

Groundwater Restoration and Long- Term Stewardship at a Former Smelter

ASARCO Site, El Paso, Texas

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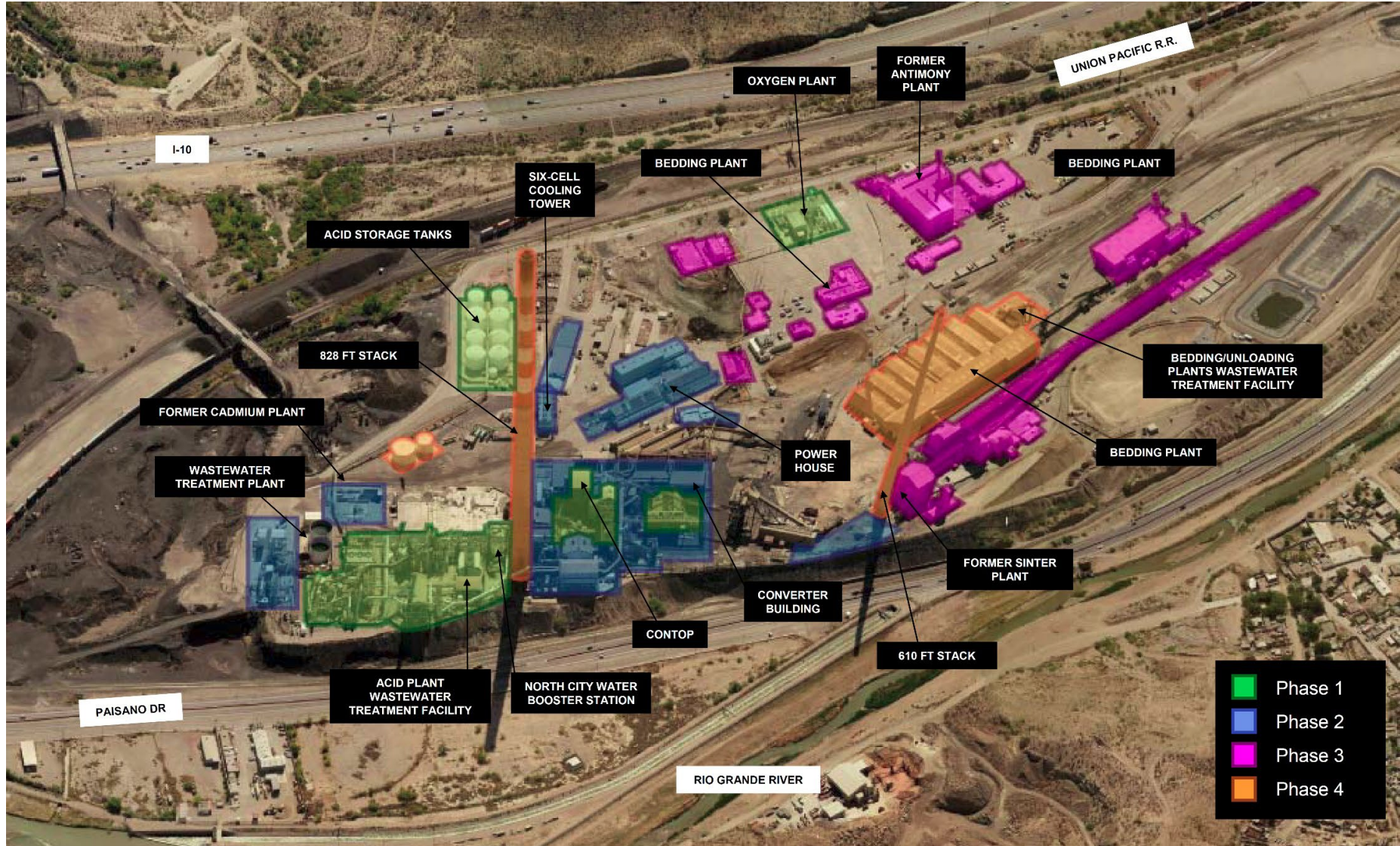
January 26 – January 28, 2026

Site History

- ASARCO El Paso Smelter, El Paso, TX
- Adjacent to Rio Grande
- 1887: Began operations as lead smelter
- 1910: Copper production
- 1980s: Operations downsizing
- 1999: Consent Decree directs ASARCO to complete corrective actions, temporary cessation of plant
- 2009: Custodial trust established to support remedial activities
 - Texas state-led remediation:
<https://www.tceq.texas.gov/remediation/sites/asarco>
 - Involvement by EPA



