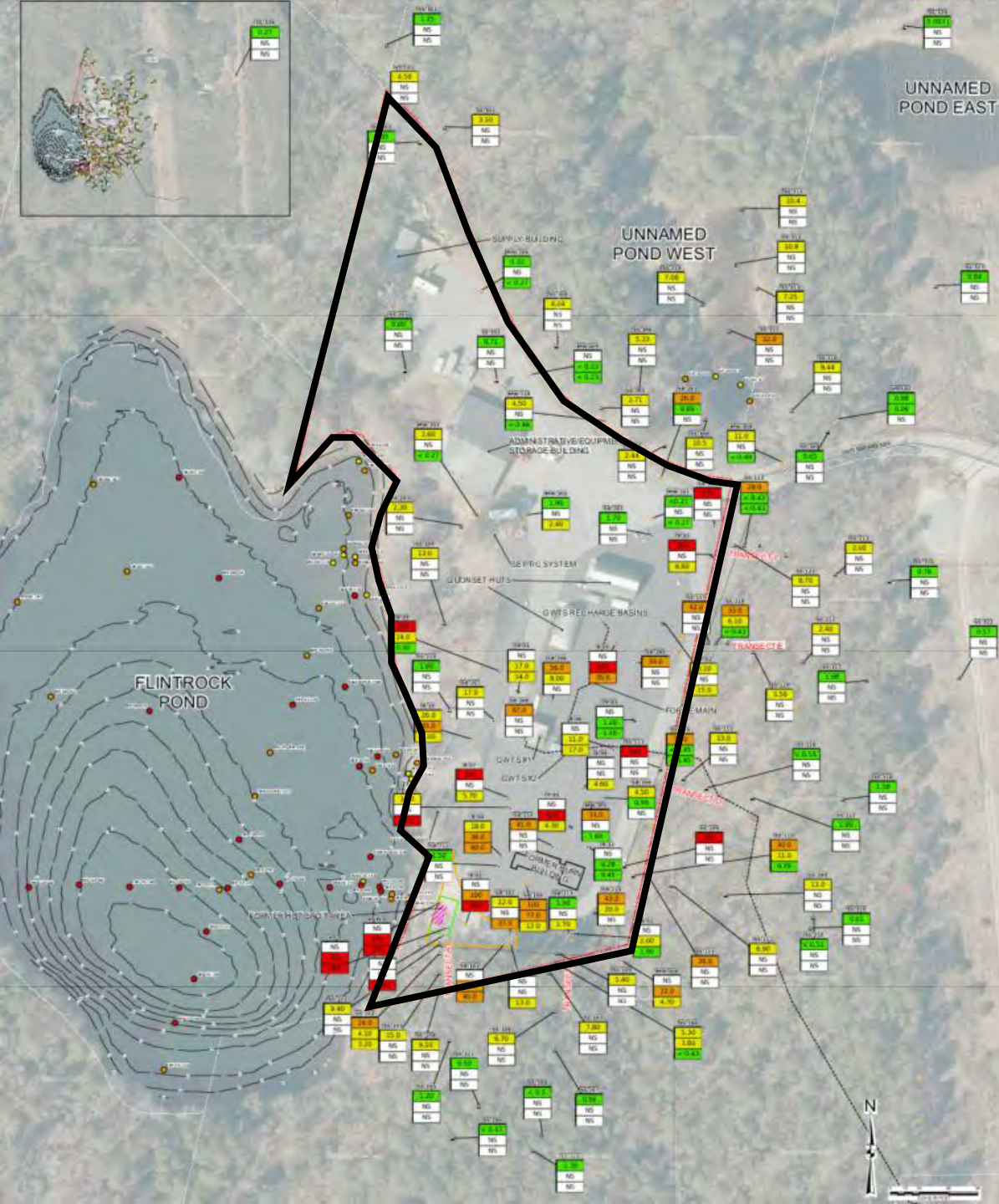
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- CAPE COD GATEWAY AIRPORT**
- BFD Supply Wells**
- Flintrock Pond**
- Mary Dunn Supply Wells**
- Mary Dunn Pond**
- AIR-1 Supply Wells**
- Maher Supply Wells**
- Mill Creek Marsh**
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Data Gap Assessment

- Regional database
- Surficial soil sampling
- Sediment/eco sampling
- Pond piezometers
- Site-wide survey data
- Regional GW gauging round
- Hydraulic conductivity testing
- Synoptic GW PFAS data
- Transient effects of supply wells
- Impacts of BWPC
- Co-mingling with other sources
- Eco/human health risk assessment



Soil PFOS Results

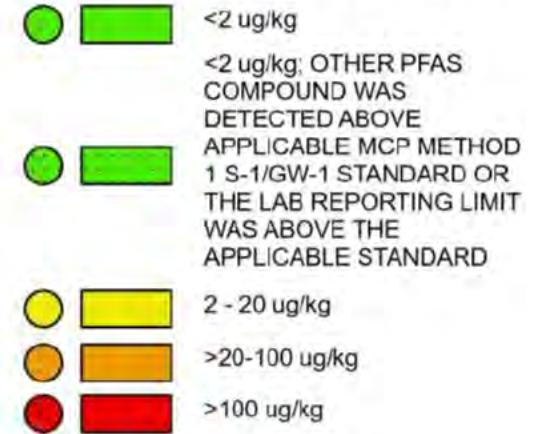


SAMPLE DEPTH KEY

0-3'
3-6'
6-15'

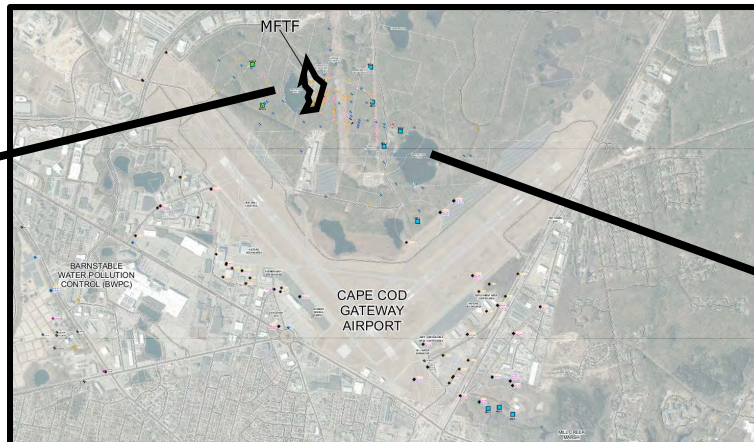
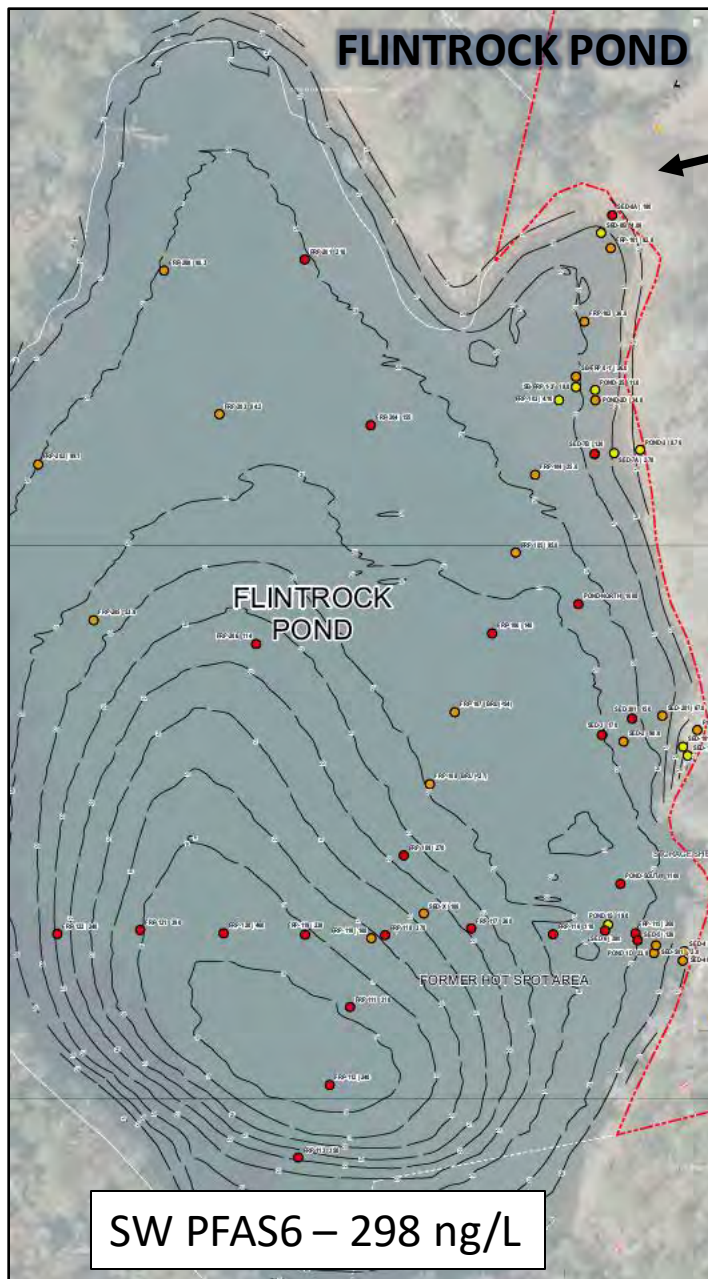
LEGEND

