



# Tracking PFAS in an Island Environment

*Northeast Conference – The Science  
of PFAS: Public Health & the  
Environment*

April 5, 2022





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Located in Concord, NH office, I am a principal geologist at Weston Solutions, Inc. with 17 years of experience in site investigations, characterization, and remediation. My focus is primarily on chlorinated solvents and emergent and recalcitrant compounds including 1,4-dioxane and PFAS.



# Presentation Overview

- Location and geologic setting
- Sources of PFAS
- Discovery of contamination
- Investigation current status
- Evaluation of data
- Summary & next steps



# Location and Geologic Setting

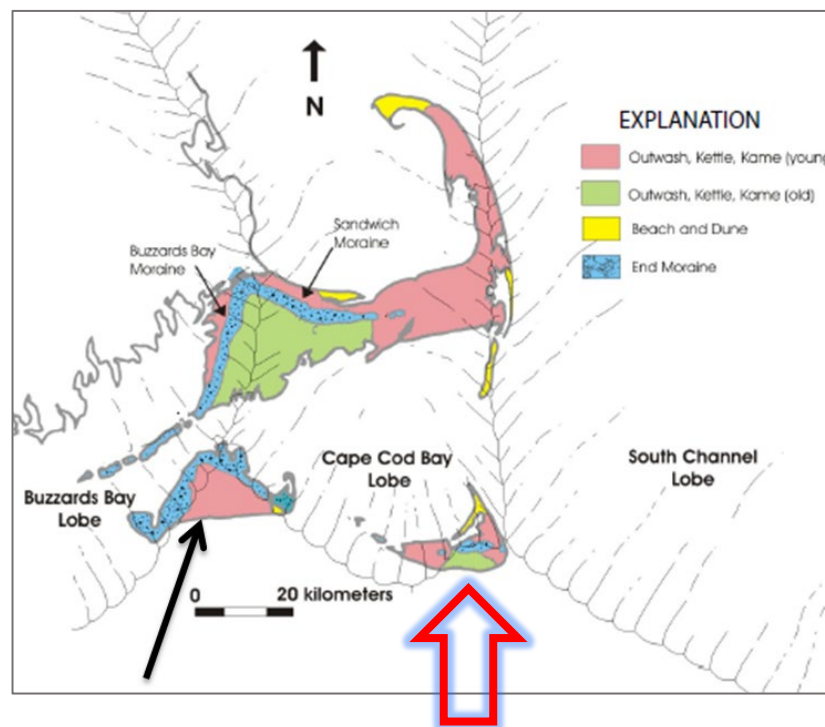
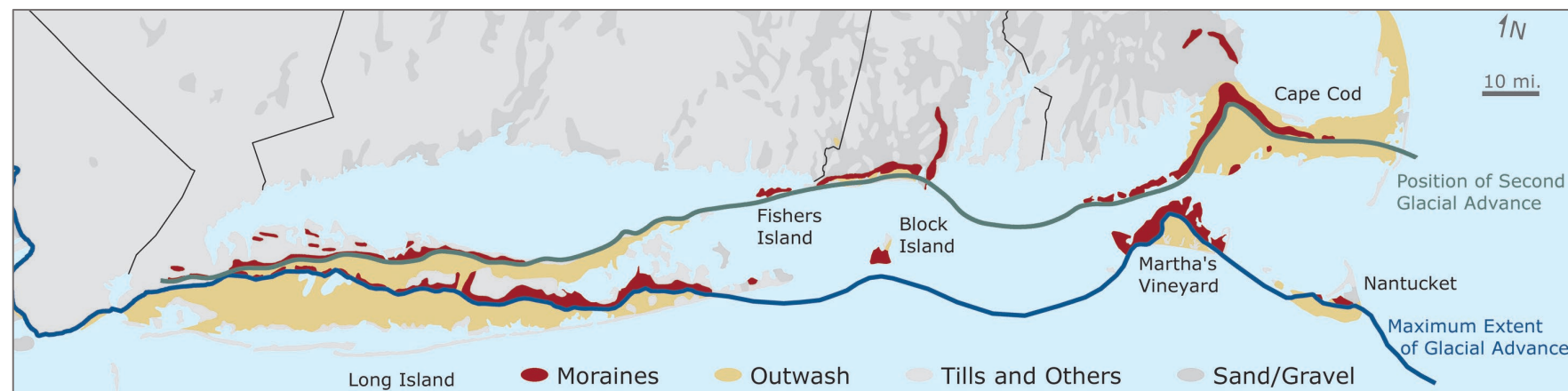


# Site Location





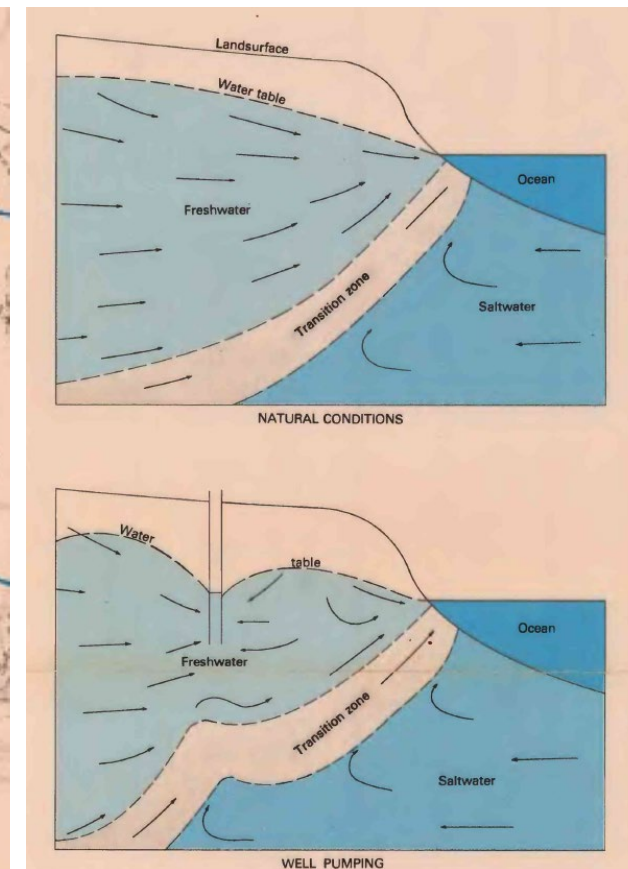
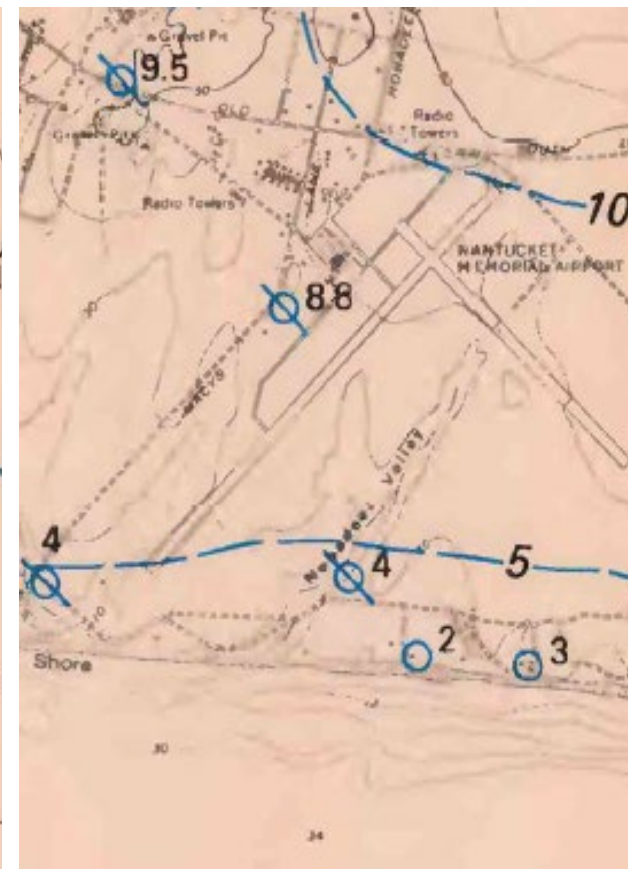
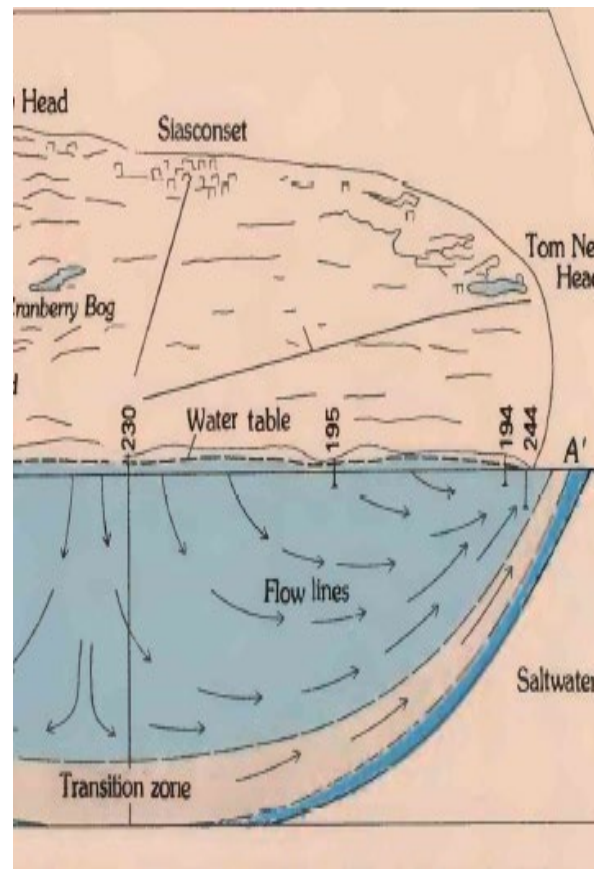
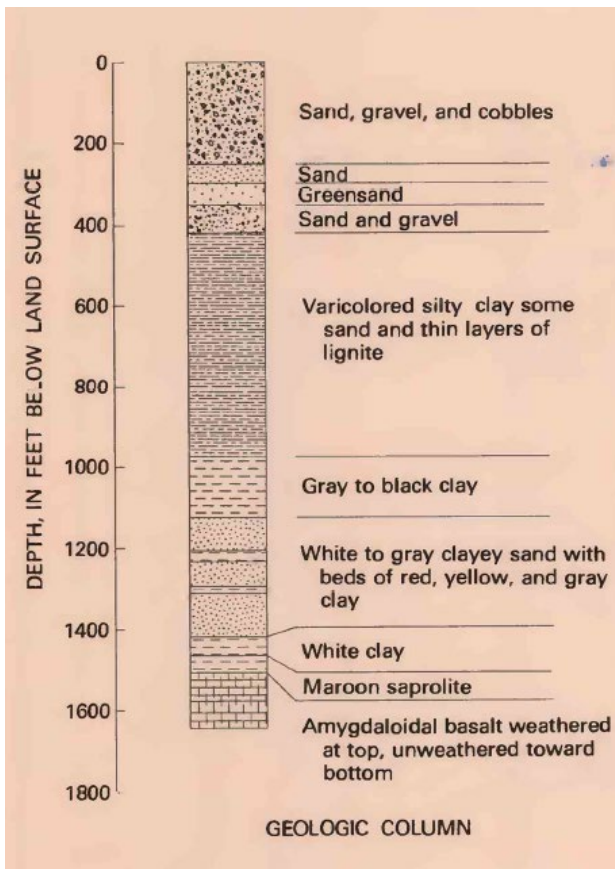
# Site Geology





# Site Hydrology

Water Resources of Nantucket Island, Massachusetts  
Eugene H. Walker (1980)













