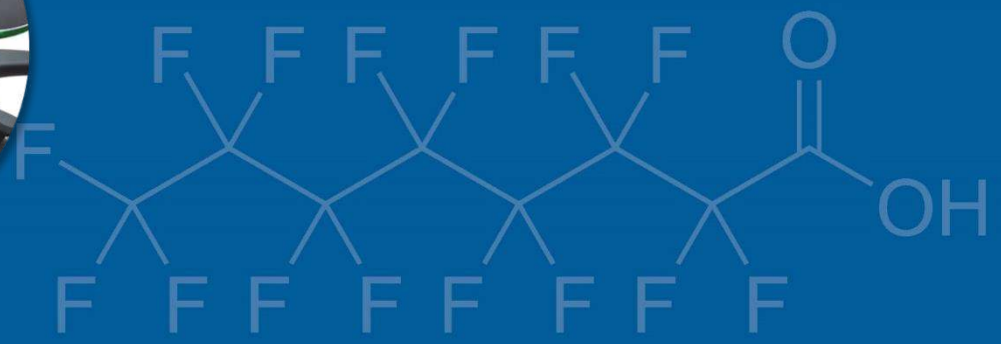


PFAS Leachability from Sampling Materials: Results of a Recent Study

September 11, 2019

2019 New Hampshire Hazardous Waste & Contaminated Sites Conference

Elizabeth Denly, ASQ CMQ/OE
Program Director – TRC's PFAS Group

TRCcompanies.com |

PFAS Sampling Issues and Quality Control

How Do We Sample PFAS?

- Similar to conventional sampling (e.g., low-flow techniques, direct push, etc.)
- Special care required to prevent cross contamination
- Use of and exclusion of specific sampling equipment and materials

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Per- and Polyfluoroalkyl Substances (PFAS) Sample Collection Guidance

Technical Guidance Documents

General PFAS Sampling Guidance
Revised October 16, 2018

PFAS Sampling Quick Reference Field Guide
Revised October 17, 2018

Residential Well PFAS Sampling Guidance
Revised October 11, 2018

Groundwater PFAS Sampling Guidance
Uploaded October 2018

Wastewater PFAS Sampling Guidance
Revised October 11, 2018

Surface Water PFAS Sampling Guidance
Revised November 28, 2018

Soil PFAS Sampling Guidance
Revised November 28, 2018

Fish Tissue PFAS Sampling Guidance
Uploaded January 2019

PFAS Sampling Dos and Don'ts

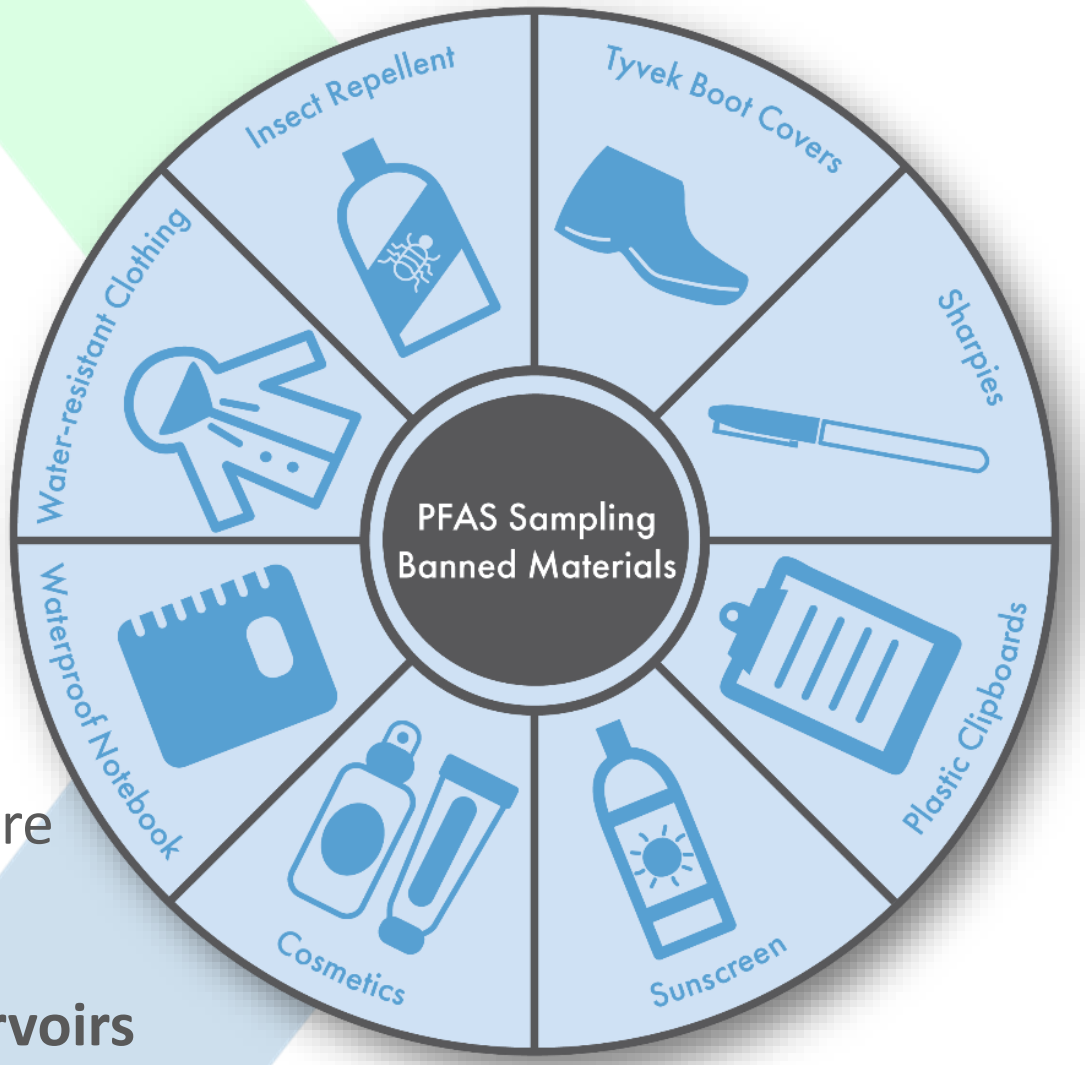
WHAT SHOULD I AVOID?	USE INSTEAD
Passive diffusion bags (PDBs)	
LDPE Hydrasleeves	✓ HDPE Hydrasleeves
Post-It notes during sample handling	
Blue Ice® (chemical ice packs)	✓ Regular ice in Ziploc® bags
Waterproof field books, plastic clipboards and spiral bound notebooks	✓ Field notes recorded on loose paper ✓ Field forms maintained in aluminum or Masonite clipboards
Unnecessary handling of items with nitrile gloves	✓ Personnel collecting and handling samples should wear nitrile gloves at all times while collecting and handling samples or sampling equipment

PFAS Sampling Dos and Don'ts

WHAT SHOULD I AVOID?	USE INSTEAD
Equipment with **Teflon®** (e.g., bailers, tubing, parts in pump) during sample handling or mobilization/demobilization	✓ High density polyethylene (HDPE) or silicone tubing/materials in lieu of Teflon®
Low-density polyethylene (LDPE) or glass sample containers or containers with Teflon-lined lids	✓ HDPE or polypropylene containers for sample storage ✓ HDPE or polypropylene caps
Tyvek® suits and waterproof boots	✓ Clothing made of cotton preferred ✓ Boots made with polyurethane and polyvinyl chloride (PVC)
Waterproof labels for sample bottles	✓ Paper labels with clear tape
Sunscreens, insect repellants	✓ Products that are 100% natural, DEET
Sharpies	✓ Ballpoint pens
Aluminum foil	✓ Thin HDPE sheeting

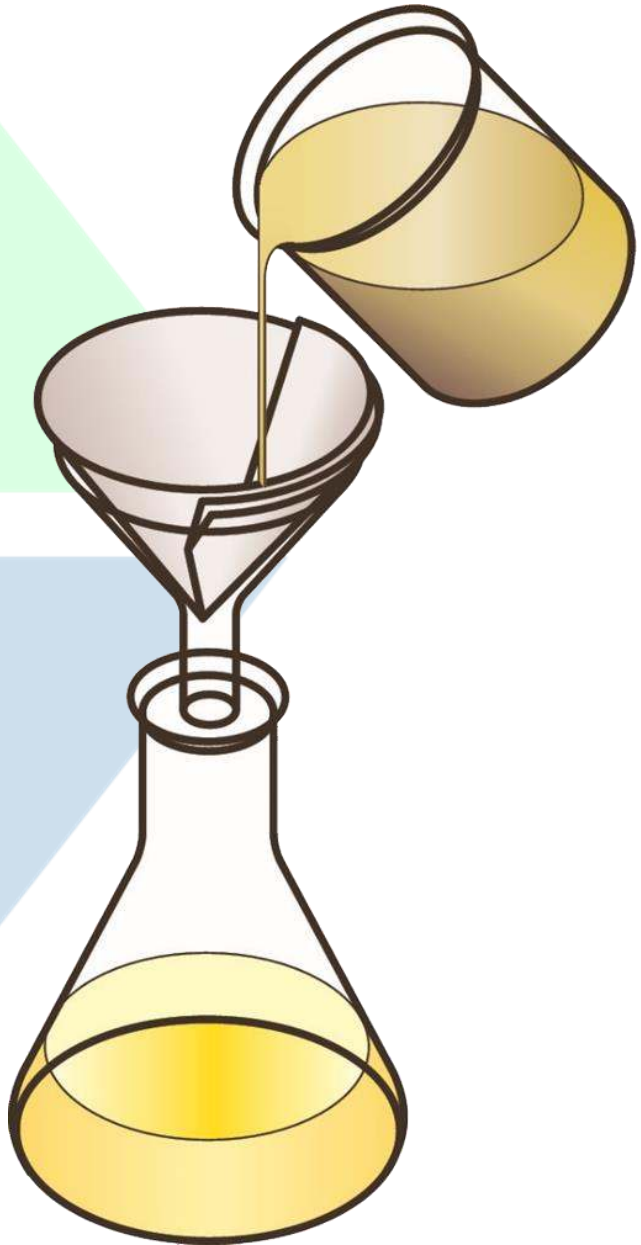
Other Special Considerations

- Field QC
- Decontamination of sampling equipment
- No pre-wrapped food or snacks
- Avoid cosmetics, moisturizers, hand creams on day of sampling.
- Visitors to site must remain at least 30 feet from sampling area.
- Wash hands with water after leaving vehicle before setting up on a well.
- **Partitioning of PFAS to surface in wells and reservoirs**



Filtering of Water Samples

- PFAS may sorb onto glass fiber filters
- Filtered/unfiltered data:
  - Is it PFAS sorbed to soil or sediment in the water sample?
  - Is it PFAS sorbed onto the glass fiber filter?
- Preferred method of dealing with particulates: low flow sampling or use of a centrifuge in the lab
- If filtering is required, do not use glass fiber filters



What Should I Wear?

- No clothing with fabric softeners
- No new clothing
- Avoid boots and other field clothing containing waterproof/resistant material
- Cotton is best

Other PFAS Sampling Precautions

- Many PFAS sampling concerns are precautionary and have no scientific data to prove
- HDPE can sorb PFAS as well (evidence of strong 6:2 FTS sorption)
- Laboratory should empty the entire sample bottle for extraction, sub-sampling from the sample bottle must be avoided
  - The empty bottle should be rinsed with methanol to desorb any PFAS on the sample bottle regardless of bottle materials
  - The rinsate should be combined with the sample materials for analysis

PFAS Contamination Study

Purpose of Study

- To evaluate the potential for PFAS cross-contamination from commonly used products
  - Determine the relative concentrations of PFAS
  - Determine the types of PFAS

PFAS in Sampling Supplies: Fact or Fiction?

Polyethylene Tubing

Re-sealable Plastic Storage Bags

Aluminum Foil

Adhesive Notes

Polyethylene Bladder

HDPE Tubing: 1/8” OD
3/8” OD

LDPE Tubing:
2 Manufacturers

Silastic Tubing

PTFE Bladder

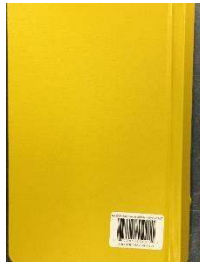
Level C Chemical-Resistant Clothing

PTFE Tubing

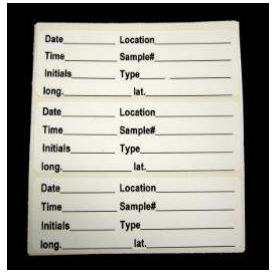
Passive Diffusion Bag

Nitrile Gloves

Bailer Line

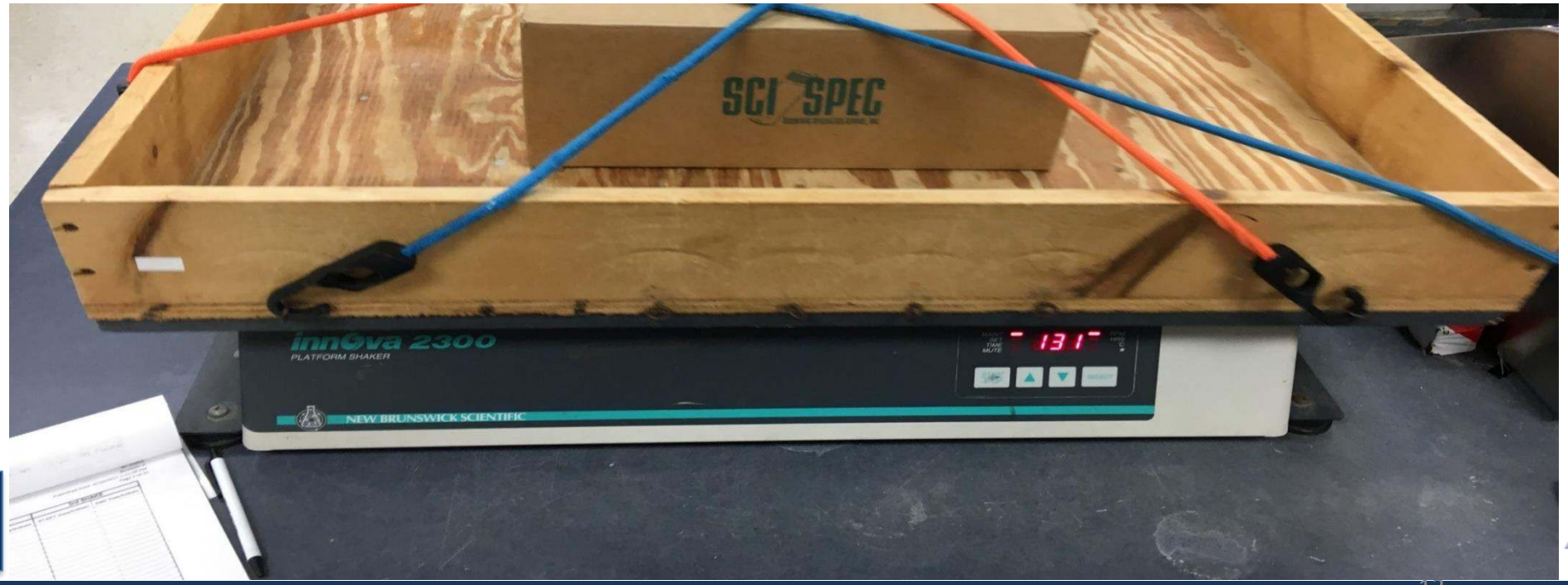


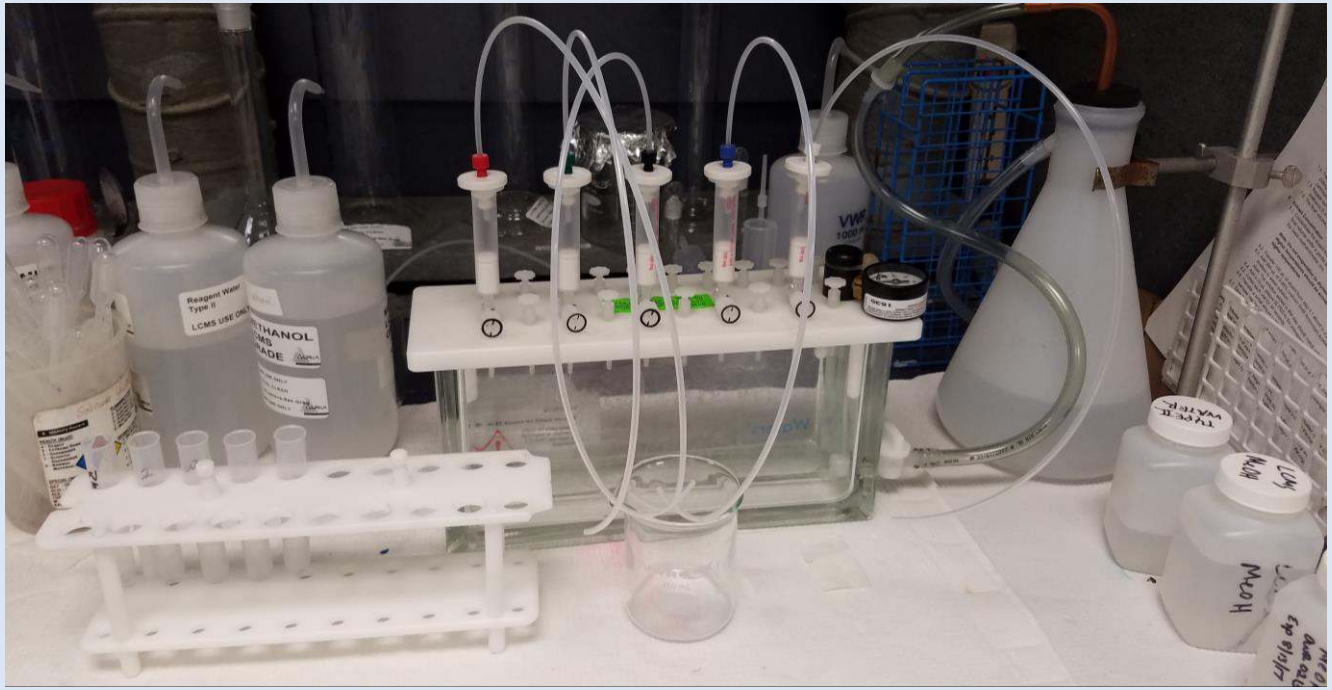
Field Book
(cover & pages)