PFOS SAMPLE CONCENTRATION

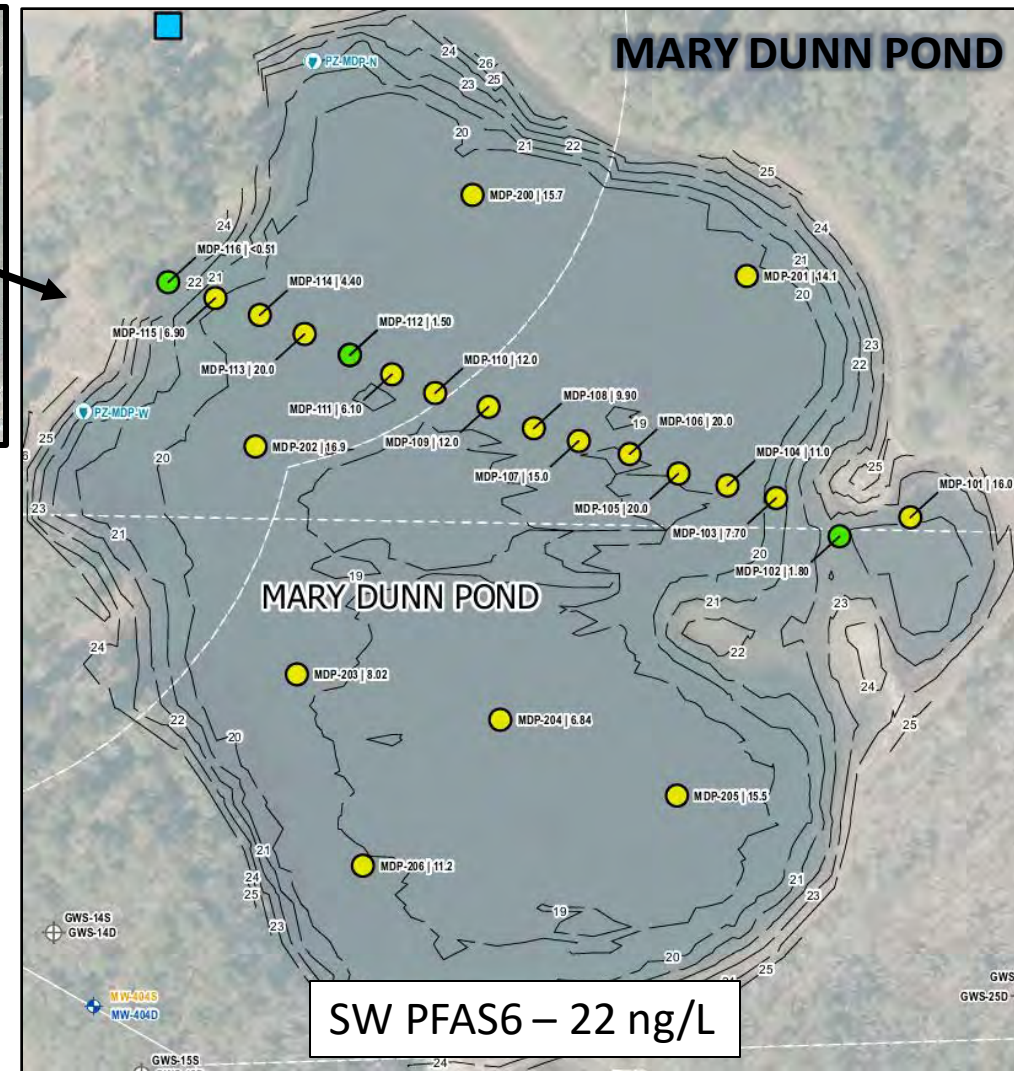


NS = NOT SAMPLED

Sediment/Surface Water PFOS/PFAS6 Results



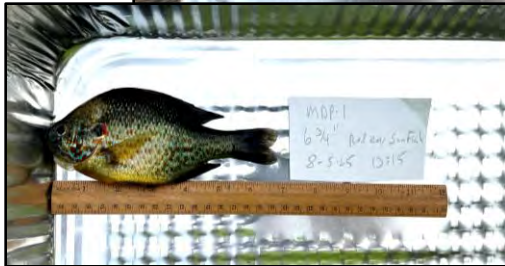
SEDIMENT SAMPLE PFOS CONCENTRATION



PFAS6 = sum of PFOS, PFOA, PFHxS, PFNA, PFHpA, PFDA

Ecological Sampling at Flintrock Pond/Mary Dunn Pond

Fish Tissue



Flying Insects via Light Traps



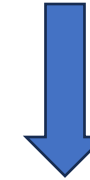
Benthic Organisms



PFOS Results (ug/kg) at Flintrock Pond/Mary Dunn Pond

Location	Fish Tissue	Flying Insects	Benthic Organisms
Flintrock Pond	25 - 665	44	62
Mary Dunn Pond	41-48	63	7.6

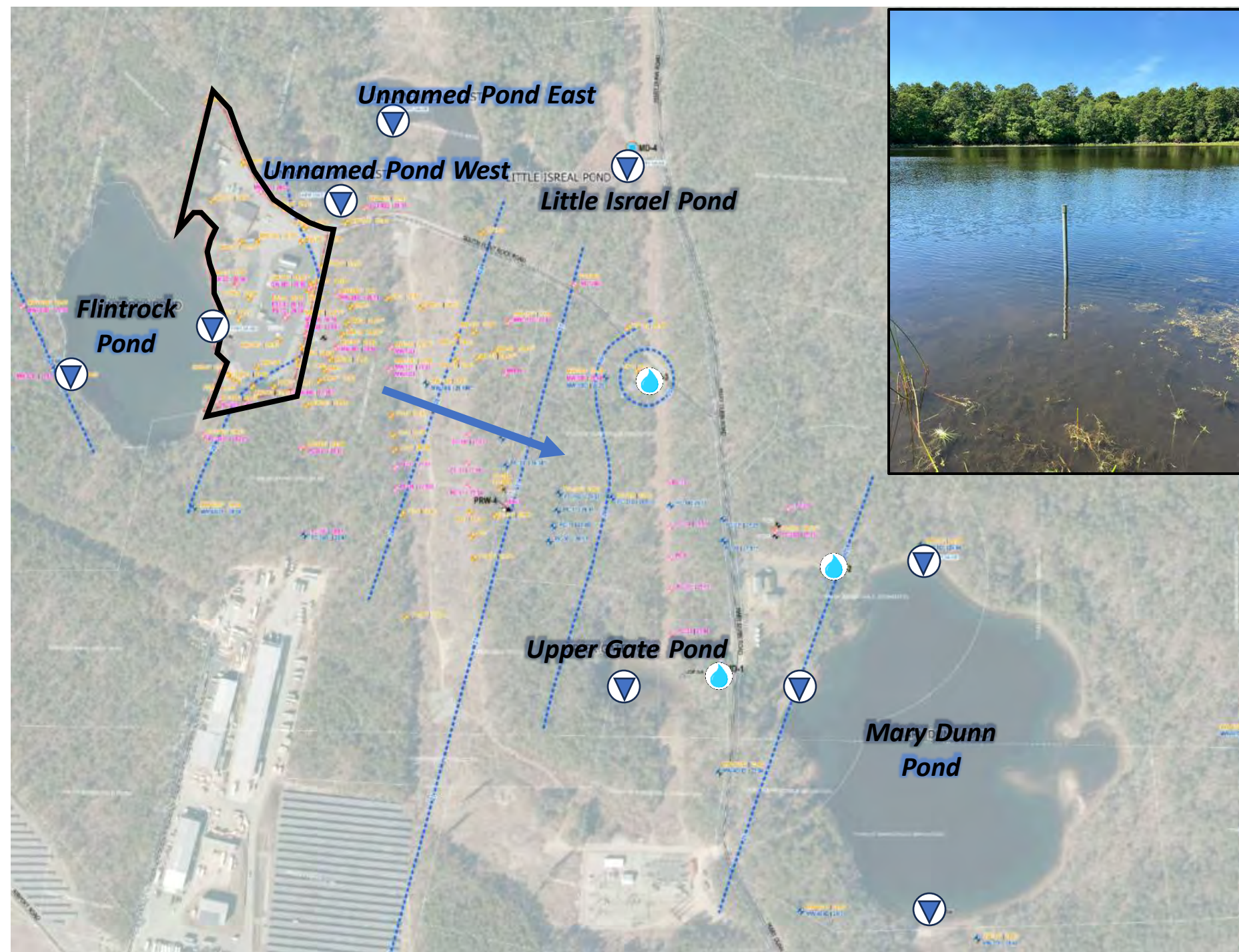
Biota used to evaluate potential impacts to higher trophic level receptors through food-chain modeling.



