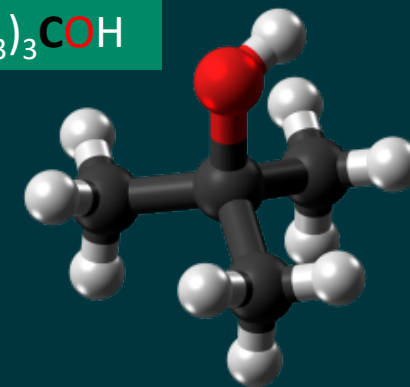


TBA Remediation Approaches at Two Distinct Sites: One Large-Scale and One with Really High Concentrations

Assaf A. Rees, PE
Engineering Manager
Remediation Practices
assaf.rees@aecom.com



TBA Fun Facts

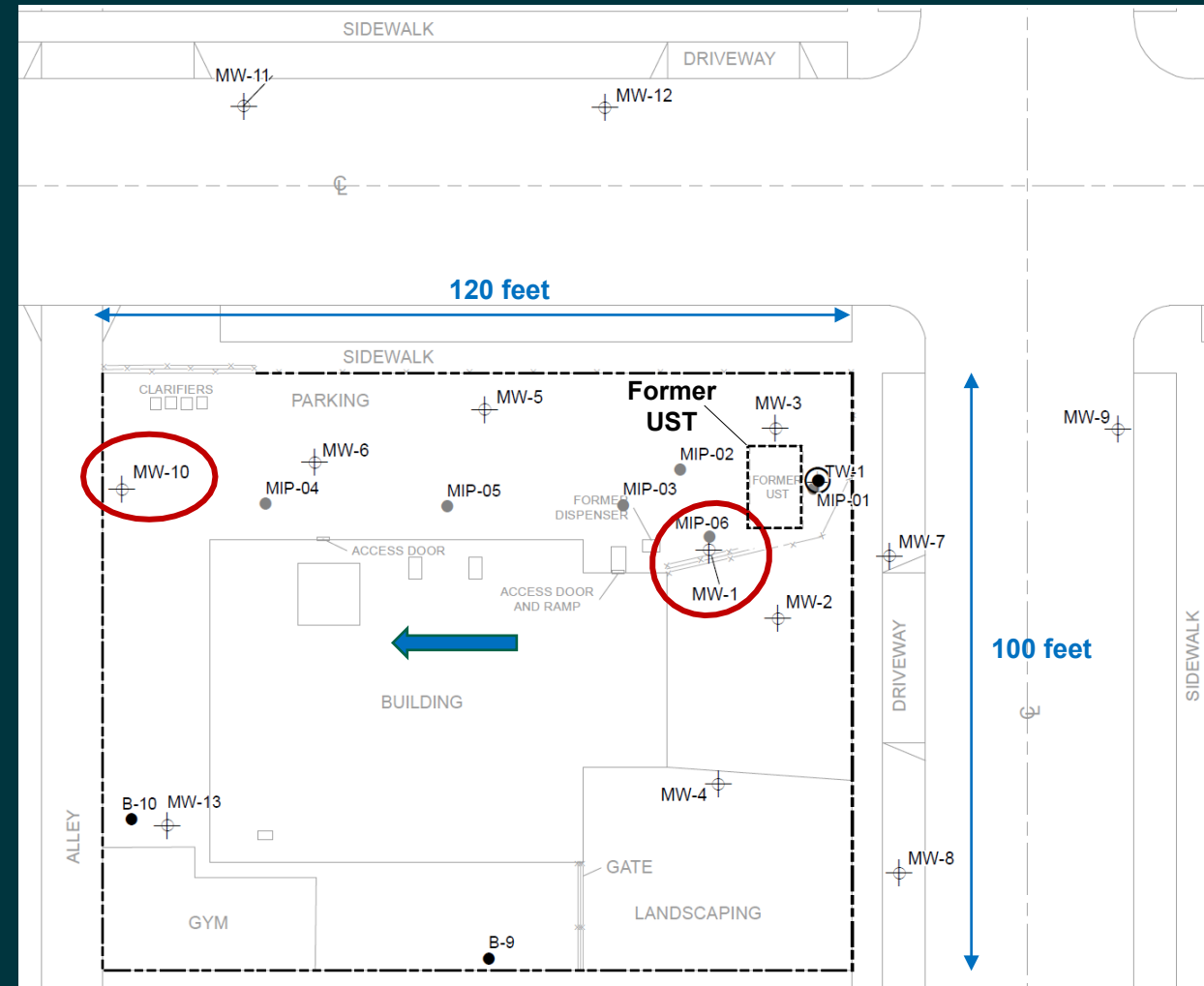
- It is an alcohol
- Alcohols are miscible in water \longrightarrow Large plumes + High concentrations
- Low Henry's constant (10^{-4}) \longrightarrow 2-3 orders below BTEX and MTBE
- TBA can occur from three sources:
 1. TBA was blended with gasoline as a fuel oxygenate, but less extensively than MTBE
 2. MTBE used for blending contains TBA as a manufacturing by-product ~0.03% to 0.8%
 3. TBA has been documented as an intermediate/transformation product of biotic and abiotic degradation of MTBE
- TBA does not have an MCL
California has an advisory Notification Level of 12 $\mu\text{g}/\text{L}$

02

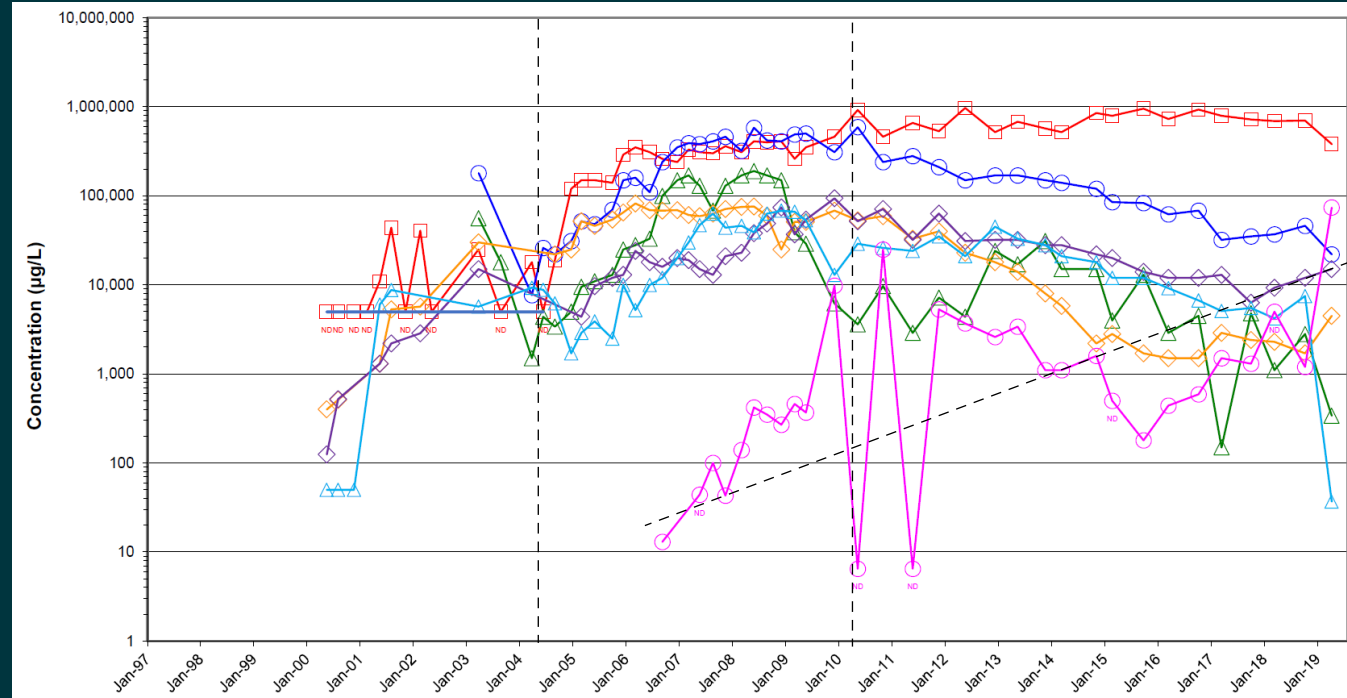
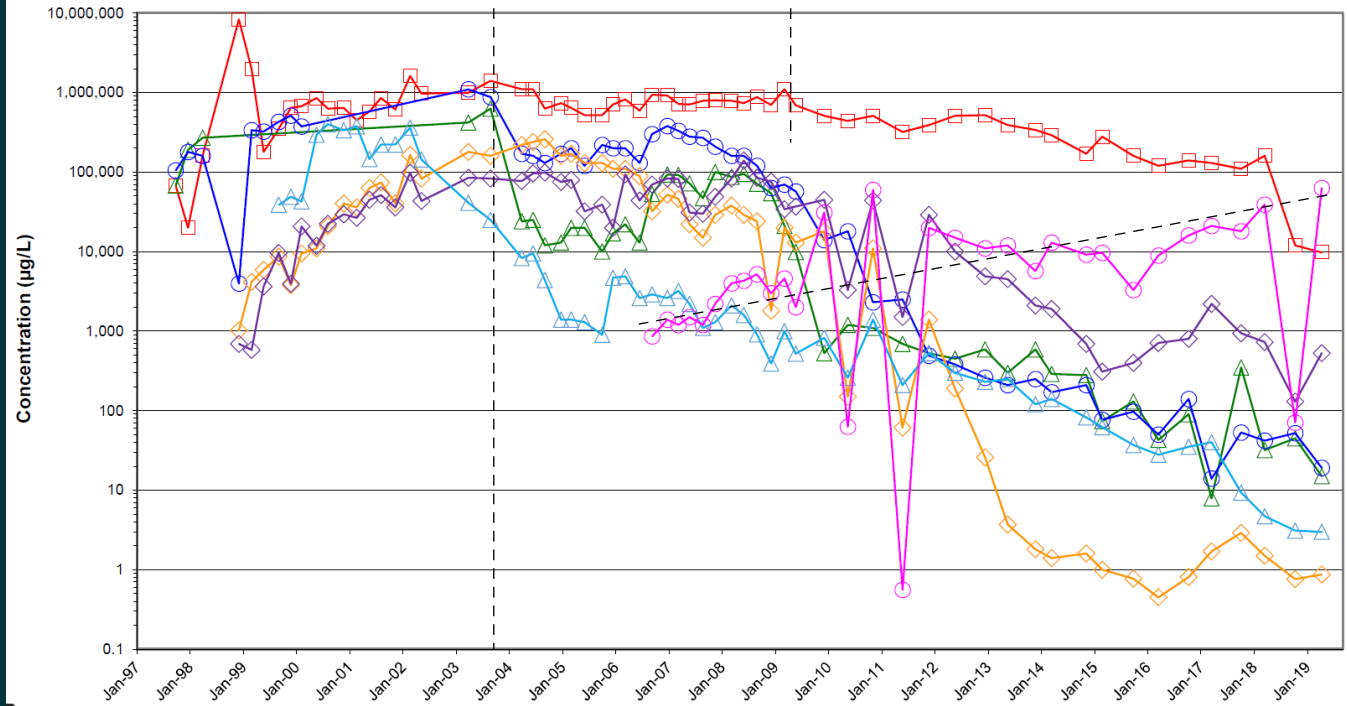
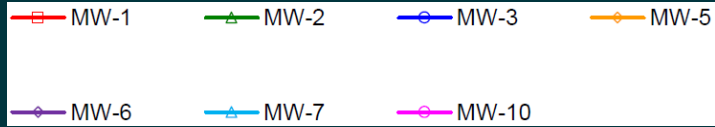
**Site One –
Former UST**

The one with really high concentrations...