Sample Labels


MONADNOCK
MONADNOCK


SCI SPEC
innOva 2300
PLATFORM SHAKER
NEW BRUNSWICK SCIENTIFIC
131



Quality Control:

Method Blanks

LCS

Calibration Checks

Extracted IS

Matrix Spikes

Experimental Design Analysis

Solid phase extraction

LC/MS/MS, isotope dilution

24-compound target list

RL = 2 ng/L

Analyte	Acronym	CAS #
4:2 Fluorotelomer sulfonic acid	4:2FTS	n/a
6:2 Fluorotelomer sulfonic acid	6:2FTS	27619-97-2
8:2 Fluorotelomer sulfonic acid	8:2FTS	39108-34-4
N-methyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
N-ethyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
Perfluorooctane sulfonamide	FOSA	754-91-6
Perfluorobutanoic acid	PFBA	375-22-4
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorononanoic acid	PFNA	375-95-1
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluoroundecanoic acid	PFUnA	2058-94-8

TRC

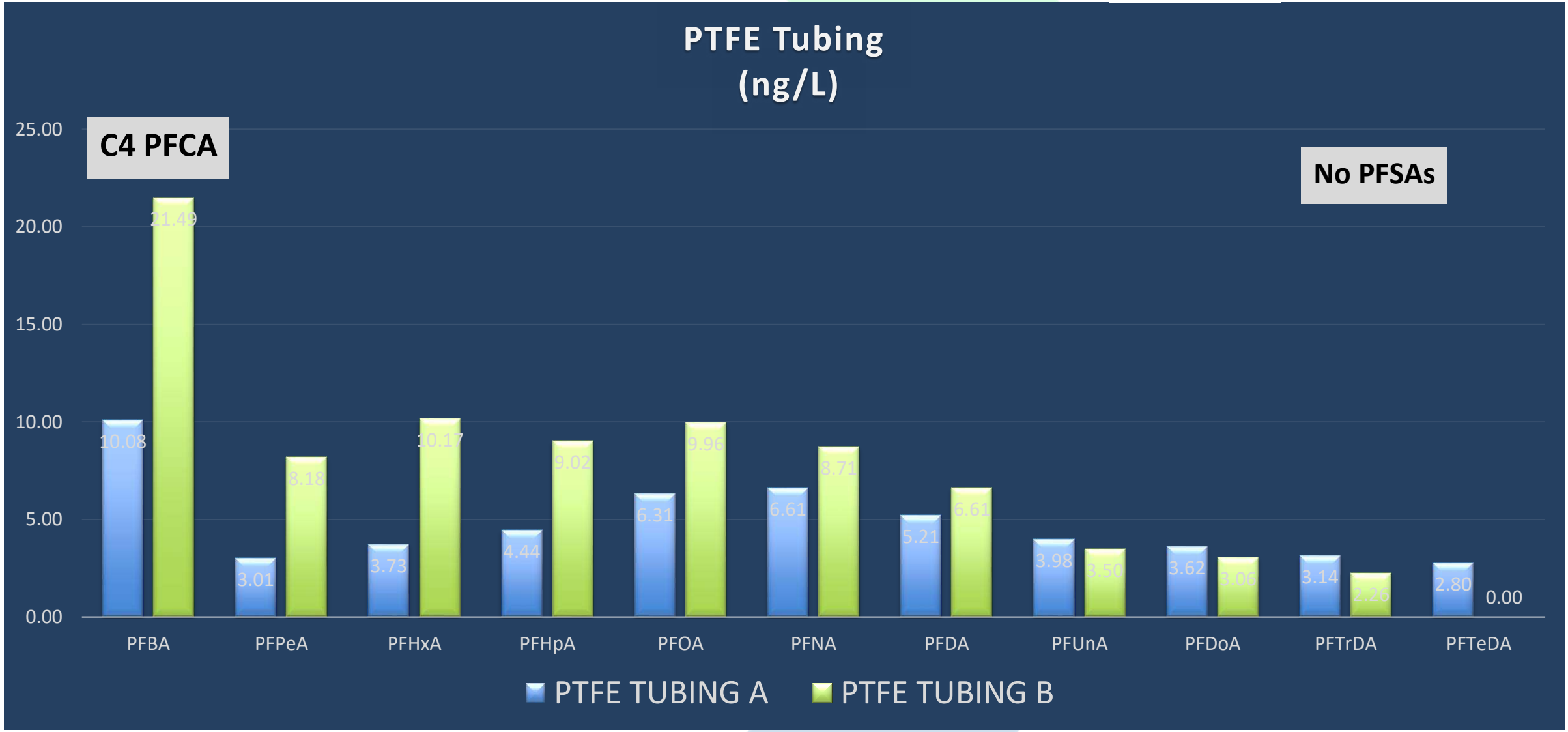
ALPHA ANALYTICAL World Class Chemistry

PFAS in Sampling Supplies: Fact or Fiction?

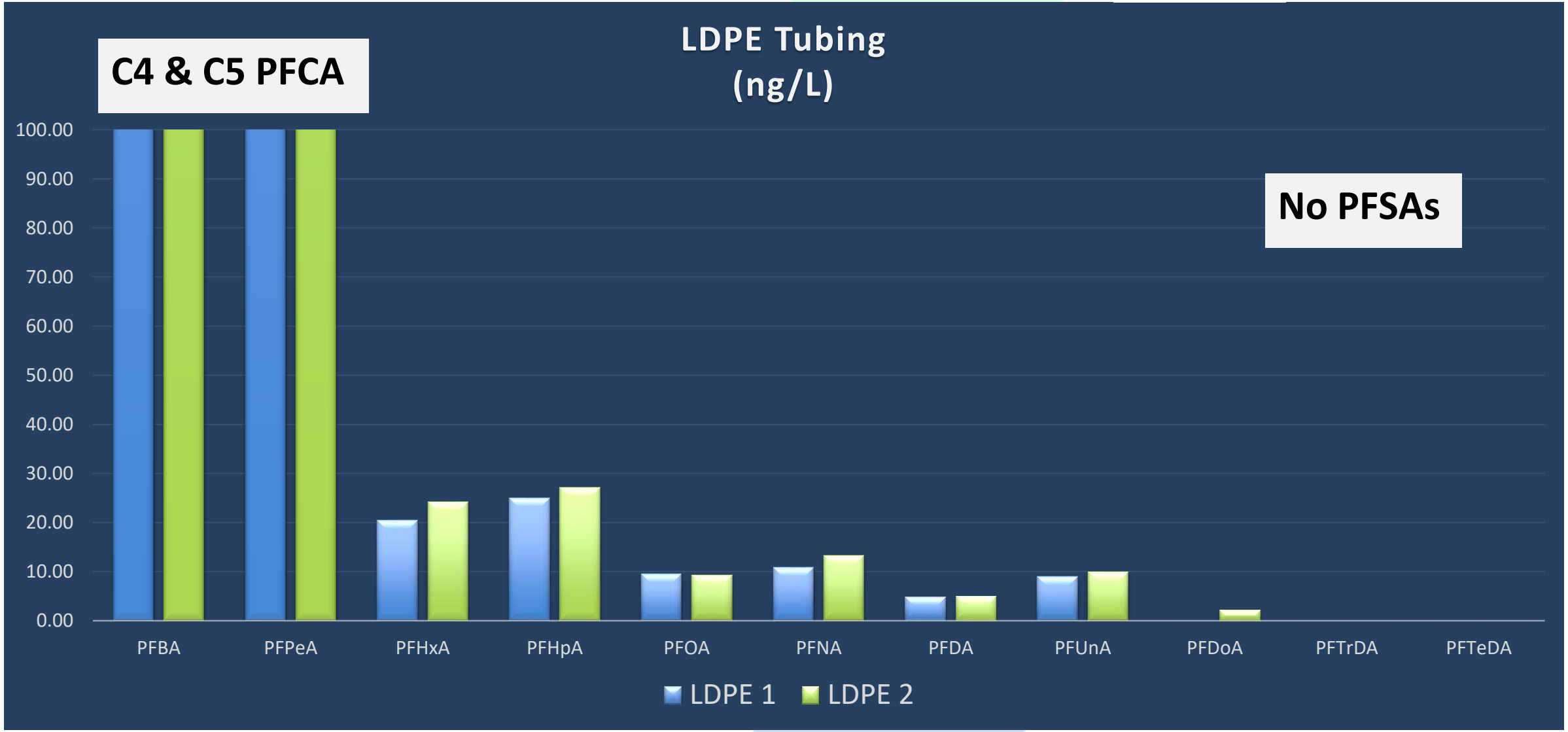
Detections of PFAS

- PTFE tubing
- LDPE tubing
- Bailer line
- Field logbook pages
- Field logbook cover
- PTFE bladder
- Water level tapes
- Sample labels

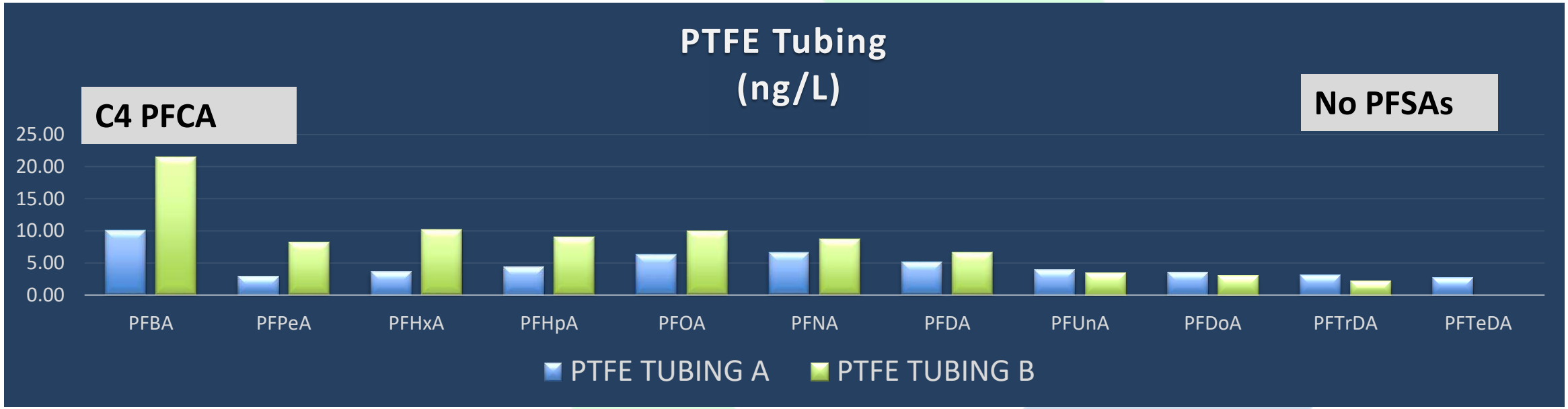
PTFE Tubing

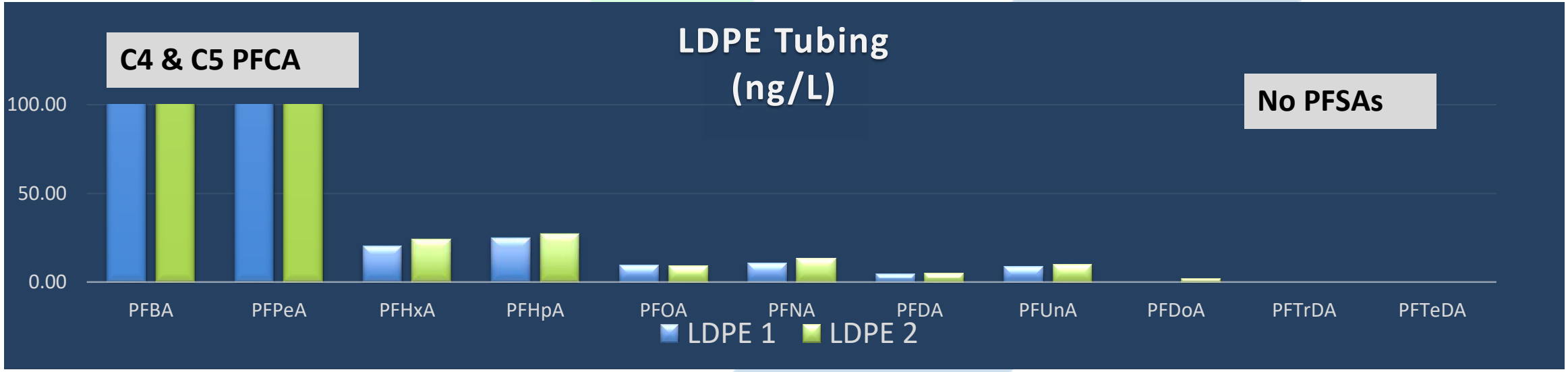

PTFE Tubing
(ng/L)
C4 PFCA
No PFSAs
ng/L
25.00
20.00
15.00
10.00
5.00
0.00
10.08
21.49
3.01
8.18
3.73
10.17
4.44
9.02
6.31
9.96
6.61
8.71
5.21
6.61
3.98
3.50
3.62
3.06
3.14
2.26
2.80
0.00
PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFNA
PFDA
PFUnA
PFDoA
PFTrDA
PFTeDA
PTFE TUBING A
PTFE TUBING B