# Sources of PFAS





# On Site Sources of PFAS

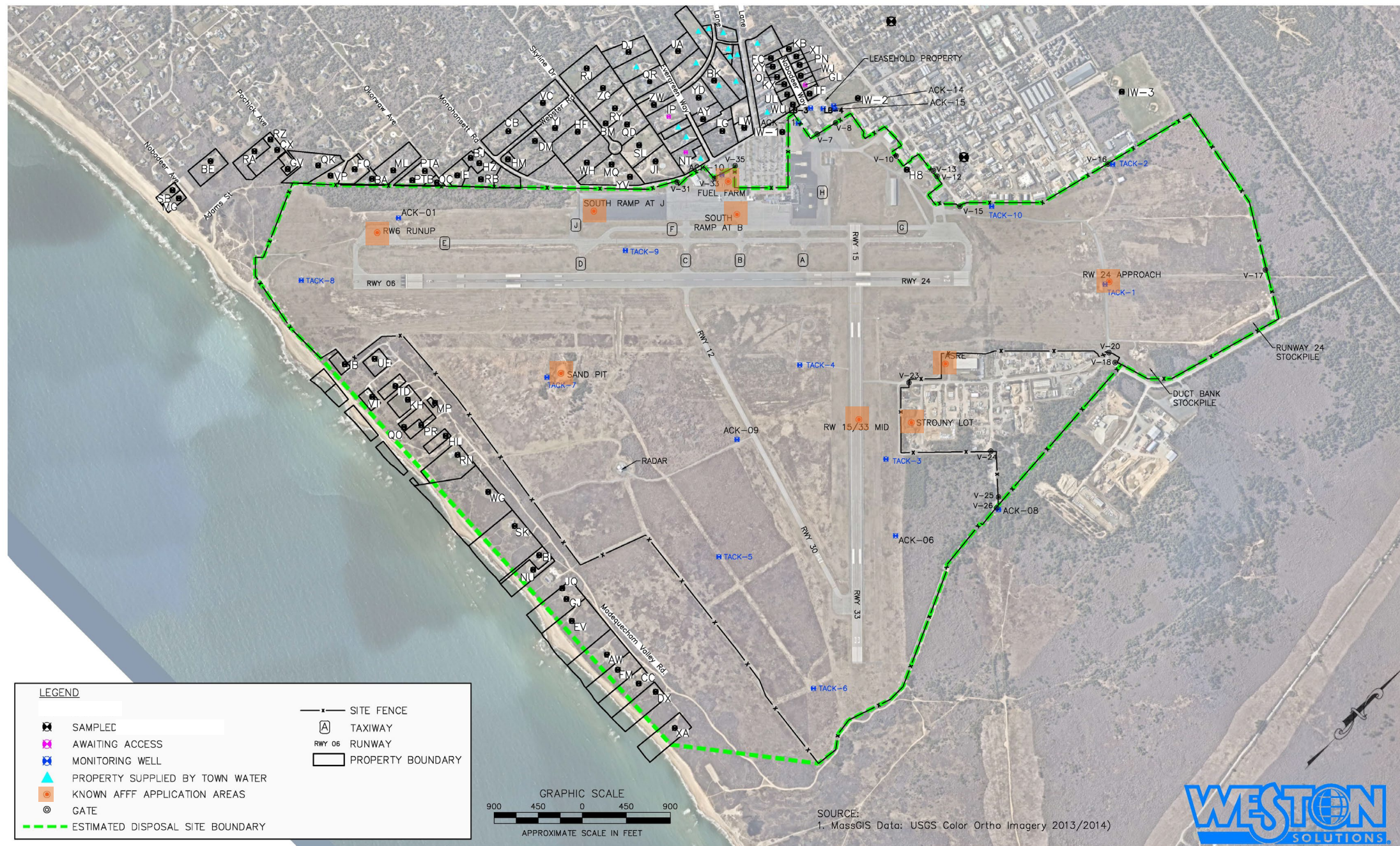
- Per 14 CFR §139.315-319, PFAS-containing AFFF is required for airports.
  - Storage of readiness and reserve; and during required drills, training, testing, and maintenance activities.
  - ACK has used AFFF since 1989 and ceased discharge to ground in 2019.
  - E-ONE testing system use eliminates surface applications.
- Initially, 9 AFFF Application areas identified.
- Fuel Farm conversion to F3.
- Other emergency response agencies participated in multiple on-airport drills.



# AFFF Application History

Application Area	Approximate Timeframe of Application	Estimated Volume of AFFF Concentrate Applied
Runway 6 Run-Up	1995-2015	25-50 gallons
South Ramp at J	2015-2018, 2022	25-55 gallons
Fuel Farm	1998-2013	~200 gallons
South Ramp at B	1995-2015	25-50 gallons
Sand Pit	1989-1994, 2008	150-300 gallons
Runway 15/33 Midpoint	1989-2013	~625 gallons
Strojny Lot	2015-2019	600-750 gallons
Runway 24 Approach	1995-2015	275-550 gallons
SRE Building	2015	Unknown







# Potential On Island Sources of PFAS

- Airport (AFFF)
- Nantucket Fire Department (AFFF)
- Landfill (SW & AFFF)
- Wastewater Treatment Plant
- Biosolids/Compost
- Septic Systems
- Bulk Fuel Storage Facilities
- Car Washes
- Boat Yards

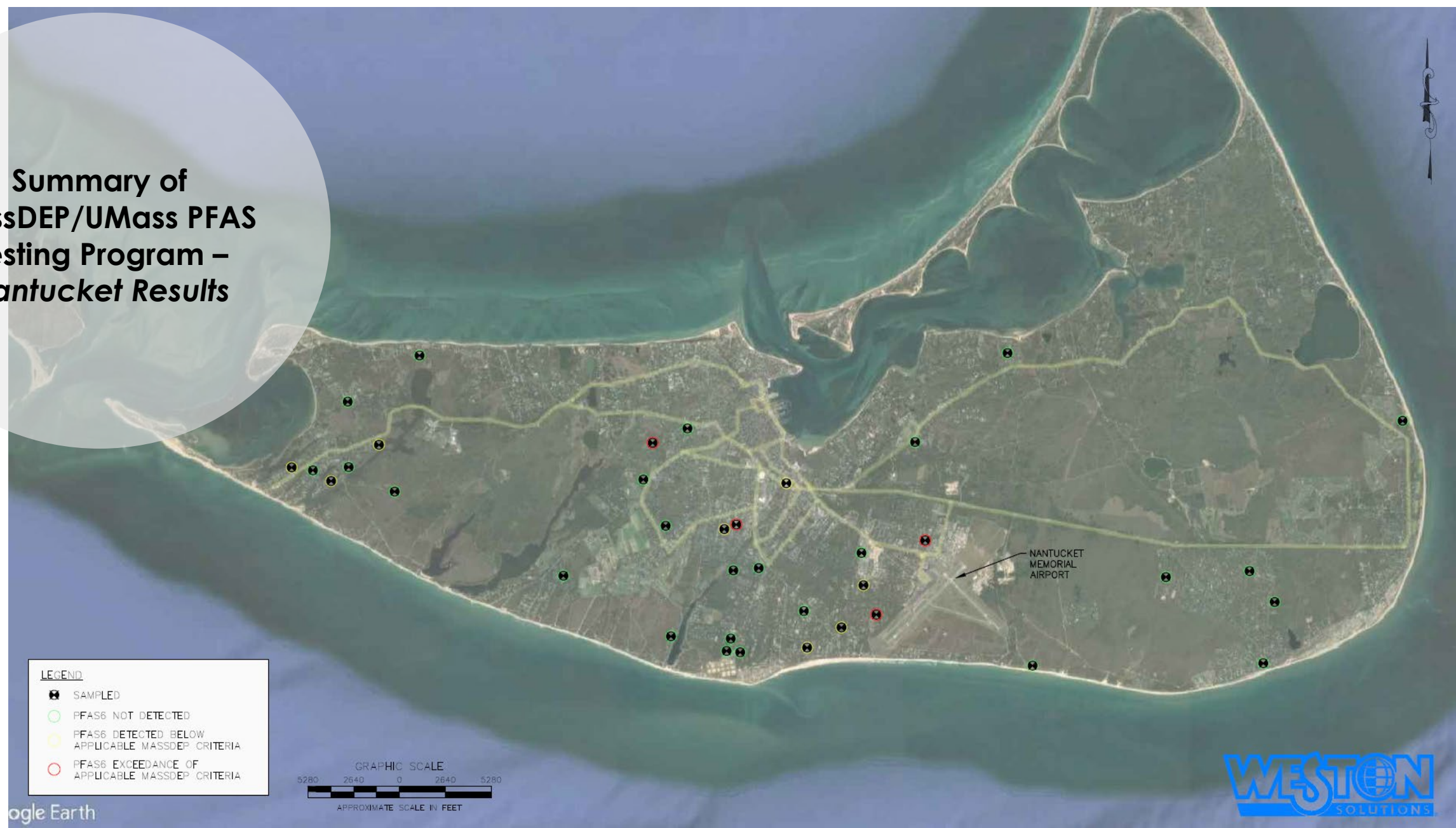


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# Summary of MassDEP/UMass PFAS Testing Program – Nantucket Results



Google Earth





# Discovery of Contamination



# Discovery of Contamination

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- **March 2019:** MassDEP issues Request for Information.
- **April 2019:** ACK response documenting past and current use of AFFF.
- **December 2019:** MassDEP issues Notice of Response Action.
- **December 2019:** MassDEP promulgates standards for "PFAS6".
- **February 2020:** Groundwater testing commences.
- **March 2020:** MassDEP informed of test results.
- **May 2020:** Treatment system installation commences (seasonal homes).





# Immediate Response Actions under the MCP

- **77 homes** sampled for PFAS following a step-out process (west only) negotiated with MassDEP.
  - 65 homes provided with bottled water.
- **19 point-of-entry treatment (POET)** systems installed in 15 homes as interim mitigation strategy.
  - IX POETs installed at high concentration locations (seasonal).
  - GAC POETs installed at lower concentration locations (west and seasonal).
- **POETs expedited** for home with concentrations >10x PFAS6.
  - Contractor procurement was a significant challenge.
- **Permanent solution:** Municipal water main and service connections provided at ACK expense.
- **On-island challenges:**
  - Logistical considerations (i.e., ferry & rental/company vehicle).
  - Seasonal residences & limited communications.
  - Mail service.
  - Supplies/Contractor availability.
  - Non-traditional property and housing arrangements.
- **Additional critical tasks** include public outreach, risk communications, and transparent information sharing.
  - [Home | ACK-PFAS.com](https://www.ack-pfas.com)