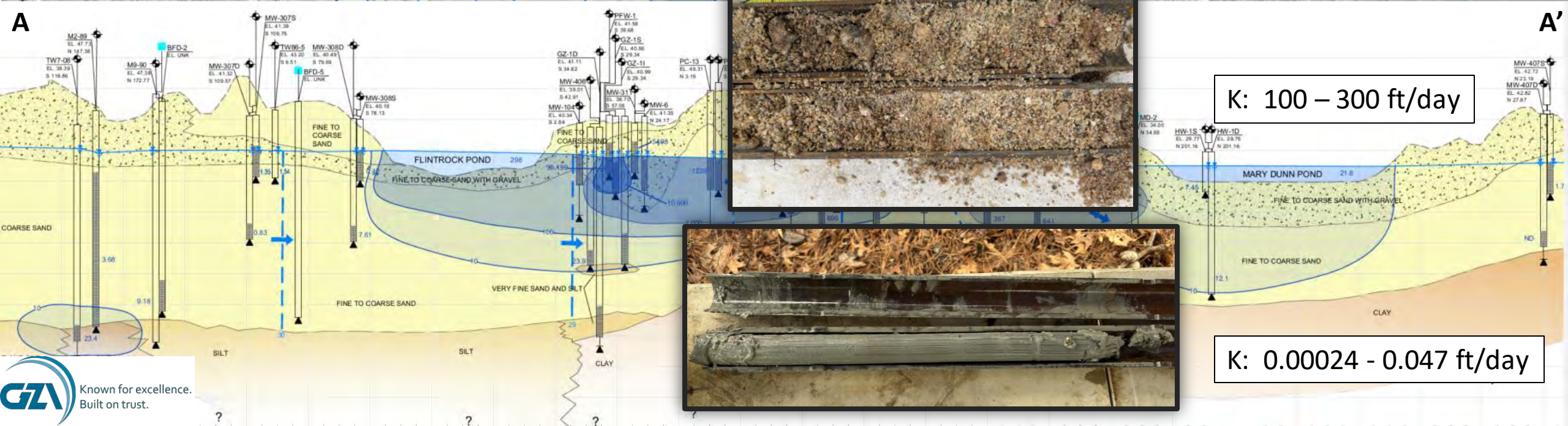
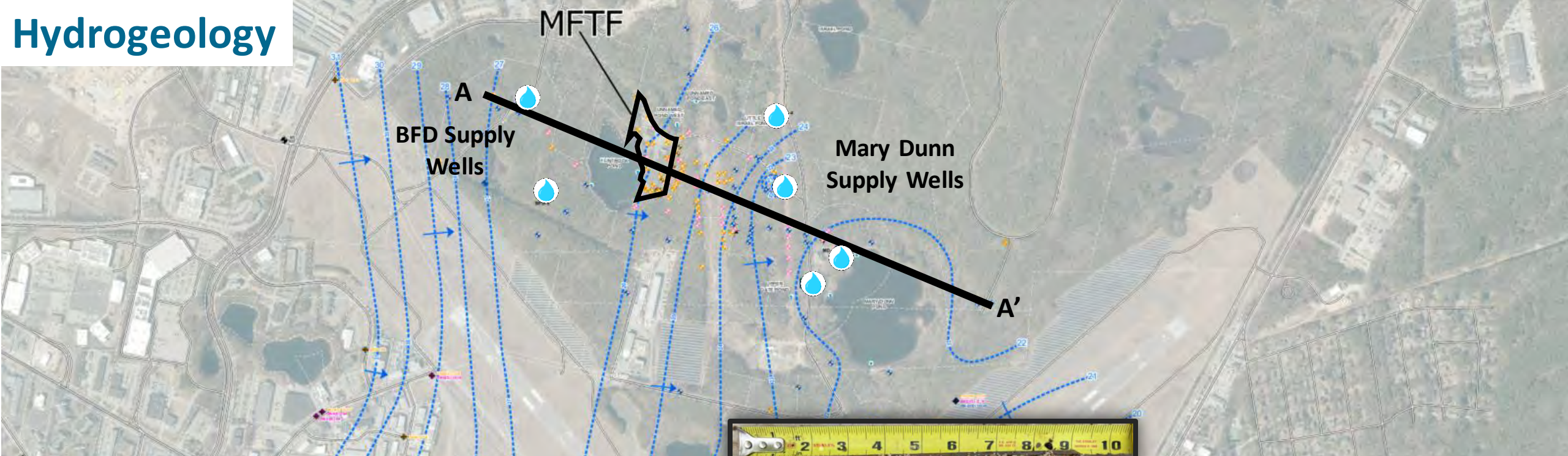
Receptor Type	Surrogate Receptor of Concern	Exposure Medium			
		Surface Water	Sediment	Soil	Biota
Sediment invertebrates	Benthic invertebrates		X		
Fish	Fish	X			
Avian piscivore	Great blue heron	X	X		X (Fish)
Mammalian piscivore	Mink	X	X		X (Fish)
Avian aerial insectivore	Tree swallow	X			X (Aerial Invertebrates)
Mammalian aerial insectivore	Little brown bat	X			X (Aerial Invertebrates)
Soil invertebrates	Earthworm			X	
Plant	Facultative plant			X	
Avian invertivores	American robin			X	X (Soil Invertebrates)
Avian carnivore	Red-tailed hawk			X	X (Small Mammals)
Mammalian herbivore	Meadow vole			X	X (Plants)
Mammalian invertivore	Short-tailed shrew			X	X (Soil Invertebrates)
Mammalian carnivore	Red fox	X		X	X (Small Mammals)

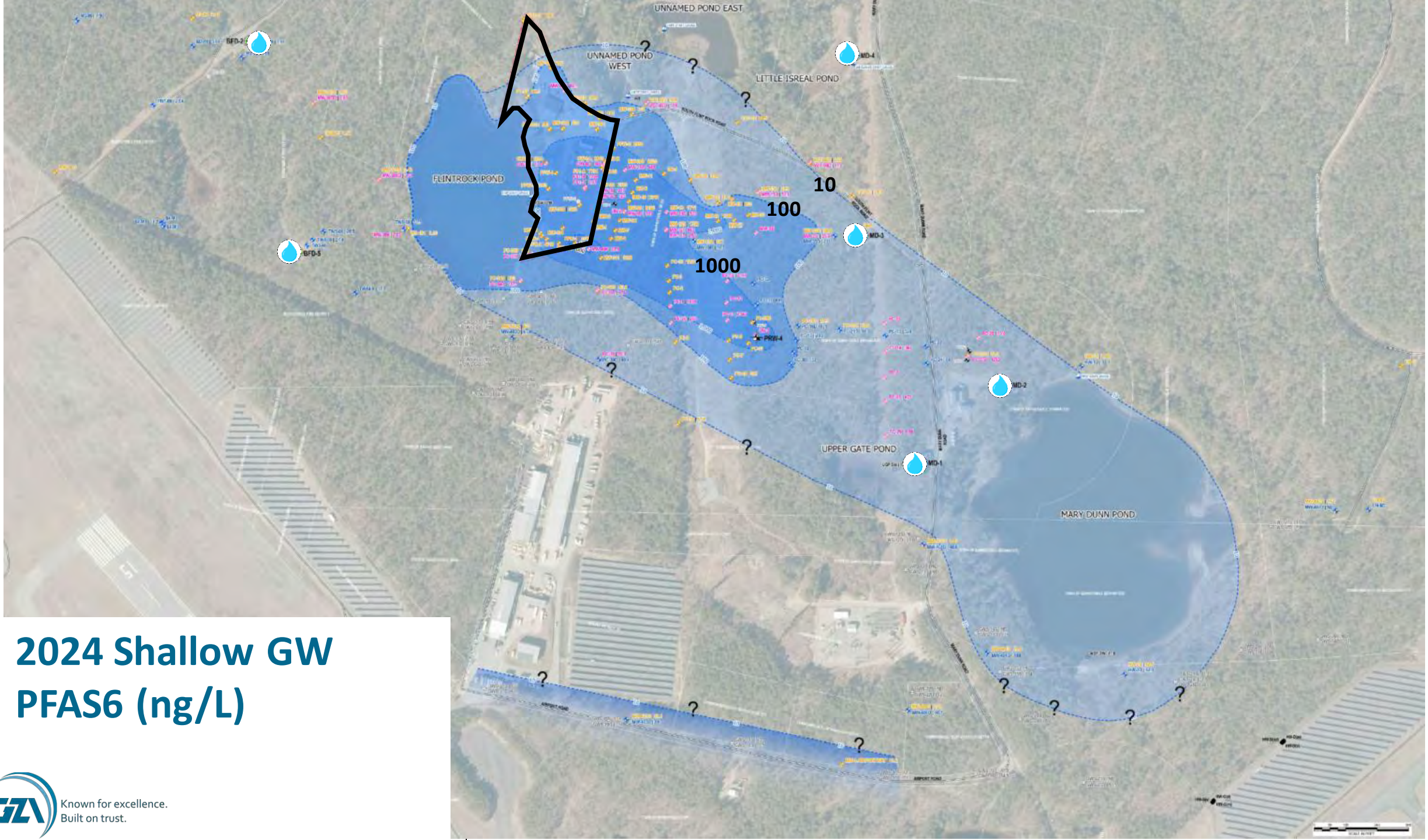
Pond Piezometers

- Screen installed below muck (0.2'-2' thick)
- Four quarters of GW/SW gauging
- Predominantly downward vertical gradients
- Slight upward vertical gradients in April



