

# MEMO

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Date:

May 31, 2017

Arcadis Project No.:

B0064479.2017

Subject:

Biosparge Pilot Study Summary Slides and Attachments

RACER Trust, Lansing Michigan, Plant 2

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The attached data package provides a summary of the biosparge pilot study completed at RACER Lansing, Plant 2 Site during the 3<sup>rd</sup> and 4<sup>th</sup> quarter 2016. Due to size restrictions, the data is transmitted as two PDF documents. Volume 1 (as follows) includes the presentation slide deck, summary figures, and summary tables. Volume 2 includes the boring logs and laboratory reports.

The daily logs and O&M logs are not provided due to size limitations, but are available for your review upon request.

Please let us know if you have any questions.

# Propane Biosparge Pilot Test Report

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5. Phase II Biosparge Pilot: Groundwater Level Data.
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17. Phase II Biosparge Pilot: TW-16-01 - Microbial Results
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1. Phase I Biosparge Pilot: Field Data
2. Phase II Biosparge Pilot: Groundwater Sampling Results
3. Phase II Biosparge Pilot: Monitoring Well Headspace Propane LEL Readings
4. Biosparge Pilot: Summary of Groundwater Analytical Results for Nearby Monitoring Wells

### Attachments

1. Soil Boring Logs
2. Laboratory Analytical Reports

# RACER LANSING BIOSPARGE PILOT TEST RESULTS SUMMARY

May 31, 2017

# Outline

- Biosparge
  - Objectives
  - Phase I Summary and Results
  - Phase II Summary and Results
  - Full-Scale Implications
- Next Steps



# Pilot Test Objectives

## Phase I

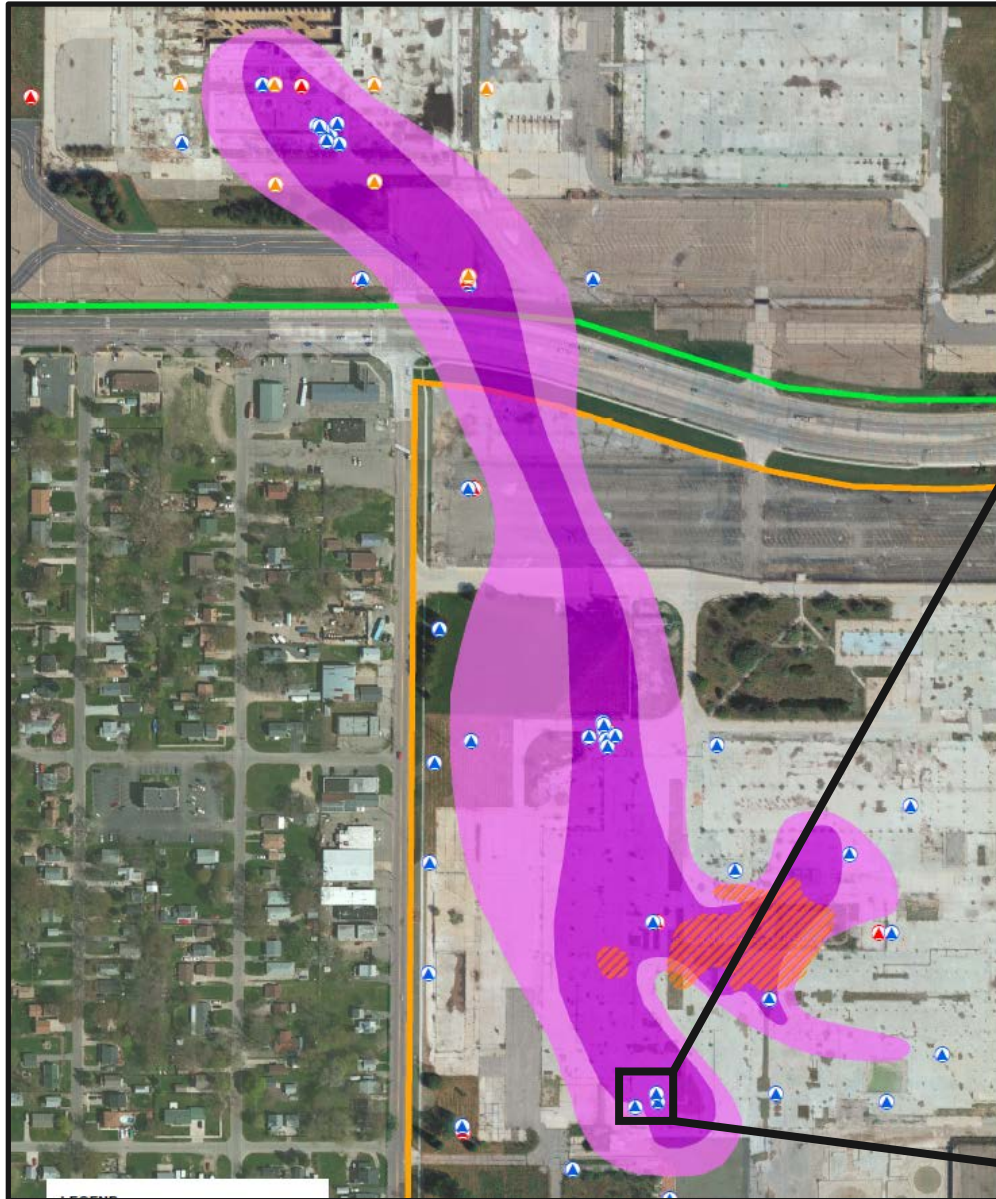
- Determine spargability and optimal well placement and operational assumptions for Phase II

## Phase II

- Confirm propane and oxygen distribution and assess microbial growth over time
- Evaluate propane and oxygen depletion rates
- Evaluate the biodegradation of 1,4-dioxane and treatment ROI
- Evaluate potential for lateral vapor migration and/or pressure buildup
- Determine if a biobarrier capable of degrading 1,4-D can be established at the site

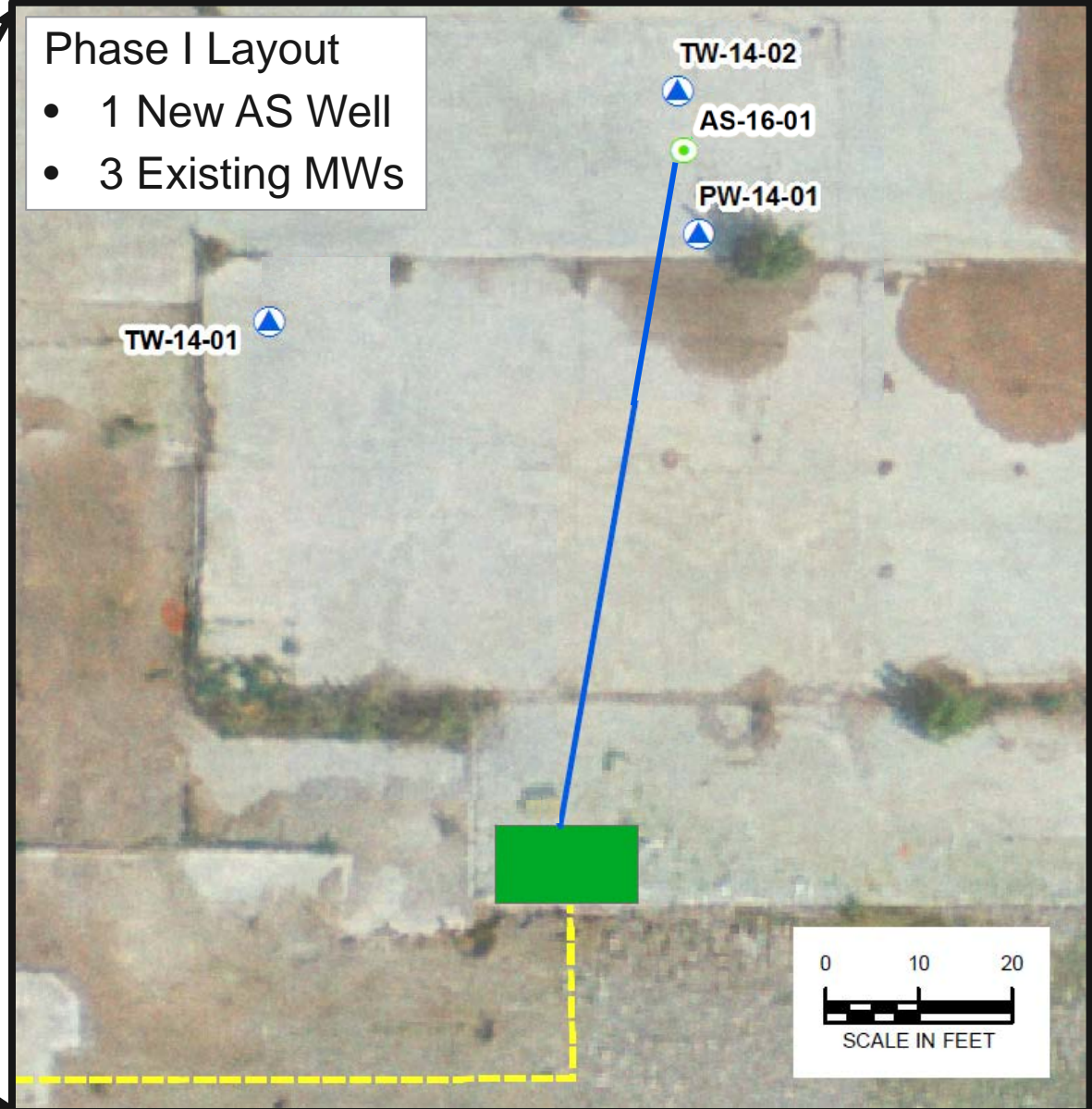


# Biosparge Pilot Test Area



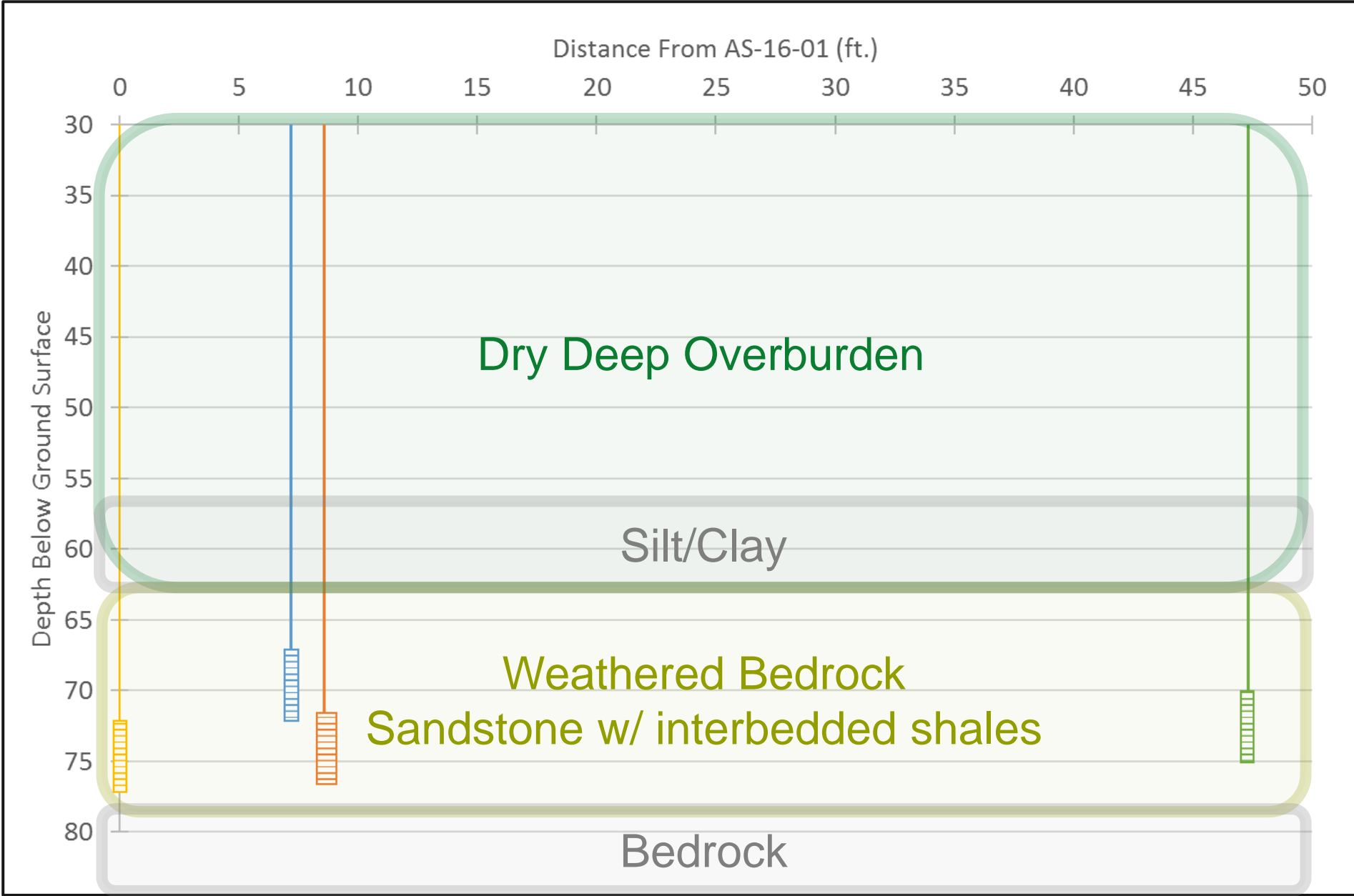
Phase I Layout

- 1 New AS Well
- 3 Existing MWs



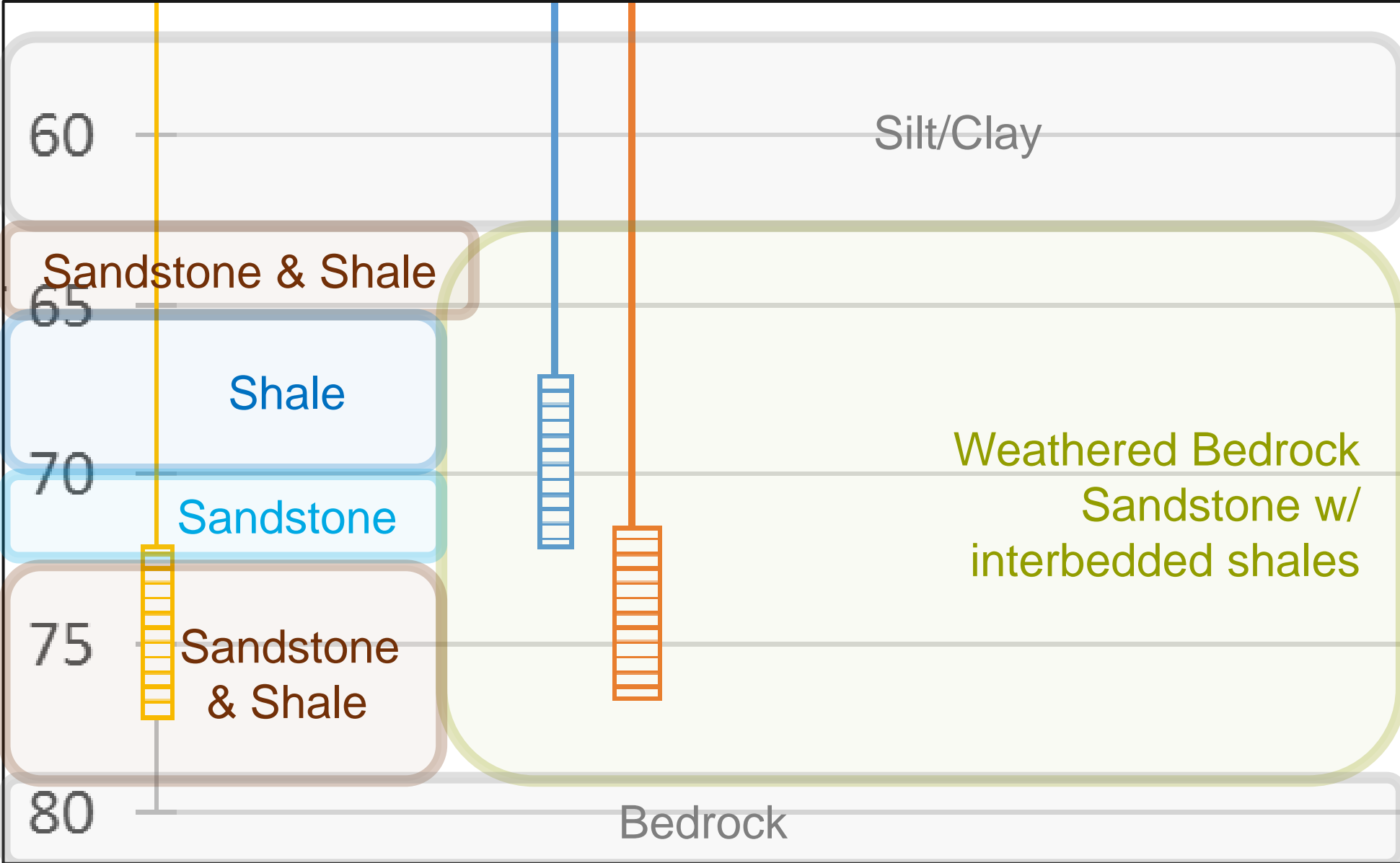
# Phase I Well Screen Elevations

- AS-16-01
- TW-14-02 (7.2 ft.)
- PW-14-01 (8.6 ft.)
- TW-14-01 (47.3 ft.)



# Phase I Well Screen Elevations

- AS-16-01
- TW-14-02 (7.2 ft.)
- PW-14-01 (8.6 ft.)



# Phase I Field Summary – June 2016

- **Day 1** ~3 hour air injection test
  - ~1 cfm at 52 psi
  - Good DO distribution – sustained overnight
  - Water level increase in MWs
- **Day 2**
  - ~10 hour cycled air injection test
  - 4 cycles, 30 minutes sparging w/ ~3 hr. rest between
  - Sustained 52 psi for each cycle
  - ~3-4 cfm – increased over time from cycle to cycle
  - Water level increase in MWs, began to stabilize

## Key Results

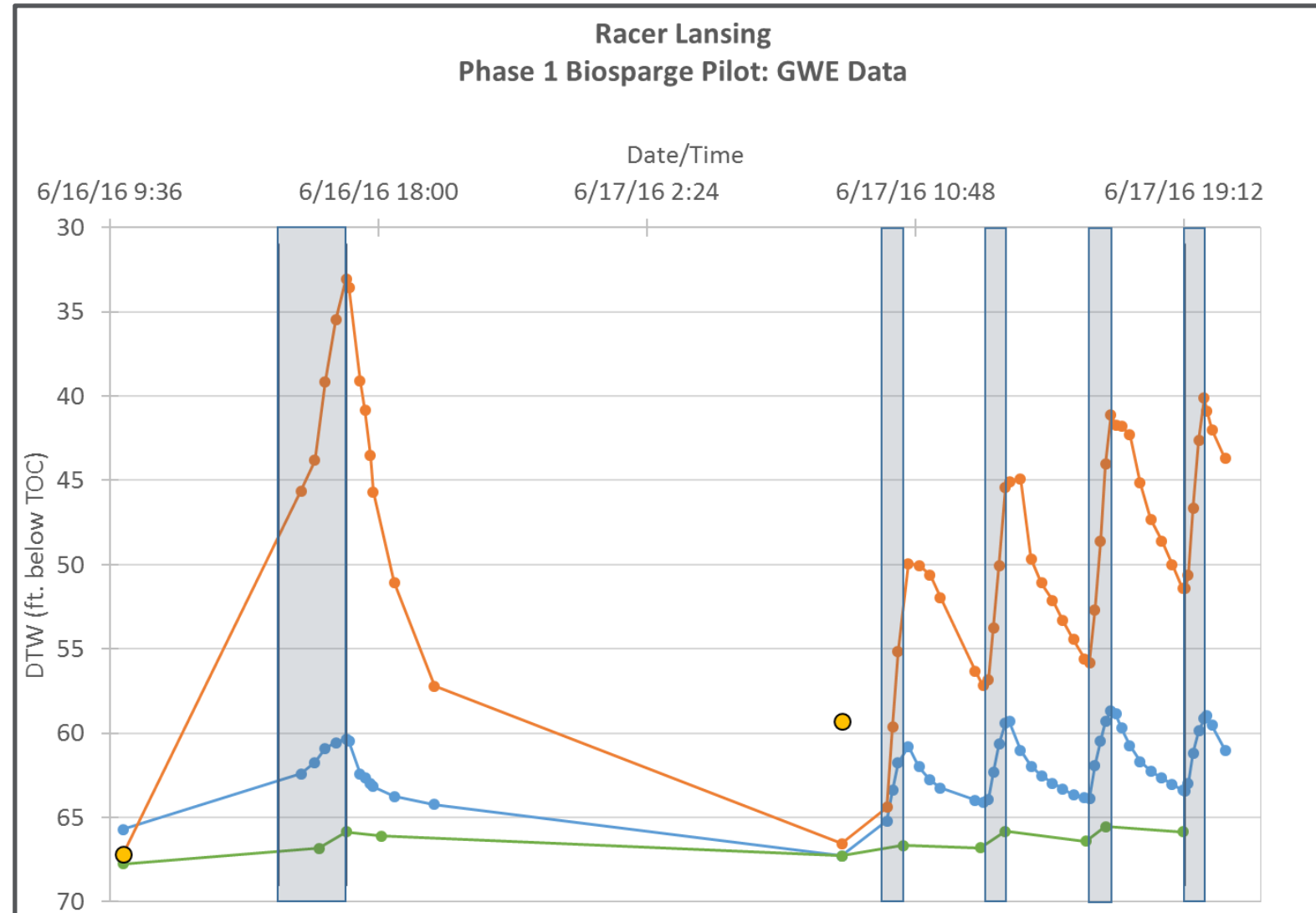
- Formation is spargable
- Observed ROI > 8 ft.
- Water level rise in monitoring wells



# Groundwater Elevation Response In Pilot Test Wells

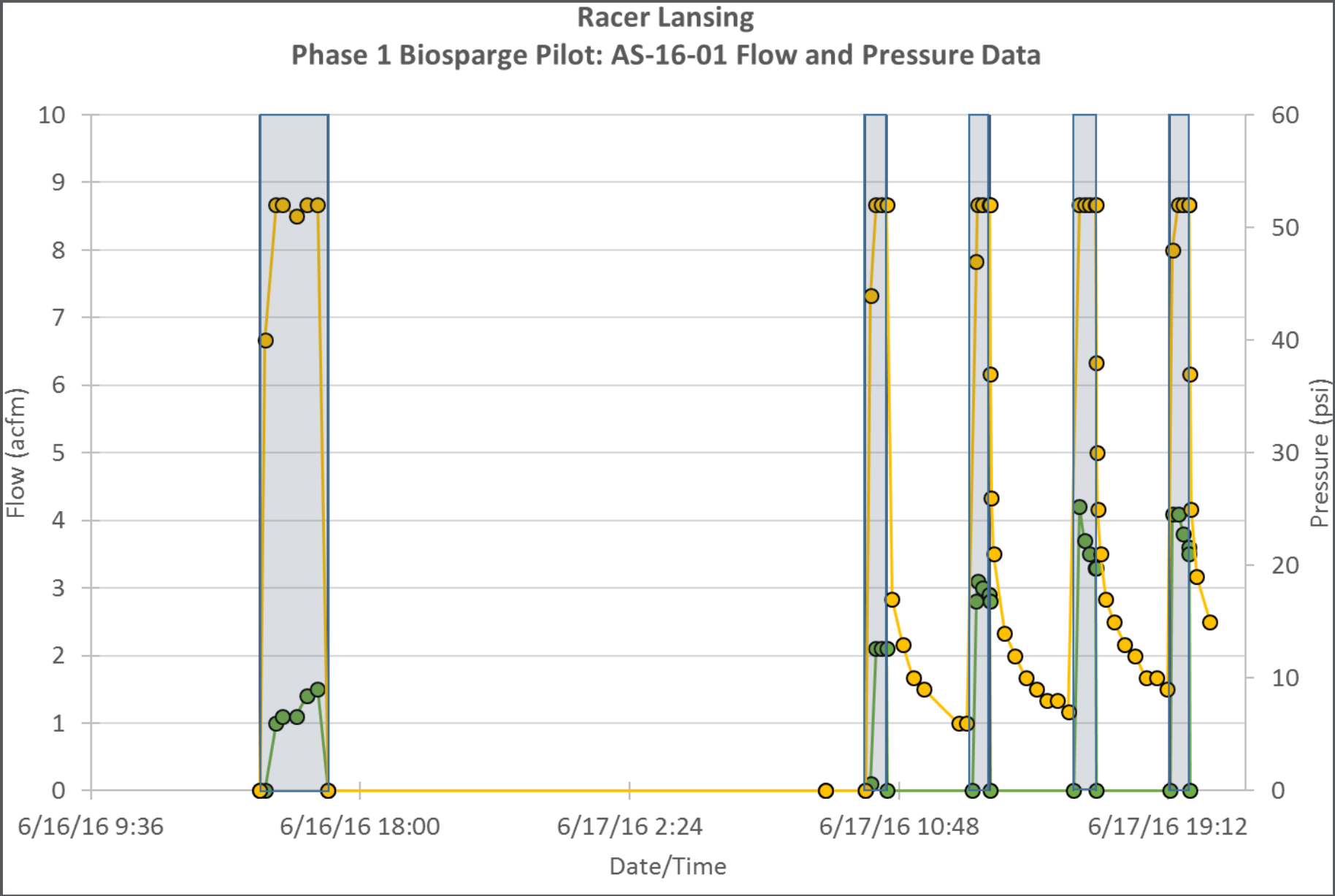
- Air Injection
- TW-14-02 (7.2 ft.)
- PW-14-01 (8.6 ft.)
- TW-14-01 (47.3 ft.)
- AS-16-01

- Continual increase in GWE for each cycle
- GWE appeared to be stabilizing near the end of Day 2
- Need to optimize air injection cycles with hydraulic response in Phase II



# Injection Summary

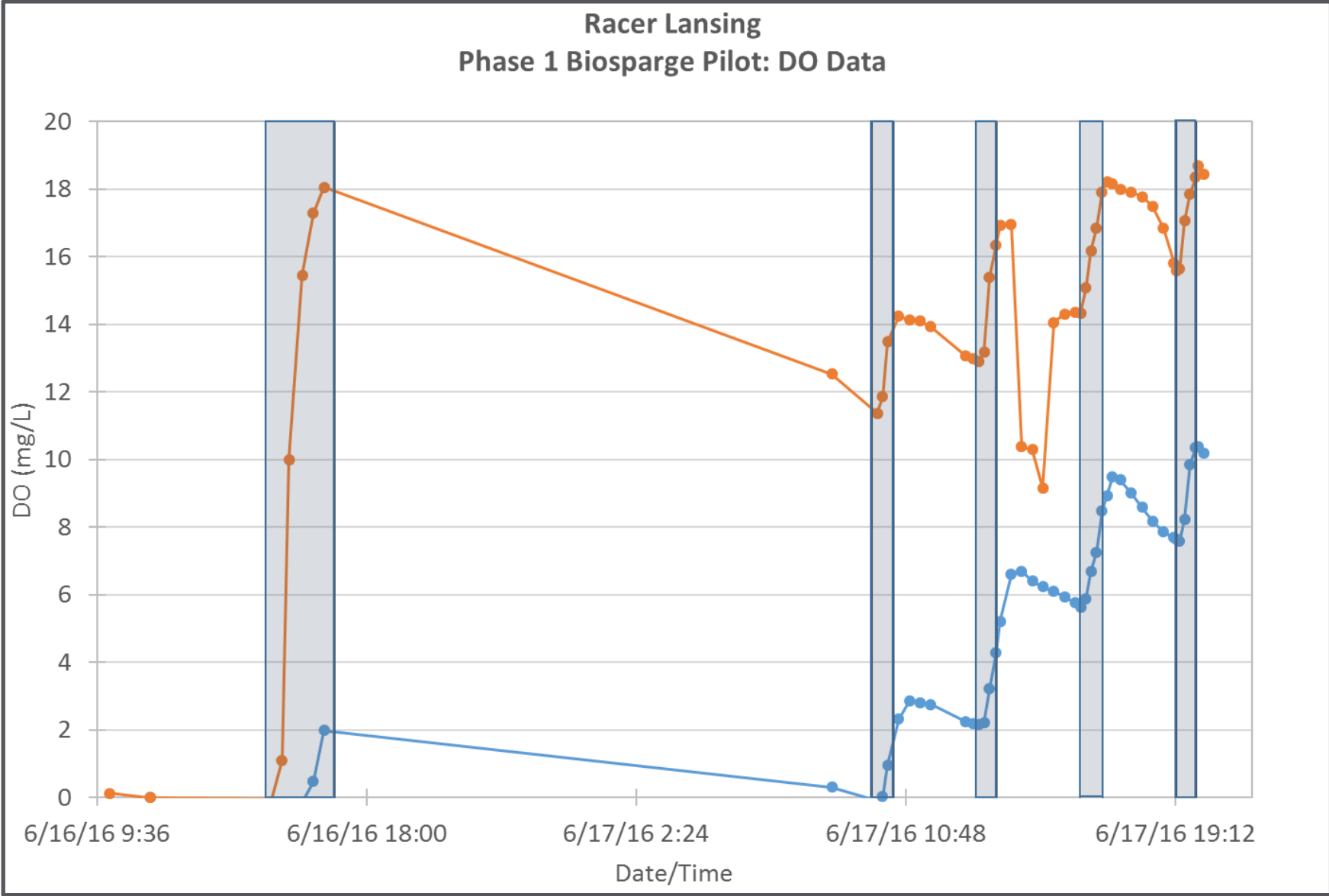
- Sustained pressure at 52 psi
- Increasing flow throughout the day
- Continual increase in pressure during rest cycles, never fully gets back to where the last cycle started



# Dissolved Oxygen Response

- Air Injection
- TW-14-02 (7.2 ft.)
- PW-14-01 (8.6 ft.)

