

# Conceptual Site Model Development and Environmental Molecular Diagnostics Use for PlumeStop<sup>®</sup> Liquid Activated Carbon<sup>™</sup> Application at a Trichlorofluoromethane Groundwater Plume

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Environmental Technologies

Battelle 2019 Bioremediation Symposium

Baltimore, MD

April 17, 2019



Antea Group

Understanding today.  
Improving tomorrow.

# Site Setting



50 Acre Manufacturing Facility In North Carolina Since 1960's

Remediation Since 1992; Antea Group Active Since 2007

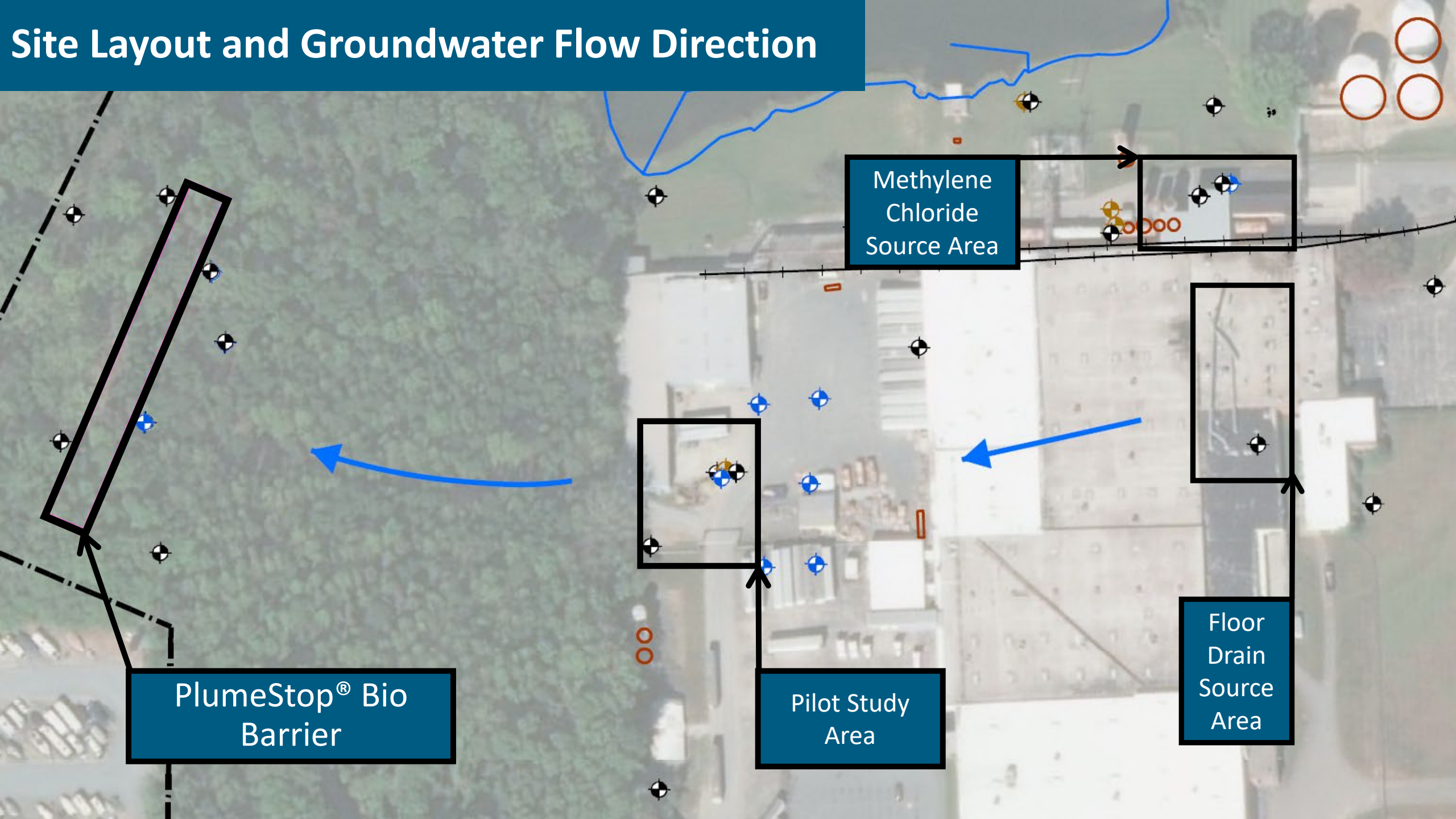
2 Source Areas: 1. Methylene Chloride, 2. Floor Drains Inside (ongoing)

