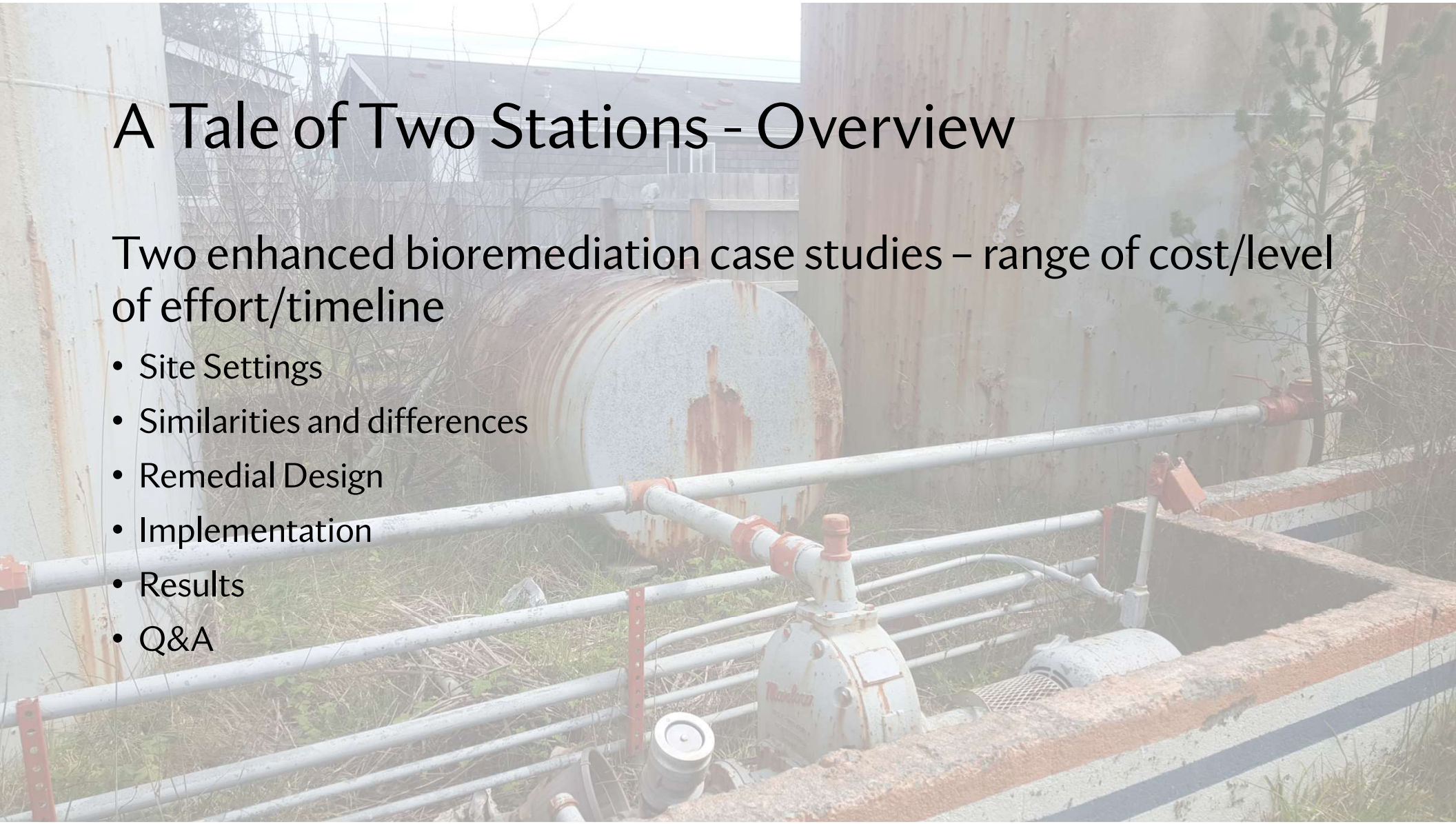
A Tale of Two Stations

Enhanced Bioremediation Case Studies

Paula Parrott, RG

Parrott Environmental Consulting, LLC



A Tale of Two Stations - Overview

Two enhanced bioremediation case studies – range of cost/level of effort/timeline

- Site Settings
- Similarities and differences
- Remedial Design
- Implementation
- Results
- Q&A

Site A Background – Site Setting

- Site A in Washington on Long Beach Peninsula between Pacific Ocean and Willapa Bay
- Shallow groundwater – 1-5 feet bgs
- Sandy soil
- Located near or potentially on top of groundwater divide
- Tidal influence
- 10-inch diameter municipal sanitary sewer near rear property
- Close adjacent residential structures