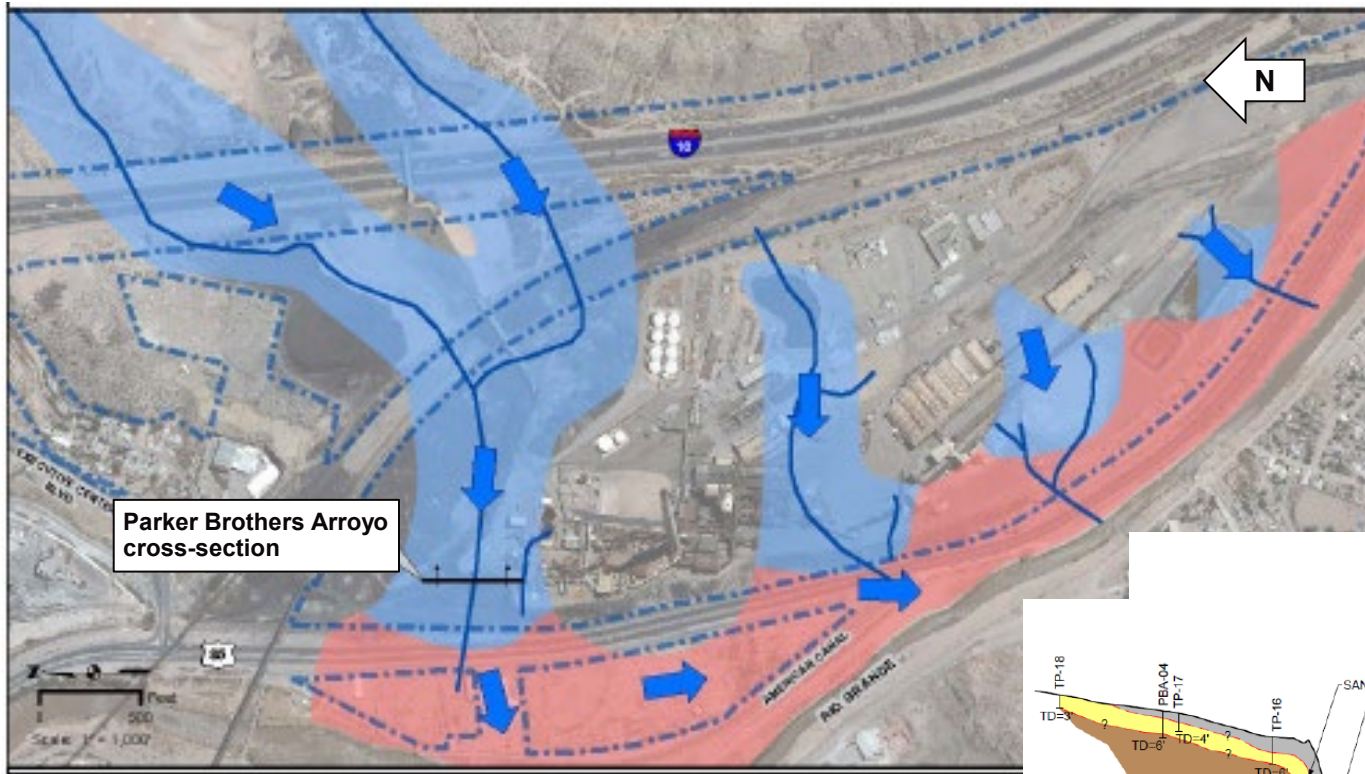
Former Site Features and Demolition



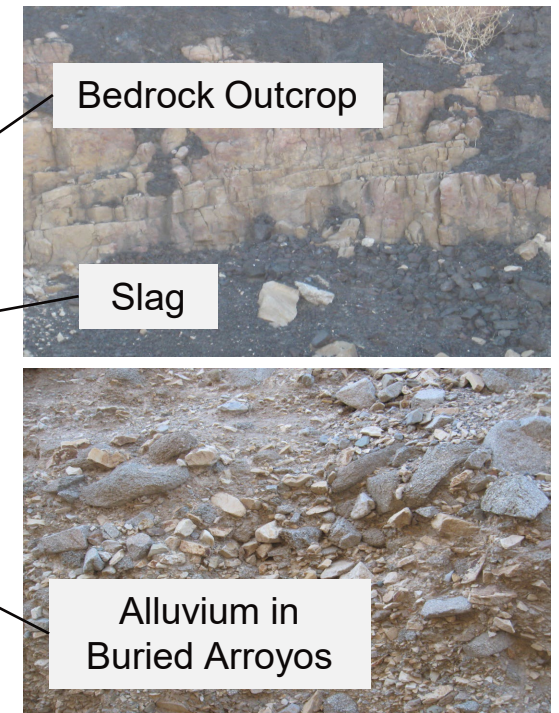
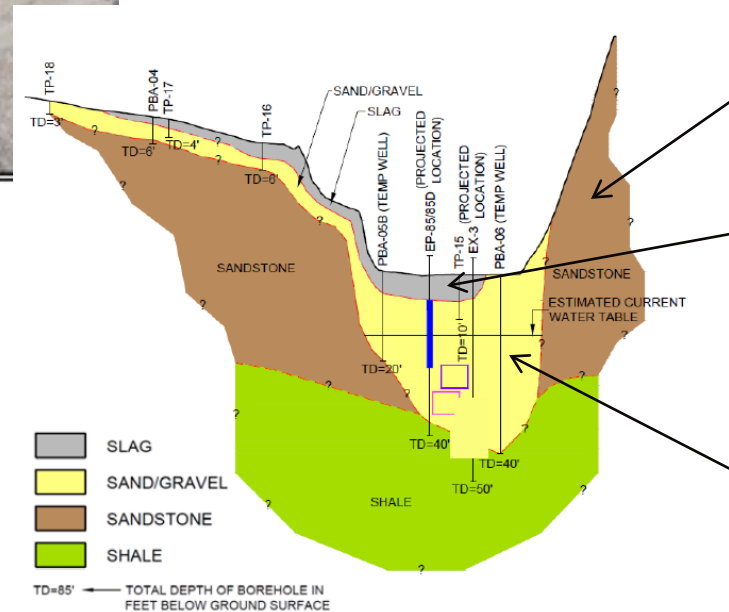
- Demolition in ~2012
- Completed in four phases

Groundwater Flow

- Arroyos mapped using surface geophysics and soil borings
- Groundwater flow focused along sand and gravel alluvium
- Groundwater remedy makes use of natural drainage features to focus remediation