LDPE Tubing

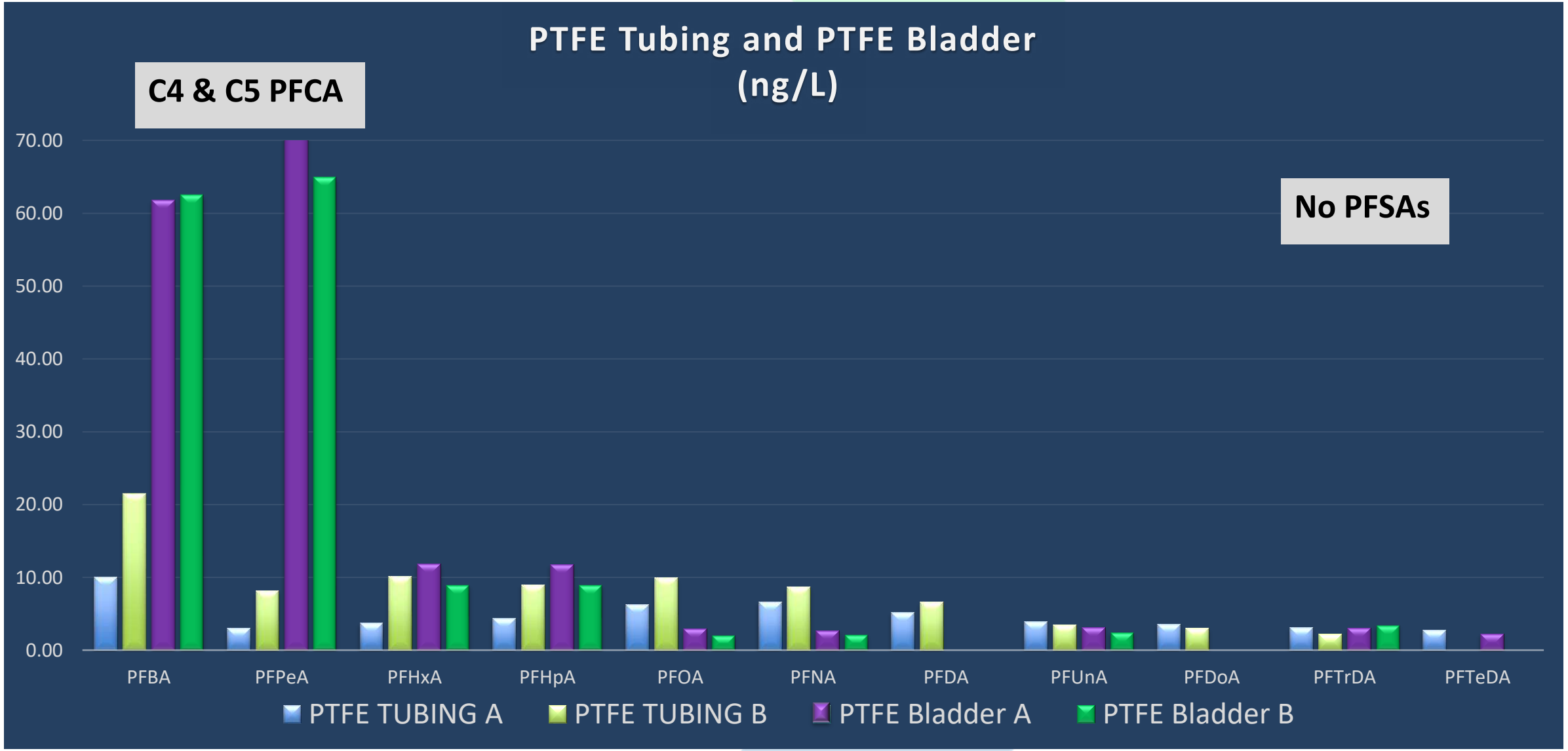

C4 & C5 PFCA
LDPE Tubing
(ng/L)
No PFSAs
ng/L
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFNA
PFDA
PFUnA
PFDoA
PFTrDA
PFTeDA
LDPE 1
LDPE 2

PTFE vs LDPE Tubing

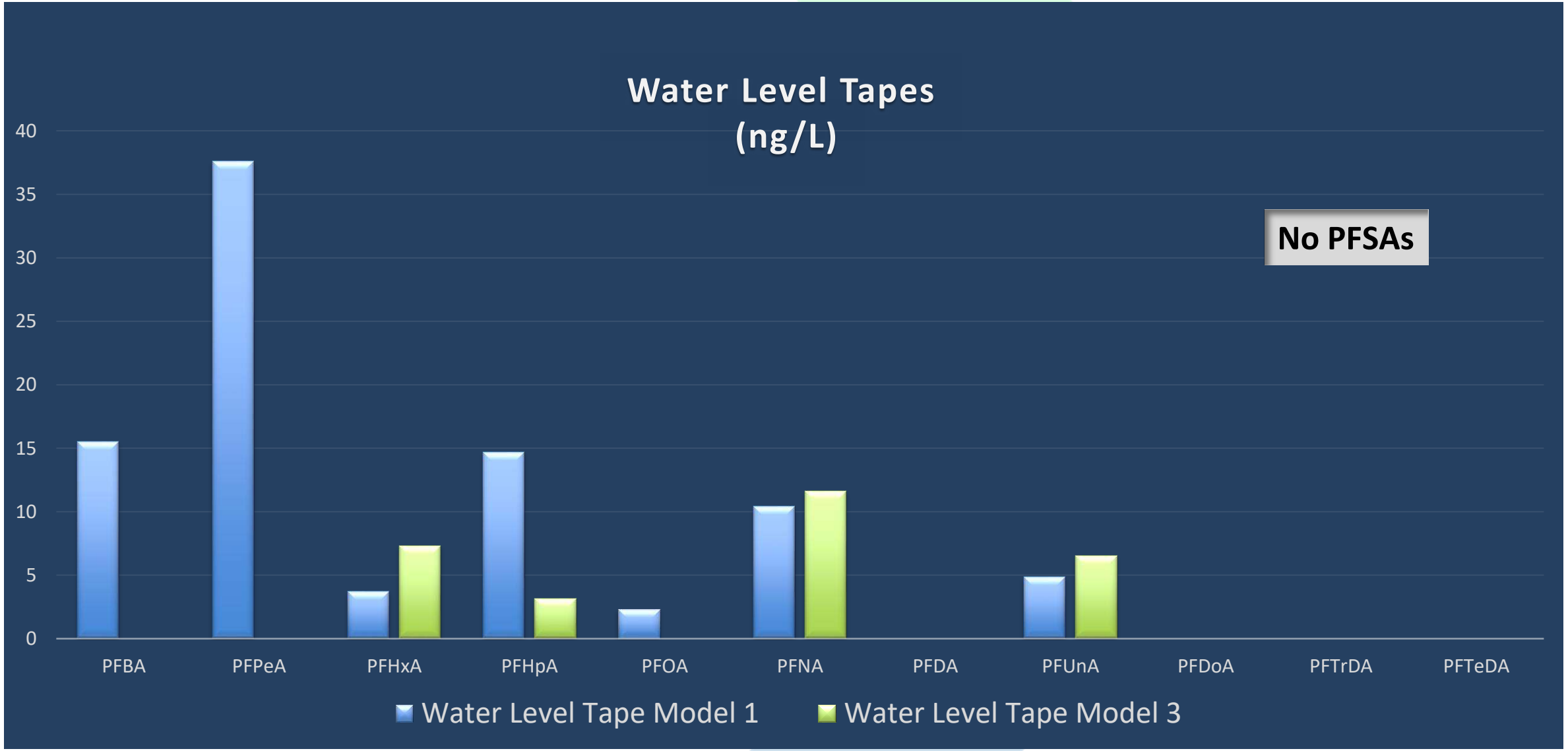




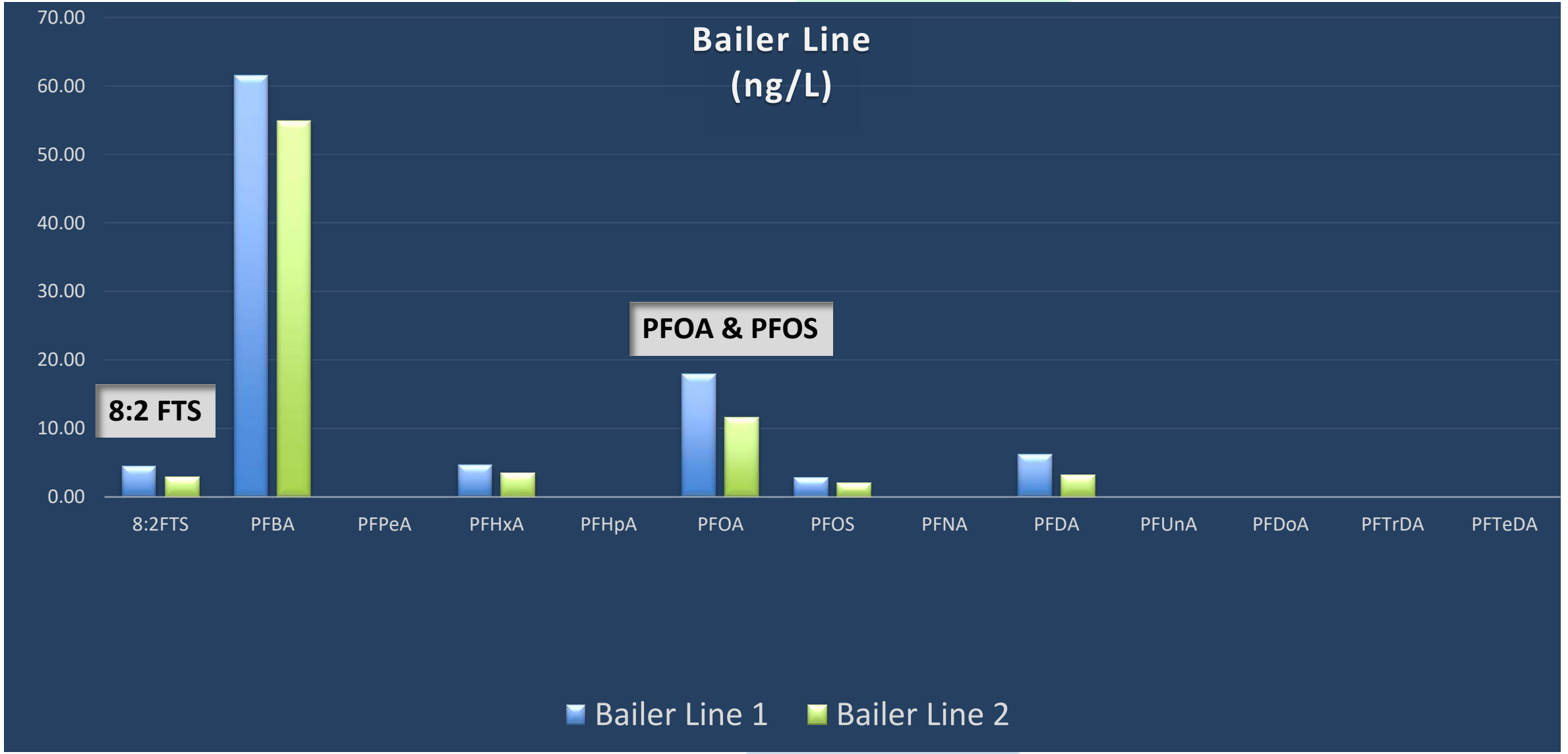
PTFE Tubing & PTFE Bladder



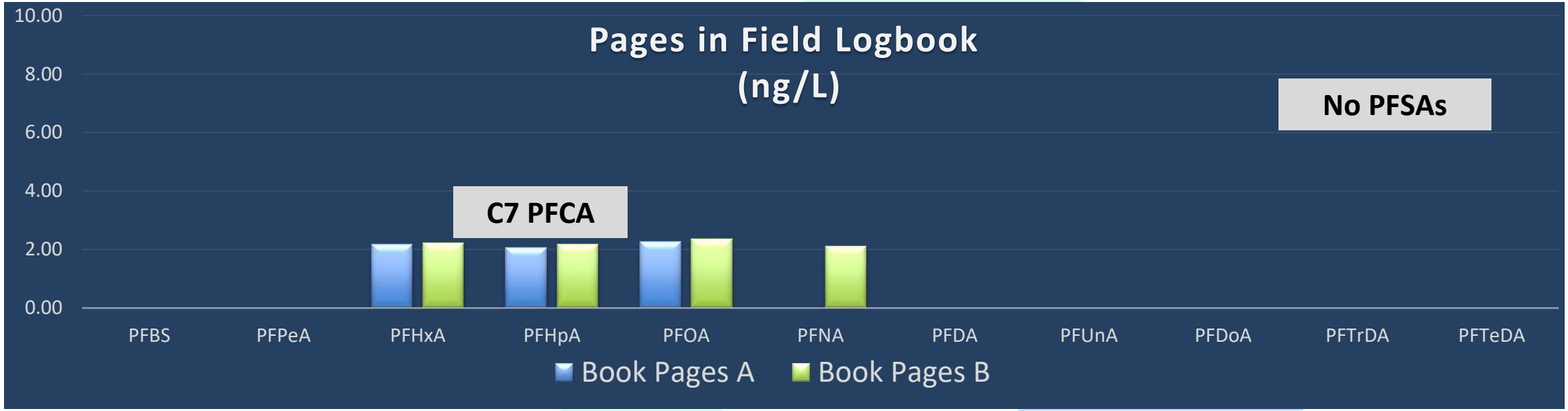
Water Level Tapes

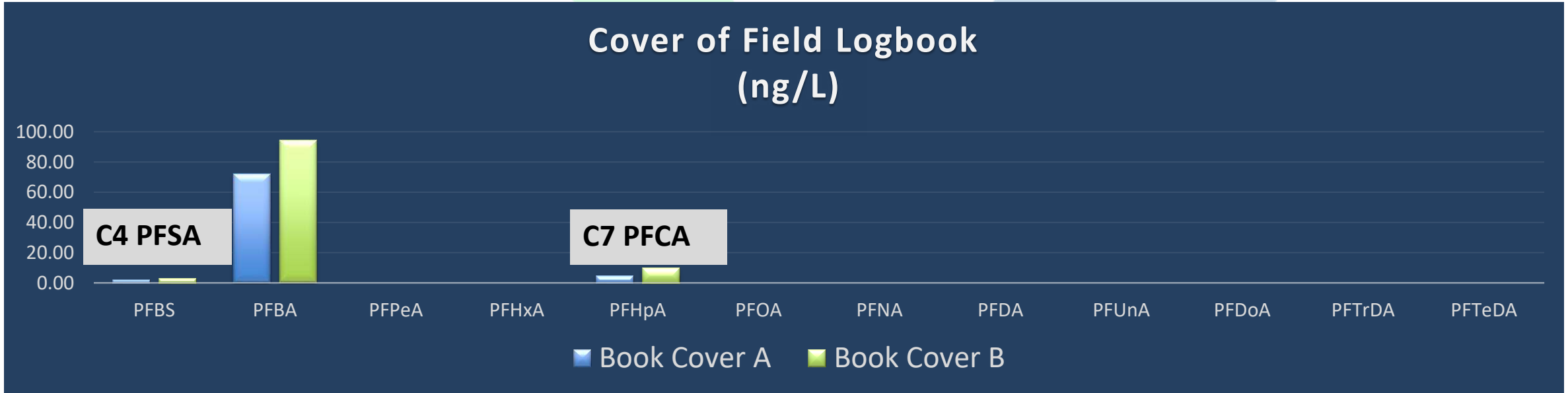


Bailer Line


Bailer Line
(ng/L)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
ng/L
8:2 FTS
PFOA & PFOS
8:2FTS
PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFOS
PFNA
PFDA
PFUnA
PFDoA
PFTrDA
PFTeDA
Bailer Line 1
Bailer Line 2

Field Book Pages vs Field Book Cover





PFCAs vs PFSAs vs Polyfluoroalkyl Substances

PFCAs	PFSAs	Polyfluoroalkyl Substances
PTFE Tubing	Bailer Line	PTFE-lined Tubing
PTFE-lined Tubing	Sample Labels	Bailer Line
LDPE Tubing	Nitrile Gloves	
Bailer Line	Field Book Cover	
Sample Labels		
Pizza Box		
Water Level Tapes		
Silastic Tubing		
Nitrile Gloves		
Field Book Pages		
Field Book Cover		
PTFE Bladder		

No PFAS Detected

Silicone Tubing	Aluminum Foil
Polyethylene Bladder	Adhesive Notes
Passive Diffusion Bag	Resealable Plastic Storage Bags
Bubble Wrap	Bentonite
Protein Bar Wrapper	

Some Conclusions of the Study

- Generally low levels of PFAS may leach off of specific sampling materials.
- These are conservative results.
  - Tubing stored in wells for extended period of time may be exception
- Forensic evaluation of sample data.
- You still need to collect equipment blanks.

Take-Away Messages

- Understand the potential for PFAS to be in the sampling materials you are using.
- Collect equipment blanks.
- Use common sense.

Questions?

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www.trccompanies.com

ACKNOWLEDGMENTS:
Phil Bassignani, Alpha Analytical
Jim Occhialini, Alpha Analytical
Mike Eberle, TRC

Thank you

Known for excellence. Built on trust.