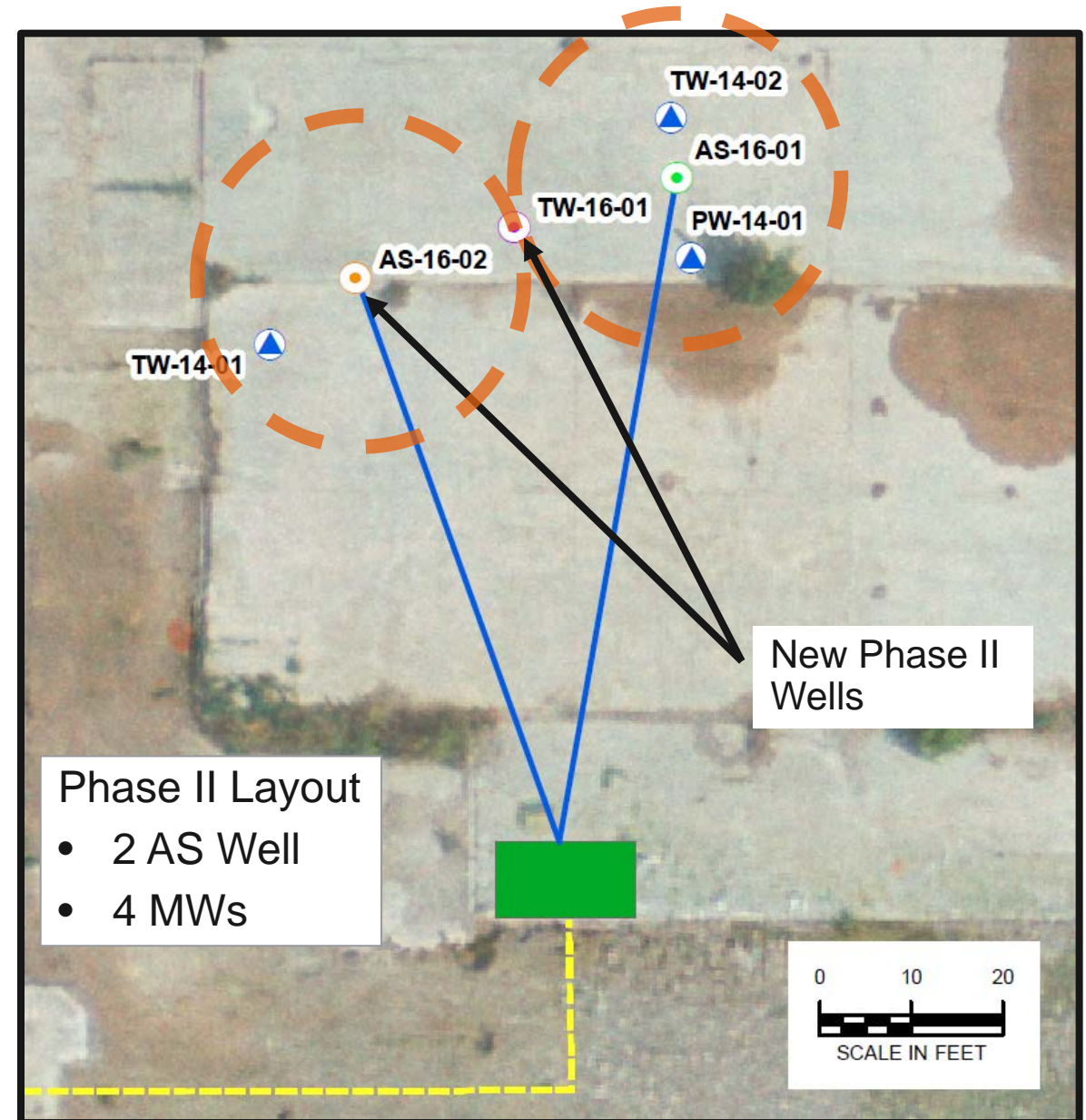
- Sustained DO overnight in PW-14-01
- May be able to increase rest cycles/sparge less and maintain DO
- Less sparge time to minimize hydraulic response in MWs



# What did it mean for Phase II

- Expected ROI > 8 feet
- Revised layout
  - 2 AS wells instead of 3 (one existing one new)
  - 1 new MW instead of 2
- Added transducers to monitor GWE in 2 wells, transducers will shut down sparge system if necessary

**New Key Objective: Must balance air injection and pressure in formation with increasing water levels in monitoring wells**



# Phase II Field Summary

October 2016 – January 2017

- Oct. 5<sup>th</sup> – System start up
  - 2 cfm, 52 psi
  - 2 hr. sparge cycles
  - 12 hr. sparge time per well per day
- Nov. 3<sup>rd</sup> – Bioaugmentation
- Dec. 12<sup>th</sup> – Increased propane 15% to 35% LEL
- Jan. 17<sup>th</sup> – Increase flow to 3 cfm
- Jan. 31<sup>st</sup> – End pilot test
  - Total 103 lbs of propane injected

## Key Results

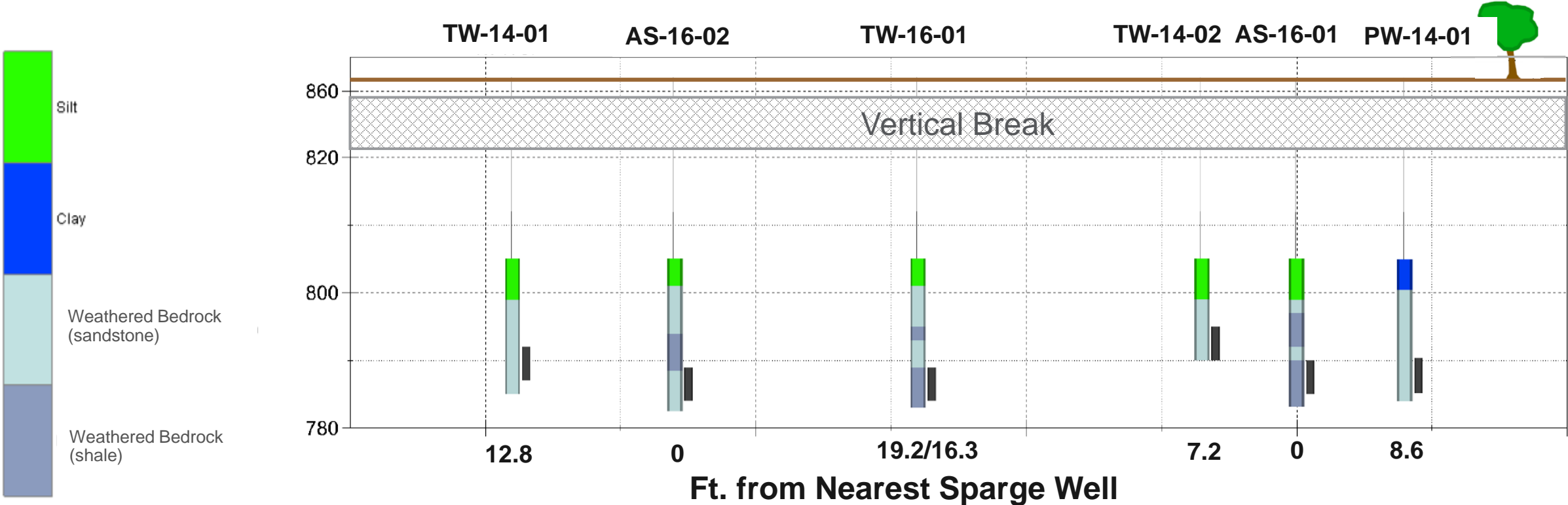
- No limiting effects from water level rise in monitoring wells, GWE stabilized over time
- Less pressure required to maintain sparge flow rate of 2-3 cfm (generally 20 to 30 psi vs. 52 psi in Phase I)
- No evidence of fouling
- DO/Propane/Microbial distribution is location dependent and highly variable



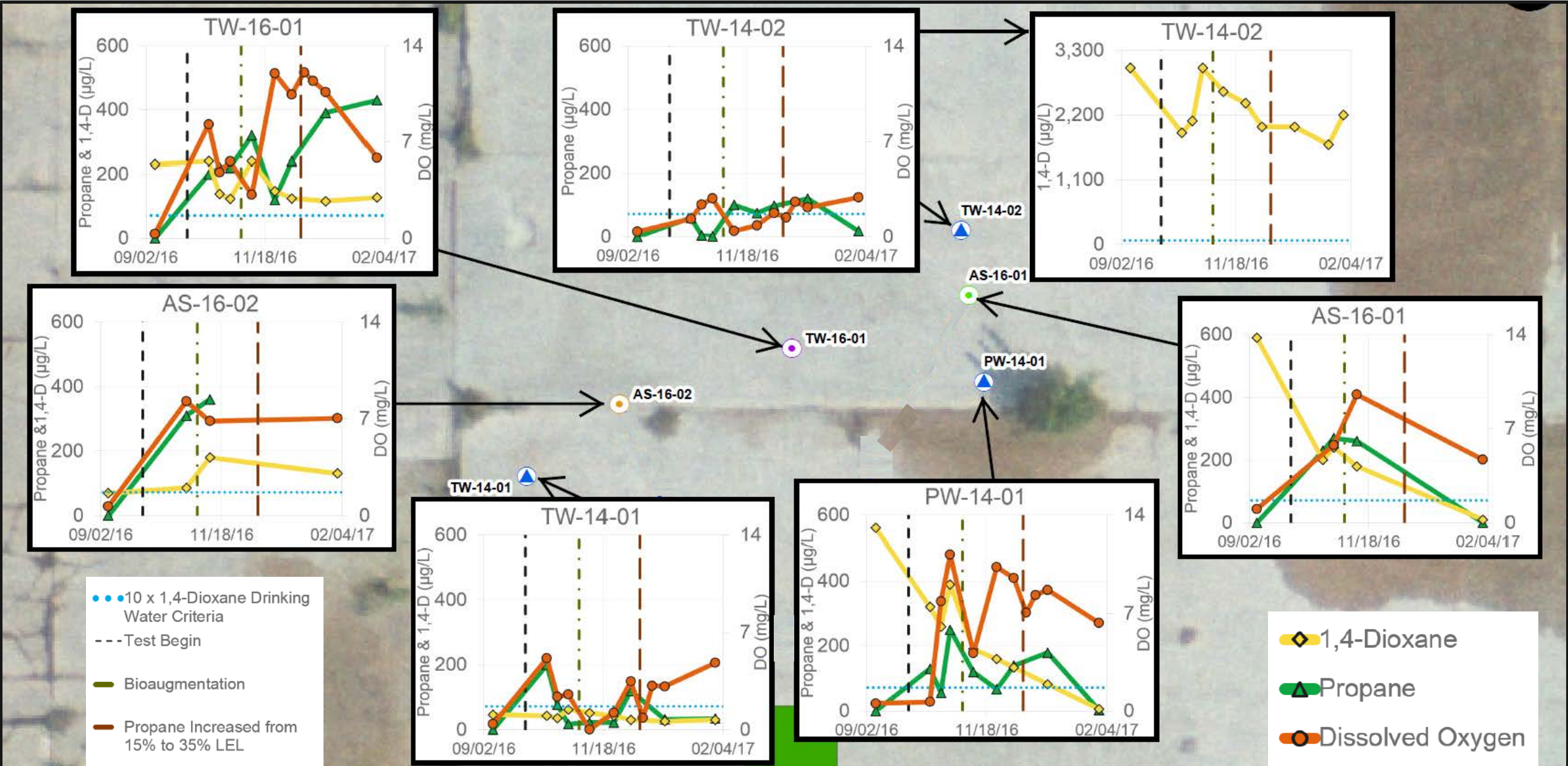
# Phase II Well Screen Elevations

## Formation Limited Distribution

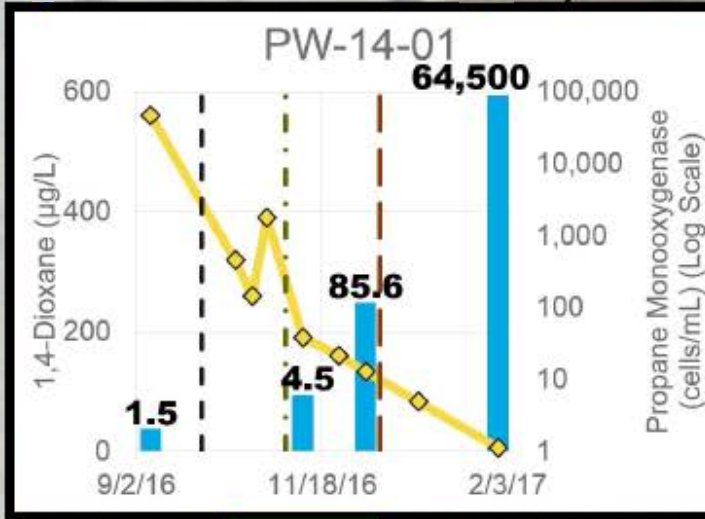
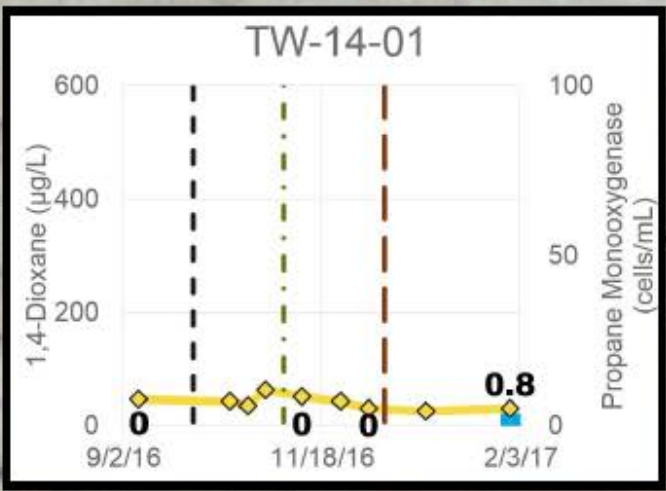
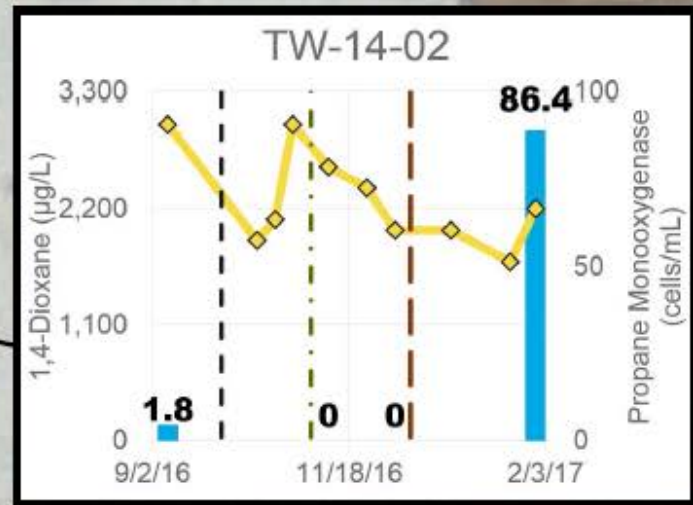
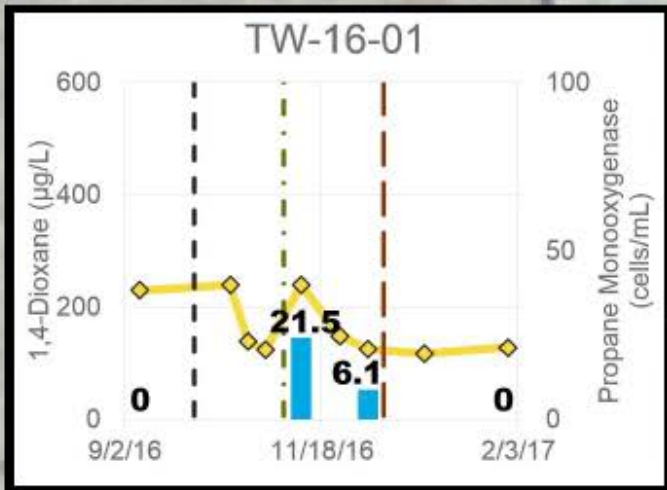
- Best connection observed between PW-14-01 and AS-16-01 (8.6 ft.)
- Good response in TW-16-01 (~18 ft.), limited response in TW-14-02 (7.2 ft.)
- 1,4-D biodegradation mimics distribution



# Phase II DO, Propane and 1,4-D Results ARCADIS Design & Consultancy for natural and built assets

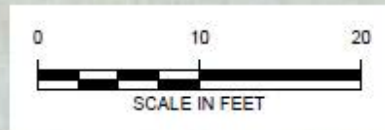


# Phase II Microbial Results



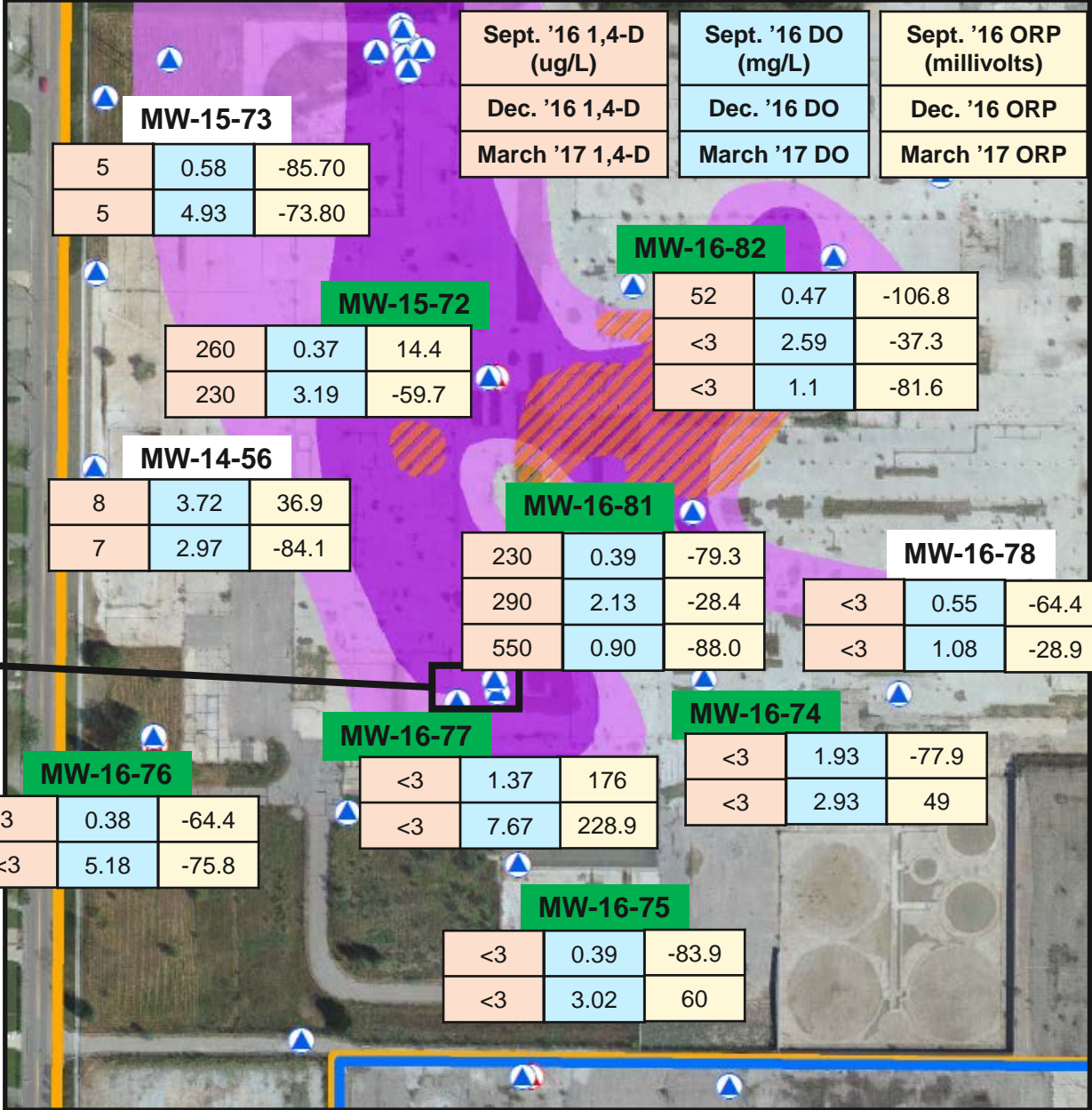
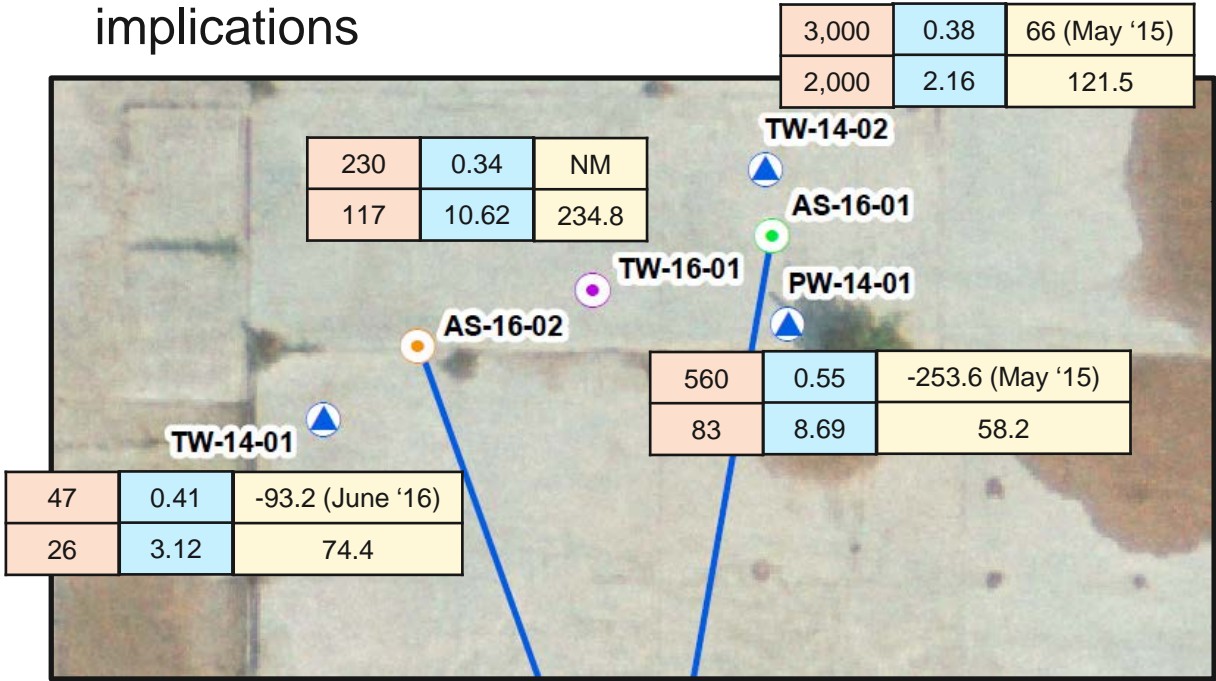
**Legend**

