

Achieving Project Success Through Remediation Failure

6th International Symposium on
Bioremediation and Sustainable
Environmental Technologies

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ESTCP Project ER-201120

FINAL REPORT

Development of an Expanded, High-Reliability Cost and Performance Database for In-Situ Remediation Technologies

ESTCP Project ER-201120

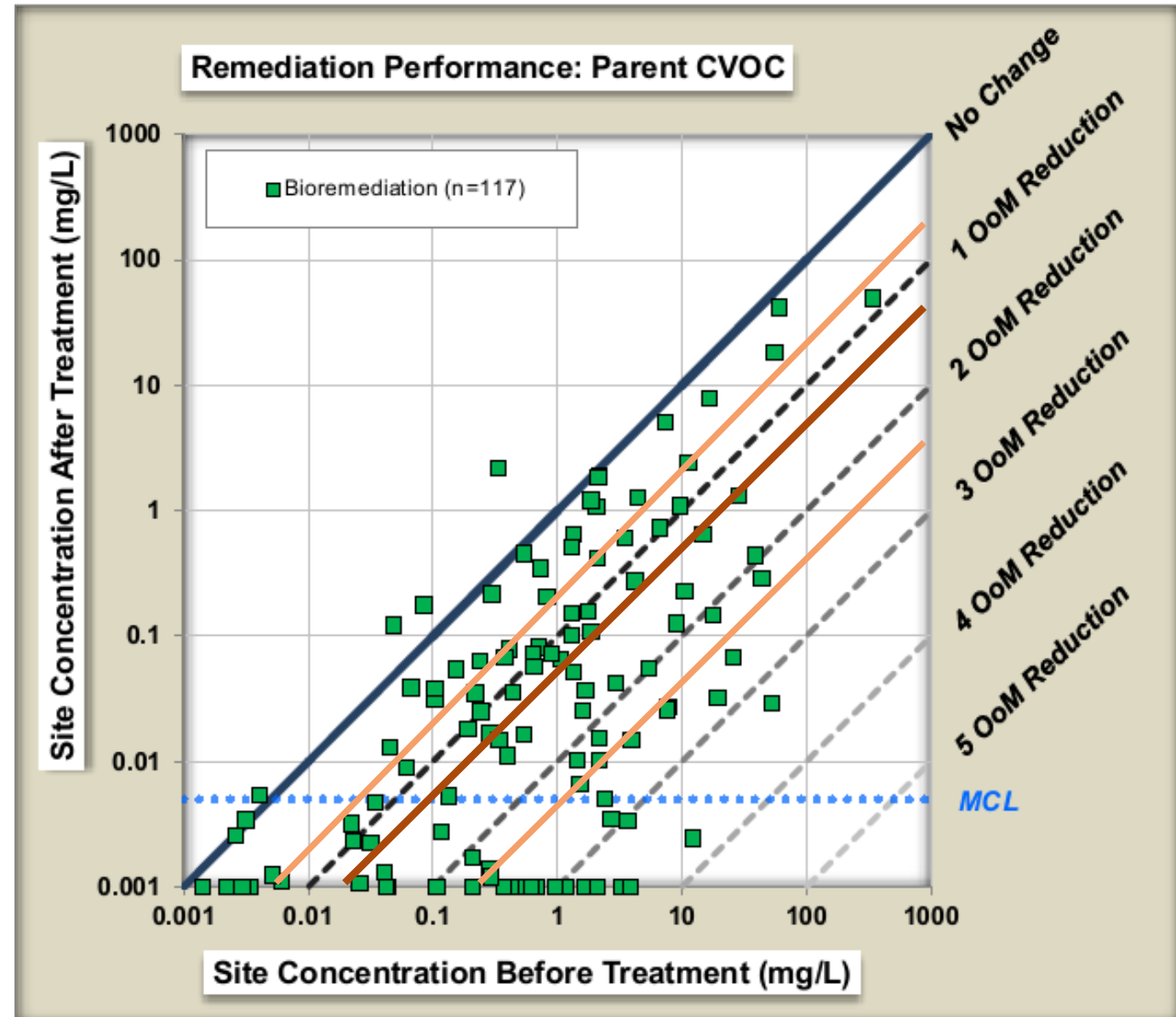
MARCH 20

Travis McGuire
David Adamson
Charles Newell
Poonam Kulkarni
GSI Environmental, Inc.

- Middle 50% of sites achieved 0.6 to 2.2 OoM decrease in geometric mean of parent compound, median decrease of 1.1 OoM
- Generally decreased when considering total CVOCs or maximum concentrations
- 21% of 710 wells achieved MCLs. 17 of 235 sites (7%) achieved MCLs at all wells for parent CVOC**

** 10 of these 17 sites had a single monitoring well

Is that good? Or bad?