Piedmont Geology & Hydrogeology—Remediation Focused on TZ

Large Dissolved VOC Plume – 1,200 ft

Mass Flux Estimated At 210 kg/year

# Site Layout and Groundwater Flow Direction



Methylene Chloride Source Area

Floor Drain Source Area

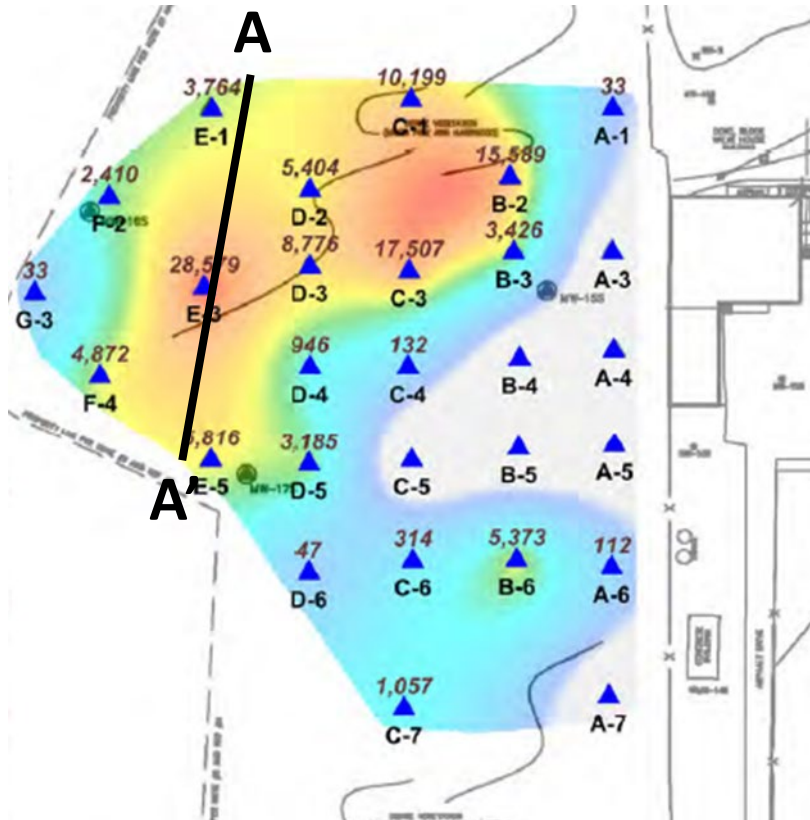
Floor Drain Source Area

Pilot Study Area

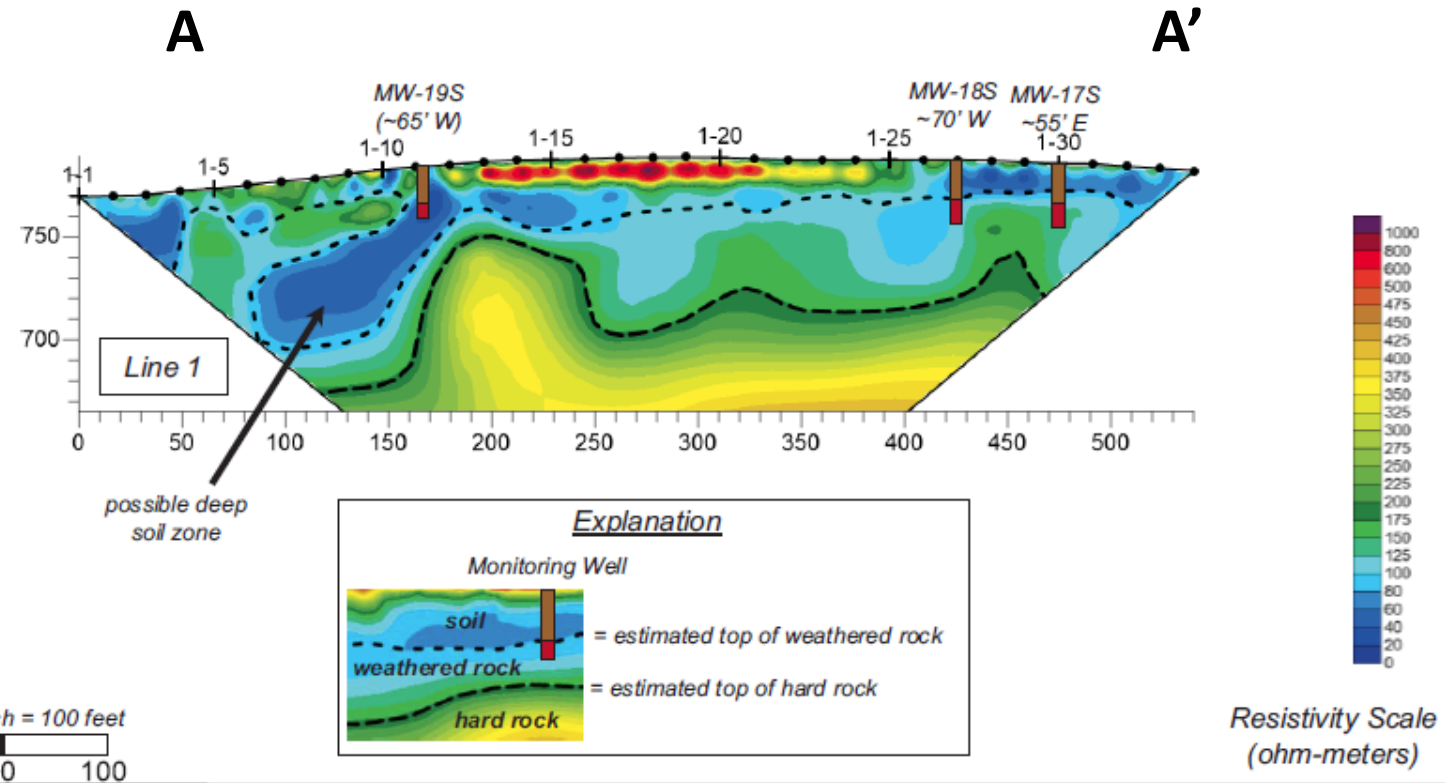
PlumeStop® Bio Barrier

# Pre-Remedial Design Investigation

## Passive Soil Gas Survey



## Surface Resistivity Survey



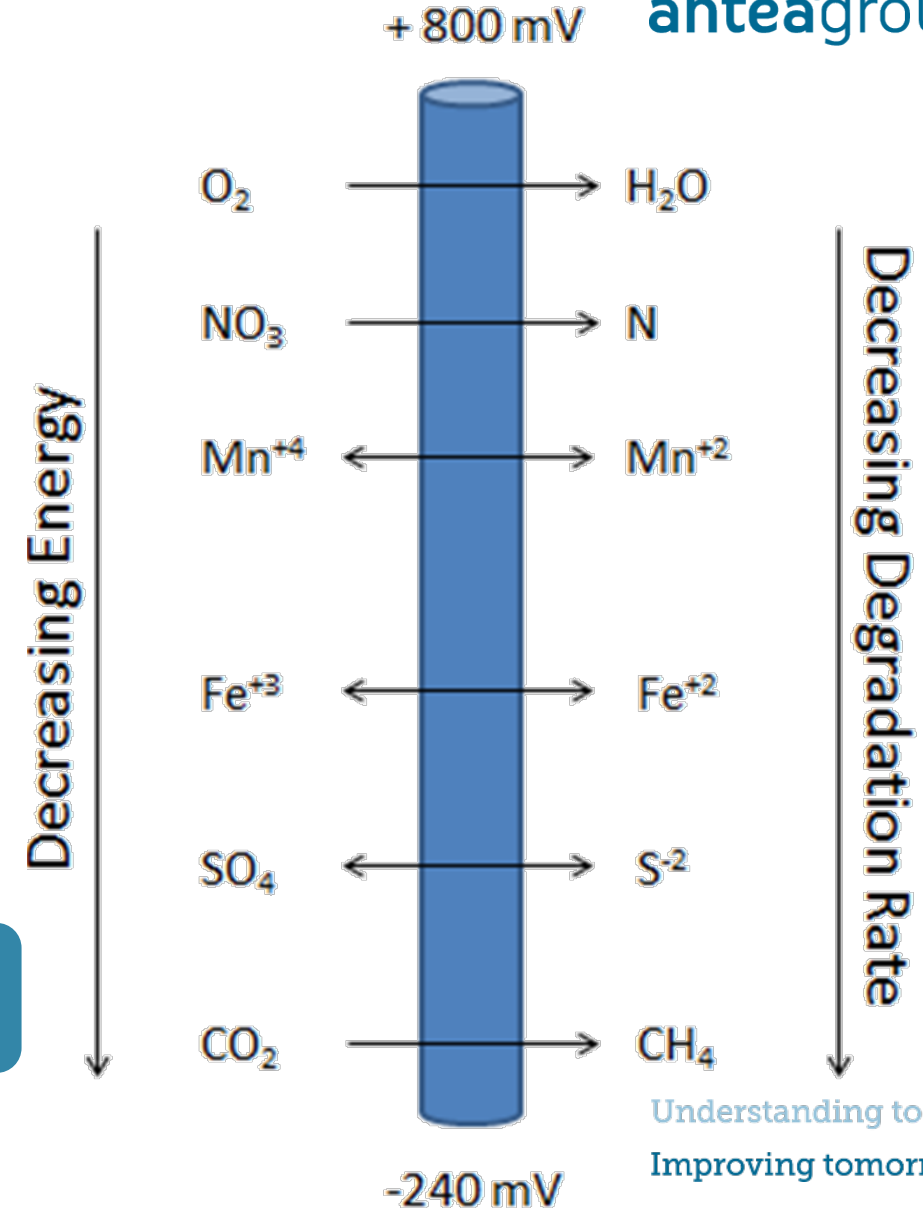
# What Geochem Data Can Tell You



antea<sup>g</sup>roup



- Where the site is on the REDOX ladder
- What microbial populations are likely dominating
- If one or more parameter excessive/outside the norm
- Aids in the refinement of the CSM
- Critical to troubleshooting poorly performing sites



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# Pilot Study

- Pilot study using DPT
  - 3,600 lbs. PlumeStop<sup>®</sup>
  - 330 lbs. HRC<sup>®</sup>
  - Design verification
    - Soil VOC data
    - Groundwater data
    - Soil geotechnical data
- One year monitoring, per NCDEQ
- State-wide use of PlumeStop<sup>®</sup> approved
- Final Design



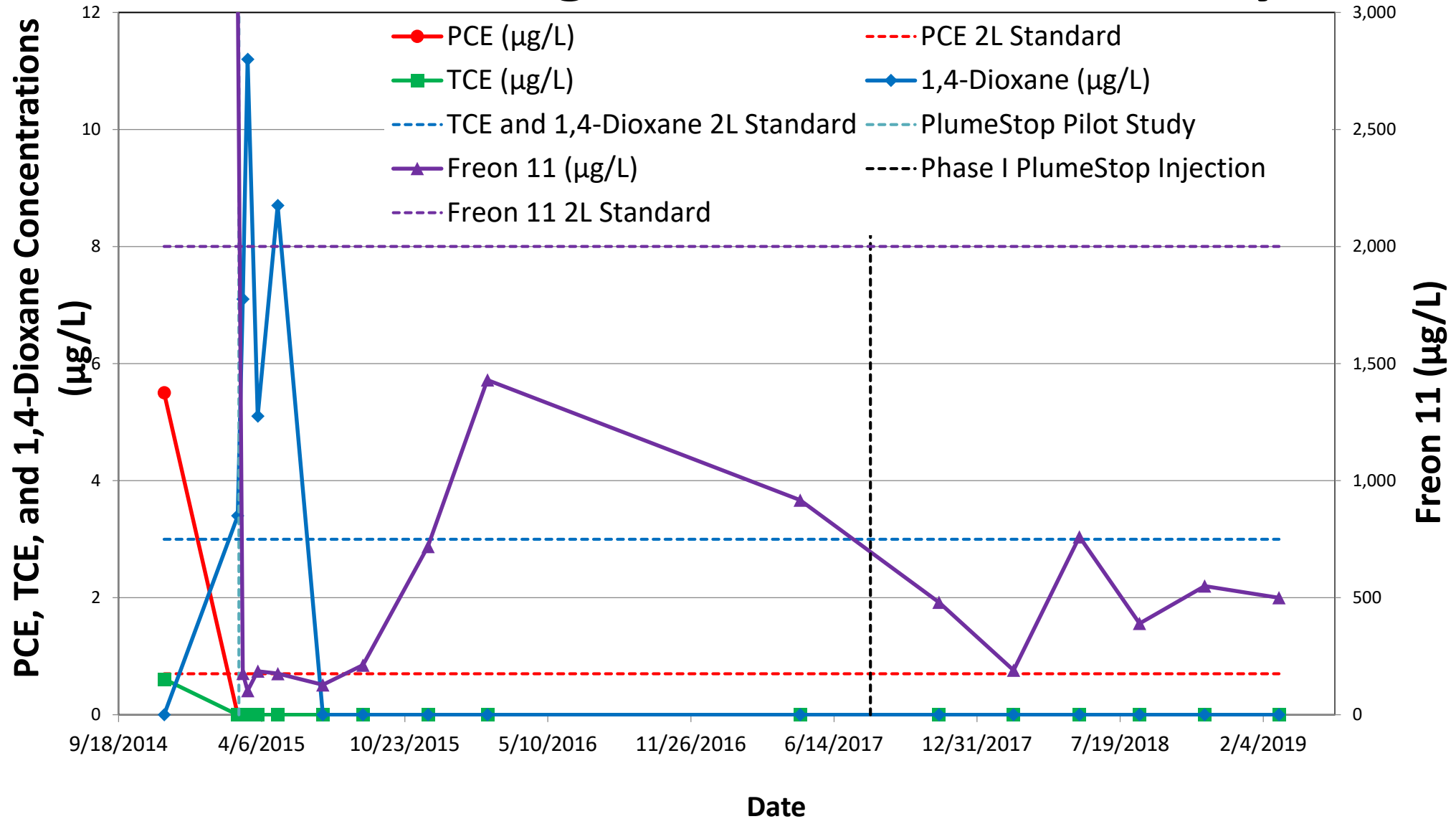
**PLUME STOP**<sup>®</sup>  
Liquid Activated Carbon

