



OCTMDL Sampling & Analysis Report 2022

Prepared in Cooperation with the Texas Commission on Environmental Quality



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Introduction

The Orange County Total Maximum Daily Load Project (OCTMDL) includes the Adams Bayou and Cow Bayou watersheds located in the southern section of the Sabine Basin, in Orange County. Impairments in these water bodies were first identified in Adams Bayou Tidal (0508) in 1992 and Cow Bayou Tidal (0511) in 1994. The Texas Commission on Environmental Quality (TCEQ) adopted the original Total Maximum Daily Loads (TMDL) for indicator bacteria, dissolved oxygen (DO), and pH for both bayous and their tributaries on June 13, 2007. The Implementation Plan (I-Plan) was adopted eight years later on August 5, 2015.

Since the adoption of the I-Plan, the Sabine River Authority (SRA-TX) has conducted routine water quality monitoring at two stations within the impaired watersheds under the Texas Clean Rivers Program. Beginning in FY2021, SRA-TX began collecting water quality data from several of the other original OCTMDL sampling stations. These stations have not been monitored since the original OCTMDL sampling program was completed. This additional data will be used to assess the current status of impairments to the primary contact recreation, aquatic life, and general uses in these waterbodies. An additional component of the project will be to collect monthly grab samples to determine the tidal influence in Adams Bayou Above Tidal (0508A) and Gum Gully (0508B) during FY2021 and FY2022.

This report provides an overview of the water quality data collected under the TMDL Program within the Adams Bayou and Cow Bayou watersheds from July 2021 through June 2022.



Figure 1. Cow Bayou at FM 1442

Water Quality Monitoring

The SRA-TX is monitoring twelve sites (Table 1) within the OCTMDL watersheds under the TMDL program. Indicator bacteria is sampled at eight sites monthly, while 24-hour parameters are collected at six sites quarterly (Table 1). The additional tidal determination sampling is taking place at three sites monthly (Table 1).

Table 1. Sampling Stations and Parameters

Site ID	AU	Bacteria Sampling	24-hour Sampling	Tidal Determination
16049 (GG)	0508B_01	<i>E. coli</i>		√
15107 (AB7)	0508A_01			√
14964 (AB8)	0508A_01			√
10457 (CB5)	0511_04	<i>Enterococcus</i>	√	
13781 (CB4)	0511_03	<i>Enterococcus</i>	√	
10453 (CB3)	0511_02		√	
16052 (CNB)	0511B_01	<i>Enterococcus</i>		
10441 (AB2)	0508_01		√	
10442 (AB3)	0508_02	<i>Enterococcus</i>	√	
16059 (AB4)	0508_03	<i>Enterococcus</i>	√	
16041 (HG)	0508C_01	<i>Enterococcus</i>		
14990 (AB5)	0508_04	<i>Enterococcus</i>		

Table 2. Abbreviation List

Abbreviation	Meaning
MPN	Most Probable Number
°C	Degrees Celsius
μS/cm	Micro Siemen per Centimeter
mg/L	Milligrams per Liter
ppt	Part per Thousand



Figure 2. Cow Bayou at FM 105

Table 3. 24-Hour Sampling Parameters

Storet Code	Parameter
00209	24-hour Average Water Temperature (°C)
00210	Maximum Daily Water Temperature (°C)
00211	Minimum Daily Water Temperature (°C)
00221	Number of Water Temperature Measurements
00212	24-Hour Average Specific Conductance (µS/cm)
00213	Maximum Daily Specific Conductance (µS/cm)
00214	Minimum Daily Specific Conductance (µS/cm)
00222	Number of Specific Conductance Measurements
89857	24-Hour Average Dissolved Oxygen (mg/L)
89856	Maximum Daily Dissolved Oxygen (mg/L)
89855	Minimum Daily Dissolved Oxygen (mg/L)
89858	Number of Dissolved Oxygen Measurements
00215	Maximum Daily pH (pH units)
00216	Minimum Daily pH (pH units)
00223	Number of pH Measurements
00218	24-Hour Average Salinity (ppt)
00217	Maximum Daily Salinity (ppt)
00219	Minimum Daily Salinity (ppt)
00220	Number of Salinity Measurements



Figure 3. 24-hr Sampling

Table 4. Tidal Determination Parameters

Storet Code	Parameter
00010	Surface Water Temperature (°C)
	Bottom Water Temperature (°C)
00094	Surface Specific Conductance (µS/cm)
	Bottom Specific Conductance (µS/cm)
00480	Surface Salinity (ppt)
	Bottom Salinity (ppt)
89870	% Pool Coverage
01351	Flow Severity



Figure 4. Adams Bayou at FM 1078

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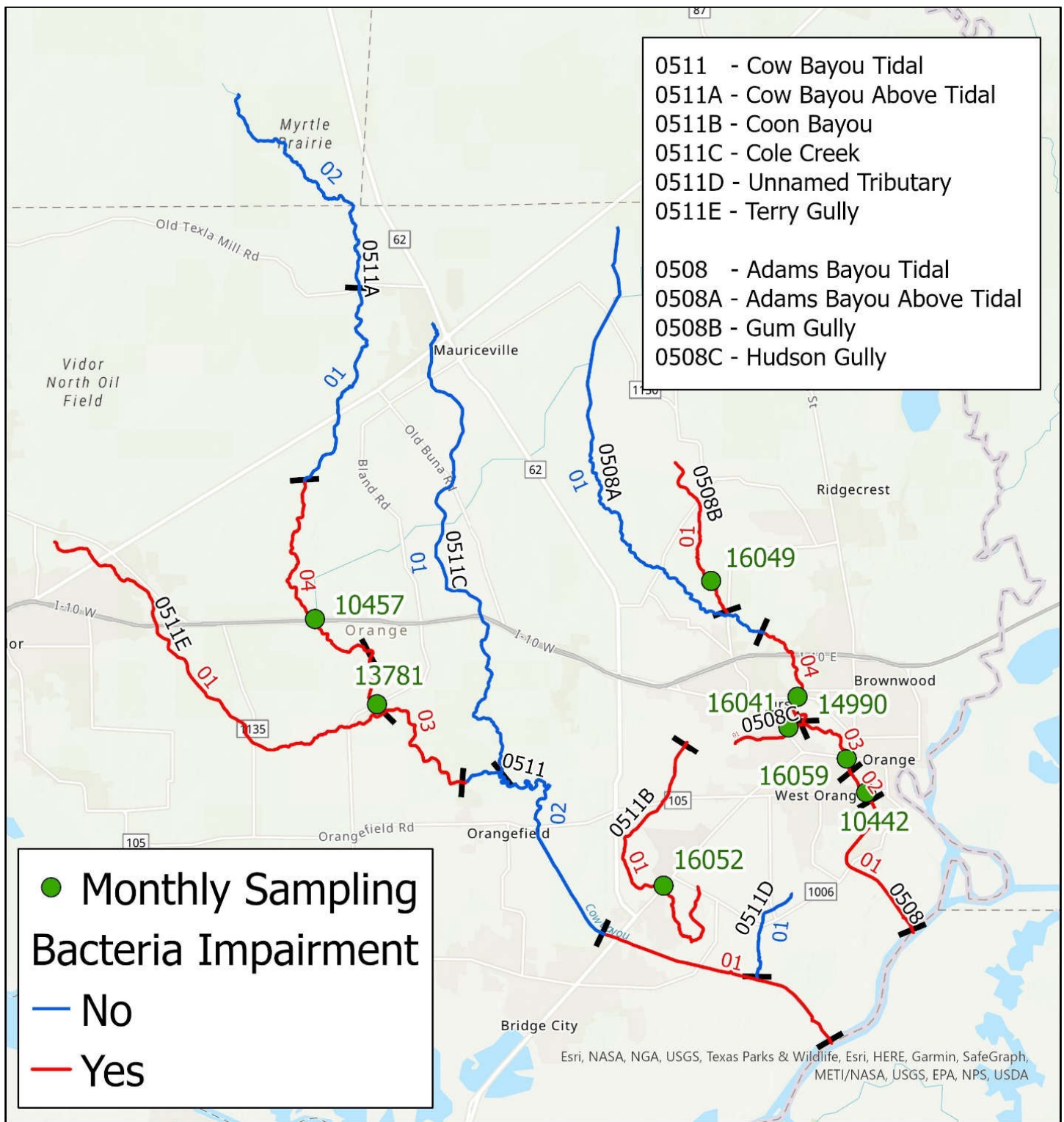


Figure 6. Monthly Bacteria Sampling Sites.

Bacteria Monitoring

Bacteria monitoring sites within the Adams Bayou watershed.

Station 16049 (GG) – Gum Gully at Haliburton Rd. upstream of the confluence with Adams Bayou.

Station 10442 (AB3) – Adams Bayou immediately downstream of Western Ave. in Orange, TX.

Station 16059 (AB4) – Adams Bayou at Green Ave. in Orange, TX.

Station 14990 (AB5) – Adams Bayou at Park Ave. in Pinehurst, TX

Station 16041 (HG) – Hudson Gully at Lexington Dr. upstream of the confluence with Adams Bayou.