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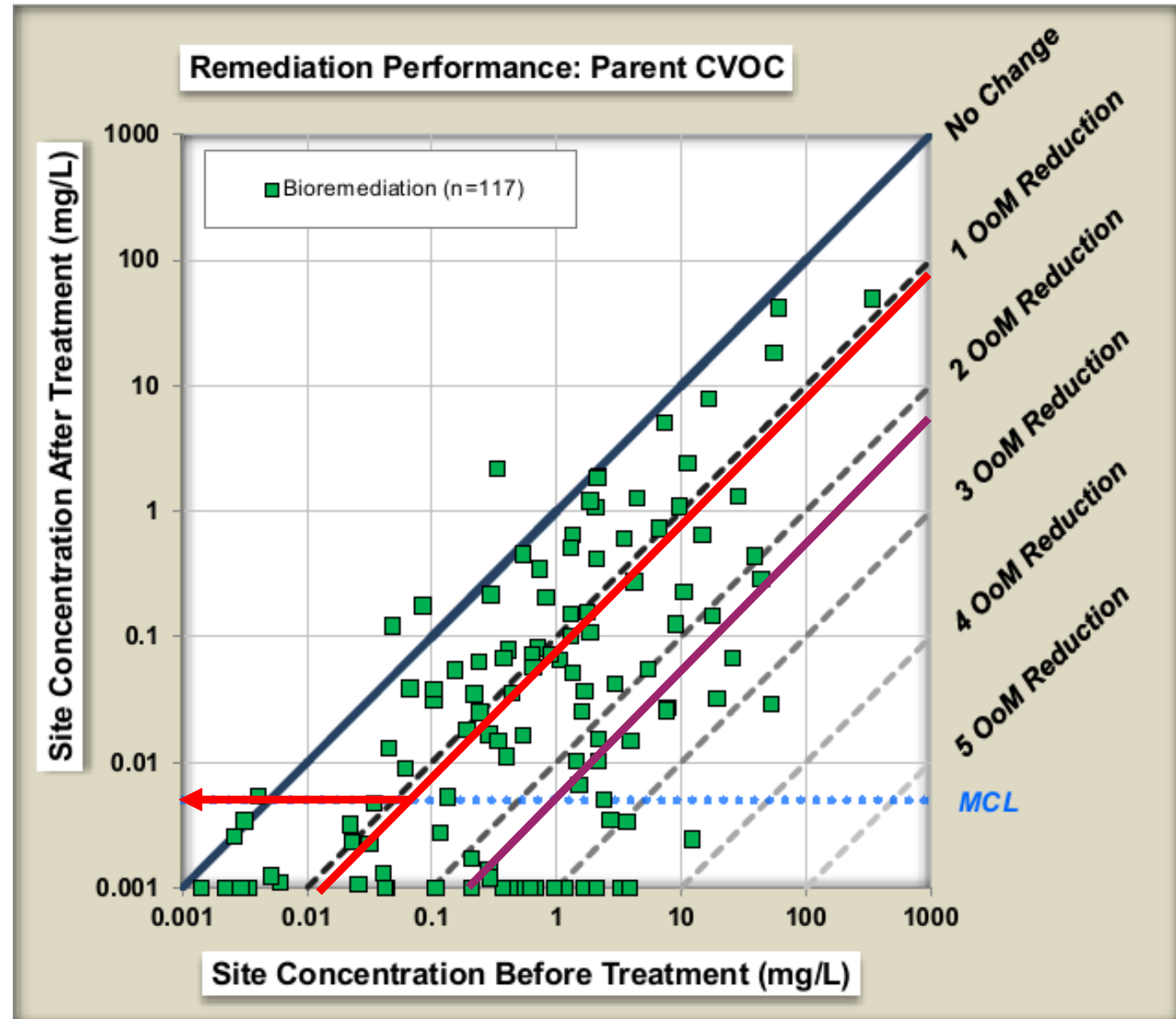
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- 92% reduction: Seems good
- If 5 µg/L is the goal, the starting concentration would be ~63 µg/L: Seems bad
- We routinely promise more
- Starting concentration of 1,000 µg/L would require a 2.3 OoM reduction to reach MCL

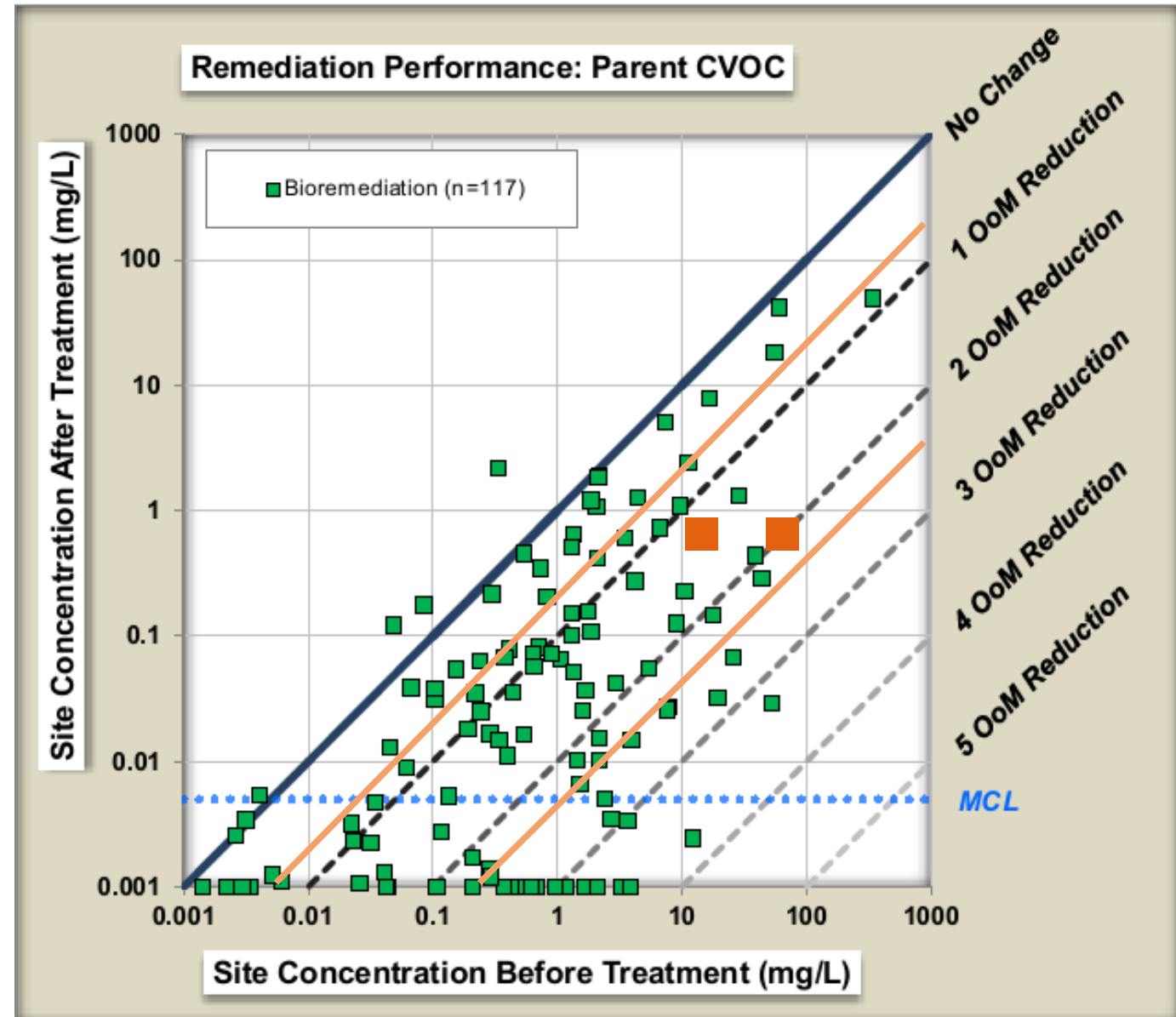
Is that good? Or bad?