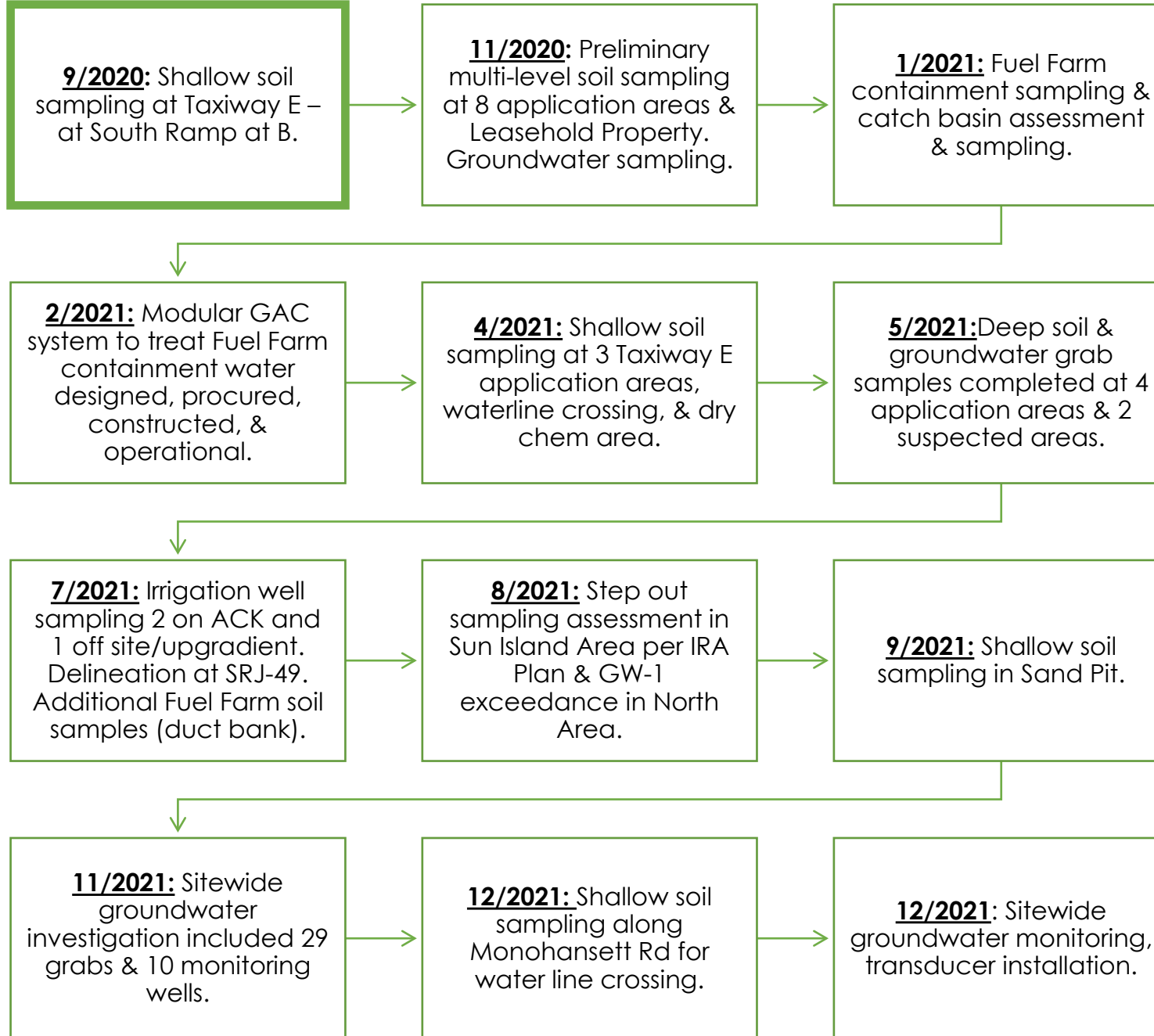
# Investigation

Current Status





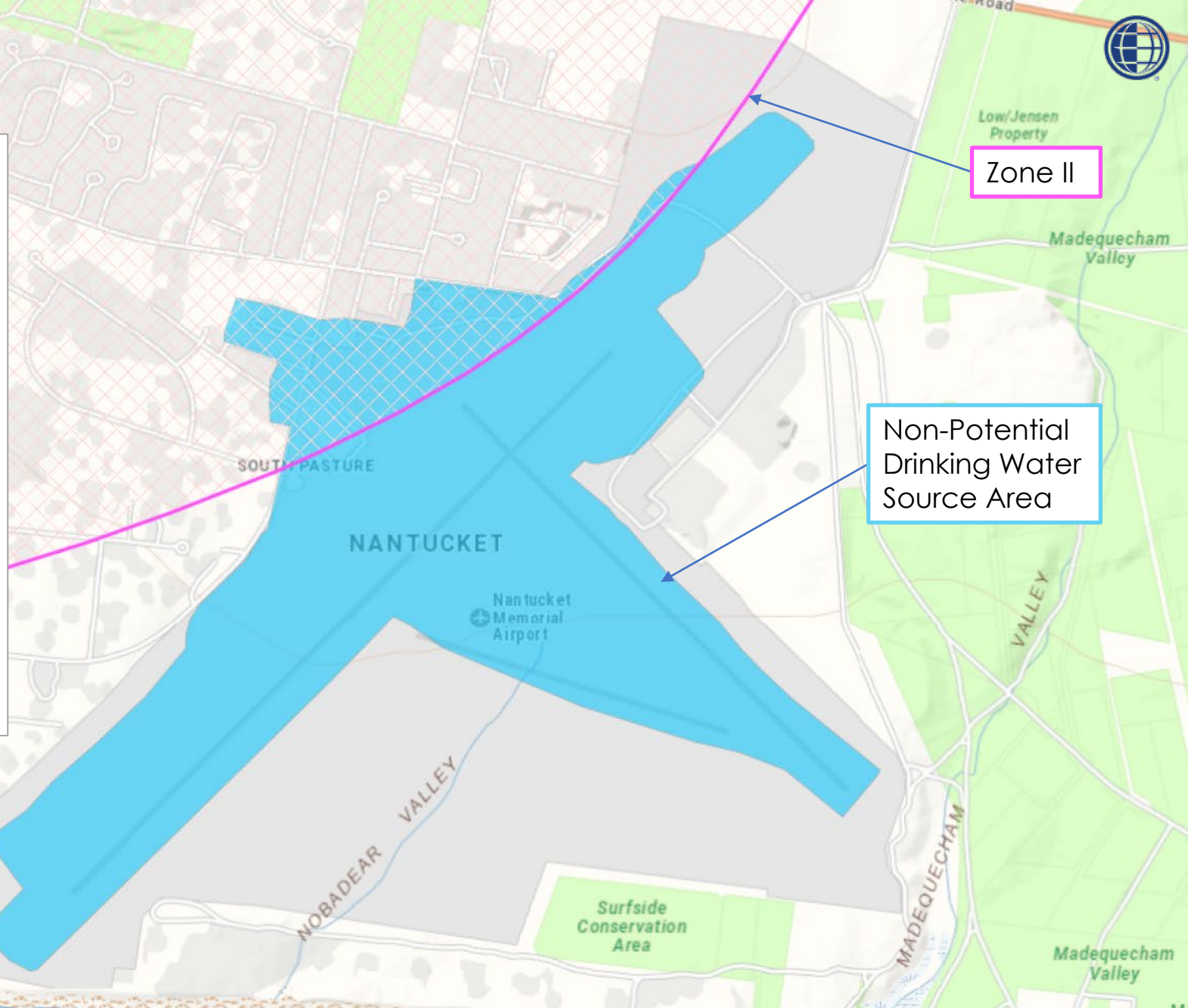
# Timeline of Investigatory Activities





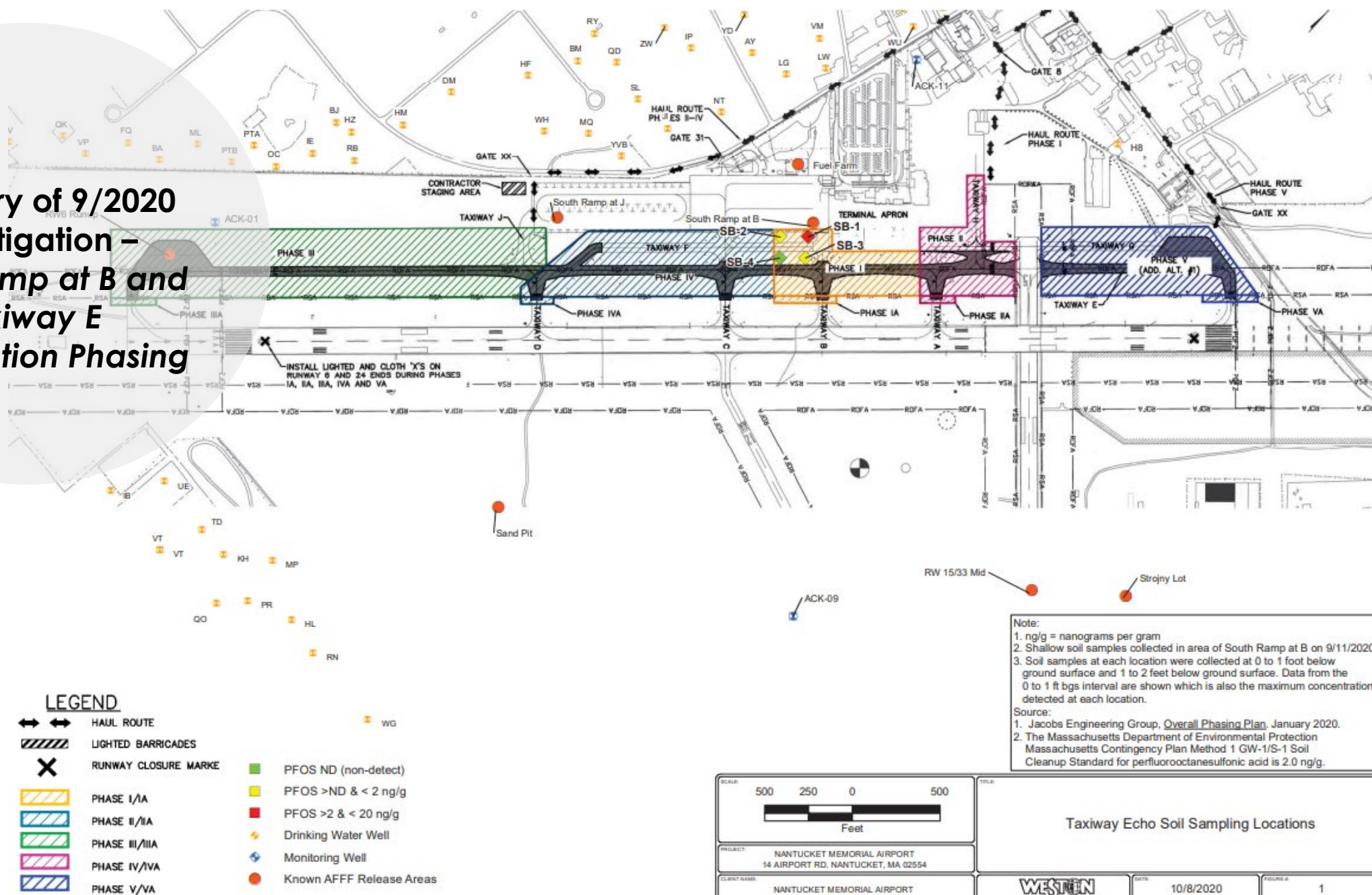
## Massachusetts Contingency Plan Method 1 Standards

- ACK is considered a Potentially Productive Aquifer exclusion zone except where it overlaps the Zone II area.
- On airport soil standards: GW-3/S-1.
  - GW-3: Standards intended to address the adverse ecological effects that could result from discharge of oil or hazardous material to surface water.
  - S-1: Residential exposure scenario.
- Off airport standards: GW-1/S-1
  - GW-1: Groundwater used as drinking water.
  - S-1: Residential exposure scenario.





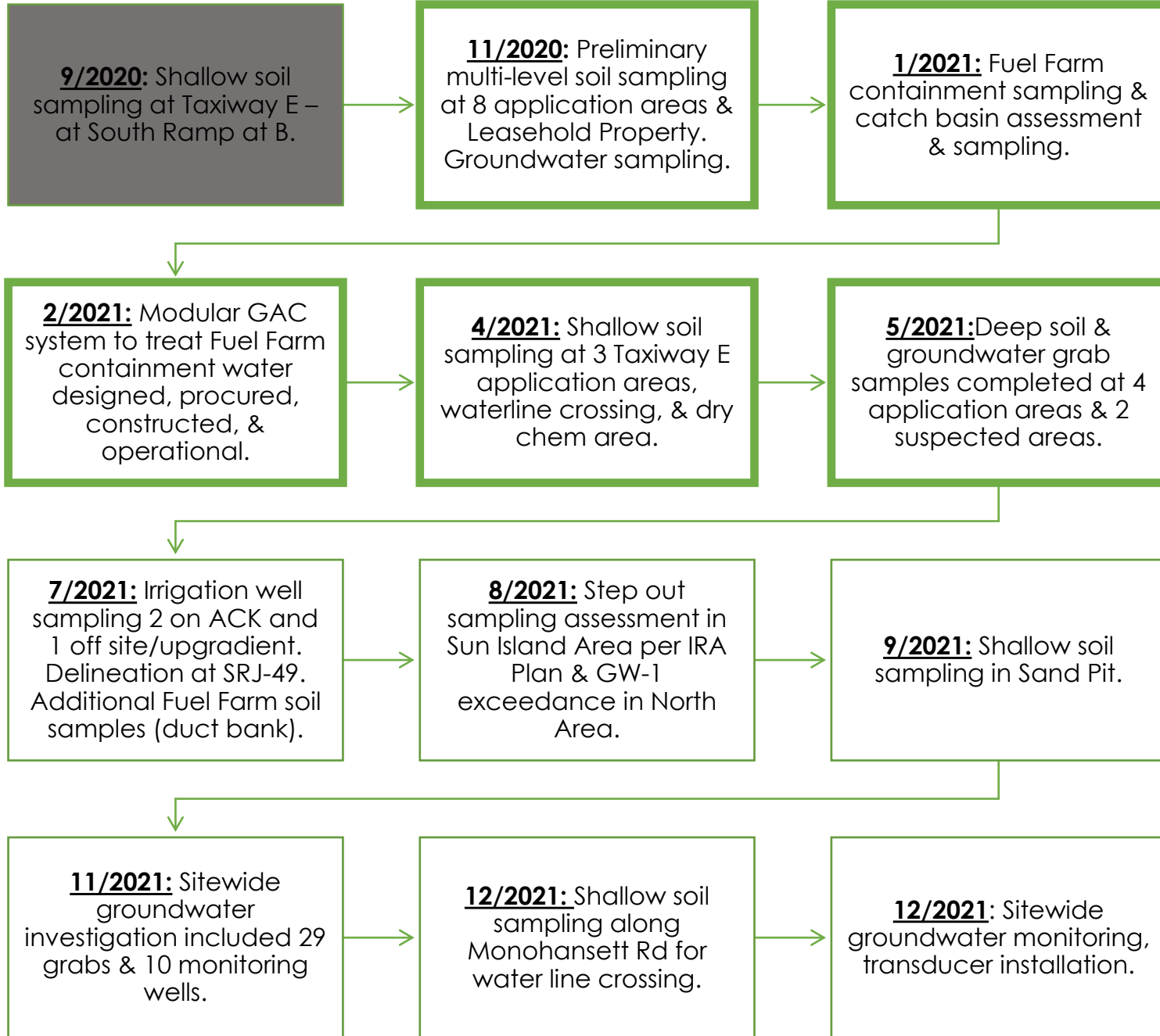
# Summary of 9/2020 Investigation – South Ramp at B and Taxiway E Construction Phasing