Table 5. Adams Bayou Watershed *Enterococcus* Sampling Results

Date	Enterococcus (MPN)			
	10442 (AB3)	16059 (AB4)	14990 (AB5)	16041 (HG)
7/15/21	1,150	1,500	226	1,900
8/25/21	238	135	269	6,130
9/23/21	41	63	52	292
10/14/21	216	85	41	97
11/9/21	31	73	63	135
12/9/21	52	97	41	41
1/20/22	NR	NR	NR	NR
2/23/22	189	158	173	857
3/23/22	17,000	15,000	24,000	8,200
4/6/22	108	195	473	301
5/19/22	275	275	197	73
6/23/22	120	96	20	934
Geomean	215	230	166	474

NR= No Result

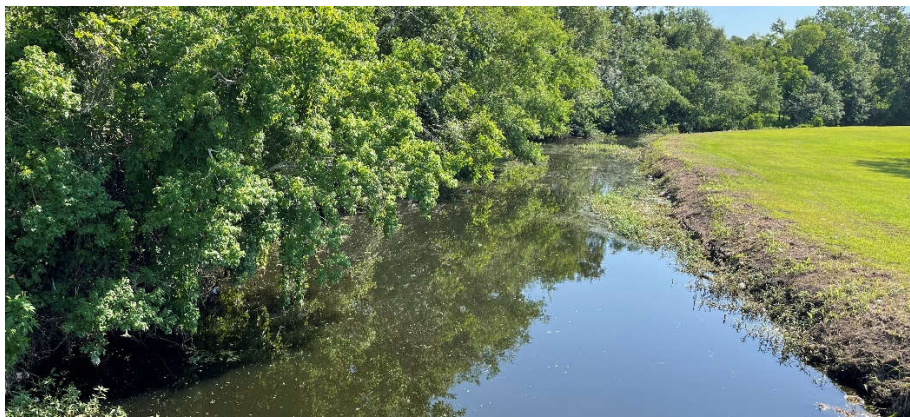


Figure 7. Hudson Gully at Lexington Drive.

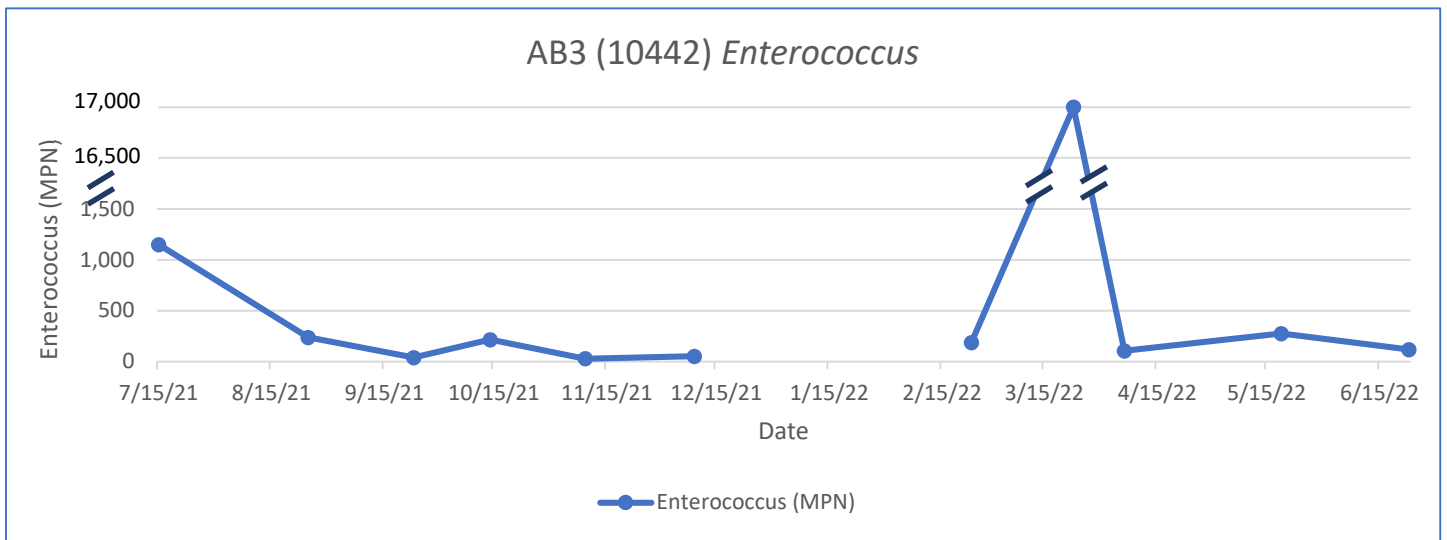


Figure 8. Site AB3 (10442) *Enterococcus* results over time.

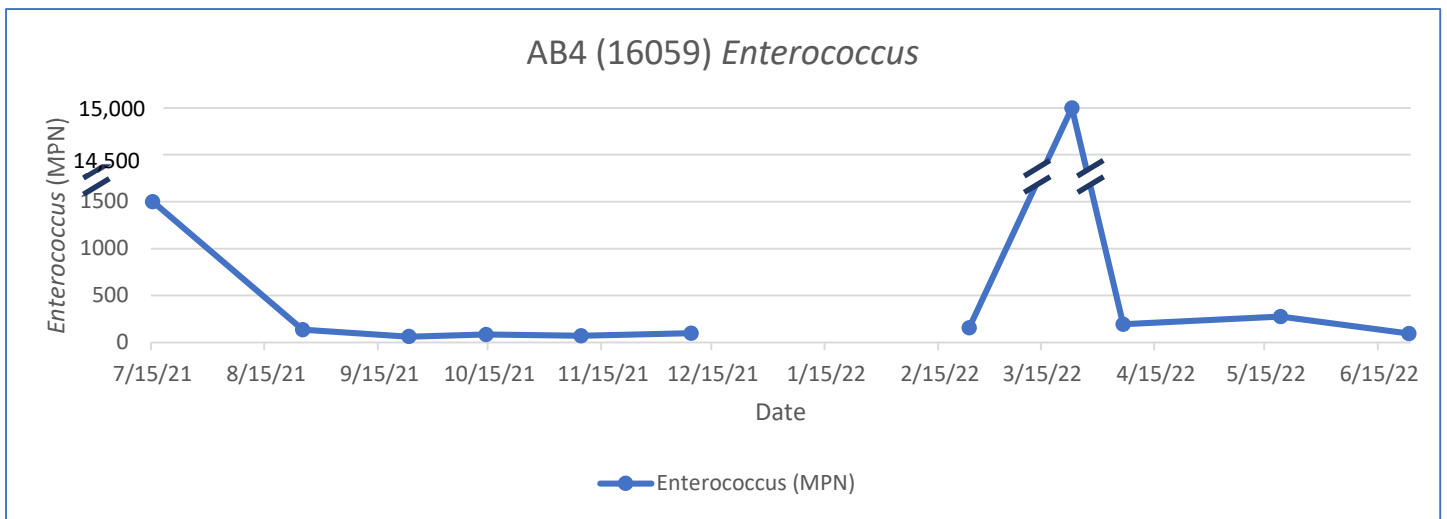


Figure 9. Site AB4 (16059) *Enterococcus* results over time.

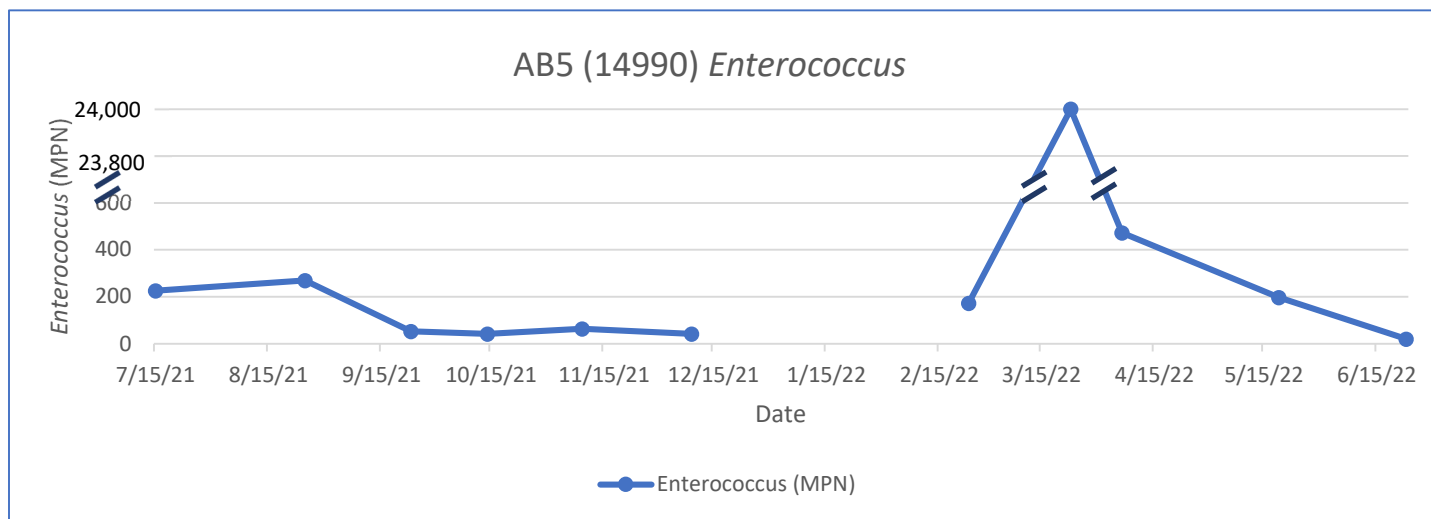


Figure 10. Site AB5 (14990) Enterococcus results over time.