Hydrogeology





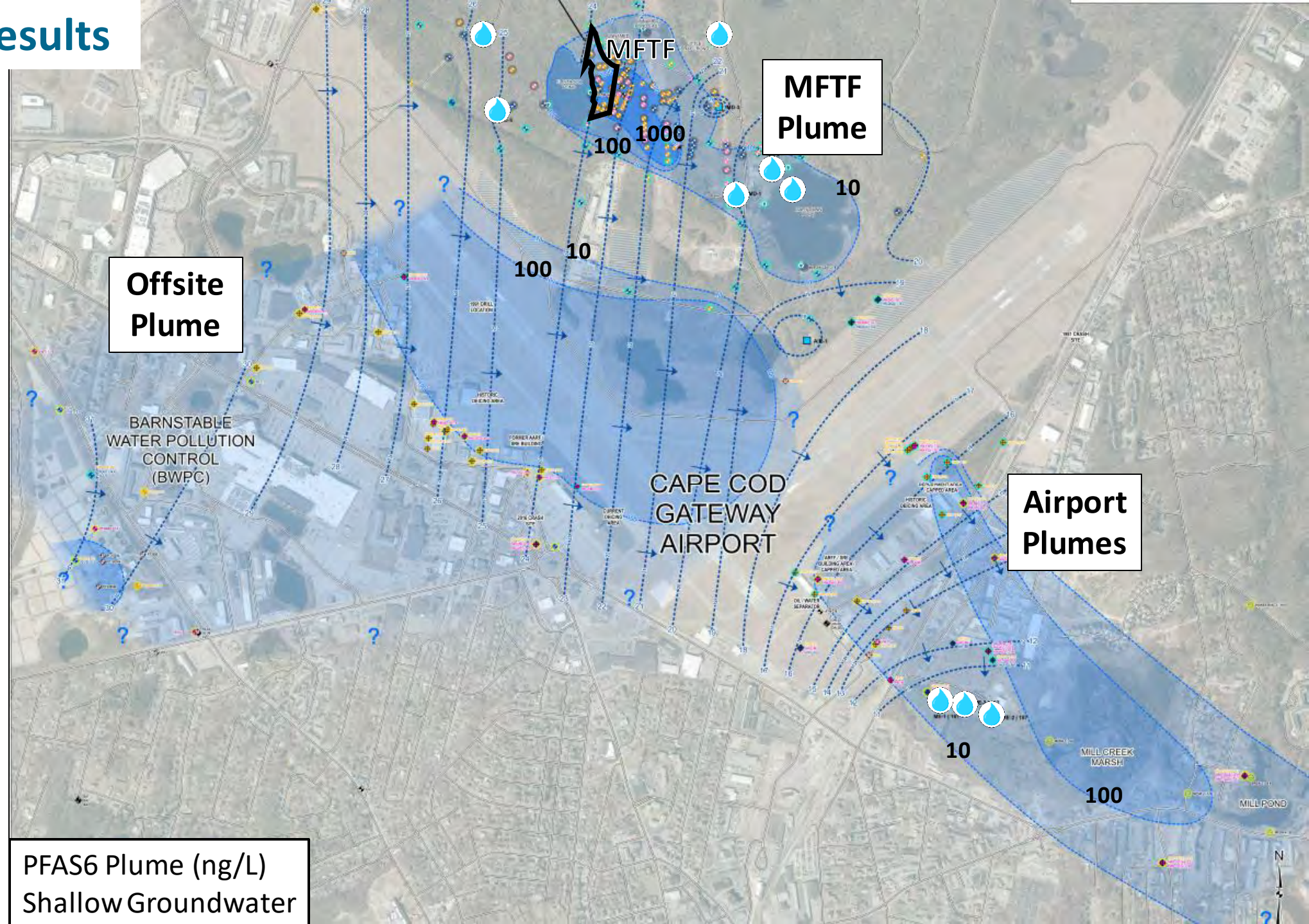
2024 Shallow GW PFAS6 (ng/L)



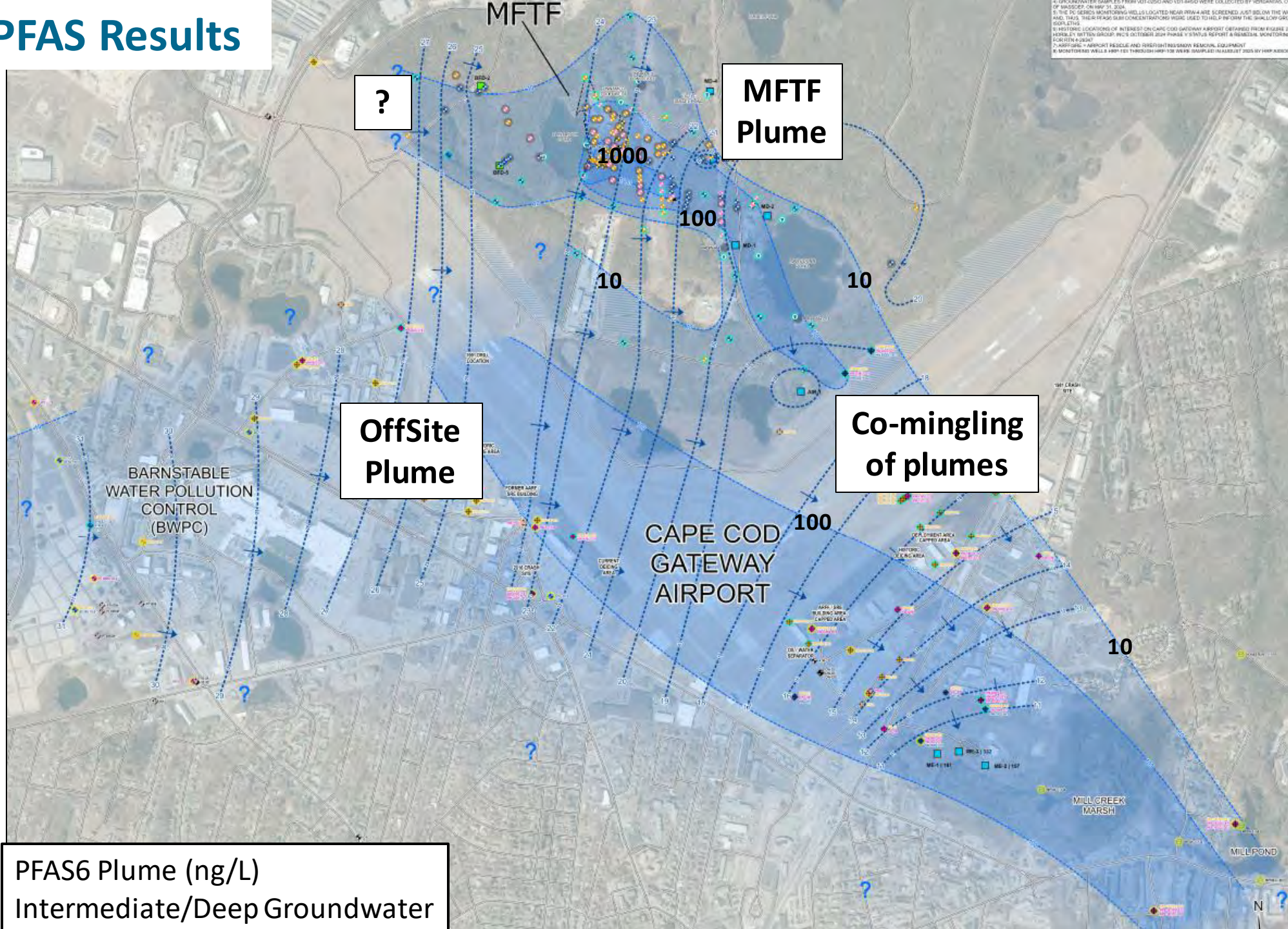
20
Pond (18/1)

Regional PFAS Results

- Coordinated sampling with the airport
- Collected samples from existing wells on BWPC & western airport runway area