**HRC-X**<sup>®</sup>  
EXTENDED  
HYDROGEN  
RELEASE  
COMPOUND



# Results: Post-Injection Pilot Study Data

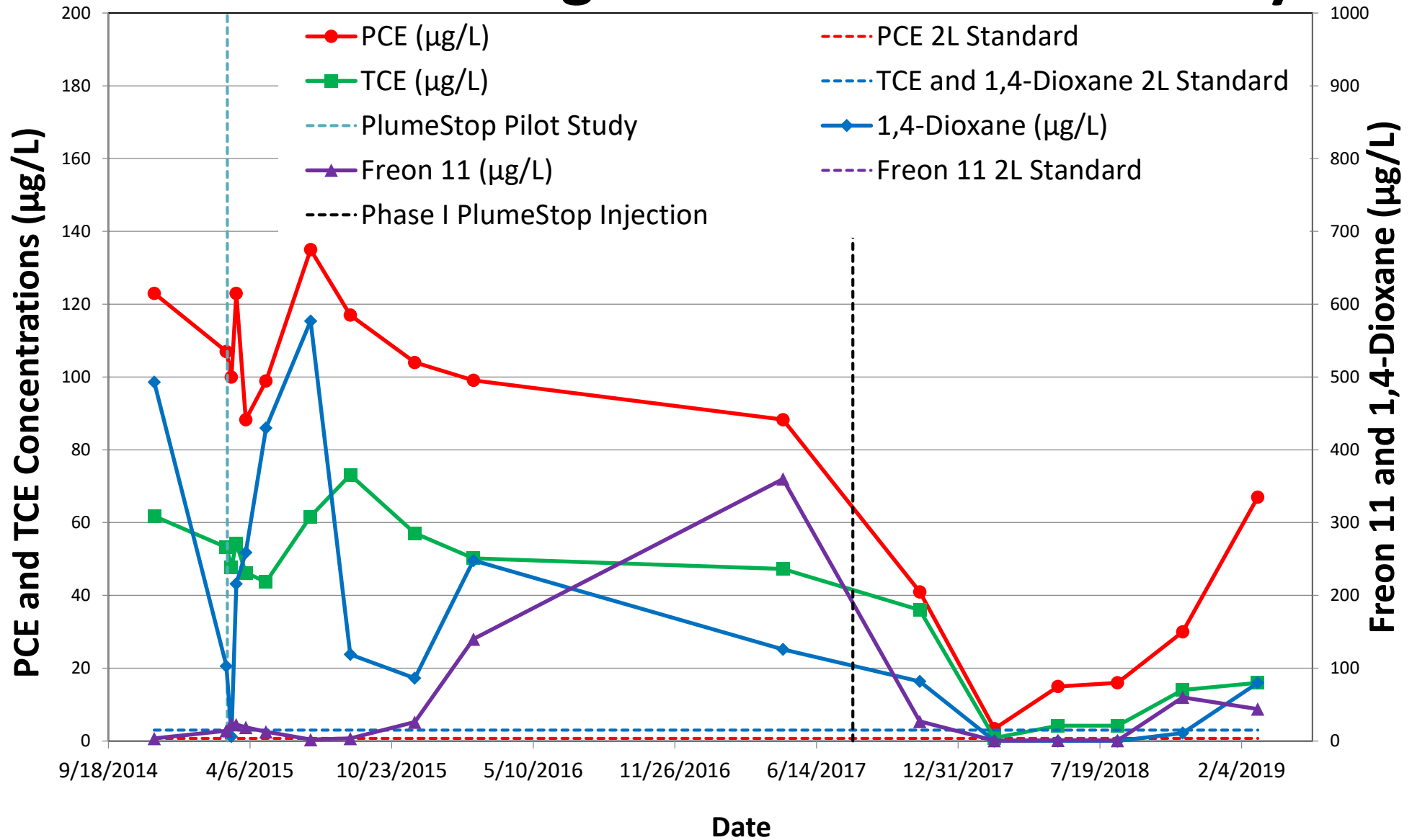
## 15 Feet Downgradient From Pilot Study





# Results: Post-Injection Pilot Study Data

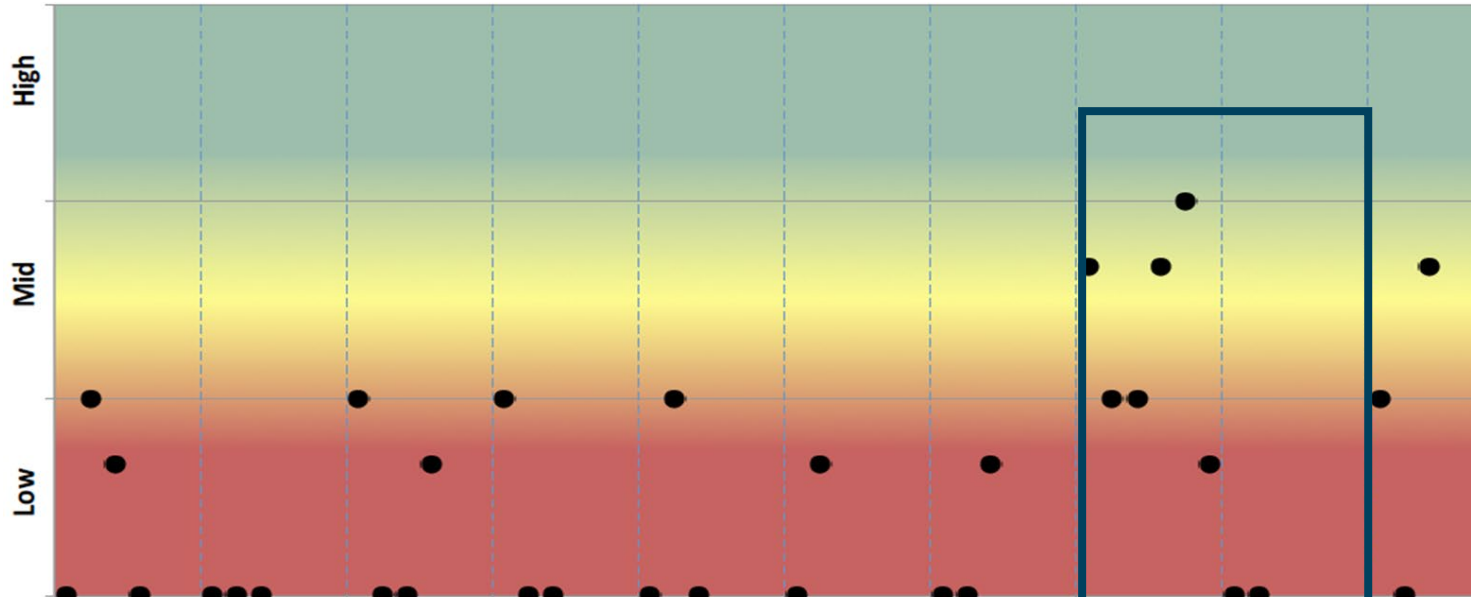
## 100 Feet Downgradient From Pilot Study