Case Study – Investigation and Remediation of 1,4-dioxane in a Glacial Till and Fractured Bedrock Hydrogeologic System, Hanover, NH

James M. Wieck, P.G.
GZA GeoEnvironmental, Inc., Bedford, NH

Outline

- 1,4-dioxane 
- Site background
- Hydrogeologic investigation/CSM
- Remedial system design and operation
- Groundwater extraction system expansion
- Summary of challenges

1,4-Dioxane

Properties

- Miscible
- Limited tendency to attach to soil (organic C partition coefficient 1.23 log Koc)
- Limited tendency to biodegrade
- Low volatility (Henry's Law Constant 4.80 X 10^{-6} atm-m^3/mol)
- Does not bioaccumulate

Probable human carcinogen based on animal studies

No EPA MCL; EPA cancer risk-based guidance 0.35 ug/L

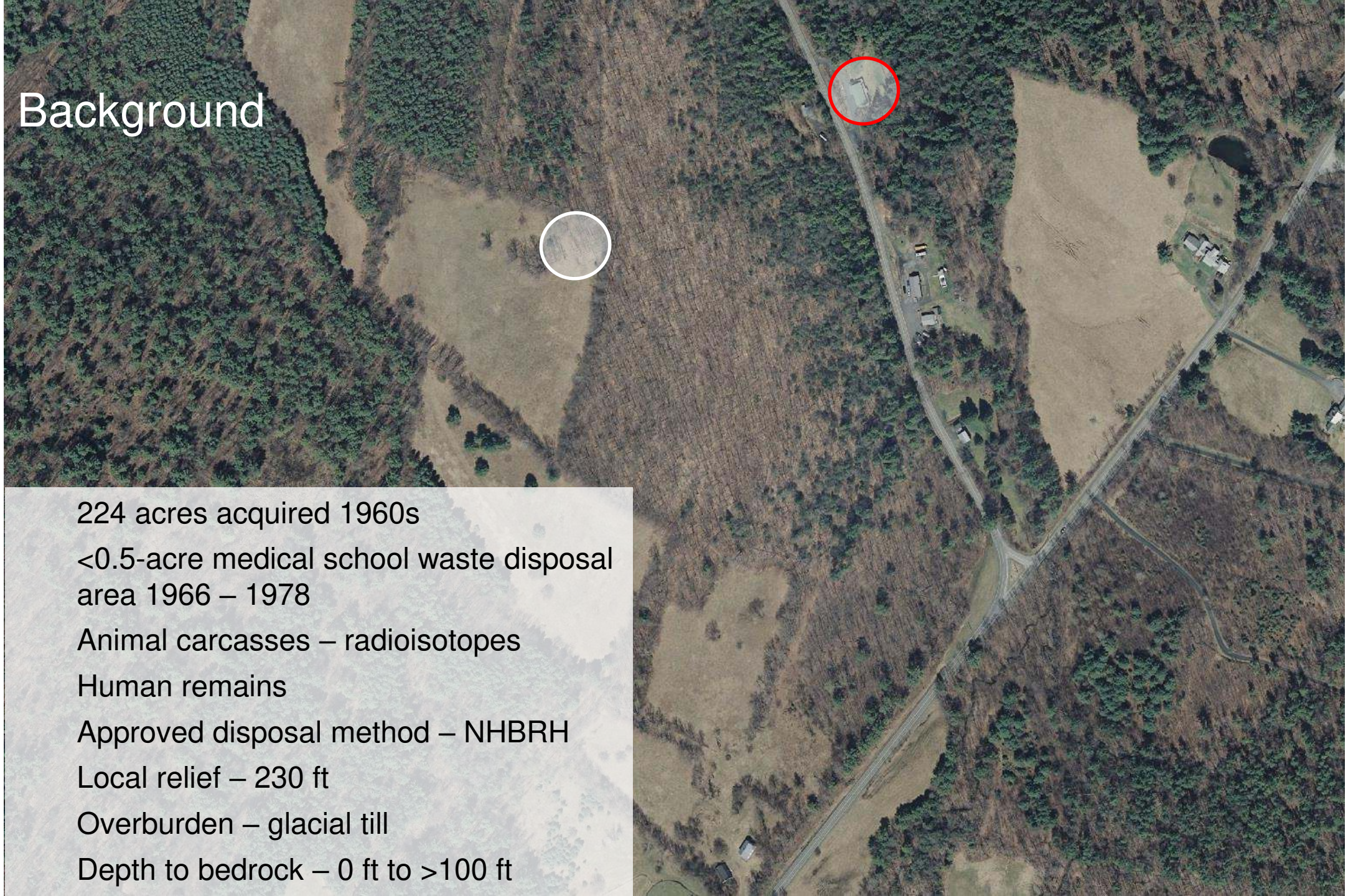
NH AGQS 0.32 ug/L (0.3 ug/L [MA]; 3 [CT]; 3 ug/L [VT]; 4.0 ug/L [ME])

Sources

- Primary use as a stabilizer in solvents (e.g., 1,1,1-TCA)
- By-product present in personal care products, paints, and many more…
- Scintillation fluid


KINGLAND FARMS
LYME
HANOVER
STREAM-1
STREAM-1A
STREAM-2
STREAM-3
STREAM-4
STREAM-5
STREAM-6
STREAM-7
STREAM-8
STREAM-9
STREAM-10
STREAM-11
STREAM-12
6 RENNIE ROAD DUG WELL
APPROXIMATE LOCATION OF HISTORIC ANIMAL CARCASS BURIAL AREA
DUG WELL - 2
ABANDONED SITE WATER SUPPLY WELL
SUPPLY WELL WSW - 1
Burial Area

Background

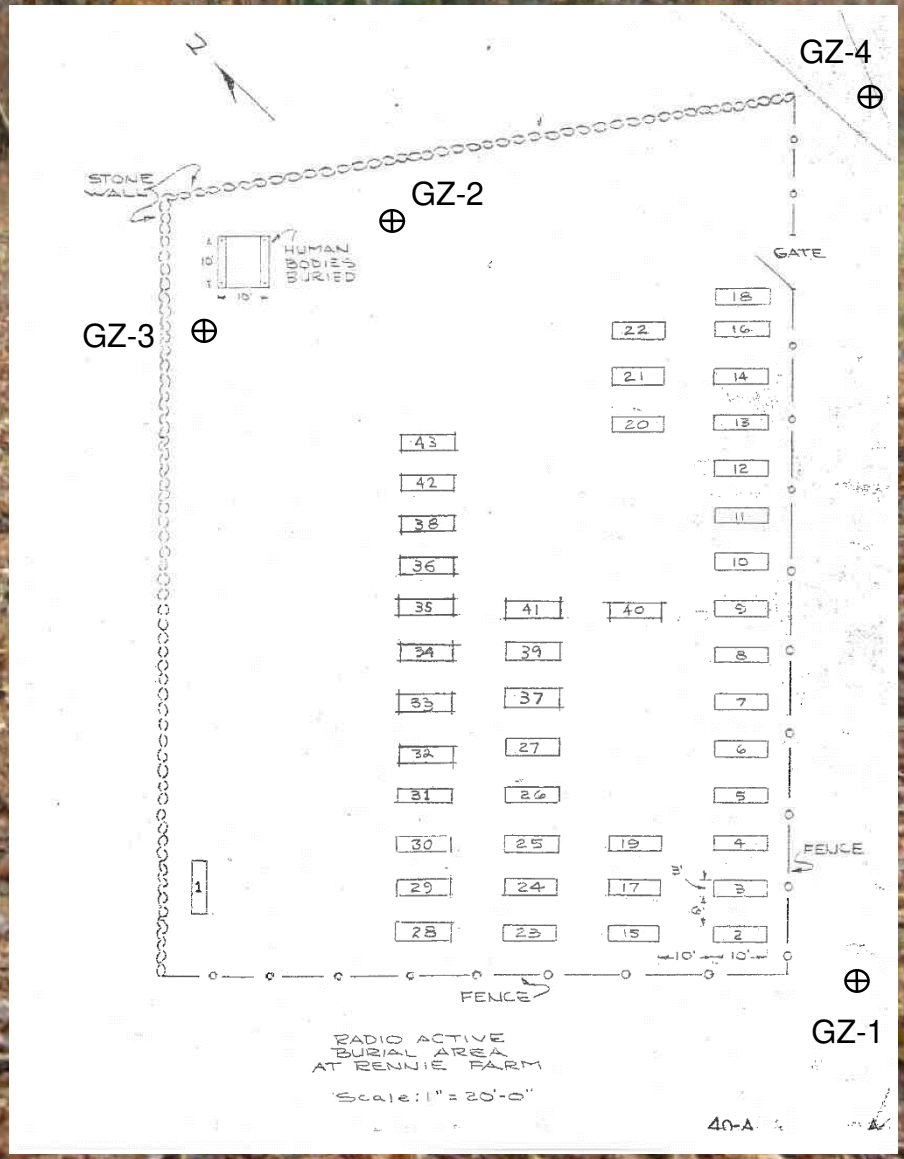


- 224 acres acquired 1960s
- <0.5-acre medical school waste disposal area 1966 – 1978
- Animal carcasses – radioisotopes
- Human remains
- Approved disposal method – NHBRH
- Local relief – 230 ft
- Overburden – glacial till
- Depth to bedrock – 0 ft to >100 ft

Research and investigation 2003 - 2011

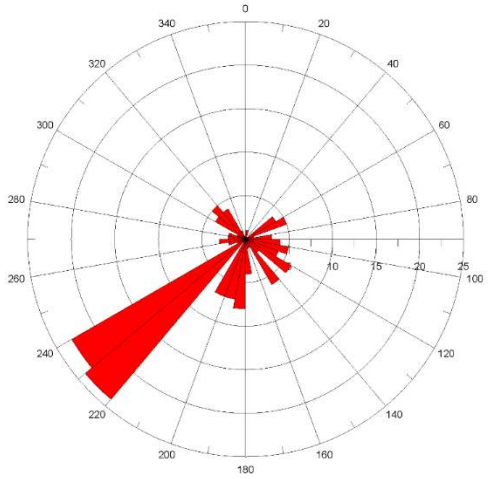
GZ-1 through GZ-4 installed 2009

Excavation December 2011



Site Investigation - Bedrock Geology

All Outcrops - Mag N



HAGER-RICHTER GEOSCIENCE, INC.

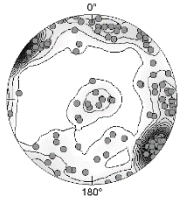
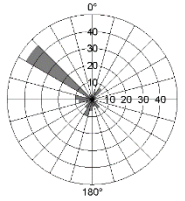
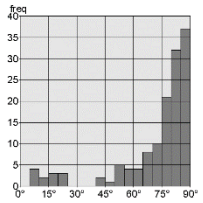
8 Industrial Way - D10
Salem, NH 03079
Phone: 603-893-9944
Fax: 603-893-8313

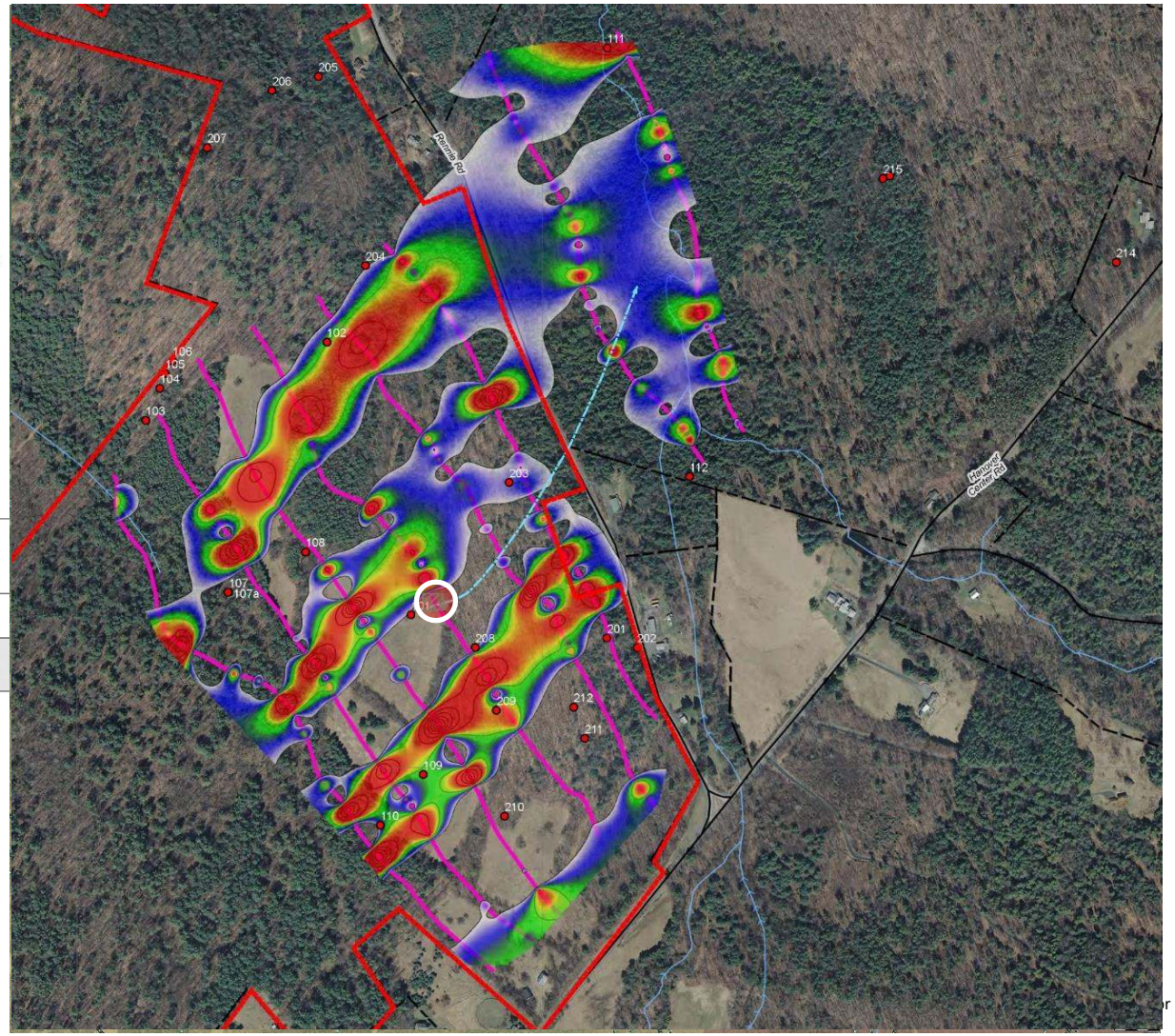
BEDROCK FRACTURE STATISTICS PLOTS

DATE(S) SURVEYED: November 23 & 24, 2015

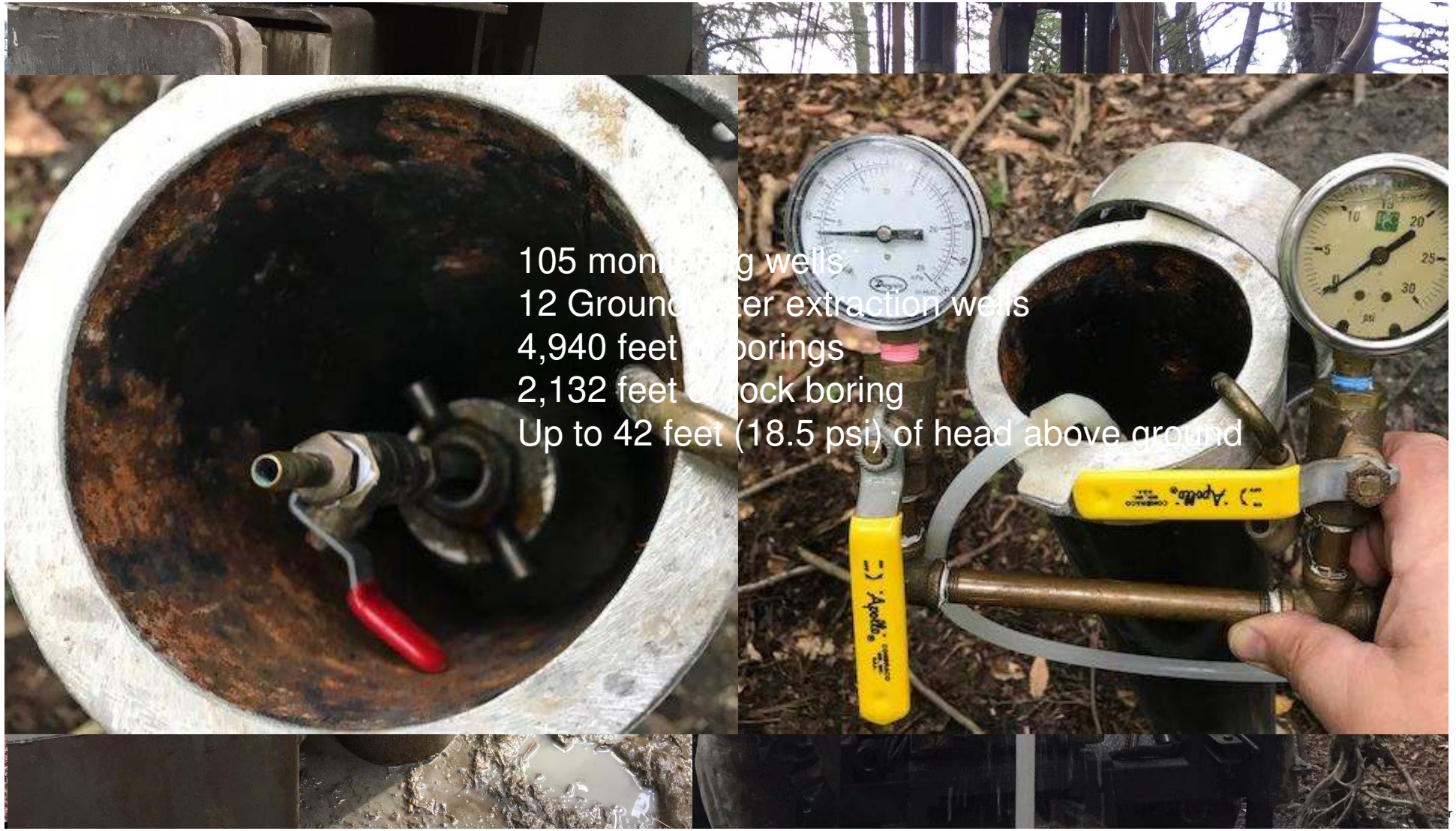
CLIENT:	GZA GeoEnvironmental, Inc.	HAGER-RICHTER FILE:	15J101
PROJECT:	Dartmouth College - Rennie Farm Site	ORIENTATION REFERENCE:	True North
LOCATION:	Hanover, New Hampshire	MAGNETIC DECLINATION:	15° West

NOTES: The bedrock fractures plotted below are based on outcrop measurements by Jeffrey Reid and Michael Howley of Hager-Richter.