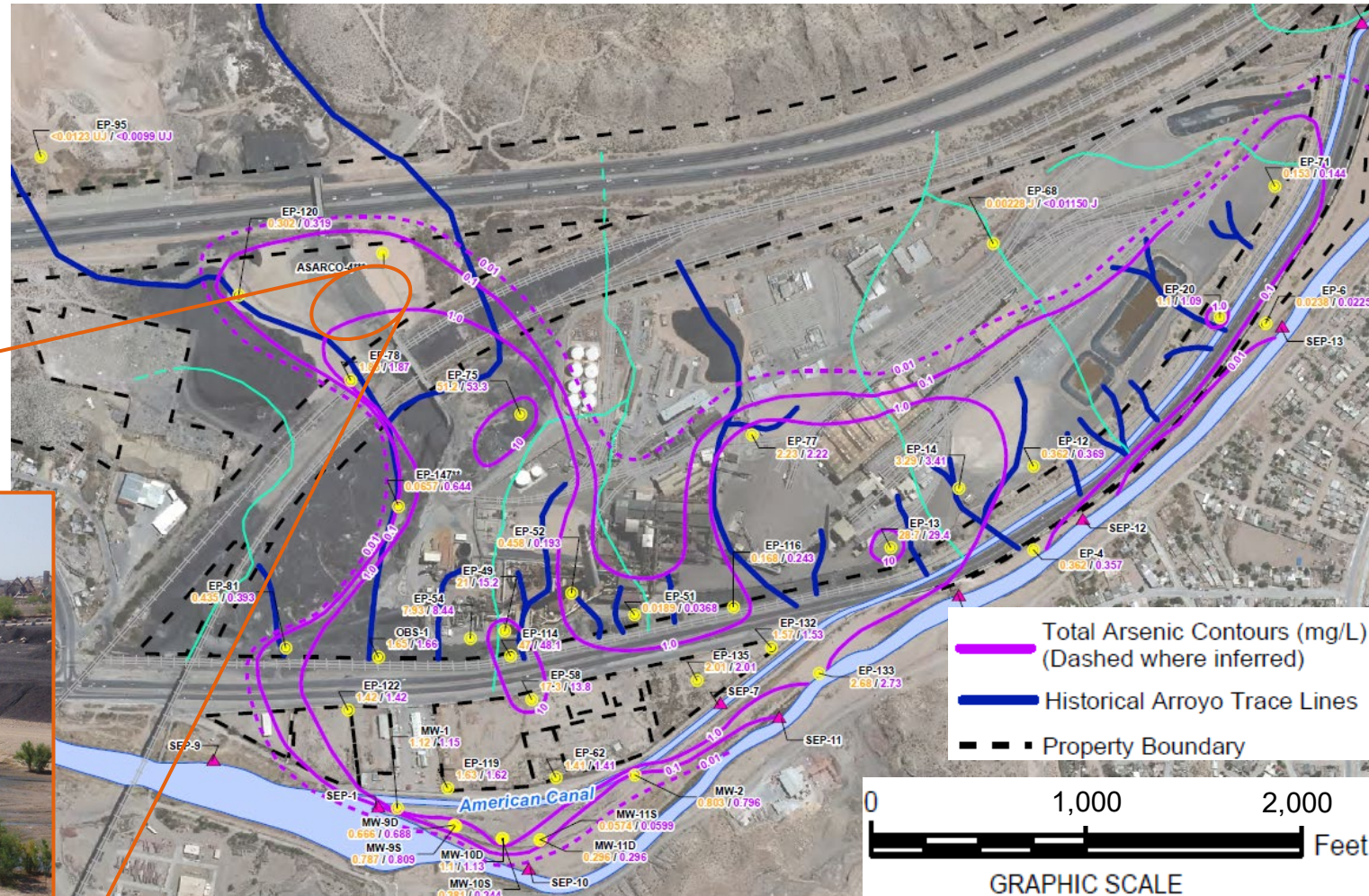


- Groundwater flow through backfilled arroyos; west toward Rio Grande floodplain
- Parker Brothers Arroyo:
 - Drainage area ~ 2,000 ac
 - Majority of groundwater flow
 - Largest control on mass flux