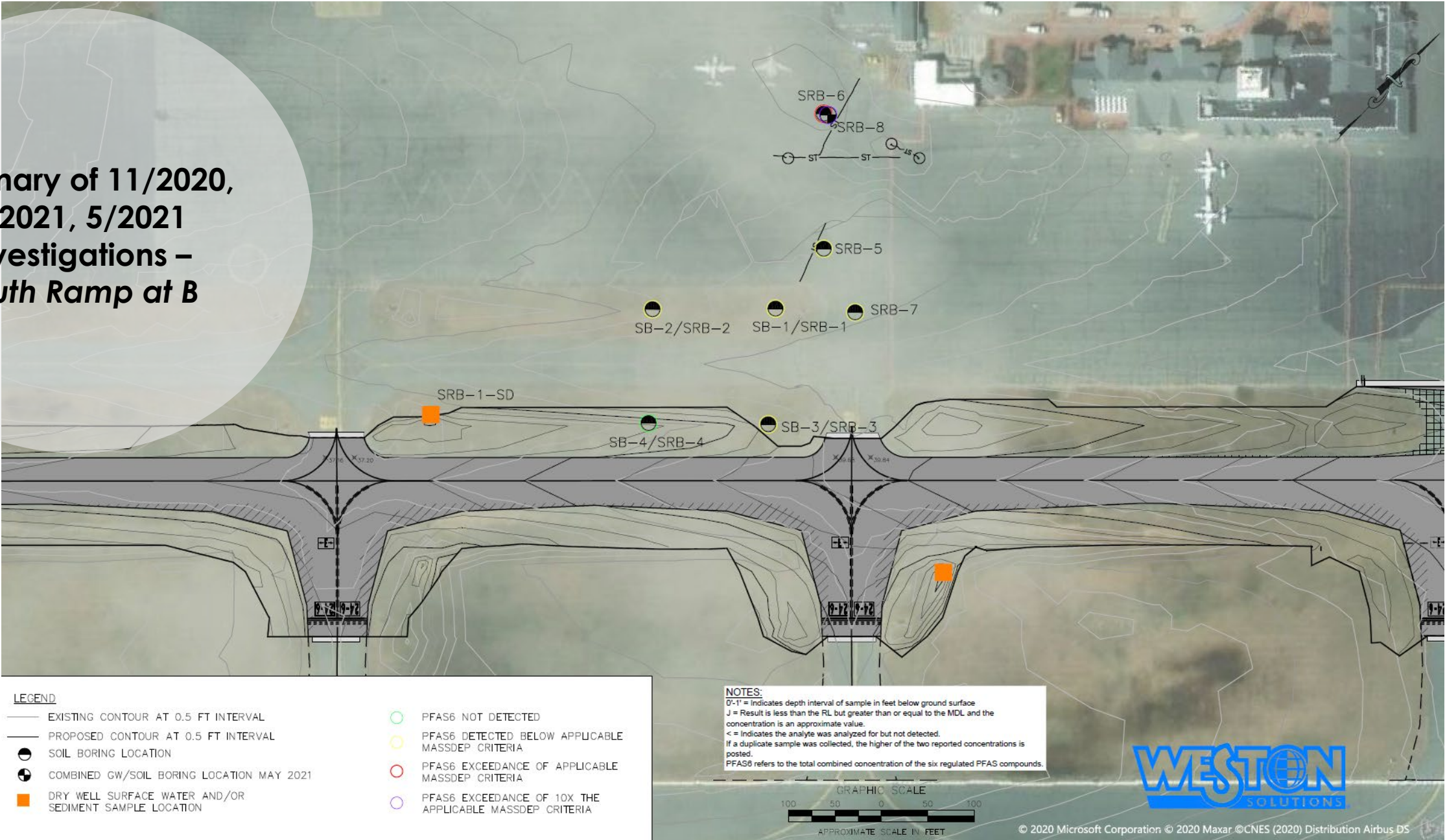
# Timeline of Investigatory Activities





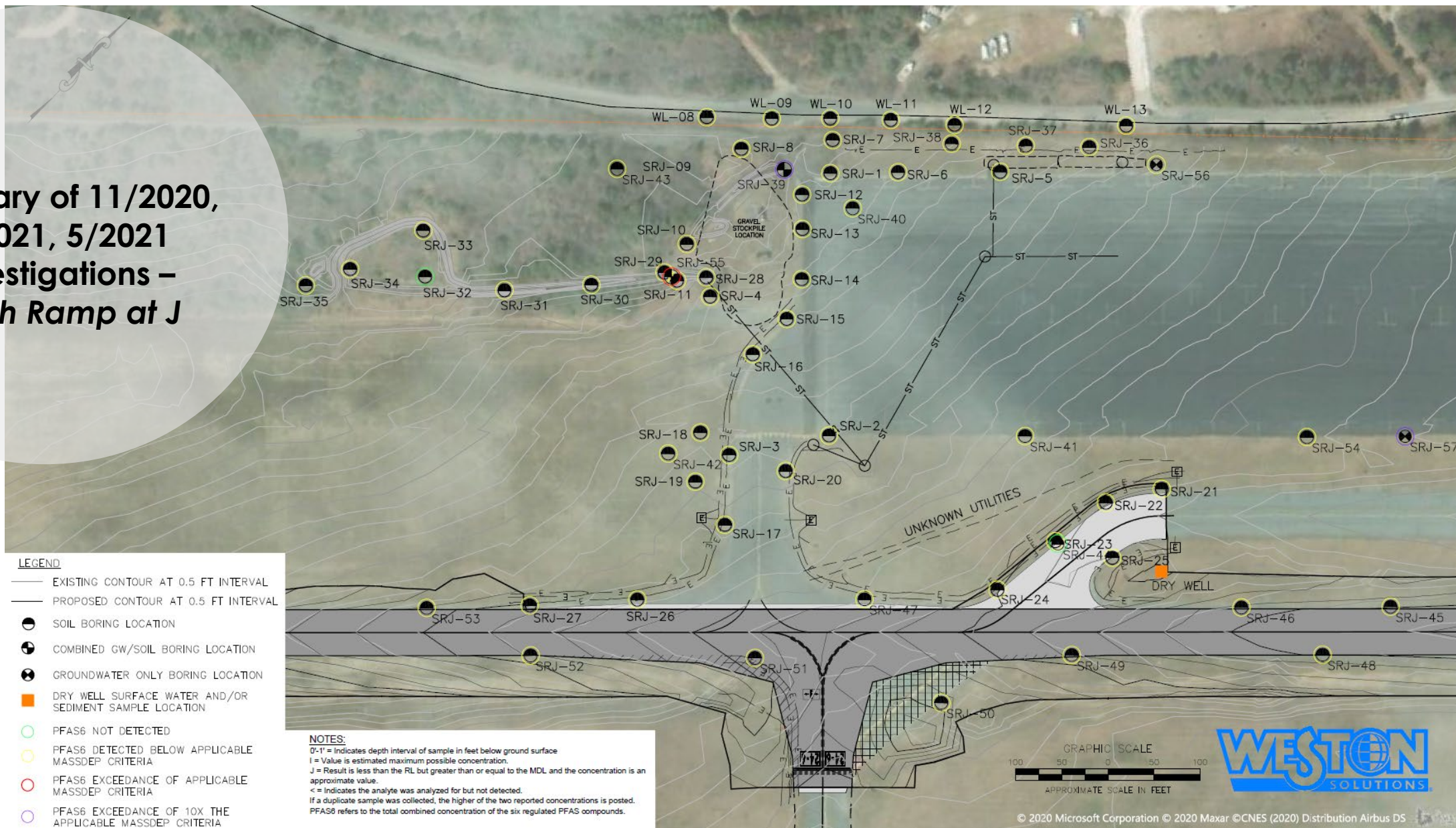


Summary of 11/2020,  
4/2021, 5/2021  
Investigations –  
South Ramp at B





# Summary of 11/2020, 4/2021, 5/2021 Investigations – South Ramp at J





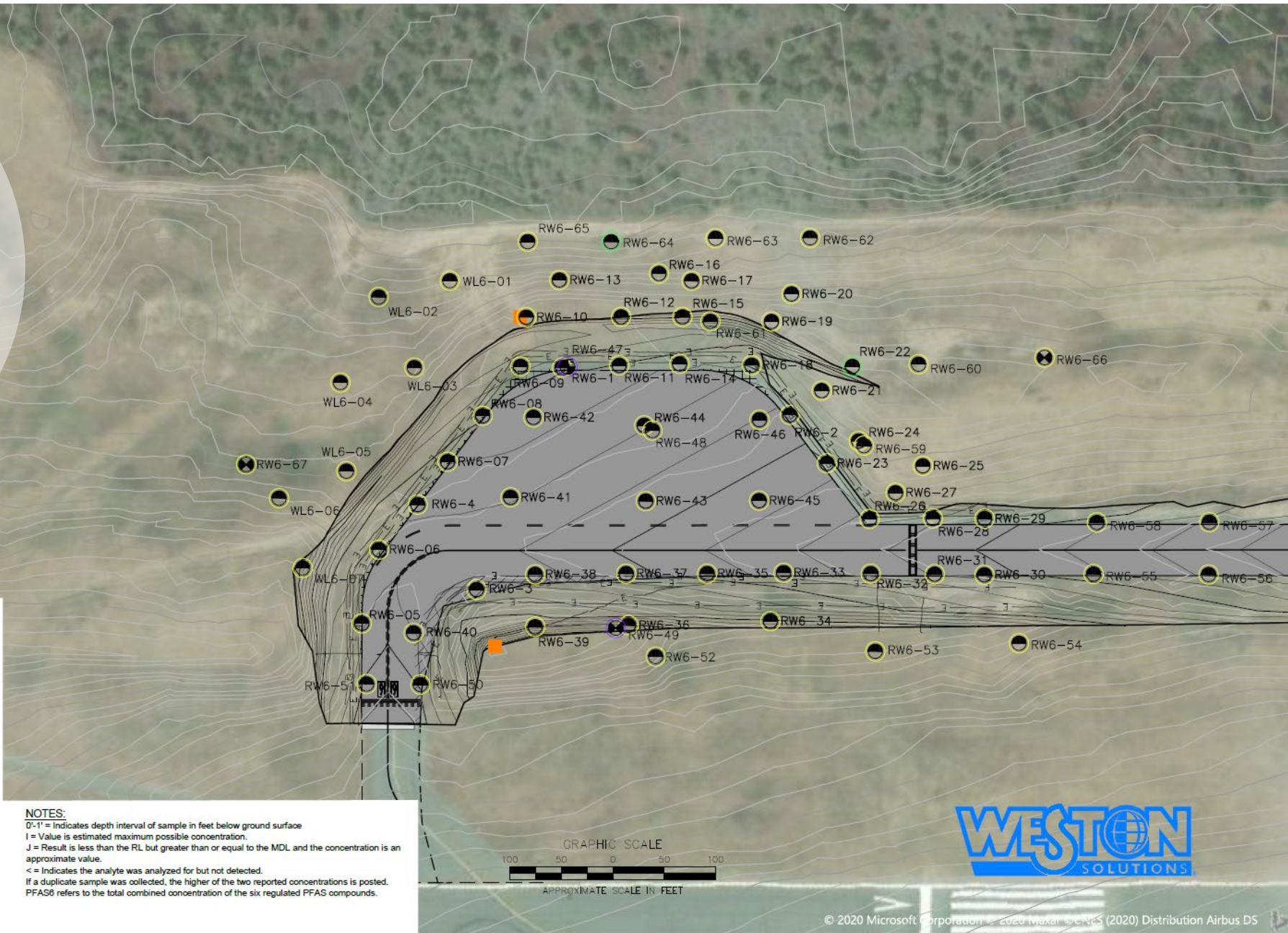
# Summary of 11/2020, 4/2021, 5/2021 Investigations – Runway 6 Run-Up

## LEGEND

- EXISTING CONTOUR AT 0.5 FT INTERVAL
- PROPOSED CONTOUR AT 0.5 FT INTERVAL
- SOIL BORING LOCATION
- ⊕ COMBINED GW/SOIL BORING LOCATION
- ⊗ GROUNDWATER ONLY BORING LOCATION
- DRY WELL SURFACE WATER AND/OR SEDIMENT SAMPLE LOCATION
- PFAS6 NOT DETECTED
- PFAS6 DETECTED BELOW APPLICABLE MASSDEP CRITERIA
- PFAS6 EXCEEDANCE OF APPLICABLE MASSDEP CRITERIA
- PFAS6 EXCEEDANCE OF 10X THE APPLICABLE MASSDEP CRITERIA

## NOTES:

0'-1' = Indicates depth interval of sample in feet below ground surface  
 I = Value is estimated maximum possible concentration.  
 J = Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.  
 < = Indicates the analyte was analyzed for but not detected.  
 If a duplicate sample was collected, the higher of the two reported concentrations is posted.  
 PFAS6 refers to the total combined concentration of the six regulated PFAS compounds.





