

# Comparison of Bioremediation of Biosparge Systems from Two Sites

Anjali Lothe ([anjali.lothe@aecom.com](mailto:anjali.lothe@aecom.com)) and  
Assaf Rees ([assaf.rees@aecom.com](mailto:assaf.rees@aecom.com))  
AECOM, Long Beach, CA, USA

# Agenda



1. Objective
2. Site Introductions
  1. Layout
  2. Biosparge System Operation parameters
3. Remediation Progress
  1. LNAPL Thickness
  2. Microbial Trends
  3. Benzene Trends
4. System Optimization- Dissolved Oxygen (DO)
  1. Flow Rate vs. DO
  2. Distance to nearest Sparge well vs. DO
  3. Porosity vs DO
5. Conclusion

01

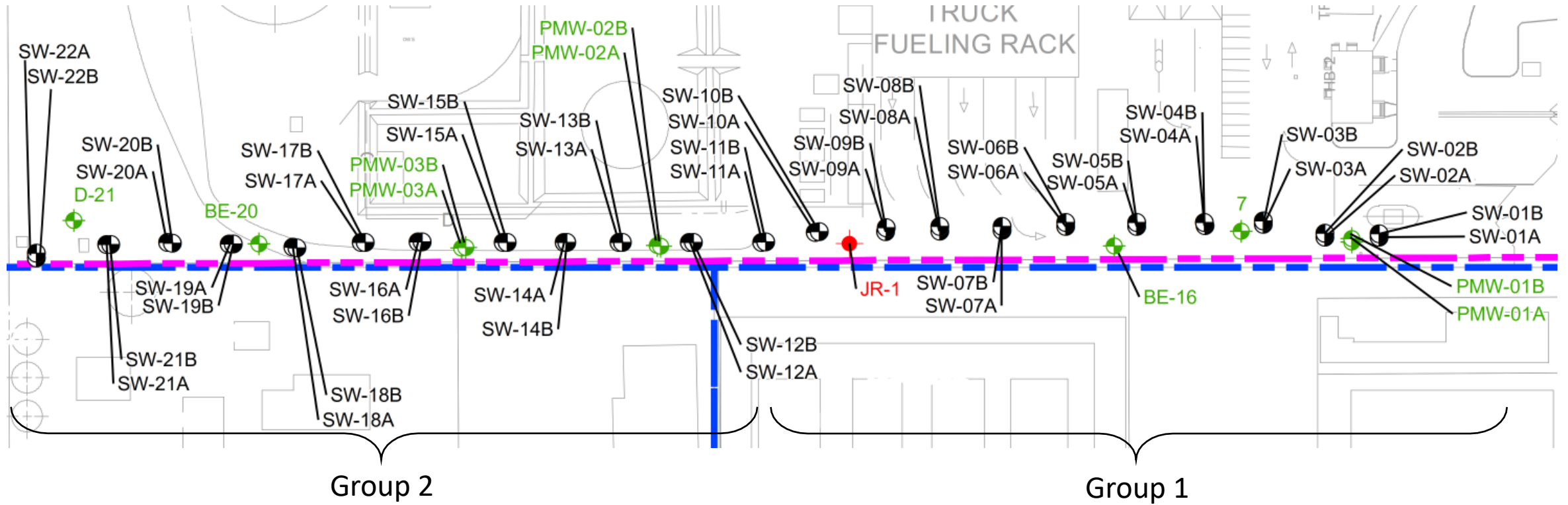
Objectives

- Review the complexities of site conditions at two active industrial petroleum sites in Southern California.
- Compare LNAPL thickness, Benzene concentration and microbial community responses to biostarging parameters.
- Analyze if achieving uniform responses across the site depends on remedy delivery.