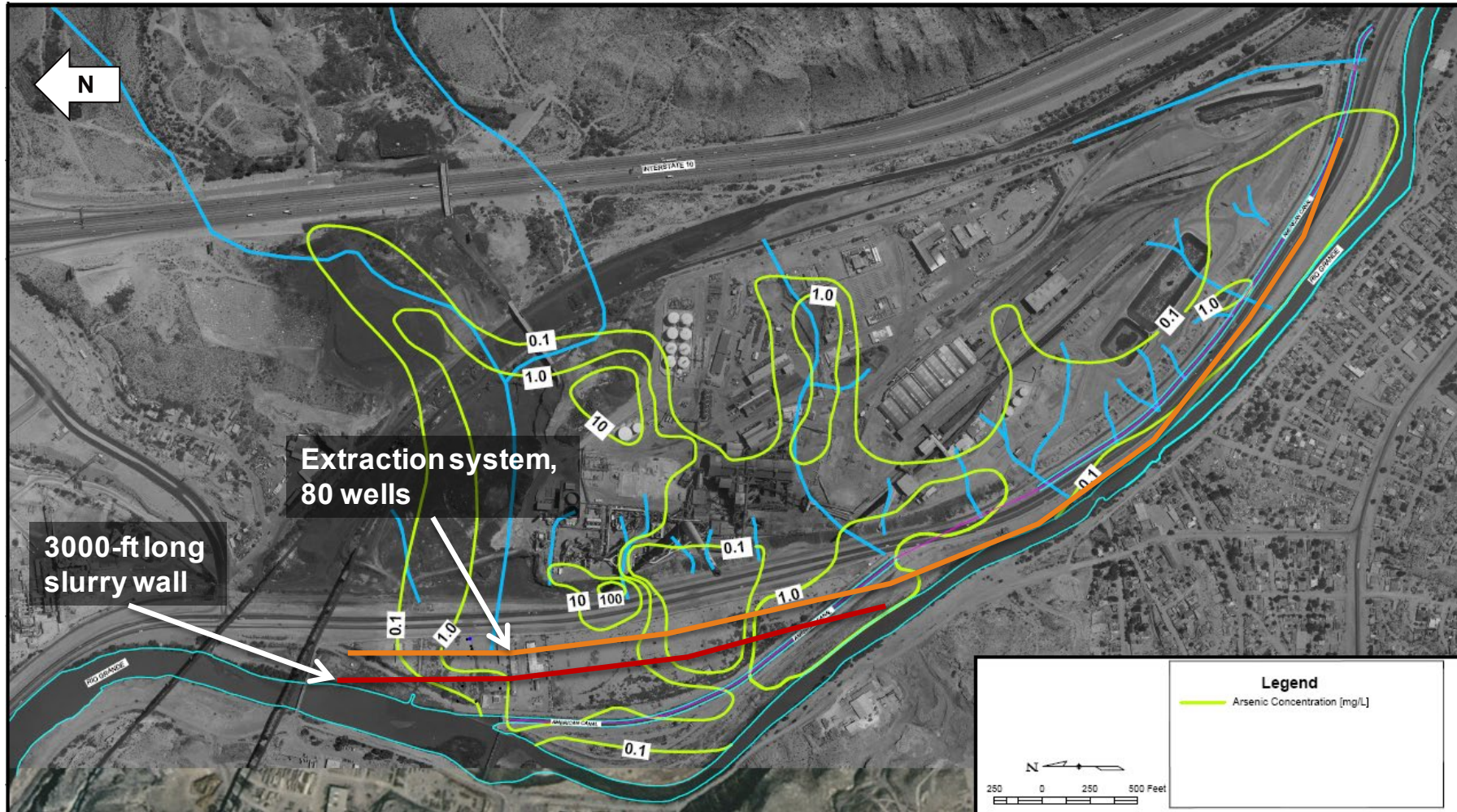


Groundwater Quality

- Groundwater impacts from 100+ years of plant operation
 - Arsenic is remedial driver ($> 10 \text{ mg/L}$)
- Stormwater accumulation in ponds underlain by slag
 - Significant source of groundwater impacts



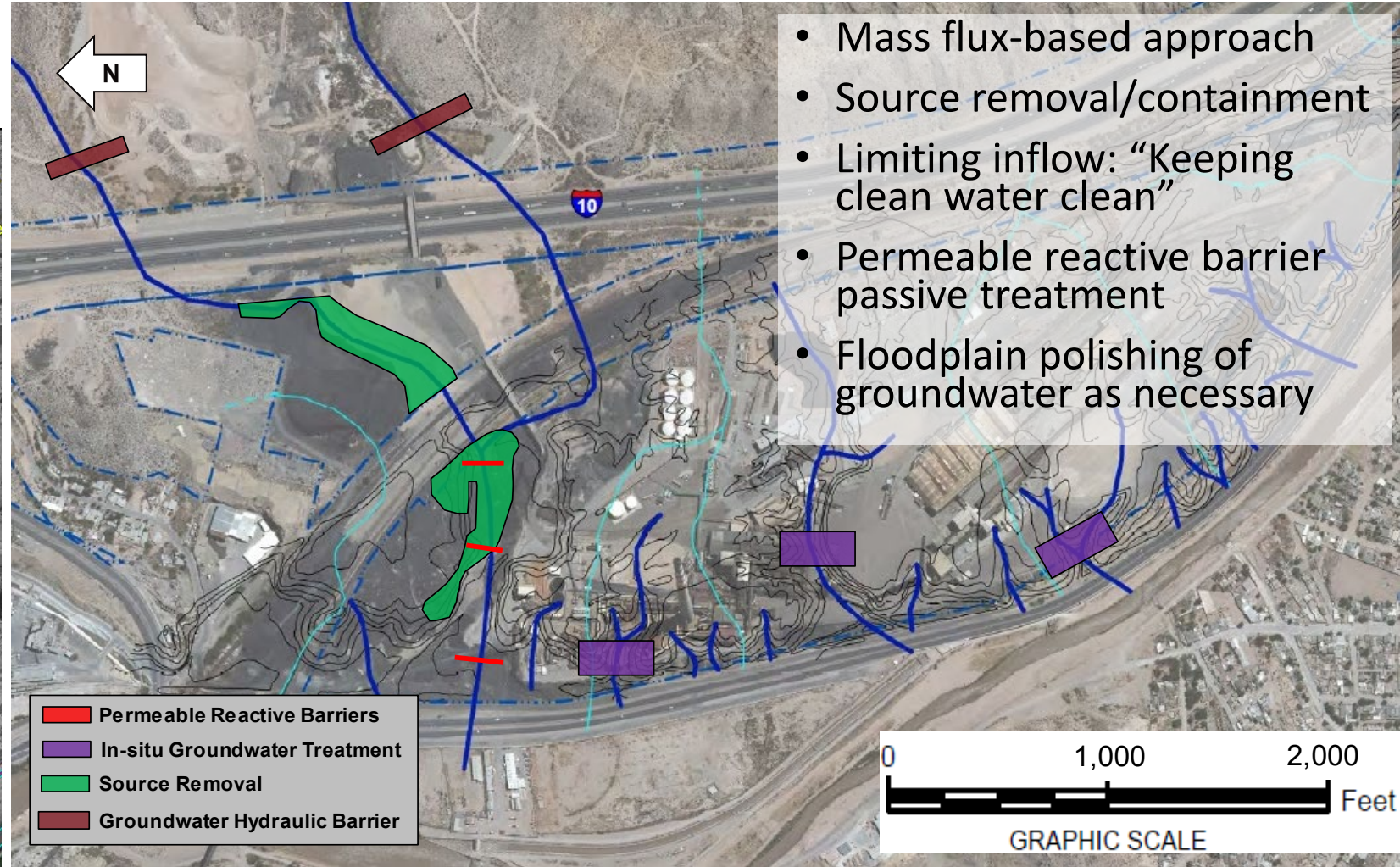
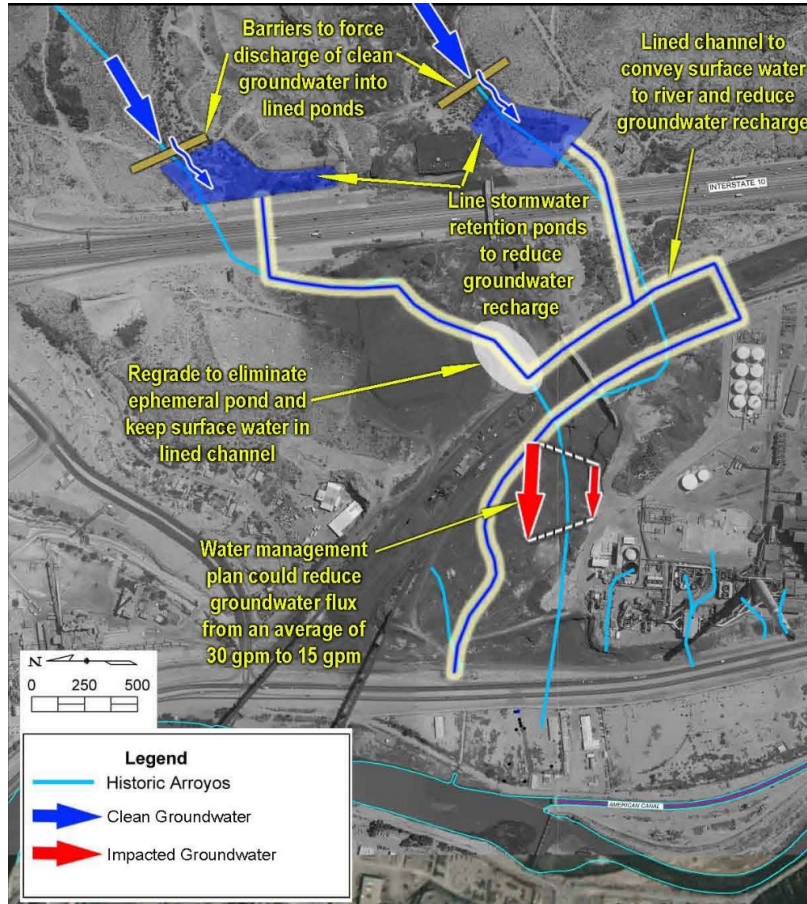
Original Remedial Strategy