- Propane Monoxygenase (Blue Bar)
- 1,4-Dioxane (Yellow Line with Diamond)
- Test Begin (Black Dashed Line)
- Bioaugmentation (Green Dashed Line)
- Propane Increased from 15% to 35% LEL (Brown Dashed Line)



# Phase II Extended DO Results

- Many wells outside the pilot test area saw > 1 mg/L increase in DO during pilot test
- DO dropped in 2 locations where monitored in Q1 2017, indicates that increase in December can be attributed to sparging activities
- Not able to estimate propane and oxygen depletion rates, does not impact pilot results or full scale implications



# Additional Phase II Results

## Propane Perimeter Monitoring ★

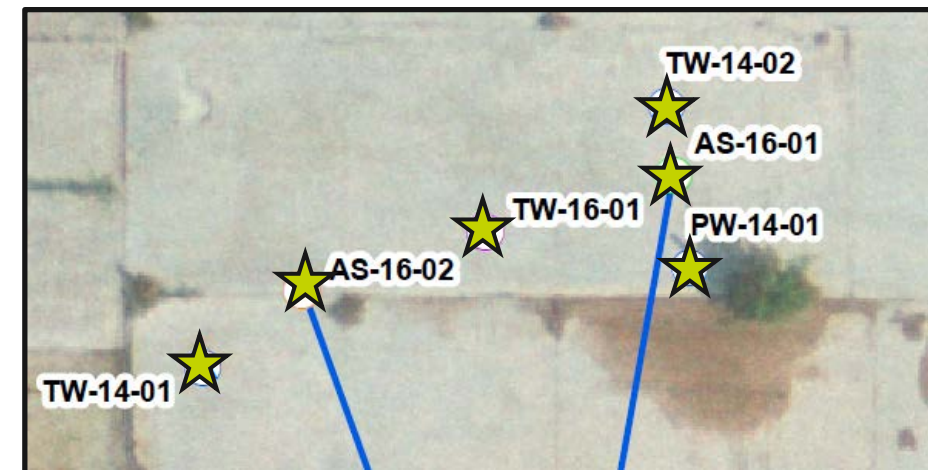
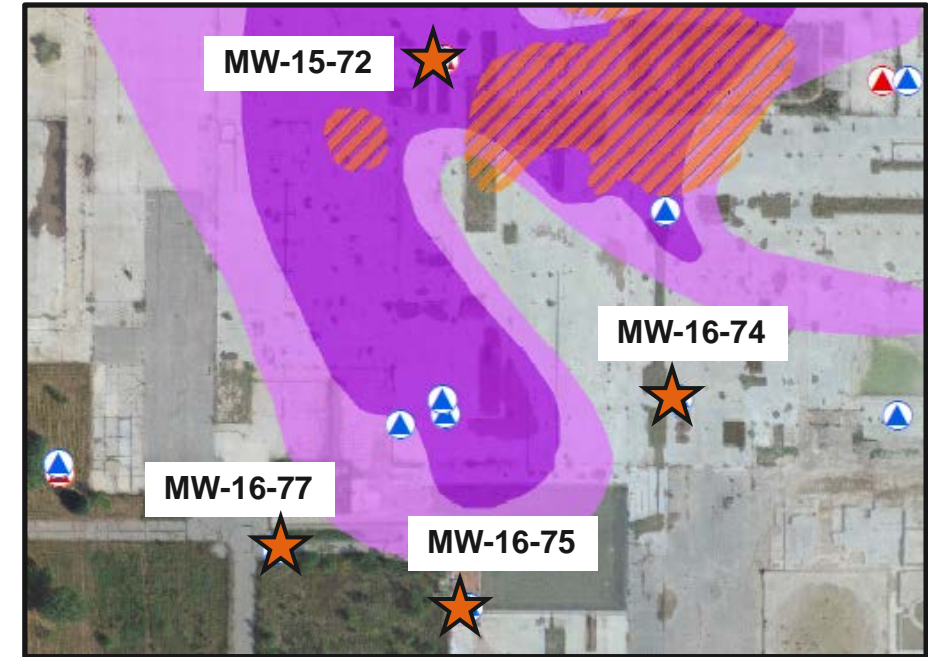
- 4 perimeter MW sampled monthly for propane
- All results were less than or equal to baseline for 3 of the 4 wells monitored
- MW-16-74 saw an increase of 28 ug/L during the pilot test

## Diammonium Phosphate Related Monitoring ★

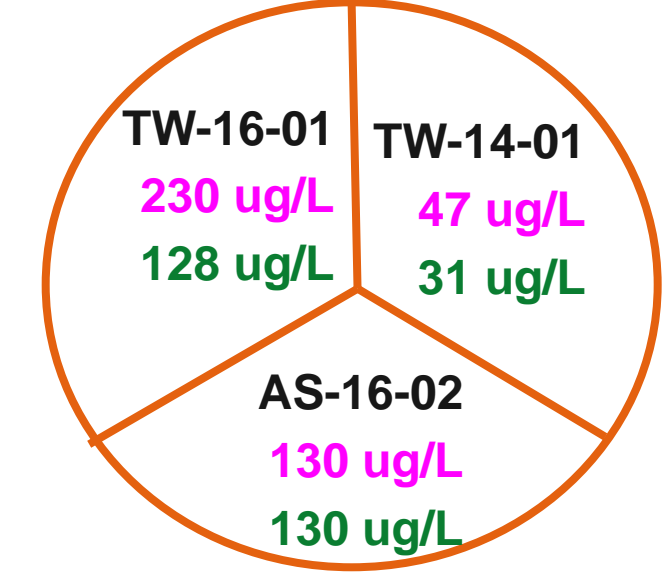
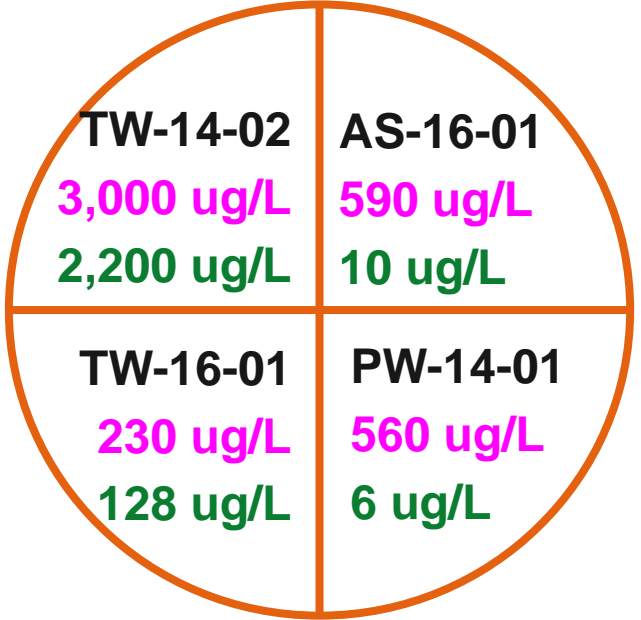
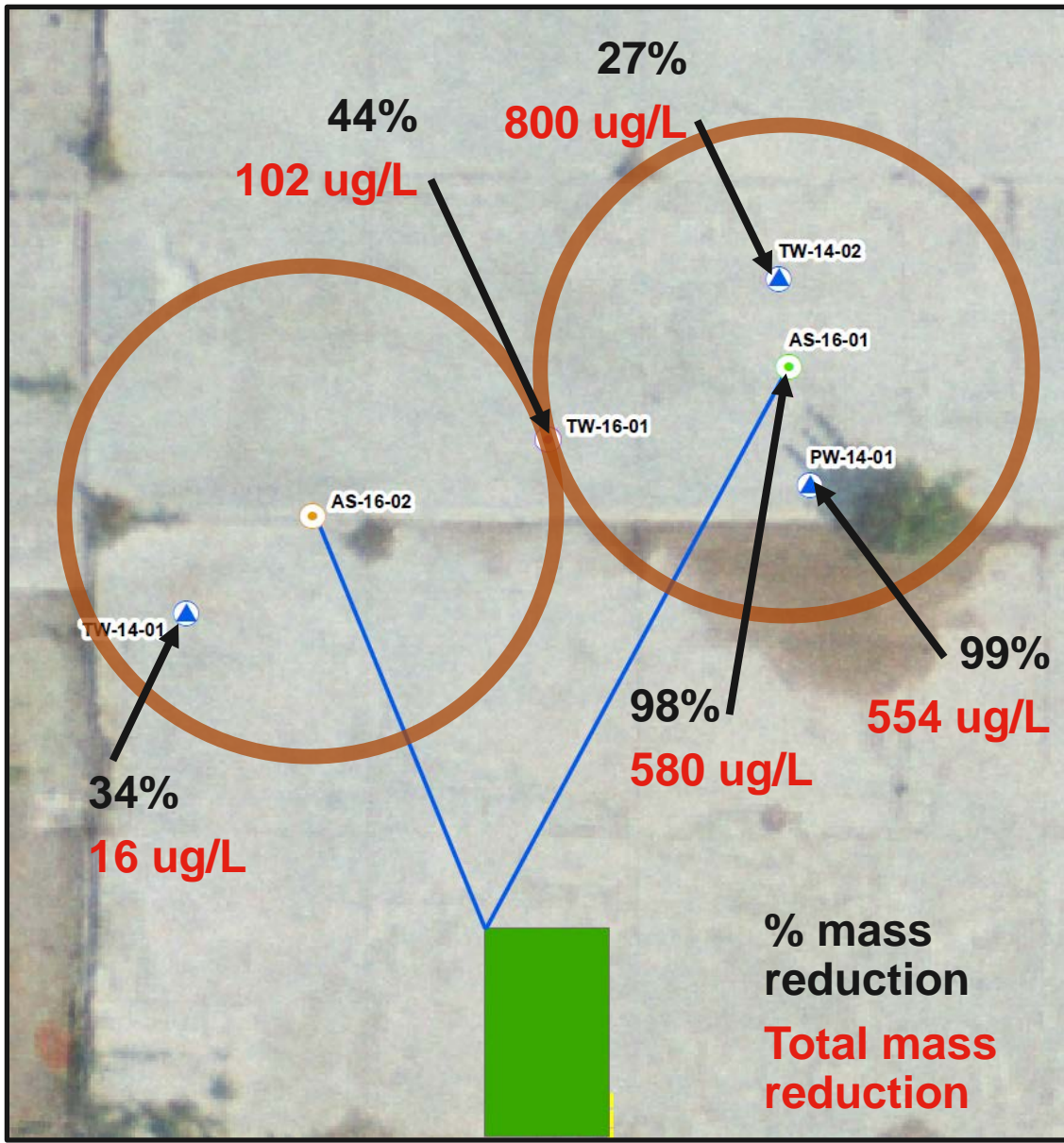
- Nitrate, Nitrite, TKN, total phosphorus and fluoride were monitored due to the DAP (bioaugmentation) injection
- Increased nutrient concentrations were observed after bioaugmentation, mainly in the AS wells, but declined as the pilot test progressed
- All fluoride results were less than or equal to baseline

## CSIA Monitoring ★

- Pending with the lab



# Phase II Results Summary



**AS-16-01**  
 Baseline average concentration = **1,100 ug/L**  
 Post pilot average concentration = **580 ug/L**  
**~50% mass reduction**

**AS-16-02**  
 Baseline average concentration = **135 ug/L**  
 Post pilot average concentration = **96 ug/L**  
**~30% mass reduction**

# Phase II Results Summary

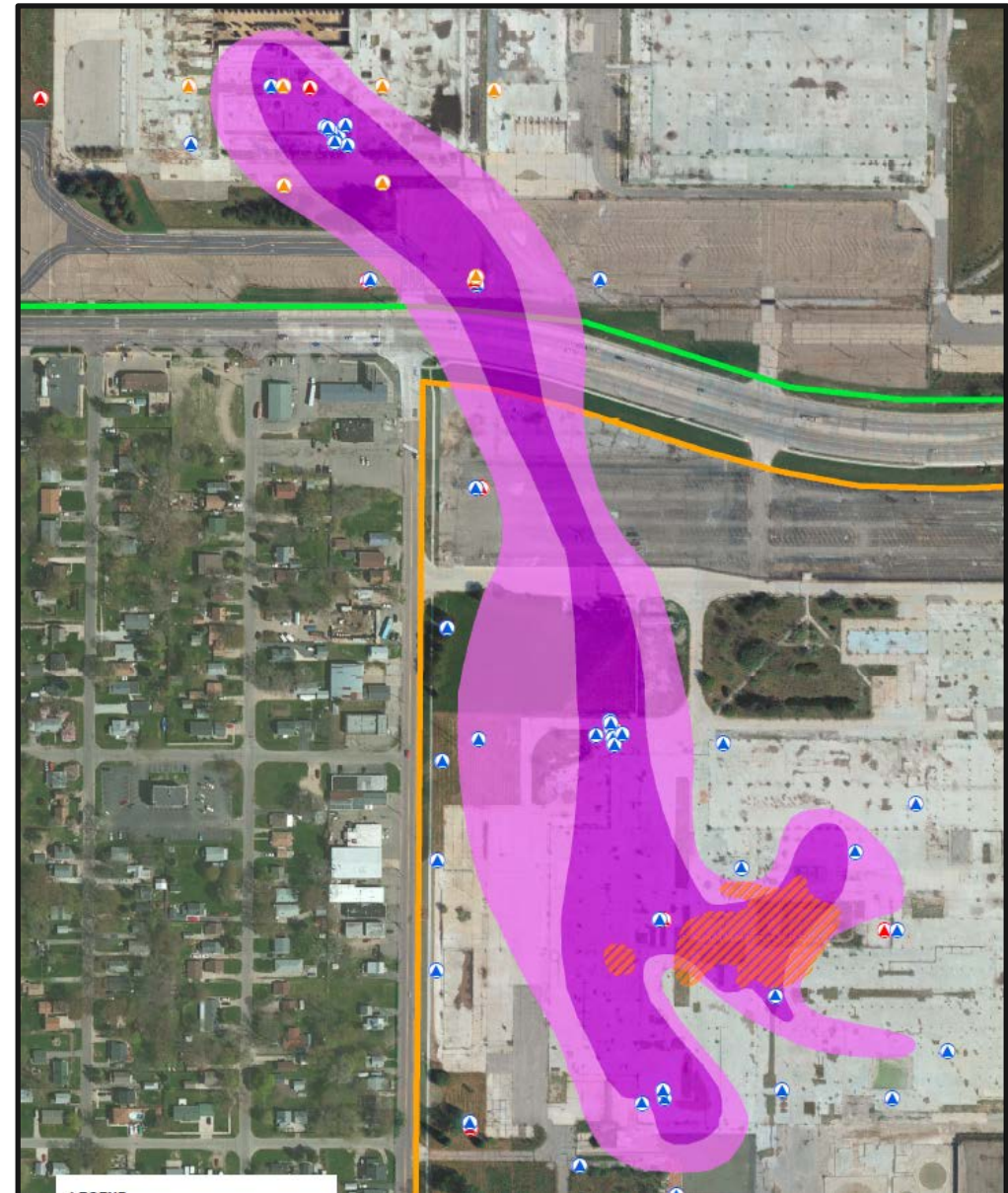
- No significant lateral vapor migration and/or pressure buildup observed during pilot test
- Wellhead LEL readings consistent 0% of LEL within pilot test area and perimeter monitoring well network
- While system had good up time, it did have shut downs. Microbes were more resilient in situ (compared to bioreactor). Microbes have access to alternate food sources and electron acceptors in situ to sustain during system shut down periods.



**A bio-barrier capable of degrading 1,4-D can be established at the Site. Overall effectiveness of the bio-barrier can be enhanced if formation driven distribution limitations can be overcome**

# Full Scale Implications

- Distribution enhancements or adaptive well installation will be considered to overcome distribution limitations for gases and bioaugmentation culture
- Treatment time once microbial community is established is fast (days to weeks), amendable to transect treatment approach
- Pilot provided a basis, however further refinement of flow rate, sparge cycle time and propane loading is anticipated



# Next Steps Related to Biosparge Option

- Continue to evaluate plume stability and potential for migration
- Full-scale biosparge evaluation
  - Conceptual layouts for biosparge alternatives
  - Identification of any additional data needs for full-scale implementation (distribution enhancement pilot testing?)
- Agreement on remedial objectives for lower 1,4-dioxane, considering:
  - Risk
  - Complexity of weathered bedrock – not feasible to get 100% treatment throughout
- Update Draft CMS in Q2/Q3 2017
  - Perched source remedy options (cost and feasibility) compared to operation of a lower 1,4-D containment system
  - Lower 1,4-D: biosparge and pump and treat/groundwater recirculation with AOP

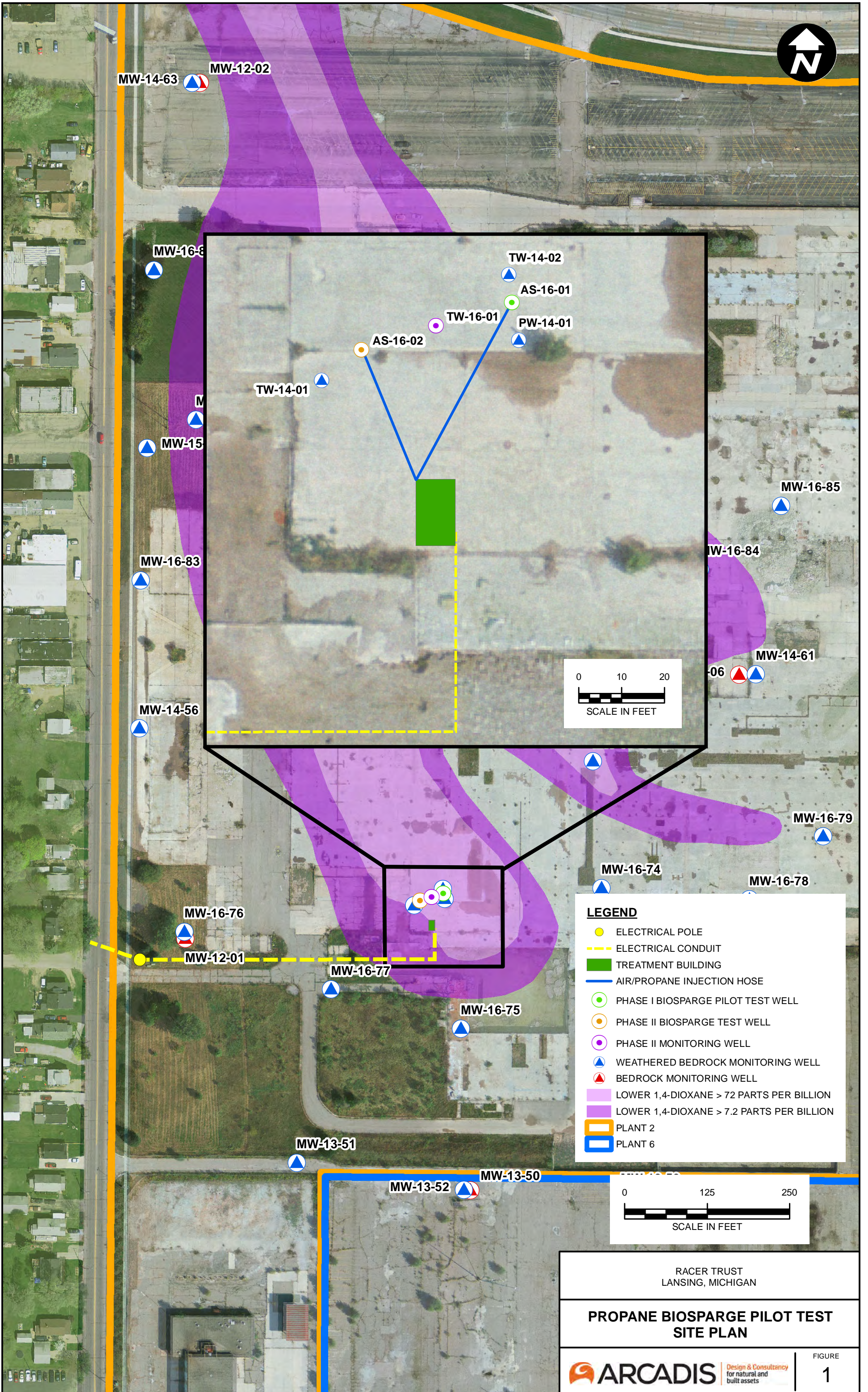
# Questions?



**Propane Biosparge Pilot Test Summary**  
**RACER Trust Plant 2 – Lansing, Michigan**

**FIGURES**






**LEGEND**

- ELECTRICAL POLE
- ELECTRICAL CONDUIT
- TREATMENT BUILDING
- AIR/PROPANE INJECTION HOSE
- PHASE I BIOSPARGE PILOT TEST WELL
- PHASE II BIOSPARGE TEST WELL
- PHASE II MONITORING WELL
- ▲ WEATHERED BEDROCK MONITORING WELL
- ▲ BEDROCK MONITORING WELL
- LOWER 1,4-DIOXANE > 72 PARTS PER BILLION
- LOWER 1,4-DIOXANE > 7.2 PARTS PER BILLION
- PLANT 2
- PLANT 6

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**PROPANE BIOSPARGE PILOT TEST  
SITE PLAN**

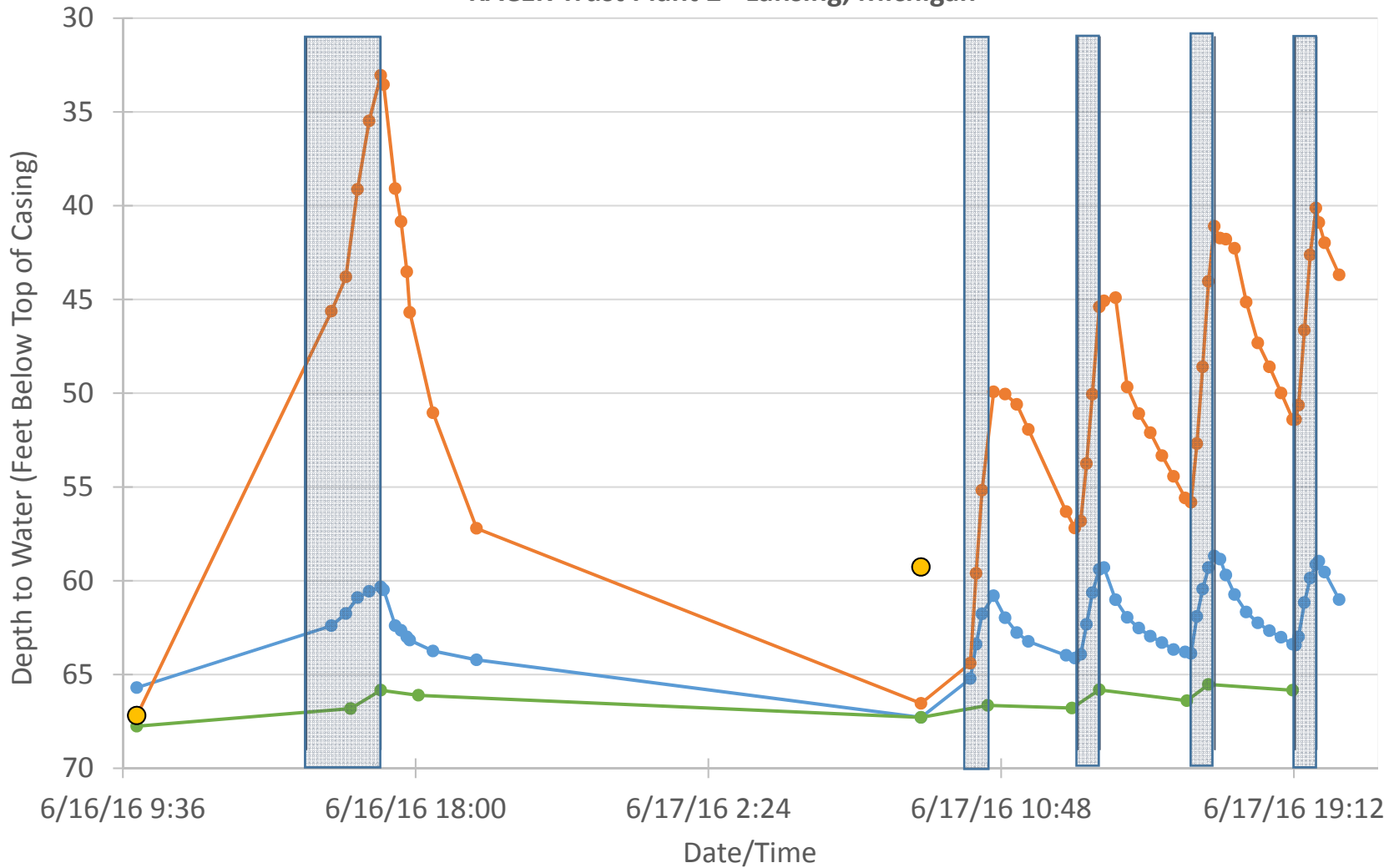


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for natural and  
built assets