- Small-scale active site
- Former USTs used for truck fueling
- 1995 Release of gasoline
- BTEX all but degraded
- MTBE & TBA have become remediation drivers



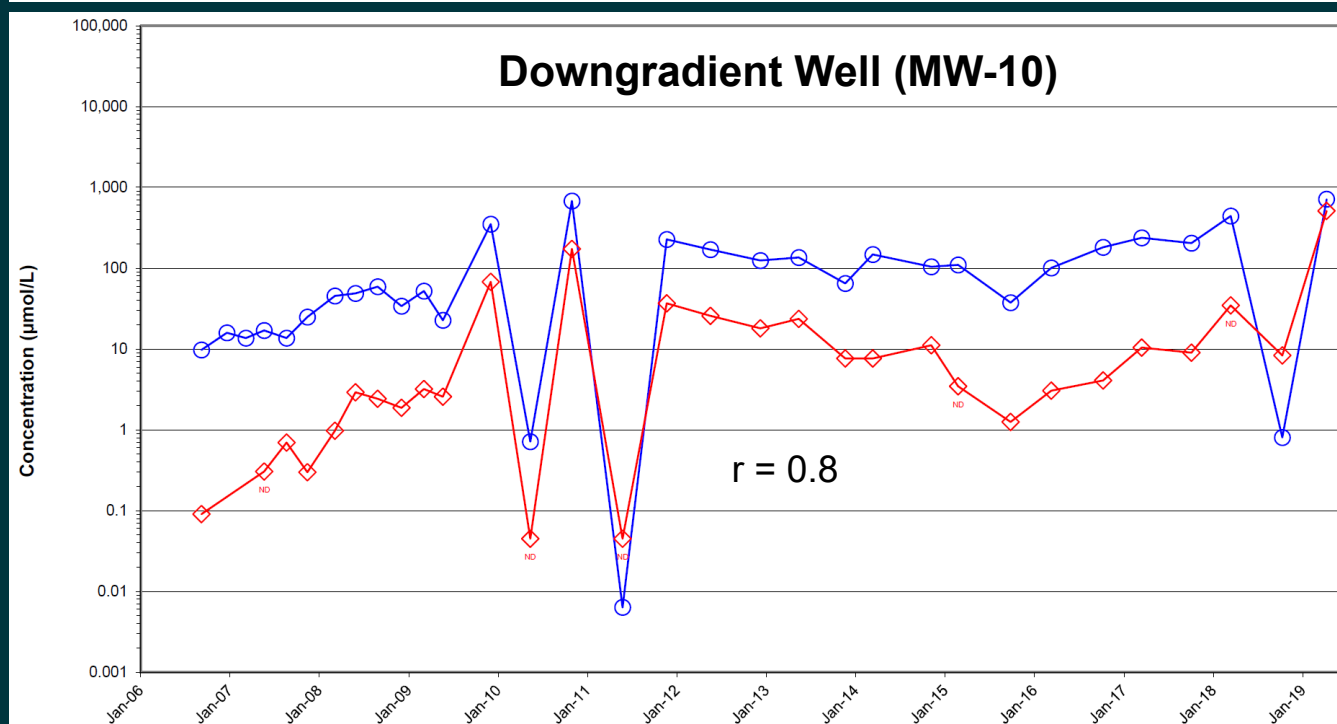
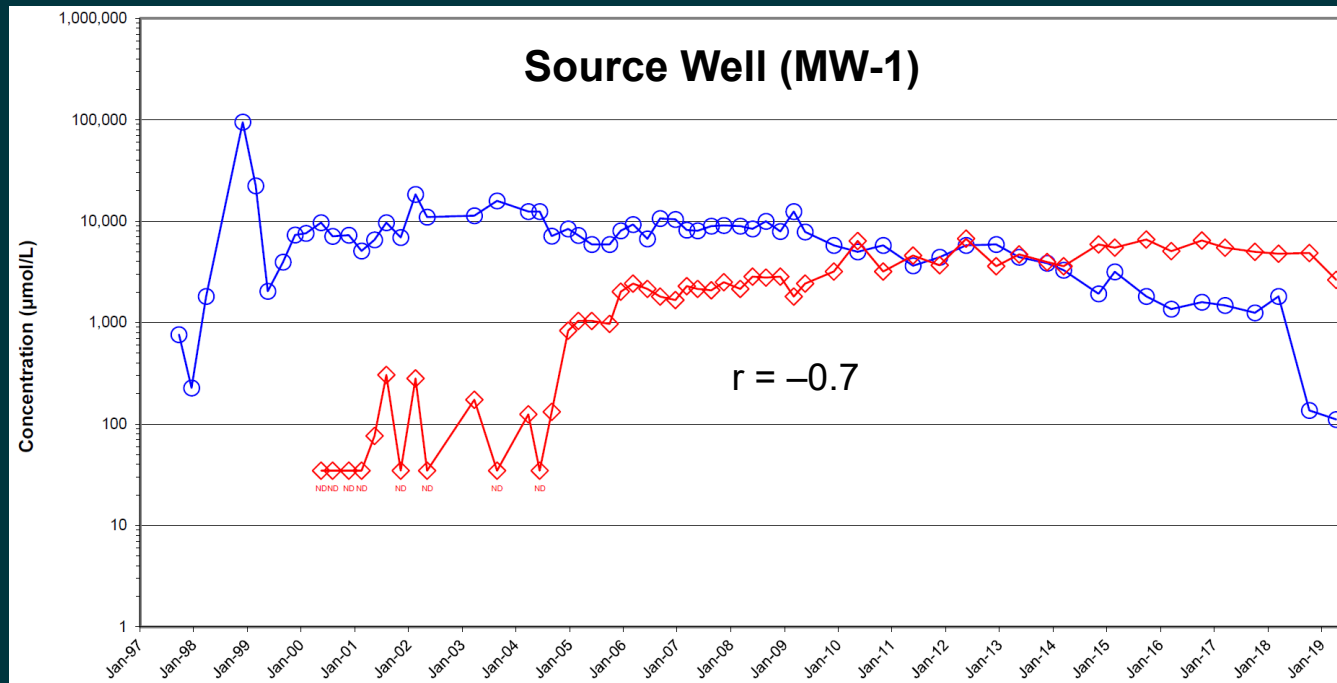
Historical Trends



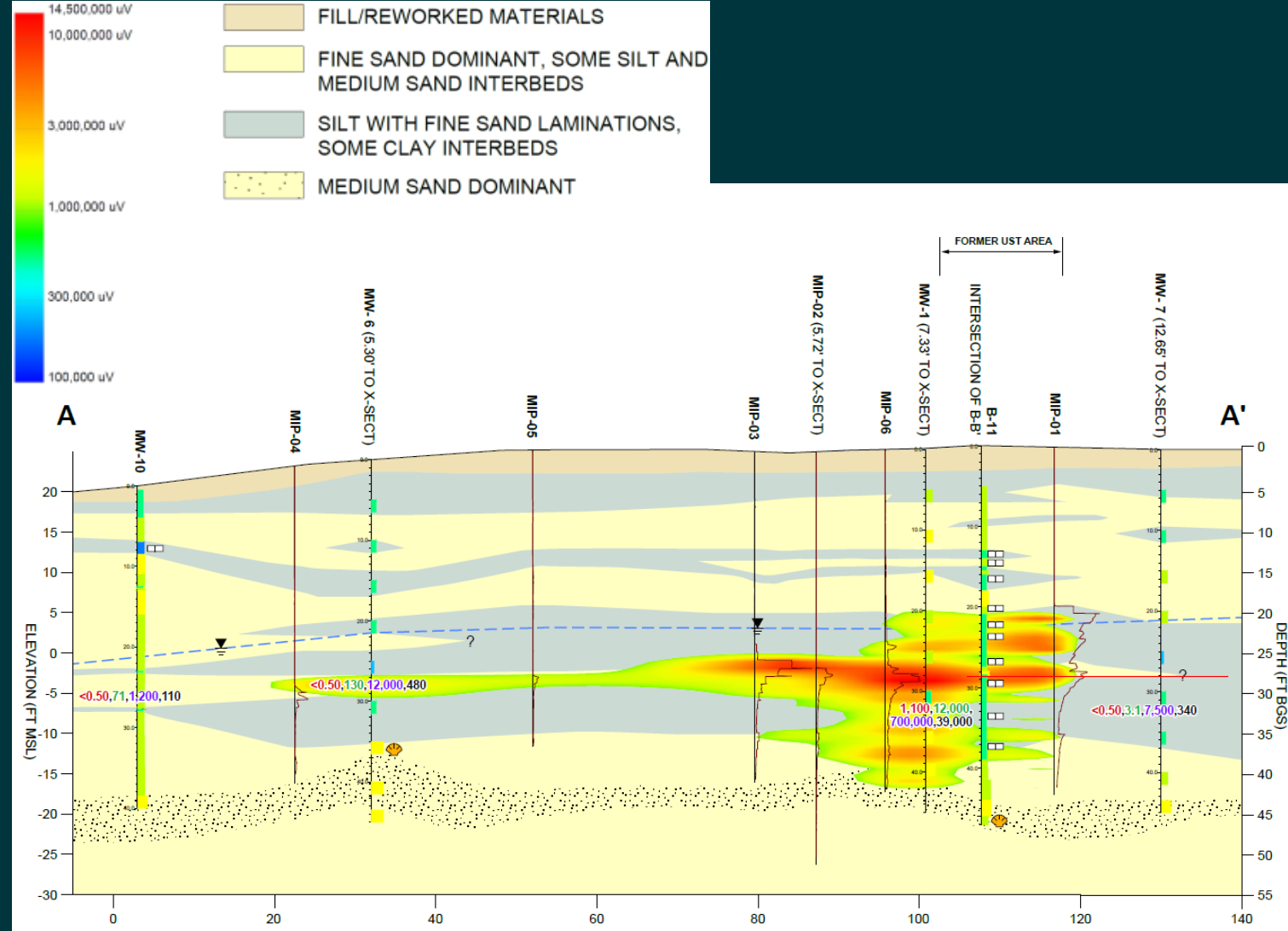
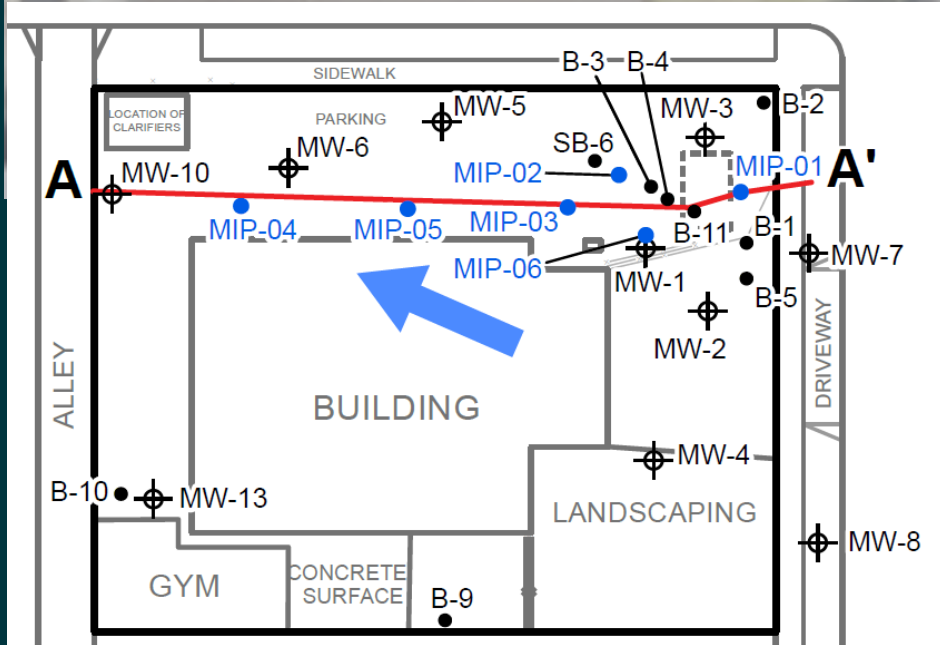
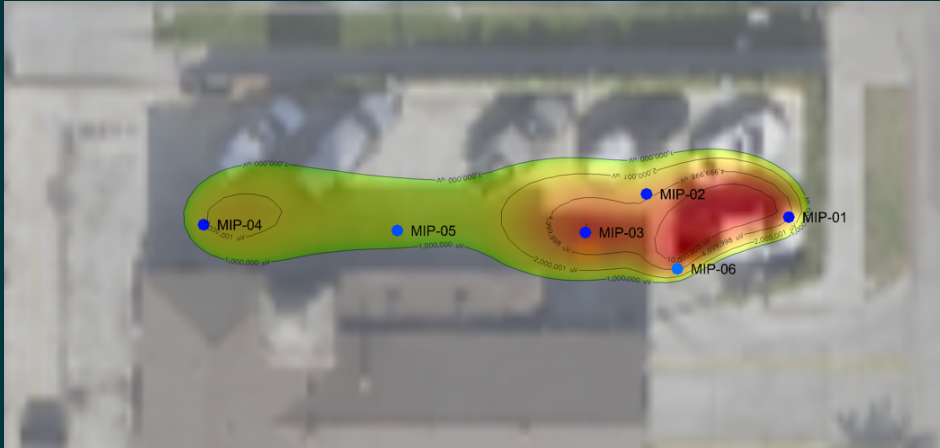
MTBE

TBA

Transformation?