Stereogram - Lower Hemisphere of Bedrock Fractures	Dip Azimuth Rose Diagram of Bedrock Fractures	Dip Angle Histogram of Bedrock Fractures
Schmidt Plot - LH - Bedrock Structures	Azimuth - Absolute (Count)	Dip Histogram (Count)
		
Number of Bedrock Fractures Plotted = 142 Contour Interval = 2	Counts: 142.00 Min: 5.00 Max: 355.00	Counts: 142.00 Min: 6.00 Max: 90.00



Monitoring Well Network Installation



Source Area Investigation

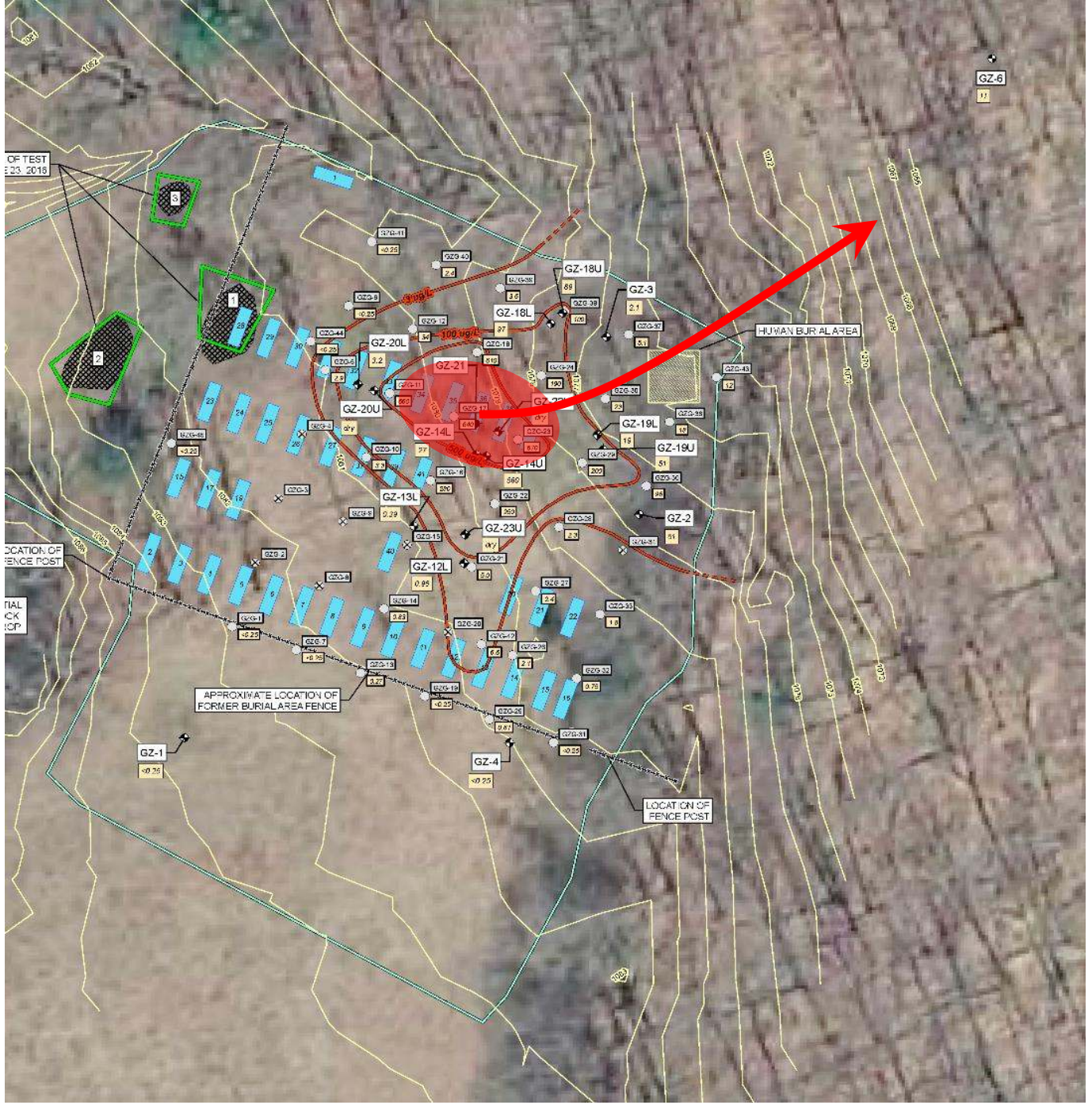
13 Monitoring wells

38 GW grab samples

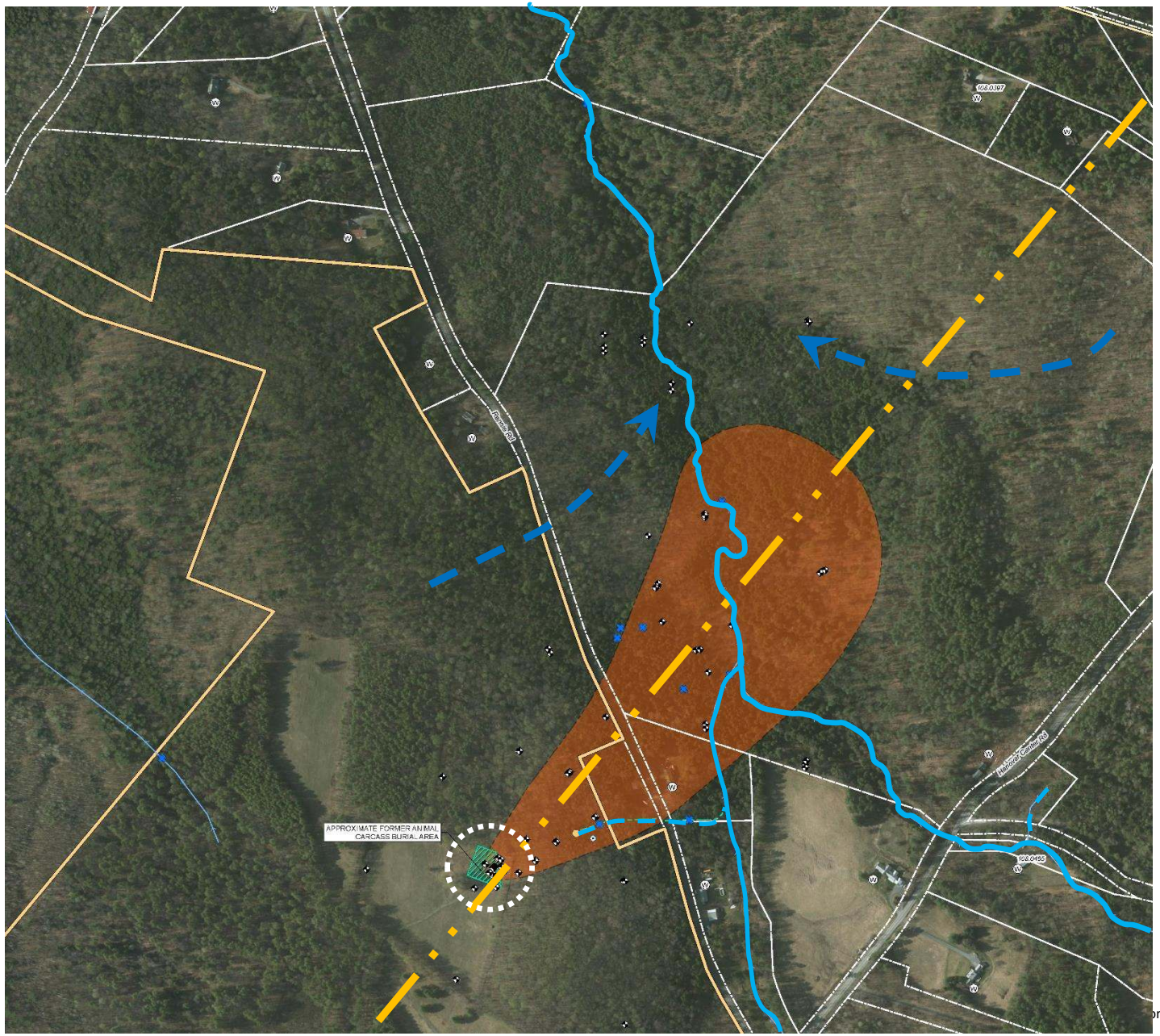
148 Soil samples

Radiological analyses of 14 soil samples

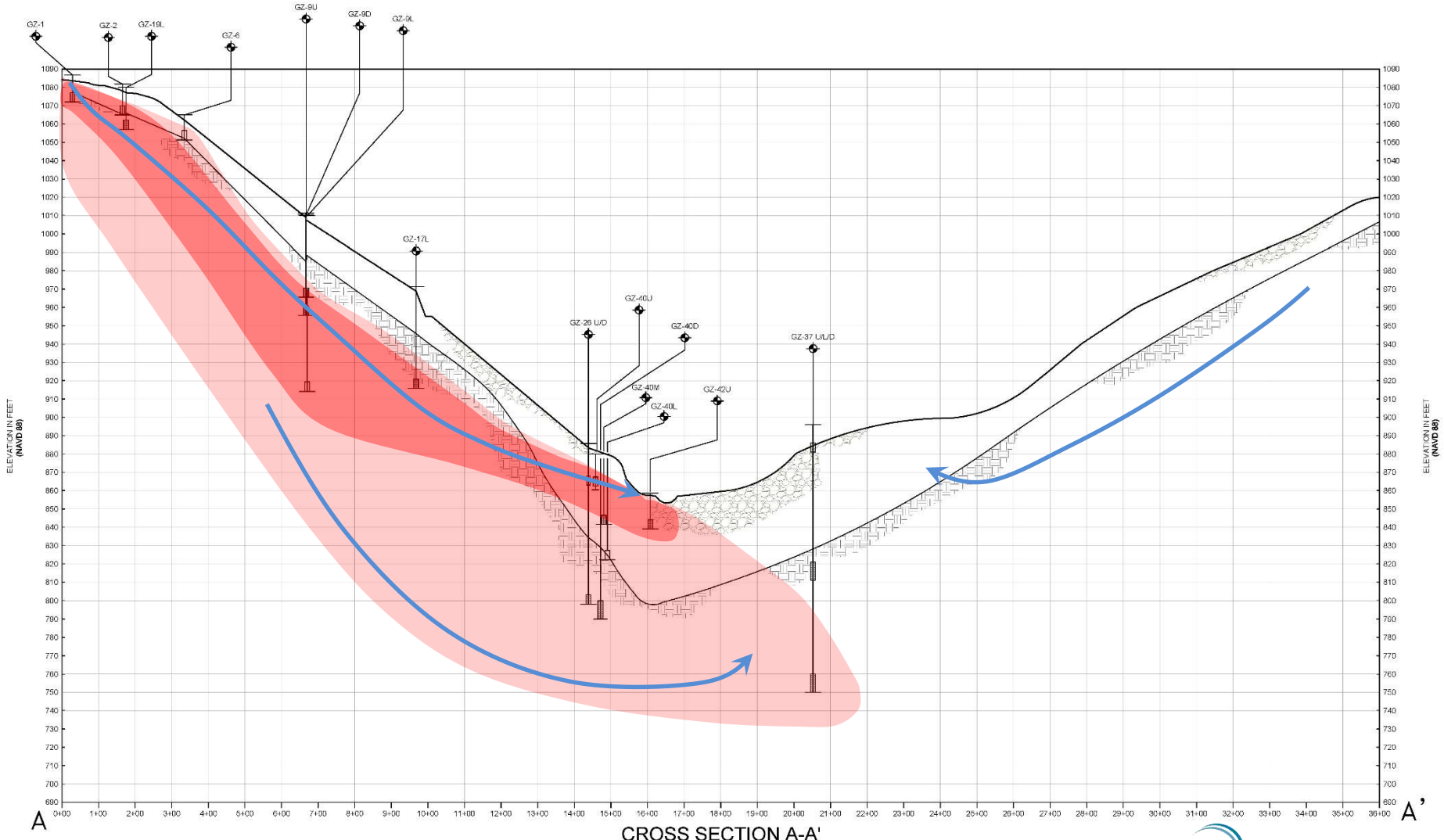
Dissolved-phase 1,4-dioxane source delineated



1,4-Dioxane Transport

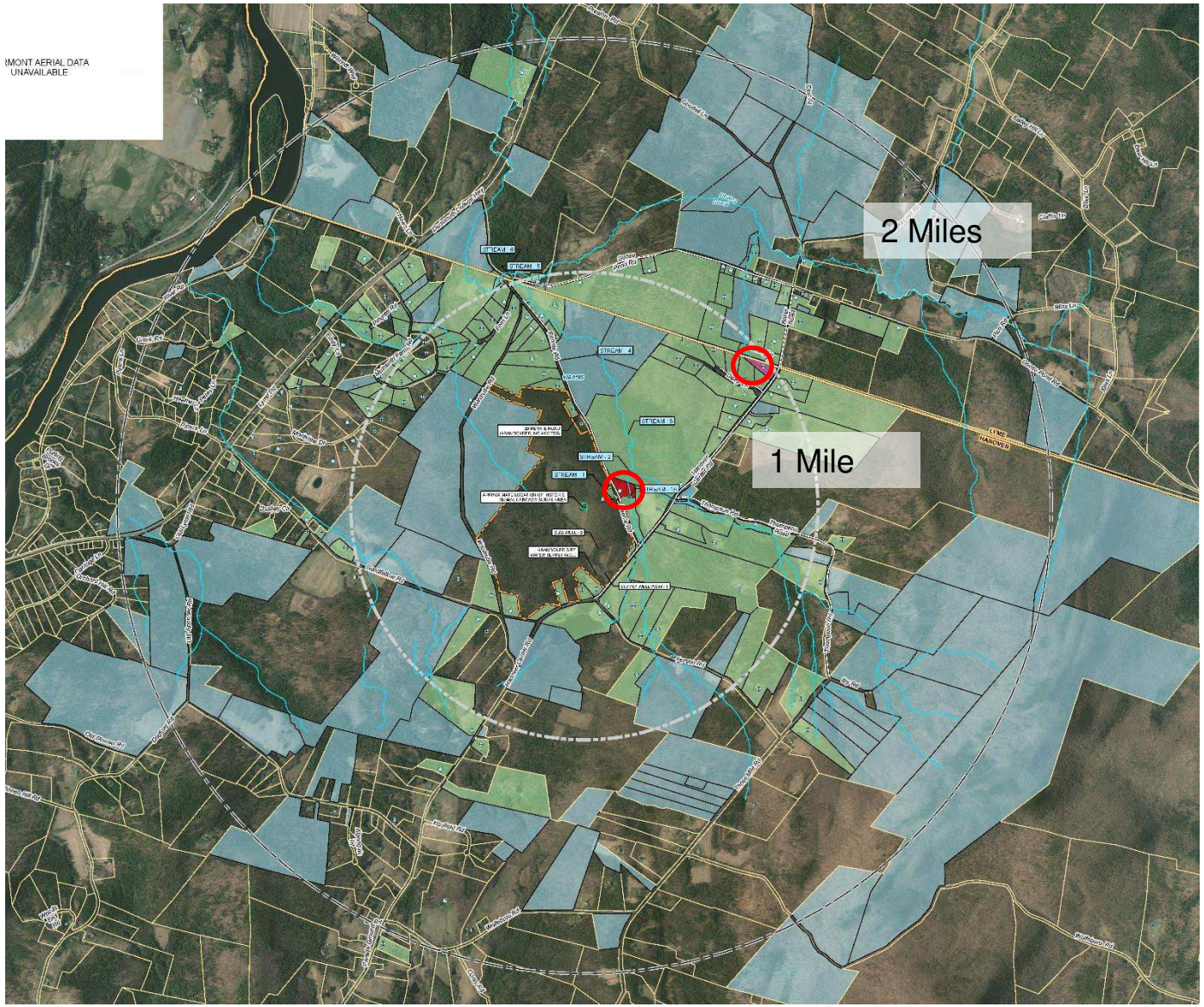


1,4-Dioxane Transport



CROSS SECTION A-A'