Site A Background – Site History

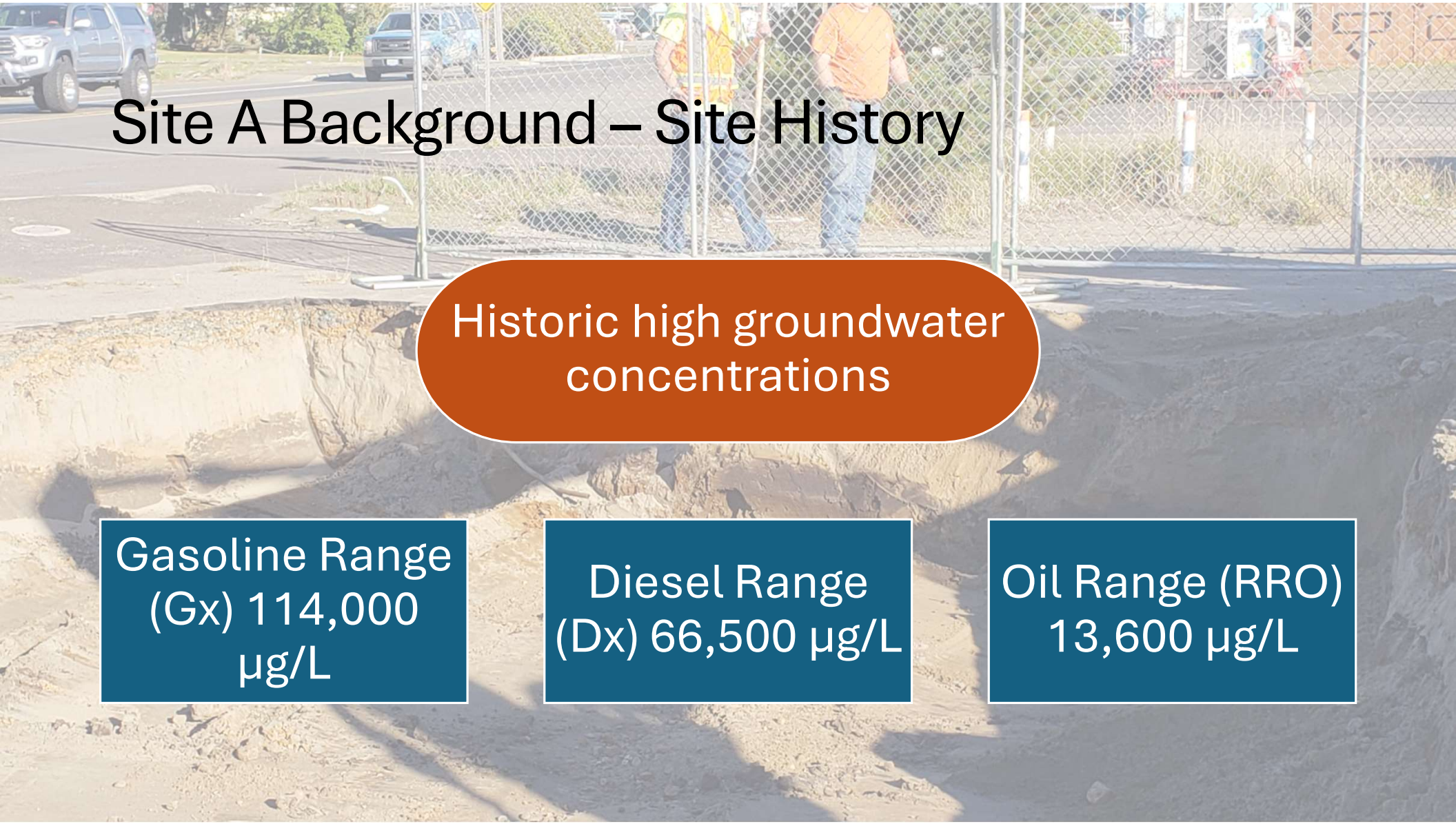
- Gas station operational until 1990s
- Anecdotal evidence of multiple surface spills
- 6 ASTs and 3 USTs
- 3 USTs and 1 AST decommissioned in 1999 and fuel dispensers removed
- Station building, 5 ASTs, concrete containment structure, piping, product lines and fuel island removed in 2017

Site A Background – Site History

- Leaking from ASTs, USTs and surface spills meant a LOT of contaminant mass in the subsurface
- Over 860 tons of PCS removed from the site
- Soil removal limited by
  - shallow groundwater,
  - roadway,
  - Utilities