Project Example #1

Example #1

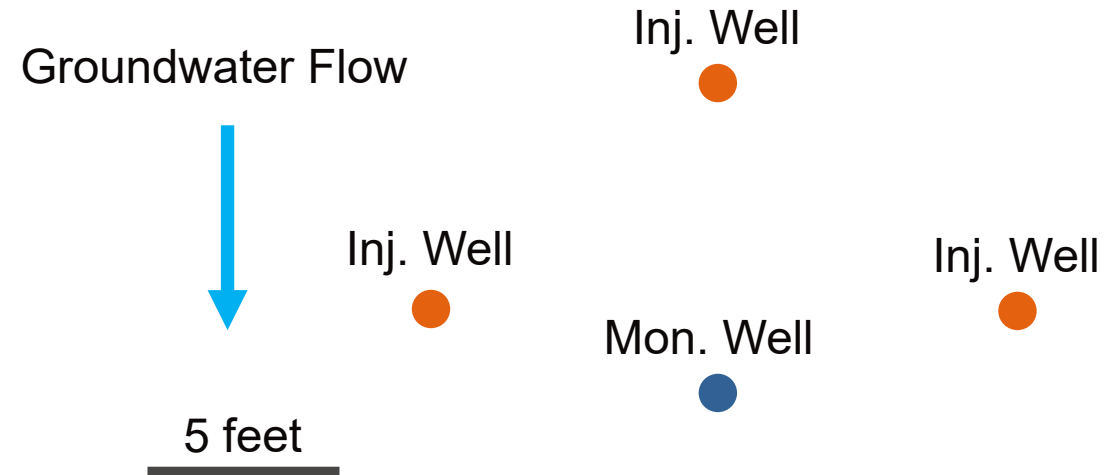
- Active chemical manufacturing facility
- Site-specific 1,2-DCA groundwater standard of 0.84 mg/L
- Two compliance wells exceeding the standard
 - Well #1 - 71.9 mg/L (~1.9 OoM reduction)
 - Well #2 - 20.3 mg/L (~1.4 OoM reduction)



Example #1

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Pilot Test Layout



Pilot Test Activities and Lessons Learned

- 6 soluble substrate injections over 2 years
- Completed in secondary area away from compliance points
- 1,2-DCA: 122 mg/L → 0.011 mg/L (~4 OoM reduction)
- ~9-month lag time to degrade chloroform (1.4 mg/L)