FIGURE

1

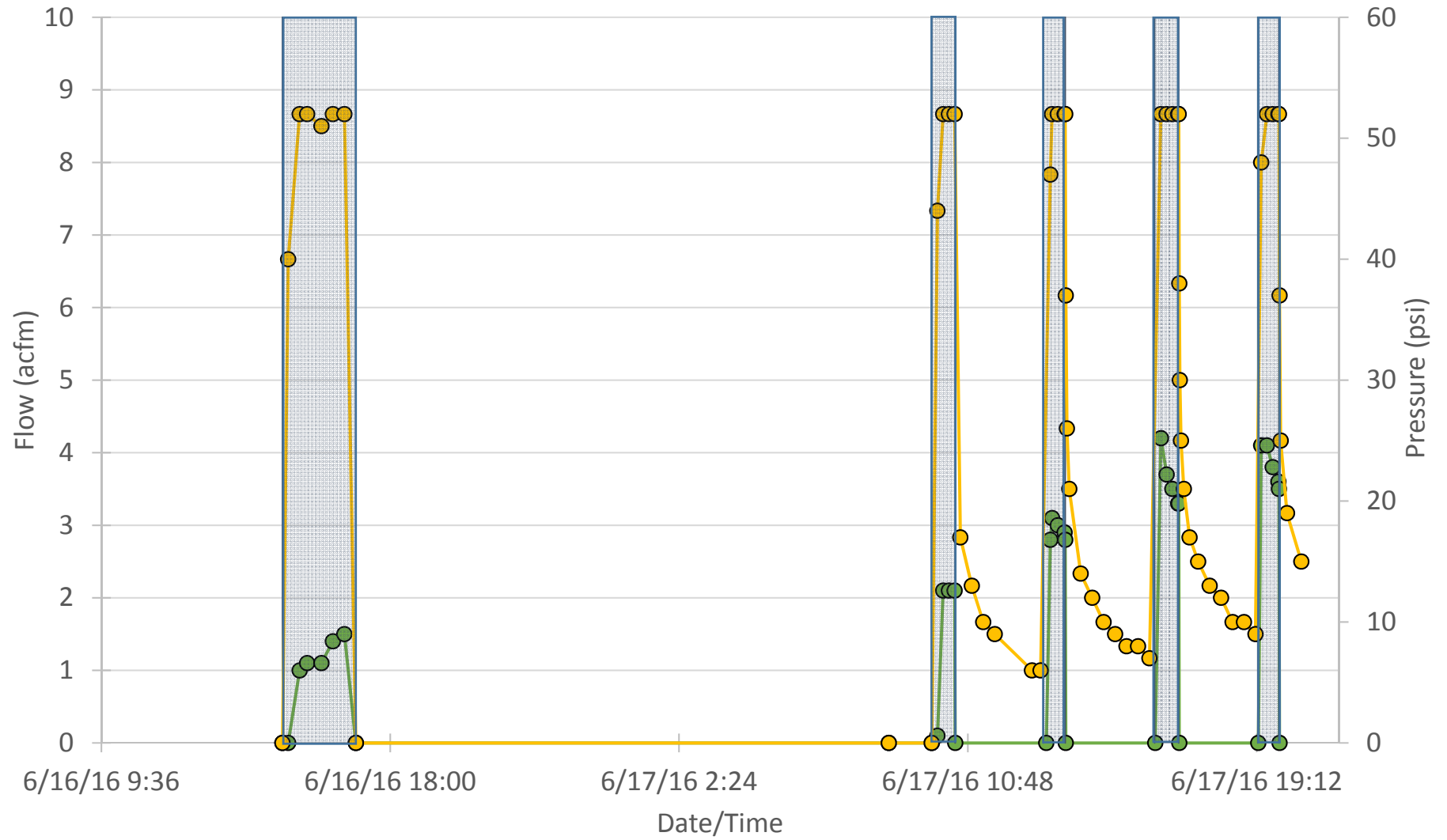
Figure 2  
 Phase I Biosparge Pilot: Groundwater Level Data  
 RACER Trust Plant 2 - Lansing, Michigan



● TW-14-02 (7.2 ft.)   
 ● PW-14-01 (8.6 ft.)   
 ● AS-16-01   
 ● TW-14-01 (47.3 ft.)   
 Air Injection

ft. - feet

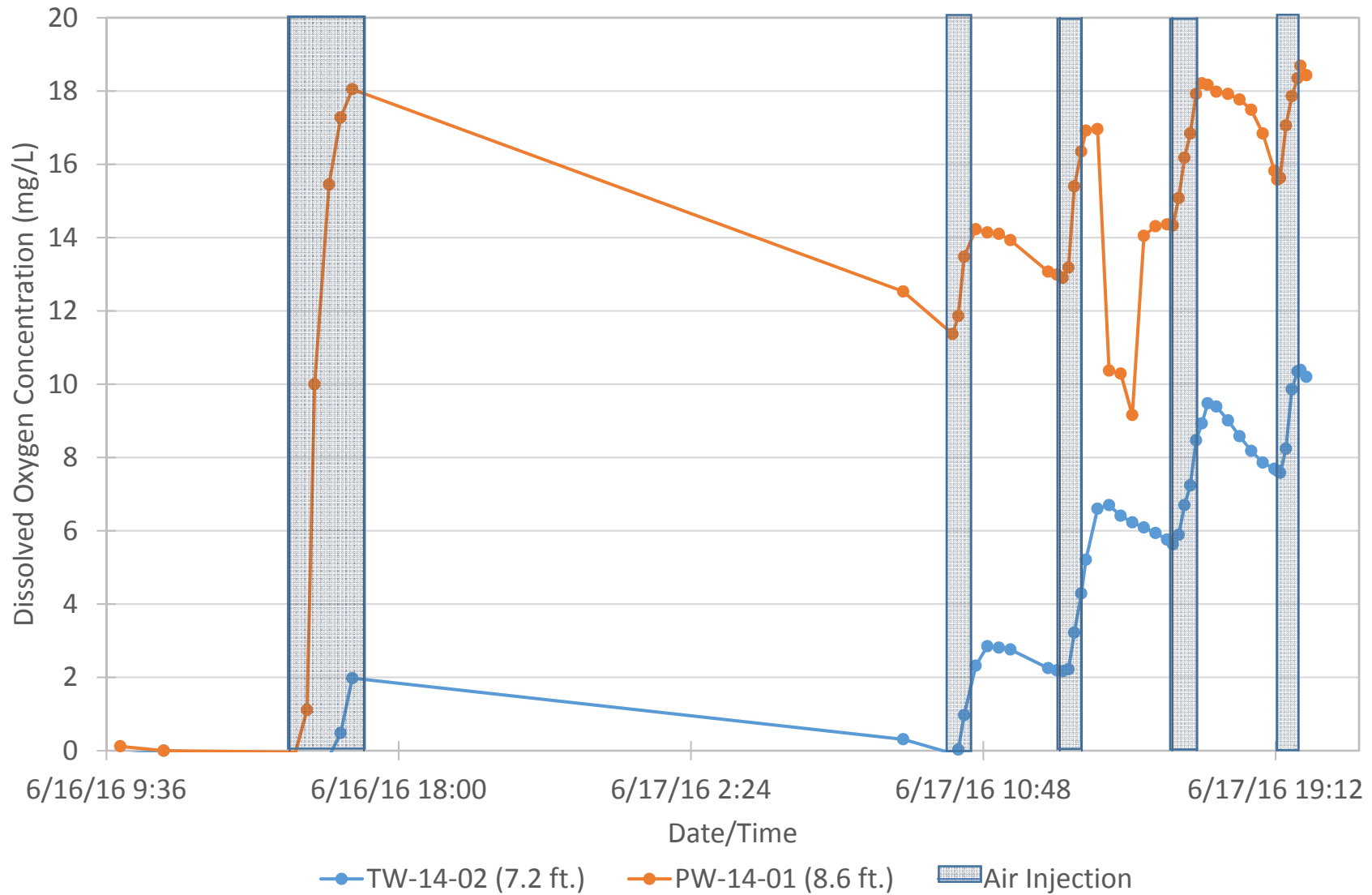
**Figure 3**  
**Phase I Biosparge Pilot: AS-16-01 Flow and Pressure Data**  
**RACER Trust Plant 2 - Lansing, Michigan**



Air Injection
  AS Flow (acfm)
  AS Pressure (psi)

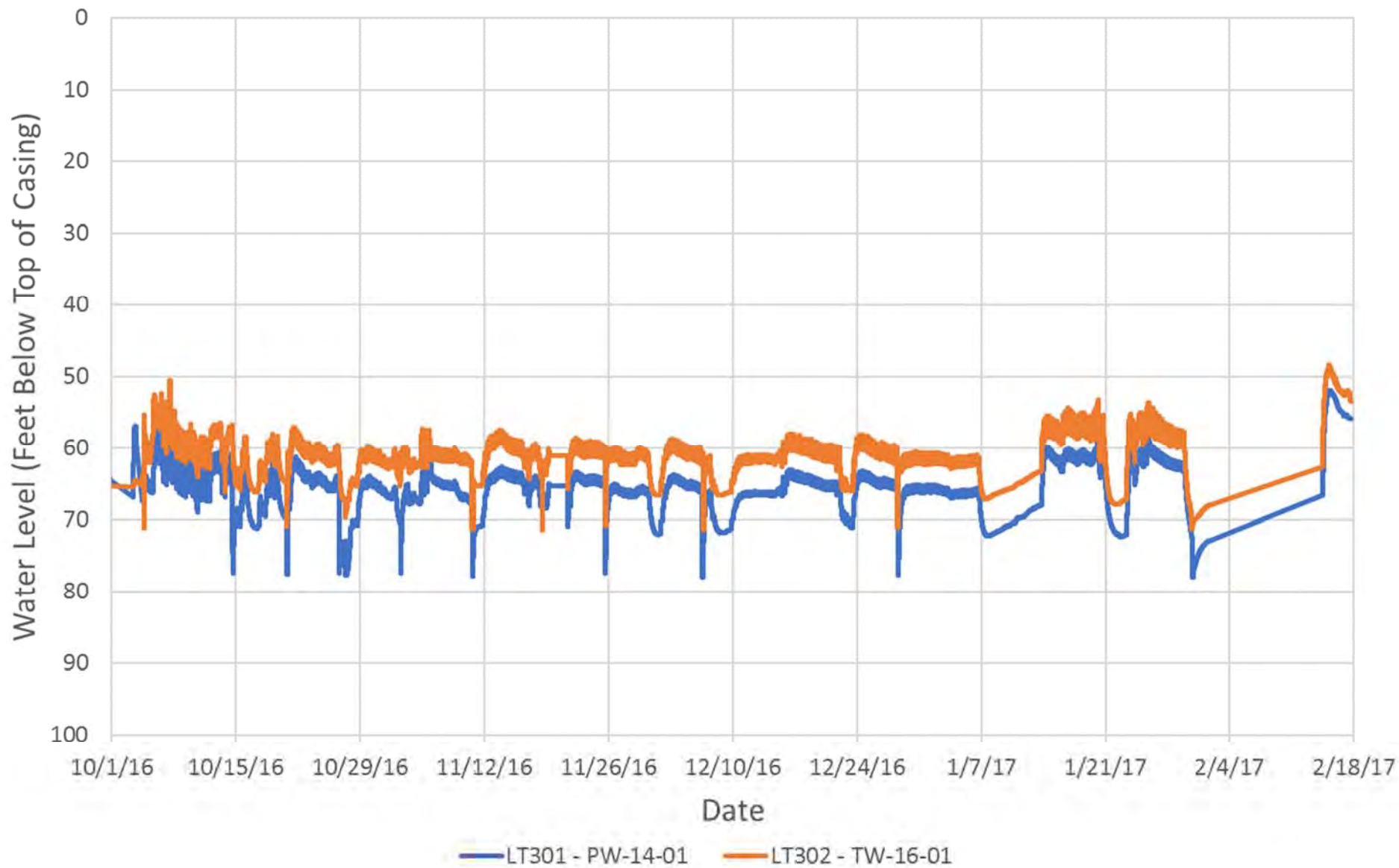
acfm - adjusted cubic feet per minute  
 psi - pounds per square inch

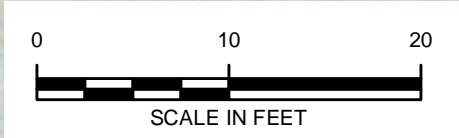
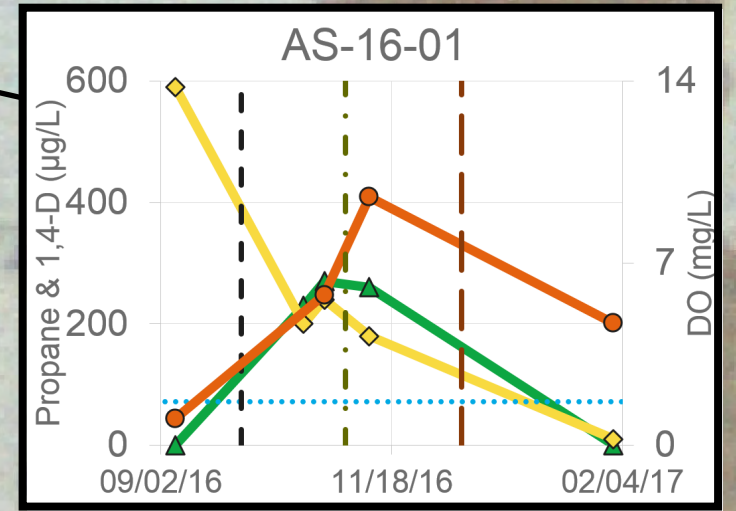
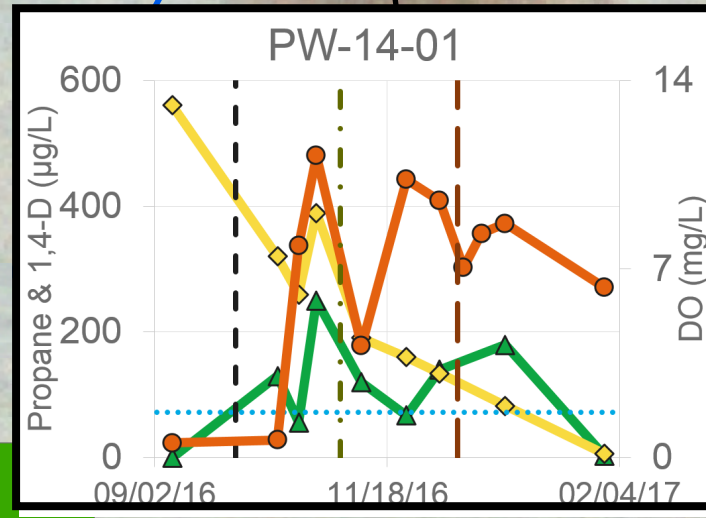
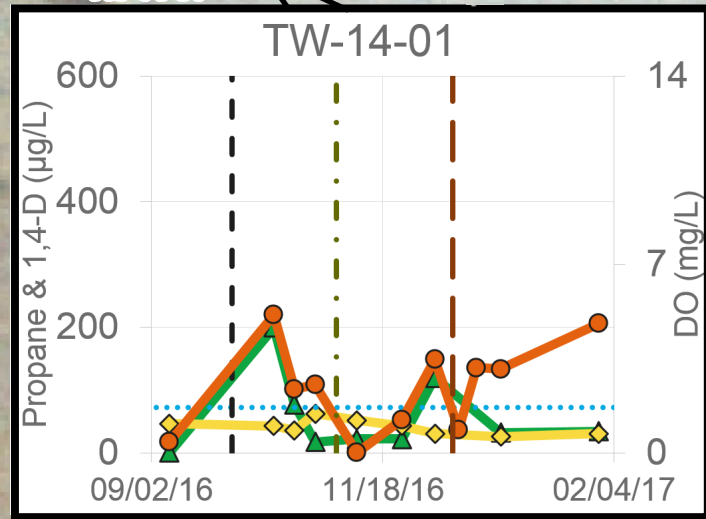
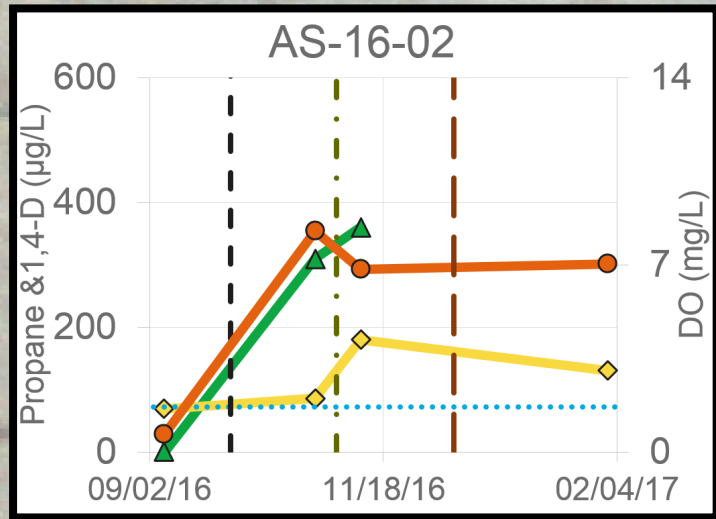
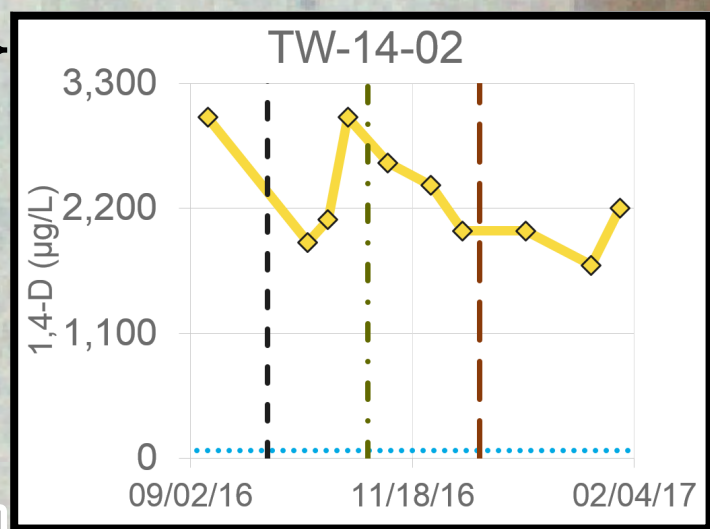
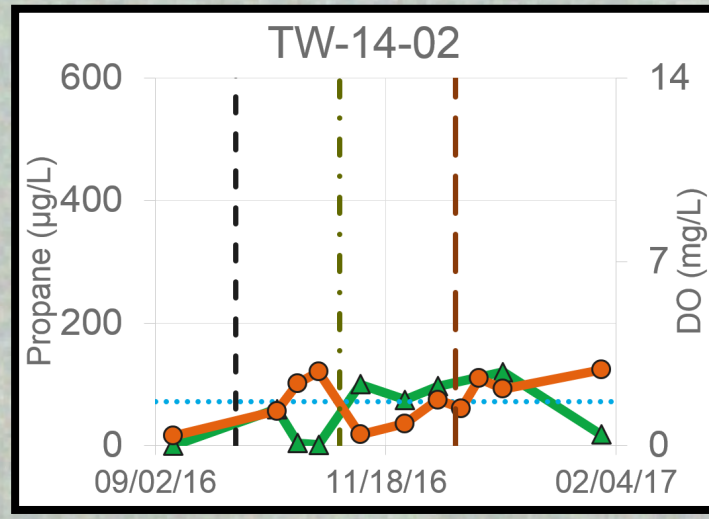
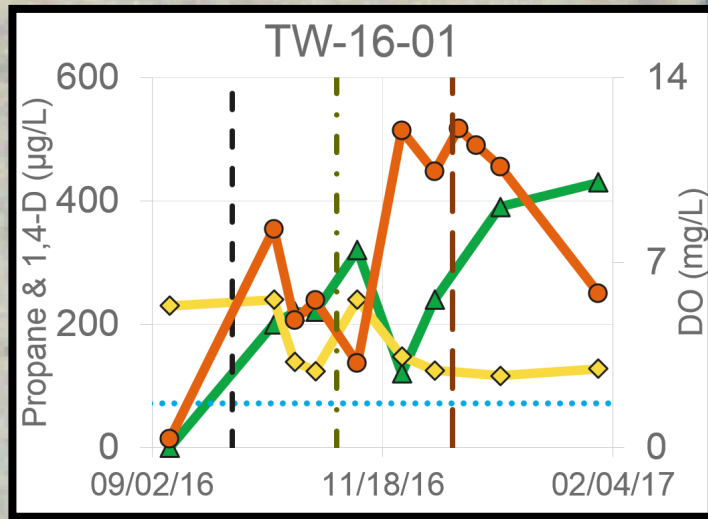
Figure 4  
Phase I Biosparge Pilot: Dissolved Oxygen Data  
RACER Trust Plant 2 - Lansing, Michigan



mg/L - Milligrams Per Liter

**Figure 5**  
**Phase II Biosparge Pilot: Groundwater Level Data**  
**RACER Trust Plant 2- Lansing, Michigan**





- 10 x 1,4-Dioxane Drinking Water Criteria
- - - Test Begin
- █ Bioaugmentation
- █ Propane Increased from 15% to 35% LEL

- ◆ 1,4-Dioxane
- ▲ Propane
- Dissolved Oxygen

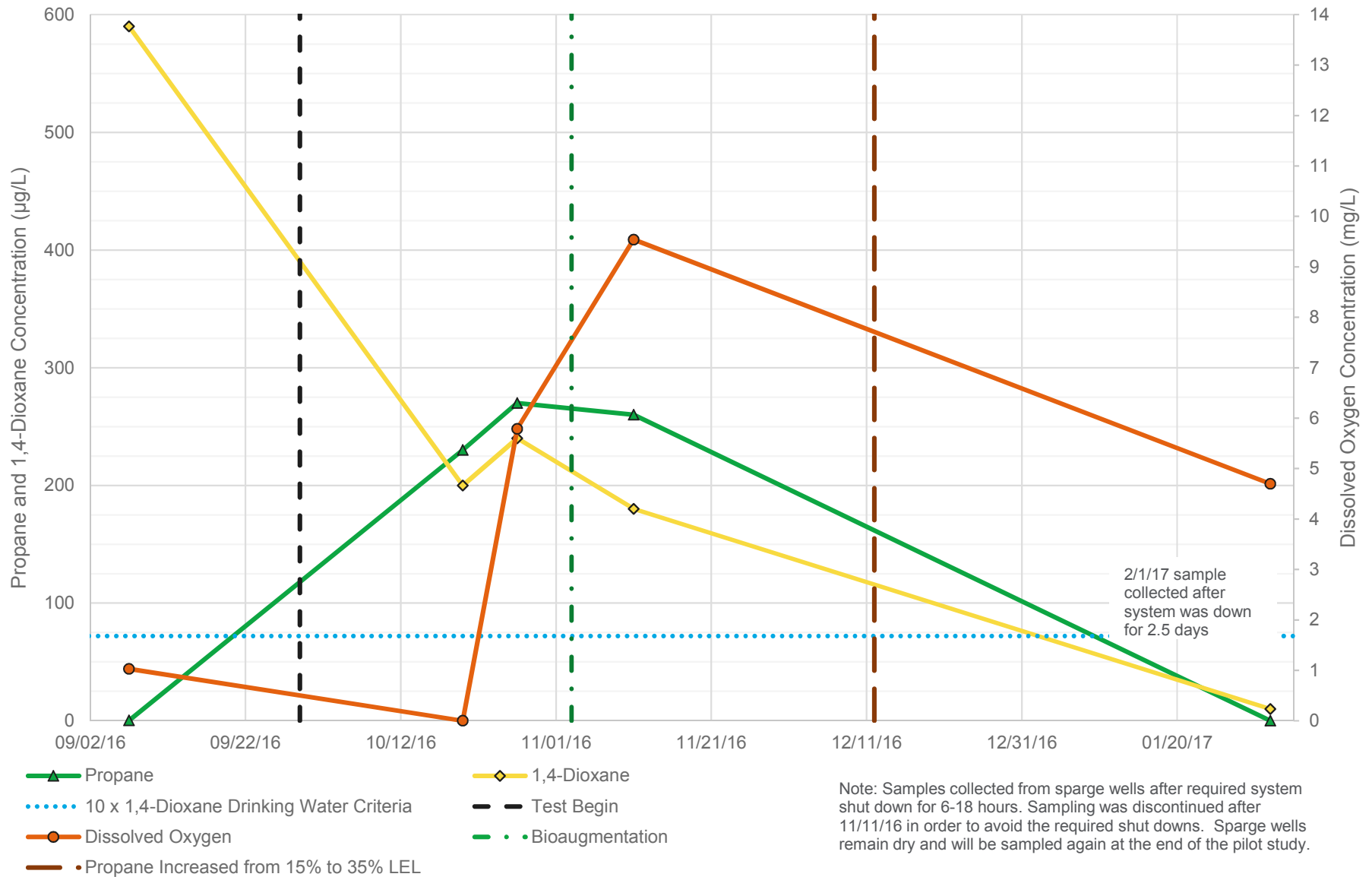
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**Phase II Biosparge Pilot: 1,4-Dioxane,  
Propane, and Dissolved Oxygen Results**

**ARCADIS** Design & Consultancy  
for natural and built assets

FIGURE  
**6**

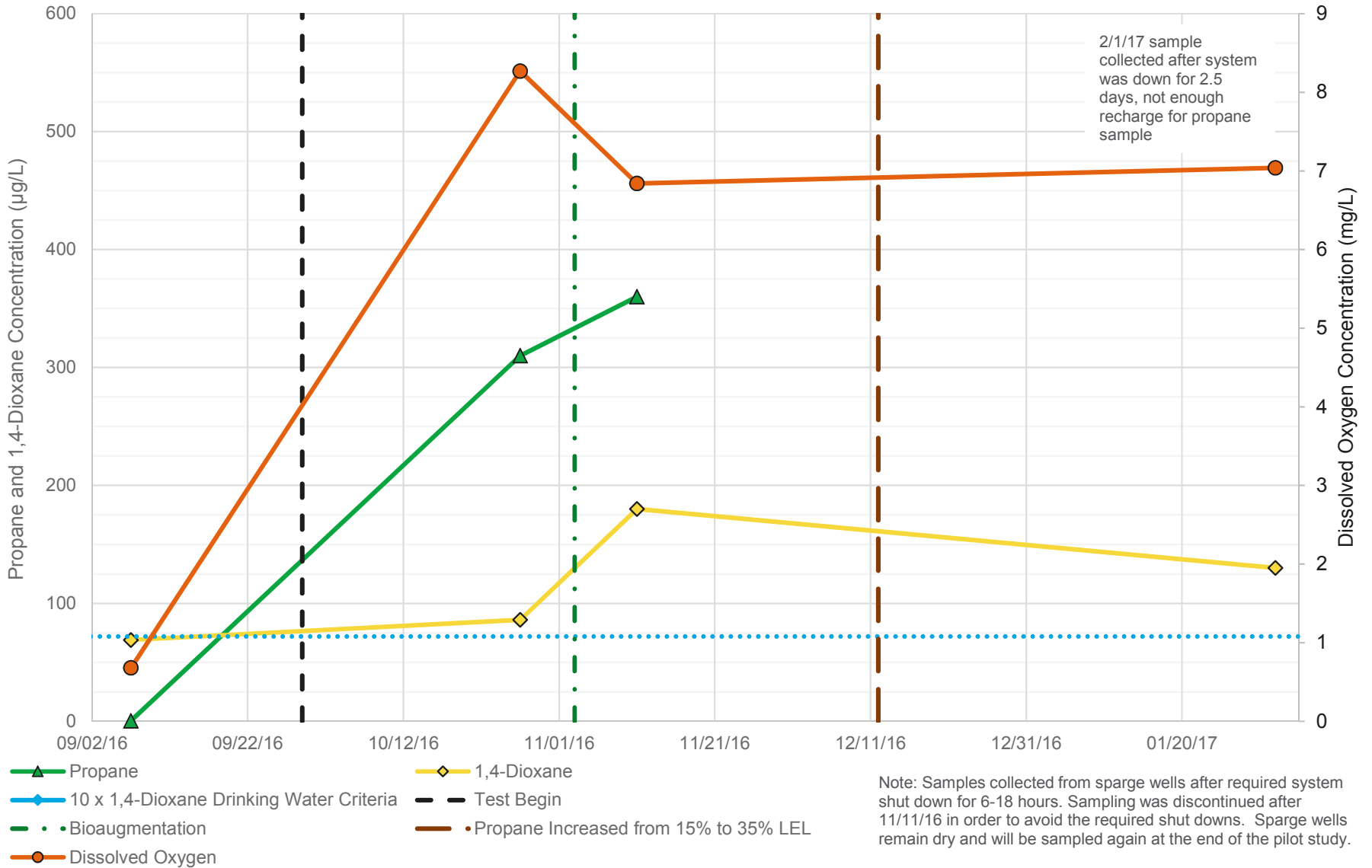
**Figure 7**  
**Phase II Biosparge Pilot: AS-16-01 - 1,4-Dioxane, Propane, and Dissolved Oxygen Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



ug/L - Micrograms per Liter, mg/L - Milligrams per Liter, LEL - Lower Explosive Limit

Beginning with the November 25, 2016 sampling event, all samples were collected while the adjacent sparge well was sparging.