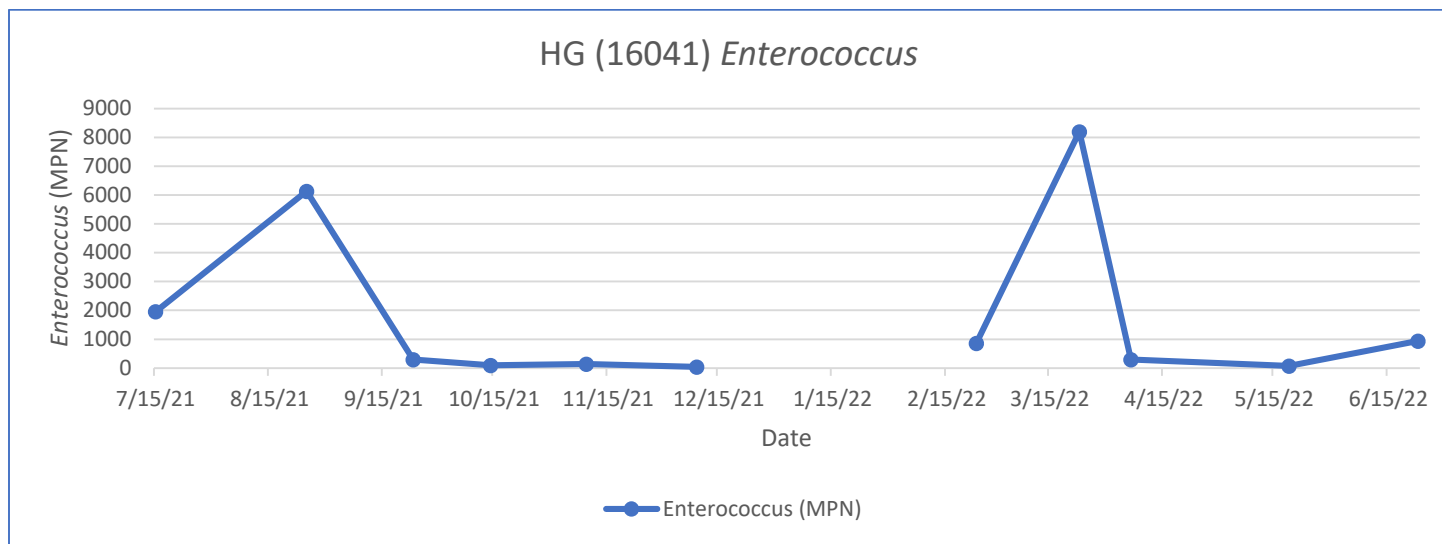


Figure 11. Site HG (16041) Enterococcus results over time.

Table 6. Adams Bayou *E. coli* Sampling Results

Date	E. coli (MPN)
	16049 (GG)
7/15/21	84
8/25/21	9
9/23/21	30
10/14/21	320
11/9/21	86
12/9/21	201
1/20/22	2,400
2/23/22	12
3/23/22	1,400
4/6/22	26
5/19/22	5
6/23/22	2
Geomean	58

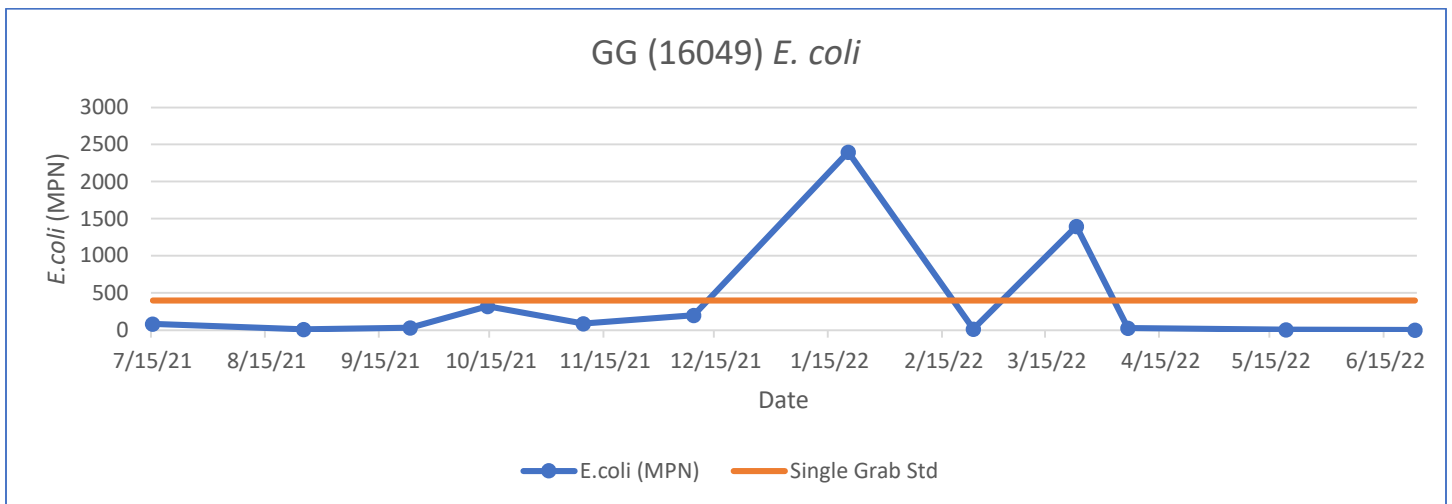


Figure 12. Site GG (16049) *E. coli* results over time.

Bacteria monitoring stations within the Cow Bayou watershed.

Station 10457 (CB5) – Cow Bayou immediately upstream of IH10 west service road west of Orange, TX.

Station 13781 (CB4) – Cow Bayou at FM 1442/North crossing between FM 105 and IH10.

Station 16052 (CNB) – Coons Bayou at SH 87 NE of Bridge City, TX.

Table 7. Cow Bayou *Enterococcus* Sampling Results

Date	Enterococcus (MPN)		
	10457 (CB5)	13781 (CB4)	16052 (CNB)
7/15/21	336	181	2,140
8/25/21	650	305	135
9/23/21	148	97	120
10/14/21	145	158	266
11/9/21	183	20	NR
12/9/21	624	20	320
1/20/22	NR	NR	NR
2/23/22	243	52	121
3/23/22	6,000	10,000	4,900
4/6/22	31	20	121
5/19/22	645	63	417
6/23/22	135	187	199
Geomean	305	114	335

NR = No Result

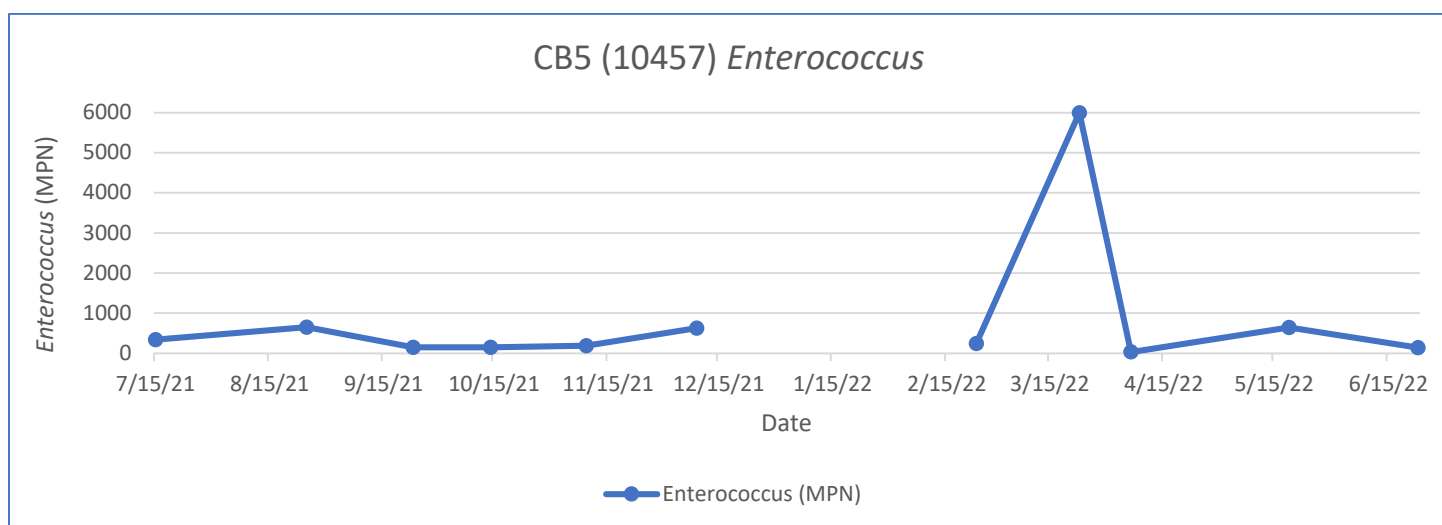


Figure 13. Site CB5 (10457) *Enterococcus* results over time.

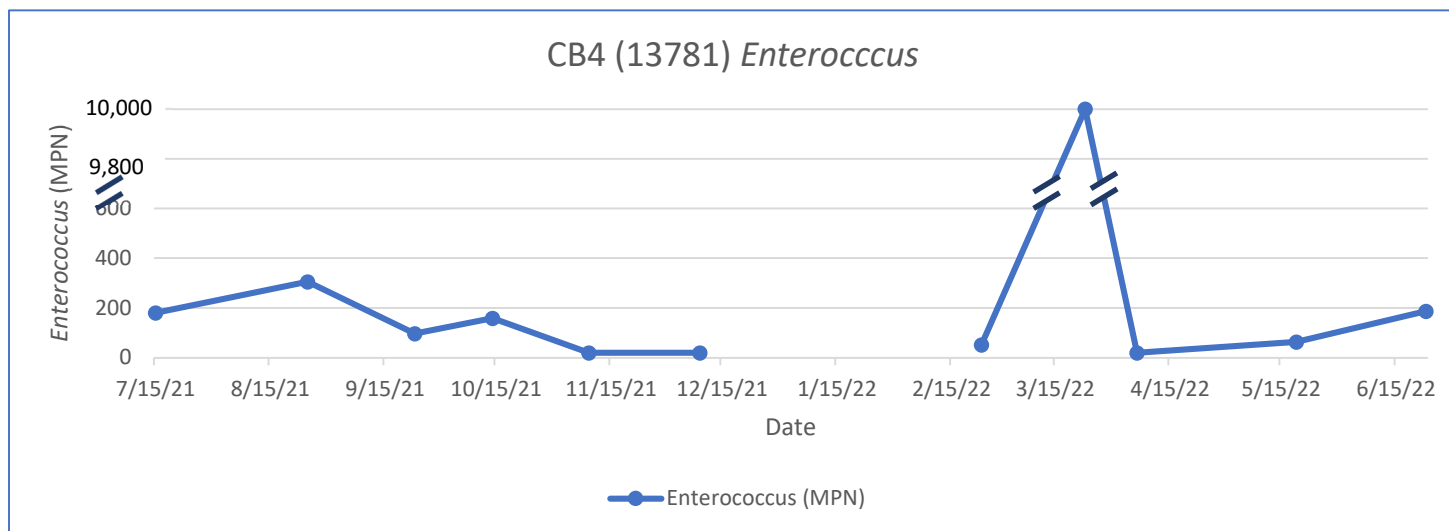


Figure 14. Site CB4 (13781) Enterococcus results over time.