02

# Site Introductions

# Site 1

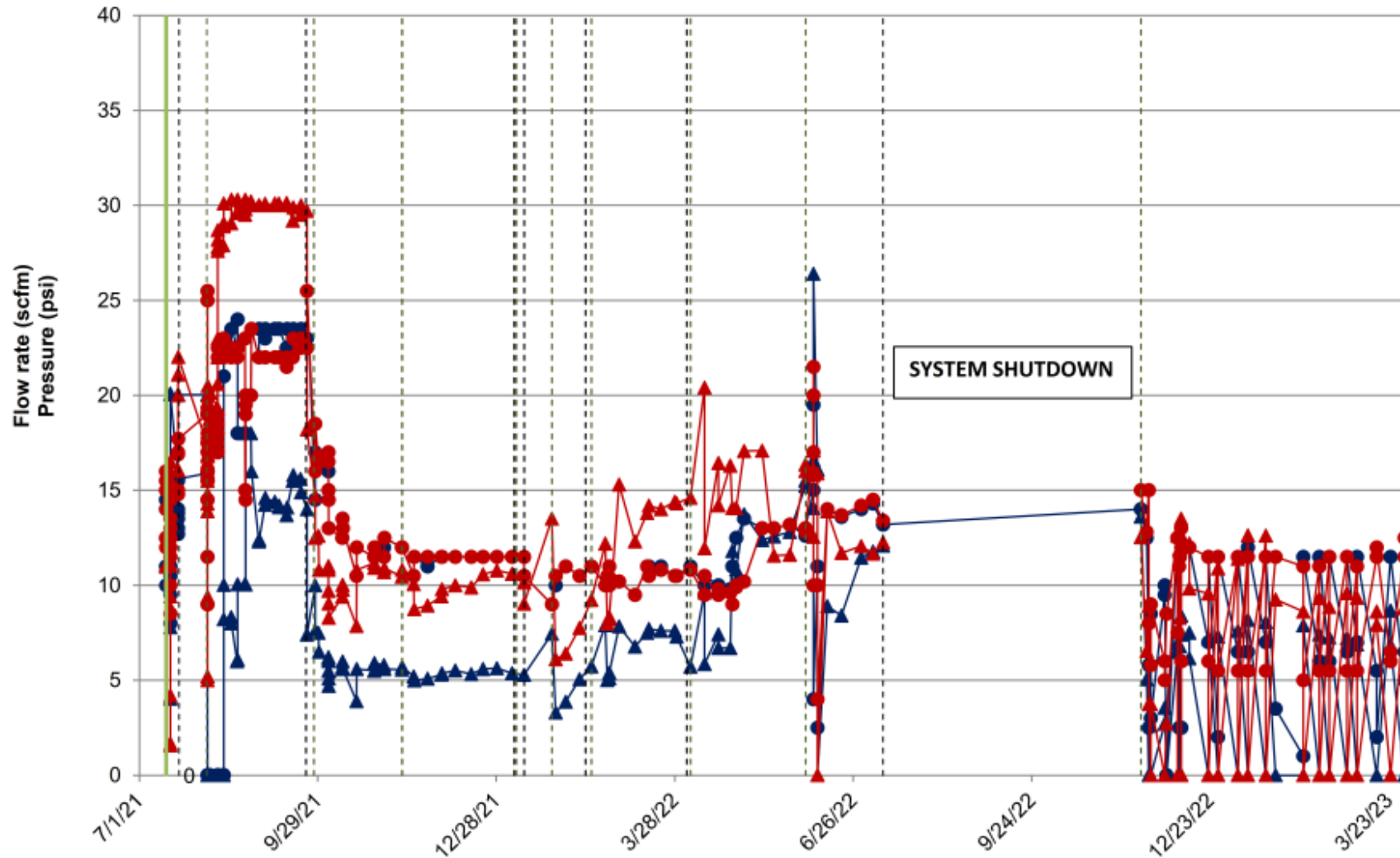


## LEGEND

-  BIOSPARGING WELL
-  MONITORING WELL



## Site 1: Branch Flow Rates and Pressure



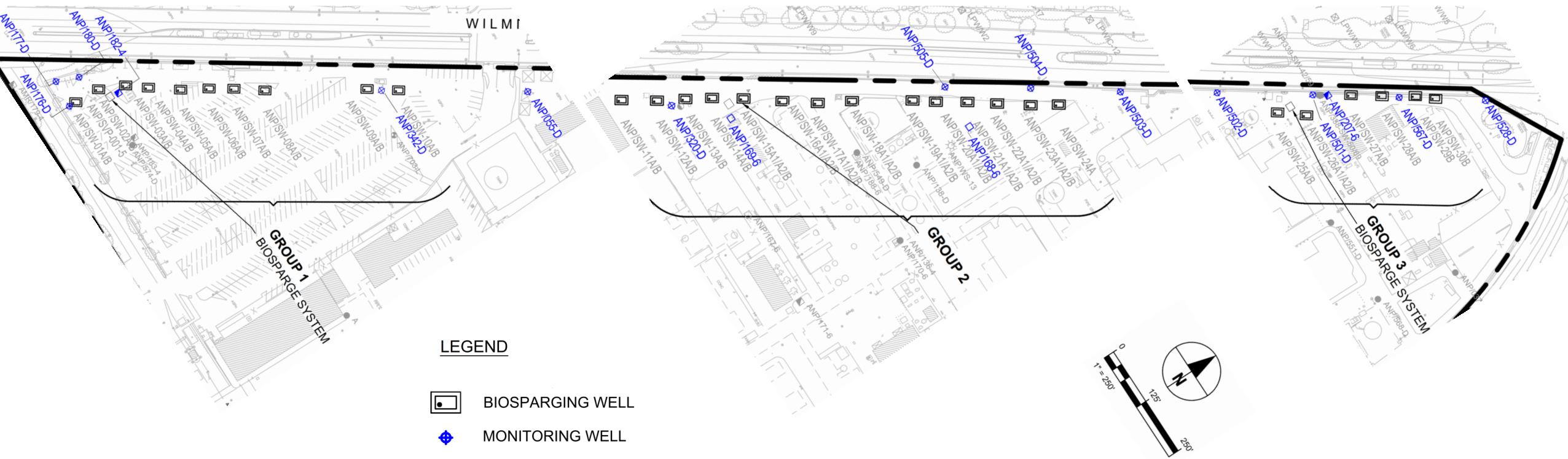
**Notes:**

psi pounds per square inch  
scfm standard cubic feet per minute



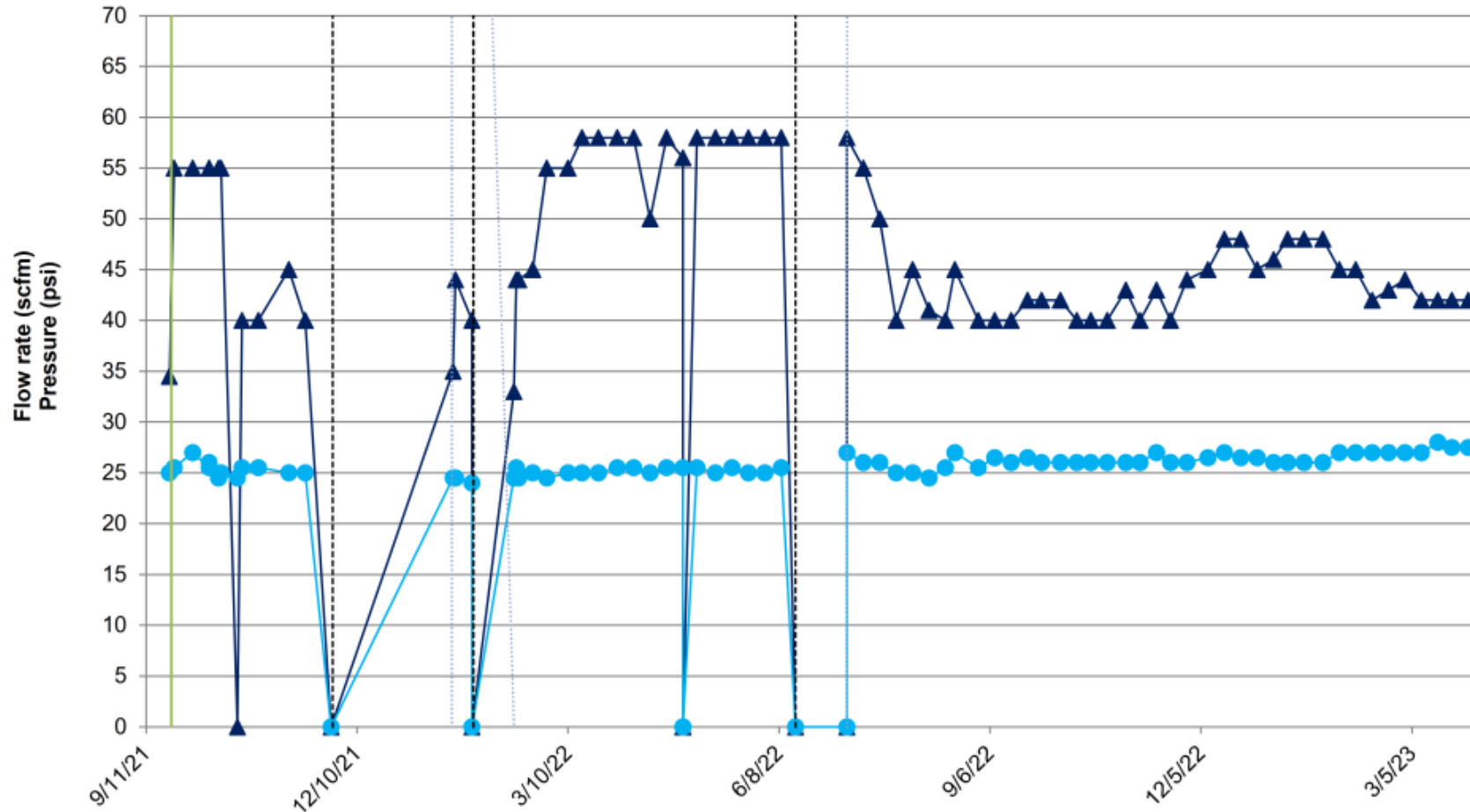