Regional PFAS Results





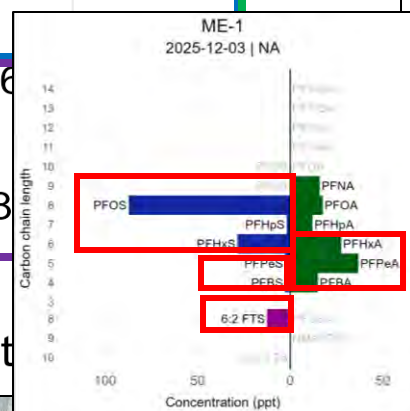
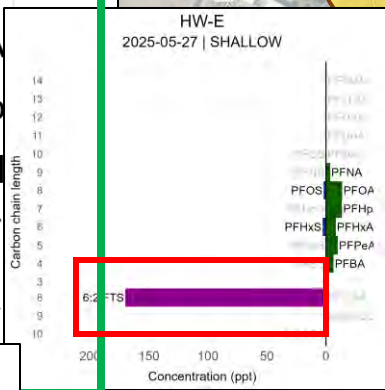
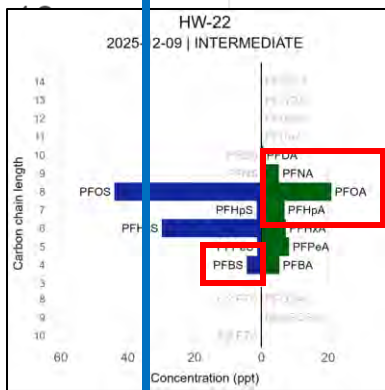
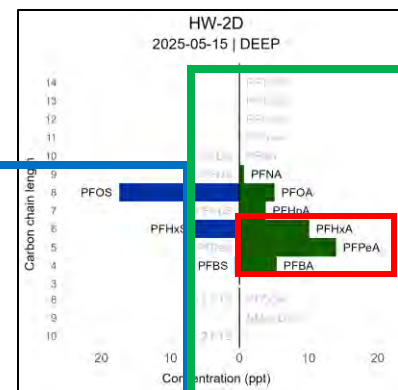
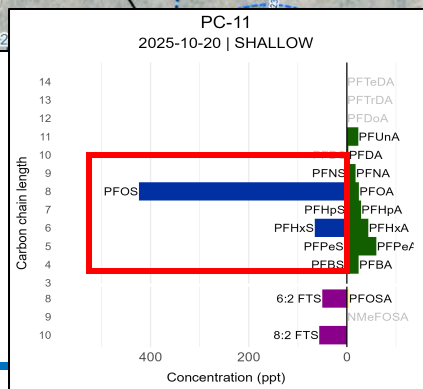
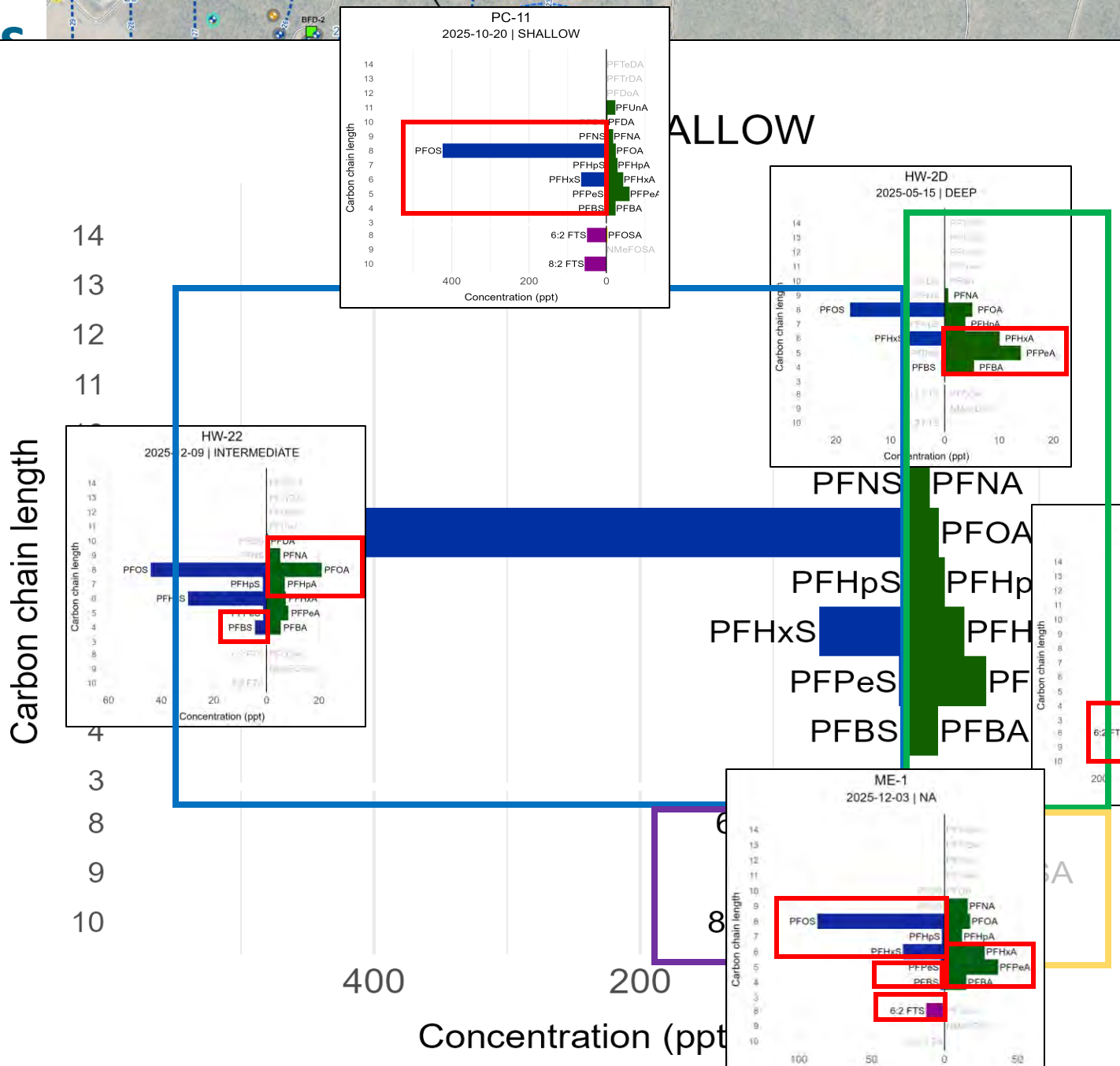
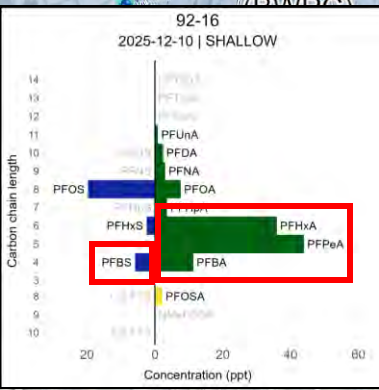
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Untangling Co-Mingled Plumes

- PFAS Forensics
 - o Bar Charts/Radar Plots
 - o Principal Component Analysis (PCA)
 - o Nominal Oxidation State of Carbon (NOSC)
- Numerical Groundwater Flow & Transport Model
 - o Refine and test CSM
 - o Particle tracking
 - o Assess past & future impacts & plume behavior

PFAS Forensics



Sulfonates
(e.g., PFOS)

Carboxylates
(e.g., PFOA)

Fluorotelomers
(e.g., 6:2 FTS)

Perfluoroalkane
sulfonamides
(e.g., PFOSA)

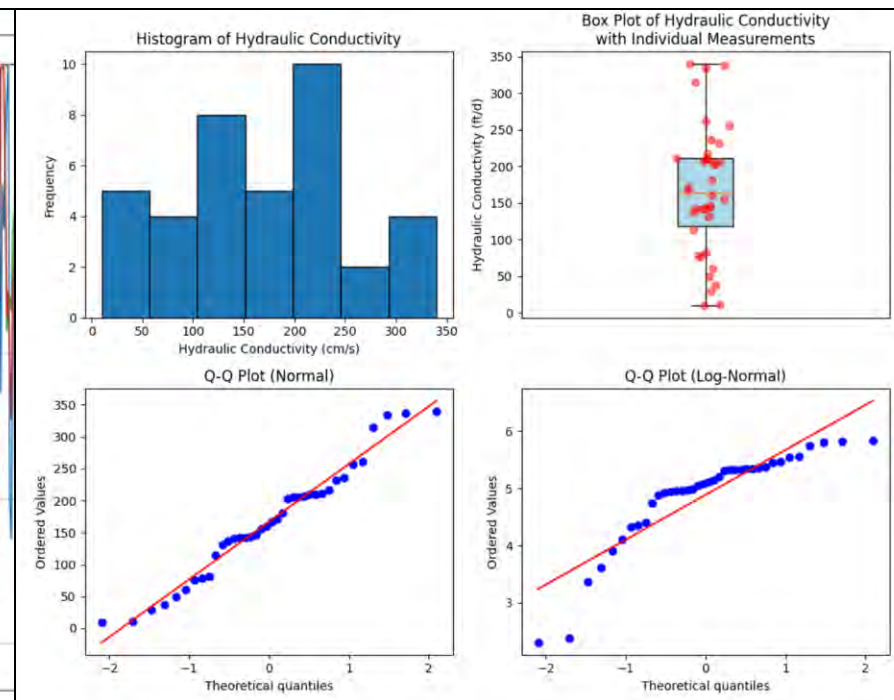
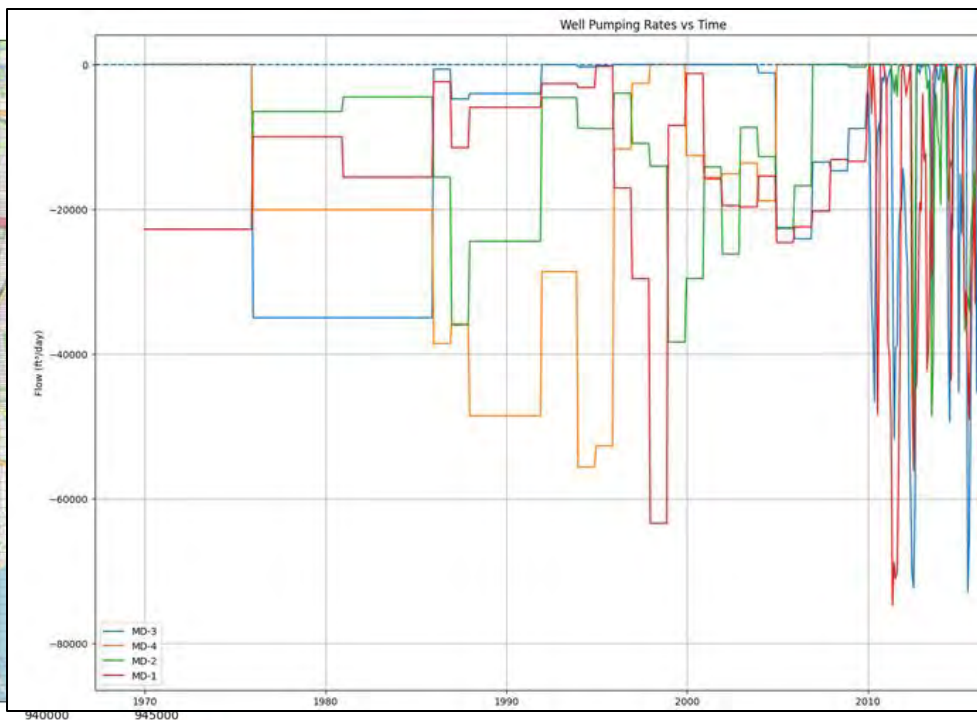
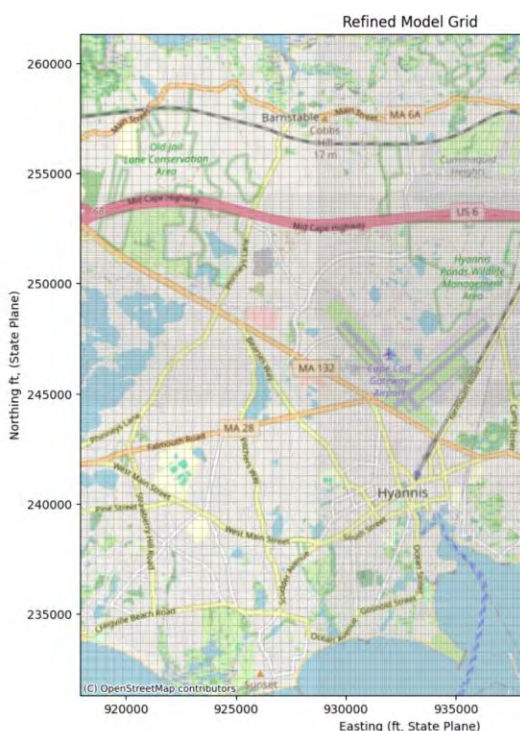
Numerical Groundwater Flow and Transport Model