Water Supply Sampling



>140 wells sampled

1 location with1,4-dioxane detected related to site

1 location with1,4-dioxane detected not related to site

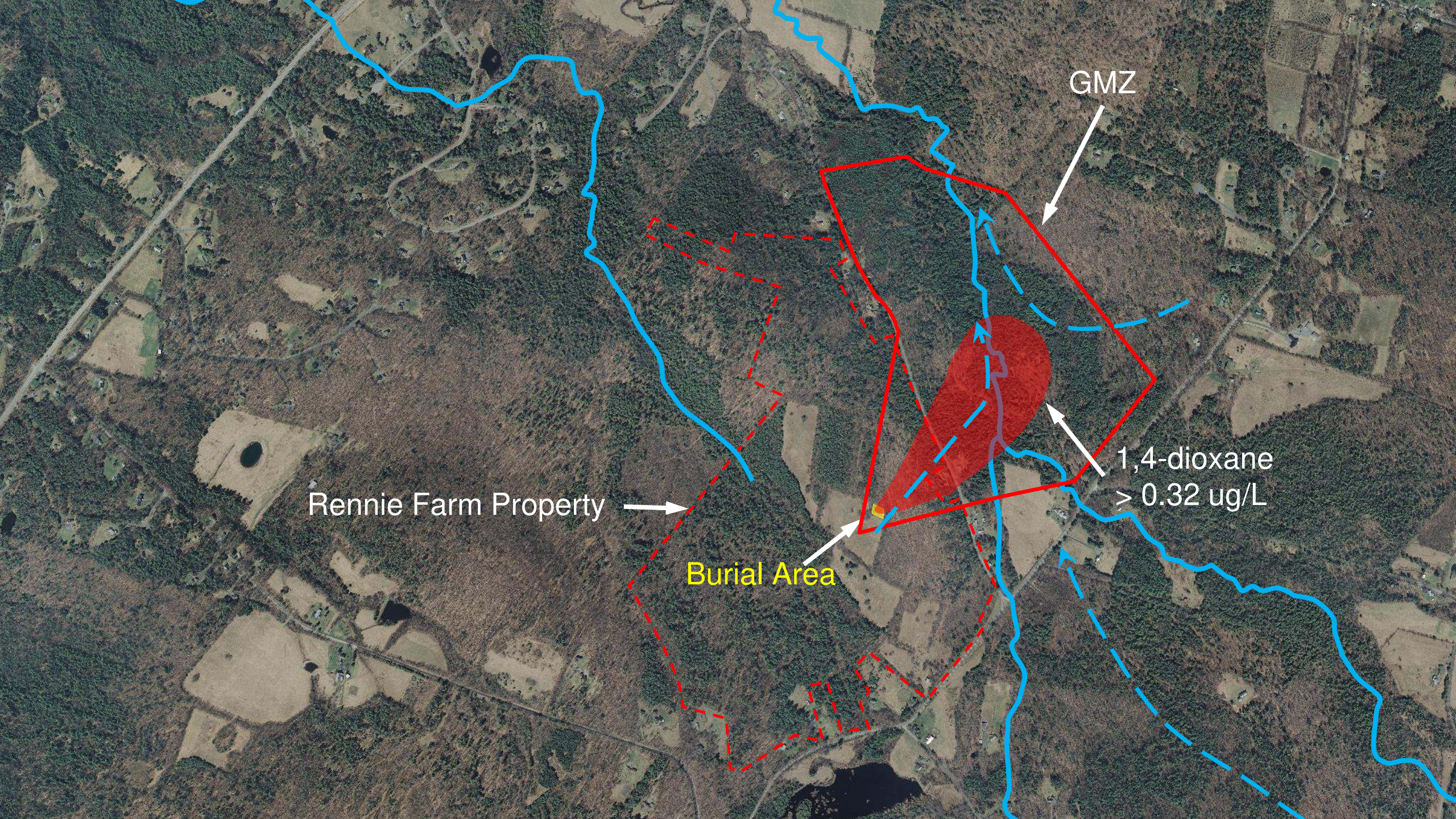
25 homes supplied with bottled water

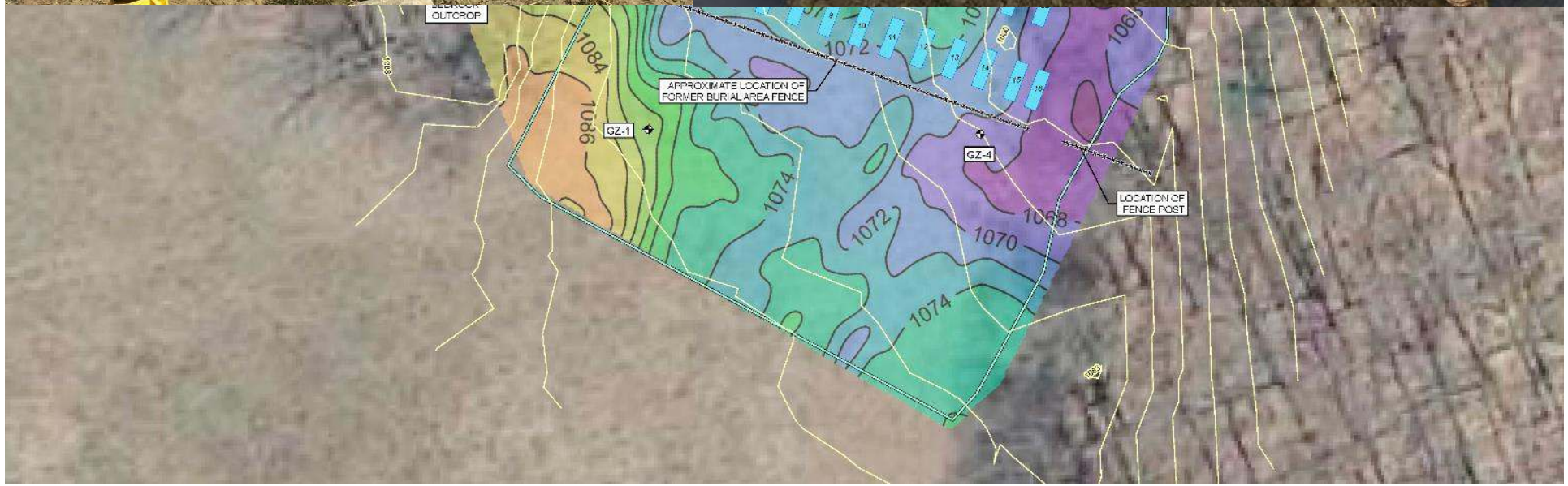
2 homes supplied with POEs

1 municipal reservoir

7 surface water locations

1 swimming pool


GMZ
1,4-dioxane
> 0.32 ug/L
Rennie Farm Property
Burial Area


BEDROCK OUTCROP
APPROXIMATE LOCATION OF FORMER BURIAL AREA FENCE
GZ-1
GZ-4
LOCATION OF FENCE POST
1084
1086
1074
1072
1070
1068
1074

1,4-Dioxane Remedial System Layout

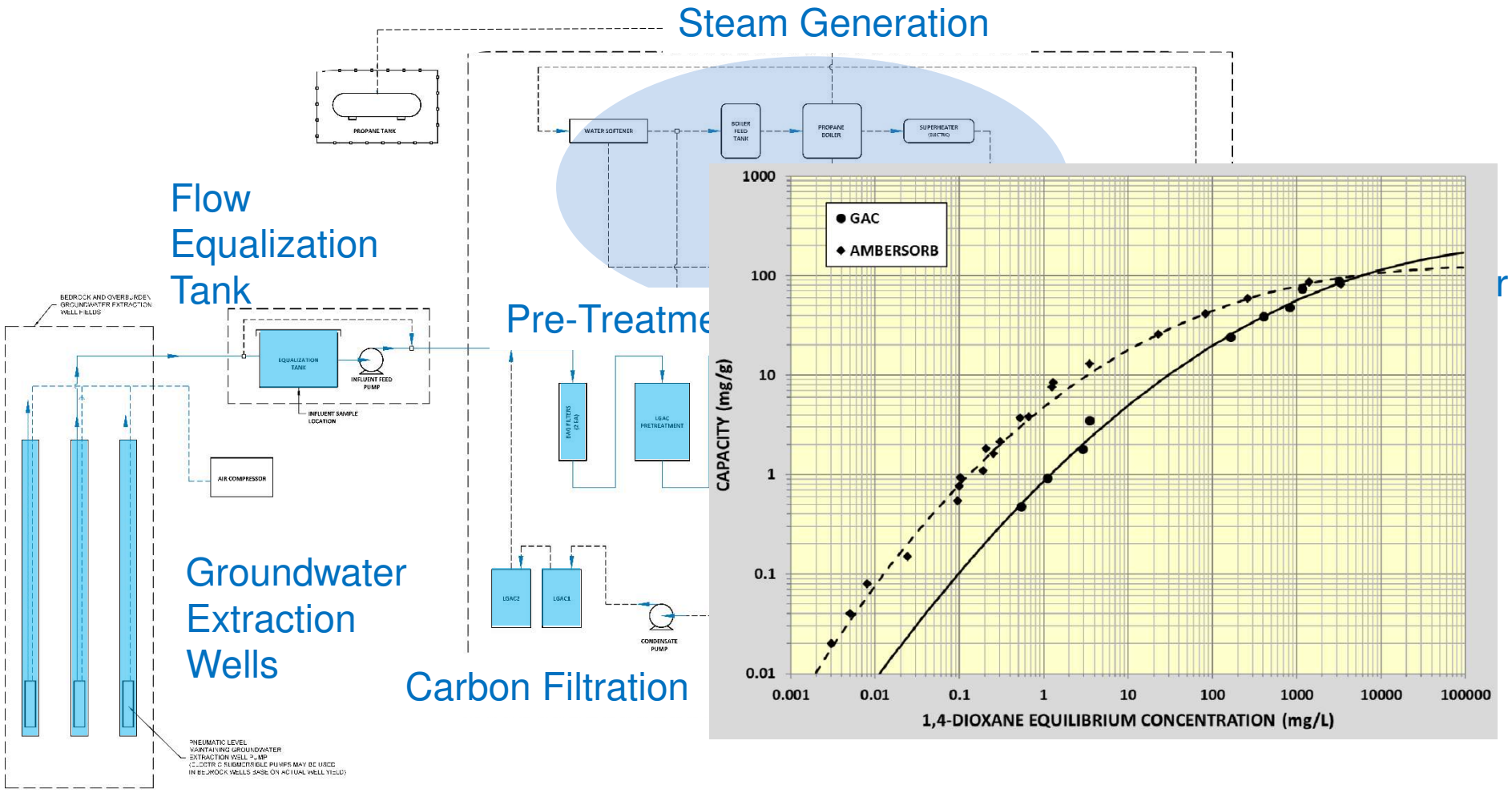
Potential Future Discharge Field

Treatment System

Constraints

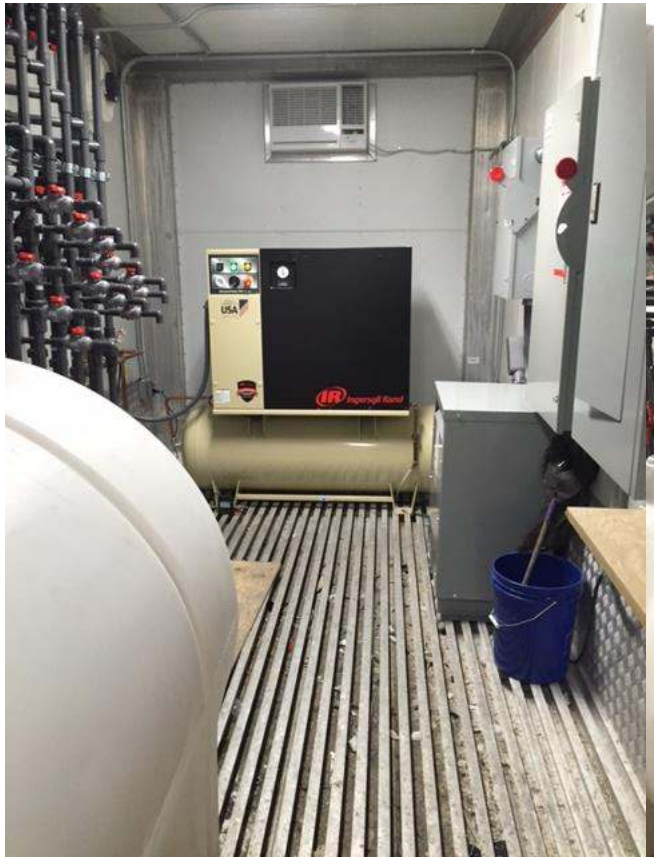
- Dissolved Source
- Glacial Till/Fractured Bedrock
- Remote Location
- Single-Phase Electrical Service
- Time
- Trust