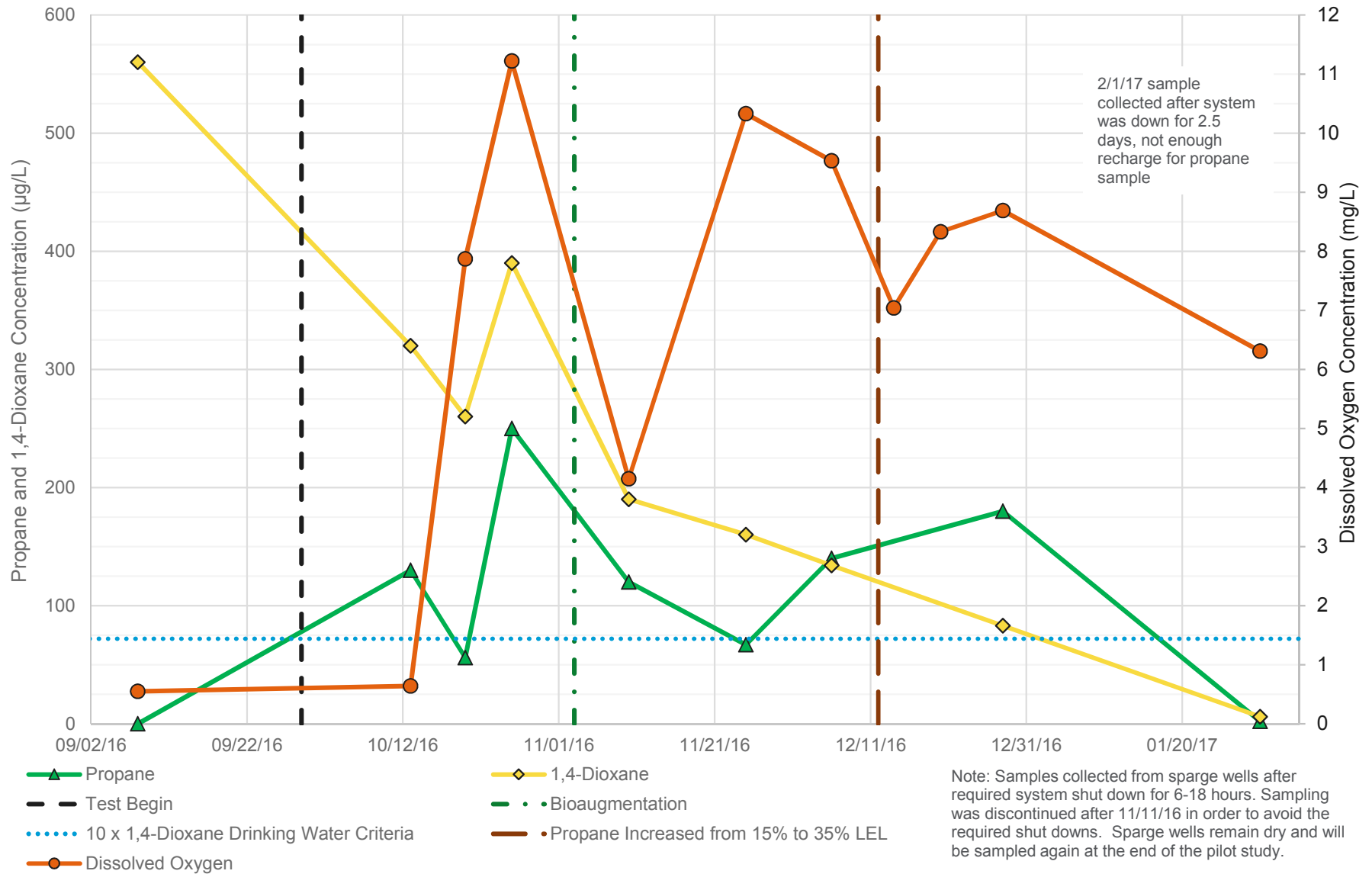
**Figure 8**  
**Phase II Biosparge Pilot: AS-16-02 - 1,4-Dioxane, Propane, and Dissolved Oxygen Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



ug/L - Micrograms per Liter, mg/L - Milligrams per Liter, LEL - Lower Explosive Limit

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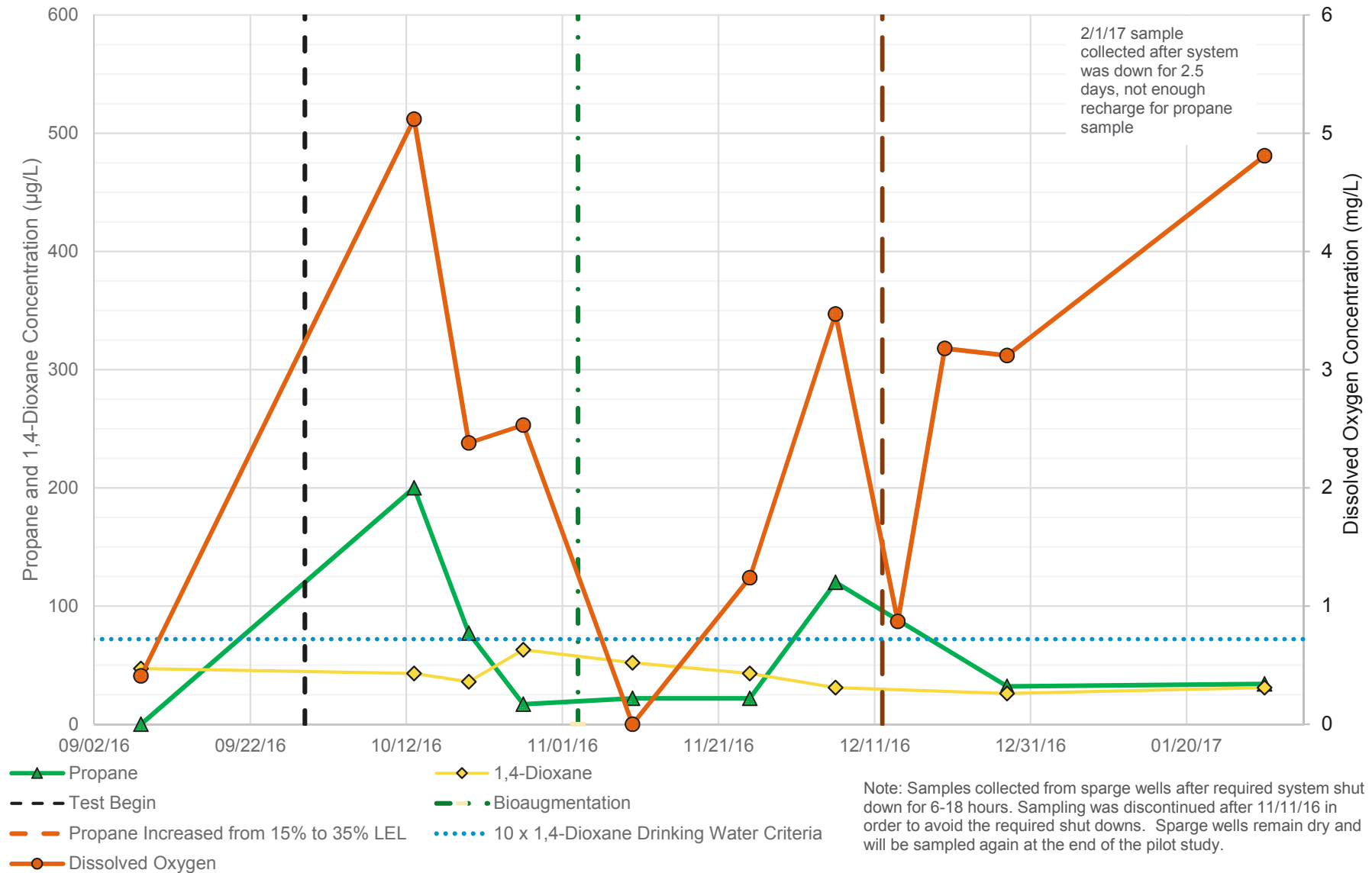
**Figure 9**  
**Phase II Biosparge Pilot: PW-14-01 - 1,4-Dioxane, Propane, and Dissolved Oxygen Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



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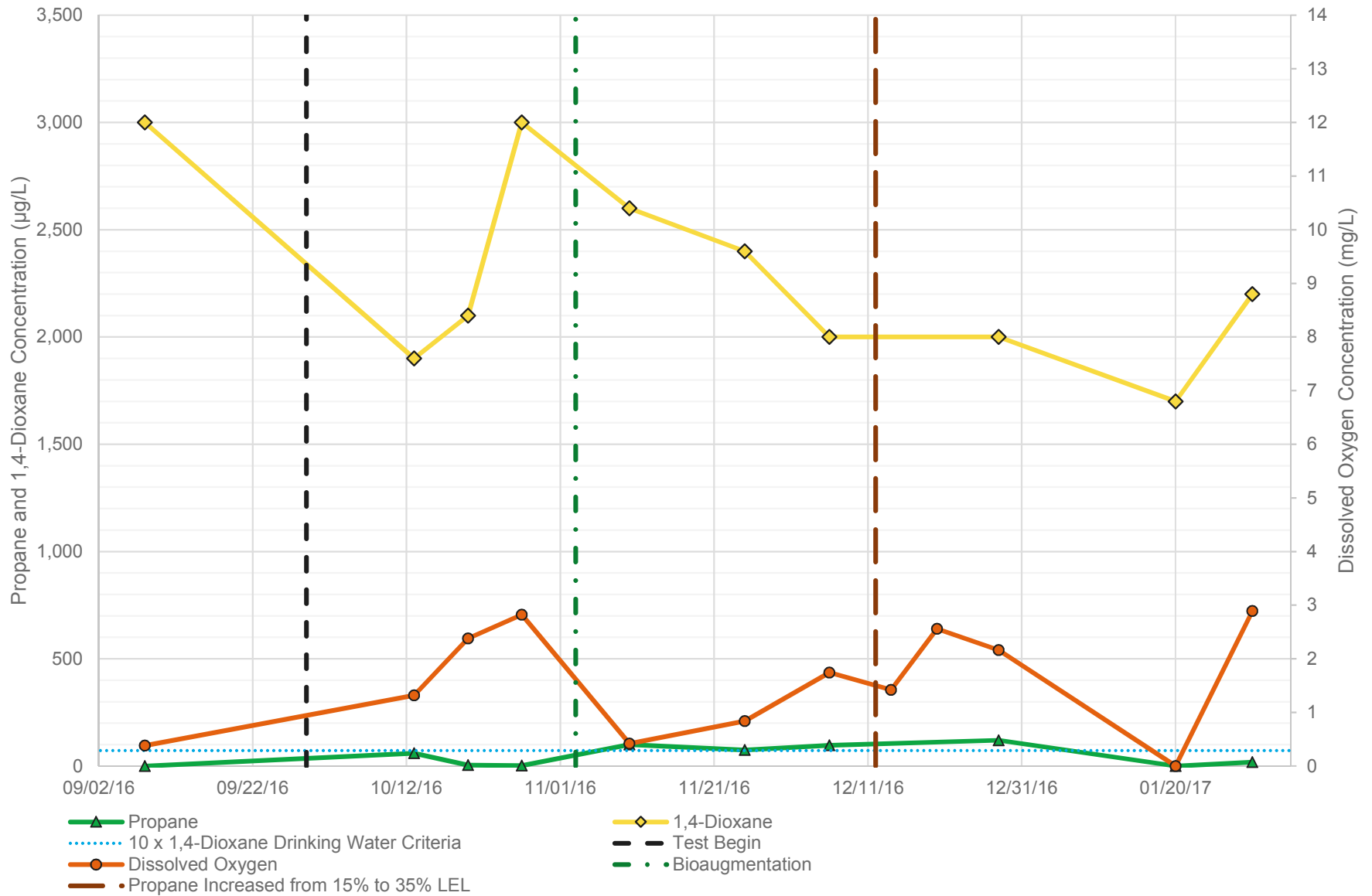
**Figure 10**  
**Phase II Biosparge Pilot: TW-14-01 - 1,4-Dioxane, Propane, and Dissolved Oxygen Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



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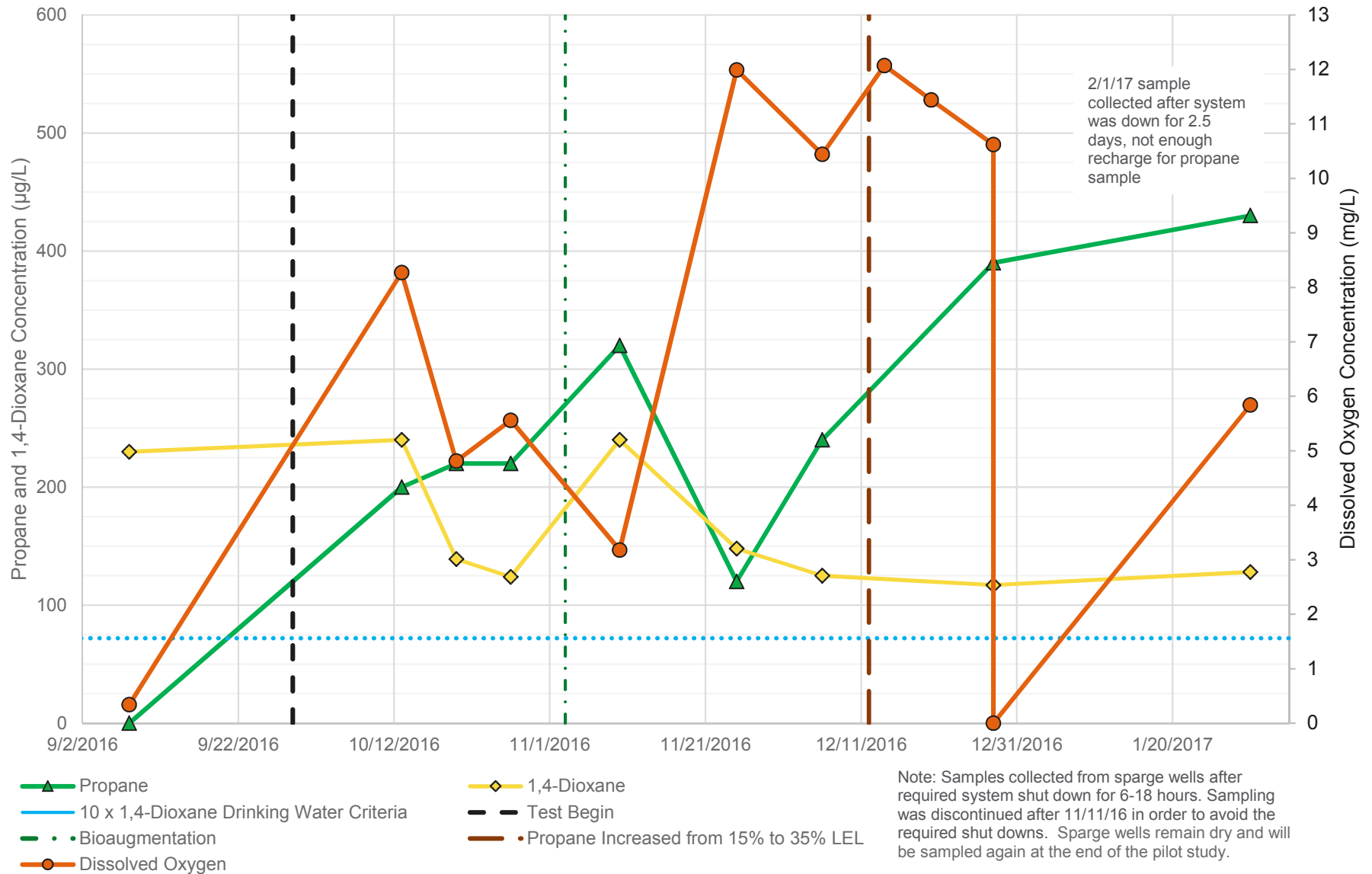
**Figure 11**  
**Phase II Biosparge Pilot: TW-14-02 - 1,4-Dioxane, Propane, and Dissolved Oxygen Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



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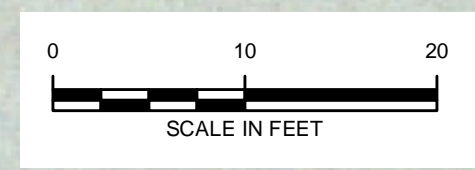
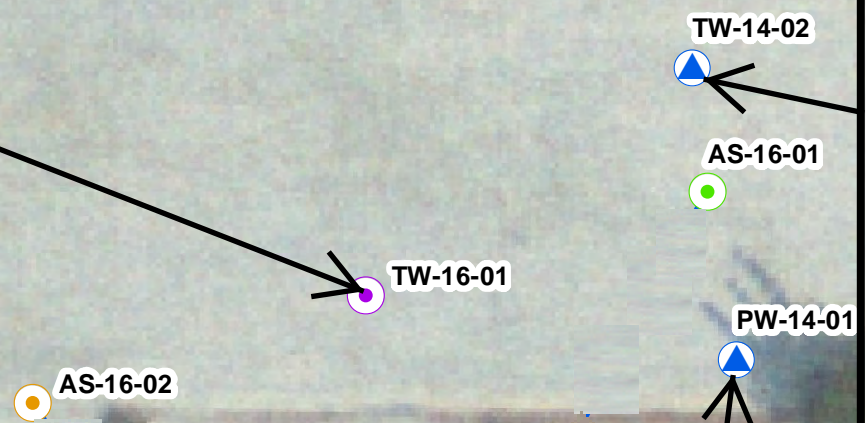
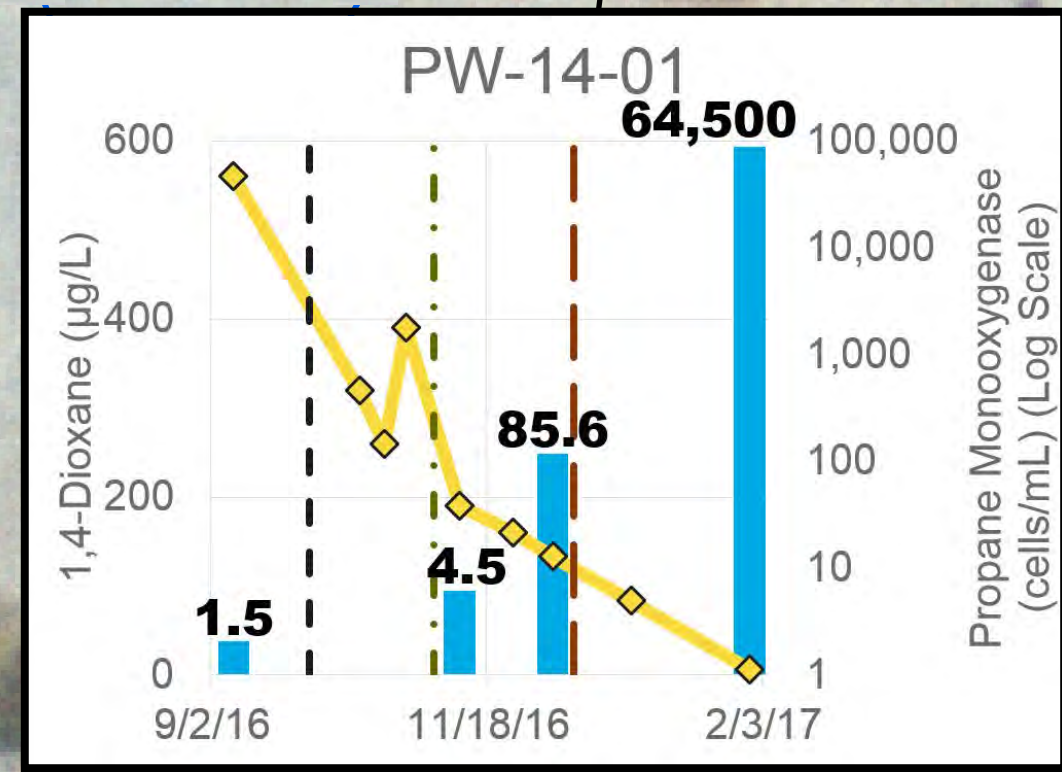
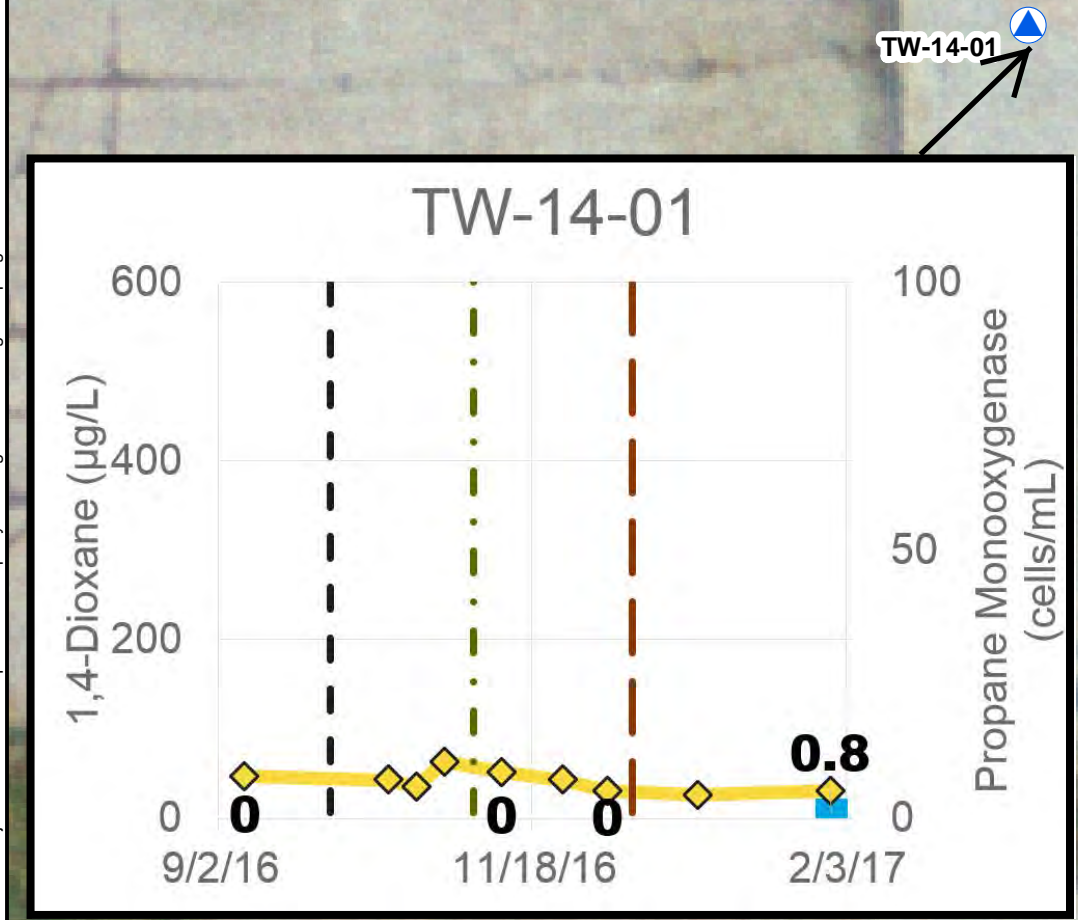
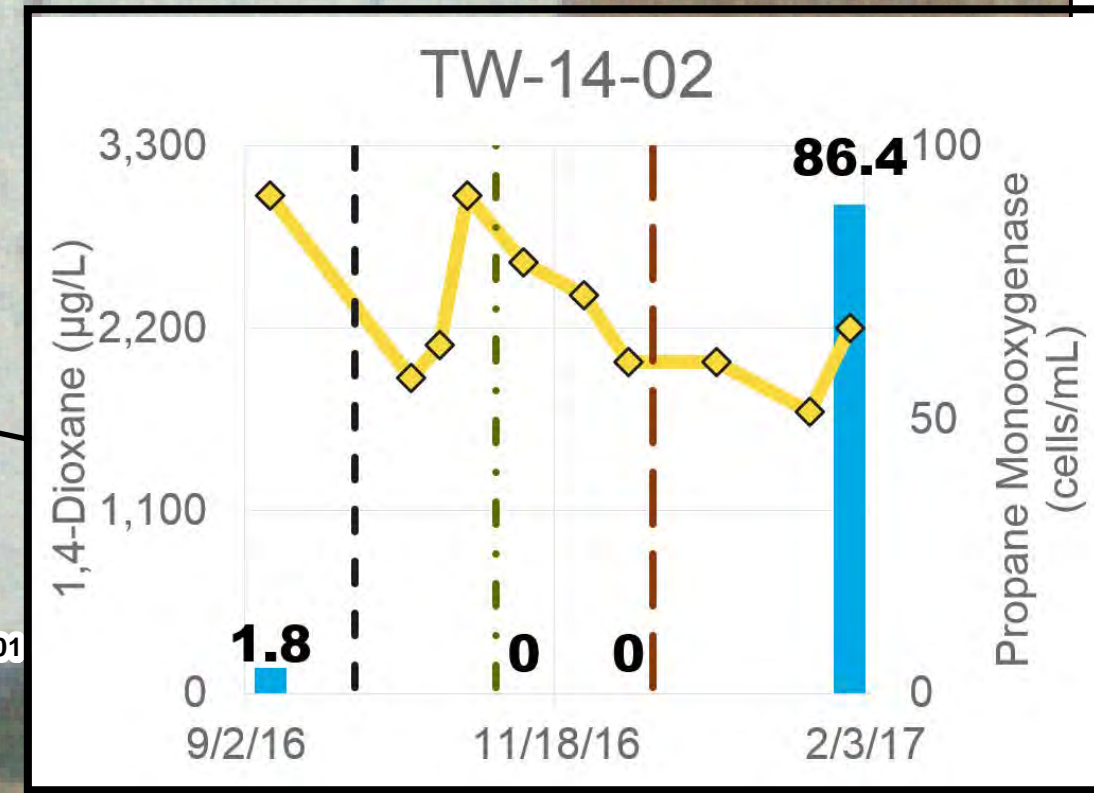
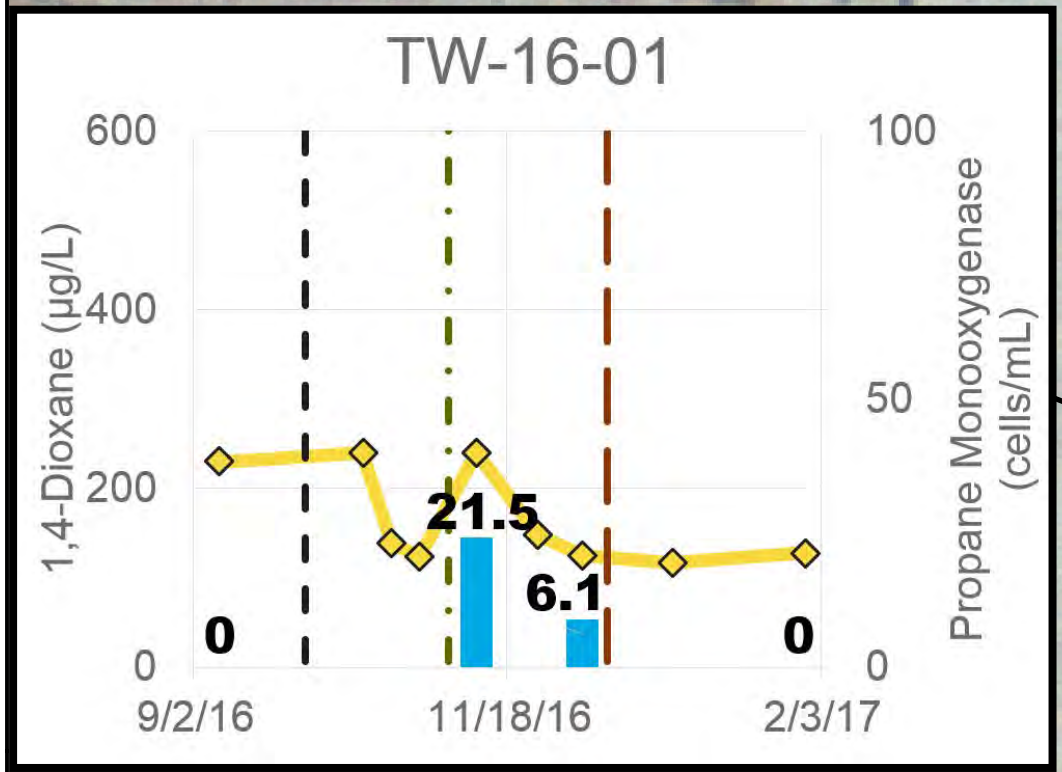
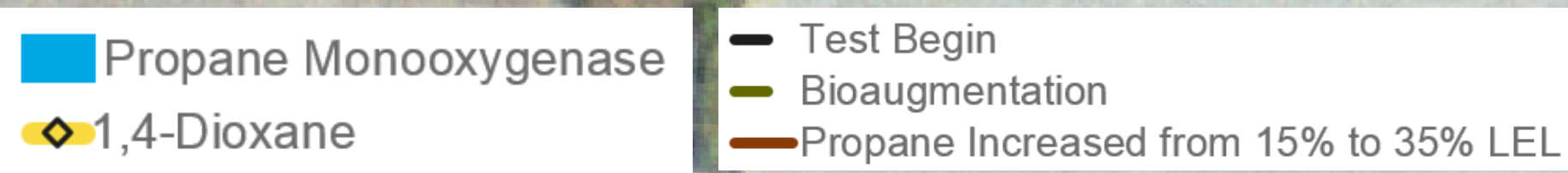
Beginning with the November 25, 2016 sampling event, all samples were collected while the adjacent sparge well was sparging.