  Excavation confirmation samples NOT clean

Site A Background – Site History



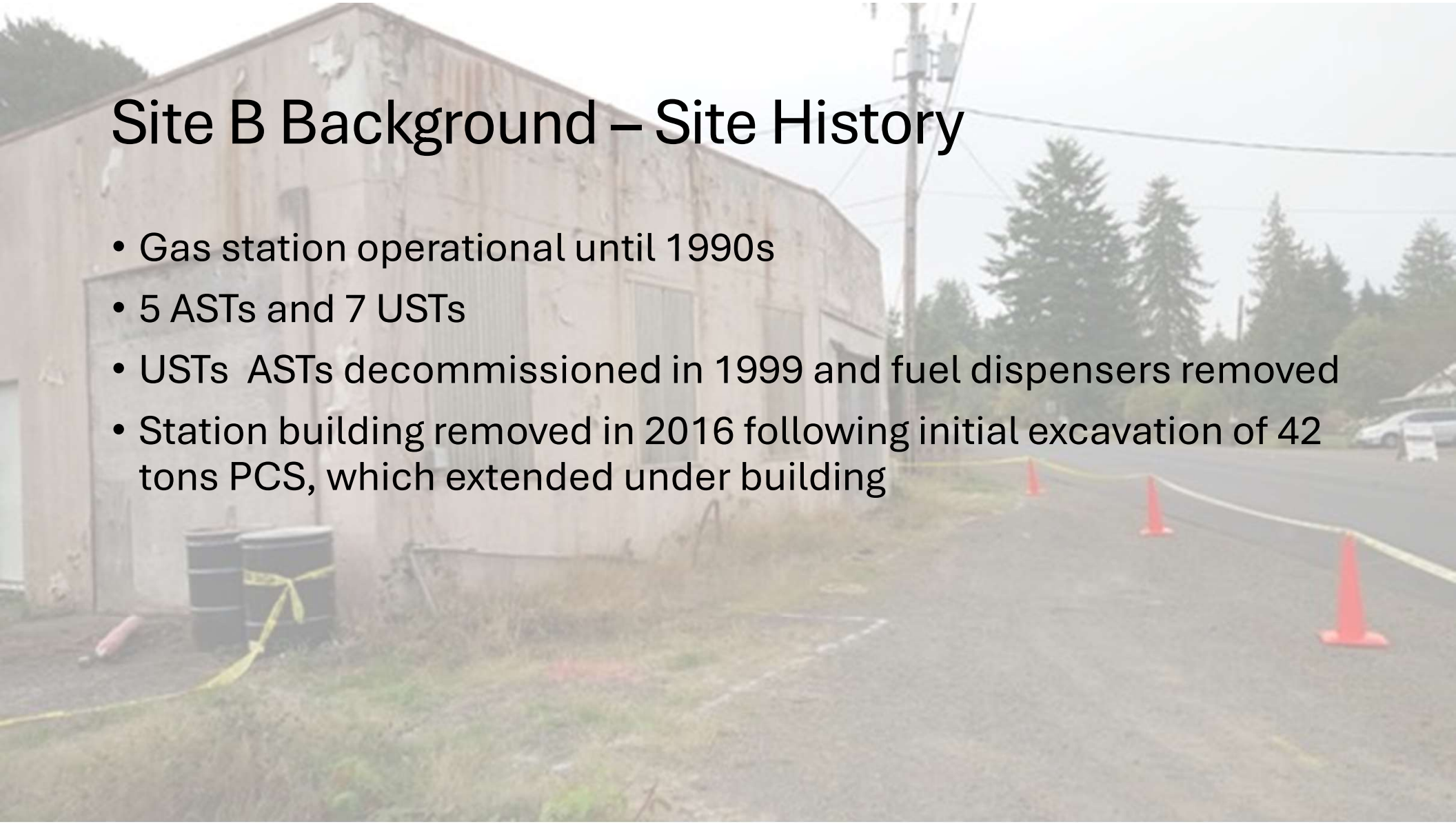
Historic high groundwater concentrations

Gasoline Range (Gx) 114,000 µg/L	Diesel Range (Dx) 66,500 µg/L	Oil Range (RRO) 13,600 µg/L

Site B Background – Site Setting

- Site B within Coast Range in Oregon
- Shallow groundwater – 5-10 feet bgs (more vadose zone)
- Silty soil with clay at depth (15 ft)
- Close adjacent residential structures