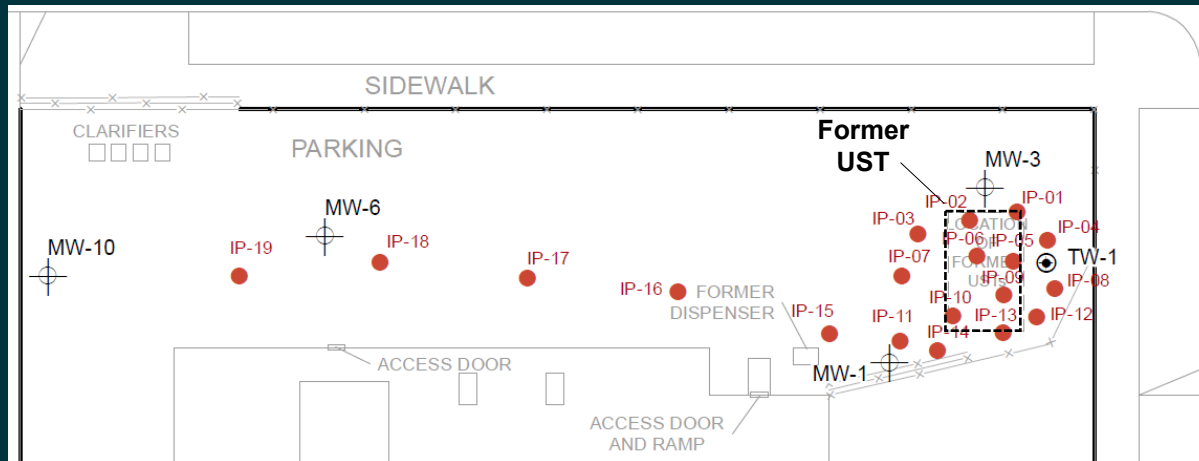


2018 MIP investigation – Enhanced CSM



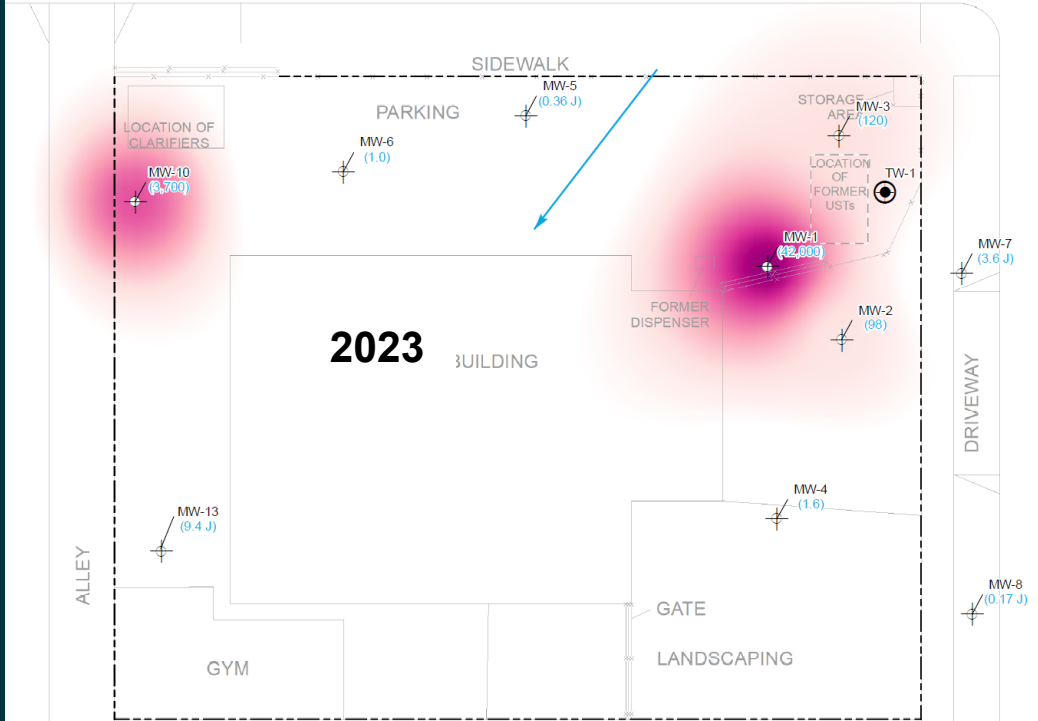
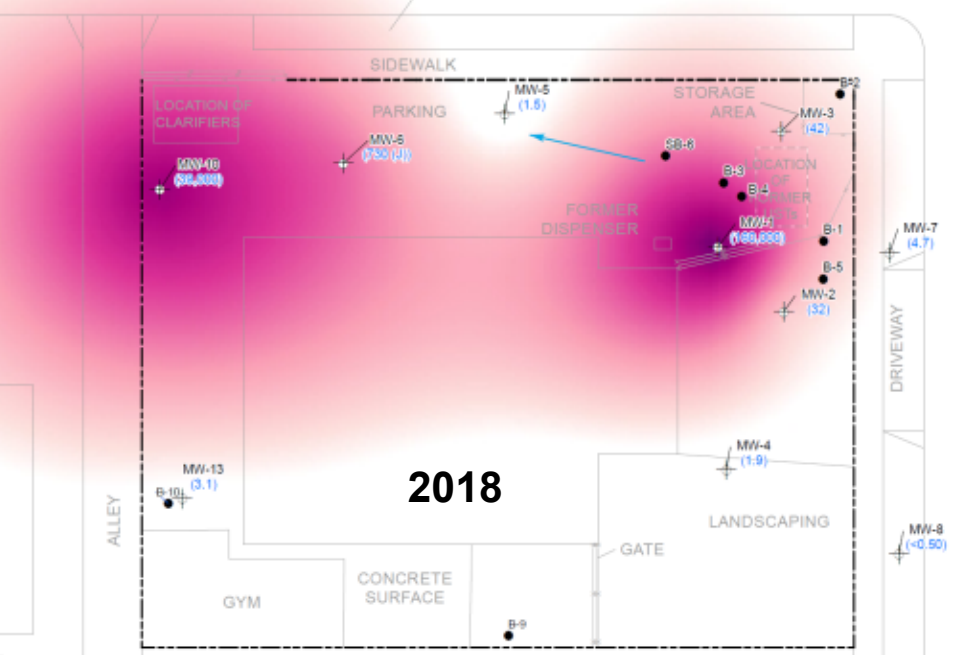
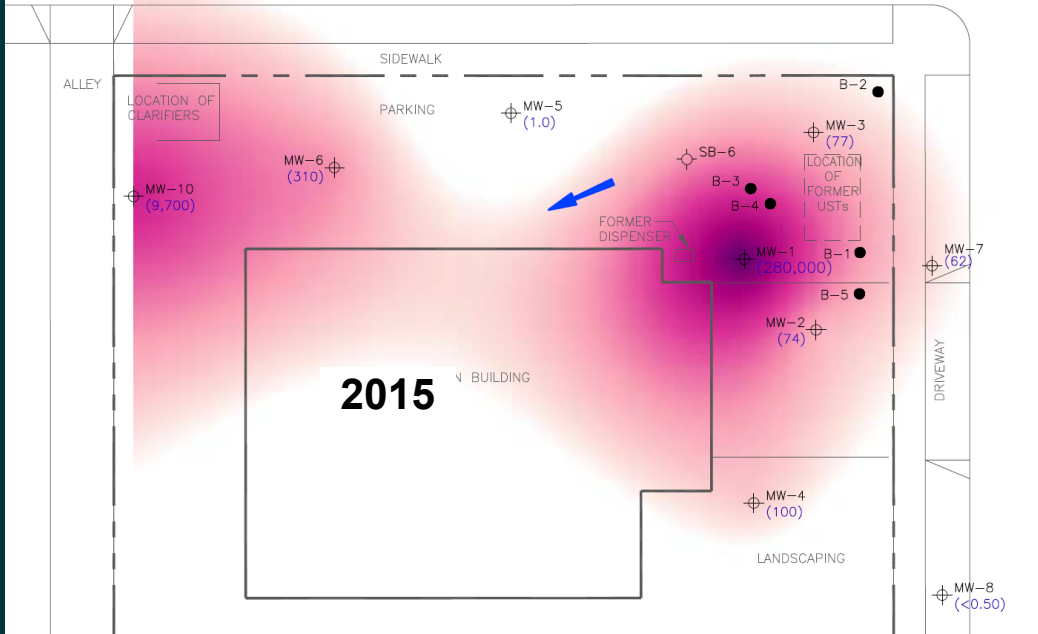
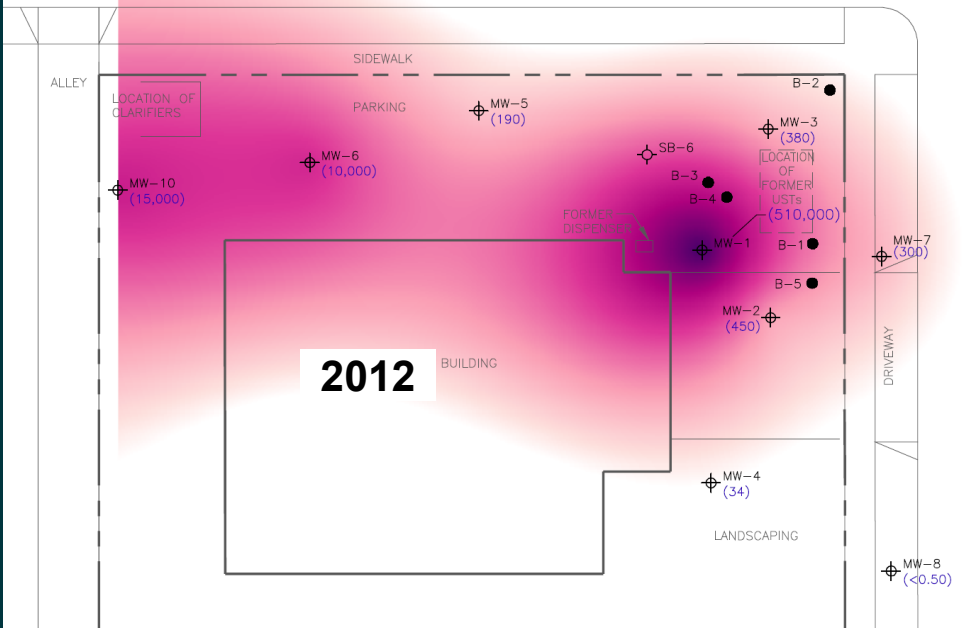
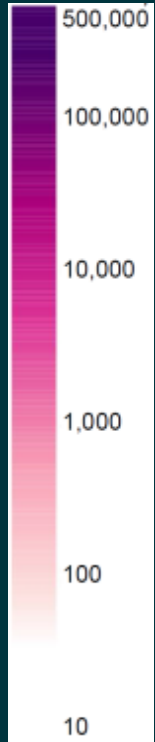
ISCO Injections

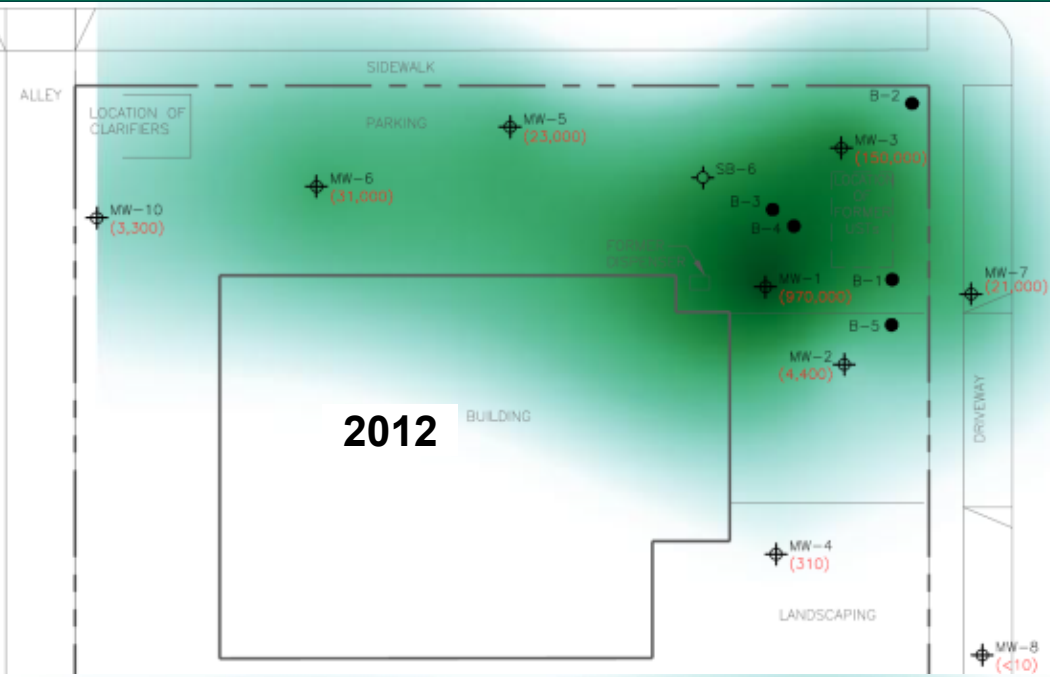
- Base-activated sodium persulfate
- Two injection events – 2019 and 2022
- 14,000 lbs of Klozur persulfate
- 2,800 gallons of 25% NaOH
- 17,000 gallons total
- 50-170 psi. 1-4 gpm