Existing USGS Model Used as a Base¹

Refined Model Grid &
Added Silty Clay Layer

Added Pumping Rates

Adjusted Hydraulic Conductivities



¹Hughes, J.D., Langevin, C.D., and Banta, E.R., 2017, Documentation for the MODFLOW 6 framework: U.S. Geological Survey Techniques and Methods, book 6, chap. A57, 40 p.

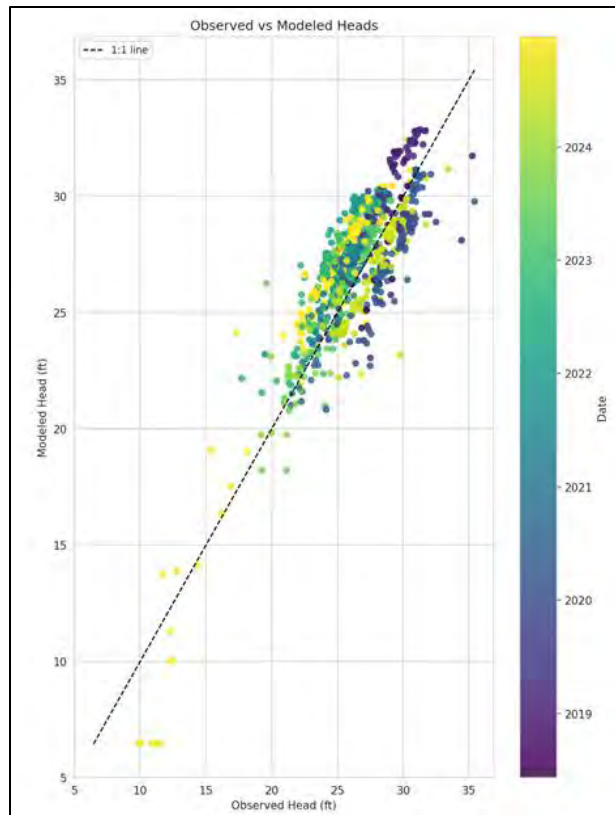


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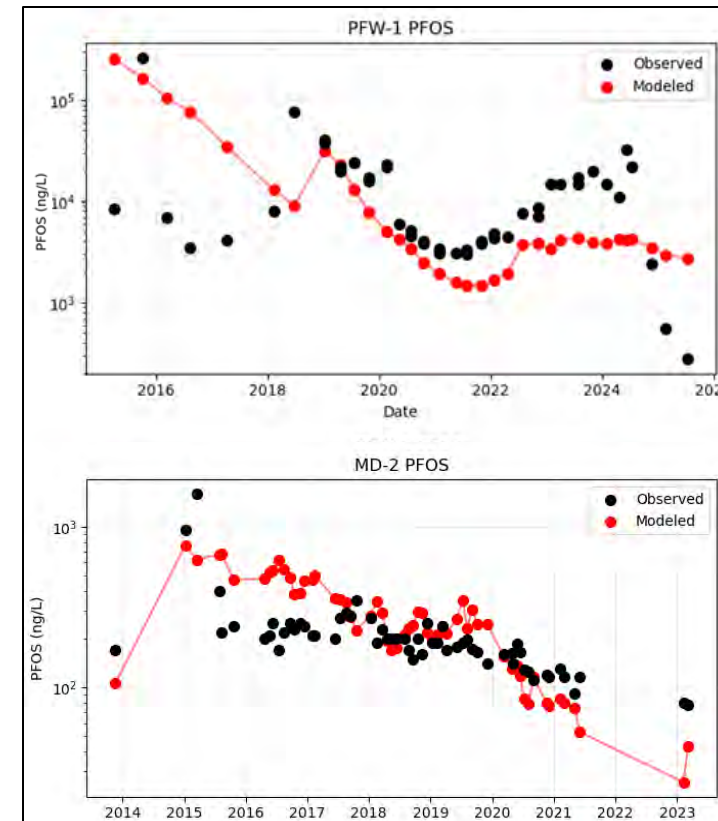


Numerical Groundwater Flow and Transport Model

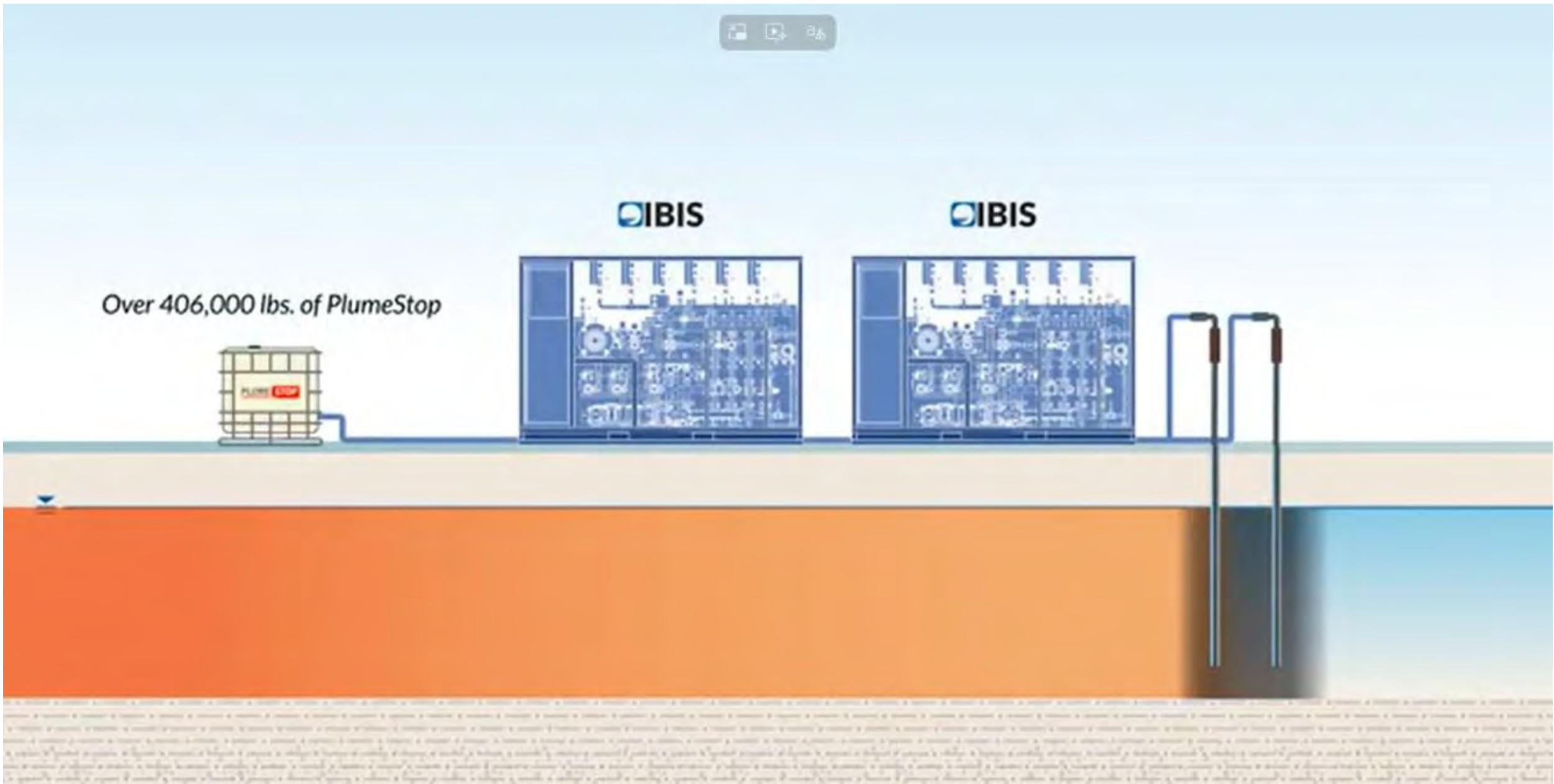
Calibrated To Observed Heads



Modeling the PFOS Plume



Permeable Reactive Barrier (PRB)