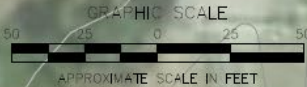


Summary of 11/2020,  
4/2021, 5/2021  
Investigations – Snow  
Removal Equipment  
Building



- LEGEND**
- SOIL BORING LOCATION
  - GROUNDWATER GRAB SAMPLE LOCATION
  - PFAS6 NOT DETECTED
  - PFAS6 DETECTED BELOW APPLICABLE MASSDEP CRITERIA
  - PFAS6 EXCEEDANCE OF APPLICABLE MASSDEP CRITERIA
  - PFAS6 EXCEEDANCE OF 10X THE APPLICABLE MASSDEP CRITERIA

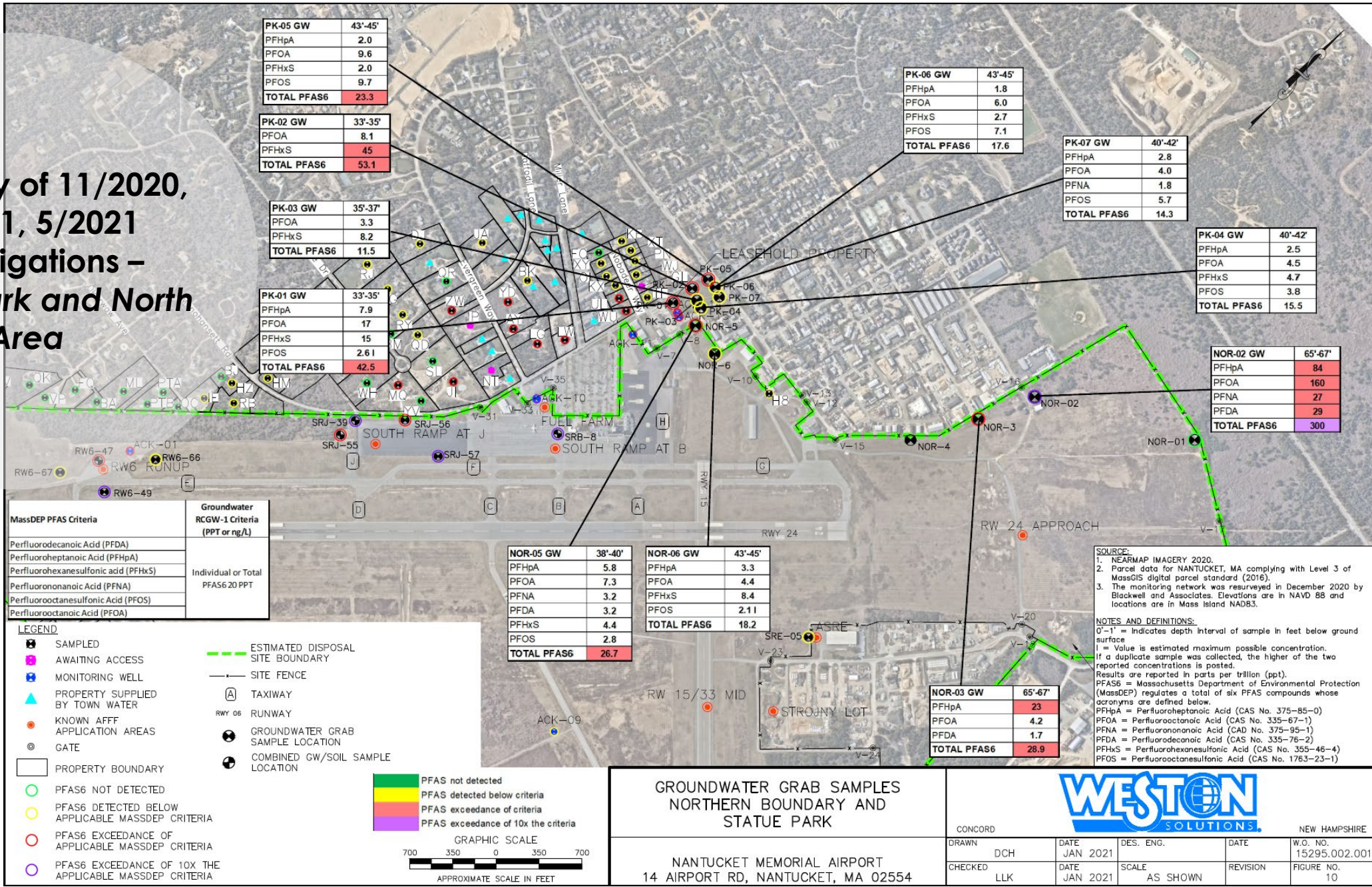
**NOTES:**  
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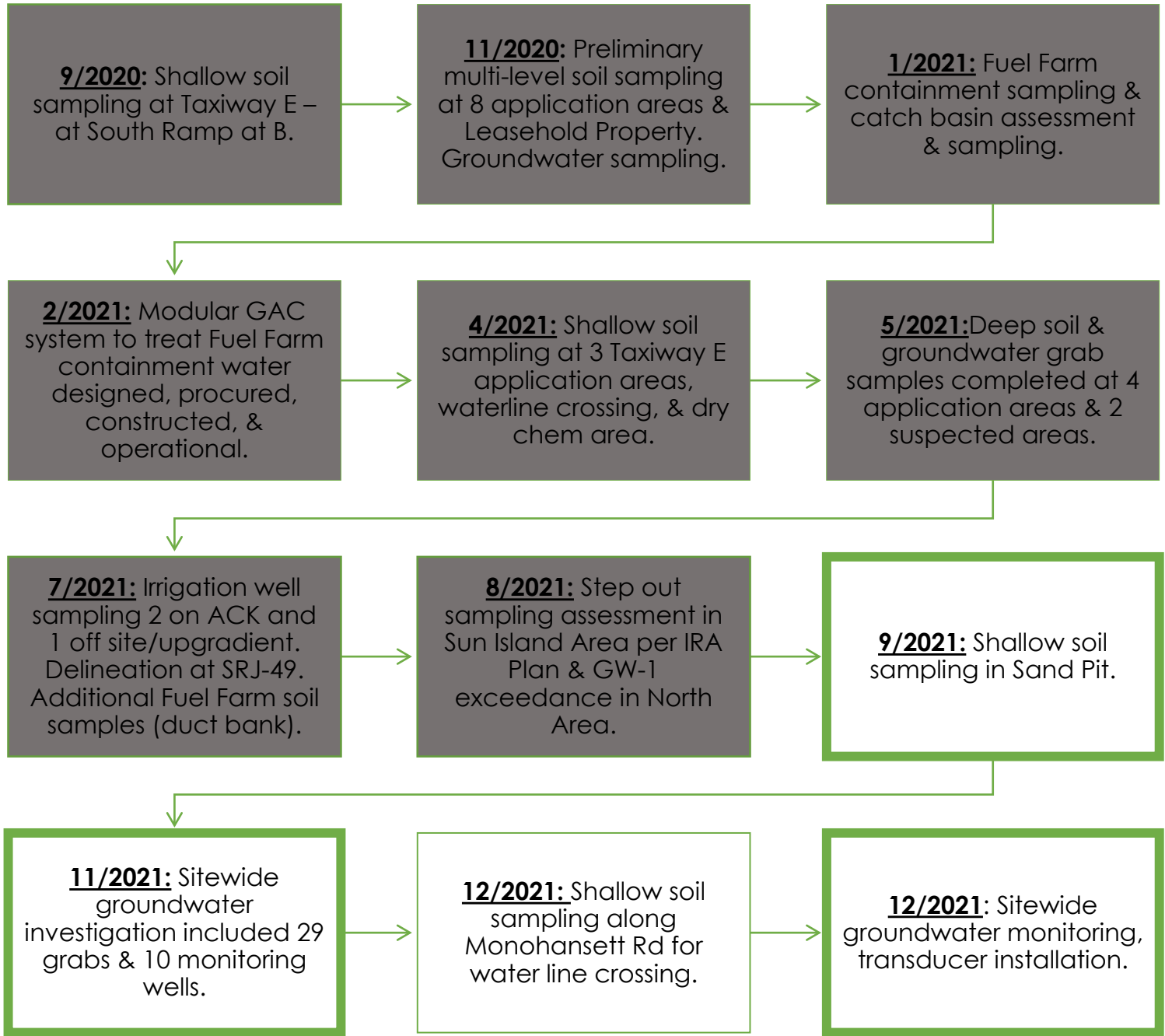
# Summary of 11/2020, 4/2021, 5/2021 Investigations – Statue Park and North Area