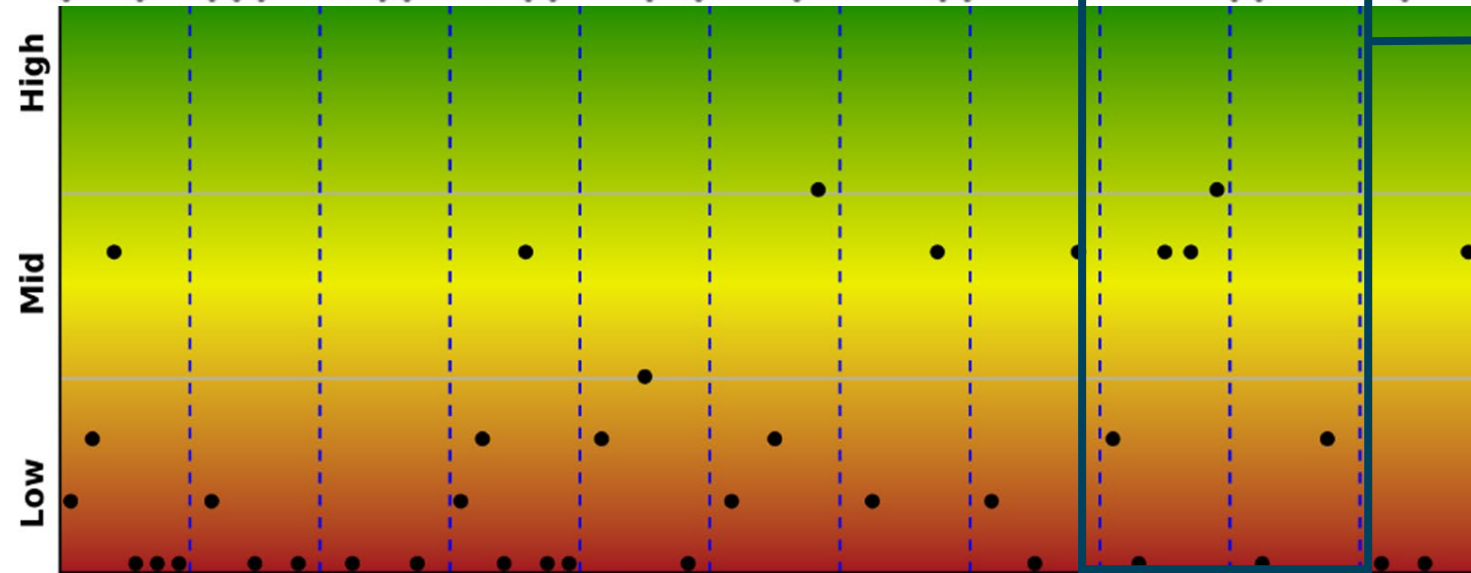
# QuantArray-Chlor



MW-12S  
December  
2014  
(pre-pilot study)



MW-12S  
September  
2018

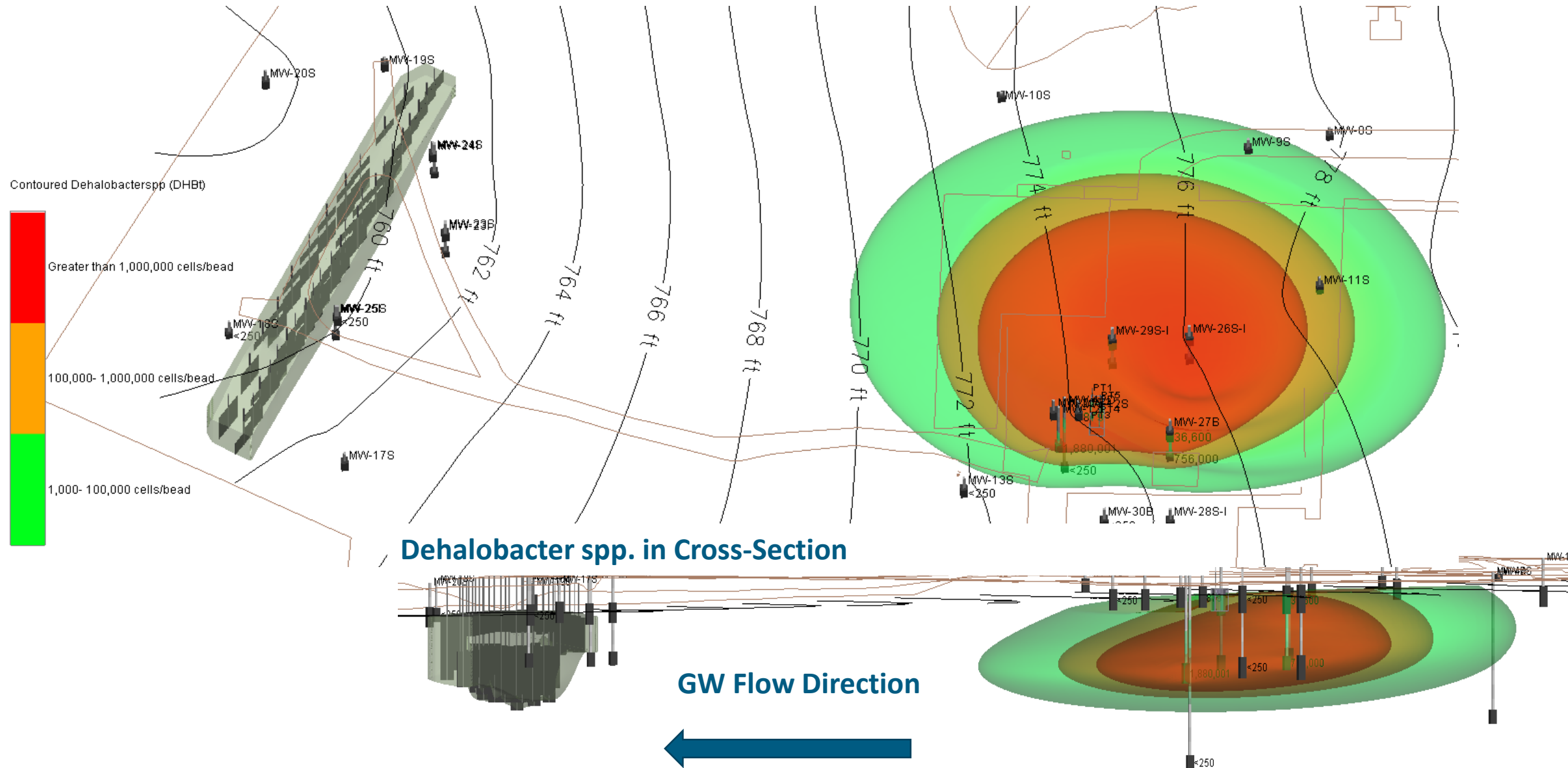


Aerobic  
(co)metabolic  
species



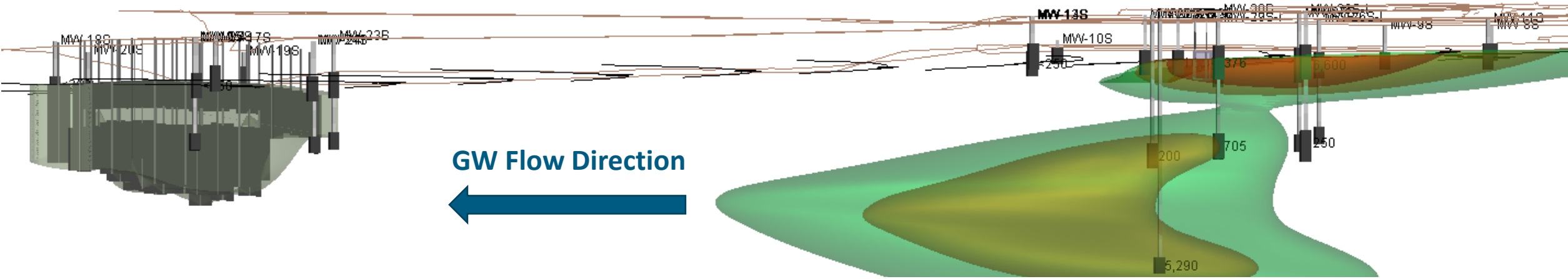
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# Dehalobacter spp.