- System was started on July 14, 2020.
- Group 1 B
  - 2.6 to 26 scfm.
  - 1 to 25 psi
- Group 2 B
  - 1.6 to 30 scfm.
  - 4 to 26 psi

# Site 2





### Site 2: Group 1 Branch Flow Rates and Pressure



Notes:

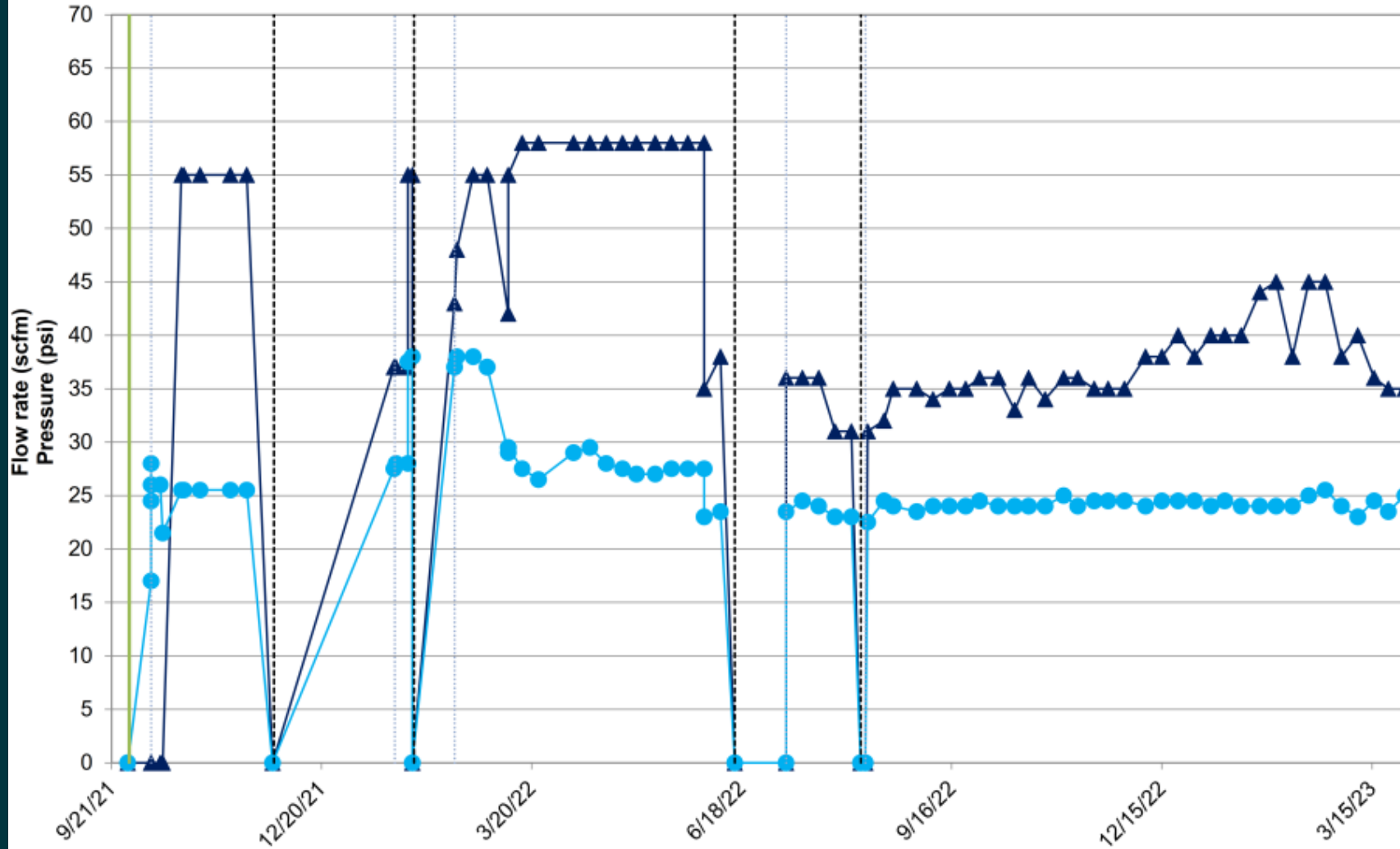
psi pounds per square inch  
scfm standard cubic feet per minute