1,4-Dioxane Treatment

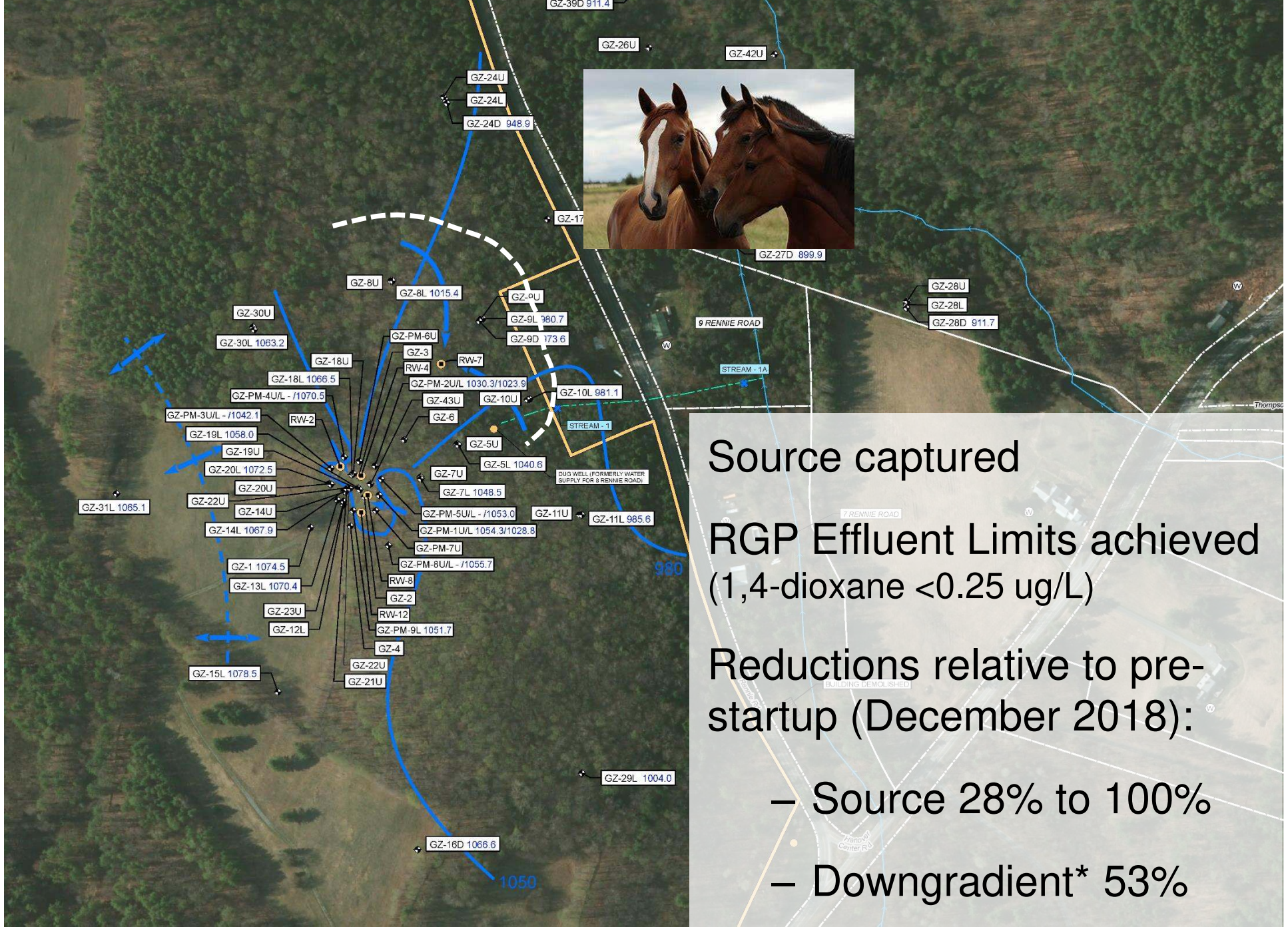


1,4-Dioxane Remedial System

Groundwater Extraction System



1,4-Dioxane Treatment



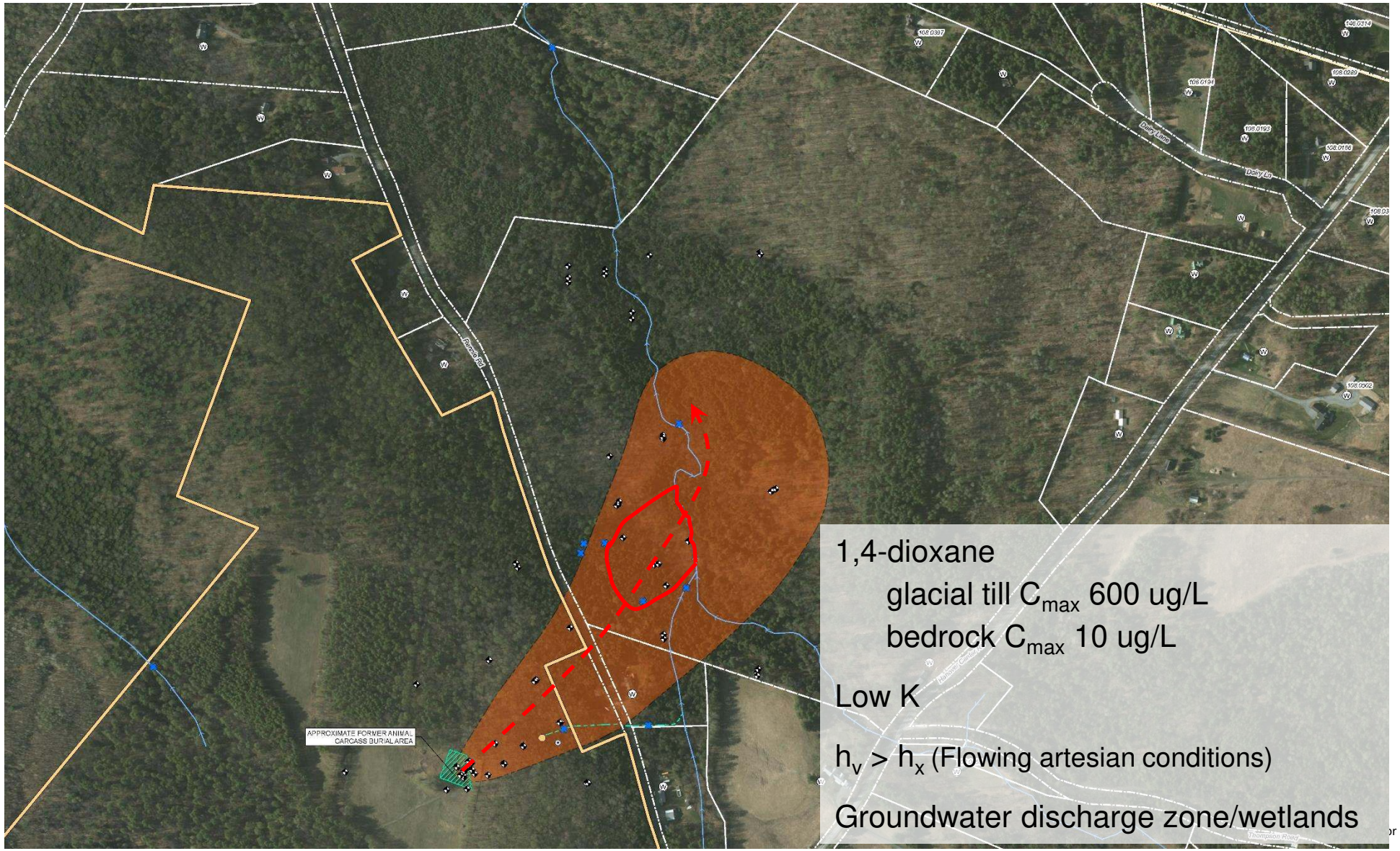
Source captured

RGP Effluent Limits achieved
(1,4-dioxane <0.25 ug/L)

Reductions relative to pre-startup (December 2018):

- Source 28% to 100%
- Downgradient* 53%

Off-Site Transport



Off-Site Groundwater Extraction

- Off-site location
- Topography
- Wetlands
- Flowing artesian conditions

Challenges/Lessons Learned

Complex hydrogeologic setting/fracture fabric characterization

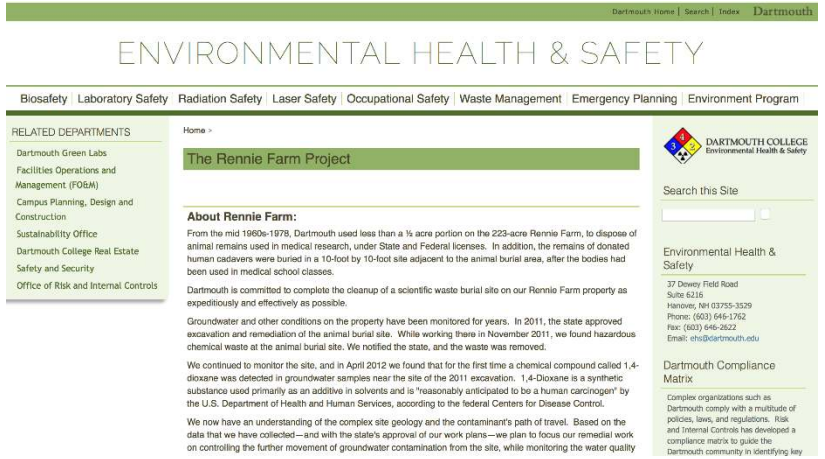
Compressed schedule

Remote location and limited infrastructure

Winter construction

Communication to public

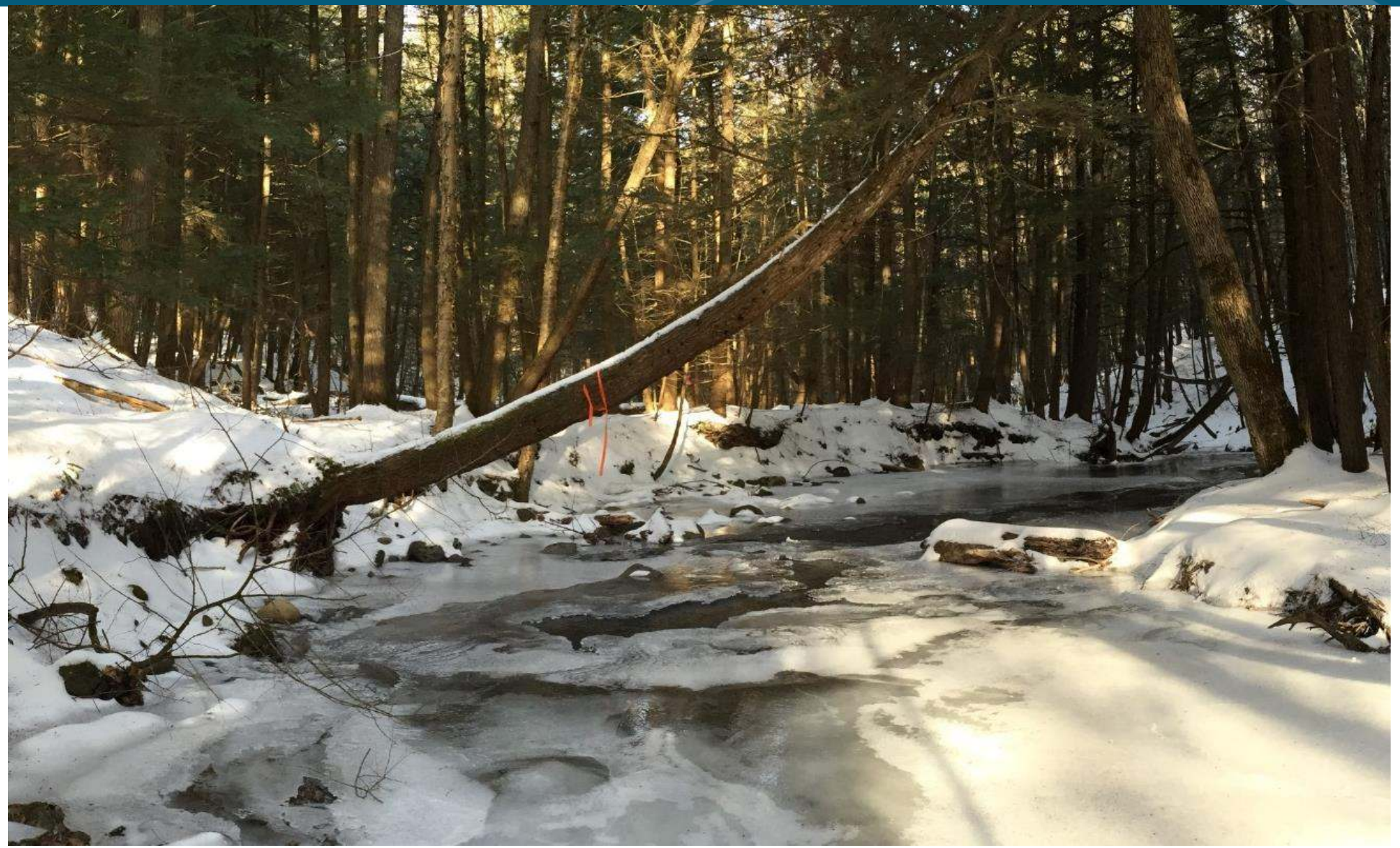
- Formal public meetings
- Informal drop-in meetings
- Dartmouth Rennie Farm website
- Periodic email updates
- Calls and emails



Low concentration sources

- Swimming pool liner
- Subsurface disposal systems

Permitting



DARTMOUTH

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GZA

Known for excellence. Built on trust.

MtBE Remediation Bureau

2019 New Hampshire Hazardous Waste

& Contaminated Sites Conference

September 11, 2019

Michael W. Juranty, P.E.

MtBE Remediation Bureau Funding

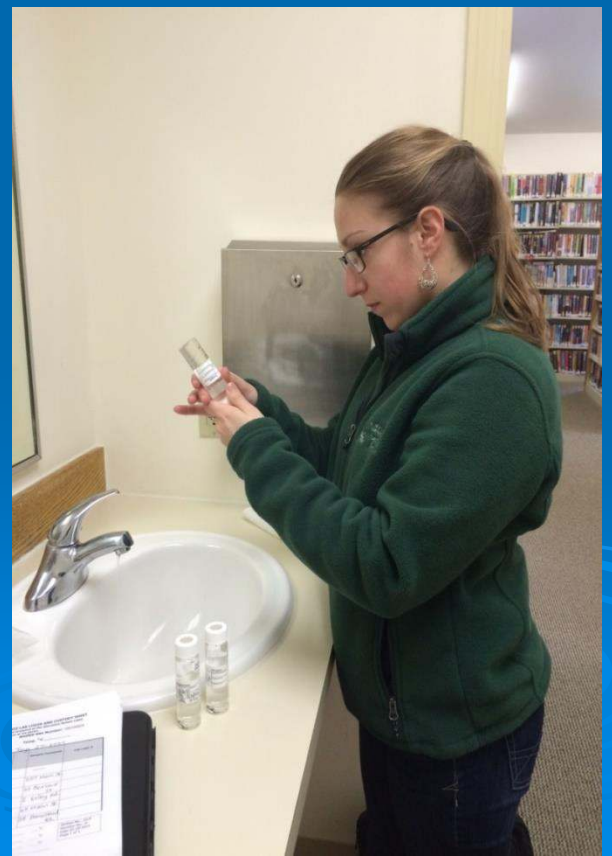
- Methyl tert-butyl ether (MtBE): Gasoline additive from late 70's to 2006
- 2003 NH MtBE litigation resulted in:
  - MtBE Settlement Funds
    - Settlement Agreement
    - Overseen by NHDOJ
  - Drinking Water & Groundwater Trust Fund
    - Statutory Authority RSA 485-F
    - Funds controlled by DWGTF Advisory Commission

Settlement Funds Related Activities

- Drinking water supply sampling
- Gasoline UST removal
- Motor Vehicle Recycling Facility assistance
- Site investigations / Closure Assessments
- Limited remediation
- Drinking water solutions

Drinking Water Supply Sampling

- **171 Communities**
- **7,727 VOCs samples from 7,470 wells**
- **1,004 MtBE Detects (13% of wells sampled)**



Underground Storage Tank Removal

Country Store

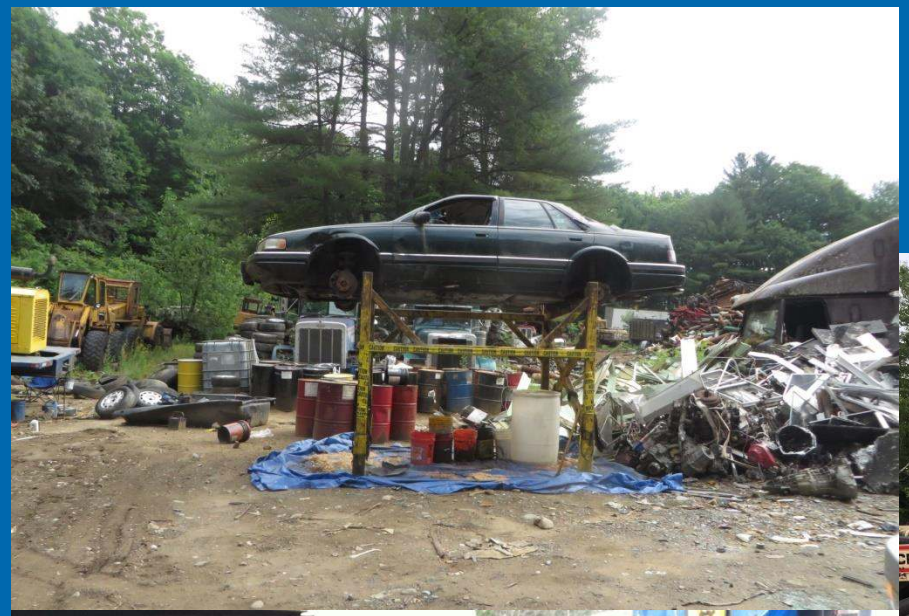
Foreclosure

Marine Patrol

UST Removal Eligibility

- **Gasoline tanks @ pre-2007 site**
- For prevention, investigation and cleanup of MtBE
- Project types:
  - Tank compliance issues
  - Historic/Unregistered tank projects
  - Terminating gasoline operations
- ***Referred by Consultants, Contractors, and UST Program***

MVRF Equipment & Concrete Pad Projects



PREVENTION

MVRF Assistance

- Integrated Prevention, Investigation, and Cleanup of gasoline releases:
  - Gasoline transfer spill reduction equipment – 82 of 118 facilities (70%)
  - Spill containment concrete pad projects – 39 yards (**33% of facilities**)
  - ***Many have never been investigated***

Assessment & Remediation

House with contaminated well

Contaminated soil removal showing bedrock impact on LNAPL migration

Drinking Water Project Types

- Bottled Water/Point of Entry (POE) Systems
- Development of New Wells
- Treatment System Design and Installation
- Extending Existing Public Drinking Water Infrastructure

Drinking Water Project Funding

- MtBE Settlement Funds (MtBE contamination only)
  - Contracted engineering
  - Engineering and construction reimbursement
- DWG Trust Fund (Public health and source water protection)
  - Grants
  - Loans