Example #1 – Full-scale Implementation

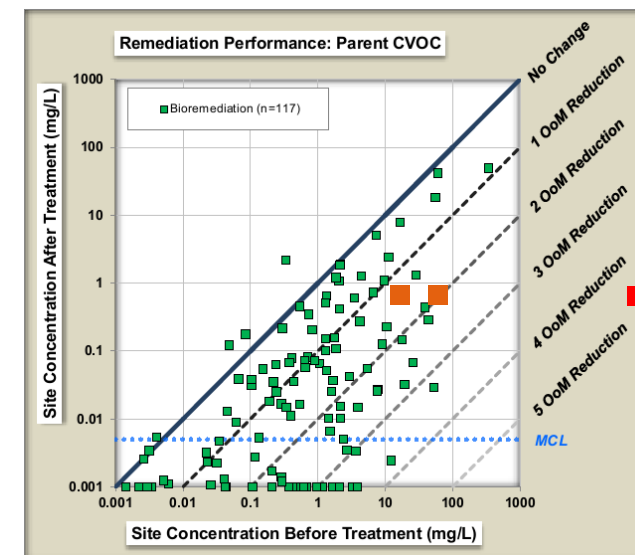
Step 1: Pre-design Investigation



Concentrations up to 14,000 mg/L



4.3 OoM reduction required



Infrastructure created significant restrictions on well placement

12 ft → 20 ft



Step 2: Well Installation

- DNAPL collecting in some wells
- Chloroform > 300 mg/L
- 1,1,2-TCA > 390 mg/L

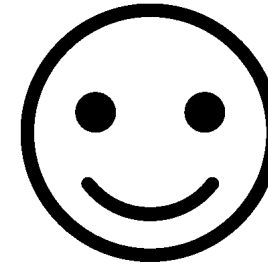


Site Example #1 – Results



The Bad