- Slurry wall to limit off-site discharge
- Groundwater extraction wells
- Aboveground groundwater treatment
- Remedy based on insufficient understanding of:
 - Discrete COC sources and drivers
 - Controls on mass flux leading to largest risk

Revised Remedial Strategy: Risk-Based Approach

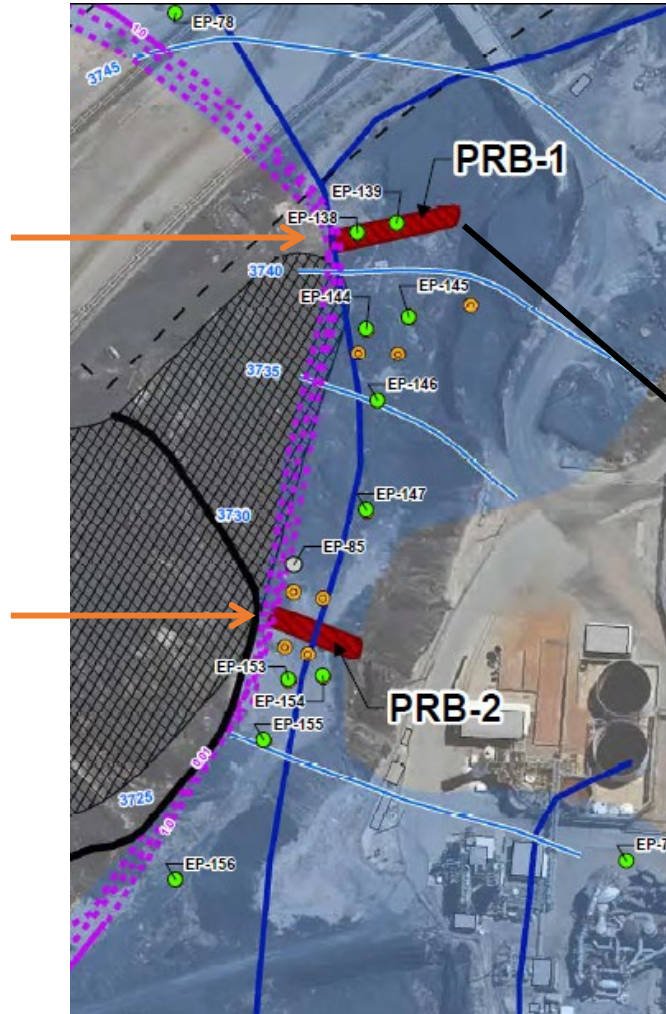
- Water Management Plan: Reduce arsenic flux to Rio Grande