Site B Background – Site History



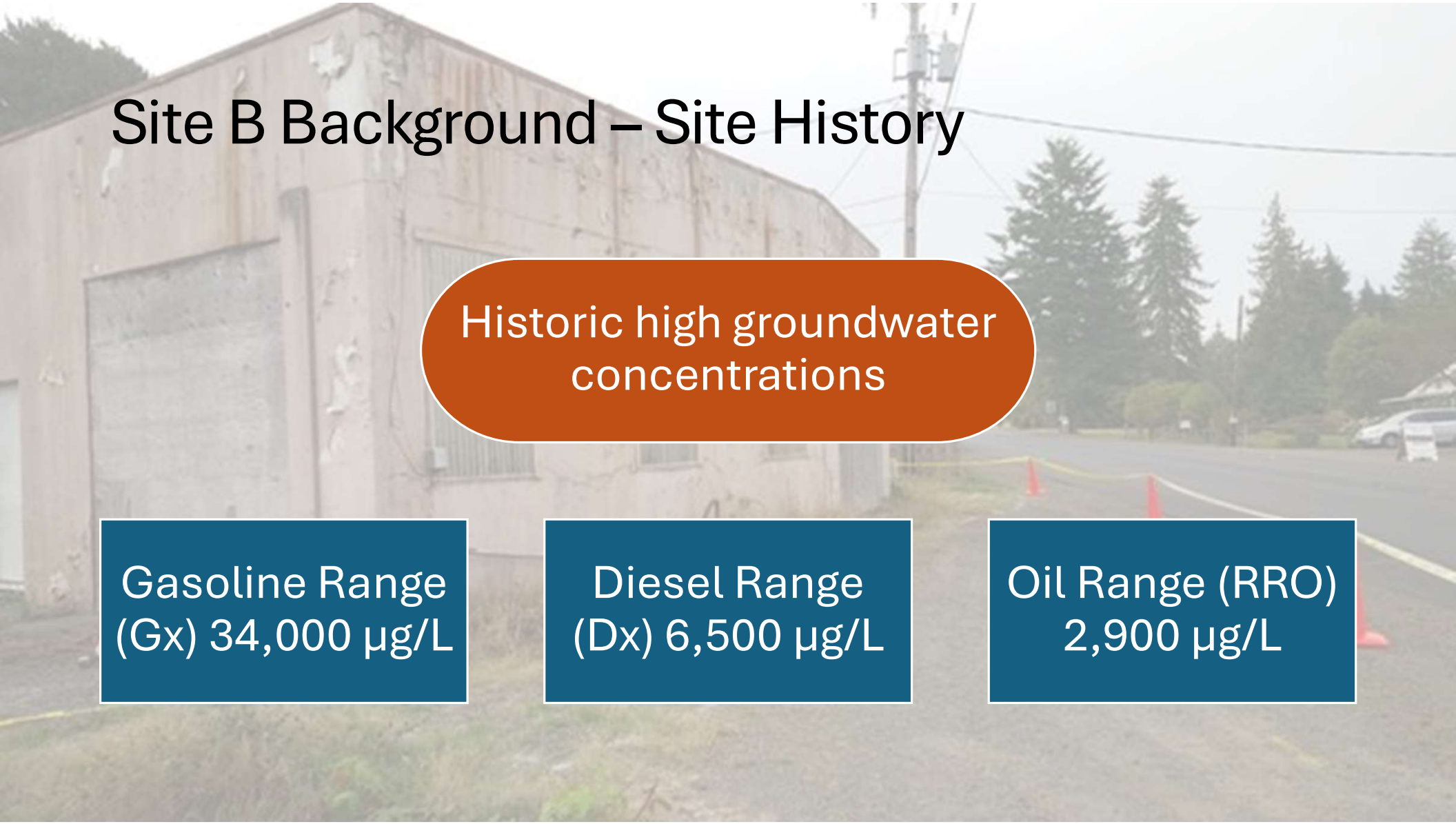
- Gas station operational until 1990s
- 5 ASTs and 7 USTs
- USTs ASTs decommissioned in 1999 and fuel dispensers removed
- Station building removed in 2016 following initial excavation of 42 tons PCS, which extended under building

Site B Background – Site History

- Leaking from ASTs and USTs mainly along western side of building
- Approximately 86 tons of PCS removed from the site
- Soil removal not limited by
  - shallow groundwater,
  - roadway,
  - Utilities

  Excavation confirmation samples clean

Site B Background – Site History



Historic high groundwater concentrations

Gasoline Range (Gx) 34,000 µg/L

Diesel Range (Dx) 6,500 µg/L

Oil Range (RRO) 2,900 µg/L

Site Similarities

Buildings able to be removed and at least some soil source removed

No vapor intrusion issues

Groundwater not used for drinking

Relatively shallow groundwater

Site Differences

Site A	Site B
Sandy soil	Silty soil
Significant source remaining	Source generally removed
Much higher GW concentrations	Lower GW concentrations
Washington MTCA	Oregon RBCs