- No meaningful change in dechlorination rates or contaminant trends



The Good

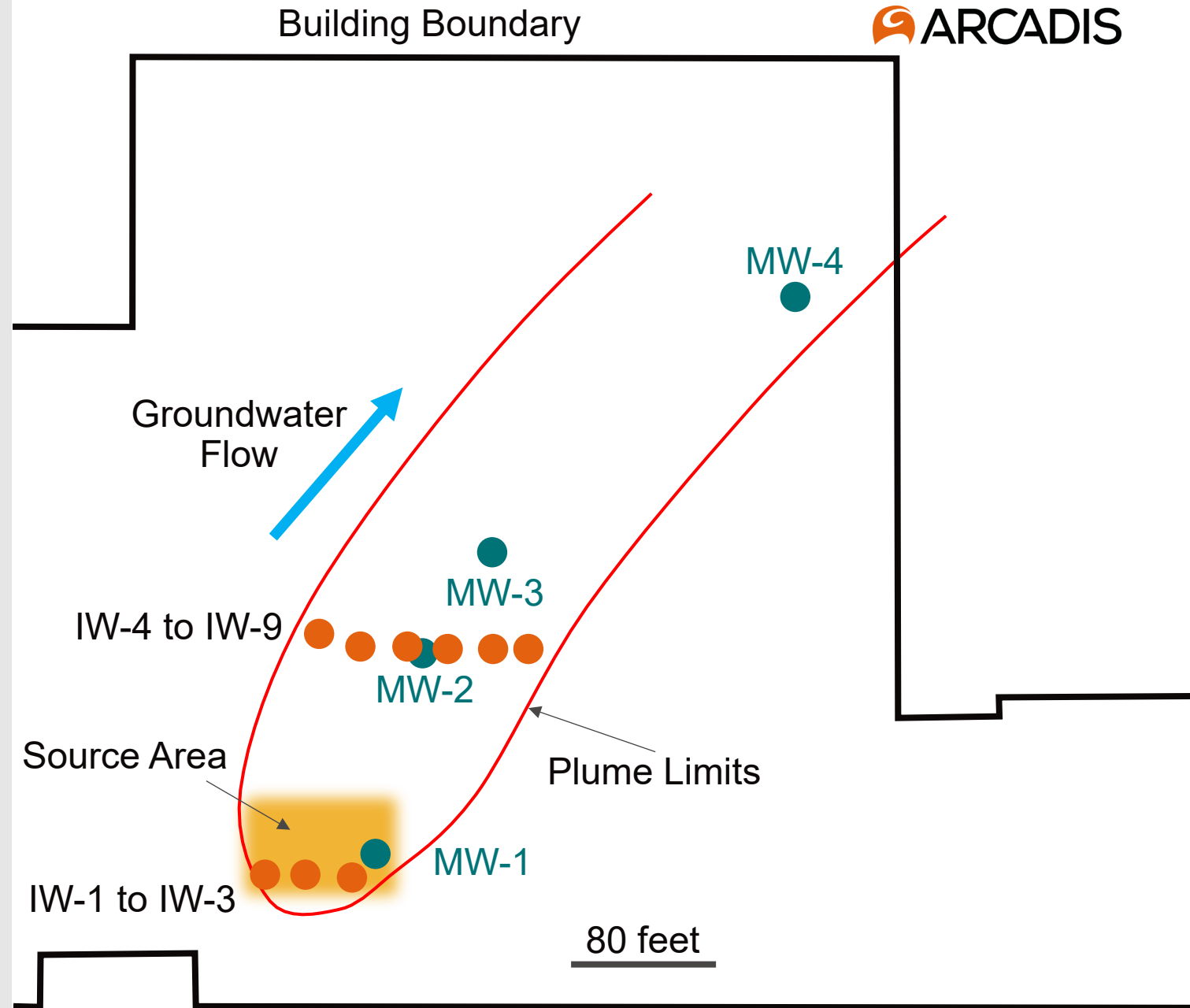
- Demonstrated that injection-based remedies are not viable
- Demonstrated that groundwater is stagnant, existing impacts are not migrating
- Documented attempt at best available/implementable technology
- Client was satisfied



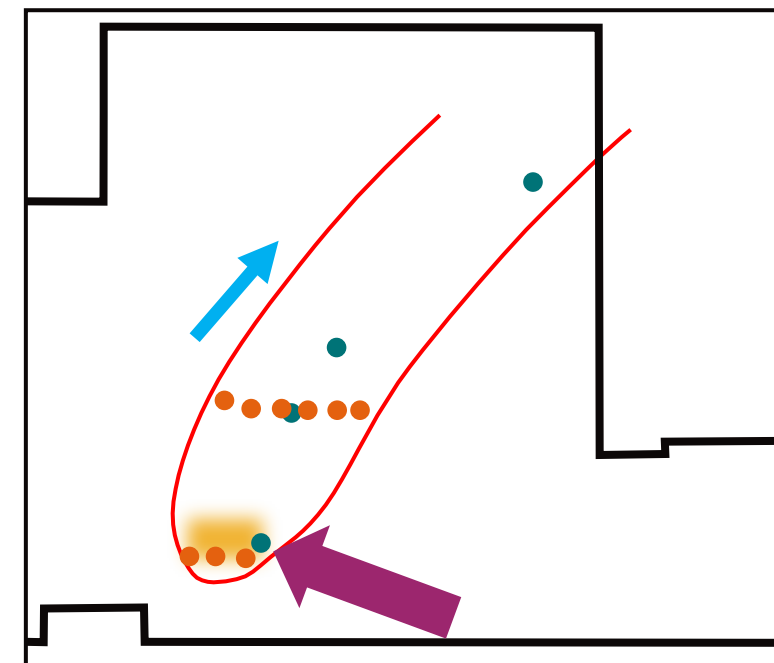
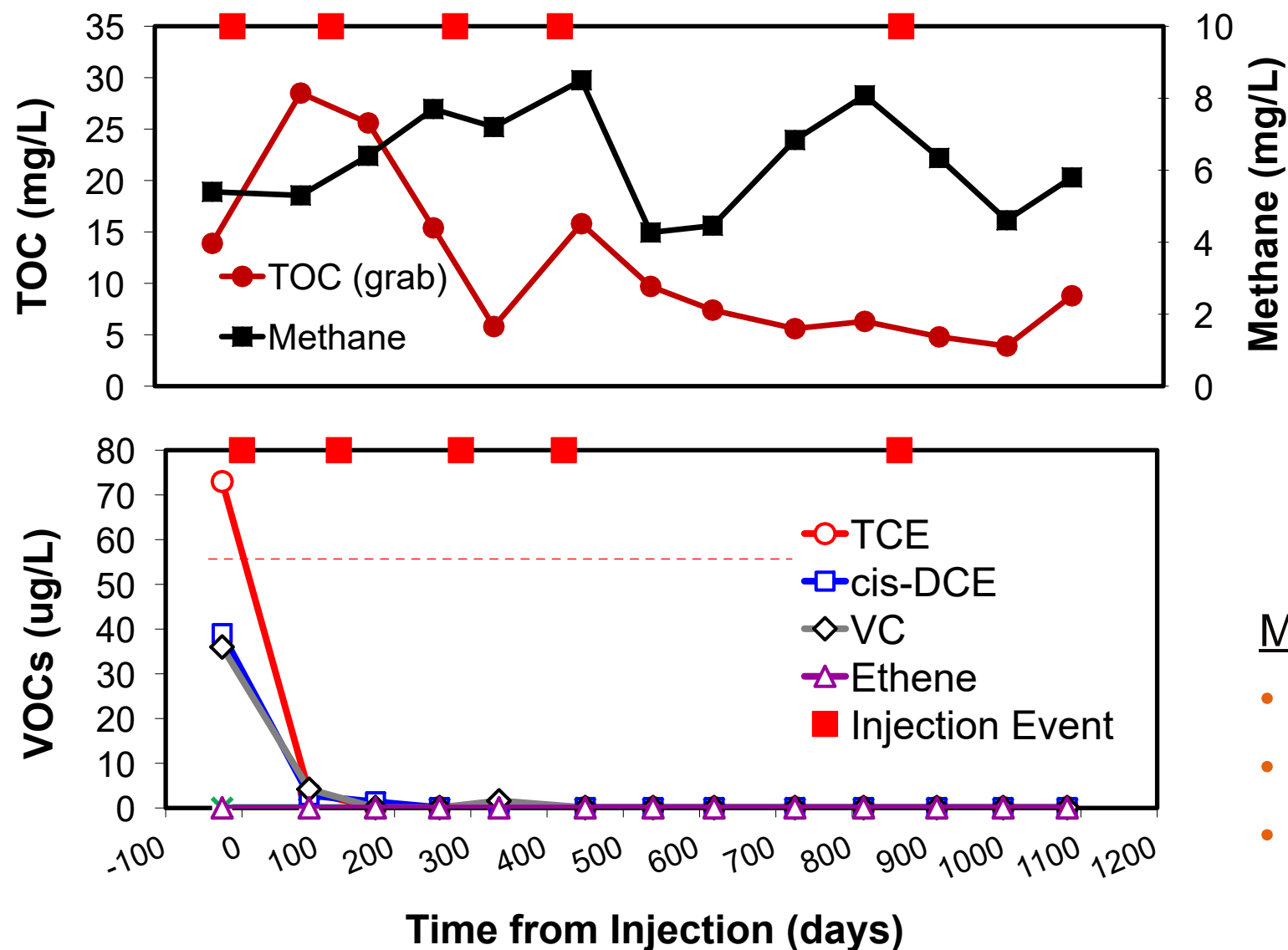
Project Example #2