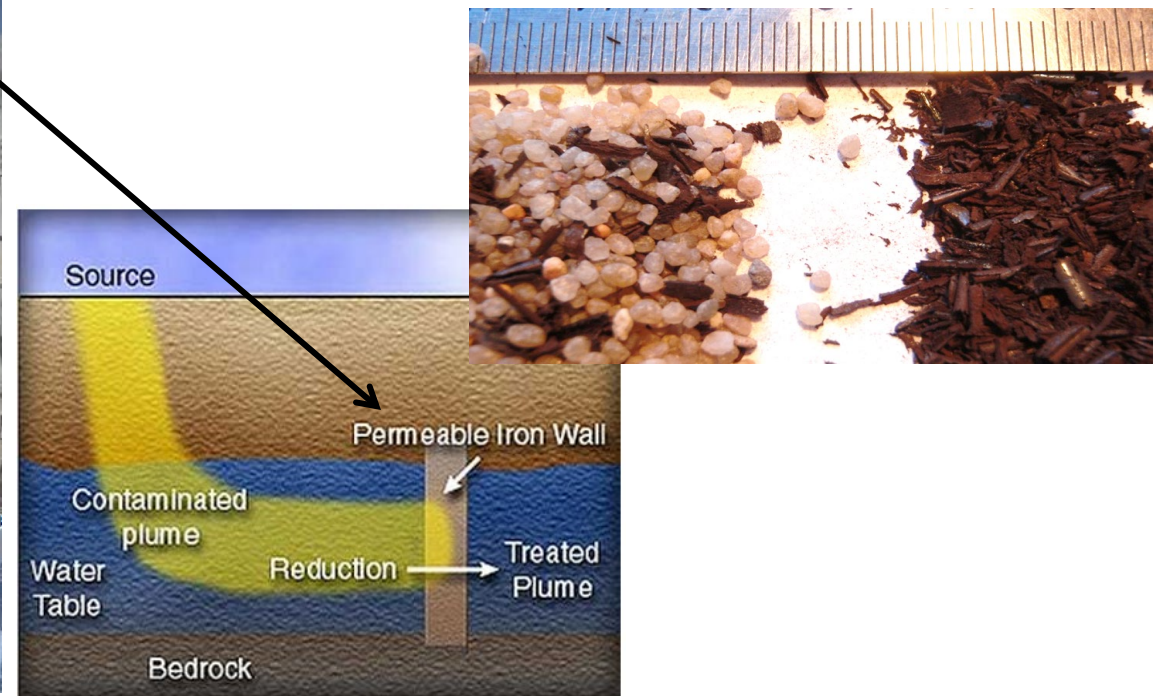
- Mass flux-based approach
- Source removal/containment
- Limiting inflow: “Keeping clean water clean”
- Permeable reactive barrier passive treatment
- Floodplain polishing of groundwater as necessary

Permeable Reactive Barriers

- Two PRBs installed in 2012:
- **PRB-1: Source area**
 - Placed downgradient of Stormwater Pond
 - Main source area in Parker Bros Arroyo
- **PRB-2: Flow bottleneck**
 - Narrowest portion of channel
 - Sandstone outcrops confine flow



- Strategy: Arsenic removal using zerovalent iron
 - Steel shavings
 - $\text{Fe}(0)$ oxidized to $\text{Fe}(\text{III}) \rightarrow \text{Fe}(\text{OH})_3$
 - Arsenic sorption by iron oxyhydroxides



PRB Design and Construction



- Uptake capacity and residence time estimated from column testing (D. Blowes lab, Univ. of Waterloo)
- 1.3 mg As/g ZVI
- Removal $t_{1/2} = 1.3$ hours