**Figure 12**  
**Phase II Biosparge Pilot: TW-16-01 - 1,4-Dioxane, Propane, and Dissolved Oxygen Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



ug/L - Micrograms per Liter, mg/L - Milligrams per Liter, LEL - Lower Explosive Limit  
 Beginning with the November 25, 2016 sampling event, all samples were collected while the adjacent sparge well was sparging.

CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl  
 G:\GIS\Project Files\MotorsLiqudationCompany\Lansing\Docs\WorkingAir Sparge Pilot Test.mxd PLOTTED: 12/28/2016 5:06:19 PM BY: dolaxa



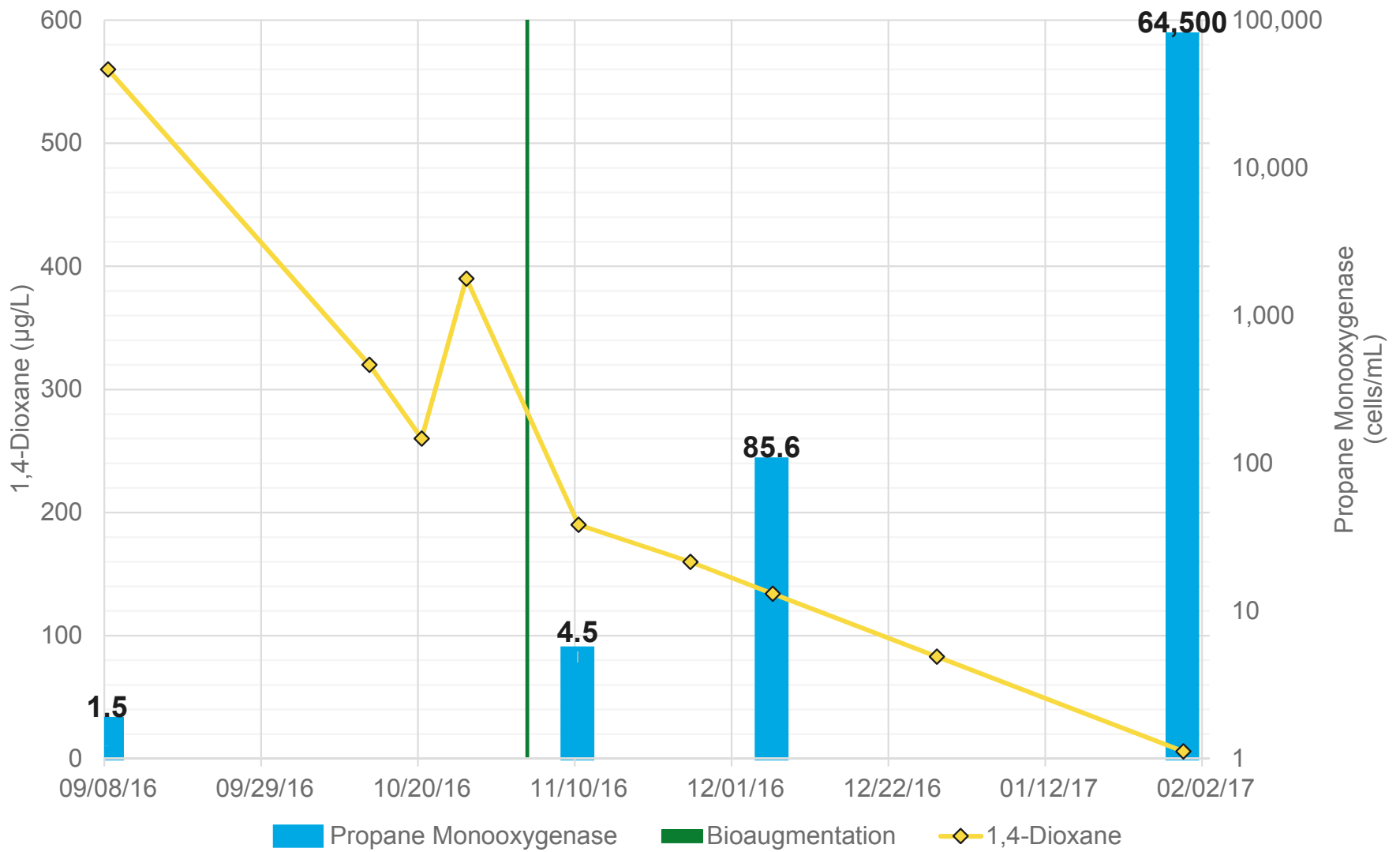
RACER TRUST  
 LANSING, MICHIGAN

**Phase II Biosparge Pilot:  
 Microbial Results**

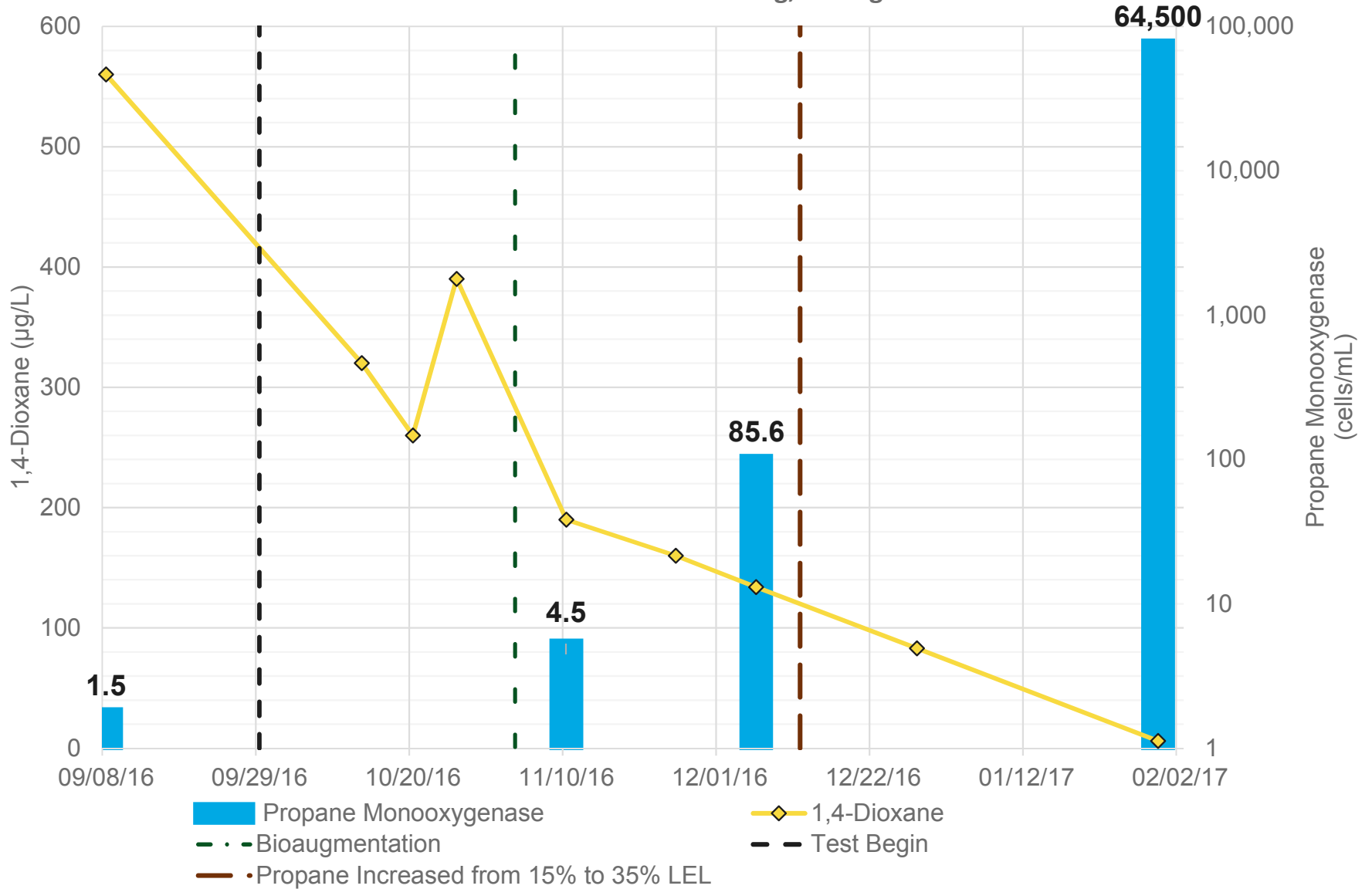
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FIGURE  
**13**

**Figure 14**  
**Phase II Biosparge Pilot: PW-14-01 - Microbial Results**  
**RACER Trust Plants 2, 3 and 6 - Lansing, Michigan**

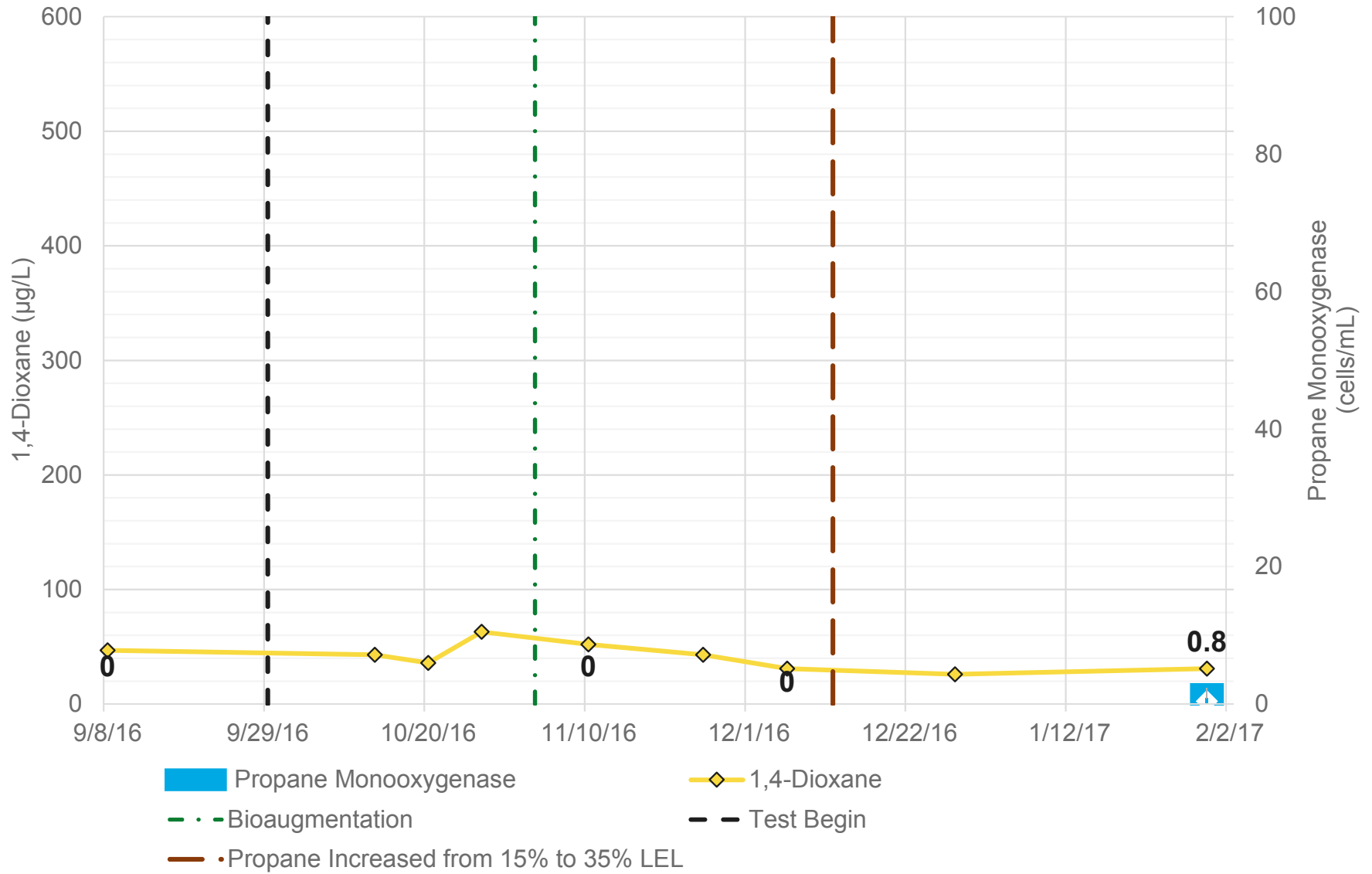


**Figure 14**  
**Phase II Biosparge Pilot: PW-14-01 Microbial Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



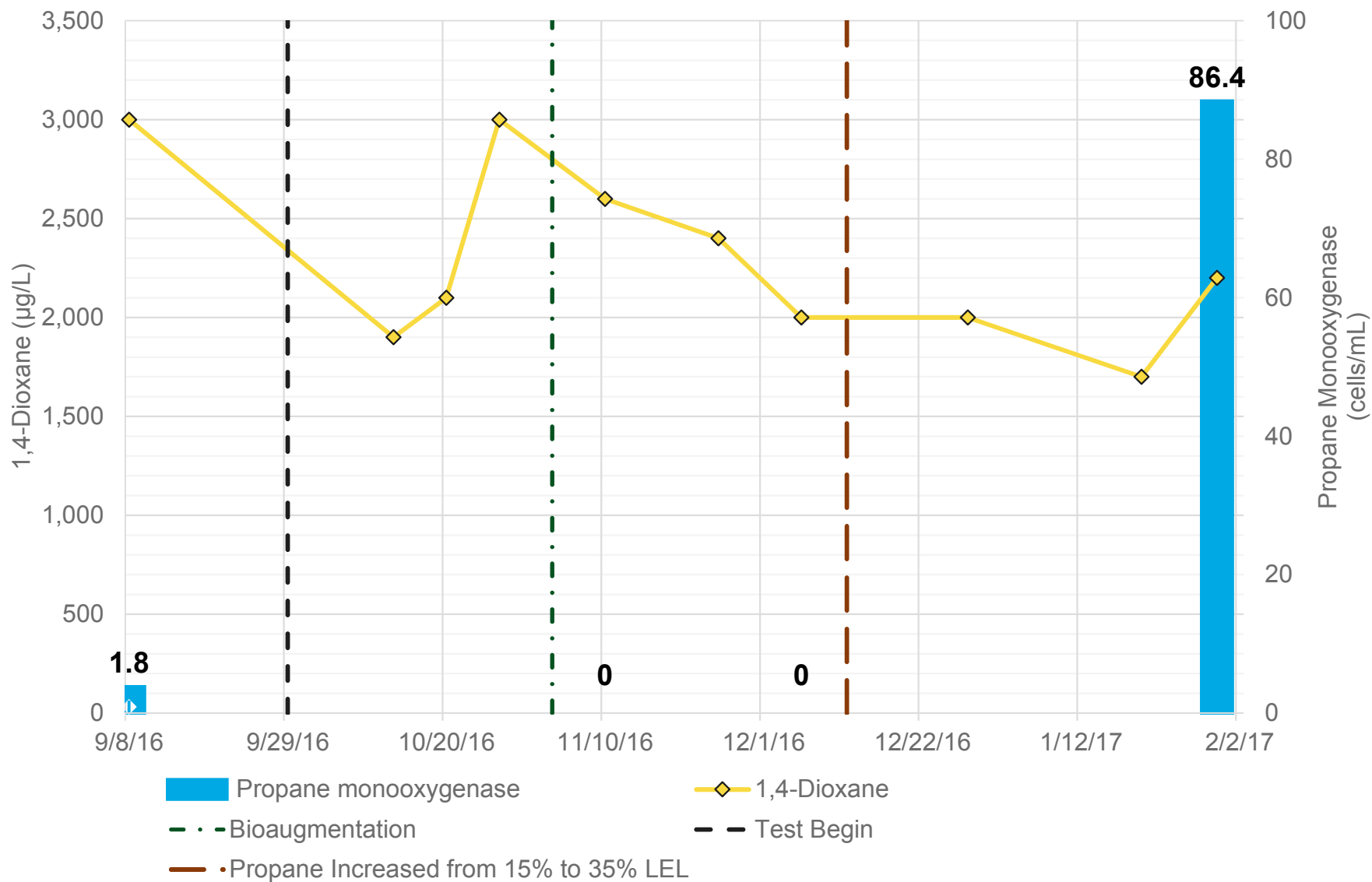
ug/L - Micrograms Per Liter, cells/mL - Cells Per Milliliter

**Figure 15**  
**Phase II Biosparge Pilot: TW-14-01 Microbial Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



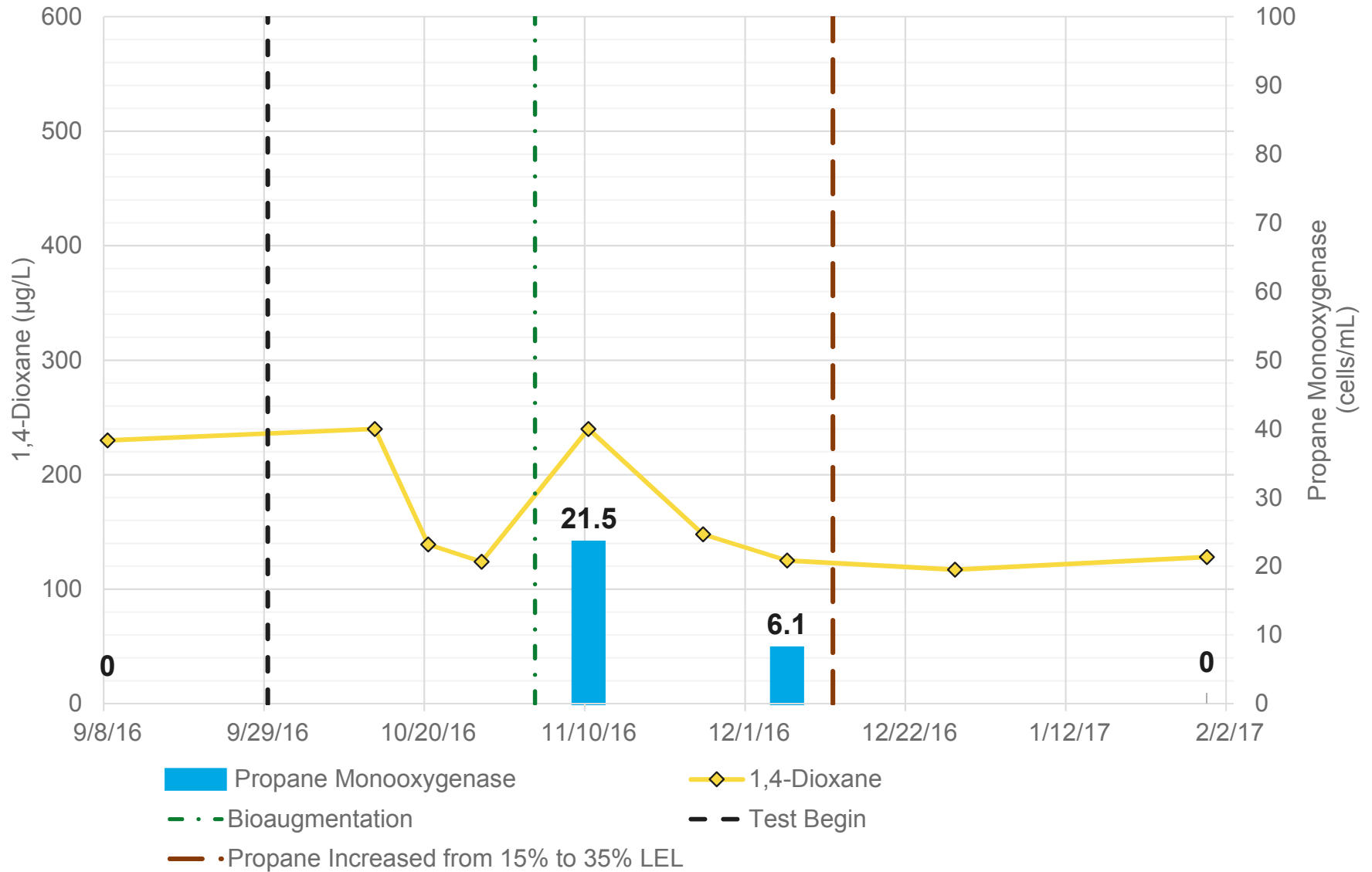
ug/L - Micrograms Per Liter, cells/mL - Cells Per Milliliter

Figure 16  
 Phase II Biosparge Pilot: TW-14-02 Microbial Results  
 RACER Trust Plant 2 - Lansing, Michigan