▲ Branch 1B (cfm) ● Branch 1B (psi) — STARTUP  
----- SHUTDOWN ..... Restart

- Group 1 of the system was started on September 21, 2021.

- 33 to 58 scfm
- 24 to 28 psi

### Site 2: Group 2 Branch Flow Rates and Pressure



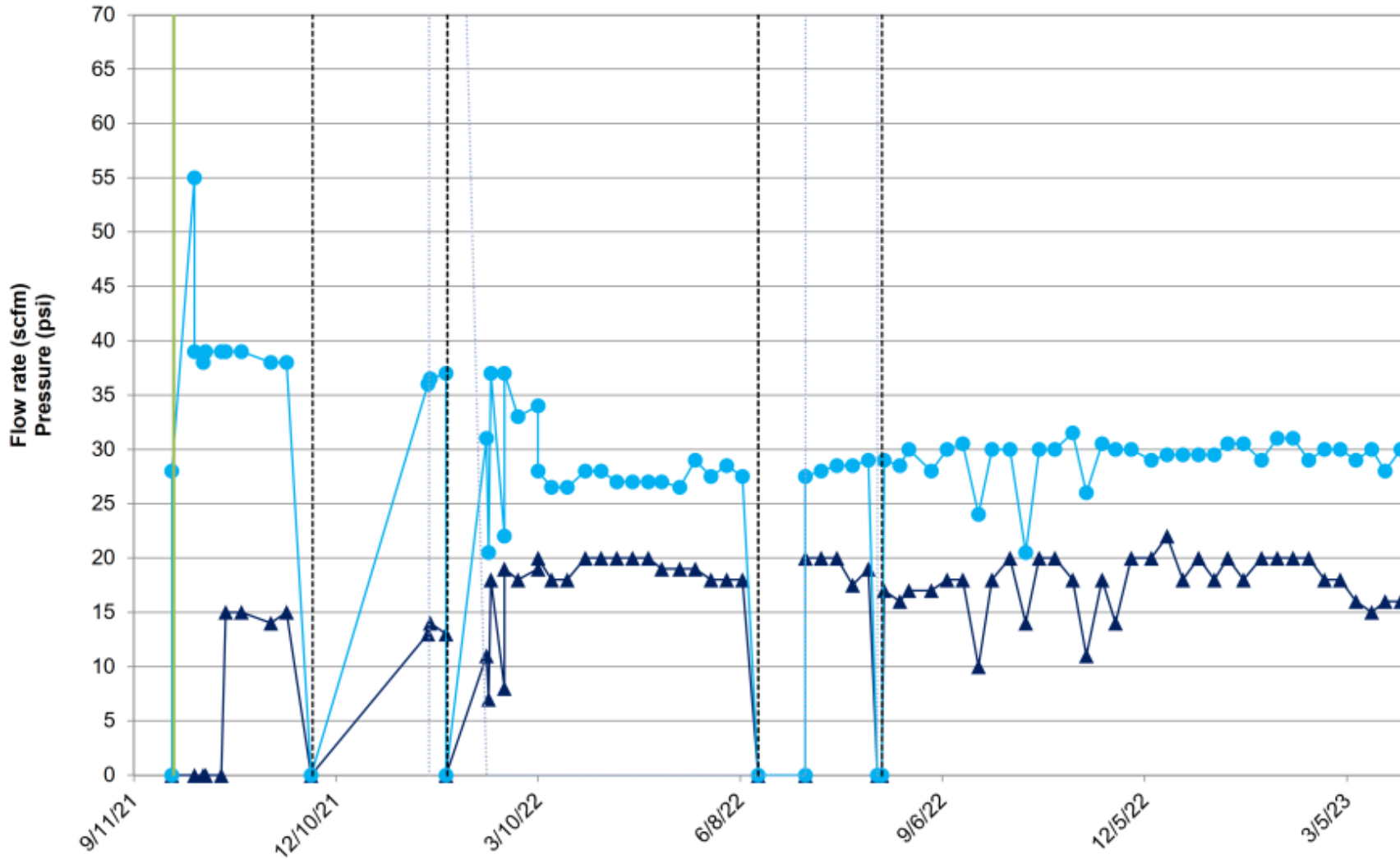
**Notes:**

psi pounds per square inch  
 scfm standard cubic feet per minute

- ▲ Branch 1B (cfm)
- Branch 1B (psi)
- STARTUP
- SHUTDOWN
- ..... Restart

- Group 2 of the system was started on September 28, 2021.
- 7 to 22 scfm.
- 21 to 55 psi

### Site 2: Group 3 Branch Flow Rates and Pressure



**Notes:**

psi pounds per square inch  
 scfm standard cubic feet per minute

- ▲ Branch 1B (cfm)
- Branch 1B (psi)
- STARTUP
- SHUTDOWN
- ..... Restart

- Group 3 of the system was started on September 21, 2021.