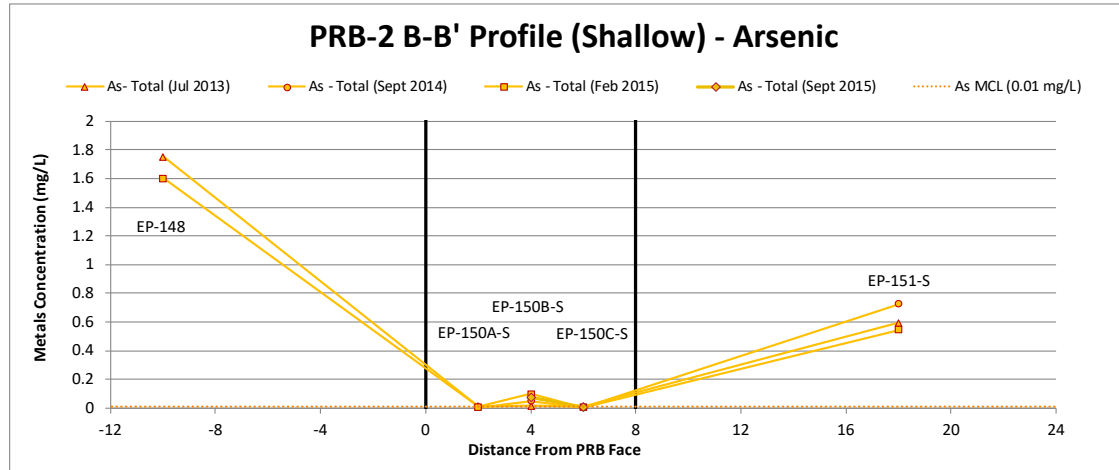
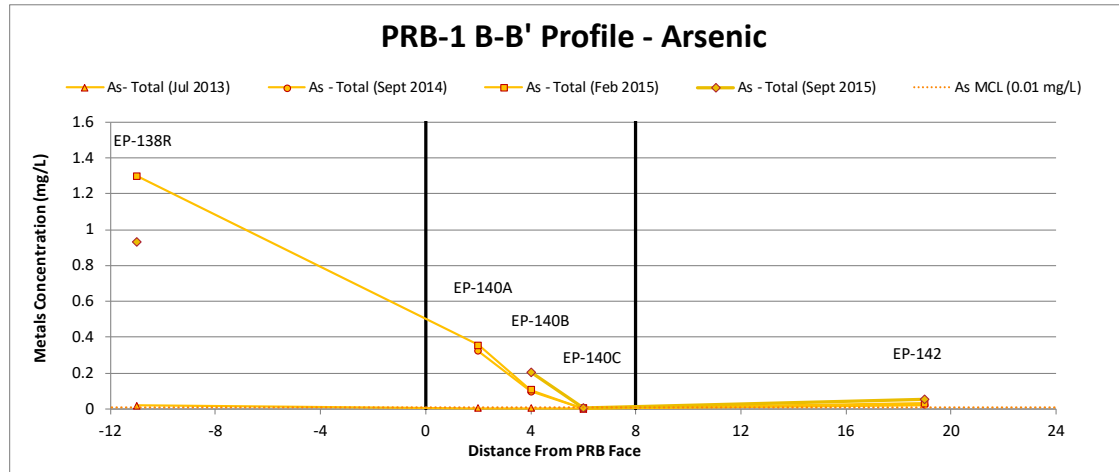
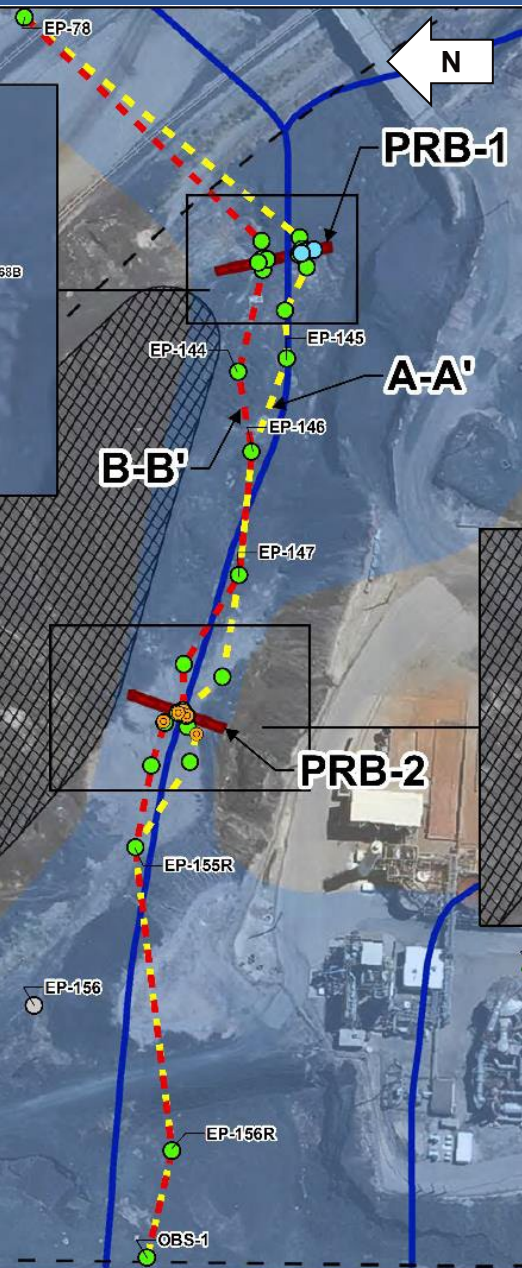
- Slide rail system install
- 8 ft wide × 25 ft deep (max) × 260 ft long
- ZVI content = 30%, balance sand (local sand pit)



- Key design parameters based on:
 - Lab testing results
 - Site hydrogeology
 - Site geochemistry

Parameter	PRB-1	PRB-2
K (ft/day)	18	116
Seepage Velocity (ft/day)	2.7	7.5
Arsenic influent concentration (mg/L)	1.0	0.5
Arsenic loading (lbs/day)	0.10	0.15
Design lifetime (years)	20	20
ZVI Demand (tons)	365	550

PRB Performance



Upgradient (East)

Downgradient (West)

- Overall effective for arsenic removal
- Some channeling exhibited
- Downgradient re-equilibration with adsorbed arsenic, but mass reduction evident
- Lesson Learned: Importance of water alkalinity and hardness (calcite scaling potential) in affecting ZVI performance

Mass Flux as Driver

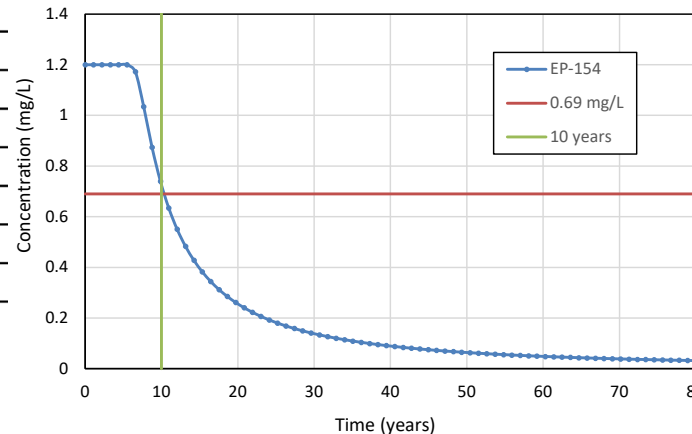
	^{SW} SW PCL ¹	Dilution Factor ²	^{SW} GW PCL ¹	Background 95% UPL ¹	Selected ^{SW} GW PCL ¹
Antimony	0.006	0.01179	0.509	NA	0.509
Arsenic	0.01	0.01179	0.848	0.02	0.848
Barium	2	0.01179	170	0.037	170
Cadmium	0.0016	0.03404	0.047	NA	0.047
Chloride	340	0.01179	28,826	425	28,826
Chromium	0.1	0.01179	8.5	0.016	8.5
Cobalt	0.24	0.03404	7.1	NA	7.05
Copper	0.07	0.03404	2.06	0.06	2.06
Iron	NE	0.03404	NE	0.704	NE
Lead	0.0073	0.01179	0.619	NA	0.619
Mercury	0.000012	0.01179	0.00102	NA	0.00102
Molybdenum	0.122	0.01179	10.3	0.069	10.3
Nickel	0.32	0.03404	9.4	NA	
Selenium	0.005	0.03404	0.147	0.035	
Silver	0.0007	0.03404	0.022	NA	
Sulfate	600	0.01179	50,870	974	
Thallium	0.00012	0.01179	0.010	NA	
Zinc	1.05	0.03404	31	0.084	
Fluoride	4	0.01179	339	8.3	
Nitrate	10	0.01179	848	NA	
Nitrite	1	0.01179	85	NA	