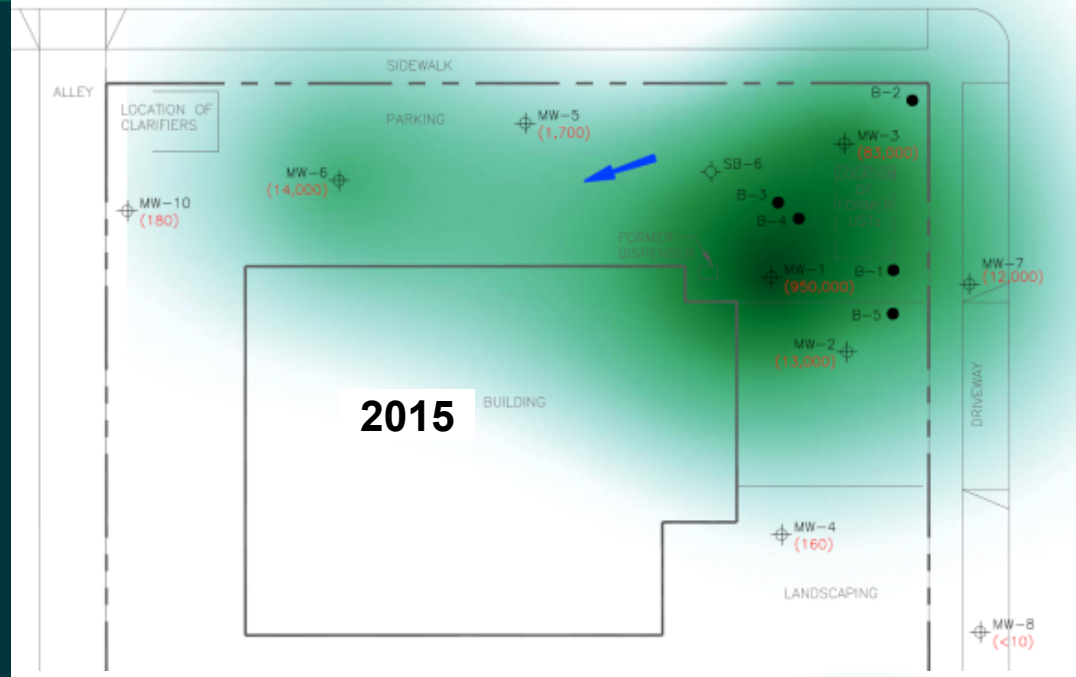
MTBE

Concentration (µg/L)

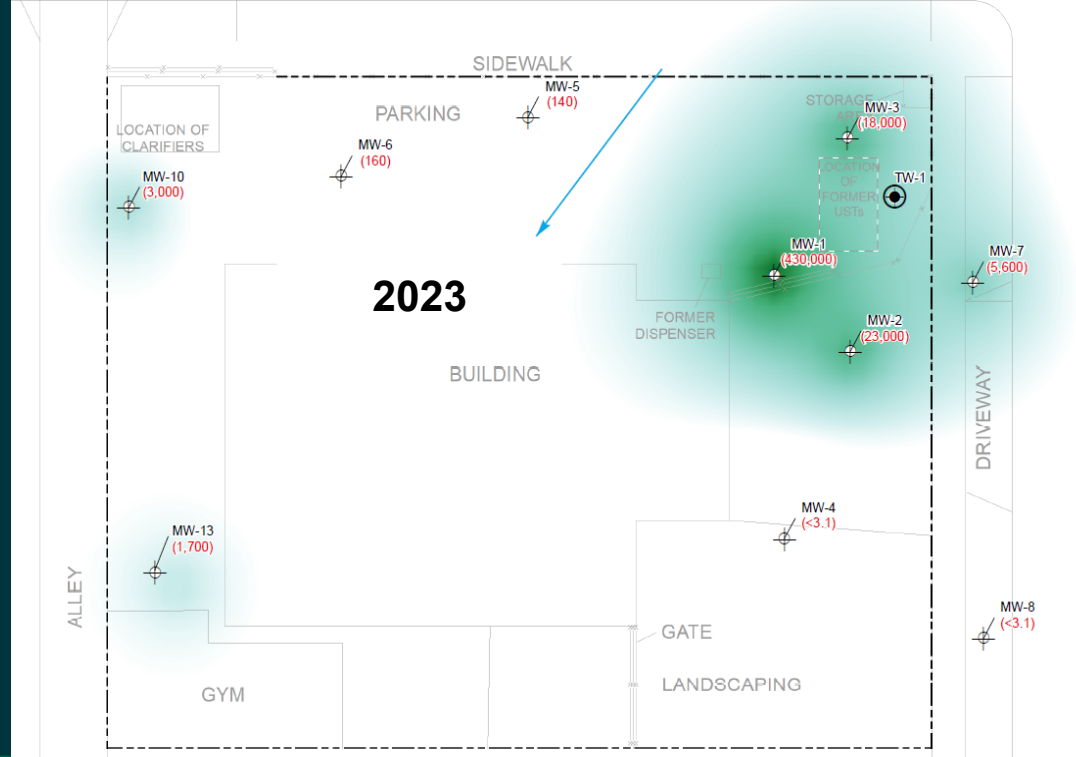
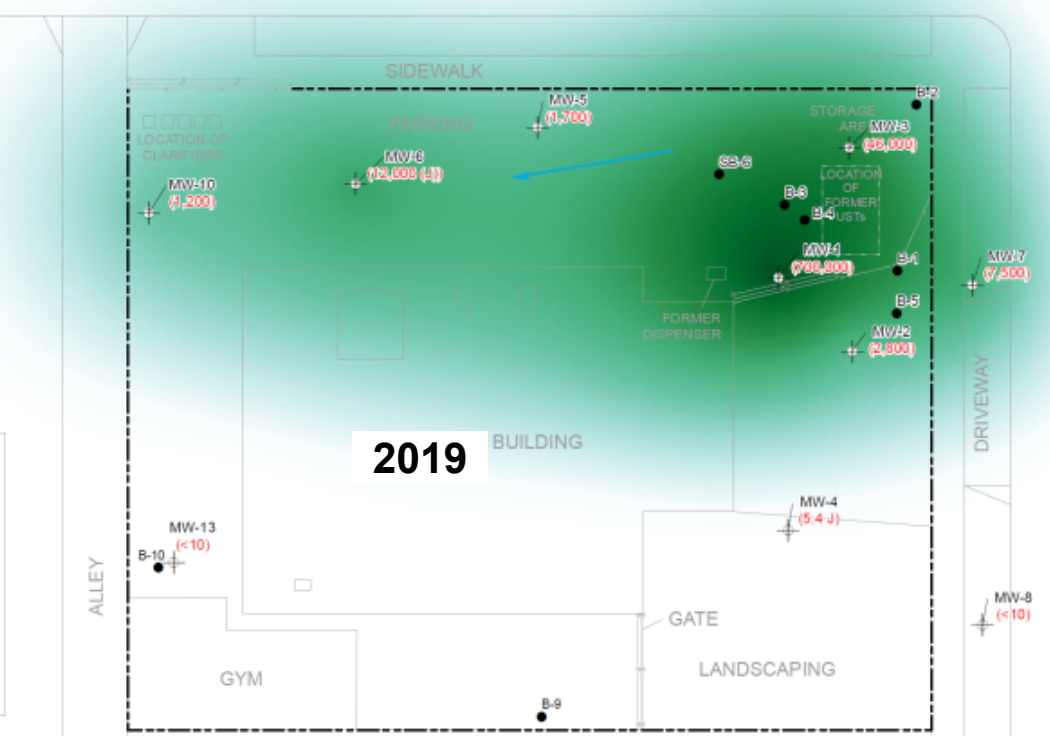
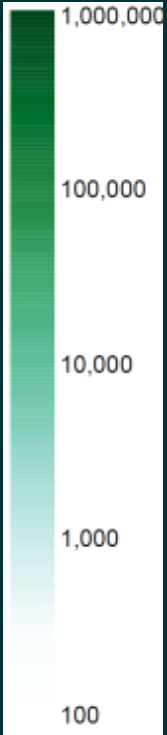




TBA



Concentration (µg/L)