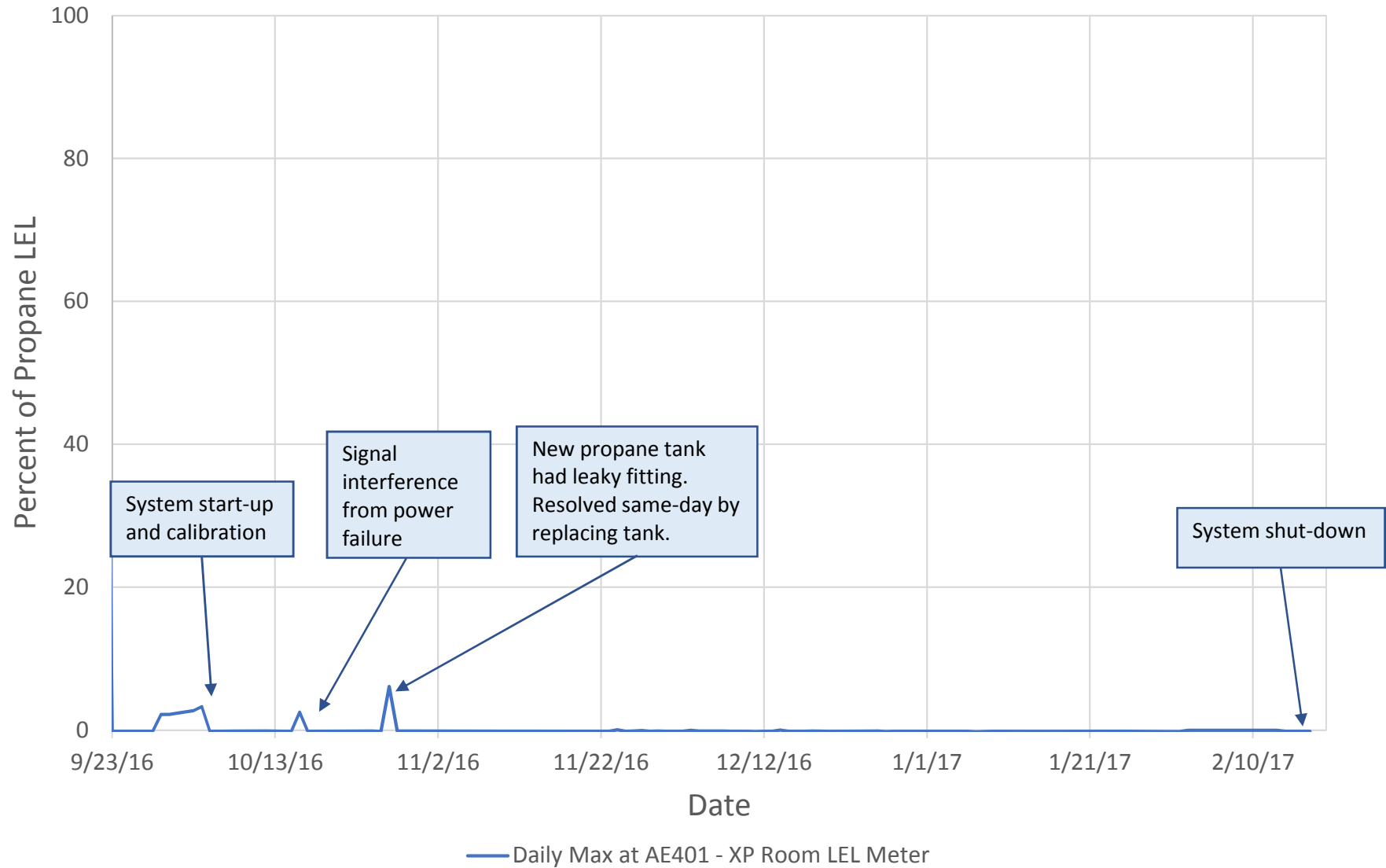
ug/L - Micrograms Per Liter, cells/mL - Cells Per Milliliter

**Figure 17**  
**Phase II Biosparge Pilot: TW-16-01 Microbial Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



ug/L - Micrograms Per Liter, cells/mL - Cells Per Milliliter

**Figure 18**  
**System Building Percent of Propane Lower Explosive Limit (LEL) Daily Maximums**  
**RACER Trust Plant 2 - Lansing, Michigan**



**Propane Biosparge Pilot Test Summary**  
**RACER Trust Plant 2 – Lansing, Michigan**

**TABLES**



**Table 1**  
**Phase I Biosparge Pilot: Field Test Data**  
**RACER Trust Plant 2 - Lansing, Michigan**

Date	Time	Comment	TW-14-02		PW-14-01		TW-14-01		AS-16-01	Injection Flow	Injection Pressure	Injection Temp
			DO (mg/L)	DTW (ft bTOC)	DO (mg/L)	DTW (ft bTOC)	DO (mg/L)	DTW (ft bTOC)	DTW	acfe	psi	deg F
6/16/2016	10:00		-0.11	65.70	0.12	67.20	0.29	67.76	67.19			
	11:15		0.00		0.00							
	14:52	Begin injection								0.0	0	
	15:02		-0.14		-0.04					0.0	40	54
	15:22		-0.16		1.11					1.0	52	54
	15:35		-0.16	62.40	10.00	45.63				1.1	52	56
	16:00		-0.16	61.75	15.45	43.80				1.1	51	55
	16:08							66.82				
	16:20		0.48	60.90	17.28	39.13				1.4	52	55
	16:40		1.98	60.57	18.05	35.48				1.5	52	55
	17:00	Stop injection		60.33		33.05		65.84		0.0	0	
	17:05			60.49		33.54						
	17:25			62.40		39.09						
	17:35			62.65		40.85						
	17:45			63.00		43.53						
	17:50			63.17		45.69						
	18:05						0	66.11				
18:30			63.75		51.05							
19:45			64.22		57.21							
6/17/2016	8:30		0.31	67.29	12.53	66.54		67.29	59.27	0.0	0	
	9:45	Begin injection								0.1	44	
	9:55		-0.08	65.22	11.37	64.40				2.1	52	70
	10:05		0.03	63.39	11.86	59.61				2.1	52	72
	10:15		0.37	61.77	13.48	55.18				2.1	52	74
	10:25							66.65				
	10:26	Stop injection										
	10:35		2.32	60.80	14.23	49.93				0.0	17	

**Table 1**  
**Phase I Biosparge Pilot: Field Test Data**  
**RACER Trust Plant 2 - Lansing, Michigan**

Date	Time	Comment	TW-14-02		PW-14-01		TW-14-01		AS-16-01	Injection Flow	Injection Pressure	Injection Temp
			DO (mg/L)	DTW (ft bTOC)	DO (mg/L)	DTW (ft bTOC)	DO (mg/L)	DTW (ft bTOC)	DTW	acfe	psi	deg F
6/17/2016	10:55		2.85	61.98	14.14	50.05				0.0	13	
	11:15		2.81	62.77	14.10	50.60				0.0	10	
	11:35		2.76	63.24	13.93	51.94				0.0	9	
	12:40		2.25	63.98	13.07	56.32				0.0	6	
	12:50							66.79				
	12:55		2.19	64.13	12.99	57.19				0.0	6	
	13:00	Begin injection										
	13:05		2.17	63.93	12.90	56.82				2.8	47	81
	13:12									3.1	52	80
	13:15		2.22	62.33	13.18	53.75				3.0	52	83
	13:25		3.22	60.64	15.80	50.06				2.9	52	82
	13:37		4.29	59.40	16.35	45.40		65.82		2.8	52	82
	13:38	Stop injection										
	13:39									0.0	37	
	13:41									0.0	26	
	13:45		5.21	59.30	16.92	45.08				0.0	21	
	14:05		6.60	61.02	16.96	44.91				0.0	14	
	14:25	DO Probe dropped in PW-14-01	6.70	61.96	10.37	49.67				0.0	12	
	14:45		6.41	62.53	10.29	51.09				0.0	10	
	15:05		6.23	62.96	9.16	52.11				0.0	9	
	15:25		6.09	63.30	14.05	53.33				0.0	8	
	15:45		5.94	63.67	14.31	54.44				0.0	8	
	16:05		5.76	63.80	14.36	55.59				0.0	7	
16:08							66.4					
16:14	Begin injection											
16:15		5.63	63.88	14.33	55.82				4.2	52	89	
16:25		5.89	61.91	15.08	52.69				3.7	52	89	

**Table 1**  
**Phase I Biosparge Pilot: Field Test Data**  
**RACER Trust Plant 2 - Lansing, Michigan**

Date	Time	Comment	TW-14-02		PW-14-01		TW-14-01		AS-16-01	Injection Flow	Injection Pressure	Injection Temp
			DO (mg/L)	DTW (ft bTOC)	DO (mg/L)	DTW (ft bTOC)	DO (mg/L)	DTW (ft bTOC)	DTW	acfe	psi	deg F
6/17/2016	16:35		6.70	60.45	16.18	48.60				3.5	52	89
	16:45		7.24	59.30	16.84	44.04		65.53		3.3	52	89
	16:55		8.47	58.69	17.92	41.10				3.3	52	89
	16:56	Stop injection										
	16:57									0.0	38	
	16:58									0.0	30	
	17:00									0.0	25	
	17:05		8.93	58.85	18.21	41.73				0.0	21	
	17:15		9.48	59.70	18.17	41.79				0.0	17	
	17:30		9.39	60.74	17.98	42.27				0.0	15	
	17:50		9.01	61.67	17.92	45.14				0.0	13	
	18:10		8.58	62.25	17.77	47.32				0.0	12	
	18:30		8.18	62.67	17.49	48.60				0.0	10	
	18:50		7.86	63.02	16.84	49.99				0.0	10	
	19:10							65.84		0.0	9	
	19:10		7.69	63.39	15.82	51.41						
	19:14	Begin injection										
	19:15		7.64	63.43	15.58	51.40				4.1	48	80
	19:20		7.58	62.99	15.63	50.64				4.1	52	81
	19:30		8.24	61.17	17.06	46.64				3.8	52	80
	19:40		9.86	59.86	17.86	42.62				3.6	52	80
	19:50		10.35	59.14	18.35	40.13				3.5	52	80
	19:51	Stop injection										
19:52									0.0	37		
19:54									0.0	25		
19:55		10.39	58.96	18.69	40.90							
20:05		10.20	59.54	18.43	41.98				0.0	19		
20:30			61.01		43.69				0.0	15		

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	AS-16-01					AS-16-02	
				09/07/16	10/20/16	10/27/16	11/11/16	02/01/17	09/07/16	10/27/16
				AS-16-01_090716	AS-16-01_102016	AS-16-01_102716	AS-16-01_111116	AS-16-01_020117	AS-16-02_090716	AS-16-02_102716
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	NA	NA	1.797	2.908	4.127	NA	2.402
Dissolved Oxygen	mg/L	--	--	1.03	NA	5.79	9.54	4.7	0.68	8.27
Oxidation reduction potential (ORP), field	millivolts	--	--	NA	NA	570.8	120.6	38.0	NA	463.0
pH	s.u.	--	--	NA	NA	6.12	7.42	7.09	NA	6.94
Temperature, field	Deg C	--	--	NA	NA	10.03	13.53	12.4	NA	10.04
Turbidity (field)	NTU	--	--	NA	NA	253	269	150	NA	over range
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	<b>590 Y<sup>a</sup></b>	<b>200 Y<sup>a</sup></b>	<b>240 Y<sup>a</sup></b>	<b>180 Y<sup>a</sup></b>	<b>10<sup>a</sup></b>	<b>69<sup>a</sup></b>	<b>86<sup>a</sup></b>
Propane	µg/L	--	--	<b>0.26 n</b>	<b>230 n</b>	<b>270 n</b>	<b>260 n<sup>(1)</sup></b>	<0.10 n	<b>0.43 n</b>	<b>310 n</b>
<b>Inorganics</b>										
Iron	mg/L	0.3	--	<b>3.92<sup>a</sup></b>	NA	NA	NA	<b>2.85<sup>a</sup></b>	<b>32.1<sup>a</sup></b>	NA
Alkalinity as CaCO <sub>3</sub>	mg/L	--	--	<b>406</b>	NA	<b>1,104</b>	NA	<b>398</b>	<b>394</b>	NA
Fluoride (Undistilled)	mg/L	--	--	<0.5	NA	NA	NA	<0.5	<0.5	NA
Manganese	mg/L	0.05	4.5	<b>0.141<sup>a</sup></b>	NA	NA	NA	<b>0.080<sup>a</sup></b>	<b>0.827<sup>a</sup></b>	NA
Nitrite-N	mg/L	1.0	--	<0.5	NA	<0.5	NA	<b>1.1</b>	<0.5	NA
TOC	mg/L	--	--	<b>10.8</b>	NA	NA	NA	<b>43</b>	<b>7.2</b>	NA
Total Kjeldahl Nitrogen	mg/L	--	--	<b>0.6</b>	NA	<b>850</b>	NA	<b>279</b>	<b>1.6</b>	NA
Total Phosphorus	mg/L	63	--	<b>0.05</b>	NA	<b>703</b>	NA	<b>99<sup>a</sup></b>	<b>0.19</b>	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	<0.02	NA	NA	NA	<b>0.04</b>	<0.02	NA
Manganese (dissolved)	mg/L	0.05	4.5	<b>0.142<sup>a</sup></b>	NA	NA	NA	<b>0.024</b>	<b>0.117<sup>a</sup></b>	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	<0.5	NA	<0.5	NA	<0.5	<0.5	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	NA	NA	NA	NA	NA	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	AS-16-02		PW-14-01				
				11/11/16	02/01/17	09/19/14	12/11/14	03/27/15	06/10/15	12/08/15
				AS-16-02_111116	AS-16-01_020117	PW-14-01_091914	PW-14-01_121114	PW-14-01_032715	PW-14-01_061015	PW-14-01_120815
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	18.08	NA	0.989	1.679	1.615	1.593	1.677
Dissolved Oxygen	mg/L	--	--	6.84	7.04	3.22	1.12	1.48	0.34	0.53
Oxidation reduction potential (ORP), field	millivolts	--	--	143.6	NA	-25.60	-71.60	-56.00	-84.70	-10.70
pH	s.u.	--	--	7.96	NA	7.33	7.16	7.13	7.05	6.91
Temperature, field	Deg C	--	--	12.39	NA	16.79	4.17	8.88	22.84	8.98
Turbidity (field)	NTU	--	--	over range	NA	3.6	7.69	0.25	5.93	18.2
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	180 Y <sup>a</sup>	130 Y <sup>a</sup>	260 Y <sup>a</sup>	350 Y <sup>a</sup>	350 Y <sup>a</sup>	350 Y <sup>a</sup>	510 Y <sup>a</sup>
Propane	µg/L	--	--	360 n <sup>(1)</sup>	NA	NA	NA	NA	NA	NA
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	NA	0.1	11.4 <sup>a</sup>	4.02 <sup>a</sup>	NA	NA
Alkalinity as CaCO <sub>3</sub>	mg/L	--	--	5,980	NA	NA	NA	NA	NA	NA
Fluoride (Undistilled)	mg/L	--	--	<1.0	NA	NA	NA	NA	NA	NA
Manganese	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
Nitrite-N	mg/L	1.0	--	<0.5	NA	NA	NA	NA	NA	NA
TOC	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	4,580	NA	NA	NA	NA	NA	NA
Total Phosphorus	mg/L	63	--	3,540	NA	NA	NA	NA	NA	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	<0.5	NA	NA	NA	NA	NA	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	NA	NA	NA	NA	NA	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	PW-14-01						
				05/17/16	09/08/16	10/13/16	10/20/16	10/26/16	11/10/16	11/25/16
				PW-14-01 (05172016)	PW-14-01_090816	PW-14-01_101316	PW-14-01_102016	PW-14-01_102616	PW-14-01_111016	PW-14-01_112516
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	1,815	NA	NA	NA	1.517	1.864	1.929
Dissolved Oxygen	mg/L	--	--	0.24	0.55	0.64	7.87	11.22	4.15	10.33
Oxidation reduction potential (ORP), field	millivolts	--	--	-253.610	NA	NA	NA	558.3	131.3	148.3
pH	s.u.	--	--	7.02	NA	NA	NA	6.80	7.30	7.38
Temperature, field	Deg C	--	--	15.29	NA	NA	NA	11.89	14.37	NM
Turbidity (field)	NTU	--	--	5.43	NA	NA	NA	59.1	146	34.2
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	<b>420 Y [440 Y]<sup>a</sup></b>	<b>560 Y<sup>a</sup></b>	<b>320 Y<sup>a</sup></b>	<b>260 Y<sup>a</sup></b>	<b>390 Y<sup>a</sup></b>	<b>190 Y<sup>a</sup></b>	<b>160 Y<sup>a</sup></b>
Propane	µg/L	--	--	NA	<0.10 n	<b>130 n</b>	<b>56 n</b>	<b>250 n</b>	<b>120 n</b>	<b>67 n</b>
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	<b>2.88<sup>a</sup></b>	NA	NA	NA	NA	NA
Alkalinity as CaCO3	mg/L	--	--	NA	<b>504</b>	NA	NA	NA	<b>382</b>	NA
Fluoride (Undistilled)	mg/L	--	--	NA	<0.5	NA	NA	NA	<1.0	NA
Manganese	mg/L	0.05	4.5	NA	<b>0.090<sup>a</sup></b>	NA	NA	NA	NA	NA
Nitrite-N	mg/L	1.0	--	NA	<0.5	NA	NA	NA	<0.5	NA
TOC	mg/L	--	--	NA	<b>8.0</b>	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	NA	<b>0.7</b>	NA	NA	NA	<b>1.4</b>	NA
Total Phosphorus	mg/L	63	--	NA	<b>0.05</b>	NA	NA	NA	<b>1.25</b>	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	<b>0.03</b>	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	<b>0.088<sup>a</sup></b>	NA	NA	NA	NA	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	NA	<0.5	NA	NA	NA	0.7	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	<b>1.50 J</b>	NA	NA	NA	<b>4.5 J</b>	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	PW-14-01					TW-14-01	
				12/06/16 PW-14-01_120616	12/14/16 NA	12/20/16 NA	12/28/16 PW-14-01_122816	01/30/17 PW-14-01_013017	06/11/15 TW-14-01_061115	09/08/16 TW-14-01_090816
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	2.036	NA	NA	2.083	2.228	1.516	NA
Dissolved Oxygen	mg/L	--	--	9.53	7.04	8.33	8.69	6.31	0.66	0.41
Oxidation reduction potential (ORP), field	millivolts	--	--	112.9	NA	NA	58.2	311.5	-93.20	NA
pH	s.u.	--	--	7.43	NA	NA	6.96	7.41	6.57	NA
Temperature, field	Deg C	--	--	14.3	NA	NA	12.83	13.6	16.50	NA
Turbidity (field)	NTU	--	--	72.9	NA	NA	313	70	7.75	NA
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	<b>134<sup>a</sup></b>	NA	NA	<b>83<sup>a</sup></b>	<b>6</b>	<b>50<sup>a</sup></b>	<b>47<sup>a</sup></b>
Propane	µg/L	--	--	<b>140 n</b>	NA	NA	<b>180 n</b>	<b>2.0 n</b>	NA	<0.10 n
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	NA	NA	NA	<b>0.19</b>	NA	<b>17.6<sup>a</sup></b>
Alkalinity as CaCO3	mg/L	--	--	<b>398</b>	NA	NA	NA	<b>352</b>	NA	<b>404</b>
Fluoride (Undistilled)	mg/L	--	--	NA	NA	NA	NA	<0.5	NA	<0.5
Manganese	mg/L	0.05	4.5	NA	NA	NA	NA	<b>0.010</b>	NA	<b>0.344<sup>a</sup></b>
Nitrite-N	mg/L	1.0	--	<0.5	NA	NA	<0.5	<0.5	NA	<0.5
TOC	mg/L	--	--	NA	NA	NA	NA	<b>6.5</b>	NA	<b>5.1</b>
Total Kjeldahl Nitrogen	mg/L	--	--	<b>0.9</b>	NA	NA	<b>0.5</b>	<b>0.5</b>	NA	<b>1.1</b>
Total Phosphorus	mg/L	63	--	<b>0.33</b>	NA	NA	<b>0.12</b>	<b>0.07</b>	NA	<b>0.35</b>
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	NA	NA	NA	<b>0.09</b>	NA	<b>0.08</b>
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	NA	NA	<b>0.009</b>	NA	<b>0.035</b>
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	1.0	NA	NA	<0.5	<0.5	NA	<0.5
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	<b>85.6</b>	NA	NA	NA	<b>64,500</b>	NA	<5.00

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	TW-14-01						
				10/13/16 TW-14-01_101316	10/20/16 TW-14-01_102016	10/27/16 TW-14-01_102716	11/10/16 TW-14-01_111016	11/25/16 TW-14-01_112516	12/06/16 TW-14-01_120616	12/14/16 NA
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	NA	NA	2.550	2.689	2.556	2.641	NA
Dissolved Oxygen	mg/L	--	--	5.12	2.38	2.53	0.0	1.24	3.47	0.87
Oxidation reduction potential (ORP), field	millivolts	--	--	NA	NA	513.4	139.6	180.3	94.2	NA
pH	s.u.	--	--	NA	NA	5.85	6.80	6.93	6.82	NA
Temperature, field	Deg C	--	--	NA	NA	10.86	14.31	10.86	12.9	NA
Turbidity (field)	NTU	--	--	NA	NA	799	over range	over range	over range	NA
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	<b>43<sup>a</sup></b>	<b>36<sup>a</sup></b>	<b>63<sup>a</sup></b>	<b>52<sup>a</sup></b>	<b>43<sup>a</sup></b>	<b>31<sup>a</sup></b>	NA
Propane	µg/L	--	--	<b>200 n</b>	77 n	17 n	22 n	22 n	<b>120 n</b>	NA
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Alkalinity as CaCO3	mg/L	--	--	NA	NA	NA	<b>366</b>	NA	<b>400</b>	NA
Fluoride (Undistilled)	mg/L	--	--	NA	NA	NA	<1.0	NA	NA	NA
Manganese	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
Nitrite-N	mg/L	1.0	--	NA	NA	NA	<0.5	NA	<0.5	NA
TOC	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	NA	NA	NA	<b>9.0</b>	NA	<b>1.3</b>	NA
Total Phosphorus	mg/L	63	--	NA	NA	NA	<b>1.6</b>	NA	<b>0.15</b>	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	NA	NA	NA	<0.5	NA	<0.5	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	NA	NA	<73.5	NA	<46.3	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	TW-14-01			TW-14-02				
				12/20/16	12/28/16	01/30/17	06/11/15	09/10/15	12/09/15	03/16/16	05/17/16
				NA	TW-14-01_122816	TW-14-01_013017	TW-14-02_061115	TW-14-02_091015	TW-14-02_120915	TW-14-02_031616	TW-14-02_051716
<b>Field Parameters</b>											
Conductance, specific	mS/cm	--	--	NA	2.708	3.005	3.343	3.629	3,527	NA	3845
Dissolved Oxygen	mg/L	--	--	3.18	3.12	4.81	0.62	0.57	2.26	0.98	0.75
Oxidation reduction potential (ORP), field	millivolts	--	--	NA	74.4	312.6	-86.3	-92.7	-26.7	-89.44	66
pH	s.u.	--	--	NA	6.65	6.69	6.96	7.09	6.58	6.88	6.95
Temperature, field	Deg C	--	--	NA	12.67	15.0	18.26	20.13	9.44	13.91	12.9
Turbidity (field)	NTU	--	--	NA	over range	280	7.15	25.4	154	8.23	84.8
<b>Organics</b>											
1,4-Dioxane	µg/L	7.2	2,800	NA	<b>26<sup>a</sup></b>	<b>31<sup>a</sup></b>	<b>2,700 Y<sup>a</sup></b>	<b>3,200 Y [3,300]<sup>a</sup></b>	<b>2,500 Y [2,600 Y]<sup>a</sup></b>	<b>2,770 Y [2,780 Y]<sup>a</sup></b>	<b>132<sup>a</sup></b>
Propane	µg/L	--	--	NA	<b>32 n</b>	<b>34 n</b>	NA	NA	NA	NA	NA
<b>Inorganics</b>											
Iron	mg/L	0.3	--	NA	NA	<b>3.04<sup>a</sup></b>	NA	NA	NA	<b>9.03 [9.02]<sup>a</sup></b>	NA
Alkalinity as CaCO3	mg/L	--	--	NA	NA	<b>360</b>	NA	NA	NA	NA	NA
Fluoride (Undistilled)	mg/L	--	--	NA	NA	<0.5	NA	NA	NA	NA	NA
Manganese	mg/L	0.05	4.5	NA	NA	<b>0.139<sup>a</sup></b>	NA	<b>0.061<sup>a</sup></b>	NA	<b>0.058 [0.057]<sup>a</sup></b>	<b>0.069<sup>a</sup></b>
Nitrite-N	mg/L	1.0	--	NA	<0.5	<0.5	NA	NA	NA	NA	NA
TOC	mg/L	--	--	NA	NA	<b>5.0</b>	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	NA	<b>3.5</b>	<b>0.4</b>	NA	NA	NA	NA	NA
Total Phosphorus	mg/L	63	--	NA	<b>1.27</b>	<b>0.05</b>	NA	NA	NA	NA	NA
<b>Inorganics-Filtered</b>											
Iron (dissolved)	mg/L	0.3	--	NA	NA	<b>0.80<sup>a</sup></b>	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	<b>0.089<sup>a</sup></b>	NA	<b>0.061<sup>a</sup></b>	NA	NA	<b>0.059<sup>a</sup></b>
<b>General Chemistry</b>											
Nitrate (as N)	mg/L	10	--	NA	<0.5	<0.5	NA	NA	NA	NA	NA
<b>Functional Genes</b>											
Propane Monooxygenase	cells/mL	--	--	NA	NA	<b>0.8 J</b>	NA	NA	NA	NA	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	TW-14-02						
				07/26/16	09/08/16	10/13/16	10/20/16	10/27/16	11/10/16	11/25/16
				TW-14-02_07262016 (Resample)	TW-14-02_090816	TW-14-02_101316	TW-14-02_102016	TW-14-02_102716	TW-14-02_111016	TW-14-02_112516
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	3,723	NA	NA	NA	3.292	3.393	3.558
Dissolved Oxygen	mg/L	--	--	NA	0.38	1.32	2.38	2.82	0.42	0.84
Oxidation reduction potential (ORP), field	millivolts	--	--	NA	NA	NA	NA	450.8	132.2	63.6
pH	s.u.	--	--	6.87	NA	NA	NA	6.41	6.96	7.04
Temperature, field	Deg C	--	--	28.3	NA	NA	NA	11.34	13.94	6.92
Turbidity (field)	NTU	--	--	138.0	NA	NA	NA	165	over range	over range
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	<b>2,780<sup>a</sup></b>	<b>3,000 Y<sup>a</sup></b>	<b>1,900 Y<sup>a</sup></b>	<b>2,100 Y<sup>a</sup></b>	<b>3,000 Y<sup>a</sup></b>	<b>2,600 Y<sup>a</sup></b>	<b>2,400 Y<sup>a</sup></b>
Propane	µg/L	--	--	NA	<0.10 n	60 n	4.2 n	1.5 n	100 n <sup>(1)</sup>	75 n
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	<b>7.14<sup>a</sup></b>	NA	NA	NA	NA	NA
Alkalinity as CaCO3	mg/L	--	--	NA	<b>444</b>	NA	NA	NA	<b>366</b>	NA
Fluoride (Undistilled)	mg/L	--	--	NA	<0.5	NA	NA	NA	<1.0	NA
Manganese	mg/L	0.05	4.5	NA	<b>0.081<sup>a</sup></b>	NA	NA	NA	NA	NA
Nitrite-N	mg/L	1.0	--	NA	<0.5	NA	NA	NA	<0.5	NA
TOC	mg/L	--	--	NA	<b>8.5</b>	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	NA	<b>1.1</b>	NA	NA	NA	<b>1.7</b>	NA
Total Phosphorus	mg/L	63	--	NA	<b>0.09</b>	NA	NA	NA	<b>0.41</b>	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	<b>0.06</b>	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	<b>0.083<sup>a</sup></b>	NA	NA	NA	NA	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	NA	<0.5	NA	NA	NA	<0.5	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	<b>1.80 J</b>	NA	NA	NA	<94.3	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID:	Date Collected:	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	TW-14-02					
				12/06/16 TW-14-02_120616	12/14/16 NA	12/20/16 NA	12/28/16 TW-14-02_122816	01/20/17 TW-14-02_012017	01/30/17 TW-14-02_013017
Sample Name:	Units								
<b>Field Parameters</b>									
Conductance, specific	mS/cm	--	--	3.55	NA	NA	3.578	NA	3.690
Dissolved Oxygen	mg/L	--	--	1.74	1.42	2.56	2.16	NA	2.89
Oxidation reduction potential (ORP), field	millivolts	--	--	122.9	NA	NA	121.5	NA	321.0
pH	s.u.	--	--	6.17	NA	NA	6.78	NA	6.92
Temperature, field	Deg C	--	--	13.3	NA	NA	13.16	NA	13.6
Turbidity (field)	NTU	--	--	over range	NA	NA	over range	NA	555
<b>Organics</b>									
1,4-Dioxane	µg/L	7.2	2,800	2,000 Y <sup>a</sup>	NA	NA	2,000 <sup>a</sup>	1,700 Y <sup>a</sup>	2,200 Y <sup>a</sup>
Propane	µg/L	--	--	97 n	NA	NA	120 n	NA	18 n
<b>Inorganics</b>									
Iron	mg/L	0.3	--	NA	NA	NA	NA	NA	5.18 <sup>a</sup>
Alkalinity as CaCO3	mg/L	--	--	374	NA	NA	NA	NA	341
Fluoride (Undistilled)	mg/L	--	--	NA	NA	NA	NA	NA	<0.5
Manganese	mg/L	0.05	4.5	NA	NA	NA	NA	NA	0.111
Nitrite-N	mg/L	1.0	--	<0.5	NA	NA	<0.5	NA	<0.5
TOC	mg/L	--	--	NA	NA	NA	NA	NA	7.4
Total Kjeldahl Nitrogen	mg/L	--	--	2.0	NA	NA	1.8	NA	0.7
Total Phosphorus	mg/L	63	--	0.77	NA	NA	0.45	NA	0.09
<b>Inorganics-Filtered</b>									
Iron (dissolved)	mg/L	0.3	--	NA	NA	NA	NA	NA	0.91 <sup>a</sup>
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	NA	NA	NA	0.026
<b>General Chemistry</b>									
Nitrate (as N)	mg/L	10	--	<0.5	NA	NA	<0.5	NA	<0.5
<b>Functional Genes</b>									
Propane Monooxygenase	cells/mL	--	--	<161	NA	NA	NA	NA	86.4