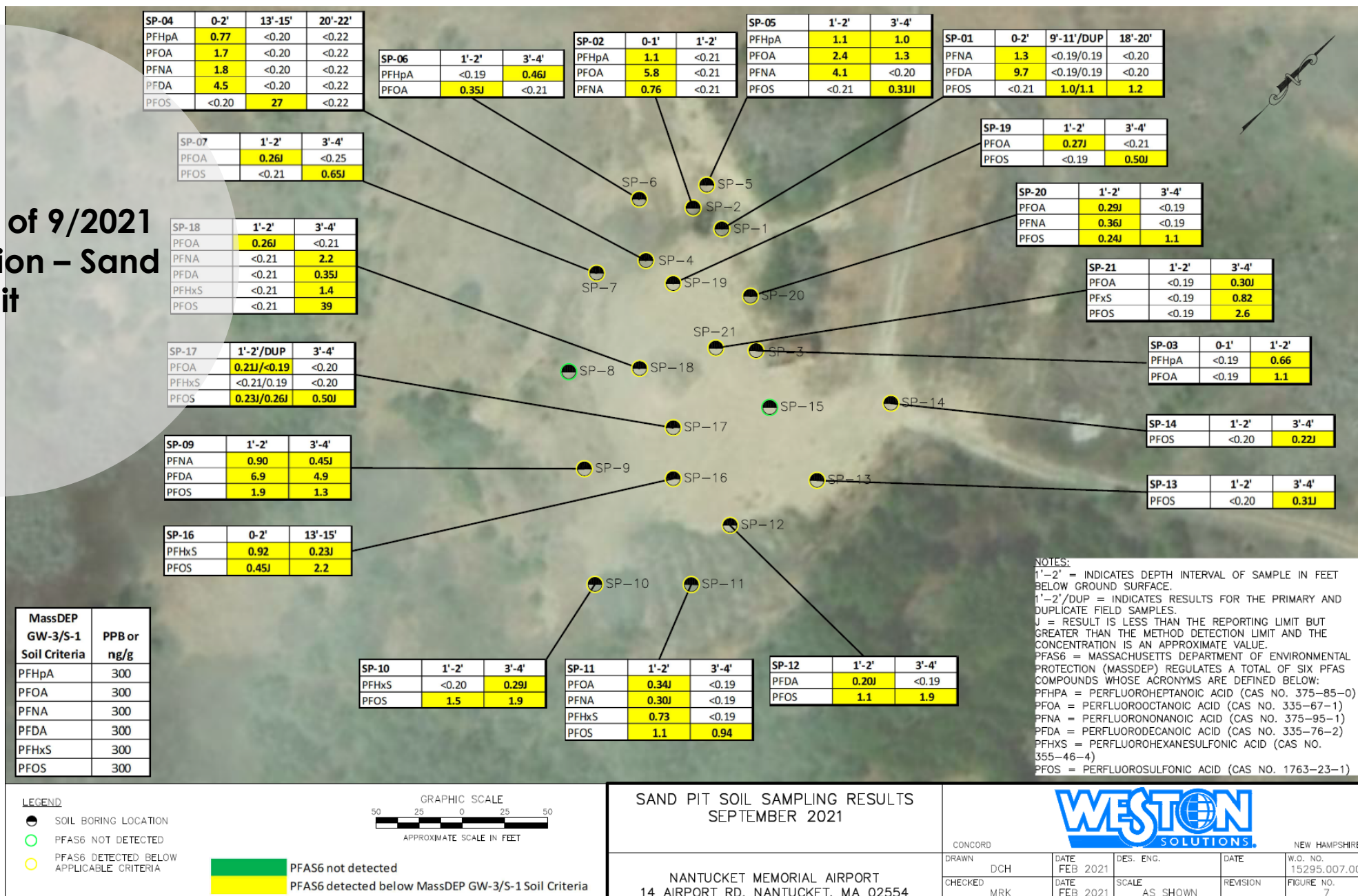
# Timeline of Investigatory Activities





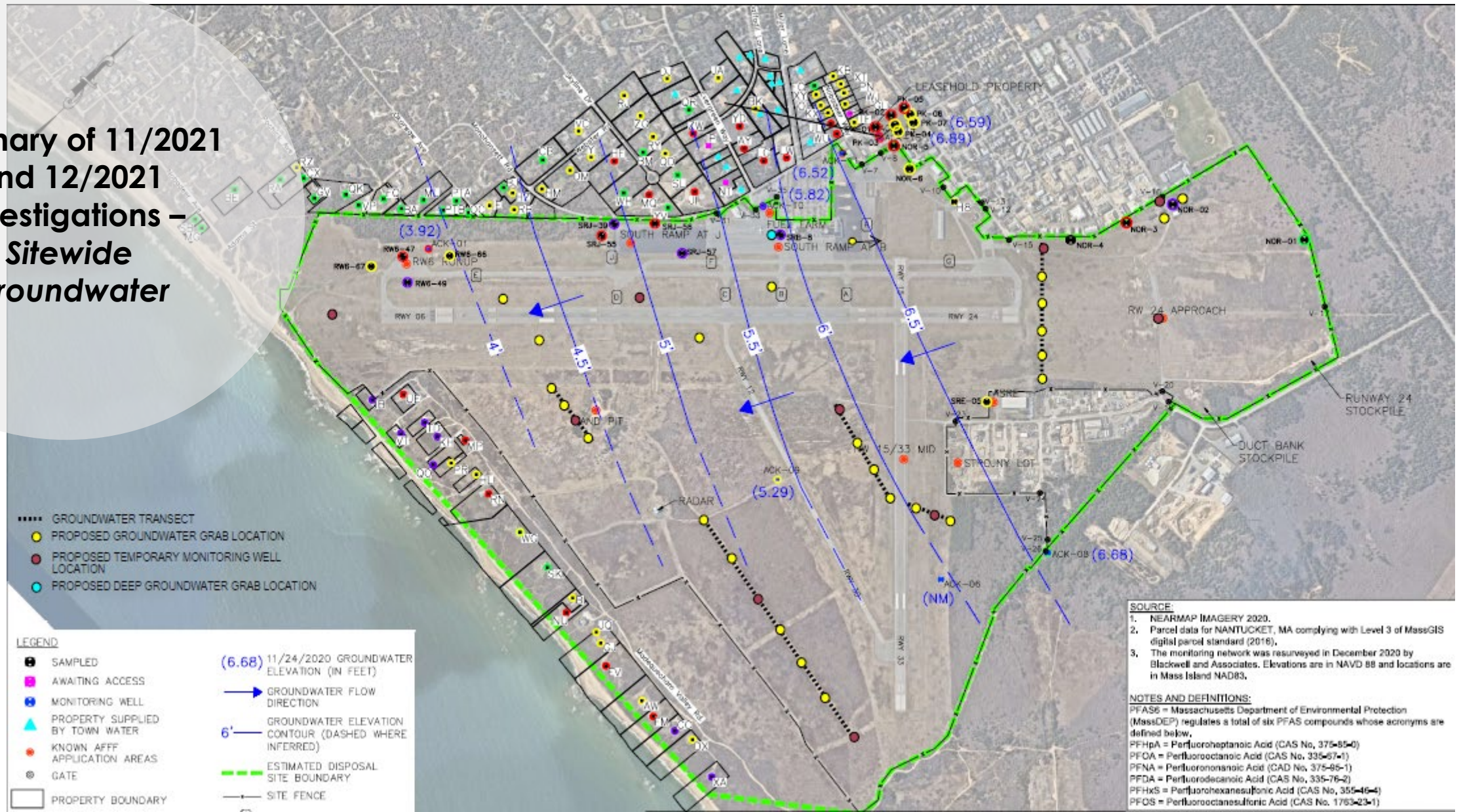


# Summary of 9/2021 Investigation – Sand Pit





# Summary of 11/2021 and 12/2021 Investigations – Sitewide Groundwater



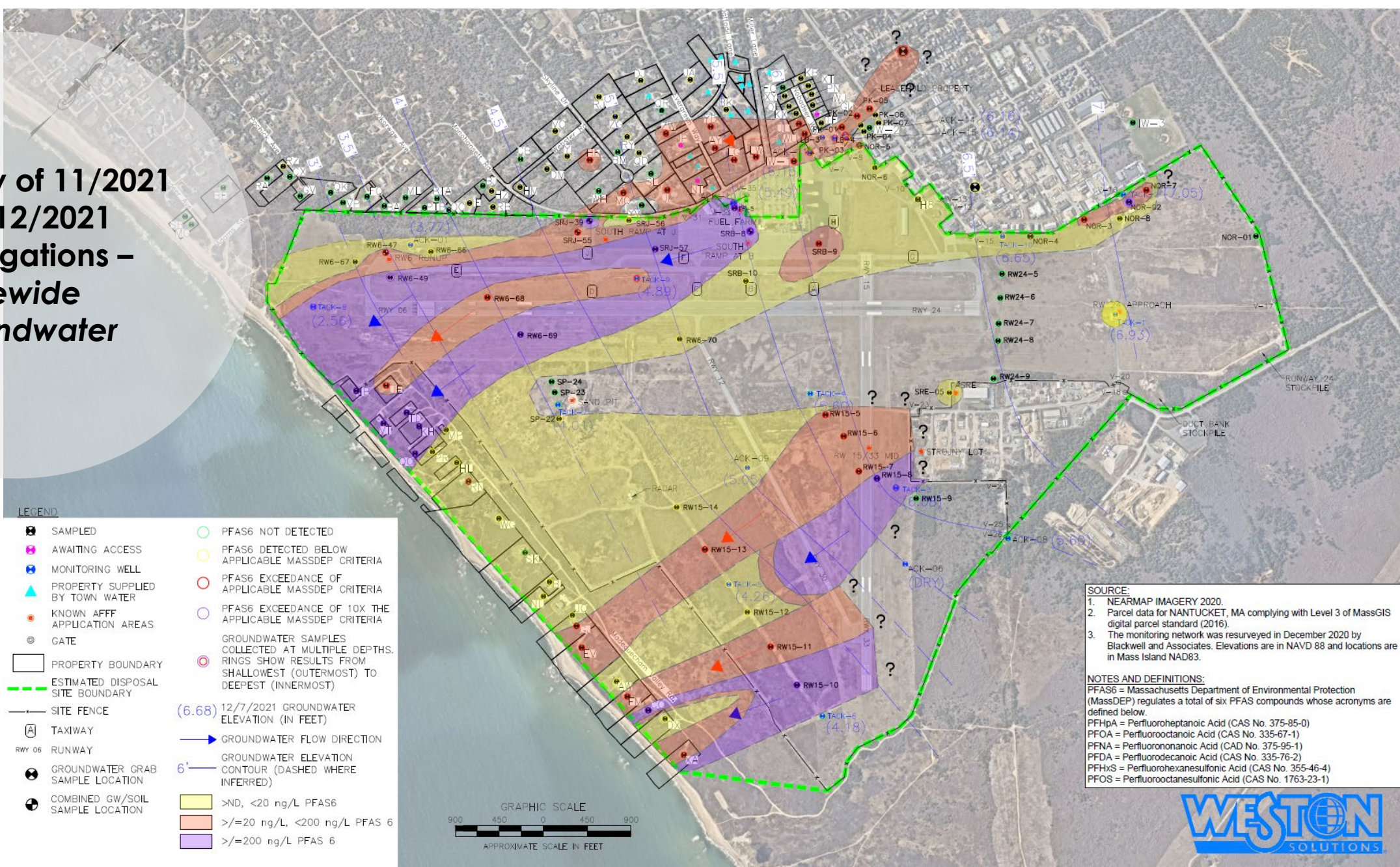


# Evaluation of Data



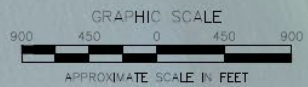


# Summary of 11/2021 and 12/2021 Investigations – Sitewide Groundwater



**LEGEND**

- SAMPLED
- AWAITING ACCESS
- MONITORING WELL
- PROPERTY SUPPLIED BY TOWN WATER
- KNOWN AFFECTED APPLICATION AREAS
- GATE
- PROPERTY BOUNDARY
- ESTIMATED DISPOSAL SITE BOUNDARY
- SITE FENCE
- TAXIWAY
- RUNWAY 06
- GROUNDWATER GRAB SAMPLE LOCATION
- COMBINED GW/SOIL SAMPLE LOCATION
- PFAS6 NOT DETECTED
- PFAS6 DETECTED BELOW APPLICABLE MASSDEP CRITERIA
- PFAS6 EXCEEDANCE OF APPLICABLE MASSDEP CRITERIA
- PFAS6 EXCEEDANCE OF 10X THE APPLICABLE MASSDEP CRITERIA
- GROUNDWATER SAMPLES COLLECTED AT MULTIPLE DEPTHS. RINGS SHOW RESULTS FROM SHALLOWEST (OUTERMOST) TO DEEPEST (INNERMOST)
- 12/7/2021 GROUNDWATER ELEVATION (IN FEET)
- GROUNDWATER FLOW DIRECTION
- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- <20 ng/L PFAS6
- >=20 ng/L, <200 ng/L PFAS 6
- >=200 ng/L PFAS 6



**SOURCE:**

1. NEARMAP IMAGERY 2020.
2. Parcel data for NANTUCKET, MA complying with Level 3 of MassGIS digital parcel standard (2016).
3. The monitoring network was resurveyed in December 2020 by Blackwell and Associates. Elevations are in NAVD 88 and locations are in Mass Island NAD83.

**NOTES AND DEFINITIONS:**

PFAS6 = Massachusetts Department of Environmental Protection (MassDEP) regulates a total of six PFAS compounds whose acronyms are defined below.