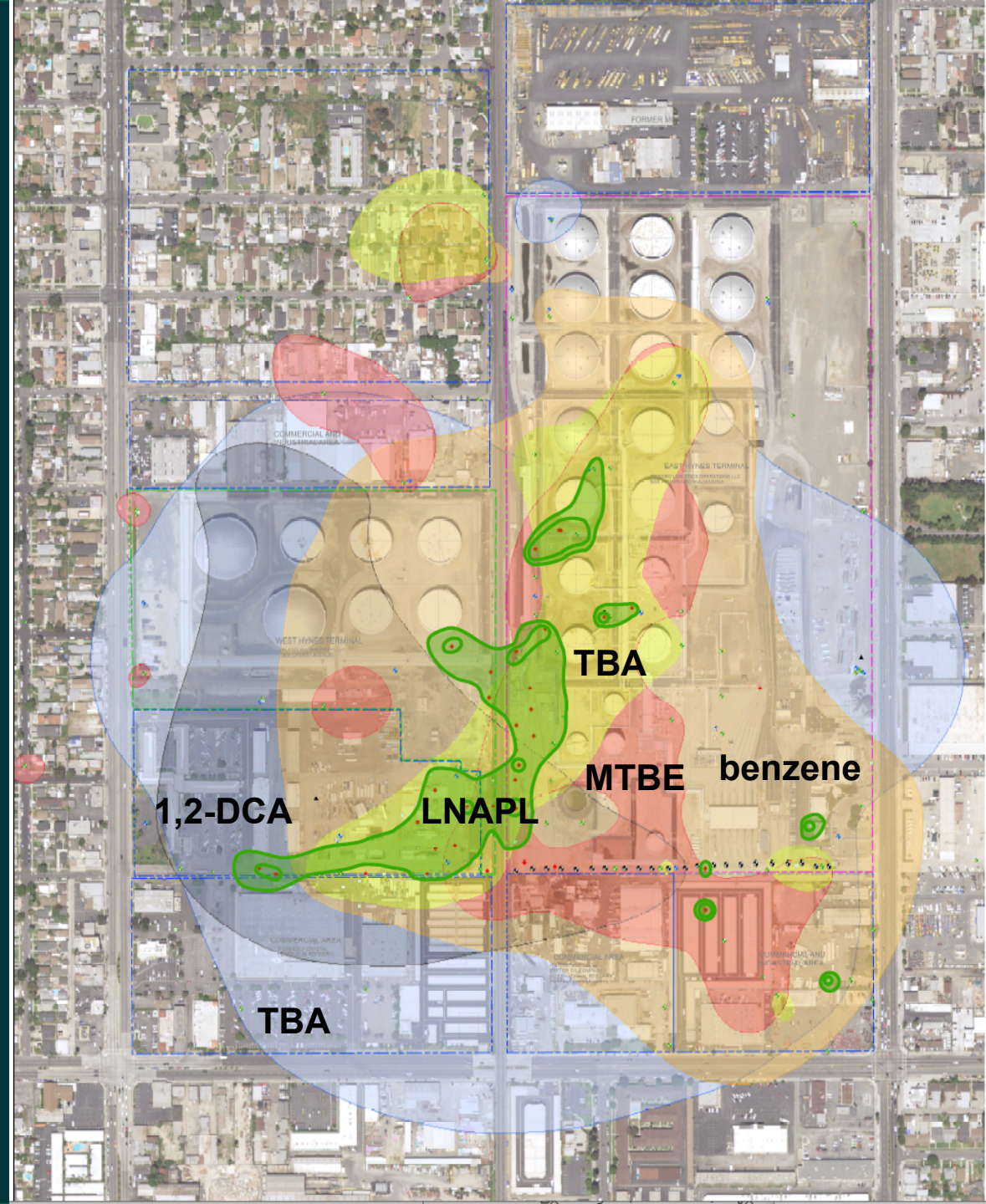


03

Site Two –
Large scale and complex
petrochemical

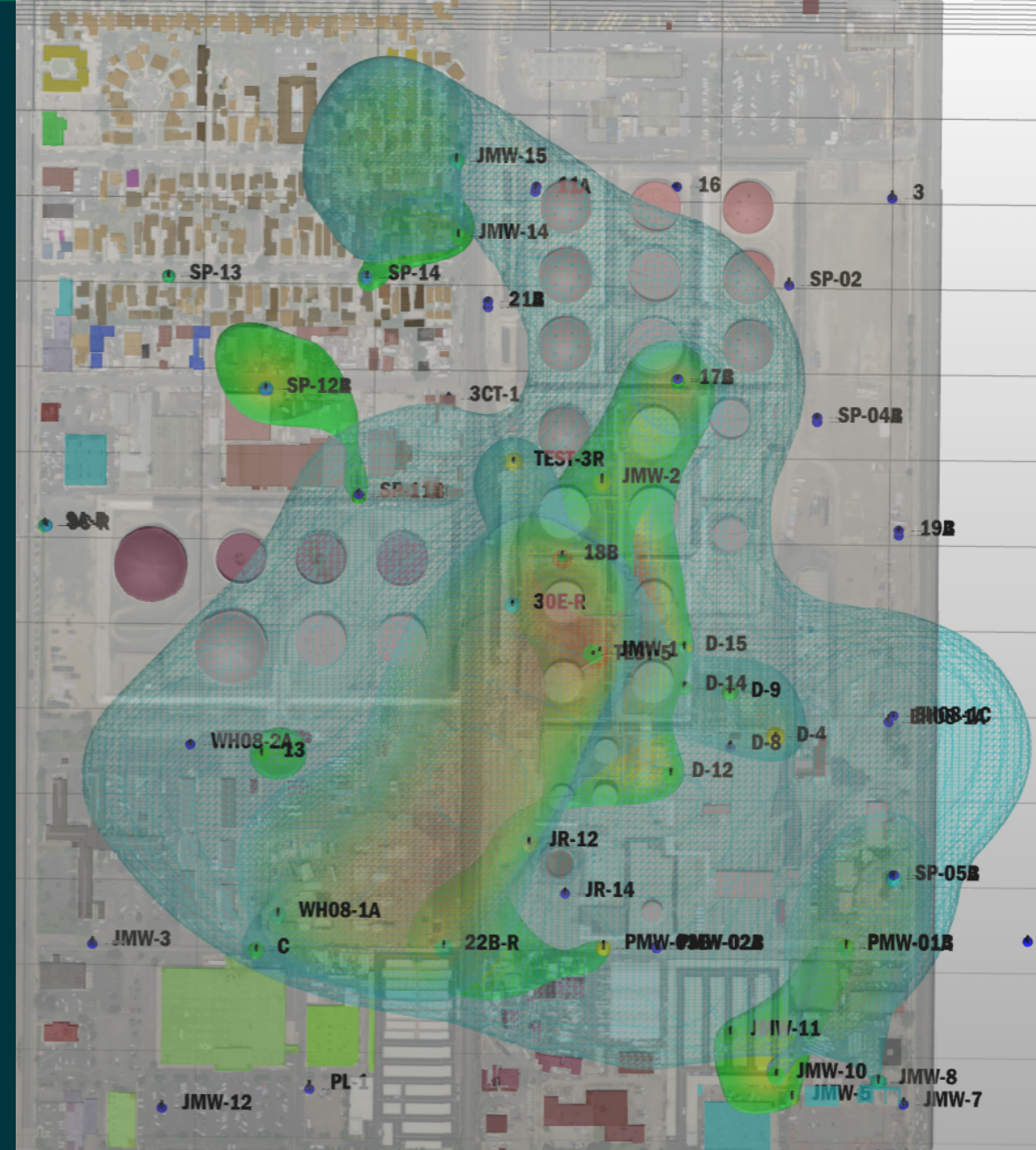
Petrochemical Facility

- Large-scale, 100 acres
- Complex industrial setting
- Decades of petroleum operations
- Historical gasoline releases
- LNAPL, BTEX, MTBE, TBA shallow impacts
- TBA, 1,2-DCA in deeper aquifer



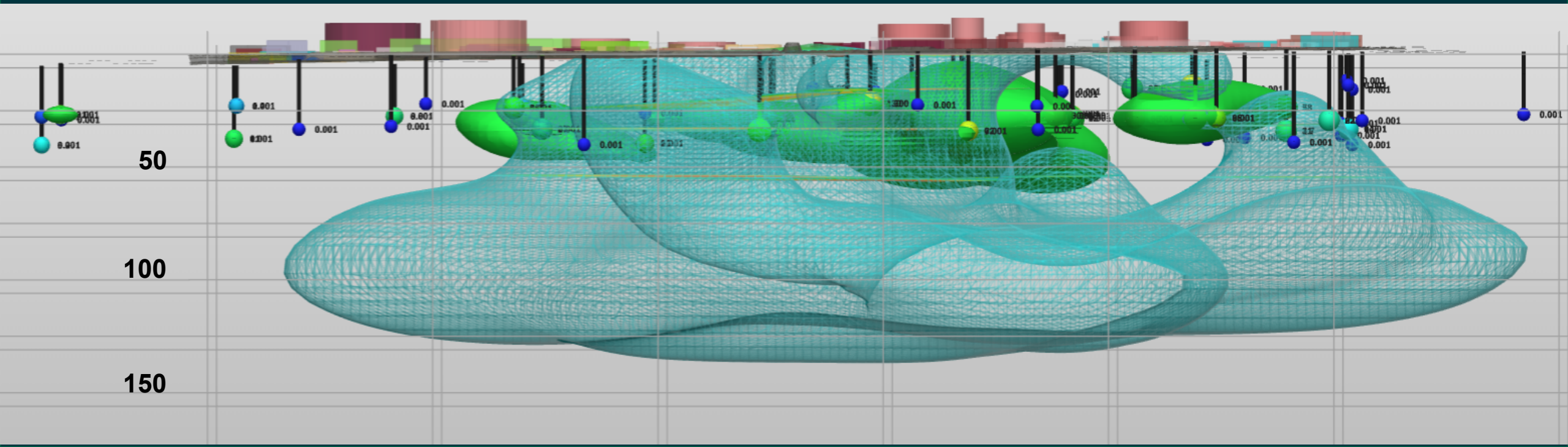
TBA as a Remediation Driver

- Largest extent in dissolved-phase
- TBA core tracks shallow MTBE and LNAPL
- Concentrations in 1,000s of $\mu\text{g/L}$



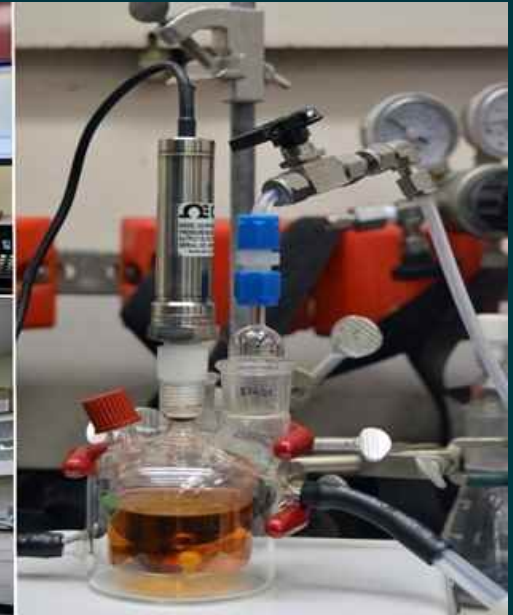
TBA as a Remediation Driver

- Primary driver for deep groundwater remediation (50-150 ft bgs)
- Likely product of MTBE aerobic degradation
- Lacking microbes/conditions for TBA degradation?



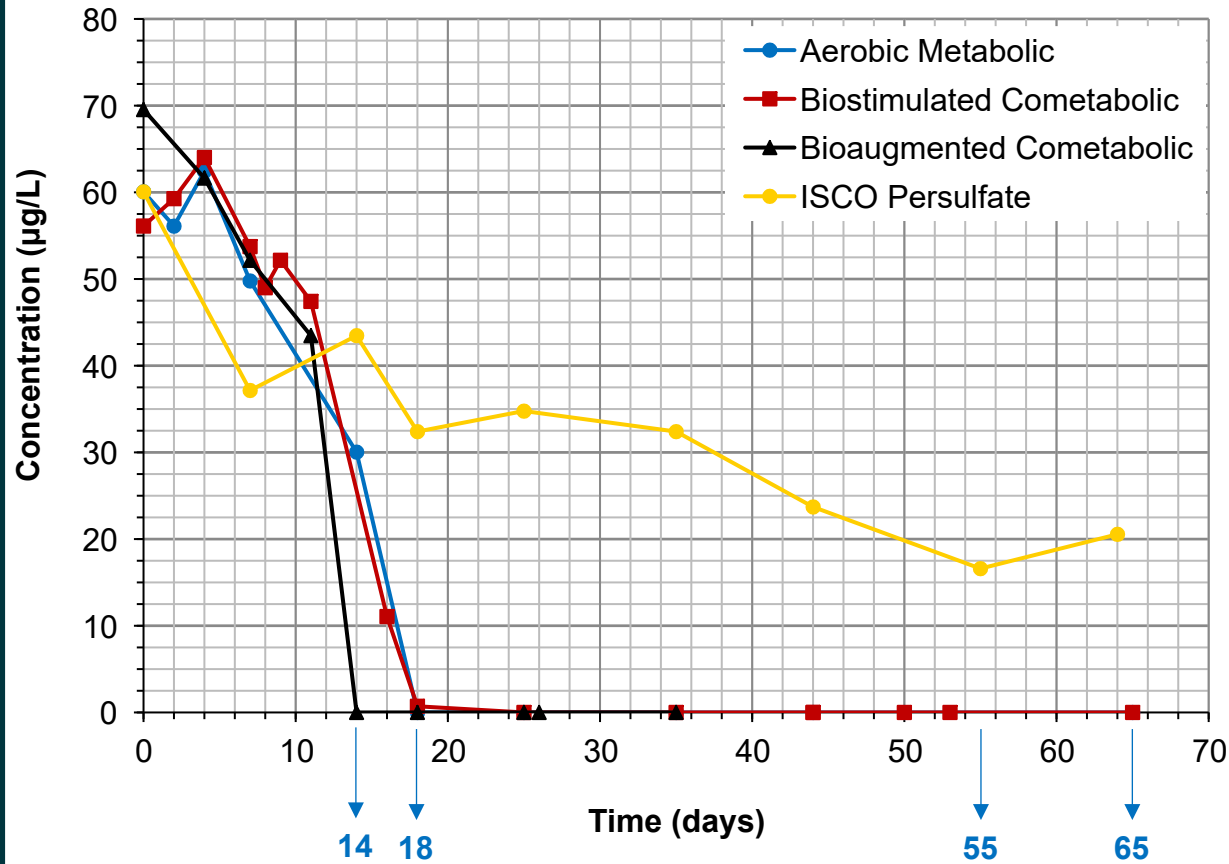
Bench-Scale Study – Treatability Lab in Austin

Treatment	Reactor Amendments							
	GW	Soil	Oxygen (mL)	Propane (mL)	DAP (mg/L)	ENV 425 (%)	Klozur™ (g)	25% NaOH (mL)
ISCO: Base-Activated Persulfate	X	X	–	–	–	–	4	4.82
Aerobic Metabolic	X	X	5	–	50	–	–	–
Biostimulated Cometabolic	X	X	5	5	50	–	–	–
Bioaugmented Cometabolic	X	X	5	5	50	2	–	–

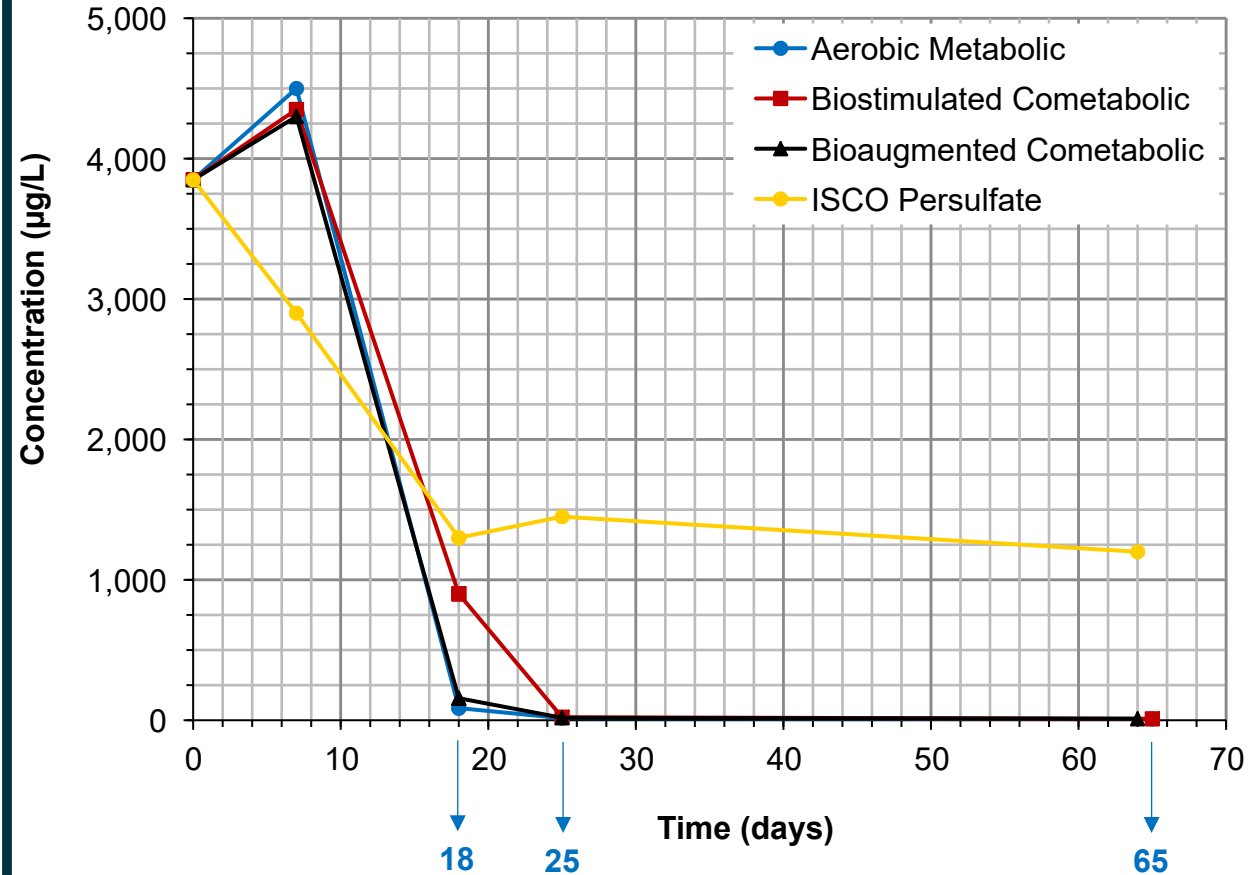


Study Results – TBA

TBA Headspace Concentrations (GC-FID)