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	TW-16-01						
				9/8/2016	10/13/2016	10/20/2016	10/27/2016	11/10/2016	11/25/2016	12/6/2016
				TW-16-01_090816	TW-16-01_101316	TW-16-01_102016	TW-16-01_102716	TW-16-01_111016	TW-16-01_112516	TW-16-01_120616
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	NA	NA	NA	1.686	1.977	1.869	1.909
Dissolved Oxygen	mg/L	--	--	0.34	8.27	4.81	5.56	3.18	11.99	10.44
Oxidation reduction potential (ORP), field	millivolts	--	--	NA	NA	NA	524.7	123.7	127.3	118.5
pH	s.u.	--	--	NA	NA	NA	5.77	7.05	7.39	7.54
Temperature, field	Deg C	--	--	NA	NA	NA	11.39	14.58	9.35	13.2
Turbidity (field)	NTU	--	--	NA	NA	NA	46.5	over range	over range	over range
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	<b>230 Y<sup>a</sup></b>	<b>240 Y<sup>a</sup></b>	<b>139<sup>a</sup></b>	<b>124<sup>a</sup></b>	<b>240Y<sup>a</sup></b>	<b>148<sup>a</sup></b>	<b>125<sup>a</sup></b>
Propane	µg/L	--	--	<0.10 n	200 n	220 n	220 n	320 n	120 n	240 n
<b>Inorganics</b>										
Iron	mg/L	0.3	--	<b>2.46 Y<sup>a</sup></b>	NA	NA	NA	NA	NA	NA
Alkalinity as CaCO <sub>3</sub>	mg/L	--	--	<b>454</b>	NA	NA	NA	<b>438</b>	NA	<b>396</b>
Fluoride (Undistilled)	mg/L	--	--	<0.5	NA	NA	NA	<1.0	NA	NA
Manganese	mg/L	0.05	4.5	<b>0.100<sup>a</sup></b>	NA	NA	NA	NA	NA	NA
Nitrite-N	mg/L	1.0	--	<0.5	NA	NA	NA	<0.5	NA	<0.5
TOC	mg/L	--	--	<b>7.9</b>	NA	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	<b>0.6</b>	NA	NA	NA	<b>1.8</b>	NA	<b>1.8</b>
Total Phosphorus	mg/L	63	--	<b>0.04</b>	NA	NA	NA	<b>0.40</b>	NA	<b>0.24</b>
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	<b>0.02</b>	NA	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	<b>0.069<sup>a</sup></b>	NA	NA	NA	NA	NA	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	<0.5	NA	NA	NA	<0.5	NA	<0.5
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	<4.80	NA	NA	NA	<b>21.5 J</b>	NA	<b>6.1 J</b>

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	TW-16-01			MW-15-72			
				12/28/16	12/28/16	01/30/17	03/15/16	03/16/16	05/16/16	09/09/16
				TW-16-01_122816_A	TW-16-01_122816_B	TW-16-01_013017	MW-15-72_031516	MW-15-72_031616	MW-15-72 (05162016)	MW-15_72_090916
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	1.964	NA	2.161	NA	NA	2452	NA
Dissolved Oxygen	mg/L	--	--	10.62	NA	5.84	3.65	NA	0.11	NA
Oxidation reduction potential (ORP), field	millivolts	--	--	234.8	NA	301.6	-43	NA	-245	NA
pH	s.u.	--	--	7.05	NA	7.14	6.92	NA	6.99	NA
Temperature, field	Deg C	--	--	10.03	NA	14.6	14.28	NA	17.0	NA
Turbidity (field)	NTU	--	--	118	NA	316	792.78	NA	12.4	NA
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	117 <sup>a</sup>	NA	128 <sup>a</sup>	NA	135 <sup>a</sup>	190 Y <sup>a</sup>	NA
Propane	µg/L	--	--	550 n	390 n	430 n	NA	NA	NA	<0.10 n
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	NA	6.72 <sup>a</sup>	NA	12.6 <sup>a</sup>	NA	NA
Alkalinity as CaCO3	mg/L	--	--	NA	NA	395	NA	NA	NA	NA
Fluoride (Undistilled)	mg/L	--	--	NA	NA	<0.5	NA	NA	NA	<0.5
Manganese	mg/L	0.05	4.5	NA	NA	0.184 <sup>a</sup>	NA	0.210 <sup>a</sup>	0.171 <sup>a</sup>	NA
Nitrite-N	mg/L	1.0	--	<0.5	NA	<0.5	NA	NA	NA	NA
TOC	mg/L	--	--	NA	NA	6.7	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	0.4	NA	0.8	NA	NA	NA	NA
Total Phosphorus	mg/L	63	--	0.03	NA	0.11	NA	NA	NA	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	NA	0.70 <sup>a</sup>	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	0.047	NA	NA	0.169 <sup>a</sup>	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	<0.5	NA	<0.5	NA	NA	NA	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	NA	<5.00	NA	NA	NA	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	MW-15-72				MW-16-77		
				11/11/16	12/07/16	12/29/16	01/31/17	06/28/16	09/09/16	11/11/16
				MW-15_72_111116	MW-15_72_120716	MW-15-72_122916	MW-15-72_013117	MW-16-77 (062816)	MW-16_77_090916	MW-16_77_111116
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	2	2	2	2	NA	NA	2
Dissolved Oxygen	mg/L	--	--	4.31	3.3	4.85	1.95	NA	NA	3.37
Oxidation reduction potential (ORP), field	millivolts	--	--	73	10	-14	171	NA	NA	90
pH	s.u.	--	--	7.05	7.05	6.93	7.09	NA	NA	7.27
Temperature, field	Deg C	--	--	15.0	13.7	13.3	11.2	NA	NA	11.8
Turbidity (field)	NTU	--	--	over range	over range	over range	256	NA	NA	over range
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	NA	NA	NA	NA	3	NA	NA
Propane	µg/L	--	--	<0.10 n <sup>(1)</sup>	<0.10 n	<.010 n	<0.10 n	NA	0.17 n	0.11 n
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Alkalinity as CaCO3	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Fluoride (Undistilled)	mg/L	--	--	<1.0	NA	NA	<0.5	NA	0.6	<1.0
Manganese	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
Nitrite-N	mg/L	1.0	--	NA	NA	NA	NA	NA	NA	NA
TOC	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Total Phosphorus	mg/L	63	--	NA	NA	NA	NA	NA	NA	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	NA	NA	NA	NA	NA	NA	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	NA	NA	NA	NA	NA	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	MW-16-77			MW-16-75			
				12/07/16	12/29/16	01/31/17	06/27/16	09/09/16	11/11/16	12/07/16
				MW-16_77_120716	MW-16-77_122916	MW-16-77_013117	MW-16-75 (062716)	MW-16_75_090916	MW-16_75_111116	MW-16_75_120716
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	2	2	2	NA	NA	2	2
Dissolved Oxygen	mg/L	--	--	3.23	5.27	2.6	NA	NA	3.71	3.17
Oxidation reduction potential (ORP), field	millivolts	--	--	43	62	64	NA	NA	69	-5
pH	s.u.	--	--	7.25	6.93	7.17	NA	NA	6.97	7.15
Temperature, field	Deg C	--	--	11.8	11.3	11.0	NA	NA	12.5	11.5
Turbidity (field)	NTU	--	--	over range	over range	727	NA	NA	over range	over range
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	NA	NA	NA	<3	NA	NA	NA
Propane	µg/L	--	--	<b>0.10 n</b>	<0.10 n	<0.10 n	NA	<b>3.2 n</b>	<b>0.51 n</b>	<b>1.2 n</b>
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Alkalinity as CaCO3	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Fluoride (Undistilled)	mg/L	--	--	NA	NA	<0.5	NA	<0.5	<1.0	NA
Manganese	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
Nitrite-N	mg/L	1.0	--	NA	NA	NA	NA	NA	NA	NA
TOC	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Total Phosphorus	mg/L	63	--	NA	NA	NA	NA	NA	NA	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	NA	NA	NA	NA	NA	NA	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	NA	NA	NA	NA	NA	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID: Date Collected: Sample Name:	Units	MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	MW-16-75		MW-16-74				
				12/29/16	01/31/17	06/28/16	09/09/16	11/11/16	12/07/16	12/29/16
				MW-16-75_122916	MW-16-75_013117	MW-16-74 (062816)	MW-16_74_090916	MW-16_75_111116	MW-16_75_120716	MW-16-74_122916
<b>Field Parameters</b>										
Conductance, specific	mS/cm	--	--	2	2	NA	NA	2	2	2
Dissolved Oxygen	mg/L	--	--	3.7	2.99	NA	NA	3.94	2.66	2.87
Oxidation reduction potential (ORP), field	millivolts	--	--	21	73	NA	NA	69	-17	19
pH	s.u.	--	--	6.9	7.21	NA	NA	7.34	7.14	6.98
Temperature, field	Deg C	--	--	11.3	10.4	NA	NA	11.5	12.9	12.3
Turbidity (field)	NTU	--	--	over range	260	NA	NA	over range	over range	over range
<b>Organics</b>										
1,4-Dioxane	µg/L	7.2	2,800	NA	NA	<3	NA	NA	NA	NA
Propane	µg/L	--	--	<b>1.0 n</b>	<b>1.7 n</b>	NA	<b>&lt;0.10 n</b>	<b>0.37 n</b>	<b>7.8 n</b>	<b>28 n</b>
<b>Inorganics</b>										
Iron	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Alkalinity as CaCO3	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Fluoride (Undistilled)	mg/L	--	--	NA	<0.5	NA	<0.5	<1.0	NA	NA
Manganese	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
Nitrite-N	mg/L	1.0	--	NA	NA	NA	NA	NA	NA	NA
TOC	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Total Kjeldahl Nitrogen	mg/L	--	--	NA	NA	NA	NA	NA	NA	NA
Total Phosphorus	mg/L	63	--	NA	NA	NA	NA	NA	NA	NA
<b>Inorganics-Filtered</b>										
Iron (dissolved)	mg/L	0.3	--	NA	NA	NA	NA	NA	NA	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA	NA	NA	NA	NA	NA	NA
<b>General Chemistry</b>										
Nitrate (as N)	mg/L	10	--	NA	NA	NA	NA	NA	NA	NA
<b>Functional Genes</b>										
Propane Monooxygenase	cells/mL	--	--	NA	NA	NA	NA	NA	NA	NA

See notes on last page

Table 2  
Phase II Biosparge Pilot: Groundwater Sampling Results  
RACER Trust Plant 2 - Lansing, Michigan

Location ID:				MW-16-74
Date Collected:		MI GW (DEQ2013) RES DW	MI GW (DEQ2013) GSI	01/31/17
Sample Name:	Units			MW-16-74_013117
<b>Field Parameters</b>				
Conductance, specific	mS/cm	--	--	2
Dissolved Oxygen	mg/L	--	--	1.79
Oxidation reduction potential (ORP), field	millivolts	--	--	7
pH	s.u.	--	--	41.6
Temperature, field	Deg C	--	--	11.2
Turbidity (field)	NTU	--	--	89.6
<b>Organics</b>				
1,4-Dioxane	µg/L	7.2	2,800	NA
Propane	µg/L	--	--	<b>13 n</b>
<b>Inorganics</b>				
Iron	mg/L	0.3	--	NA
Alkalinity as CaCO3	mg/L	--	--	NA
Fluoride (Undistilled)	mg/L	--	--	<0.5
Manganese	mg/L	0.05	4.5	NA
Nitrite-N	mg/L	1.0	--	NA
TOC	mg/L	--	--	NA
Total Kjeldahl Nitrogen	mg/L	--	--	NA
Total Phosphorus	mg/L	63	--	NA
<b>Inorganics-Filtered</b>				
Iron (dissolved)	mg/L	0.3	--	NA
Manganese (dissolved)	mg/L	0.05	4.5	NA
<b>General Chemistry</b>				
Nitrate (as N)	mg/L	10	--	NA
<b>Functional Genes</b>				
Propane Monooxygenase	cells/mL	--	--	NA

See notes on last page

**Table 2**  
**Phase II Biosparge Pilot: Groundwater Sampling Results**  
**RACER Trust Plant 2 - Lansing, Michigan**



**Table Notes:**

MI GW (DEQ2013) - Michigan DEQ 2013 Residential Drinking Water Criteria RES DW

MI GW (DEQ2013) GSI - Michigan DEQ 2013 Groundwater-Surface Water Interface Criteria

(1) The trisodium phosphate preserved container pH was measured as below the expected pH (10 S.U.) as assigned to propa **NA**

-- Bold fonts represent data where detections were noted above the MDL.

-- Data shown in [ ] represent duplicate sample analytical results.

- - = Not listed in the MDEQ Criteria Tables.

Results are only shown for VOCs with at least one detection. Full laboratory data is included as an attachment.

mS/cm - milli Siemens per centimeter

mg/L - milligrams per liter

s.u. - standard unit

Deg. C. - degrees celcius

NTU - Nephelometric Turbidity Unit

ug/L - micrograms per liter

a - Sample exceeds Residential Drinking Water Criteria. 1,4-Dioxane includes the proposed

b - Sample exceeds Groundwater Surface Water Interface Criteria

n - The laboratory does not hold NELAP/TNI accreditation for this method or analyte

Y - Elevated reporting limit due to high target concentration

J - Estimated gene copies below PQL but above LQL

**Table 3**  
**Phase II Biosparge Pilot**  
**Monitoring Well Headspace Propane LEL Readings**  
**RACER Trust Plant 2 - Lansing, Michigan**

Percent of Propane LEL				
Date:	1/6/17	1/13/17	1/17/17	1/30/17
<b>Response Well ID</b>				
TW-14-02	0	0	0	0
PW-14-01	0	0	0	0
TW-16-01	0	0	0	0
TW-14-01	0	0	0	0
<b>Auxiliary Well ID</b>				
MW-15-72	0	0	0	0
MW-16-74	0	0	0	0
MW-16-75	0	0	0	0
MW-16-77	0	0	0	0
MW-14-54	0	0	0	0
MW-12-08	0	0	0	0
<b>Air Sparge Well ID<sup>(1)</sup></b>				
AS-16-01	0	0	0	0
AS-16-02	0	0	0	0

**Notes**

Values reported in percent air.

During the October 3, 2016 start-up activities, ambient LEL percent readings near the wellheads of the two air sparge wells and four response wells were 0 percent.

<sup>(1)</sup> For air sparge wells, the LEL readings were collected near the wellhead of the sparge well. The well remained sealed.

LEL = Lower Explosive Limit

**Table 4**  
**Biosparge Pilot: Summary of Routine Groundwater Analytical Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID:		MW-14-56	MW-14-56	MW-14-56	MW-14-56
Date Collected:		03/16/16	05/04/16	09/22/16	12/15/16
Sample Name:	Units	MW-14-56_031616	MW-14-56_050416	MW-14-56_092216	MW-14-56_12152016
<b>Field</b>					
Conductance, specific	umhos/cm	4,177.5	NA	4,599	NA
Dissolved oxygen (DO)	mg/L	3.11	15.3	3.72	2.97
Oxidation reduction potential (ORP), field	millivolts	93.6	244.61	36.9	-84.10
pH	s.u.	6.63	6.73	6.82	6.77
Temperature, field	Deg C	12.41	13.42	17.81	11
Turbidity (field)	NTU	60.69	5.97	39.9	48.6
<b>Laboratory</b>					
1,4-Dioxane	ug/L	9 <sup>a</sup>	6	8 <sup>a</sup>	7

**Table 4**  
**Biosparge Pilot: Summary of Routine Groundwater Analytical Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID:		MW-15-72	MW-15-72	MW-15-72	MW-15-72
Date Collected:		03/16/16	05/16/16	09/22/16	09/23/16
Sample Name:	Units	MW-15-72_031616	MW-15-72 (05162016)	MW-15-72_092216	MW-15-72_092316
<b>Field</b>					
Conductance, specific	umhos/cm	1,710.86	NA	1,858	1,775
Dissolved oxygen (DO)	mg/L	0.93	0.11	0.38	0.37
Oxidation reduction potential (ORP), field	millivolts	-42.680	-245.220	-67.0	-59.70
pH	s.u.	6.92	6.99	7.5	7.31
Temperature, field	Deg C	14.28	17.04	18.92	17.1
Turbidity (field)	NTU	792.78	12.43	10.1	8.74
<b>Laboratory</b>					
1,4-Dioxane	ug/L	135 <sup>a</sup>	190 Y <sup>a</sup>	300 Y <sup>a</sup>	260 Y <sup>a</sup>

**Table 4**  
**Biosparge Pilot: Summary of Routine Groundwater Analytical Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID:		MW-15-72	MW-15-73	MW-15-73	MW-15-73
Date Collected:		12/19/16	03/15/16	05/13/16	09/22/16
Sample Name:	Units	MW-15-72-121916	MW-15-73_031516	MW-15-73_051316	MW-15-73_092216
<b>Field</b>					
Conductance, specific	umhos/cm	NA	1,298.42	NA	2,326
Dissolved oxygen (DO)	mg/L	3.19	0.93	0.89	0.58
Oxidation reduction potential (ORP), field	millivolts	14.4	-97.590	-168.880	-85.70
pH	s.u.	7	6.92	6.89	6.89
Temperature, field	Deg C	10.1	12.2	14.44	17.63
Turbidity (field)	NTU	31.3	9.61	34.26	6.22
<b>Laboratory</b>					
1,4-Dioxane	ug/L	230 Y <sup>a</sup>	<6 B	<3	5

**Table 4**  
**Biosparge Pilot: Summary of Routine Groundwater Analytical Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID:		MW-15-73	MW-16-74	MW-16-74	MW-16-75
Date Collected:		12/20/16	09/22/16	12/16/16	09/21/16
Sample Name:	Units	MW-15-73_122016	MW-16-74_092316	MW-16-74-121616	MW-16-75_092116
<b>Field</b>					
Conductance, specific	umhos/cm	NA	2,094	NA	1,524
Dissolved oxygen (DO)	mg/L	4.93	1.93	2.93	0.39
Oxidation reduction potential (ORP), field	millivolts	-73.80	-77.90	49	-83.90
pH	s.u.	6.96	7.18	7.25	7.12
Temperature, field	Deg C	9.1	20.56	8.2	15.09
Turbidity (field)	NTU	159	NA	117	5.67
<b>Laboratory</b>					
1,4-Dioxane	ug/L	5	<3	<3	<3

**Table 4**  
**Biosparge Pilot: Summary of Routine Groundwater Analytical Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID:		MW-16-75	MW-16-76	MW-16-76	MW-16-77
Date Collected:		12/14/16	09/21/16	12/19/16	09/21/16
Sample Name:	Units	MW-16-75_121416	MW-16-76_092116	MW-16-76_121916	MW-16-77_092316
<b>Field</b>					
Conductance, specific	umhos/cm	NA	1,856	NA	1,314
Dissolved oxygen (DO)	mg/L	3.02	0.38	5.18	1.37
Oxidation reduction potential (ORP), field	millivolts	60	-64.40	-75.80	176
pH	s.u.	6.96	7.2	7.24	7.19
Temperature, field	Deg C	11	15.05	9.4	16.02
Turbidity (field)	NTU	170	8.88	75	70.9
<b>Laboratory</b>					
1,4-Dioxane	ug/L	<3	3	<3	<3

**Table 4**  
**Biosparge Pilot: Summary of Routine Groundwater Analytical Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID:		MW-16-77	MW-16-78	MW-16-78	MW-16-81
Date Collected:		12/14/16	09/22/16	12/16/16	09/22/16
Sample Name:	Units	MW-16-77_121416	MW-16-78_092216	MW-16-78_121616	MW-16-81_092216
<b>Field</b>					
Conductance, specific	umhos/cm	NA	1,326	NA	2,634
Dissolved oxygen (DO)	mg/L	7.67	0.55	1.08	0.39
Oxidation reduction potential (ORP), field	millivolts	228.9	-64.40	-28.90	-79.30
pH	s.u.	7.3	6.79	7	6.85
Temperature, field	Deg C	4.6	15.85	8.3	17.2
Turbidity (field)	NTU	233	7.23	9.8	8.9
<b>Laboratory</b>					
1,4-Dioxane	ug/L	<3	<3	<3	230 Y <sup>a</sup>

**Table 4**  
**Biosparge Pilot: Summary of Routine Groundwater Analytical Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**



Location ID:		MW-16-81	MW-16-81	MW-16-82	MW-16-82
Date Collected:		12/15/16	03/06/17	09/22/16	12/15/16
Sample Name:	Units	MW-16-81_121516	MW-16-81_030617	MW-16-82_092216	MW-16-82_121516
<b>Field</b>					
Conductance, specific	umhos/cm	NA	3,665	NA	NA
Dissolved oxygen (DO)	mg/L	2.13	0.90	0.47*	2.59
Oxidation reduction potential (ORP), field	millivolts	-28.40	-87.98	-106.80	-37.30
pH	s.u.	7.02	7	7.81	7.24
Temperature, field	Deg C	8.5	14.28	24.66	0.1
Turbidity (field)	NTU	33.9	115.01	13.50	7.7
<b>Laboratory</b>					
1,4-Dioxane	ug/L	290 Y <sup>a</sup>	550	52 <sup>a</sup>	<3

**Table 4**  
**Biosparge Pilot: Summary of Routine Groundwater Analytical Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**



<b>Location ID:</b>		MW-16-82
<b>Date Collected:</b>		03/06/17
<b>Sample Name:</b>	<b>Units</b>	MW-16-82_030617
<b>Field</b>		
Conductance, specific	umhos/cm	1318.14
Dissolved oxygen (DO)	mg/L	1.11
Oxidation reduction potential (ORP), field	millivolts	-81.64
pH	s.u.	7.23
Temperature, field	Deg C	13.98
Turbidity (field)	NTU	7.16
<b>Laboratory</b>		
1,4-Dioxane	ug/L	< 3

**Table 4**  
**Biosparge Pilot: Summary of Groundwater Analytical**  
**Results for Nearby Monitoring Wells**  
**RACER Trust Plant 2 - Lansing, Michigan**

**Table Notes:**

\*DO Value of 0.47 mg/L was measured 10 minutes prior to sampling. The measurement taken at the time of sampling was discarded because the sampling pump stopped.

-- Shading indicates result exceeding one or more MDEQ Part 201 Generic Cleanup Criteria and Screening Levels, Dated December 30, 2013.

- - = Not listed in the MDEQ Criteria Tables.

mg/L - milligrams per liter

s.u. - standard unit

Deg. C. - degrees celcius

NTU - Nephelometric Turbidity Unit

ug/L - micrograms per liter

umhos/cm - micromhos per centimeter

a - Sample exceeds Residential Drinking Water (DW) Criteria

b - Sample exceeds Groundwater Surface Water Interface (GSI) Criteria

NA - Not Analyzed

**Laboratory**

**Lab and Validation Data Qualifiers:**

B = Compounds also found in associated method blank.

X = Elevated reporting limit due to matrix interference.

Y = Elevated reporting limit due to high target concentration.

O = Analysis performed by outside laboratory.