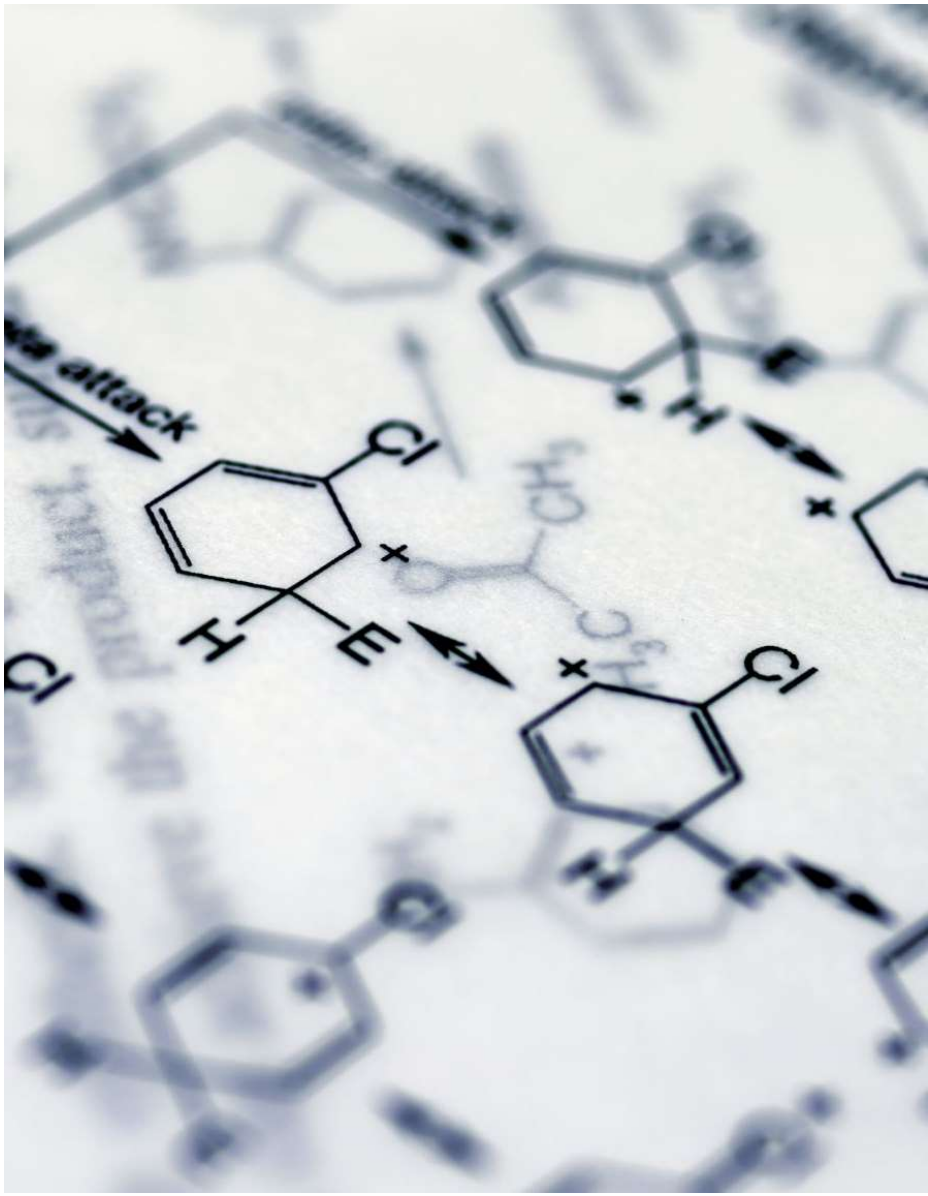
Site Differences – Regulatory Framework

WA Model Toxics Control Act	OR Risk-Based Concentrations
Considers all GW "Water of the State" = Drinking Water	Cleanup levels based on calculated risk factors and use scenarios
Method A - Default	Oregon RBCs – Construction/Excavation Worker
GRO: 800 µg/L	GRO: 4500 µg/L
DRO: 500 µg/L	DRO: 4600 µg/L