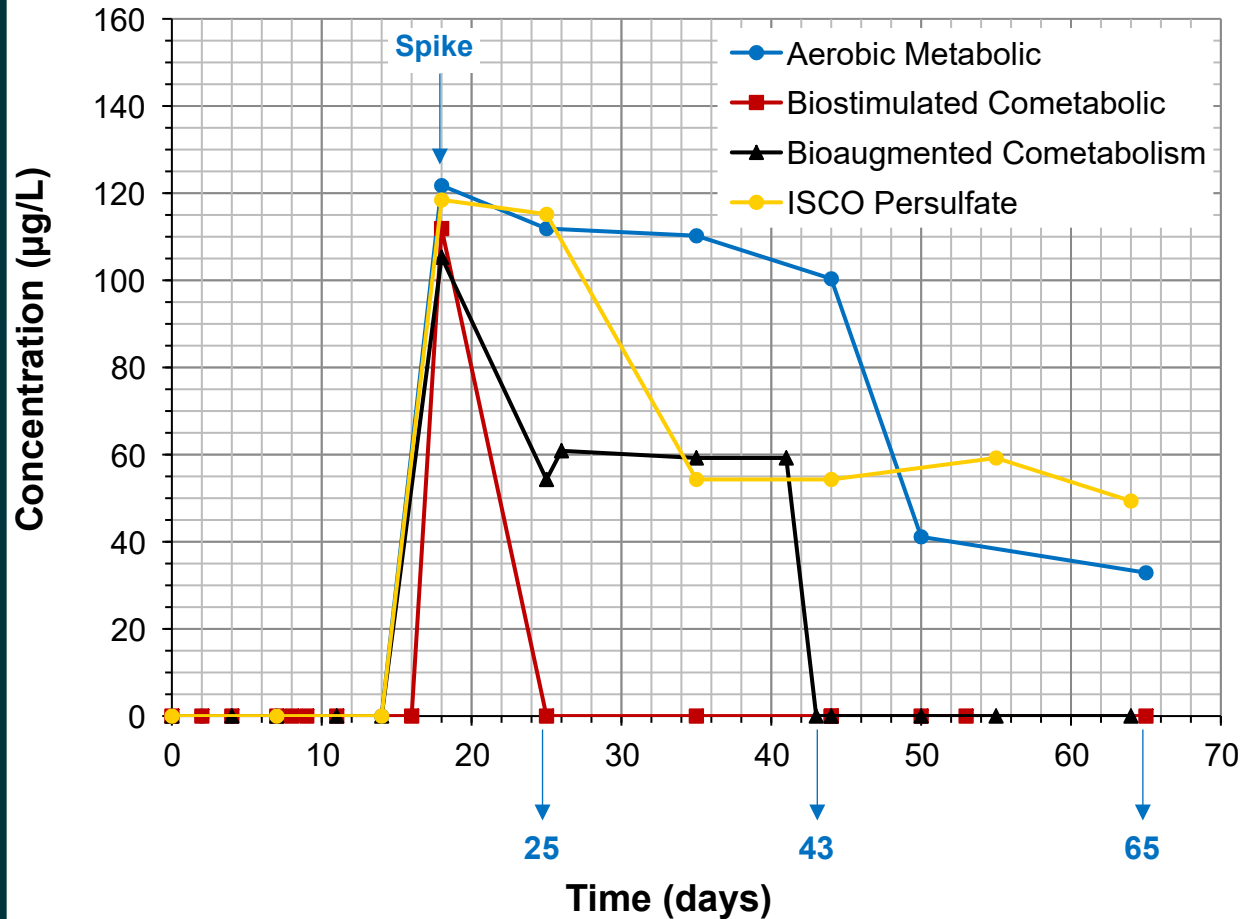


TBA Concentrations in Water (Method 8260)

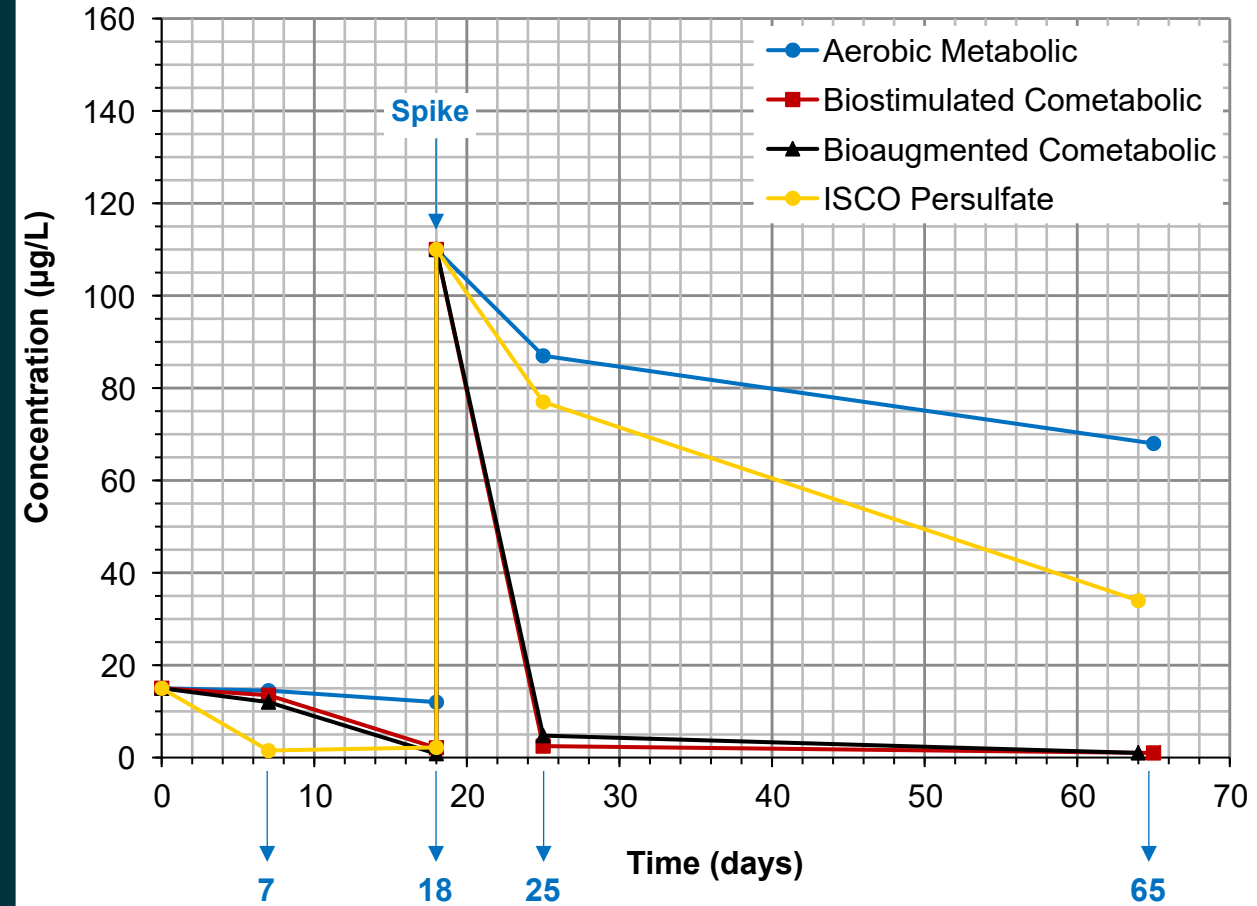


Study Results – 1,2-Dichloroethane

1,2-DCA Headspace Concentrations (GC-FID)



1,2-DCA Concentrations in Water (Method 8260)



Thank You!