Example #2

- Active manufacturing facility
- Chlorinated ethenes (TCE) exceeding MCLs and Groundwater Volatilization Criteria (GVC) – 68 µg/L
- 4 wells exceeding criteria
 - MW-1 – 73 µg/L (~0.1 OoM reduction)
 - MW-2 – 1,700 µg/L (~1.4 OoM reduction)
 - MW-3 – 560 µg/L (~0.9 OoM reduction)
 - MW-4 – 1,100 µg/L (~1.2 OoM reduction)
- 5 injections over 2.5 years
 - 4 soluble
 - 1 sparingly soluble



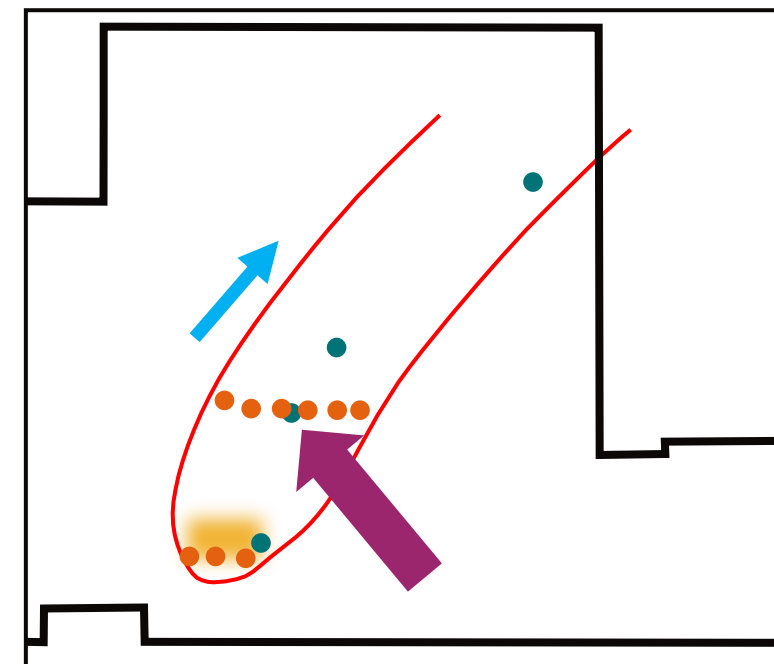
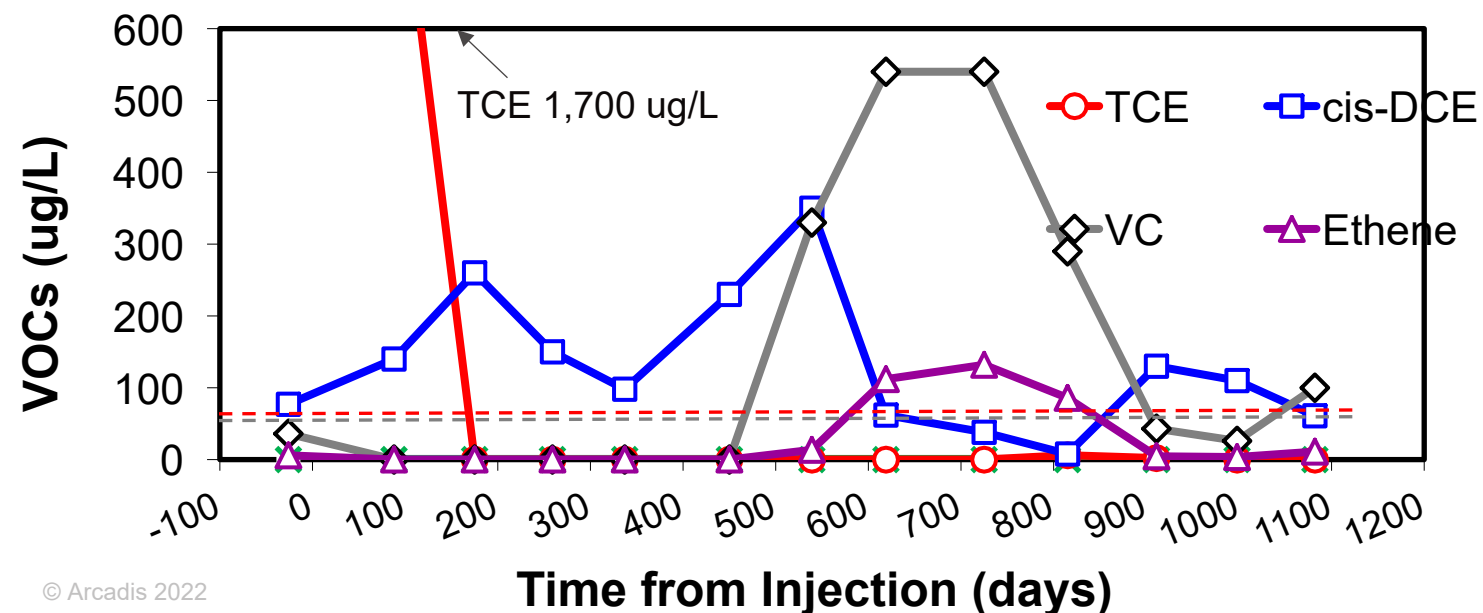
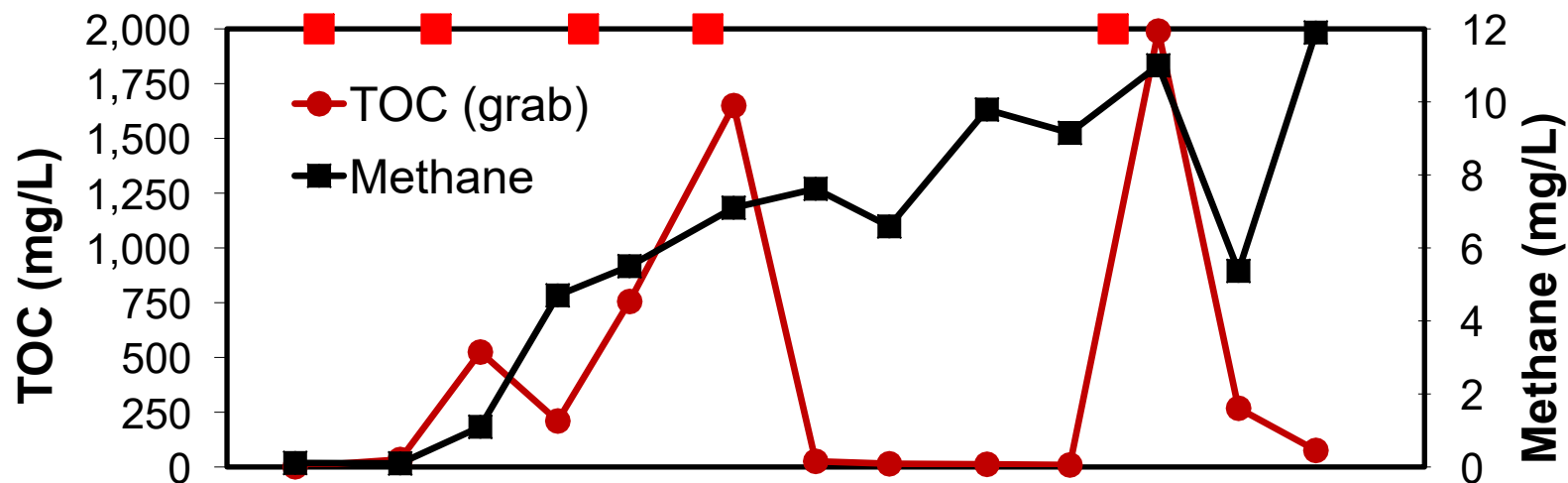
Example #2 – Results