Design/Implementation – Bioremediation Elements

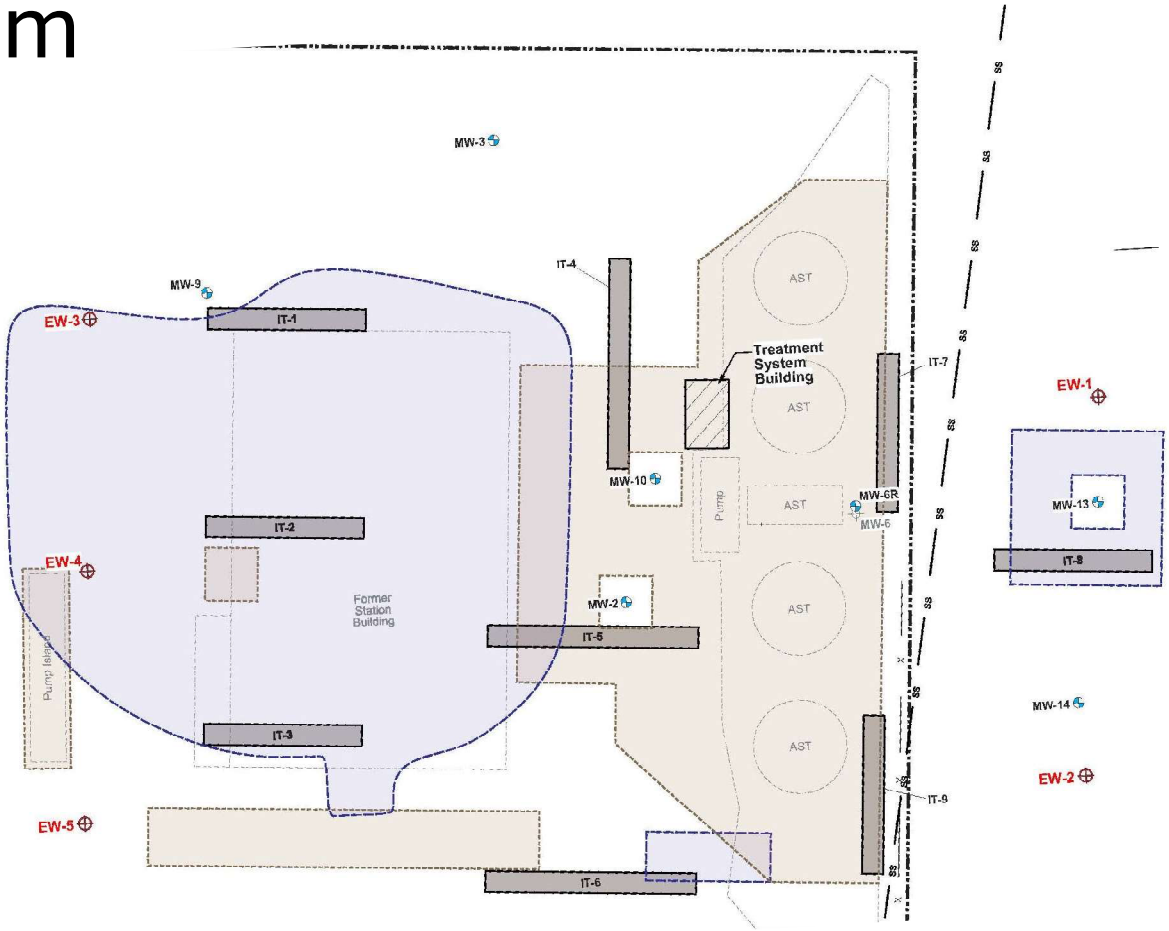
We utilized the following ETEC products:

- CBN nutrients
- EZT-EA™ Enzyme Accelerator
- EZT-A2™ TPH Bacterial Consortium
- PetroSolv™ Biosurfactant
- FeSolv™ – Controls mineral and hardness scaling
- DO-IT™ System equipped with Super-Ox™ Dissolved Oxygen generator



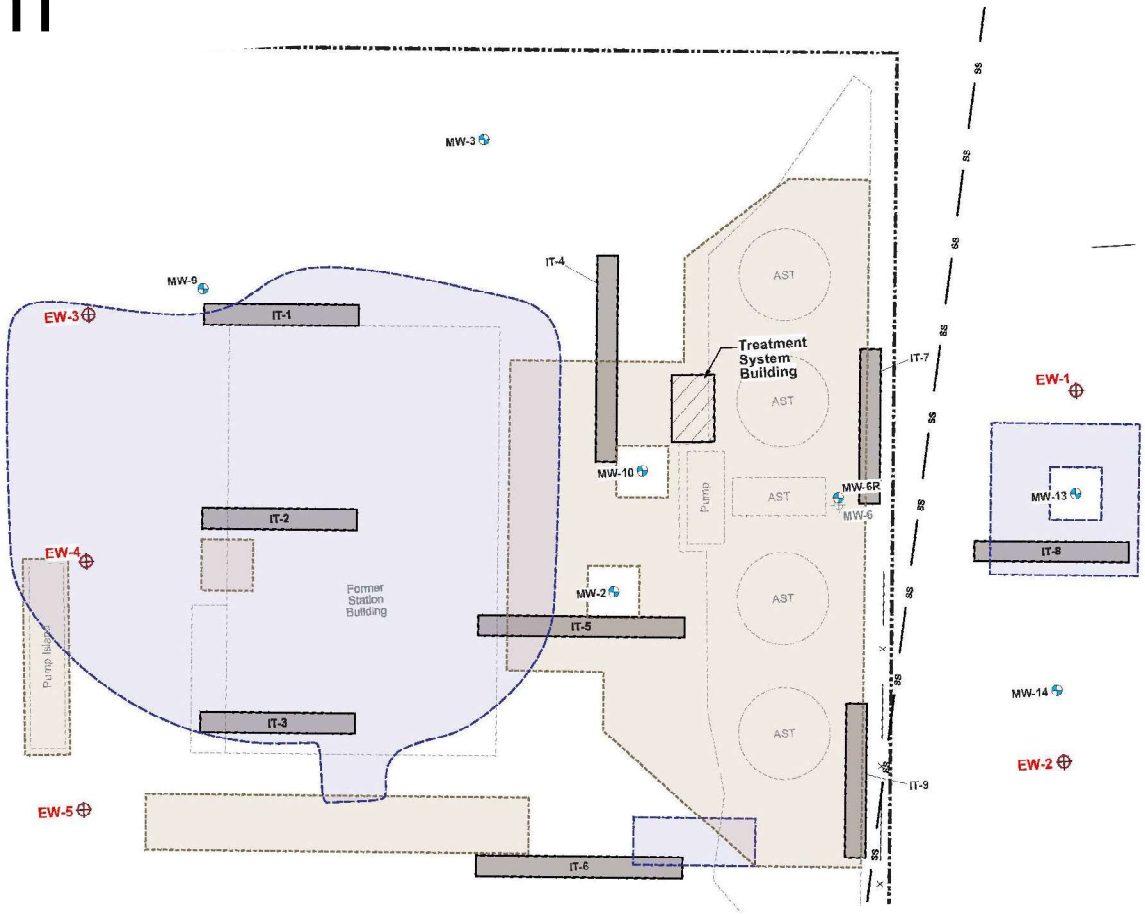
Design/Implementation – Site A – Recirculation System