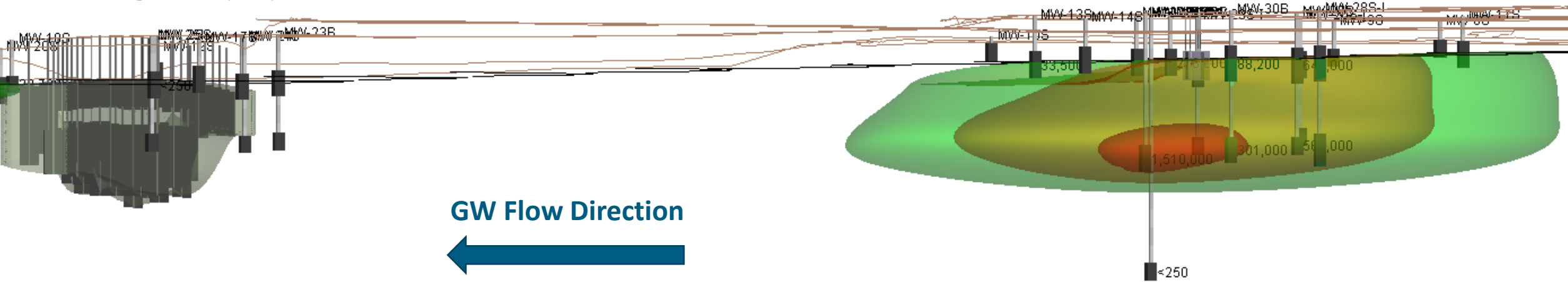


# Microbial Community Cross-Section

Desulfitobacterium spp (DSB) above cells/bead

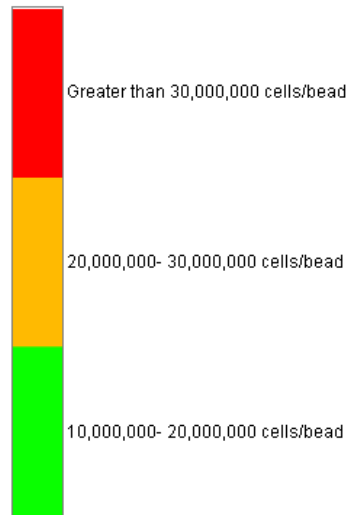
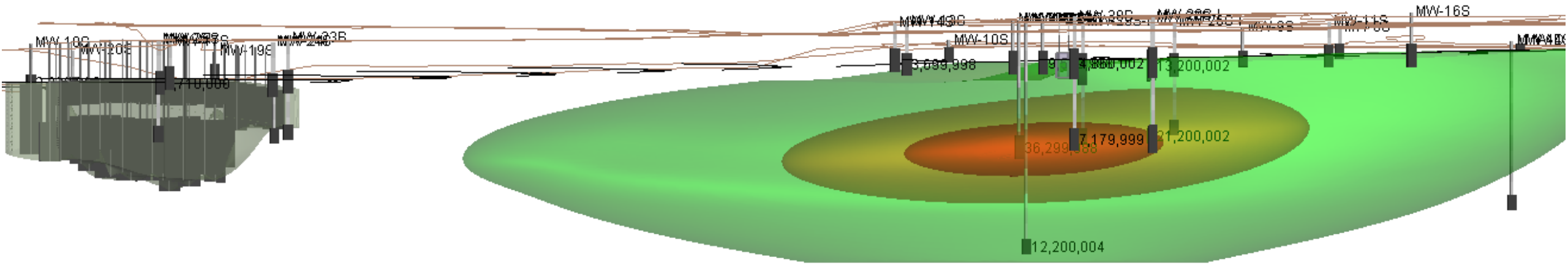


Sulfate Reducing Bacteria (APS) above cells/bead



# Total Eubacteria – Phase 2 Area

Total Eubacteria (EBAC) above cells/bead



GW Flow Direction

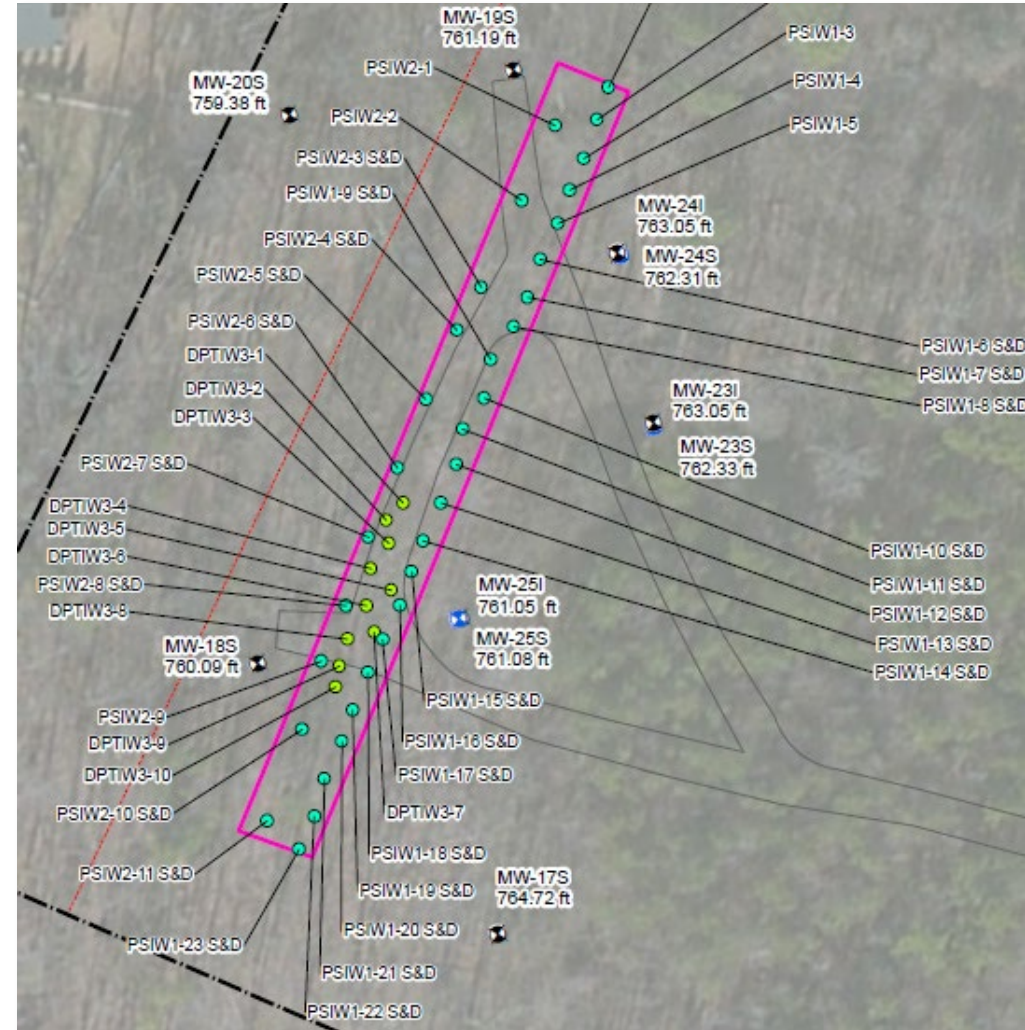




# Full Scale Phase 1 PlumeStop®



- Largest PlumeStop® application for Freon 11 plume in the world
- 32,400 lbs. PlumeStop® applied into injection wells
- 5,700 lbs. PlumeStop® applied by DPT
- 5,400 lbs. HRC-X®
- 5,400 lbs. HRC Primer®
- 33 injection well locations
- 10 DPT locations