MW-1

- Fringe source location
- No large change in TOC/CH₄
- VOCs dropped quickly below target criteria

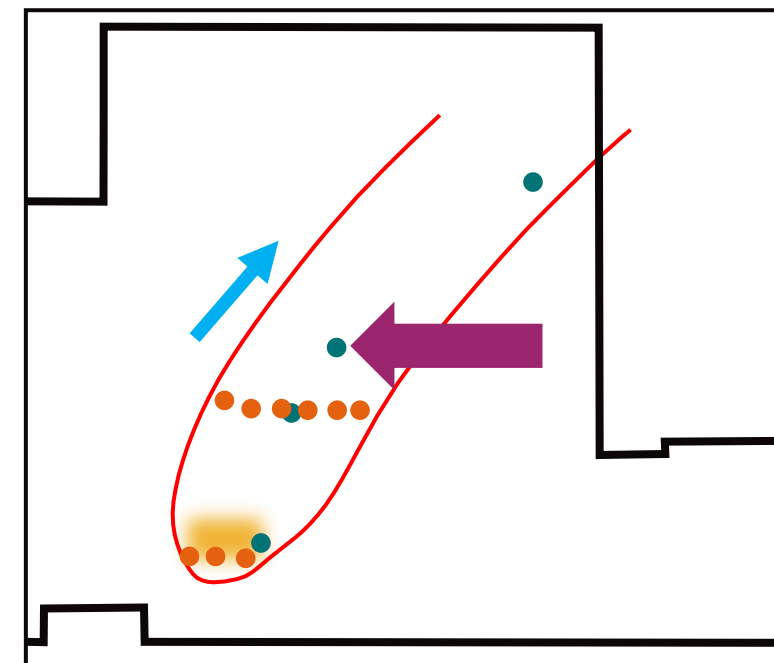
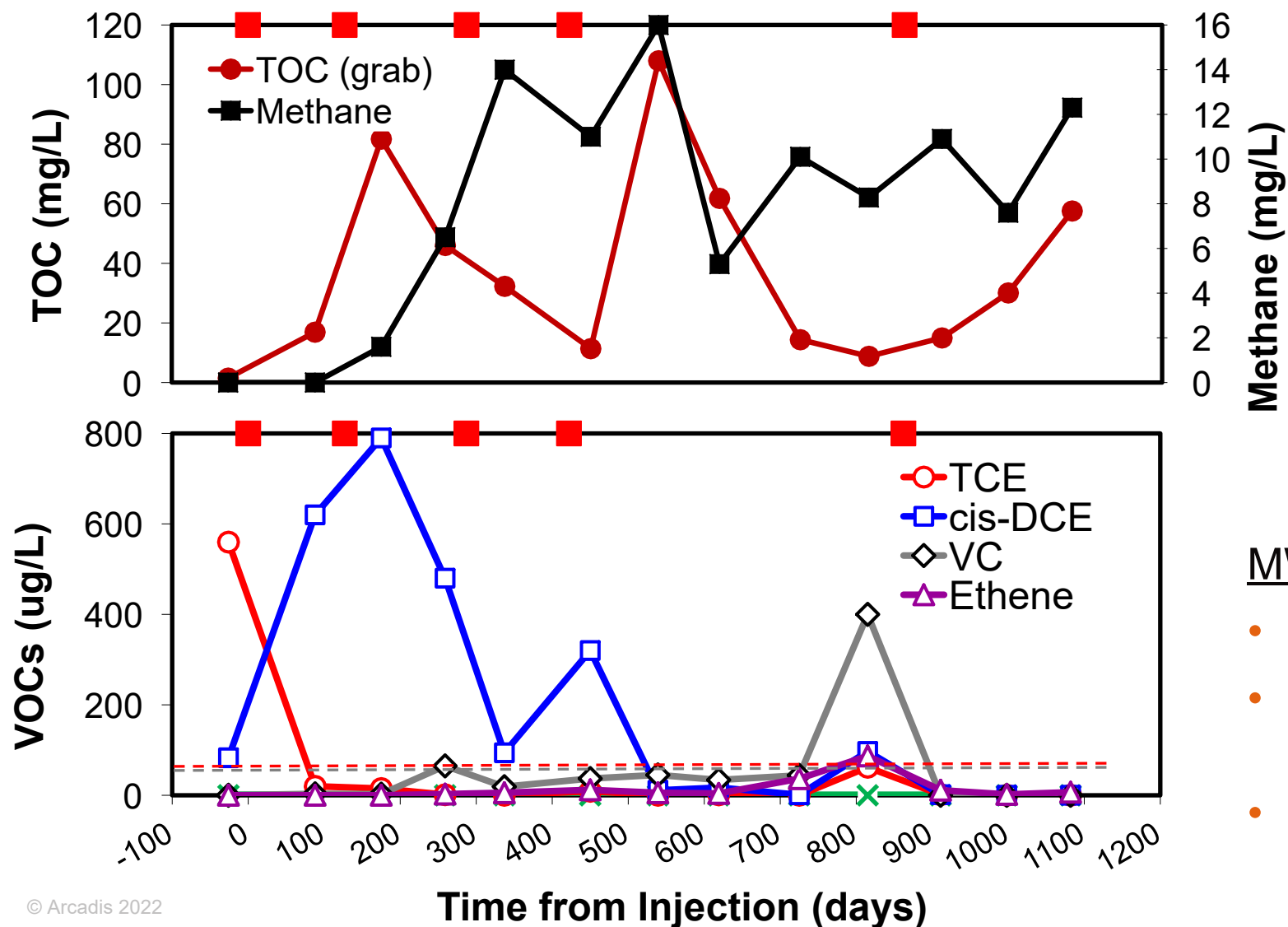
Example #2 – Results



MW-2

- Inline with injection transect
- Good dechlorination/transient TOC
- TCE below target criteria, but VC increased

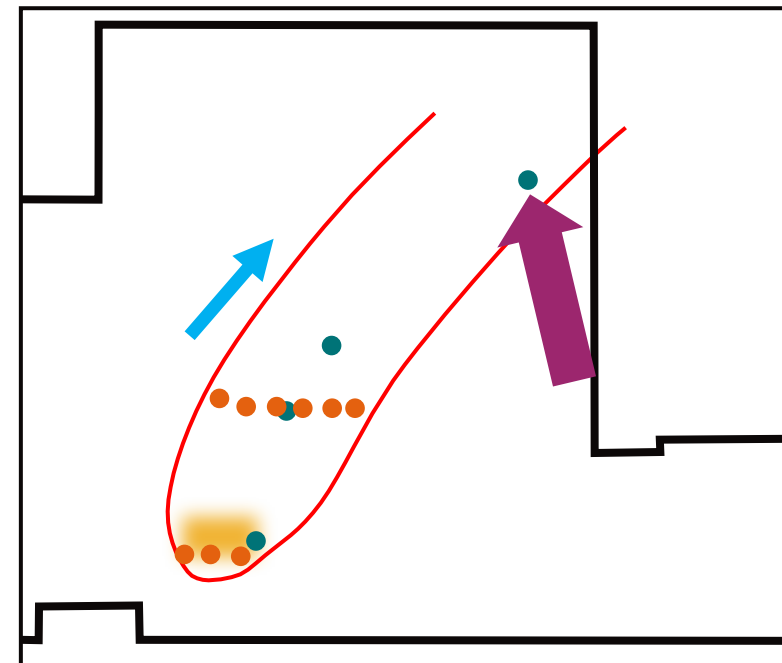
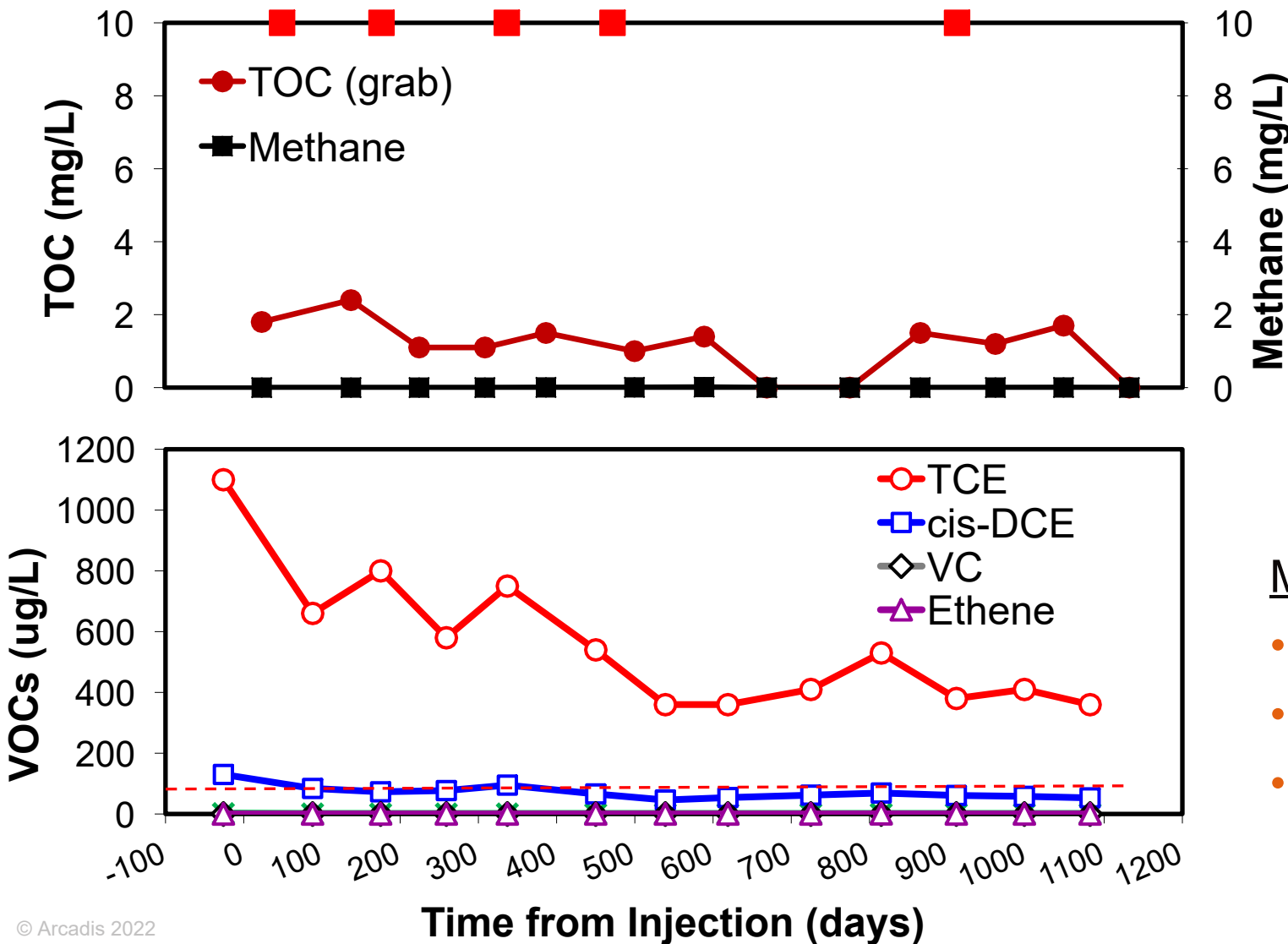
Example #2 – Results