- 31 to 58 scfm.
- 17 to 38 psi

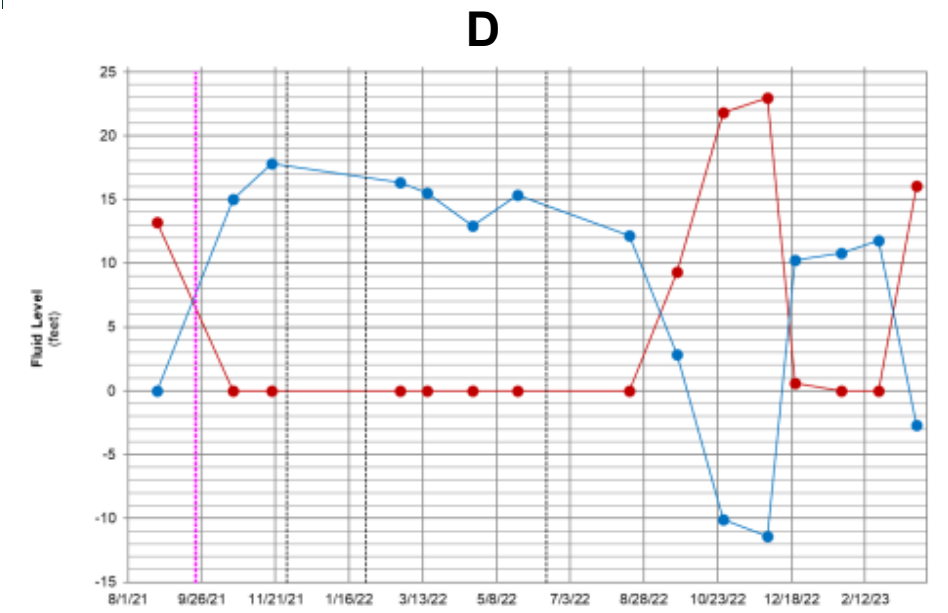
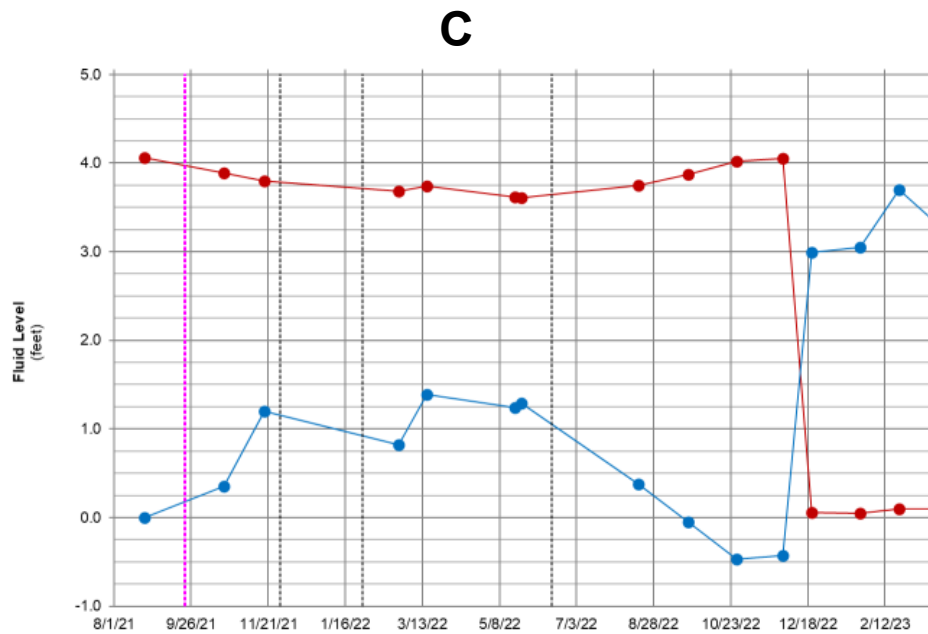
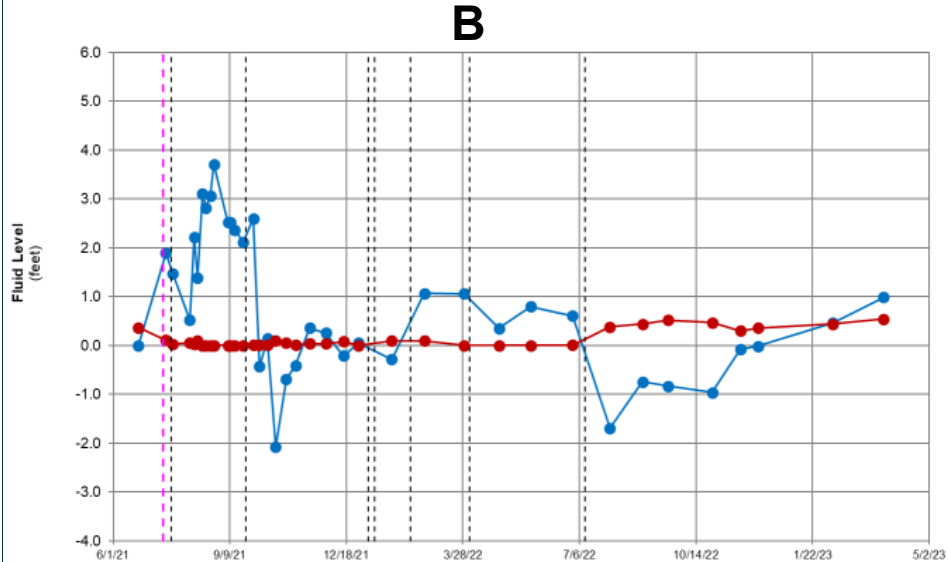
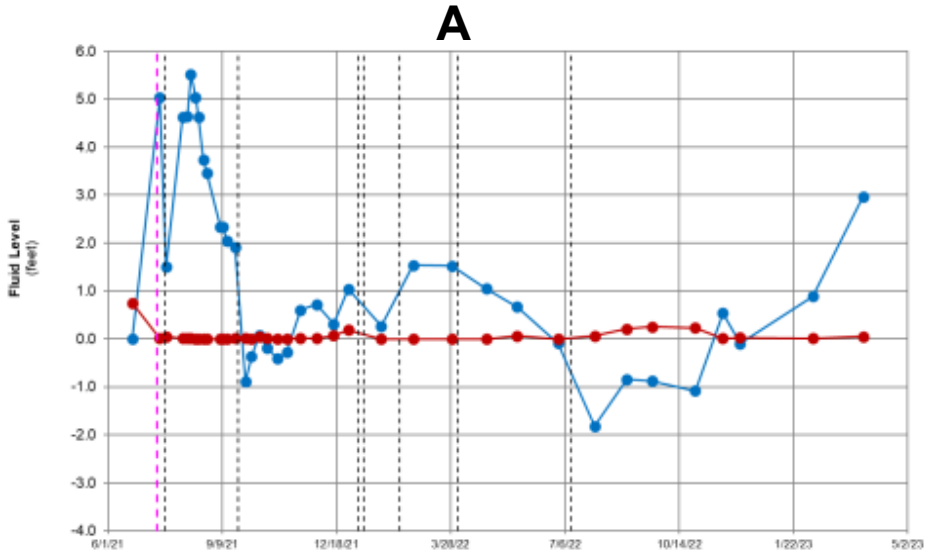
# Summary of Site Overview

Site	Top of Screen	Bottom of Screen	Number of wells	Average Flow Rate Per well (scfm)	Average Pressure Per well (psi)
Site 1- Group 1B	35.5	39	11	1	1
Site 1- Group 2B	36	39	11	1	1
Site 2- Group 1B	73	86	10	4	2
Site 2- Group 2B	74	89	13	3	2
Site 2- Group 3B	62	80	6	2	5