- ETEC DO-IT™ Recirculation System
- Five 4” Extraction Wells
- Nine 15-20’ long injection trenches at 3’ bgs
- Average flow of 86,000 gallons per month



Design/Implementation – Site A – Recirculation System

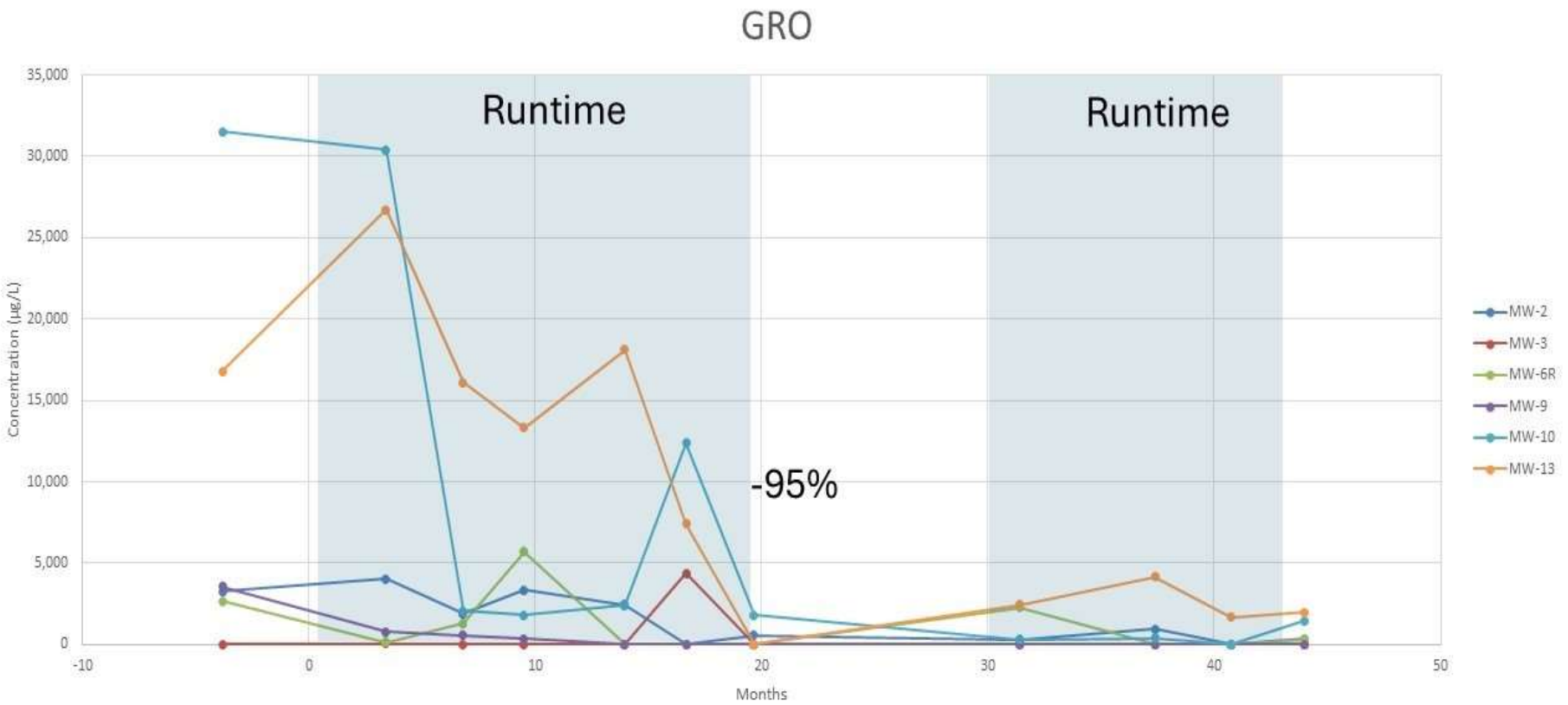
- Hydraulic control of plume
- Treatment of dissolved and adsorbed contaminants
- Maximum contact between treatment solution and contaminants