PFHpA = Perfluoroheptanoic Acid (CAS No. 375-85-0)

PFOA = Perfluorooctanoic Acid (CAS No. 335-67-1)

PFNA = Perfluorononanoic Acid (CAS No. 375-95-1)

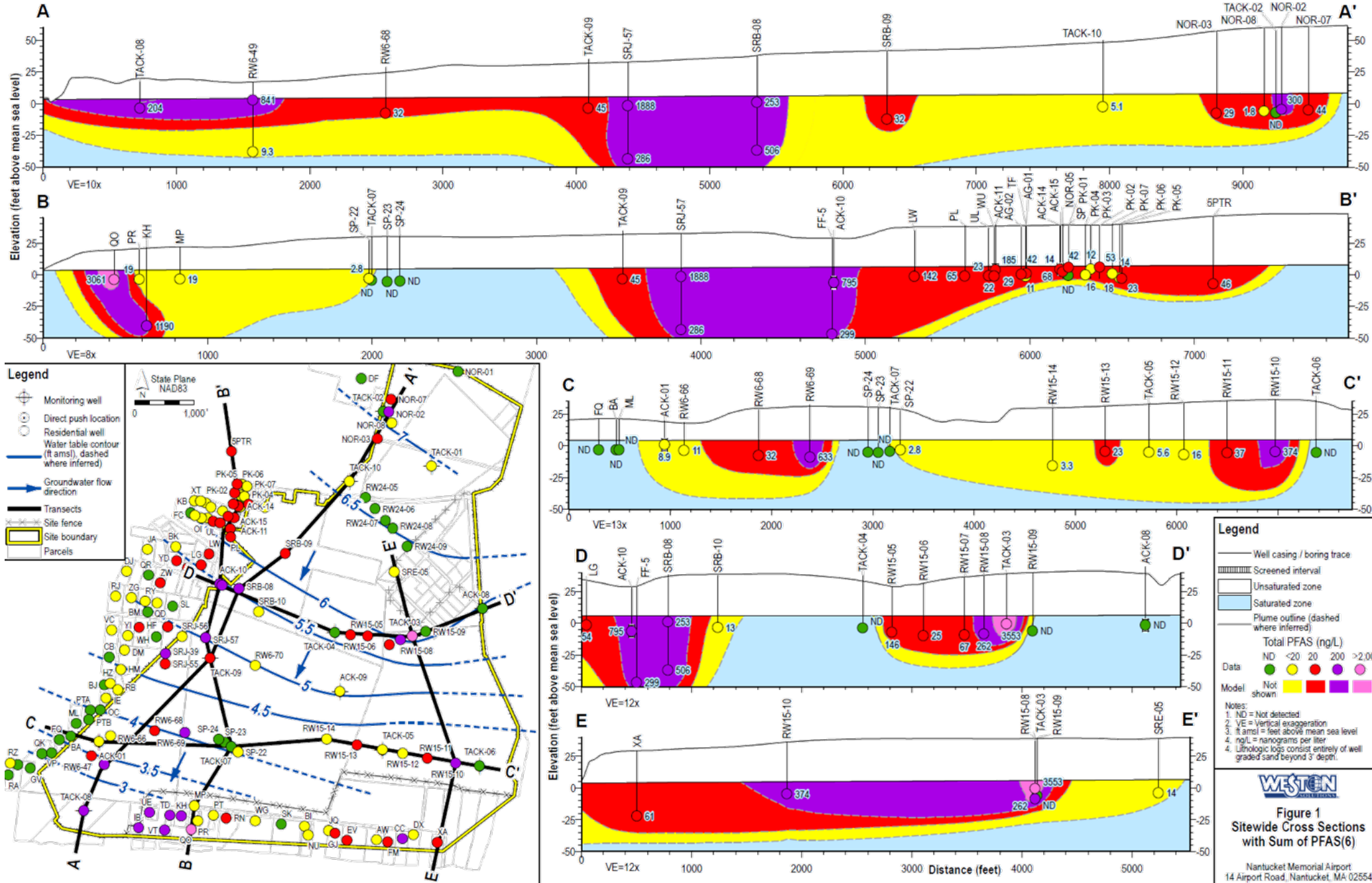
PFDA = Perfluorodecanoic Acid (CAS No. 335-76-2)

PFHxS = Perfluorohexanesulfonic Acid (CAS No. 355-46-4)

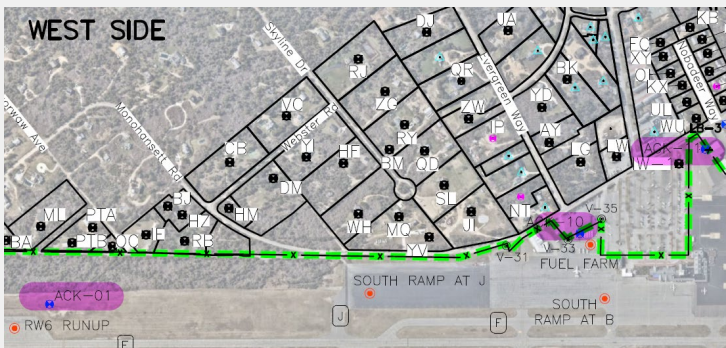
PFOS = Perfluorooctanesulfonic Acid (CAS No. 1763-23-1)







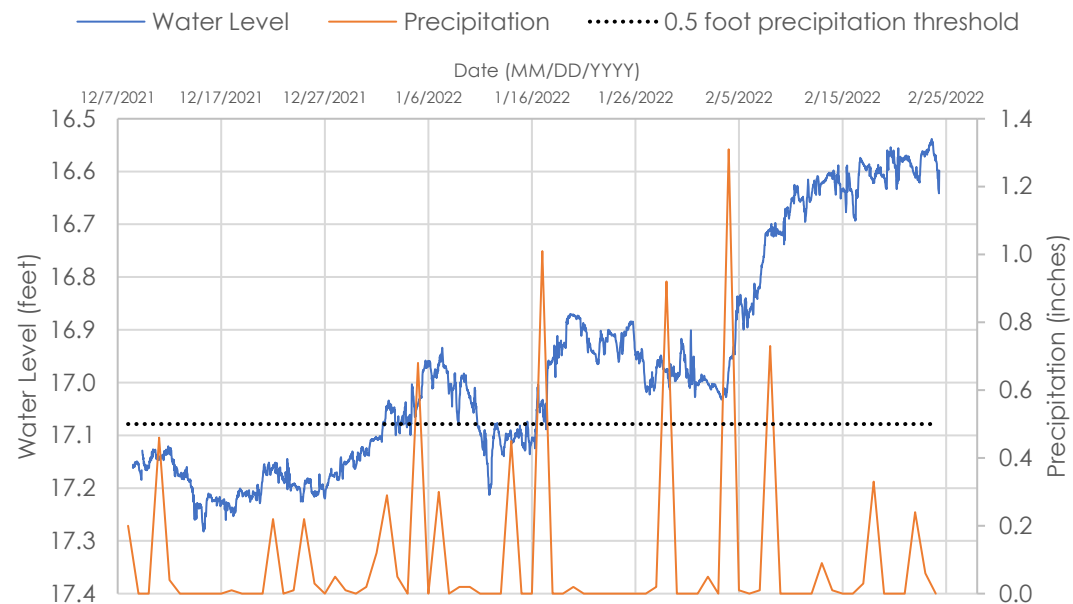




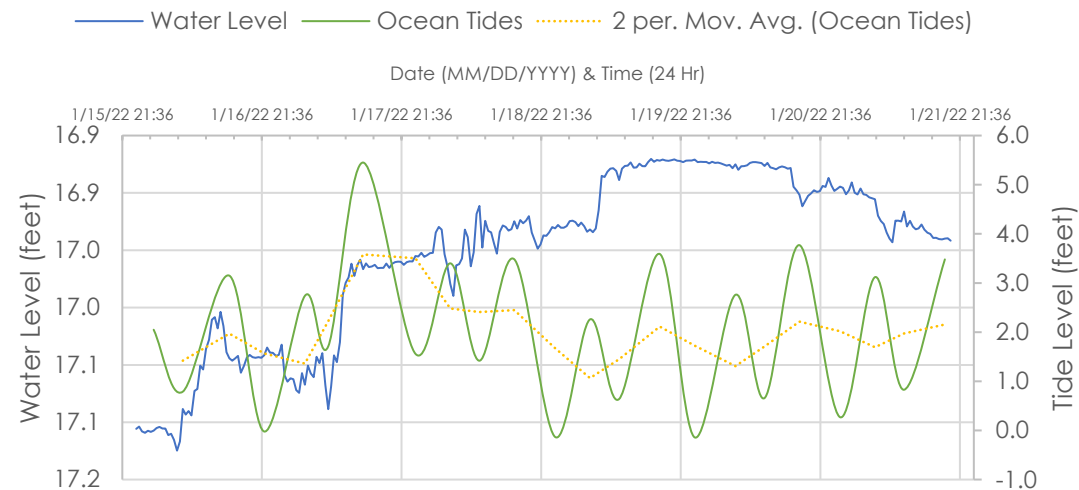
## Summary:

- Strong precipitation influence.
- Tidal influence.
- Limited to no apparent pumping influence.