02

# Remediation Progress

# LNAPL Thickness



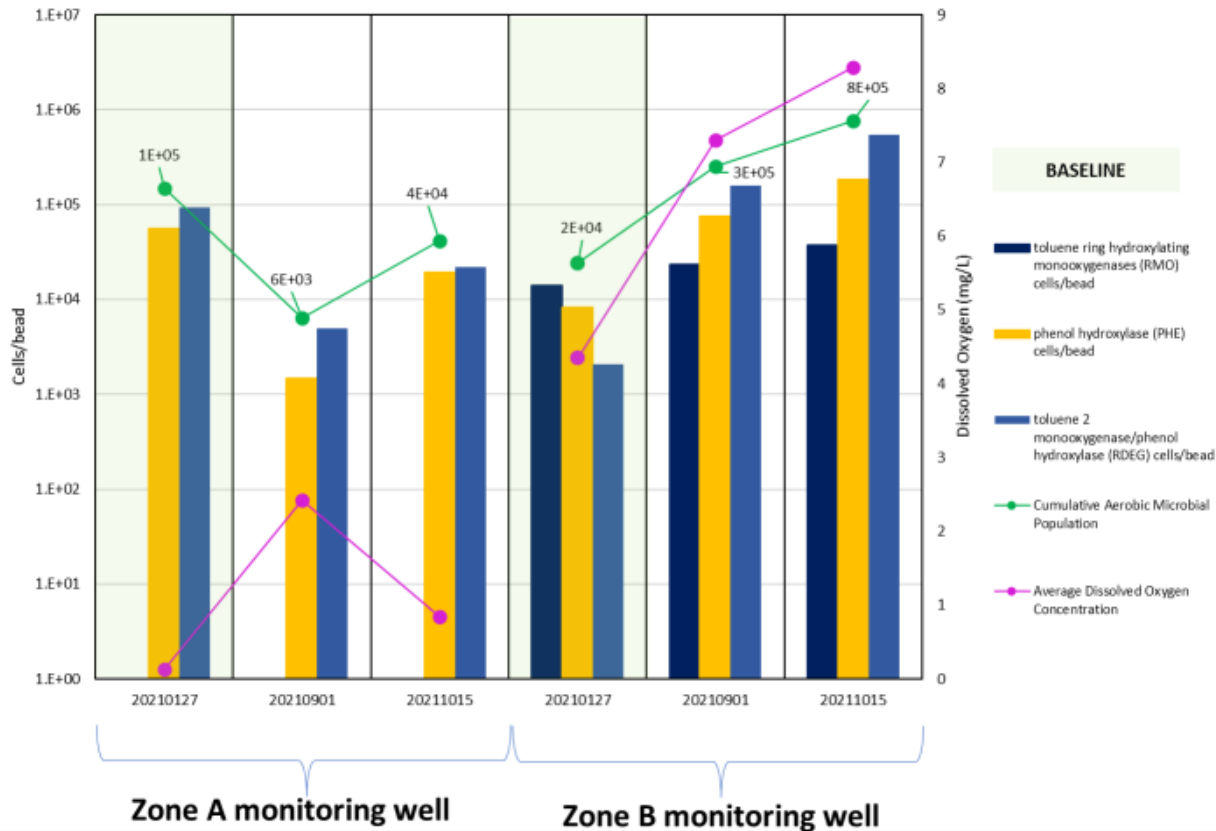
Site 1

Site 2

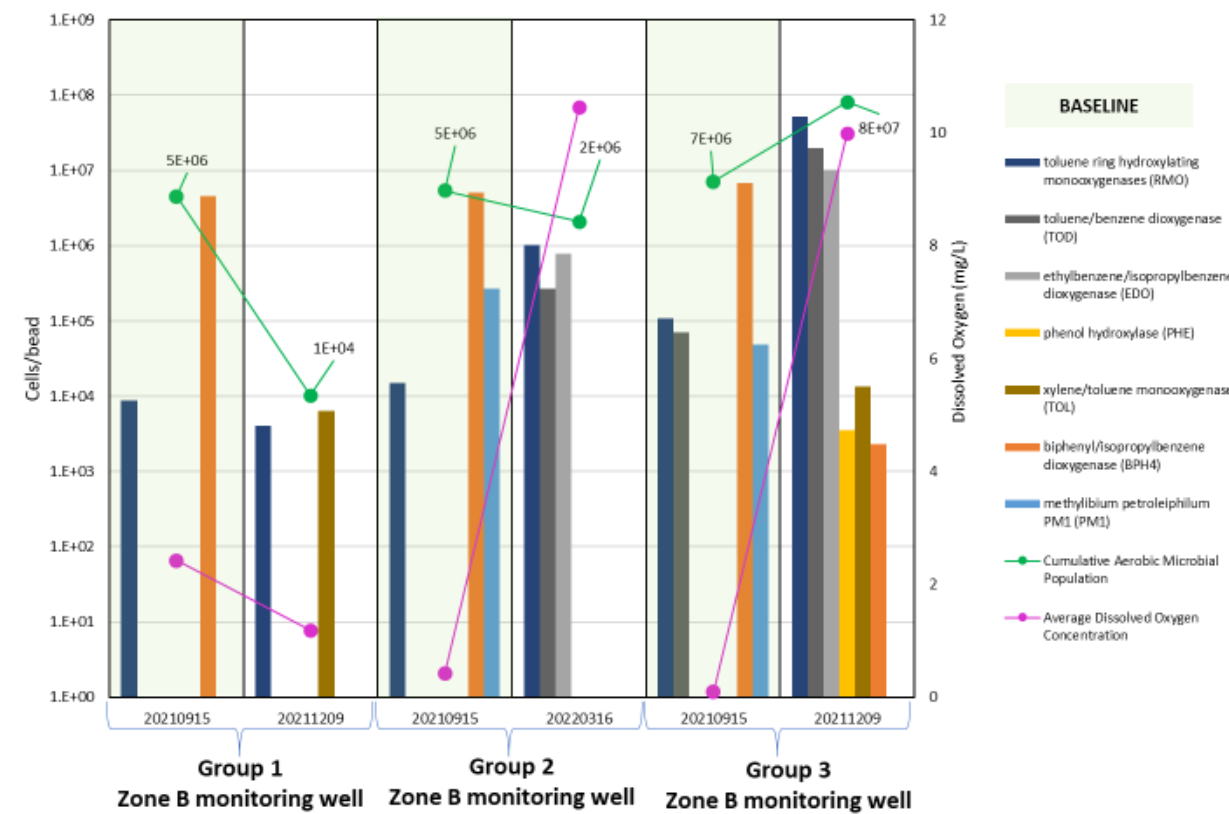
- LNAPL Thickness
- Change in GW Elevation
- STARTUP
- SHUTDOWN

# Microbial Trends

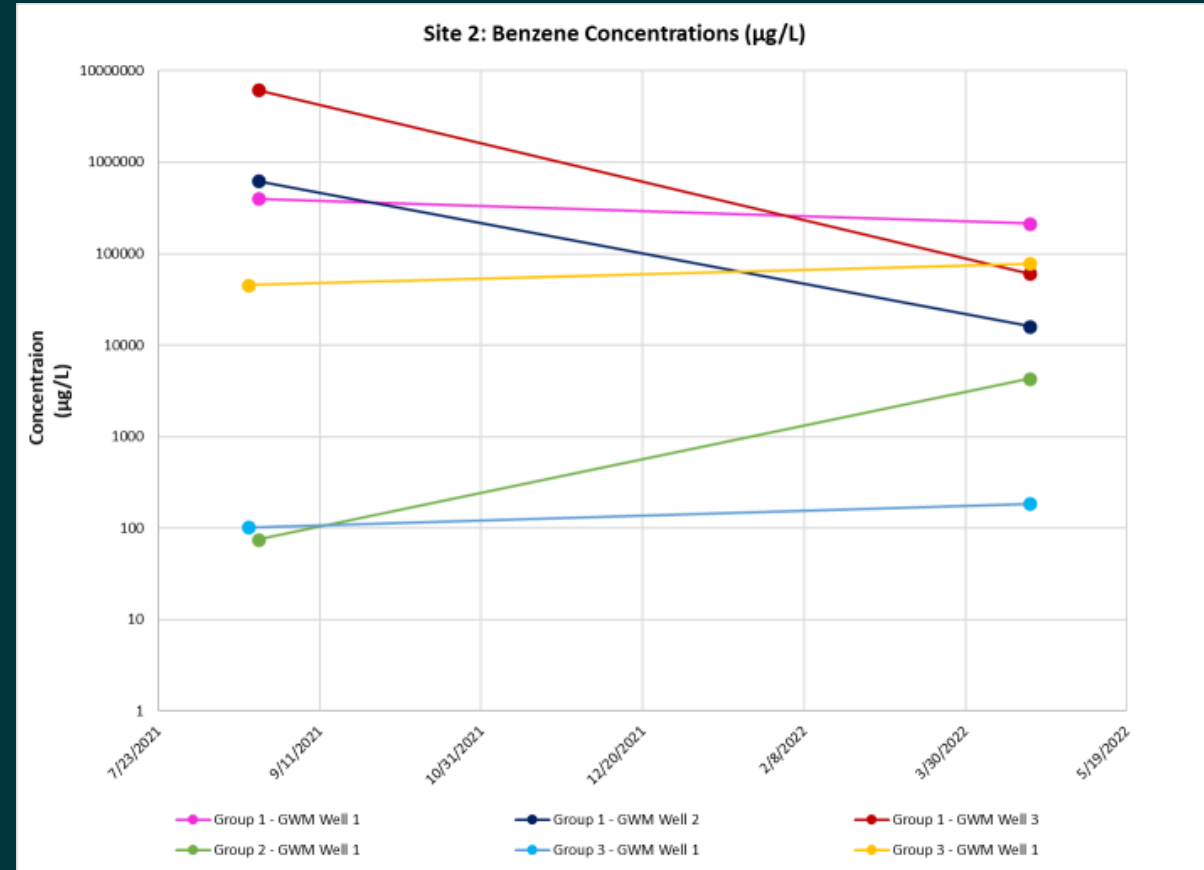
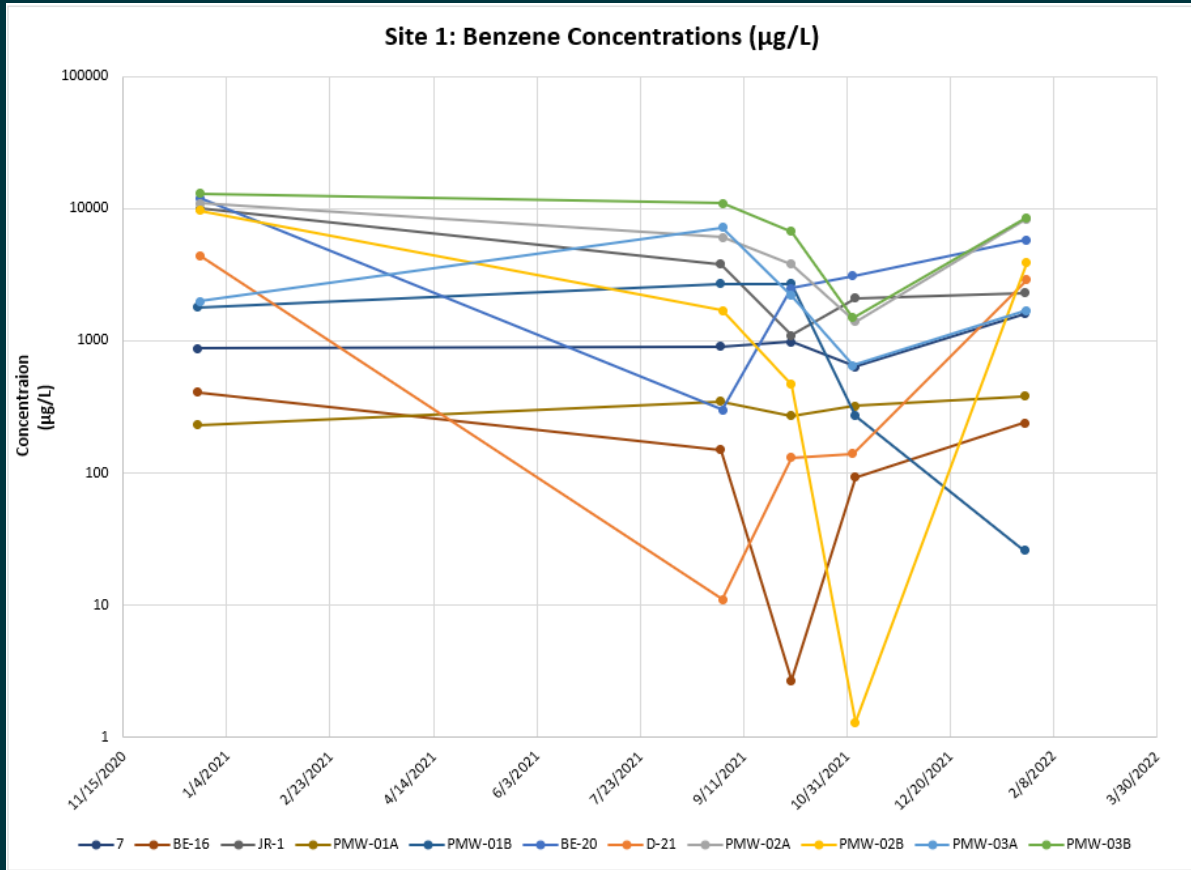
## Site 1- Microbial Analysis