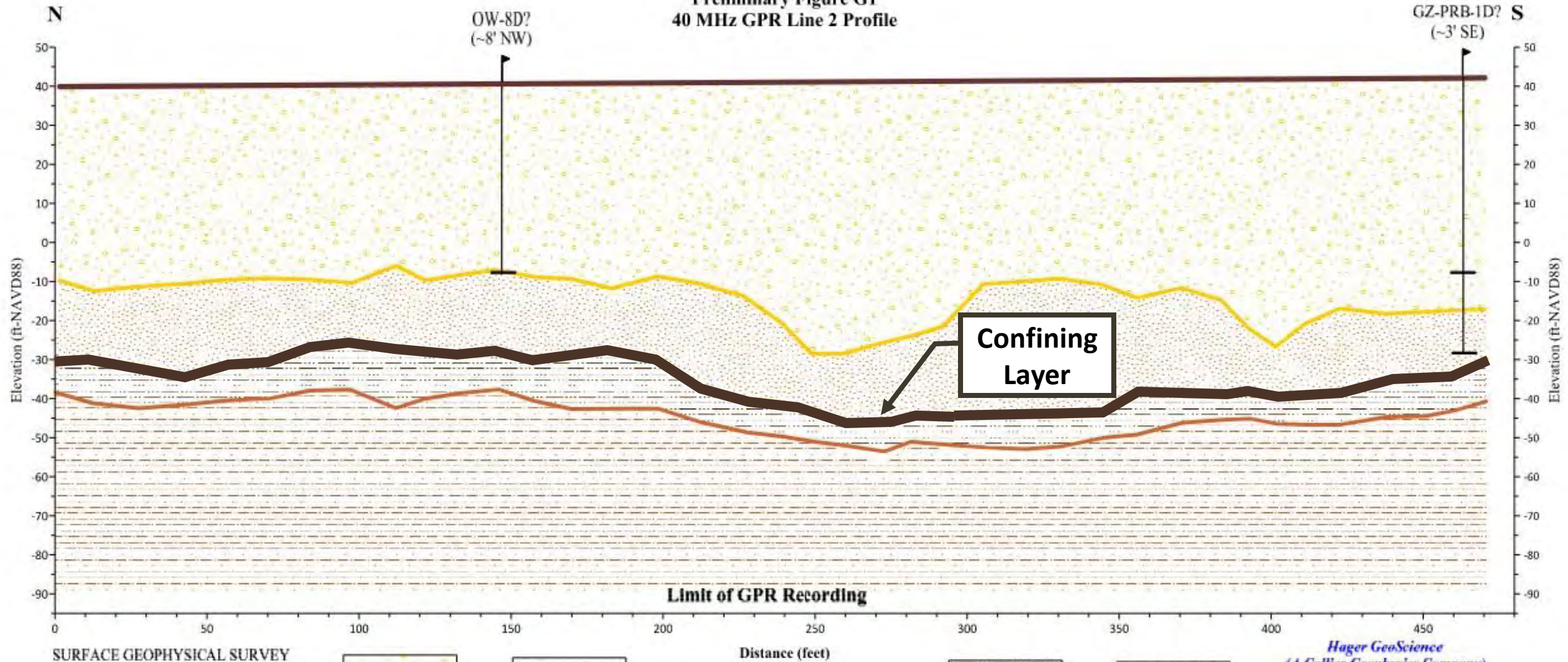


PRB Pilot Test

- Demonstrate applicability and obtain design inputs for full-scale remedy
- Colloidal Activated Carbon (CAC) – PlumeStop®
- ~10 ft x 30 ft Area downgradient of “hot spot”
- Injected ~26,000 Gallons of CAC in October/November 2024
- PFAS6 Concentrations were reduced from (~35,000 ppt) to non-detect (99.9% reduction!)



**Preliminary Figure G1
40 MHz GPR Line 2 Profile**



**SURFACE GEOPHYSICAL SURVEY
FIRE/RESCUE TRAINING ACADEMY
BARNSTABLE COUNTY
HYANNIS, MA**

March 2025 File No. 250022



Undifferentiated S&G



Fine Silty Sand



Silty Clay



Clay

Hager GeoScience
(A Collier Geophysics Company)
596 Main Street, Woburn, MA 01801
(781) 935-8111 hgi@hagergeoscience.com



Full-Scale PRB

- 406,400 lbs. (604,135 gal.) of PlumeStop® (~200 totes)
- 247 Injection Points, spaced ~5 feet apart
- PRB length = 617 Feet
- PRB Depth = Approx. 70 to 90 feet bgs
- Segmented into “high dose” and “low dose” areas



In Situ Remediation using Colloidal Activated Carbon

- Form of activated carbon
- Particle Sizes 1 – 2 μm
- Suspended as a colloid in a polymer solution
- Distributes widely under low pressure
- Provides extremely fast sorption sites
- Converts underlying geology into purifying filter
- Patented technology



How do you Design the Remediation?

Barrier lifespan modelled on isotherms, dynamic sorption

Dose based on:

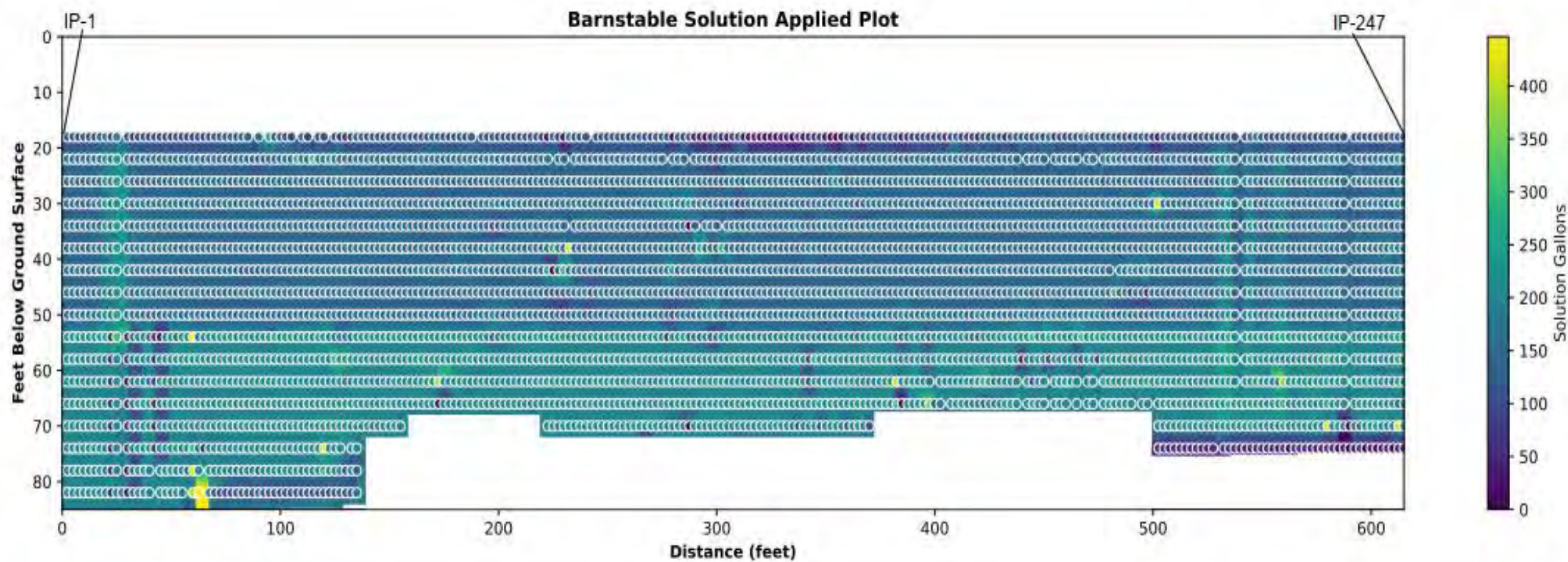
- Target contaminant flux
- Competitive sorption
 - Other contaminants
 - Natural organics (will degrade)

Table 3: PlumeForce Model Inputs		
Compound	Low Dose Input (ng/L)	High Dose Input (ng/L)
PFNA	145	191
PFOS	3,490	23,800
PFOA	1,355	561
PFHpA	565	328
PFHxS	2,865	2,135
PFDA	35	87
Sum MA PFAS 6	8,455	27,102