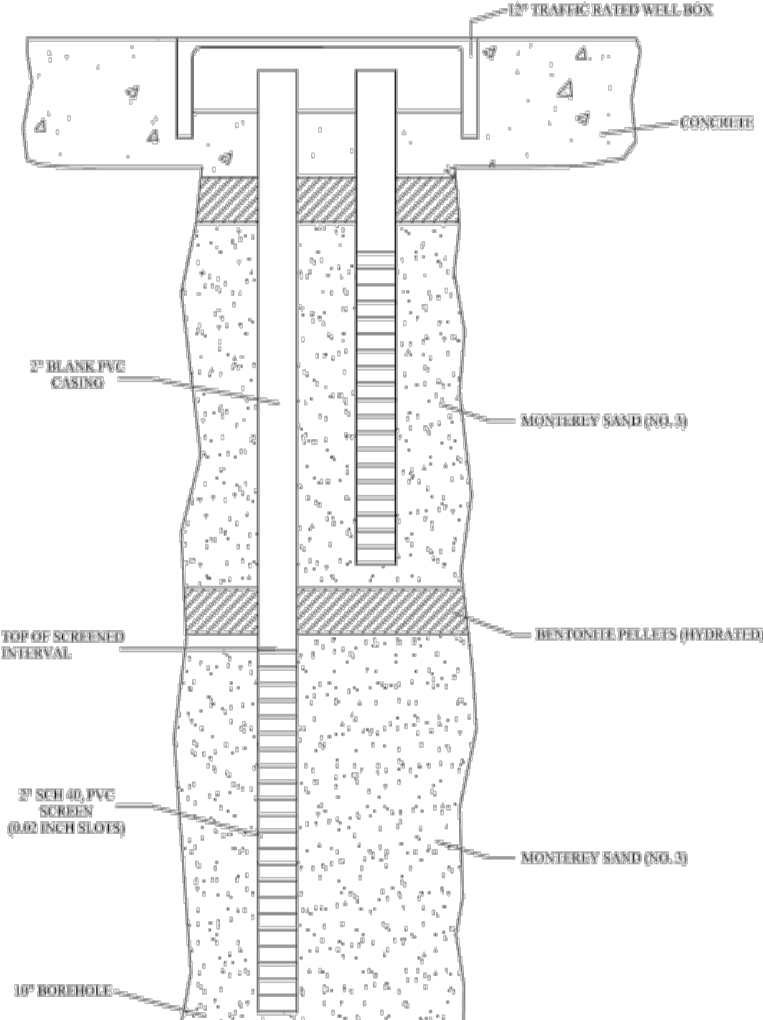


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# The Chemistry - Tools



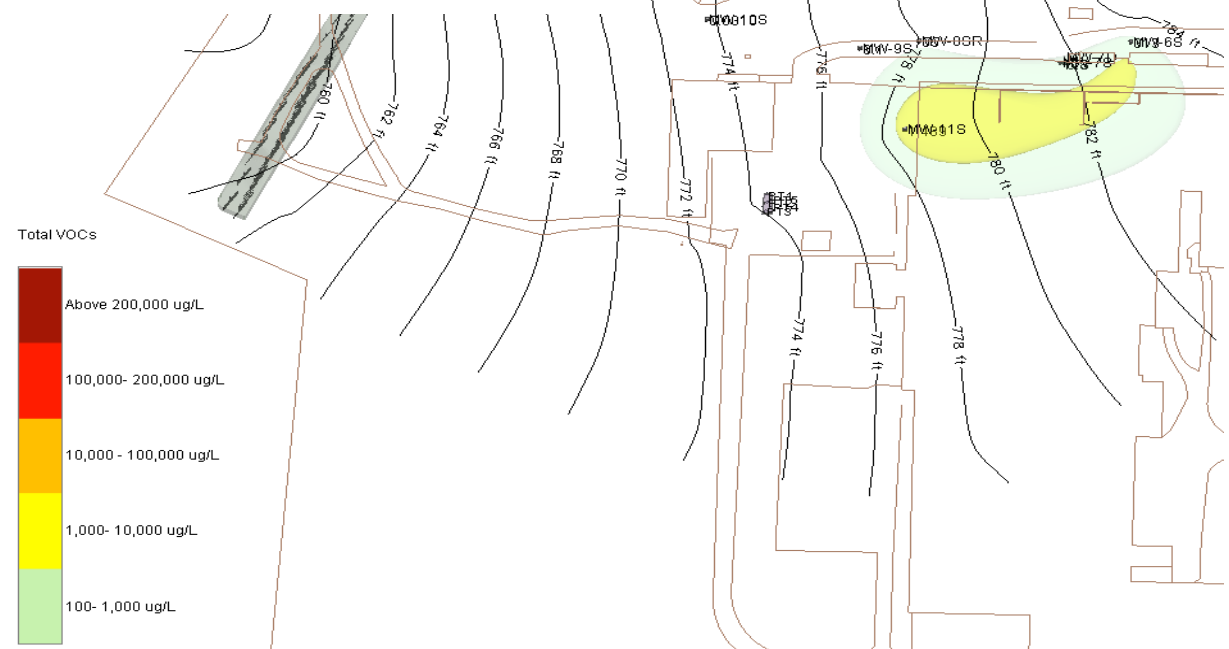
Nested Well Construction Details



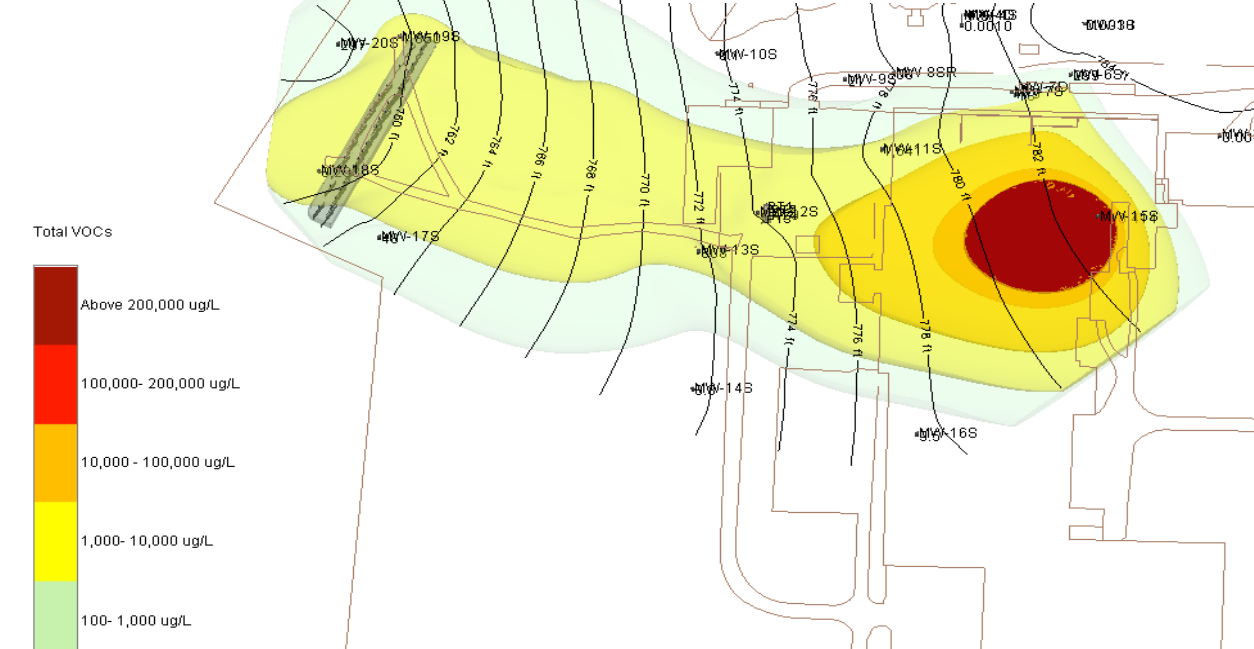
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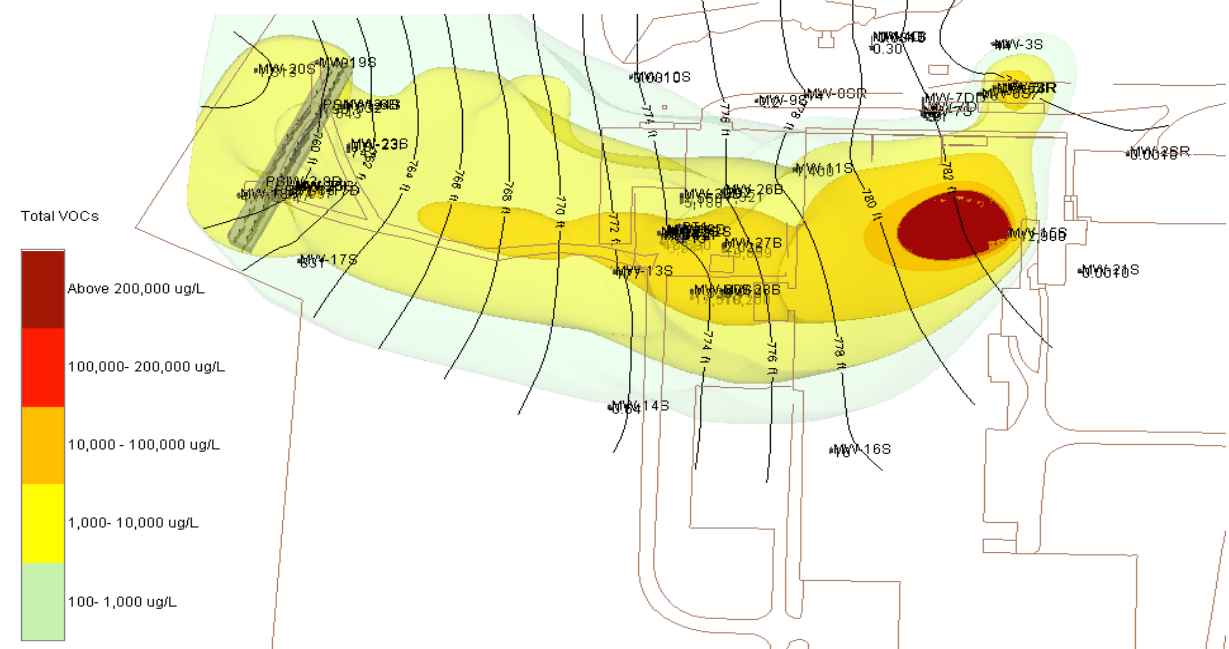
# Total VOCs October 2012