## Site 2- Microbial Analysis



# Benzene Trends



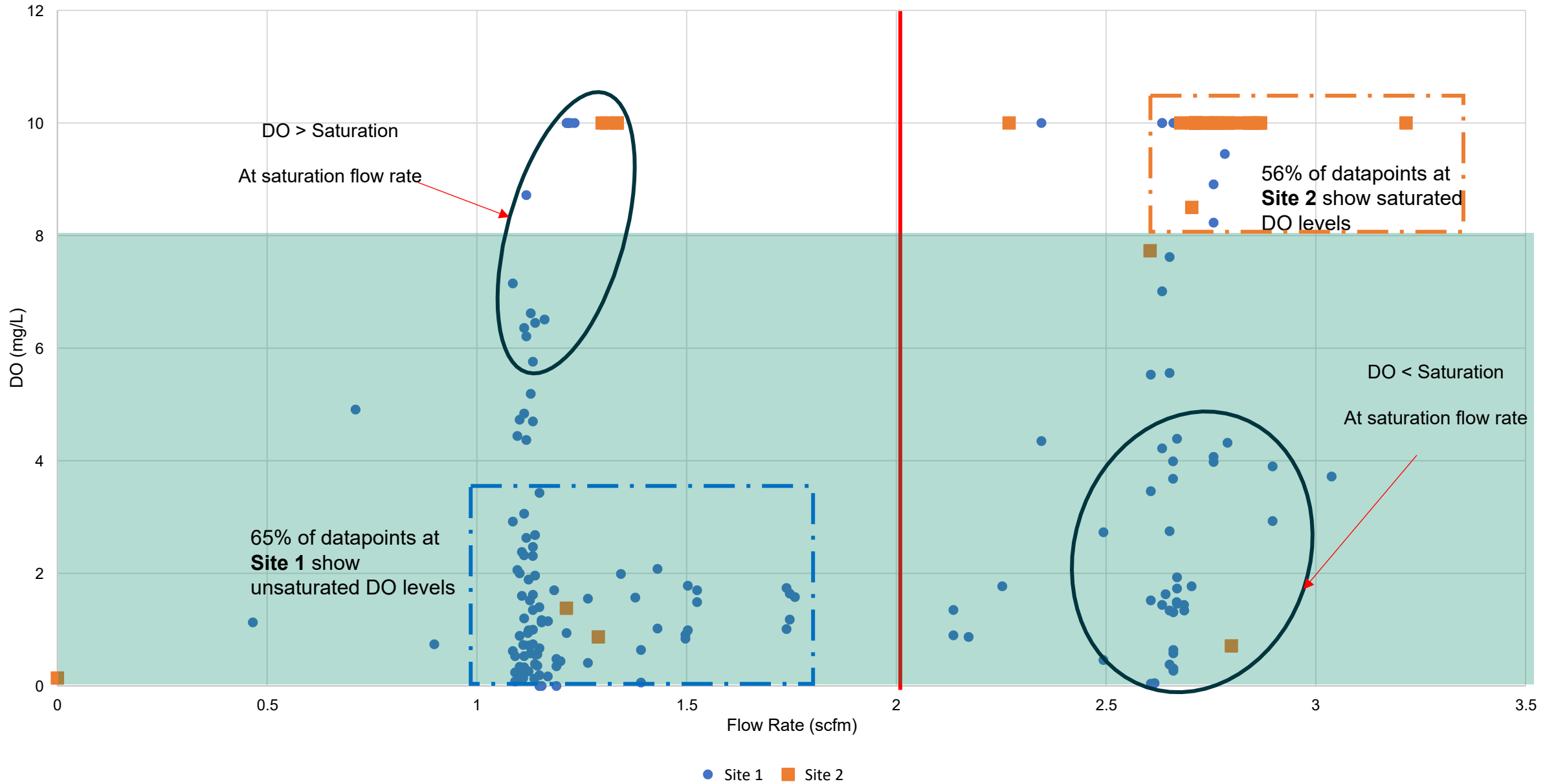


03

**System Optimization  
Uniform Distribution of  
Dissolved Oxygen**

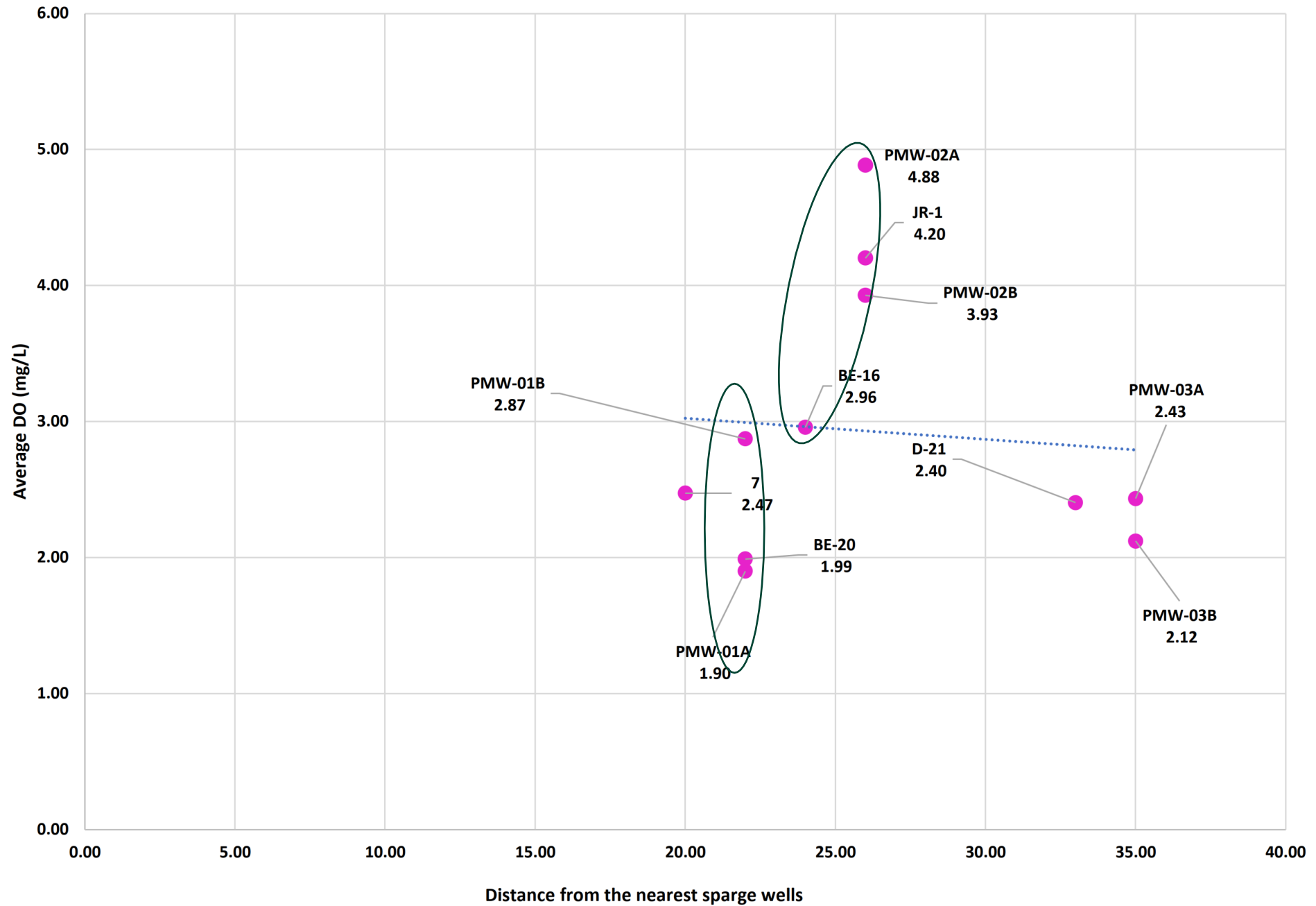
# Dissolved Oxygen vs Flow Rates

# DO vs Flow Rate

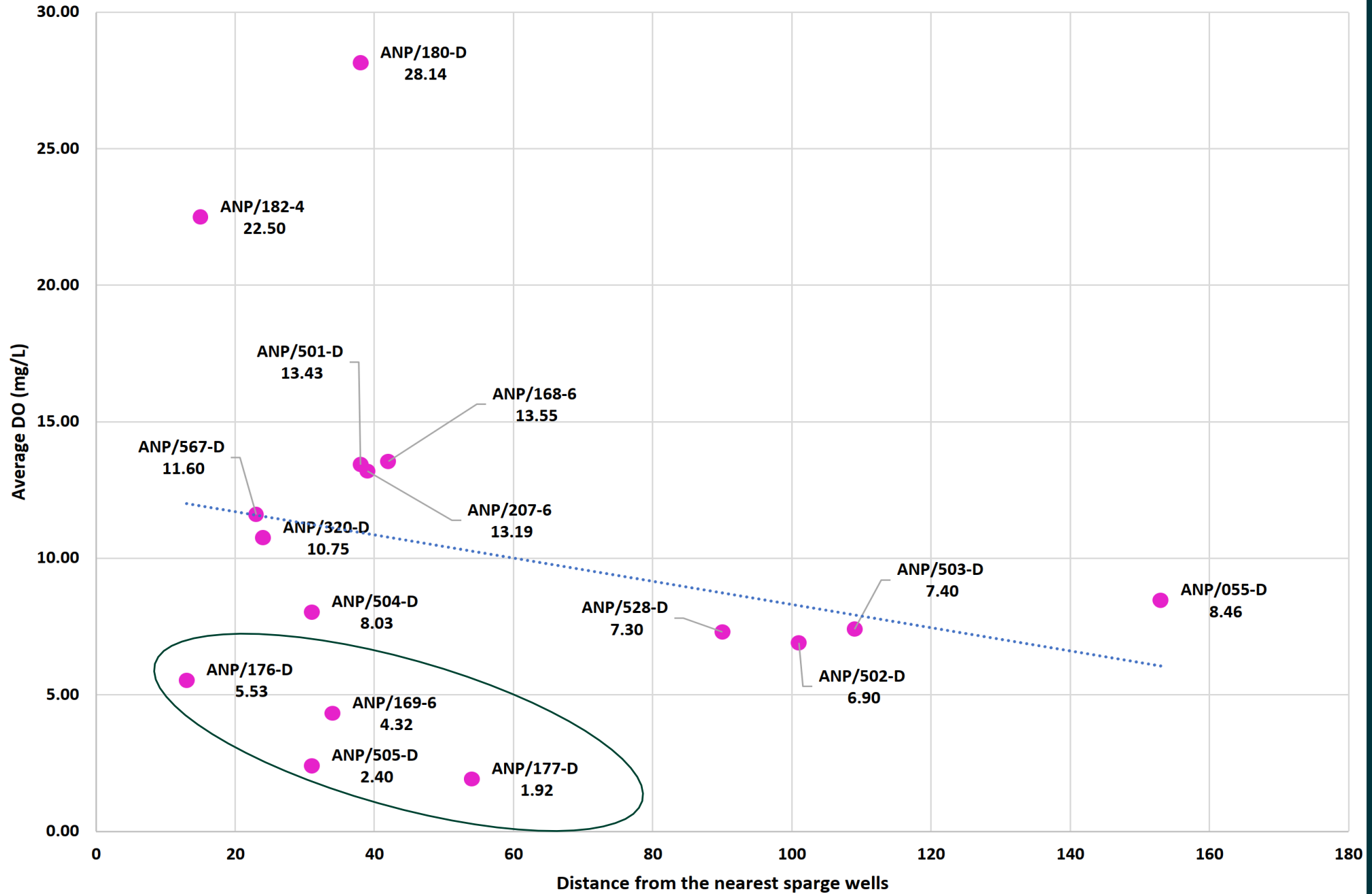


# Dissolved Oxygen vs Distance from nearest Sparge Well

# Site 1: Dissolved Oxygen vs Distance for Sparge wells



# Site 2: Dissolved Oxygen vs Distance for Sparge wells



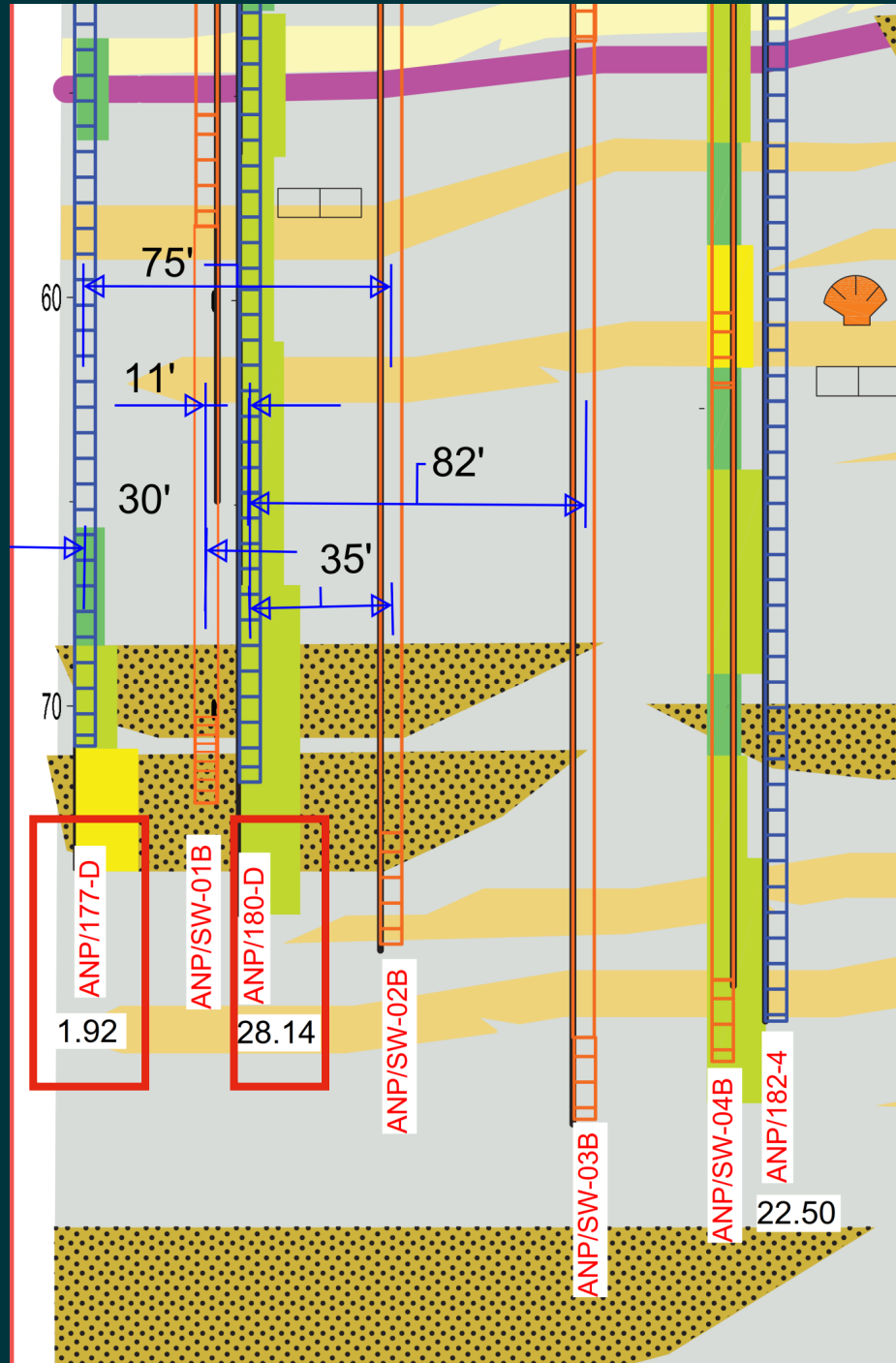
# Dissolved Oxygen vs Porosity

# Site 2: Cross Section

## GRAIN SIZE LOG










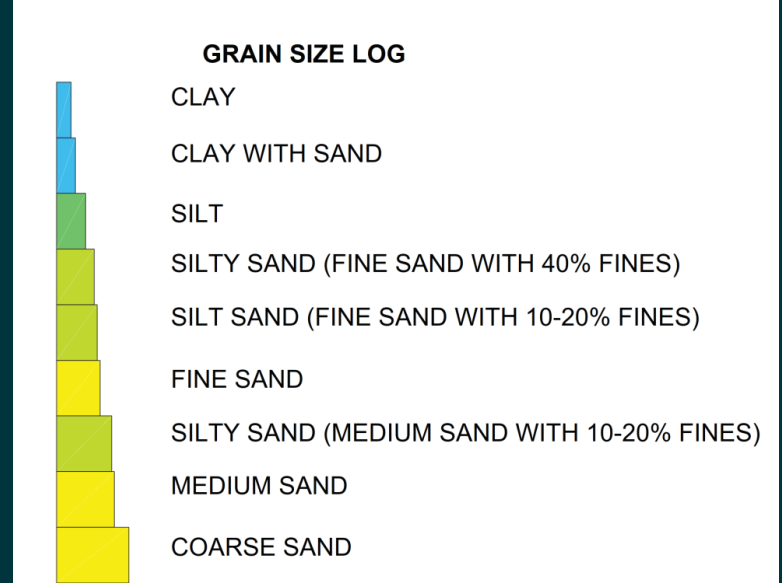
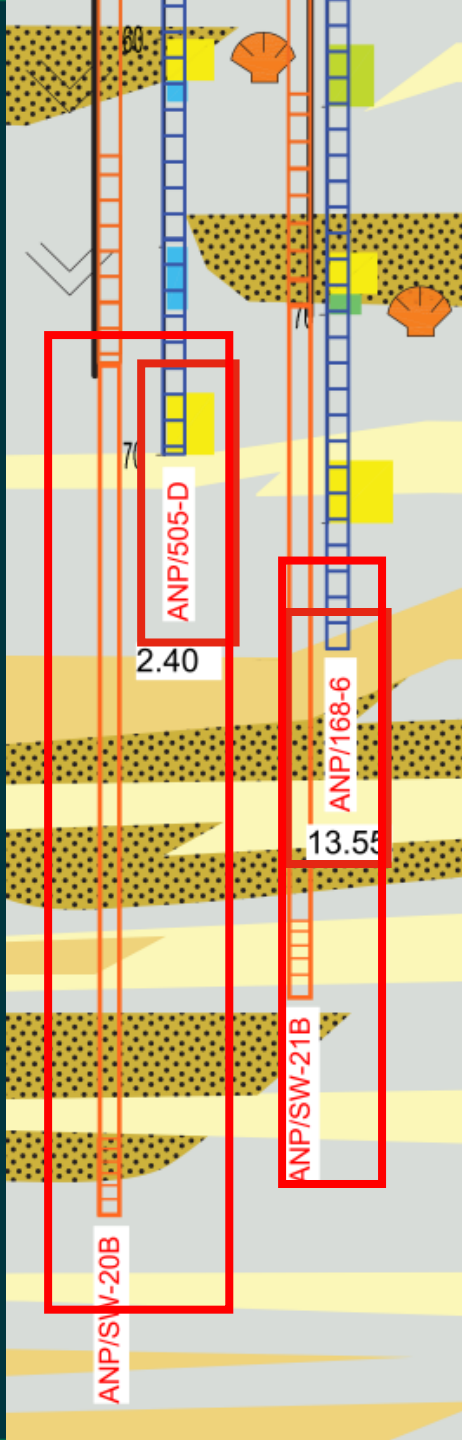
- MEANDERING CHANNEL POINT BARS - COARSE TO MEDIUM SAND, FINING UP TO VERY FINE SAND
- OVERBANK LEVEE/SPLAY - COARSE TO MEDIUM SAND, FINING UP TO VERY FINE SAND AND SILT
- FLOODPLAIN FINES - SILT AND CLAY
- BAYHEAD DELTA MOUTHBARS - FINE TO MEDIUM SAND WITH MINOR CLAY. COARSE SAND LOCALLY
- ESTUARINE MUD - SILT AND CLAY
- TIDAL BARS - FINE MUDDY SAND, COARSENING UP TO CLEANER VERY FINE TO FINE/MEDIUM SAND
- TIDAL CHANNELS - FINE TO MEDIUM SAND, FINING UP TO VERY FINE SAND AND SILT, PROFUSE MUD INTERBEDS