Design/Implementation – Site A – Recirculation System

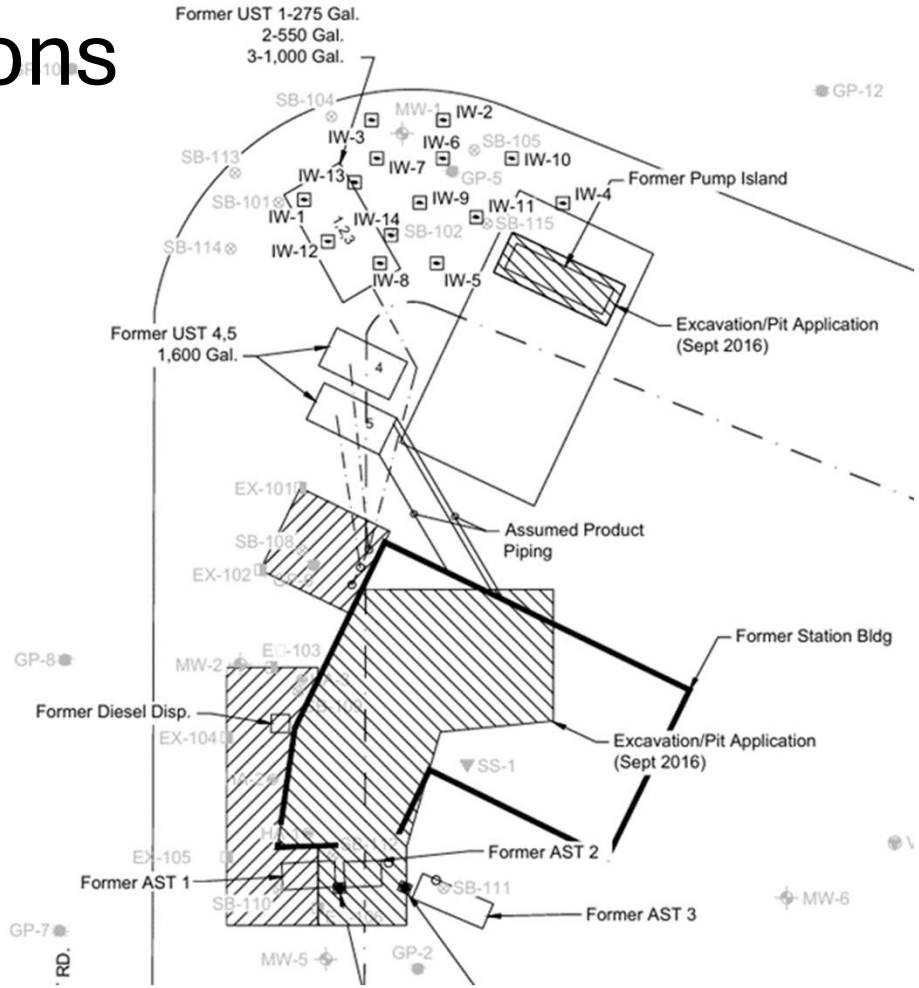
- System start-up December 2018
- 20,800 lbs CBN
- 280 gal each EA + A2
- 2,633 lbs dissolved oxygen
- Total flow of over 7 million gallons

Site A - Results



Design/Implementation – Site B
Pit Application and Injections

- Pit application of 10 gal A2, 1000 lbs CBN, 40 gal PetroSolv in 1500 gal water in excavation
- Injection into 15 points combined 1000 lbs CBN, 75 gal PetroSolv, 15 gal A2



Site B - Results

Achieved construction worker RBC for groundwater within 2 years

Site closed!

Thanks!

- Paula Parrott, RG
- www.parrott-environmental.com
- paula@parrott-environmental.com