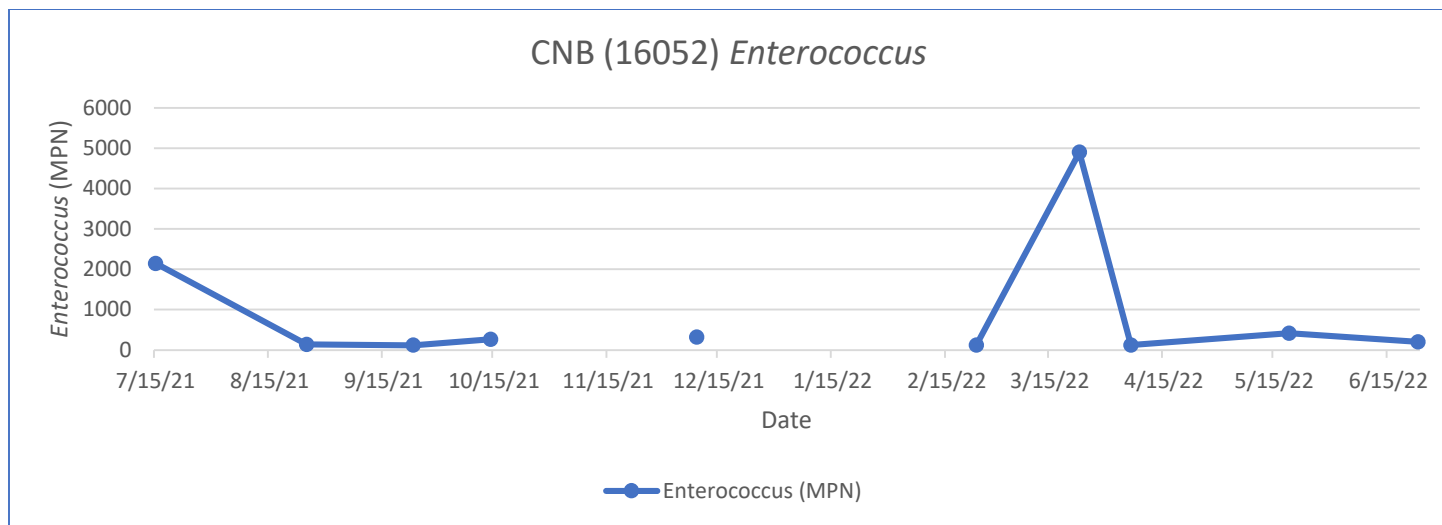


Figure 15. Site CNB (16052) Enterococcus results over time.

Bacteria Monitoring Results

Bacteria results greater than the single grab standard were commonly found throughout the sampling period. The sampling event on 3/23/22 occurred one day after heavy rainfall and the results from that date were significantly greater than the others at each site.

The geomean over the sampling period was greater than the standard of 35 MPN at each of the seven *Enterococcus* sites. The one *E. coli* sampling site had a geomean well below the standard of 126 MPN.

24-hour Monitoring

24-hour monitoring sites within the Adams Bayou watershed.

Station 10441 (AB2) – Adams Bayou at FM 1006 in Orange, TX.

Station 10442 (AB3) – Adams Bayou immediately downstream of Western Ave. in Orange, TX.

Station 16059 (AB4) – Adams Bayou at Green Ave. in Orange, TX.

Table 8. Station 10441 (AB2) 24-hour results.

Date	Water temp (°C)			Sp. Conductance (µS/cm)			DO (mg/L)			pH (units)		Salinity (ppt)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
8/12/21	31.2	34.4	32.0	314	359	333	4.0	9.3	5.8	6.9	7.8	0.2	0.2	0.2
10/8/21	25.3	27.3	25.9	311	646	446	1.9	4.6	2.6	6.1	6.3	0.2	0.3	0.2
1/5/22	14.7	15.7	15.0	3,340	4,060	3,720	6.6	7.9	7.5	7.2	7.3	1.8	2.2	2.0
4/22/22	23.7	25.2	24.4	1,678	3,094	2,449	3.5	7.0	5.6	6.8	7.1	0.9	1.7	1.3

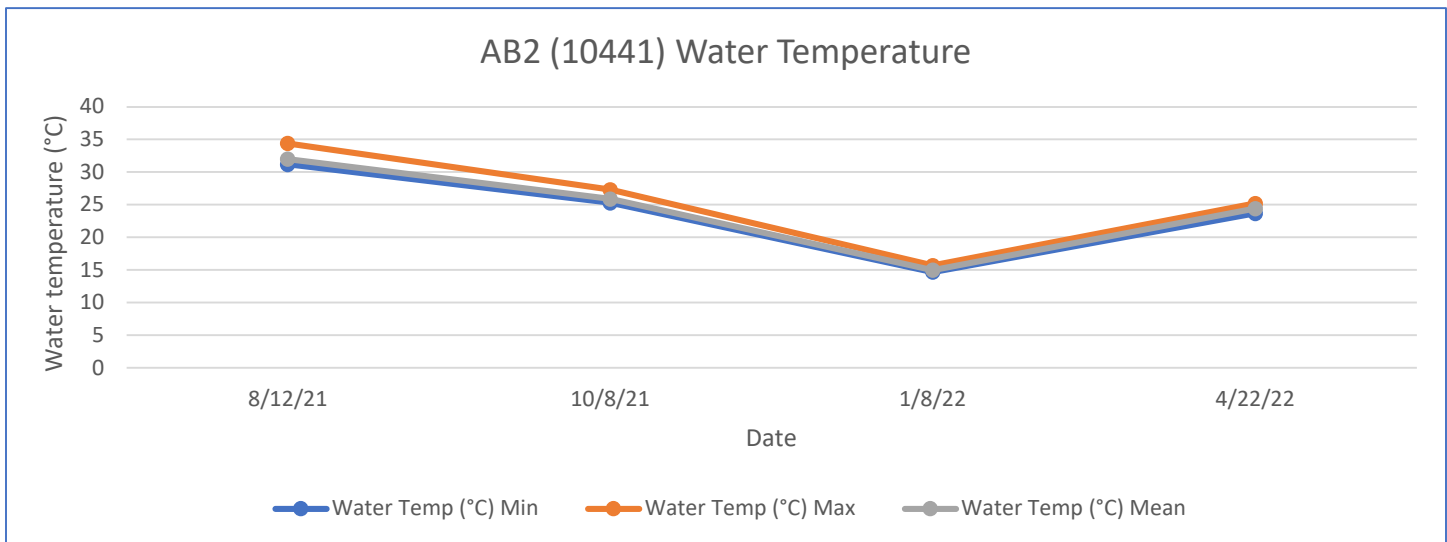


Figure 16. Site AB2 (10441) Water Temperature over time.

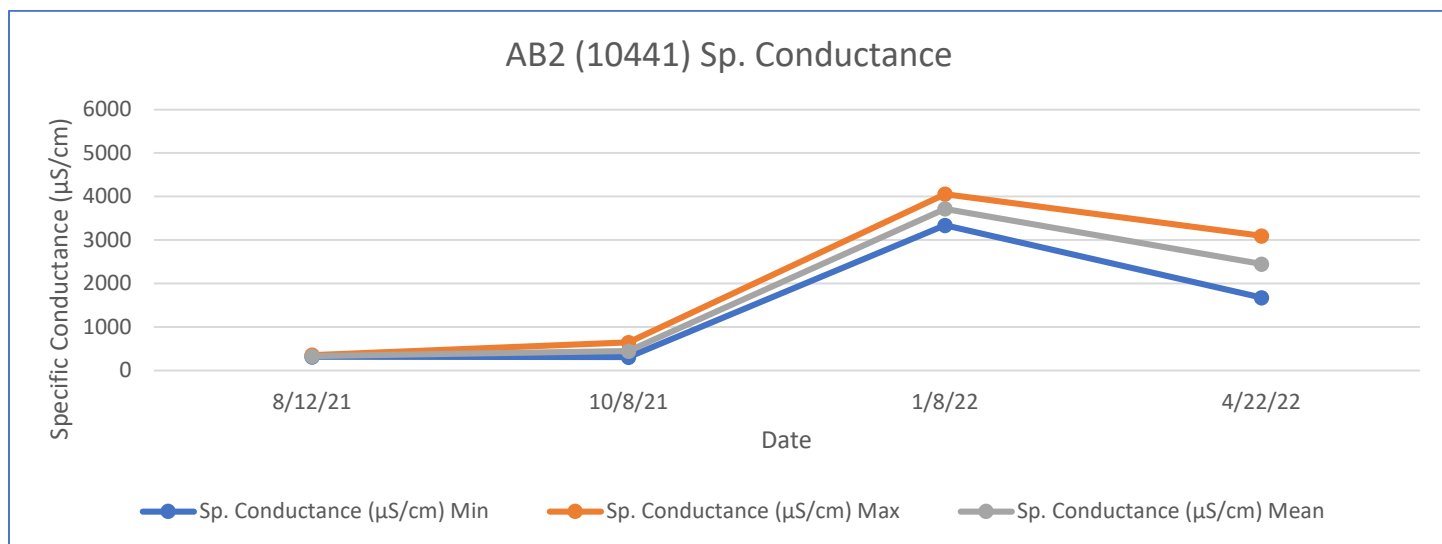


Figure 17. Site AB2 (10441) Specific Conductance over time.