# Site 2: Cross Section

-  MEANDERING CHANNEL POINT BARS - COARSE TO MEDIUM SAND, FINING UP TO VERY FINE SAND
-  OVERBANK LEVEEEE/SPLAY - COARSE TO MEDIUM SAND, FINING UP TO VERY FINE SAND AND SILT
-  FLOODPLAIN FINES - SILT AND CLAY
-  BAYHEAD DELTA MOUTHBARS - FINE TO MEDIUM SAND WITH MINOR CLAY. COARSE SAND LOCALLY
-  ESTUARINE MUD - SILT AND CLAY
-  TIDAL BARS - FINE MUDDY SAND, COARSENING UP TO CLEANER VERY FINE TO FINE/MEDIUM SAND
-  TIDAL CHANNELS - FINE TO MEDIUM SAND, FINING UP TO VERY FNE SAND AND SILT, PROFUSE MUD INTERBEDS



03

# Conclusions

- Dissolved Oxygen concentrations correlate with
  - the magnitude of flow rates
  - The distance of the nearest sparge well
  - and the permeability of the formation.
- To achieve uniform distribution and remediation at any site the effective zone of sparging influence can be optimized by studying the three key factors that affect the DO concentrations.

# Thank You!

Anjali Lothe ([anjali.lothe@aecom.com](mailto:anjali.lothe@aecom.com)) and  
Assaf Rees ([assaf.rees@aecom.com](mailto:assaf.rees@aecom.com))  
(AECOM, Long Beach, CA, USA)