Notes:

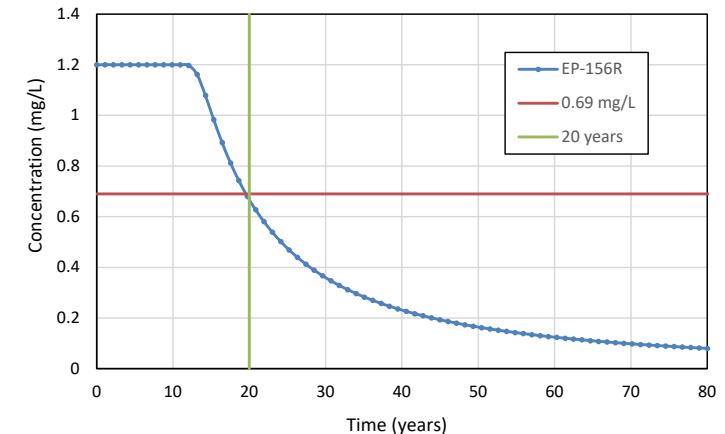
1. Results are shown in milligrams per liter (mg/L).

- Determination of:
 - Protective Concentration Levels (PCL) for surface water, sediment, soil, groundwater
 - Attenuation Action Levels (AALs) for individual monitoring wells
- Based on mass flux and mixing; ensuring concentrations are protective of receptors
- Prediction of when target GW/SW concentrations will be attained
 - Transport model developed for arsenic
 - Arsenic sorption based on lab extraction tests

EP-154 Arsenic Concentration

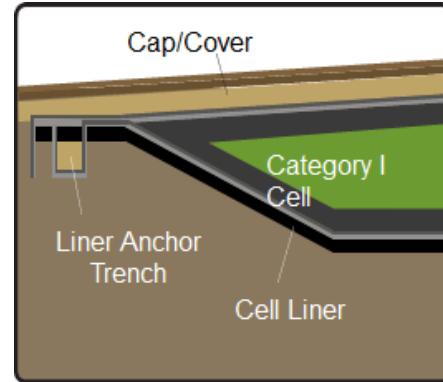


EP-156R Arsenic Concentration



Surface Cleanup and Water Management

- Source removal and recontouring: Facilitate runoff
- Wastes contained onsite, recycling of equipment and materials
- Thick soil covers (up to 5 feet) to allow utility installation



Current Status

- Source removal, surface water management complete
- Achievement of performance goals in progress
- Land sale(s) in progress



Summary

- Revised remedial approach
 - Better use of site-specific characteristics
 - Passive options, keeping clean water clean
 - Mass flux approach: Target largest impacts
- Collaborative process with TCEQ, EPA, TxDOT, and stakeholders (e.g., rail)
- Permeable Reactive Barriers
 - Effective removal of arsenic from groundwater
 - Adequate treatment despite water quality challenges
- Effective regulatory strategy is key to meeting end-goal

Better Outcome with Reduction in Long-Term Site Stewardship

Thank You!



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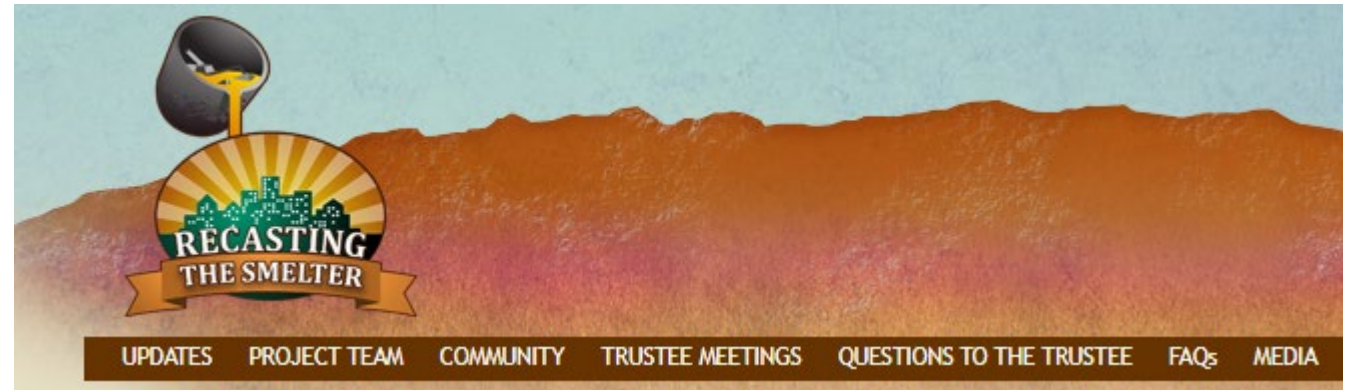
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Scott Brown

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Site Owner: Texas Custodial Trust

<https://www.recastingthesmelter.com>

Site Management: PathForward Consulting

- Roberto Puga
- Ken Hewlett

<https://www.pathforwardconsult.com>