Drinking Water Infrastructure Projects

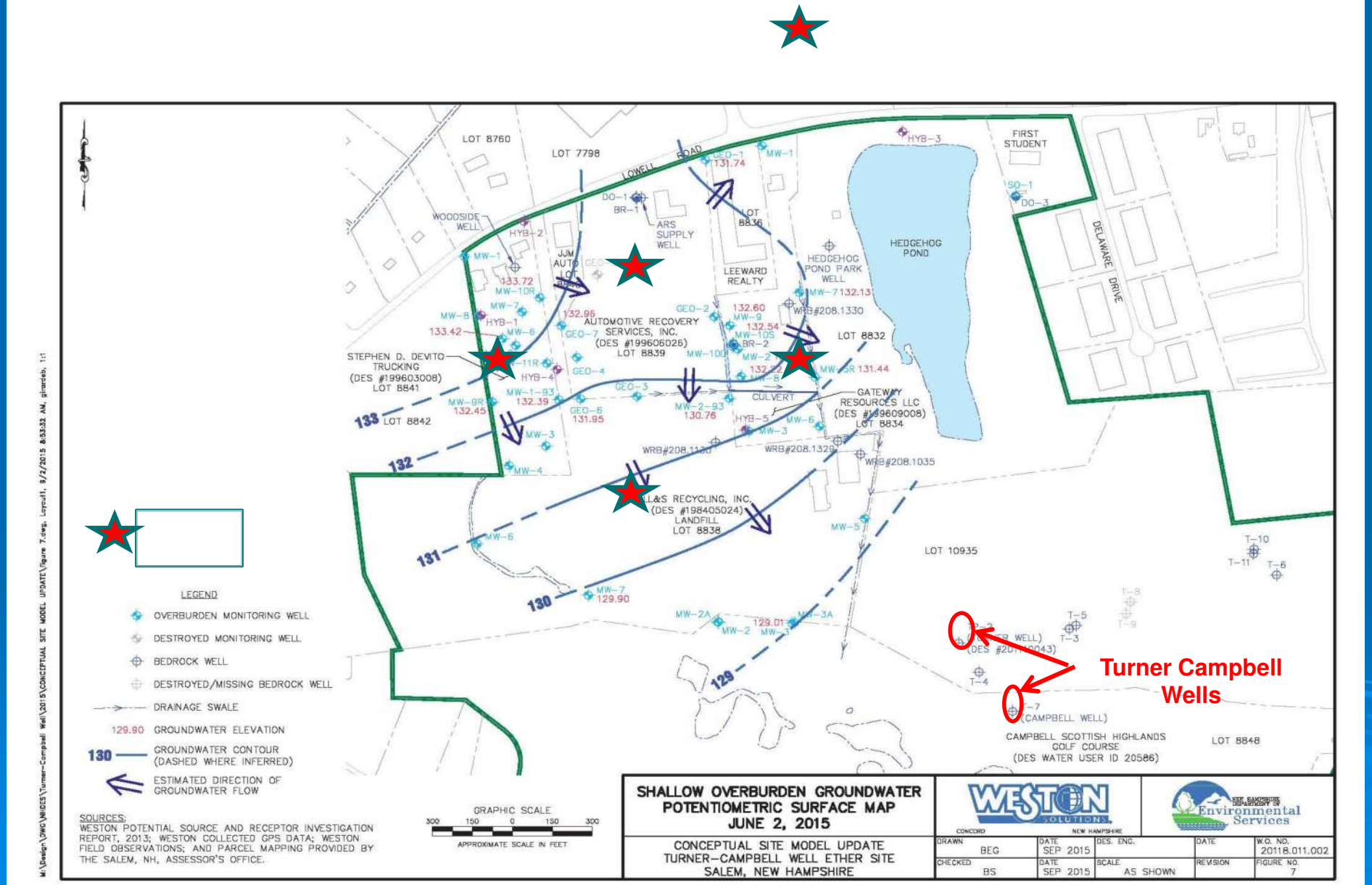
- Combined Settlement Funds and Trust Fund Projects
  - Lee Traffic Circle
  - **Rochester Route 202A Extension**
  - **Southern NH Regional Interconnect Project** (Plaistow Lido, Windham Exit 3, Salem's Turner & Campbell well)
  - Swanzey Mobile Home Park Well Development

Drinking Water Project Example

- Southern NH Regional Drinking Water Supply Project Objectives:

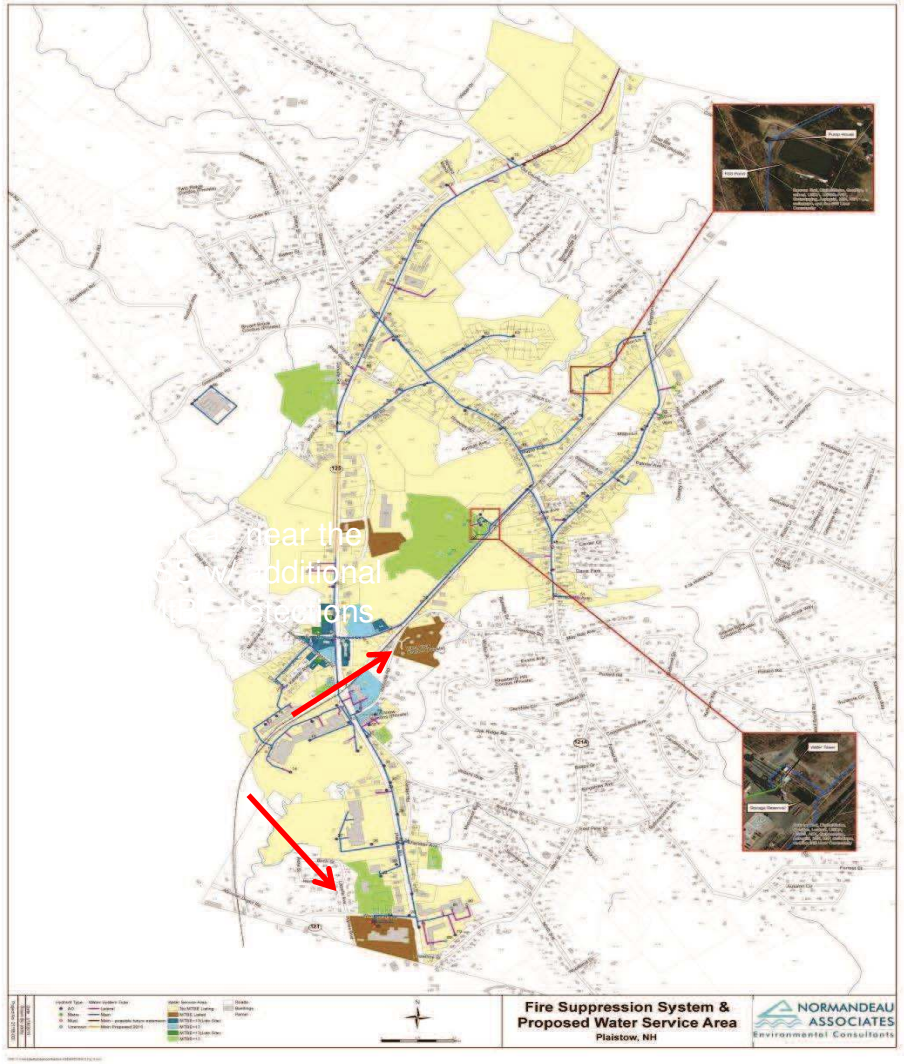
  - Address MtBE contamination of Salem's Turner Campbell water well aquifer
  - Address water supply contamination issues in Plaistow and Windham
  - Address current and future drinking water supply shortfalls in Salem, HAWC, Plaistow and Windham

MtBE Contamination at Salem Wells



Plaistow: Multiple MtBE Contamination Areas

FSS Water Service Area



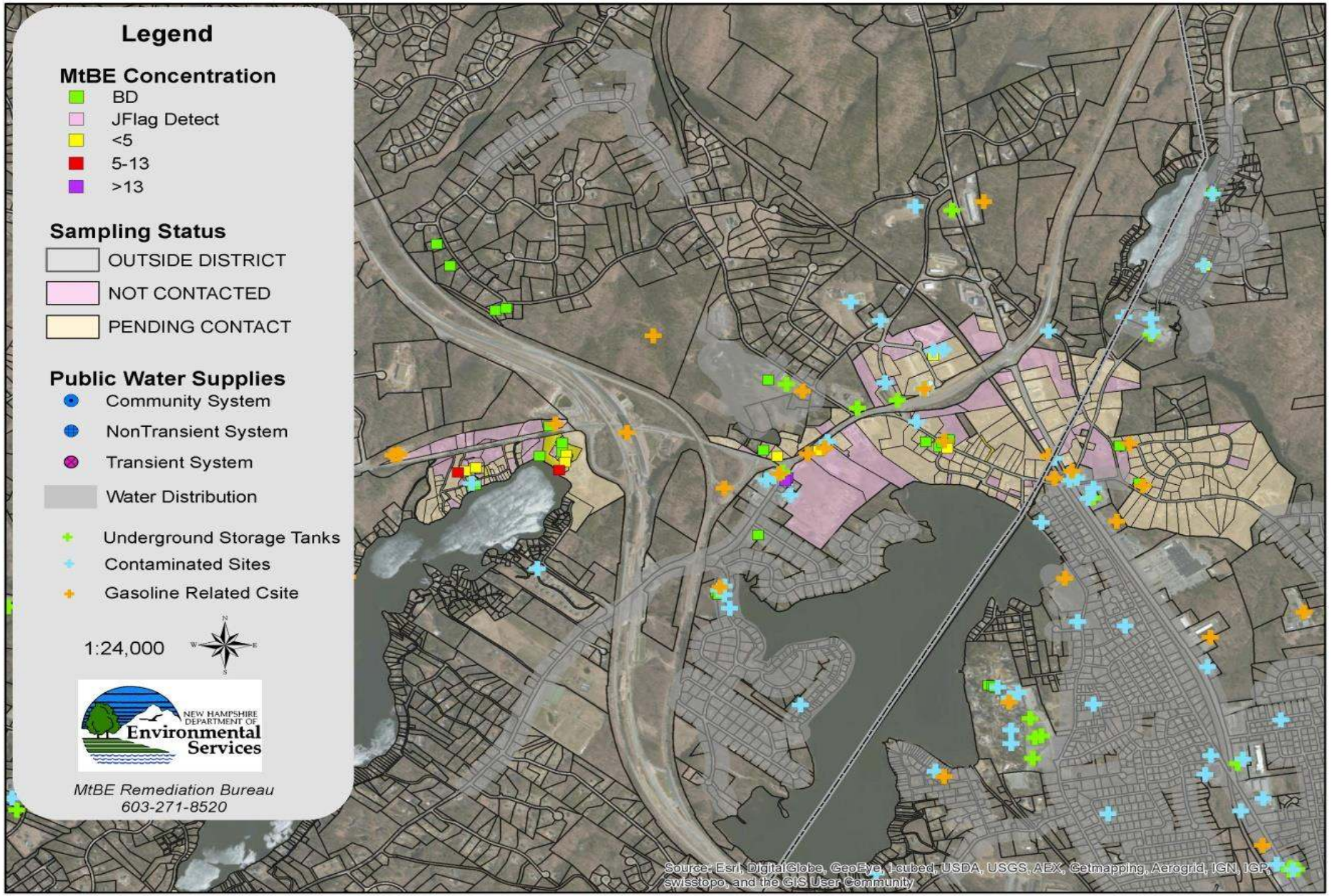
WSA includes 366 parcels

- Residential - 189
- Commercial - 115
- Industrial - 9
- Combined Mixed Uses - 5
- Others - 48

WSA includes 36 MtBE parcels

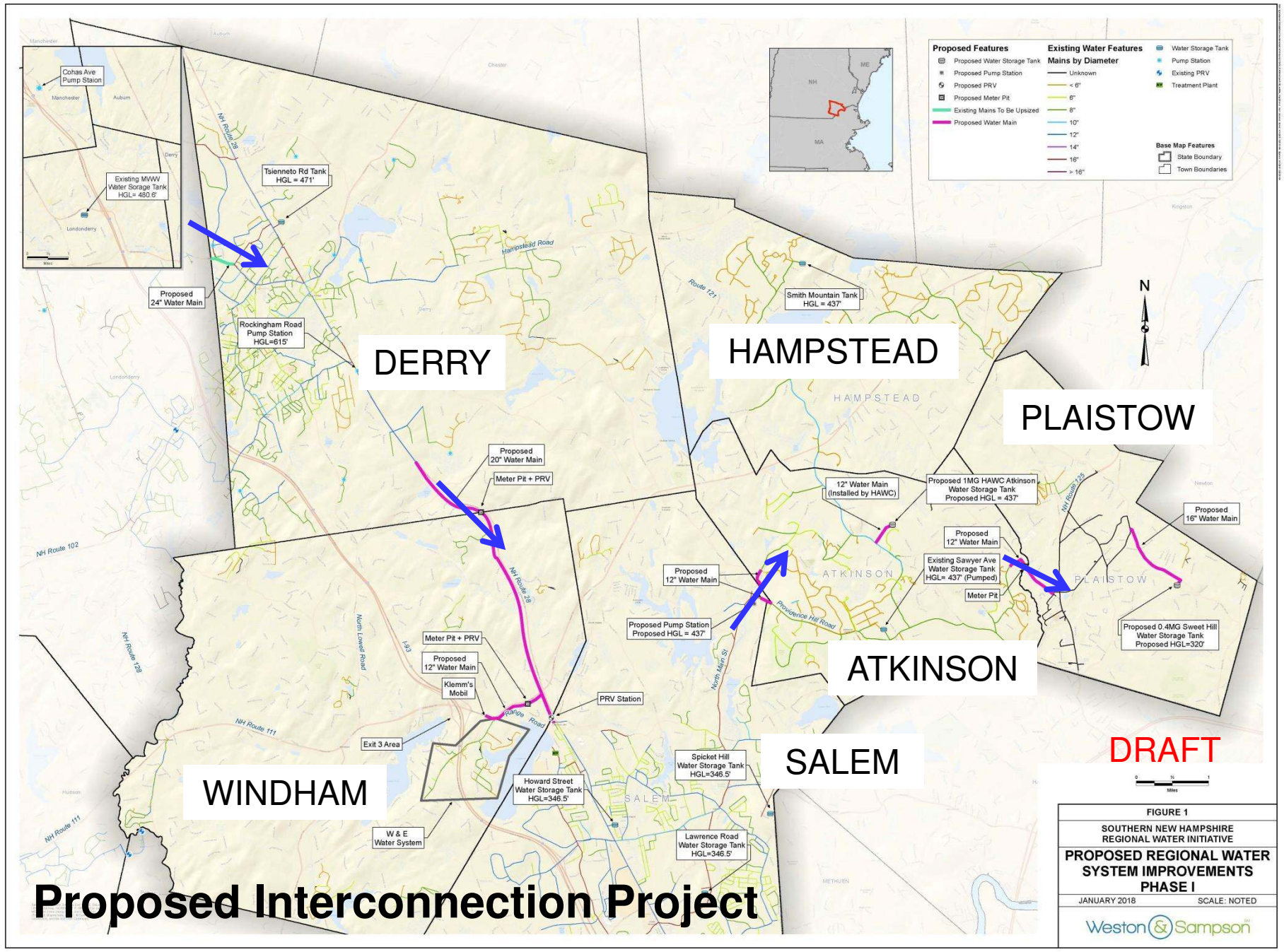
- Lido MtBE > 13 ppb - 9
- Lido MtBE < 13 ppb - 3
- Non Lido MtBE > 13 ppb - 7
- Non Lido MtBE < 13 ppb - 11
- Other Sites (no data) - 6

Windham Exit 3 Area (Klemm's Mobil)



Southern NH Project Strategy

- Manchester source water via Derry core system
- Interconnection from Derry to Salem
- Interconnection to Windham
- Interconnection to HAWC
- Interconnection to Plaistow
- Addition of water storage tanks to address hydraulics
- Mixed Funding


Proposed Features
Proposed Water Storage Tank
Proposed Pump Station
Proposed PRV
Proposed Meter Pit
Existing Mains To Be Upsized
Proposed Water Main
Existing Water Features
Mains by Diameter
Unknown
< 6"
6"
8"
10"
12"
14"
16"
> 16"
Water Storage Tank
Pump Station
Existing PRV
Treatment Plant
Base Map Features
State Boundary
Town Boundaries
Cohas Ave Pump Staion
Existing MWW Water Sorage Tank HGL= 480.6'
Tsienneto Rd Tank HGL = 471'
Proposed 24" Water Main
Rockingham Road Pump Station HGL=615'
DERRY
Smith Mountain Tank HGL = 437'
HAMPSTEAD
PLAISTOW
N
Proposed 20" Water Main
Meter Pit + PRV
12" Water Main (Installed by HAWC)
Proposed 1MG HAWC Atkinson Water Storage Tank Proposed HGL = 437'
Proposed 16" Water Main
Proposed 12" Water Main
Existing Sawyer Ave Water Storage Tank HGL= 437' (Pumped)
Meter Pit
Proposed 12" Water Main
Proposed Pump Station Proposed HGL = 437'
Proposed 0.4MG Sweet Hill Water Storage Tank Proposed HGL=320'
ATKINSON
Meter Pit + PRV
Proposed 12" Water Main
Klemm's Mobil
PRV Station
Exit 3 Area
WINDHAM
Howard Street Water Storage Tank HGL=346.5'
Spicket Hill Water Storage Tank HGL=346.5'
SALEM
W & E Water System
Lawrence Road Water Storage Tank HGL=346.5'
DRAFT
Proposed Interconnection Project
FIGURE 1
SOUTHERN NEW HAMPSHIRE REGIONAL WATER INITIATIVE
PROPOSED REGIONAL WATER SYSTEM IMPROVEMENTS PHASE I
JANUARY 2018
SCALE: NOTED
Weston & Sampson

Questions?

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(603) 271-8873
michael.juranty@des.nh.gov

MtBE Settlement Funds
https://www.des.nh.gov/organization/divisions/waste/mtbe/index.htm

Drinking Water and Groundwater Trust Fund
https://www4.des.state.nh.us/nh-dwg-trust/