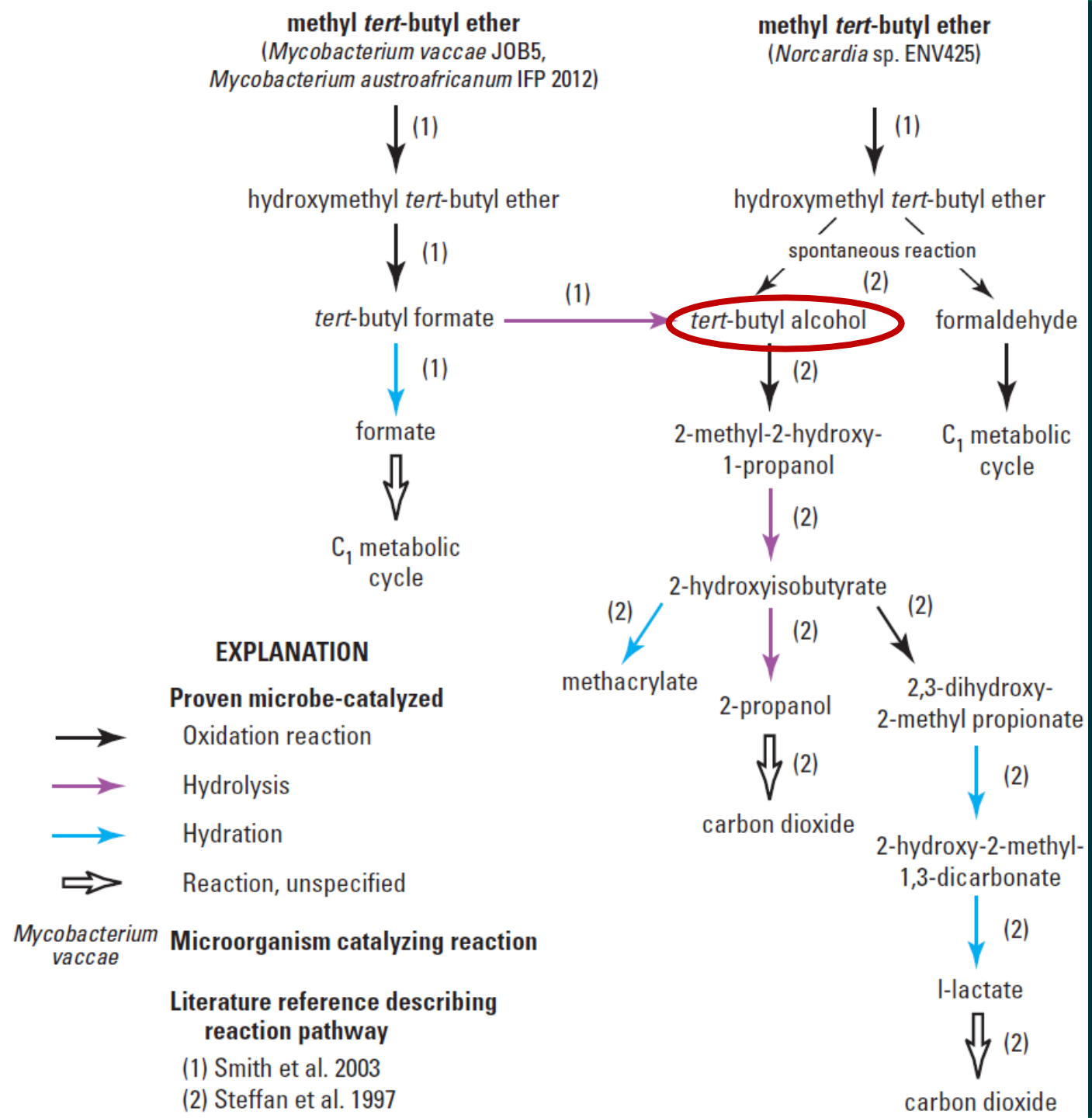
Daniel Monson
Marathon Petroleum

Francisco Barajas
AECOM Treatability Lab

Douglas Wright
AECOM Oakland

Mica Ben-Tzour
AECOM San Diego

Degradation Pathway



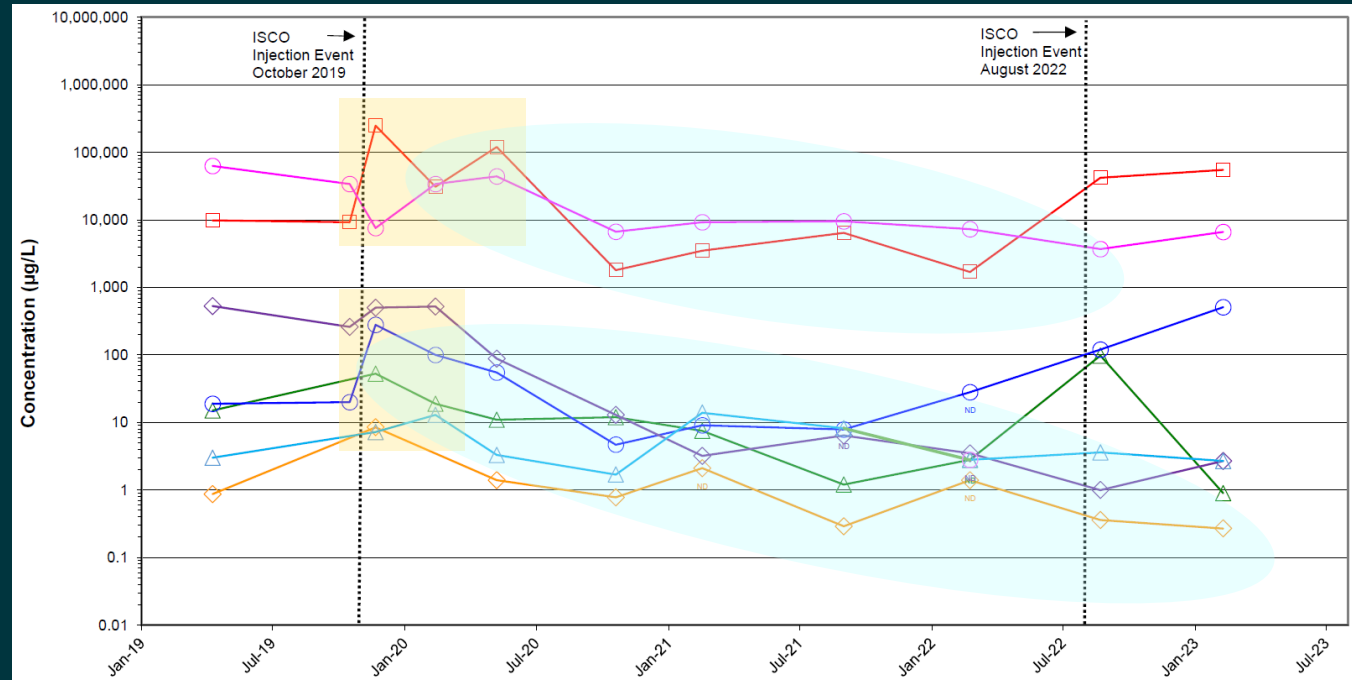
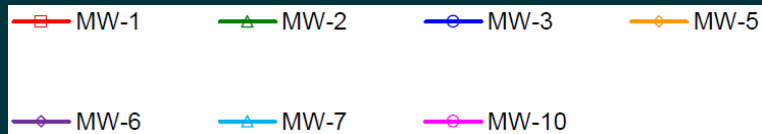
Remedy Performance

- MTBE

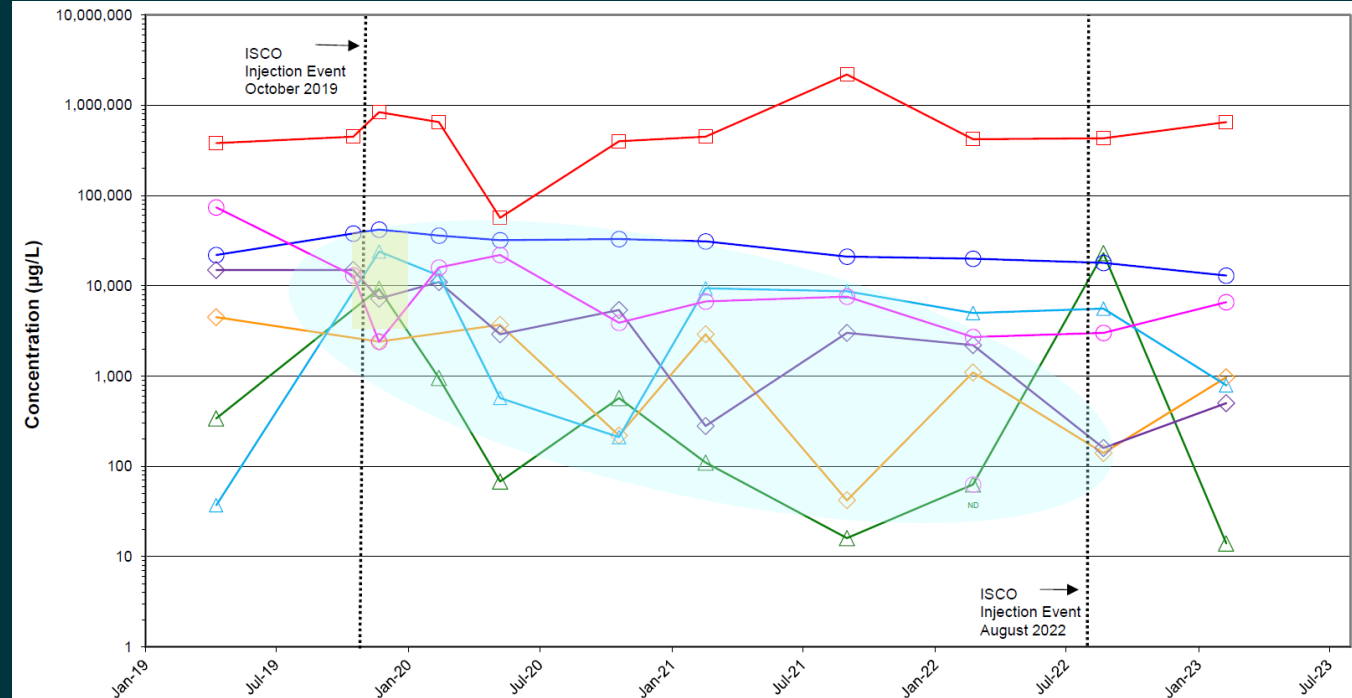
- Increases in all wells following injections – desorbing mass
- Followed by 1-2 oom reduction
- Rebound around source area

- TBA

- Few increases following the injection
- Followed by 1-2 oom reduction down- and cross-gradient
- No change around source area



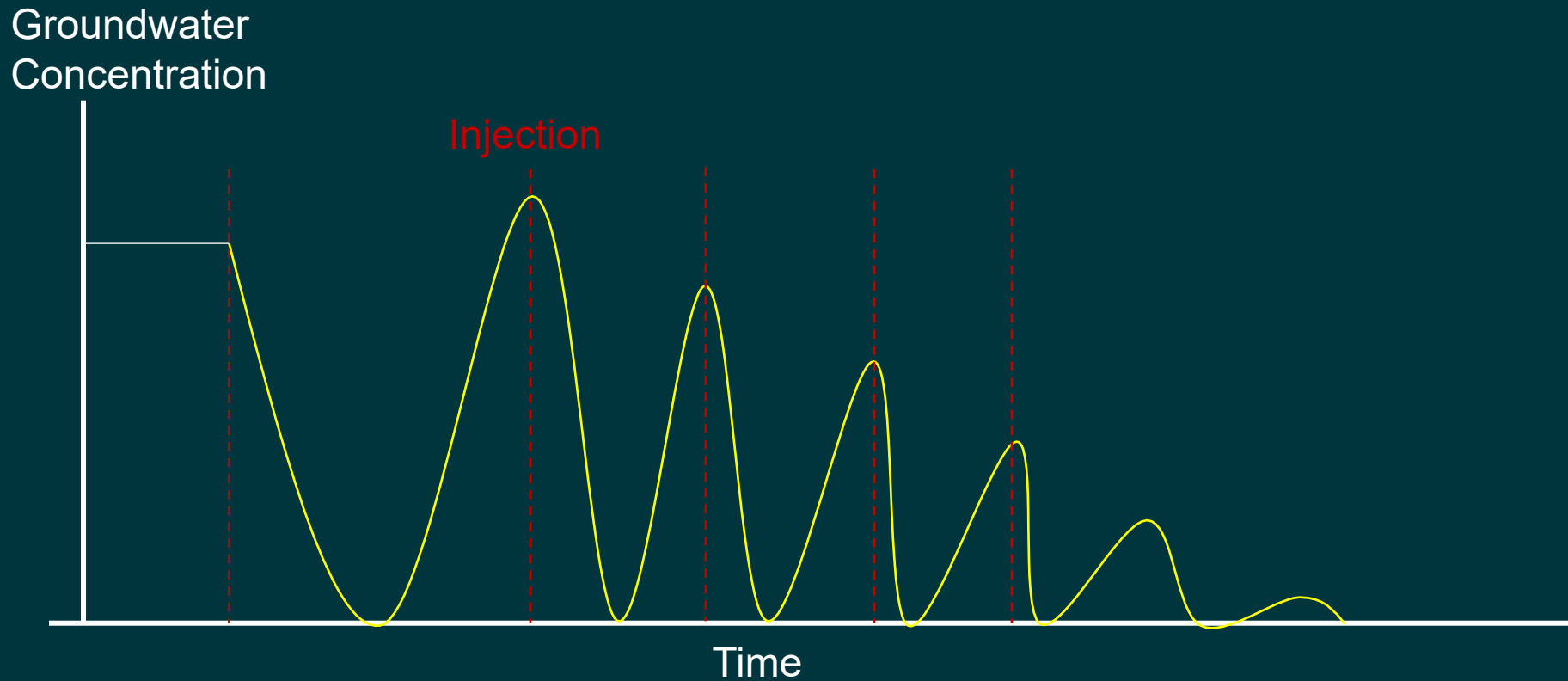
MTBE



TBA

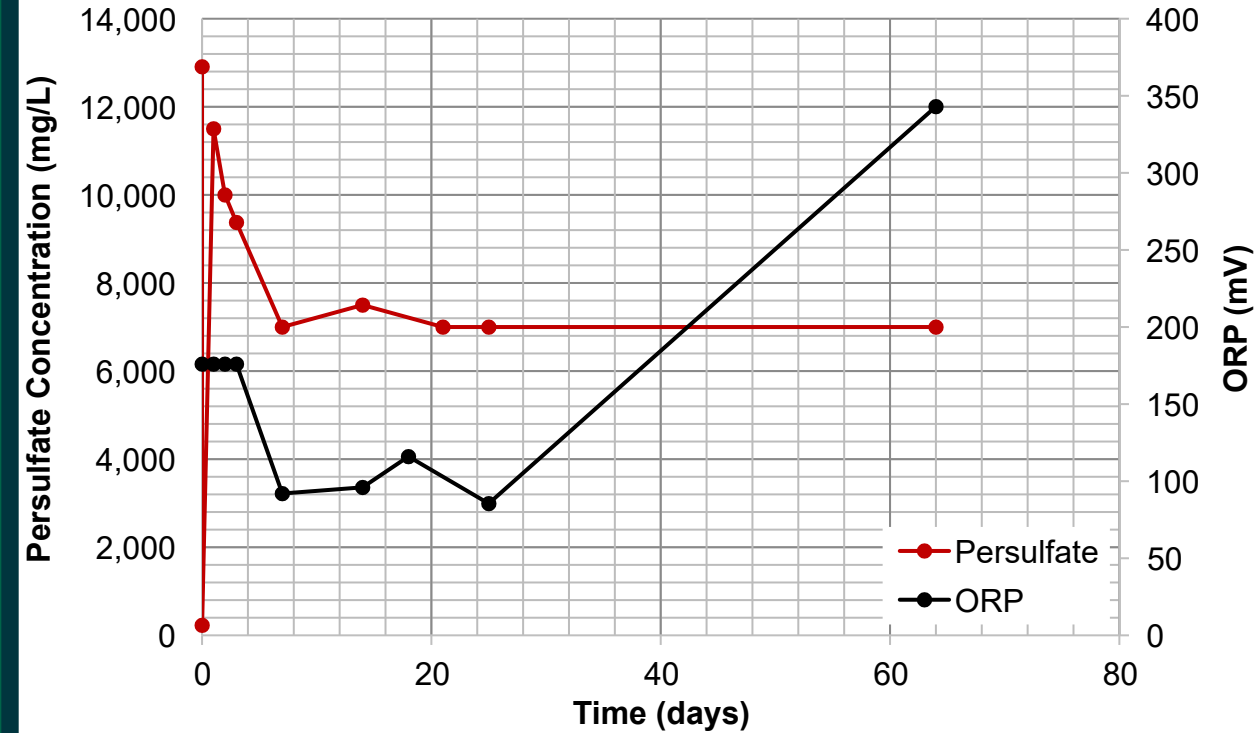
Where are we in the Cycle?