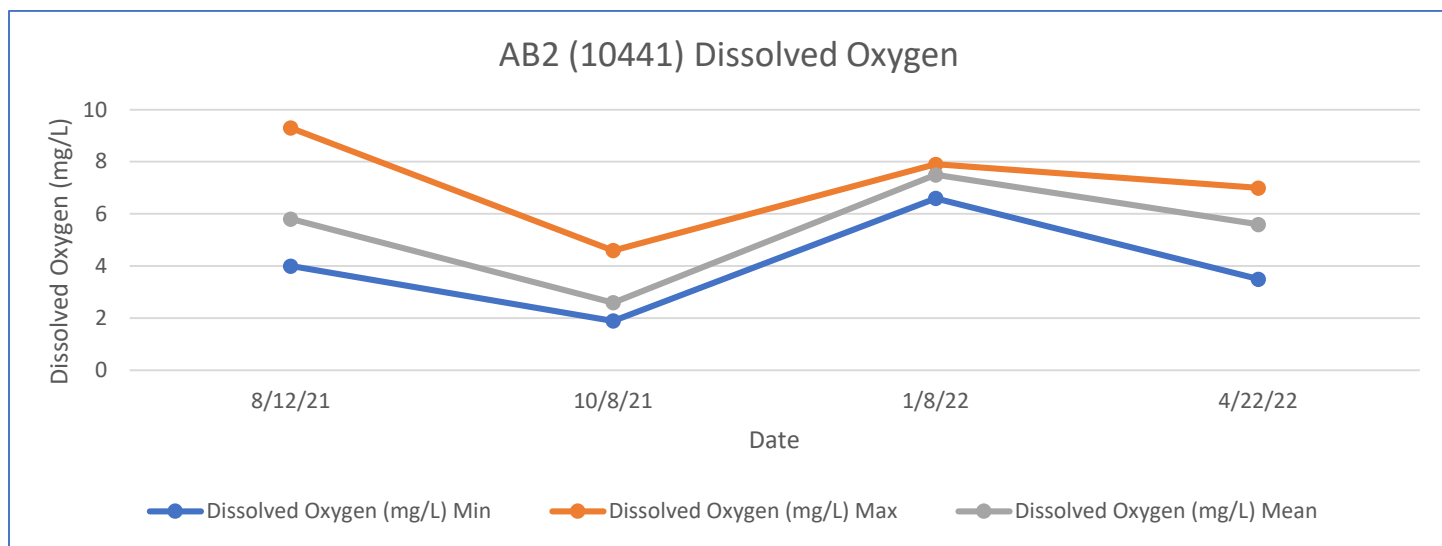


Figure 18. Site AB2 (10441) Dissolved Oxygen over time.

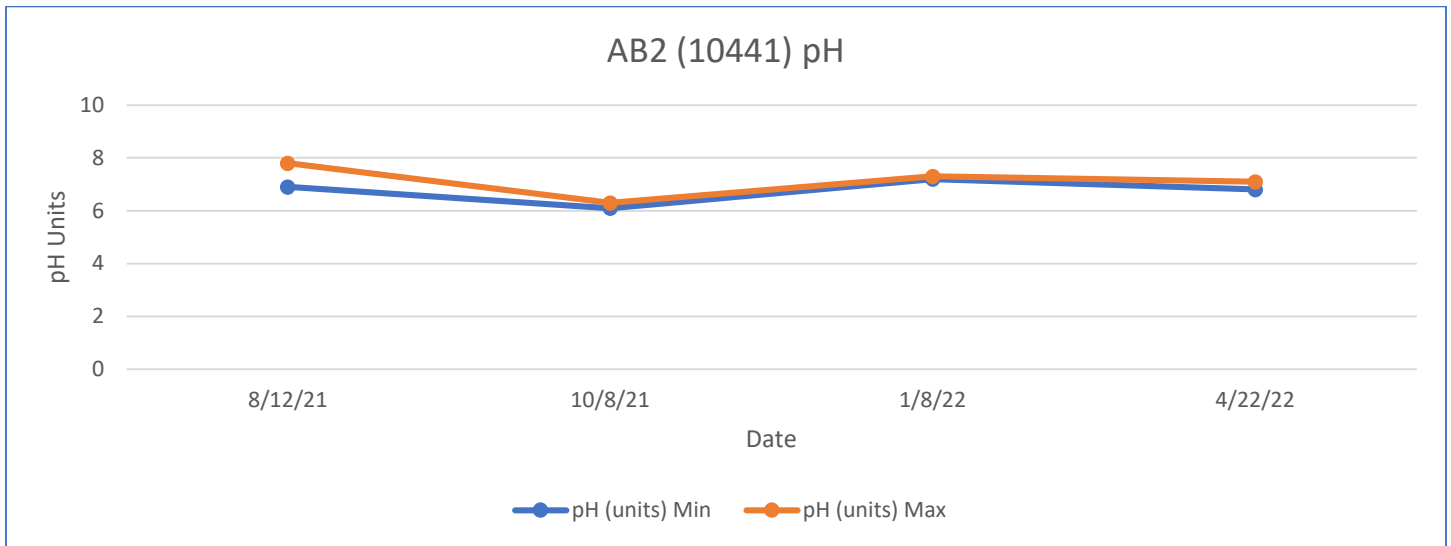


Figure 19. Site AB2 (10441) pH over time.

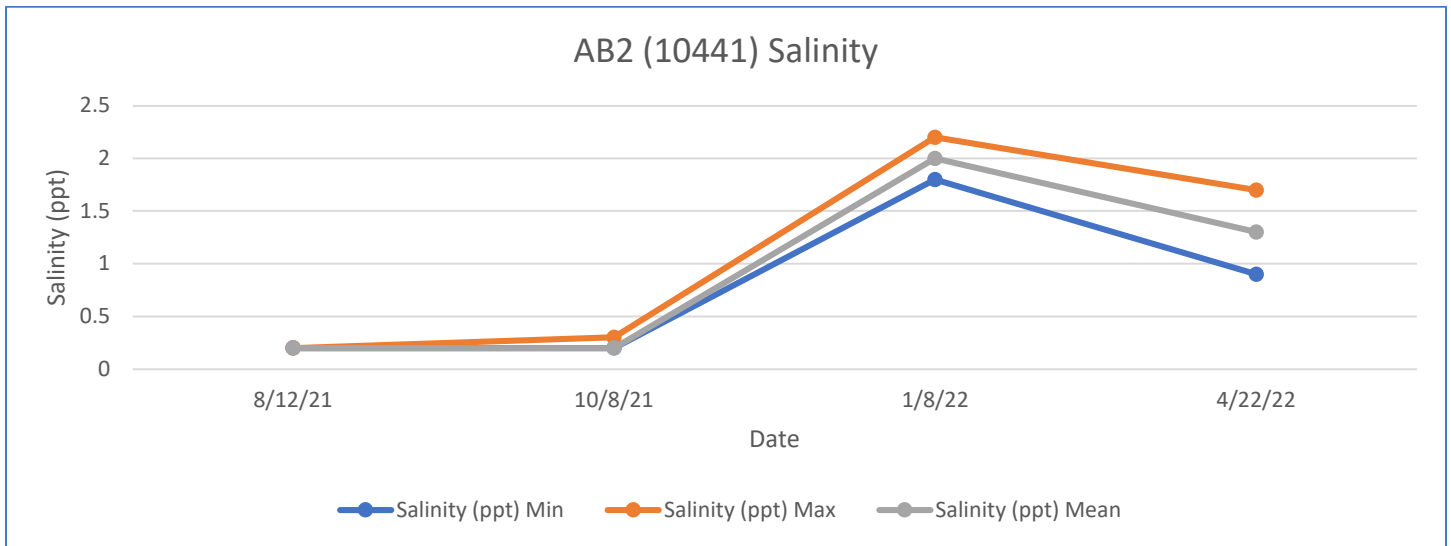


Figure 20. Site AB2 (10441) Salinity over time.

Table 9. Station 10442 (AB3) 24-hour results.

Date	Water temp (°C)			Sp. Conductance (µS/cm)			DO (mg/L)			pH (units)		Salinity (ppt)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
8/12/21	31.2	32.7	31.6	232	244	238	1.2	6.6	3.6	6.7	7.2	0.1	0.1	0.1
10/7/21	25.1	27.2	25.6	156	216	181	0.7	1.7	1.1	6.5	6.6	0.1	0.1	0.1
1/5/22	15.1	16.6	15.6	2,240	3,540	3,010	4.3	6.6	5.5	6.8	6.9	1.2	1.9	1.6
4/6/22	22.8	24.6	23.2	622	817	713	1.4	3.4	2.2	6.8	6.8	0.3	0.4	0.4

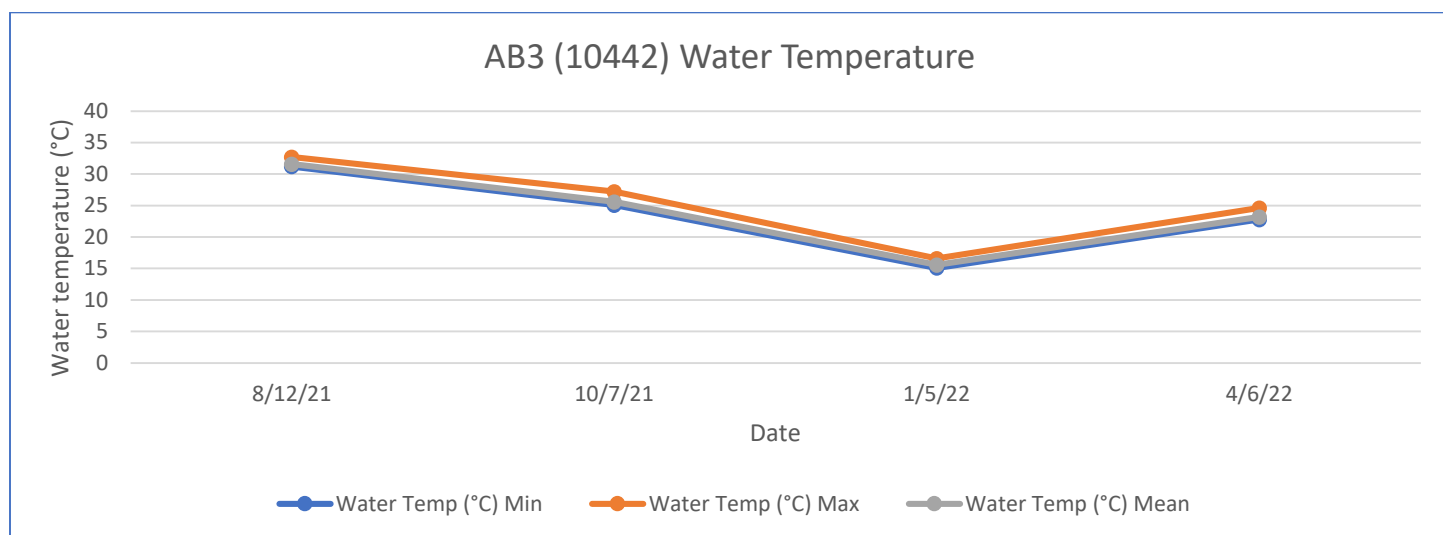


Figure 21. Site AB3 (10442) Water Temperature over time.