MW-3

- Downgradient “reactive zone” well
- Achieved target criteria for TCE and VC
- Representative of what is leaving the treatment area

Example #2 – Results



MW-4

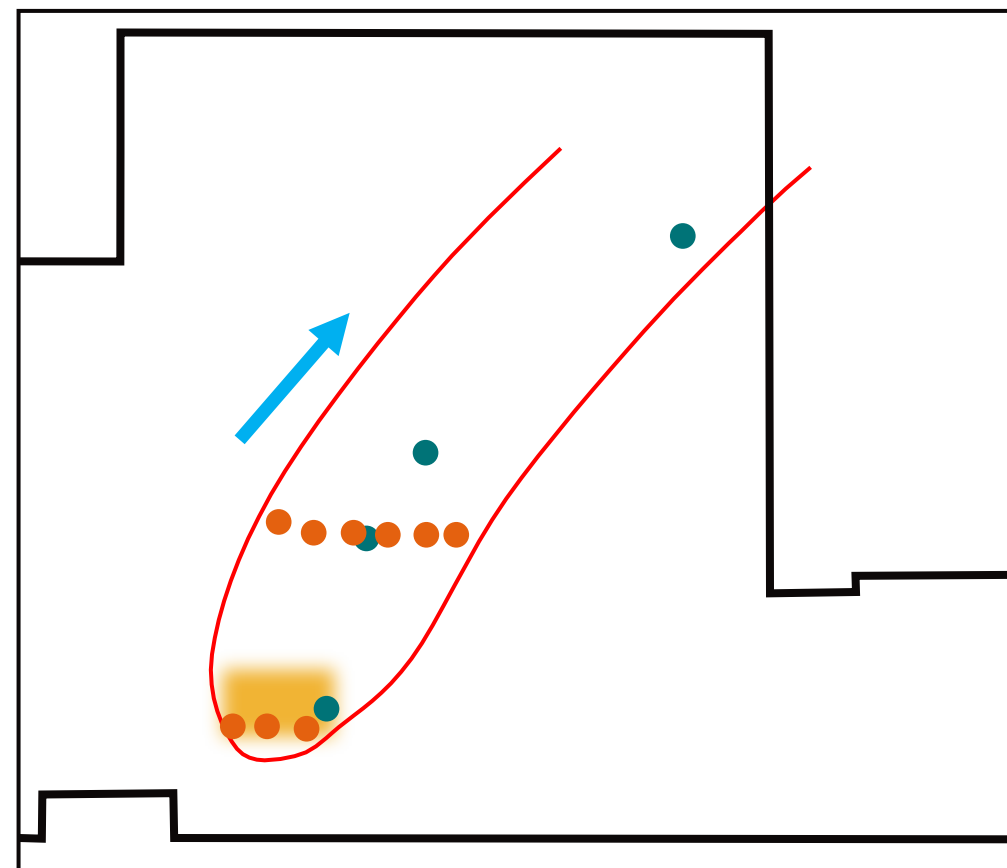
- Flushing zone well
- Decreasing trend
- Has not reached target criteria

Example #2 – Takeaways

- Target criteria met at some wells, but not all
- Early communication with client that a long flushing period will be required
- Education with regulators
 - Biomass will sustain reducing conditions
 - High-flux zones have been treated
- No additional injections planned, project considered successful despite not actively reaching criteria

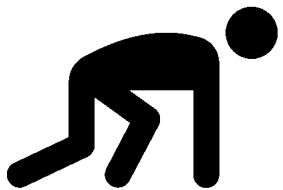


Typical first reaction is to install more injection wells or extend injections



Summary

- Pushing for lower and lower treatment results isn't the only way to achieve project success
- These sites were successful not because they reached quantitative goals, but because they met the expectations that had been set
- It can be easier, cheaper and equally acceptable to move the finish line closer



Contact Information



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