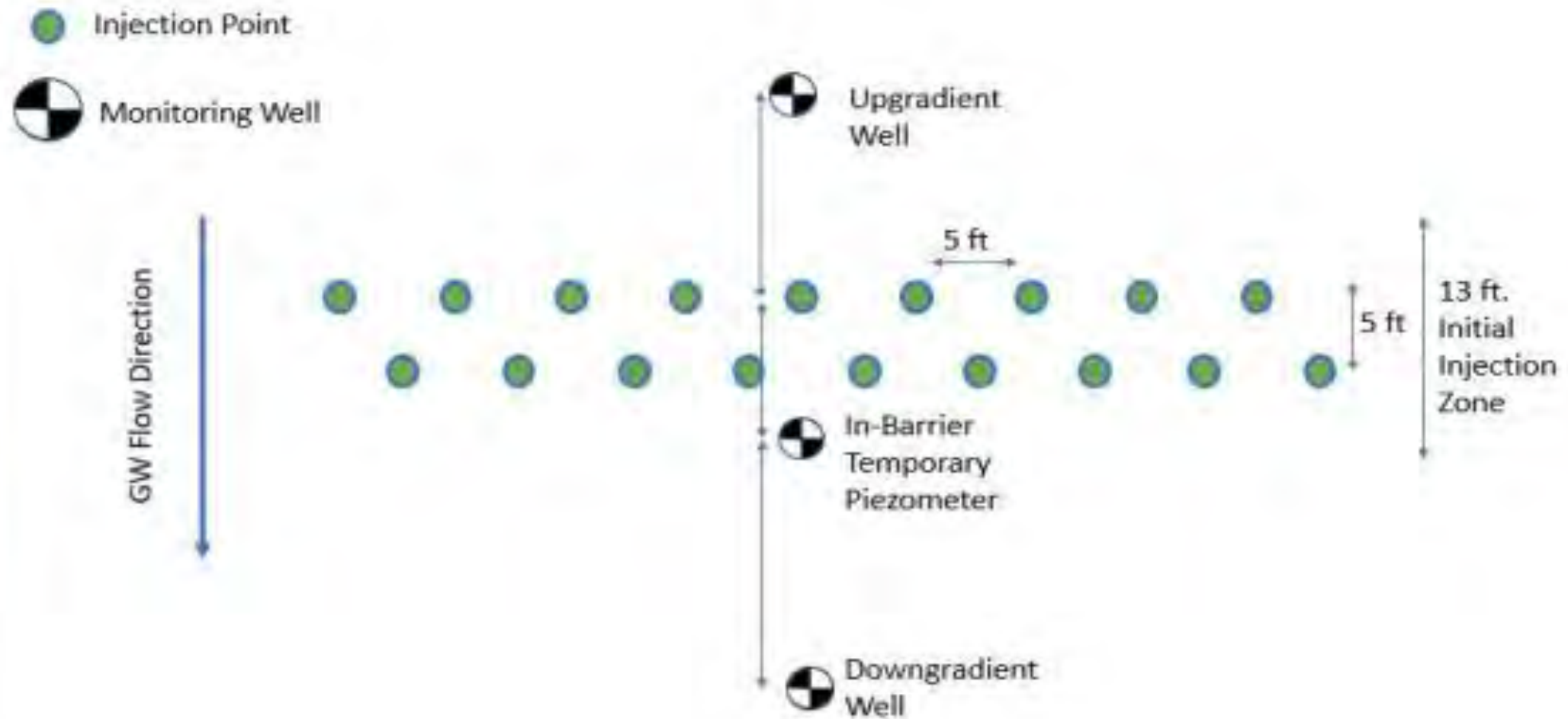
REGENESIS Remediation Services (RRS)

- **I**nline **B**lending and **I**njection **S**ystem
- Data logging/automated capture
- Reduced material handling,
 - **NO BATCH TANKS**
- Precise reagent dosing
- Capable of blending up to 4 amendments at simultaneously





Placement Validation



Site Photos



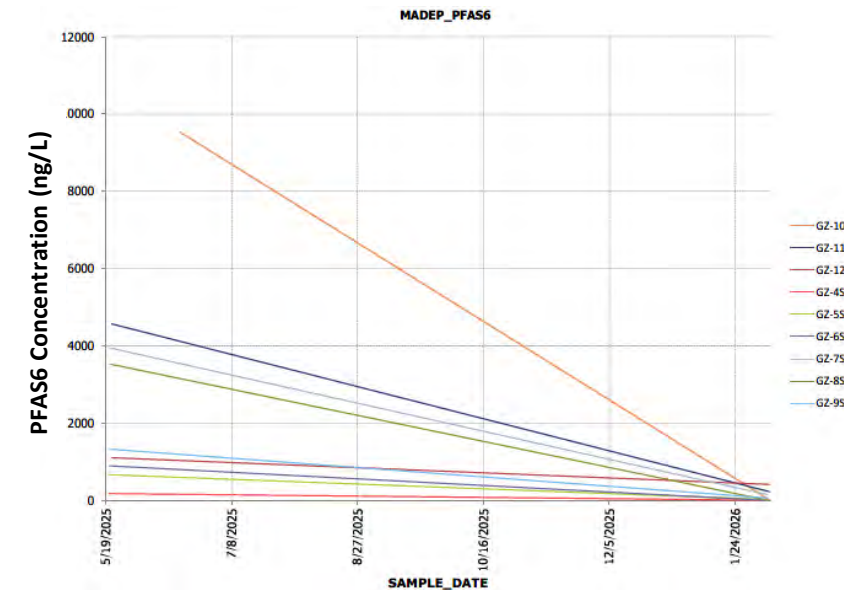


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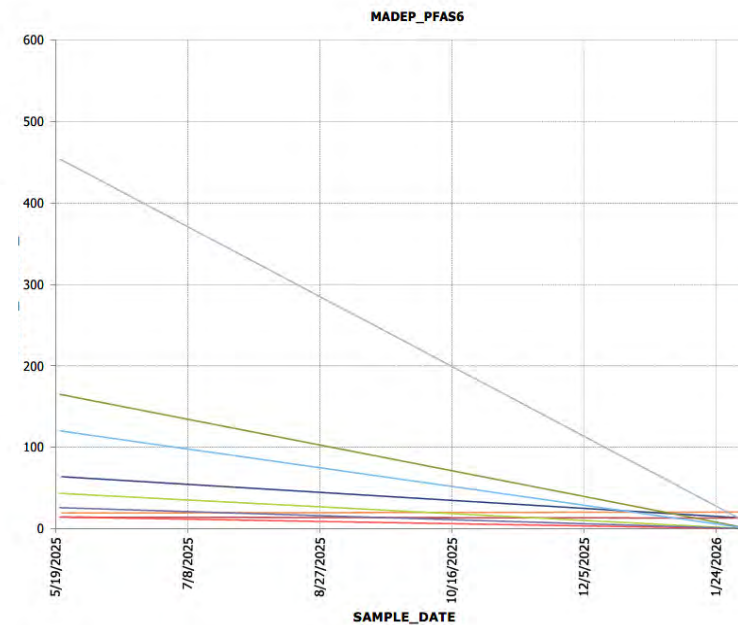


PV Groundwater Monitoring Results: Feb 2026

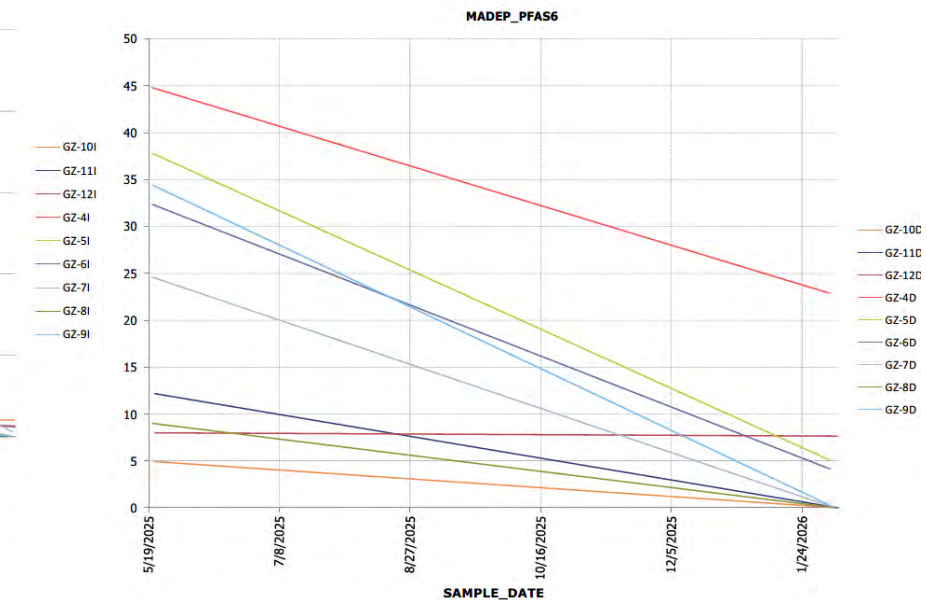
All results in ng/L (ppt)



Shallow



Intermediate



Deep



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Interim Status Thoughts

- While the hydrogeology is relatively simple, the “Site” is complicated!
 - Lack of detailed AFFF usage
 - Impacts of pumping from the municipal wells
- Comingling of multiple plumes
 - Different initial source constituents
 - Impacts of individual constituents’ retardation and transformations
- Current risk to the public is mitigated by engineering controls
- Future migration from the Site expected to be limited by PRB
 - Downgradient benefits



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Future MCP Compliance Tasks

- Complete Phase II CSA (Groundwater Investigation)
- Phase III Remedial Alternatives Report
 - PRB with monitoring
 - Assess the effectiveness of the existing groundwater containment system
 - Assess feasibility and benefit of on-site groundwater extraction
- Phase IV Remedial Implementation



Thank You!



Known for excellence.
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Paul Ruzala, P.E.

Barnstable County Assets and Infrastructure Manager
paul.ruzala@capecod.gov

Michael Dutton, JD, ICMA-CM

County Administrator
michael.dutton@capecod.gov

David E. Leone, LSP

Principal, LSP-of-Record
GZA GeoEnvironmental, Inc.
DavidE.Leone@gza.com

John Paquin, P.G.

Principal, Project Coordinator
GZA GeoEnvironmental, Inc.
John.Paquin@gza.com

Jennifer McKechnie, P.G., LSP

Senior Project Manager
GZA GeoEnvironmental, Inc.
Jennifer.McKechnie@gza.com

Daniel Scanlon

Senior Project Manager
GZA GeoEnvironmental, Inc.
Daniel.Scanlon@gza.com