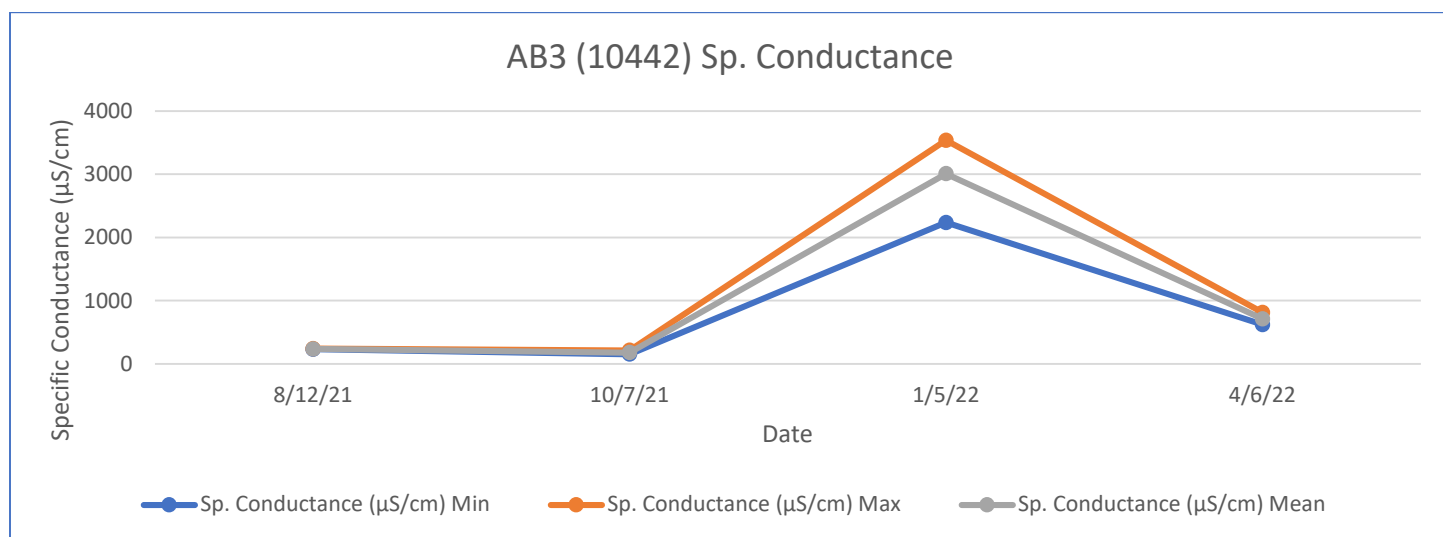


Figure 22. Site AB3 (10442) Specific Conductance over time.

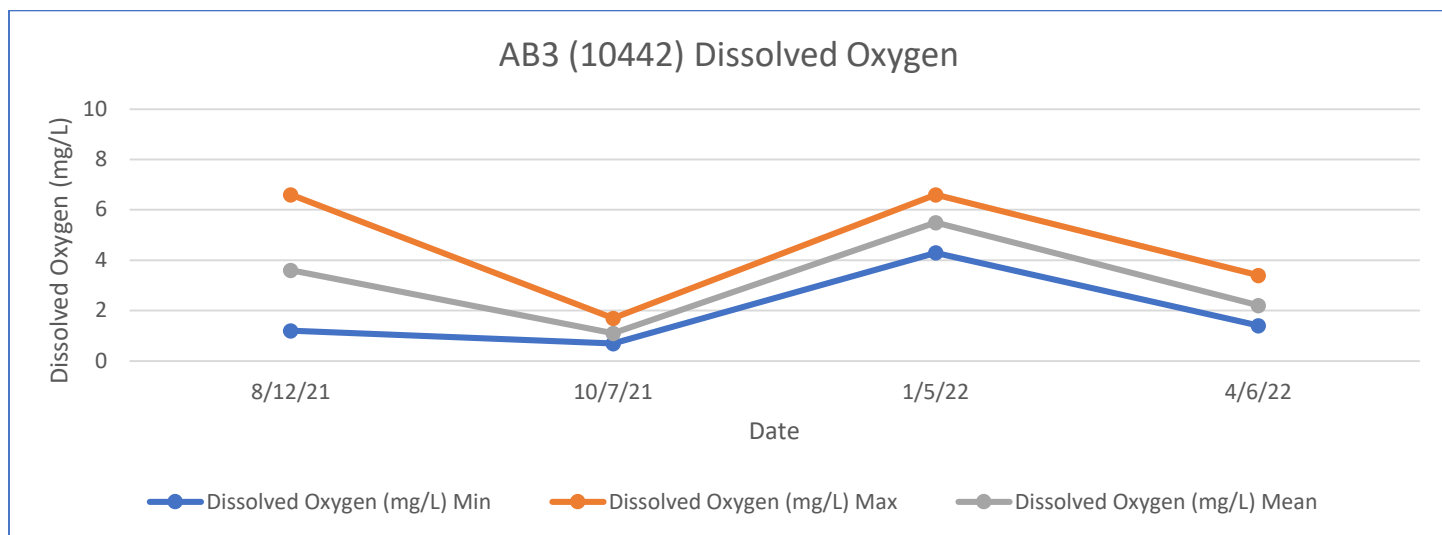


Figure 23. Site AB3 (10442) Dissolved Oxygen over time.

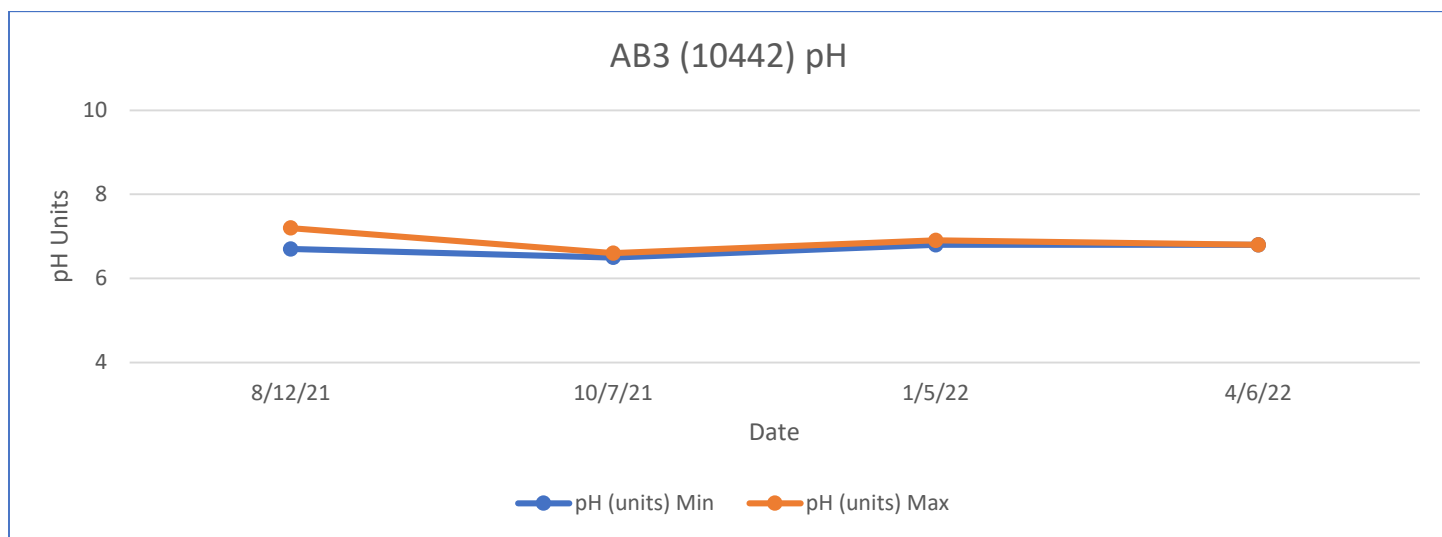


Figure 24. Site AB3 (10442) pH over time.