- ISCO accelerates mass transfer into groundwater

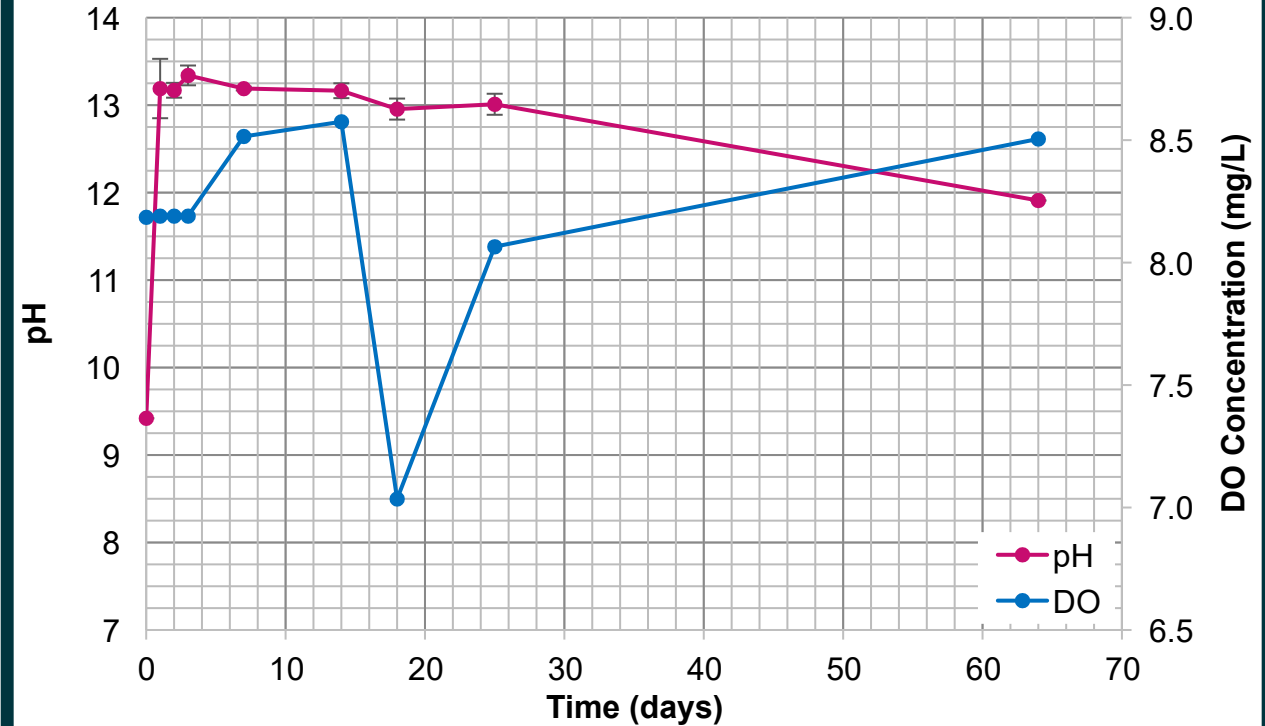


Study Results – ISCO Parameters

ISCO Persulfate and ORP

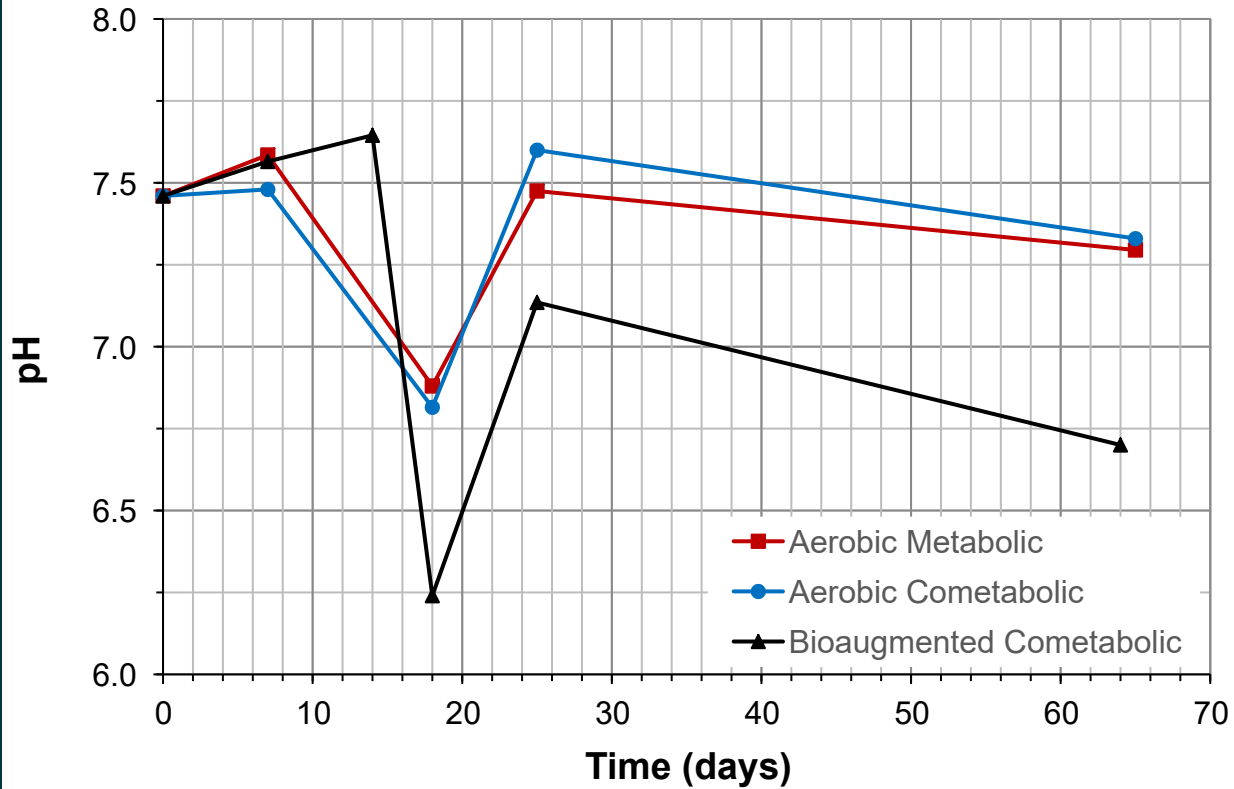


ISCO pH and DO Concentrations

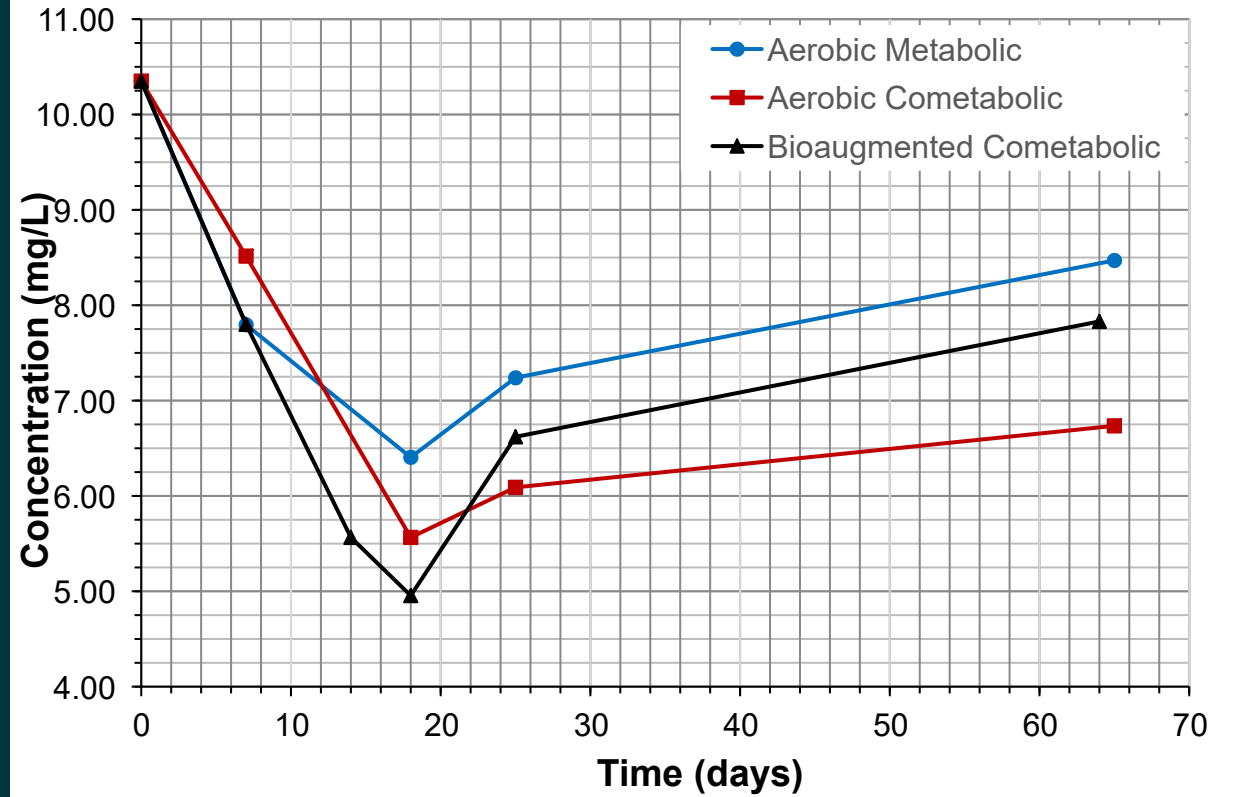


Study Results – Microcosm Parameters

pH

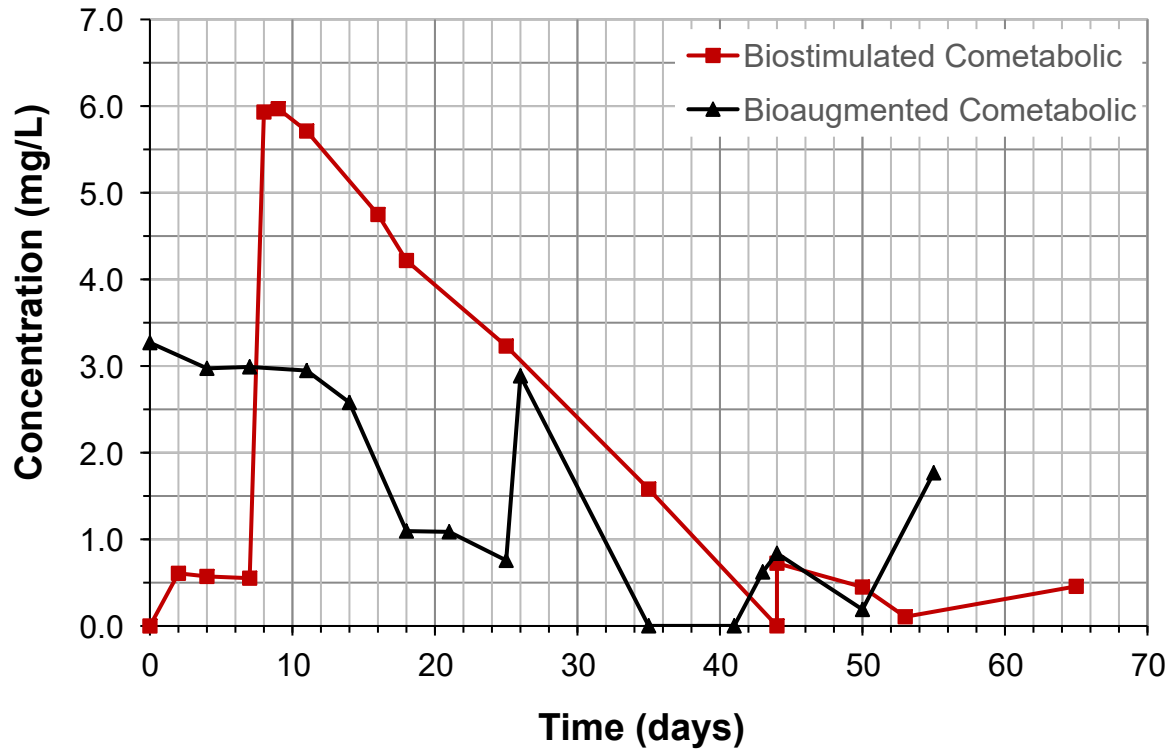


DO Concentrations



Study Results – Cometabolic Parameters

Propane (GC-FID)



Propane Monooxygenase