## ACK-01

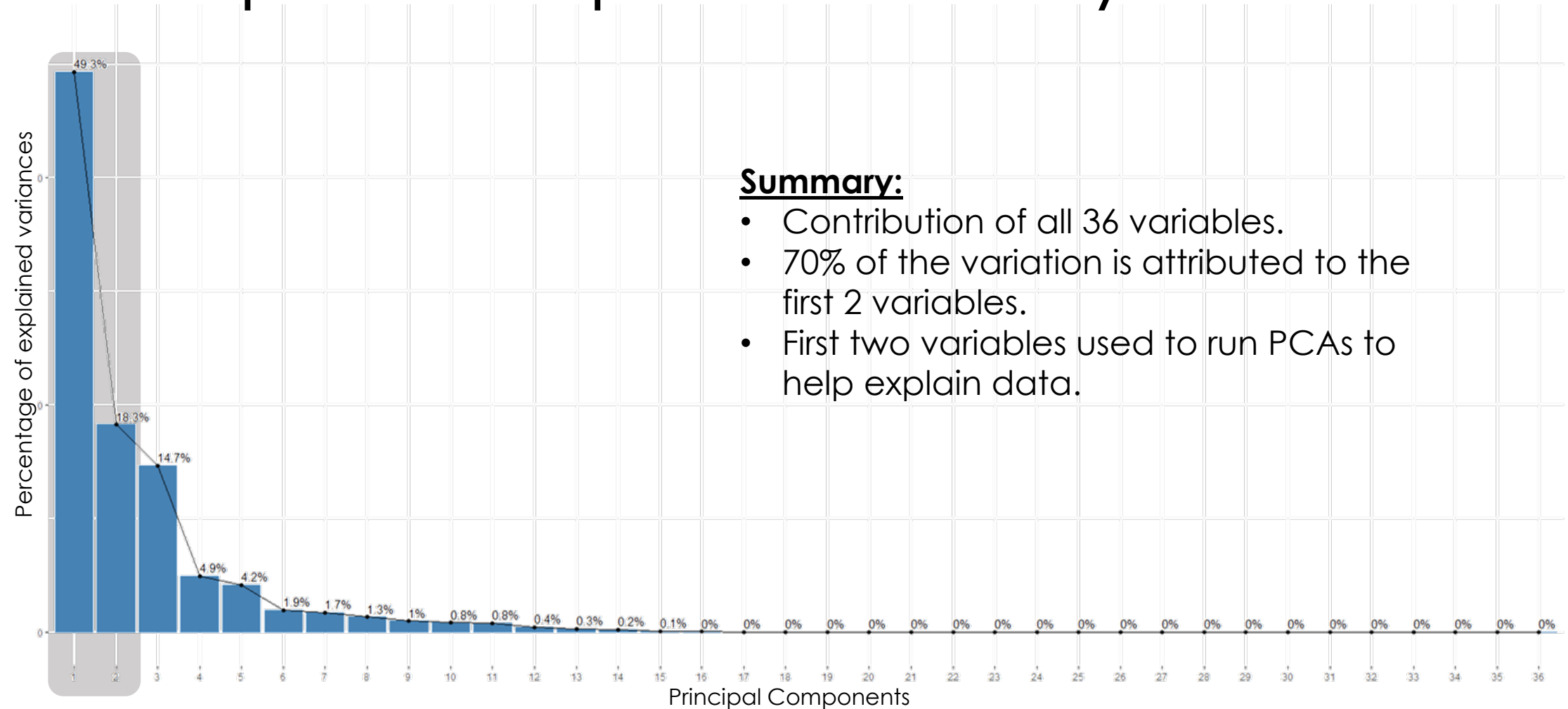


## ACK-01 Crest Chart Jan. 16, 2022 - Jan. 21, 2022





# Principal Component Analysis

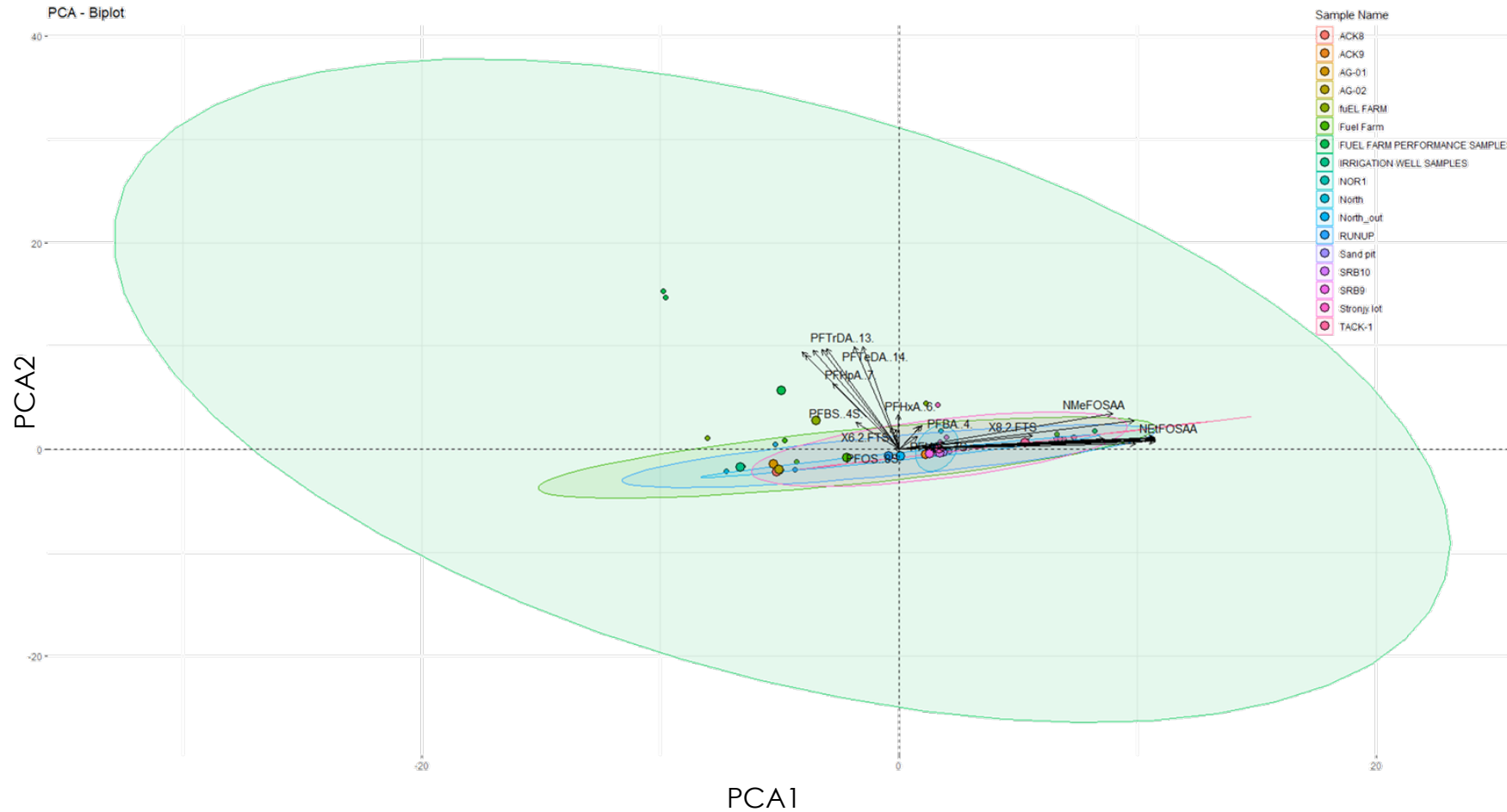


## Summary:

- Contribution of all 36 variables.
- 70% of the variation is attributed to the first 2 variables.
- First two variables used to run PCAs to help explain data.



# PCA – Biplot

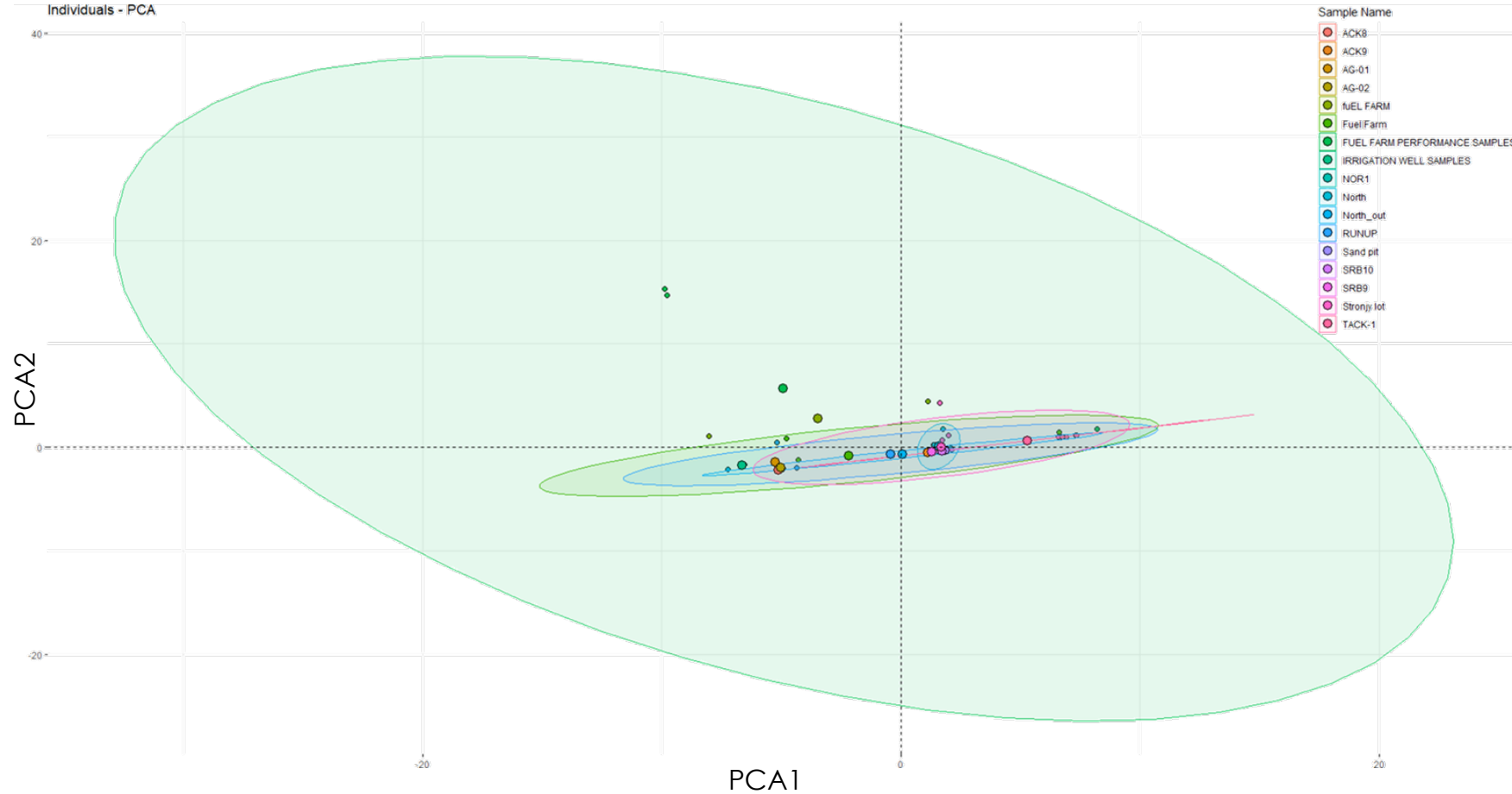


## Correlation Summary:

- PFCAs correlated with each other.
- Precursors & FTS correlate with PFBA.
- Vector relative distance from center:
  - PCA1 influenced by precursors.
  - PCA2 influenced by longer chain PFCAs.



# PCA – Individuals



## Correlation Summary:

- 2 defined groupings.
  - Sand Pit & Strojny Lot
  - Fuel Farm





# Summary

Next Steps



# Investigation Summary To-date

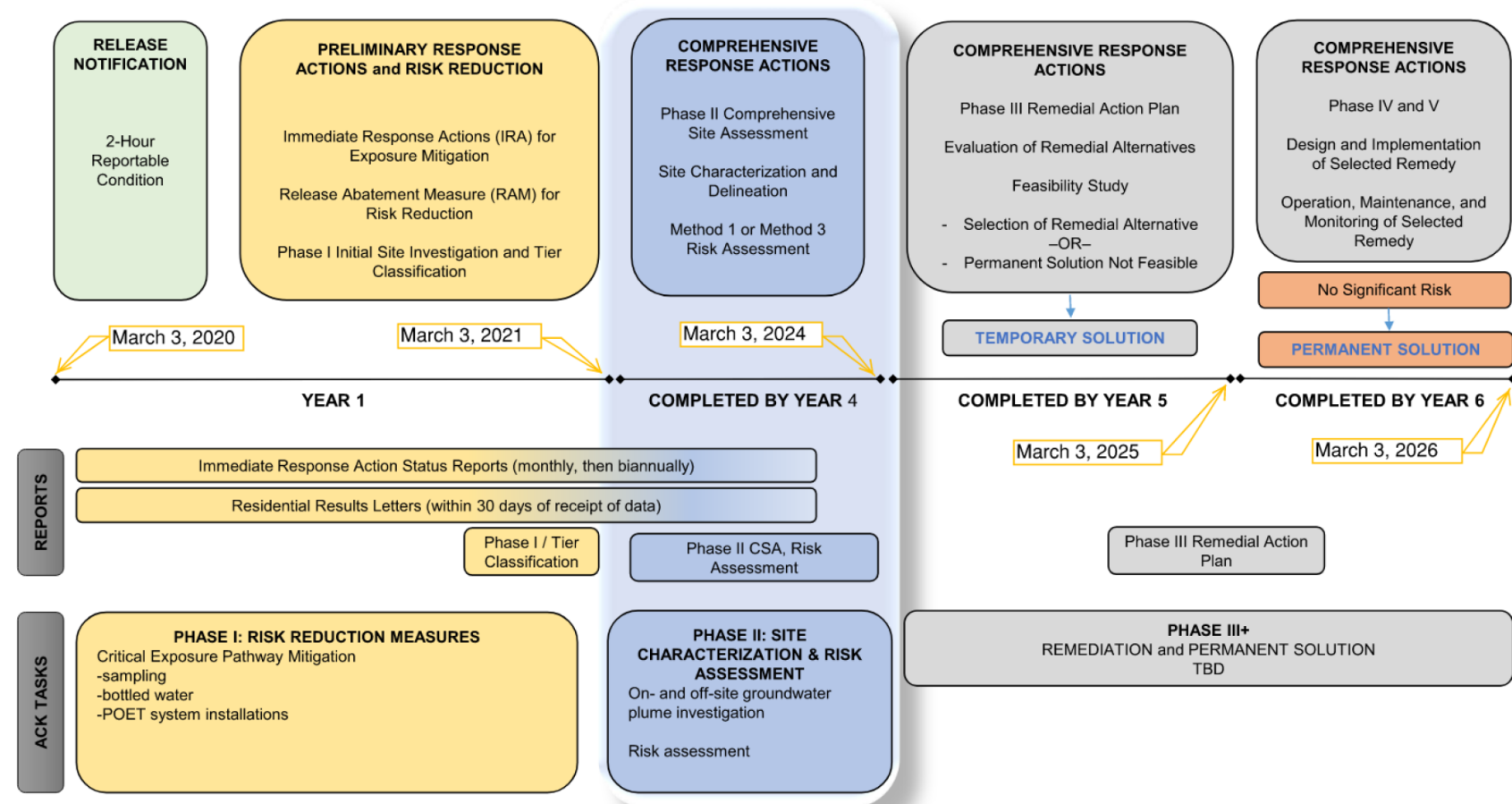
- POETs effective as short-term mitigation measures.
  - Ongoing performance monitoring data and treatment volumes tracking indicate proper designs for conditions.
- Drinking water exposure routes mitigated & water line near completion.
- Additional work to be done to completely define nature and extent.
- Transducer data suggest limited on-ACK influence from pumping at residential wells.
- Poor correlation noted between reported AFFF usage and groundwater impacts at application areas.
- General “haze” of PFAS impacts detected in shallow soils.
- Limited deep soil impacts in areas of most significant groundwater impacts.
- PCA suggest at least two clusters and PFCA and precursors are the compounds that contribute to the variance observed across the site.



# Summary and Next Steps

- 2 years remaining in “Phase 2” under the Comprehensive Site Assessment.
  - Complete Method 1 Risk Assessment.
- Additional investigations to confirm nature and extent.
  - Some lateral bounds uncertain.
  - Potential additional sources near Runway 33 Run-Up & North Area.
  - Vertical extent unbounded.
  - Verify potential upgradient/off-site sources.
  - Keep transducers where they are for now to observe summer month conditions.

## MCP TIMELINE AND ACK TASKS





# Thank you!

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