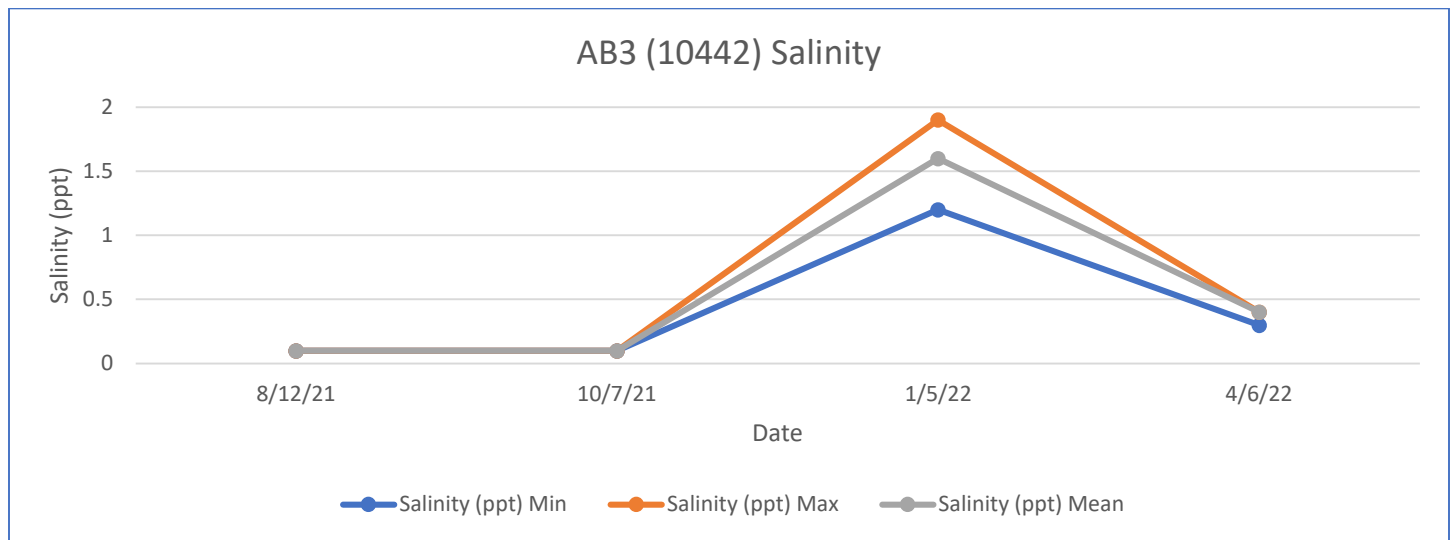


Figure 25. Site AB3 (10442) Salinity over time.

Table 10. Station 16059 (AB4) 24-hour results.

Date	Water temp (°C)			Sp. Conductance (µS/cm)			DO (mg/L)			pH (units)		Salinity (ppt)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
9/9/21	29.4	30.6	29.9	353	430	381	1.6	3.2	2.2	6.7	6.8	0.2	0.2	0.2
12/2/21	16.9	17.8	17.4	4,050	8,480	5,680	4.5	5.7	5.2	6.6	6.7	2.2	4.8	3.1
3/23/22	18.6	20.4	19.3	219	485	294	4.2	5.1	4.7	6.7	7.1	0.1	0.2	0.1
6/7/22	28.9	30.4	29.5	814	991	891	1.8	3.2	2.3	7.0	7.1	0.4	0.5	0.5

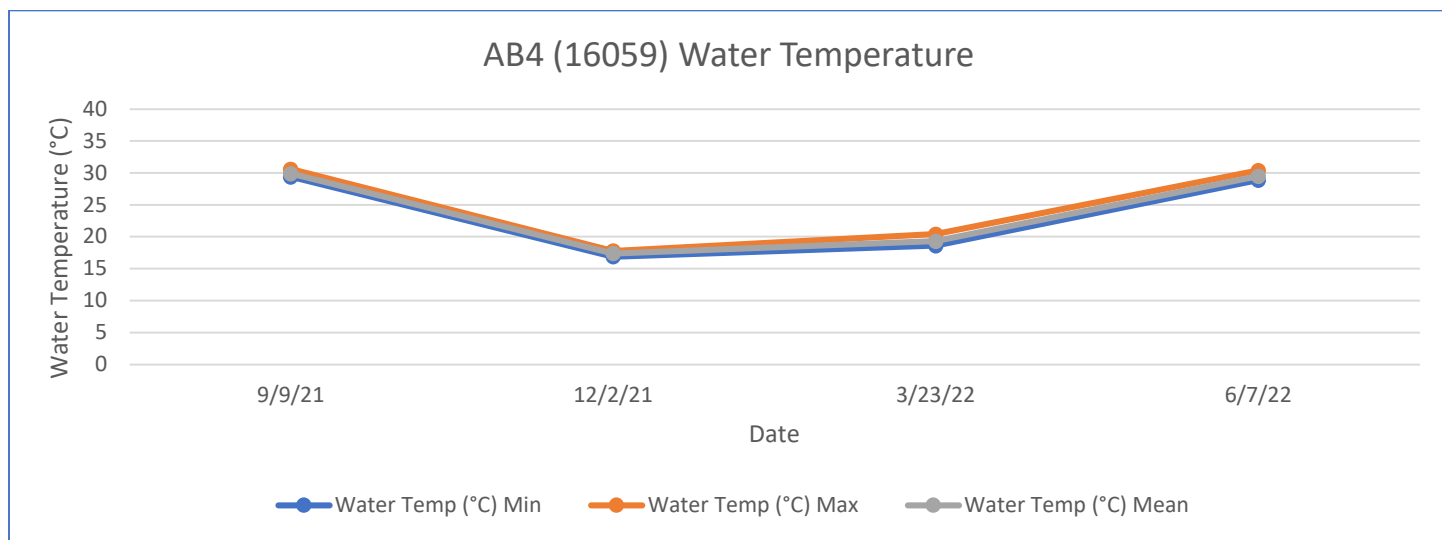


Figure 26. Site AB4 (16059) Water Temperature over time.

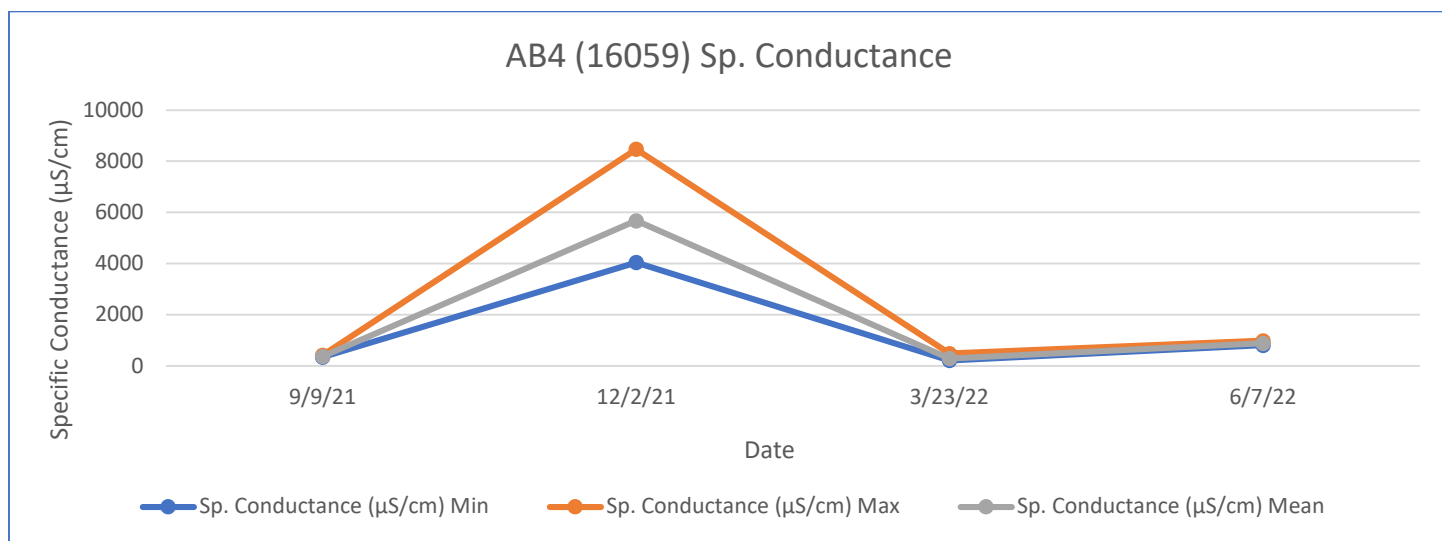


Figure 27. Site AB4 (16059) Specific Conductance over time.

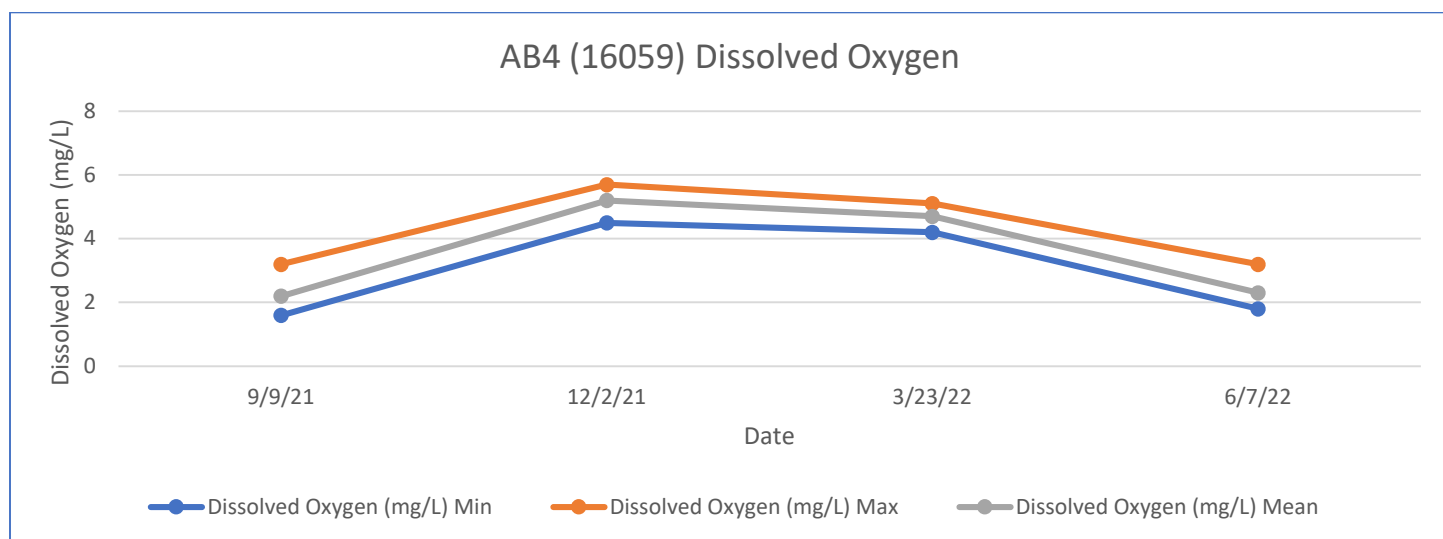


Figure 28. Site AB4 (16059) Dissolved Oxygen over time.