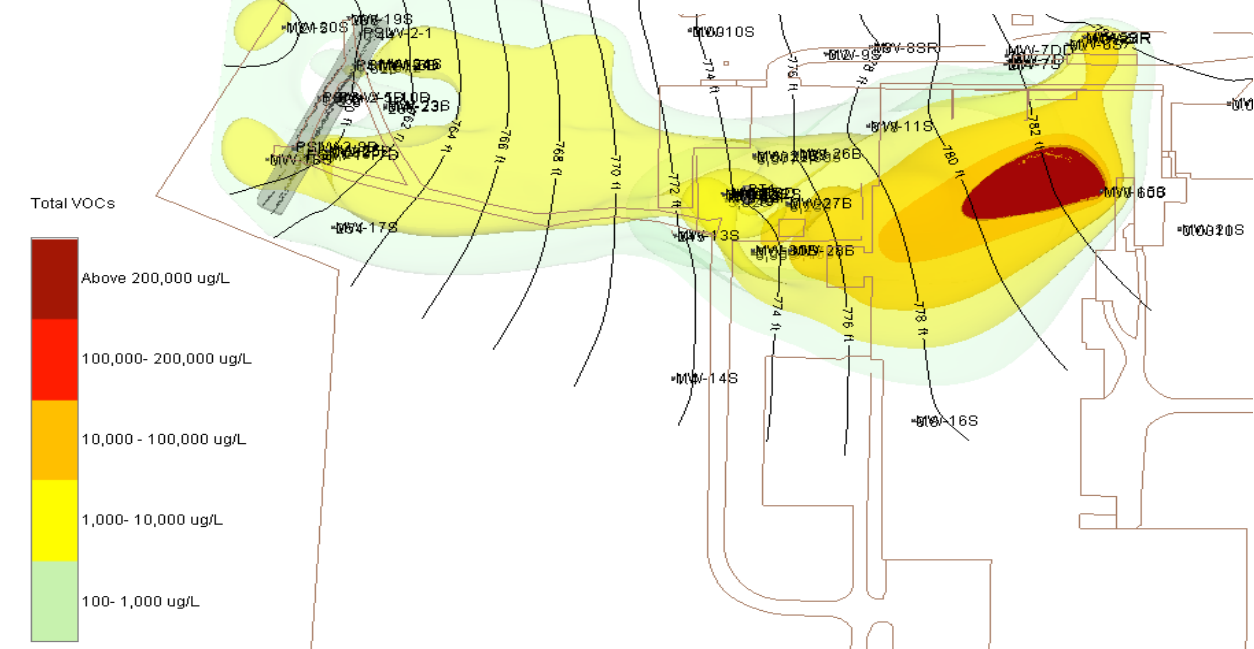
# Total VOCs November 2014



# Total VOCs November 2018

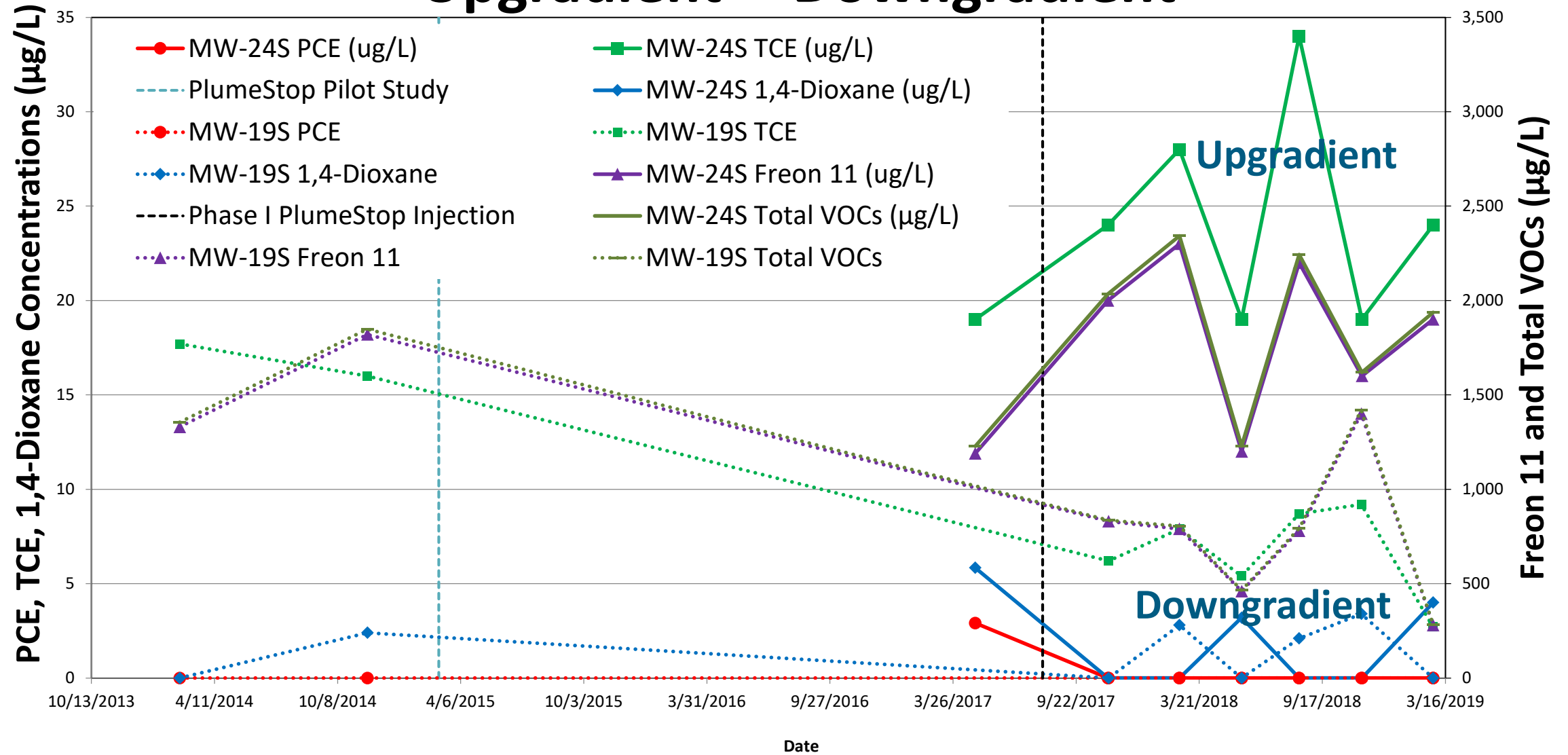


# Total VOCs February 2019



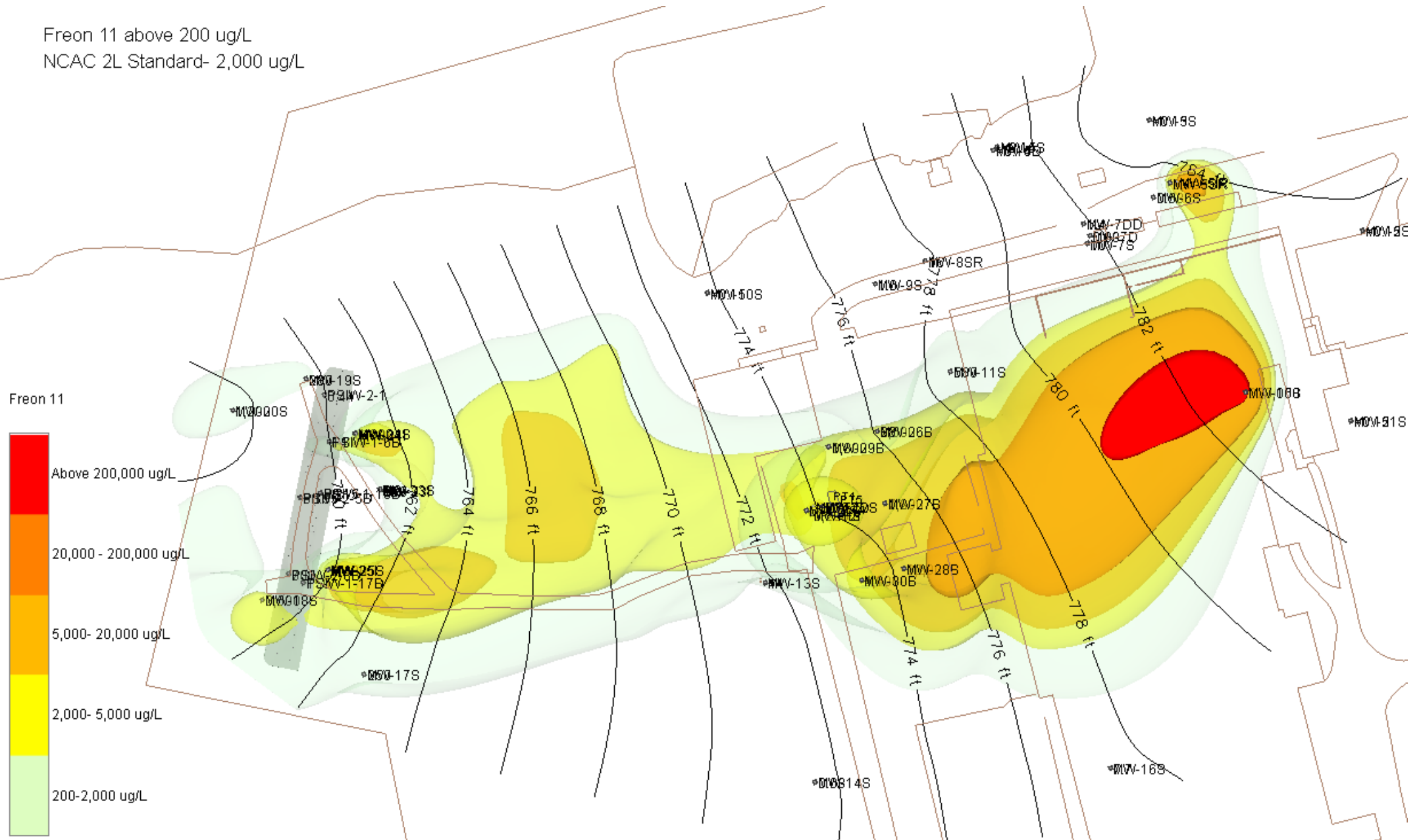
# Results – Post Injection Barrier Area

## Upgradient -- Downgradient



# Groundwater Plume Visualization-Freon 11

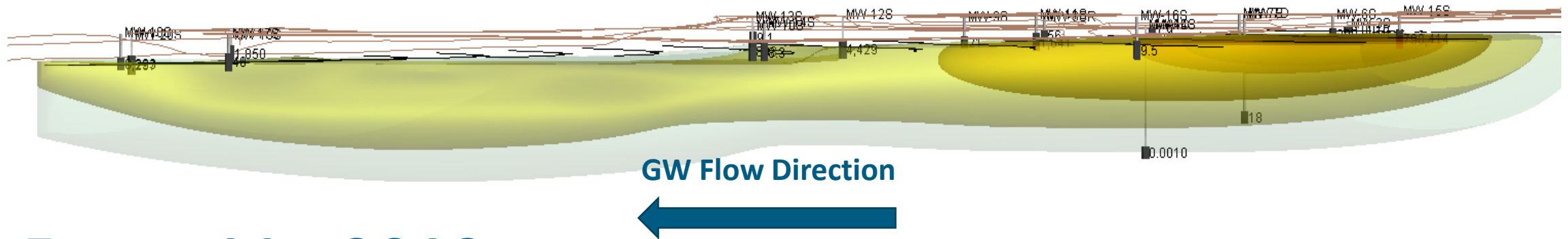
Freon 11 above 200 ug/L  
NCAC 2L Standard- 2,000 ug/L



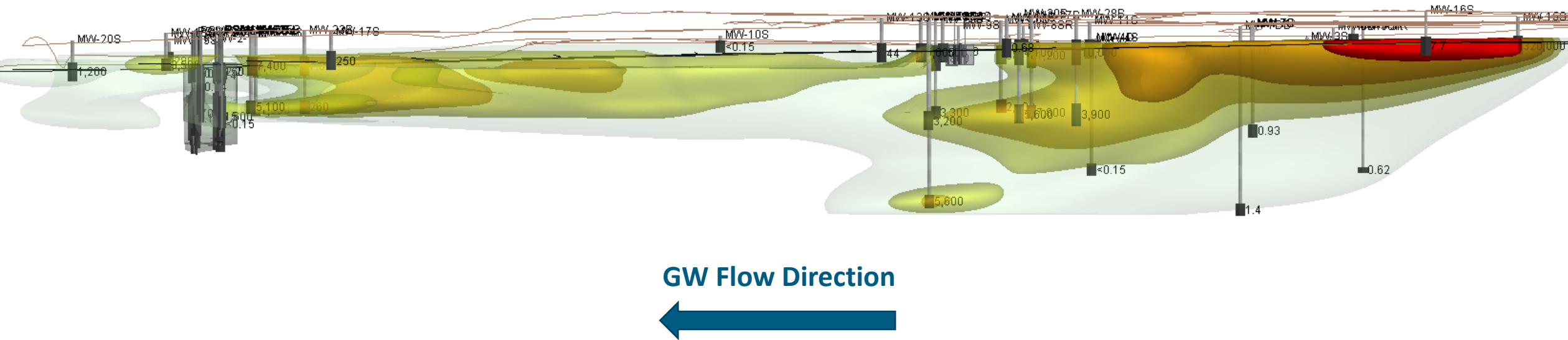


# 3D Cross Sections

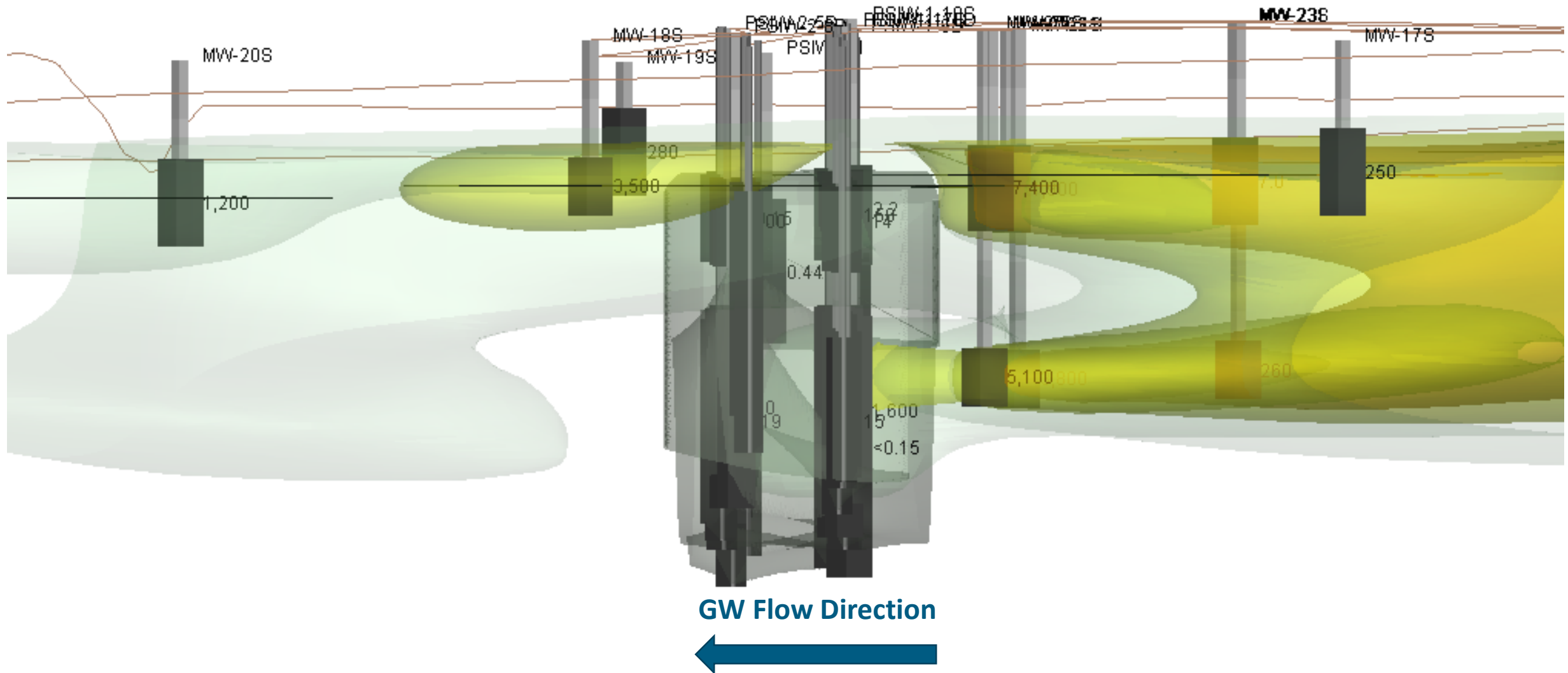
## Total VOCs - 2014



## Freon 11 - 2019



# Freon 11 Cross Section – February 2019



# Summary



Robust data collection is needed

Data collection during RI pays off in the long run



Consider all the tools available for use

Performance monitoring is key



Field awareness keeps everyone safe

Preparedness improves project quality



Remedial design leads to surgical placement

Consider options that yield results and save funds

# Thank You



If you don't have time to do it right the *first* time, what makes you think you'll have time (and resources) to do it right the *second* time?

We do more than effectively solve client challenges; we deliver sustainable results for a better future.



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