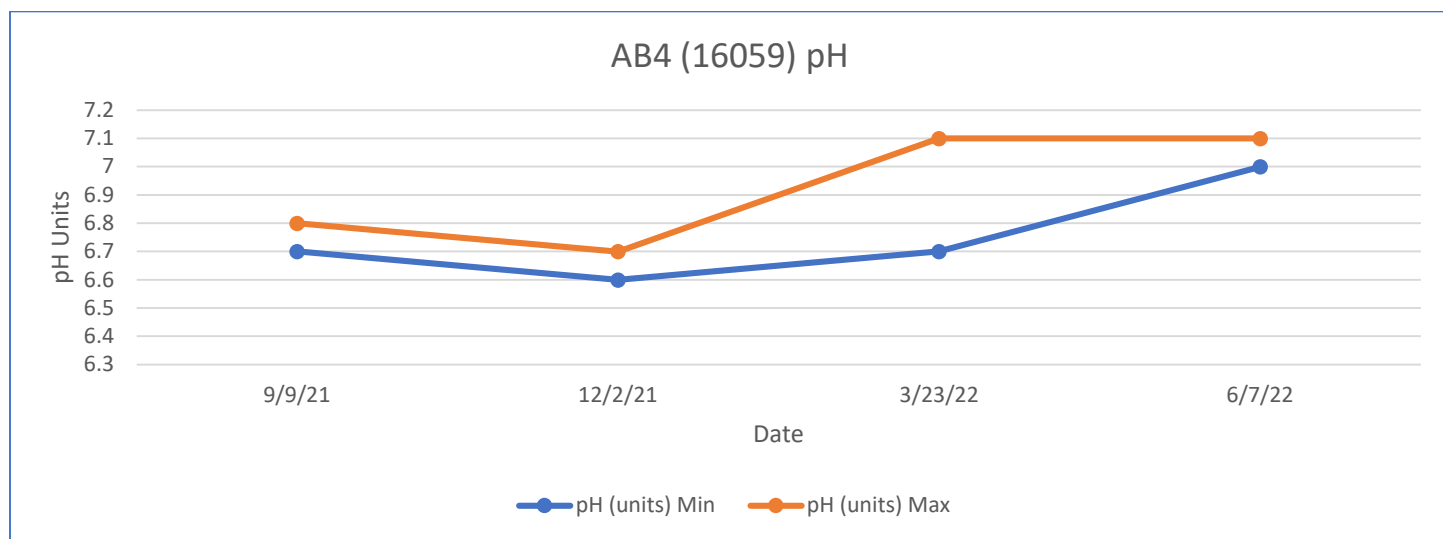


Figure 29. Site AB4 (16059) pH over time.

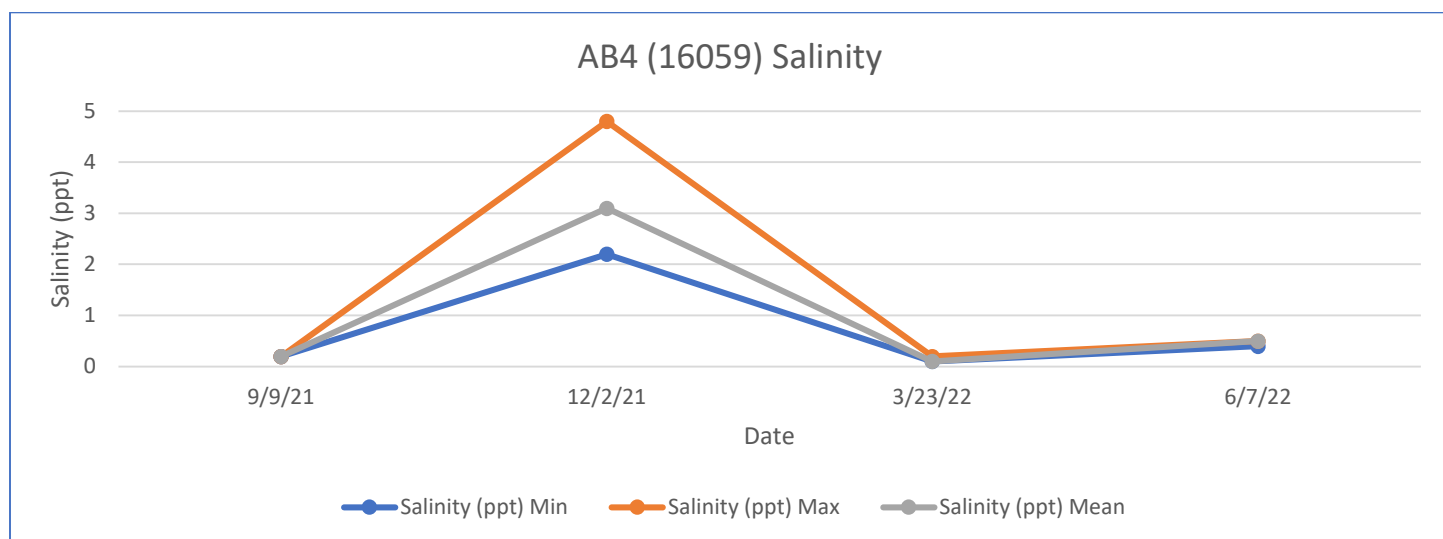


Figure 30. Site AB4 (16059) Salinity over time.



Figure 31. Adams Bayou at Green Avenue.

24-hour monitoring sites within the Cow Bayou watershed.

Station 10453 (CB3) – Cow Bayou at FM 105 East of Orange, TX.

Station 13781 (CB4) – Cow Bayou at FM 1442/North crossing between FM 105 and IH10.

Station 10457 (CB5) – Cow Bayou immediately upstream of IH10 west service road west of Orange, TX.

Table 11. Station 10453 (CB3) 24-hour results.

Date	Water temp (°C)			Sp. Conductance (µS/cm)			DO (mg/L)			pH (units)		Salinity (ppt)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
9/9/21	29.4	31.0	30.1	264	364	314	3.1	5.5	4.2	6.6	6.8	0.1	0.2	0.2
12/2/21	16.5	18.8	16.5	4,130	5,360	4,540	4.5	8.0	6.1	6.7	6.9	2.3	3.0	2.5
3/23/22	18.3	19.9	19.1	83	200	120	5.1	5.6	5.5	6.3	6.6	<0.1	0.1	<0.1
6/7/22	29.9	31.1	30.4	1,380	1,585	1,487	5.1	7.5	6.4	7.0	7.3	0.7	0.8	0.8

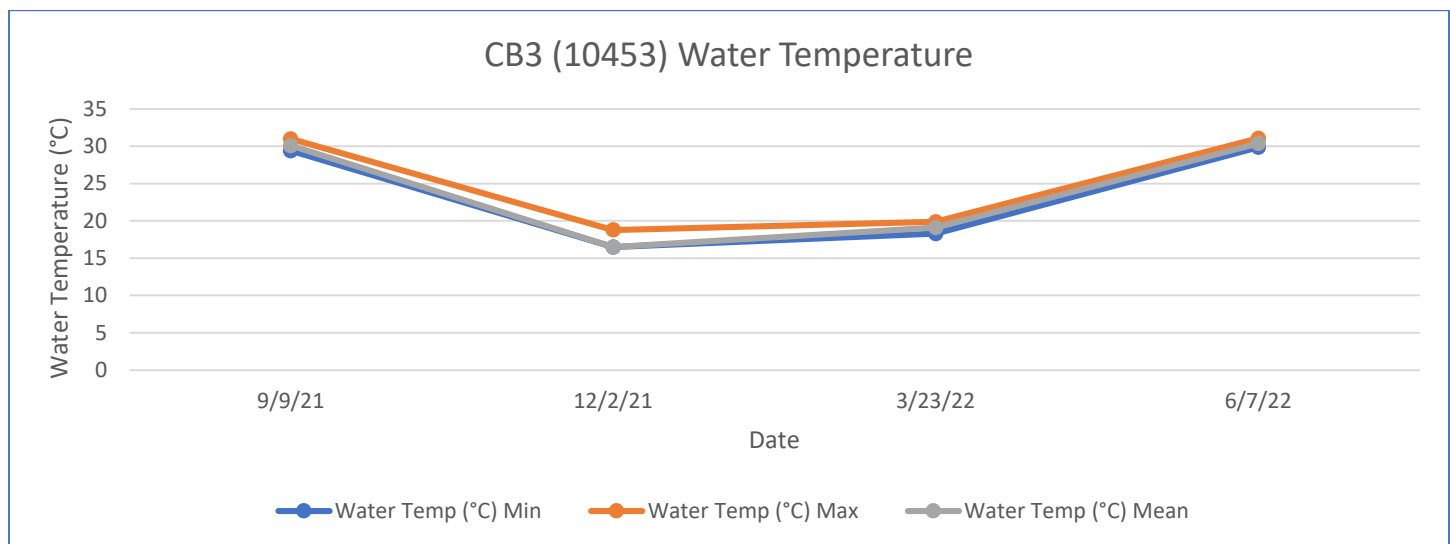


Figure 32. Site CB3 (10453) Water temperature over time.

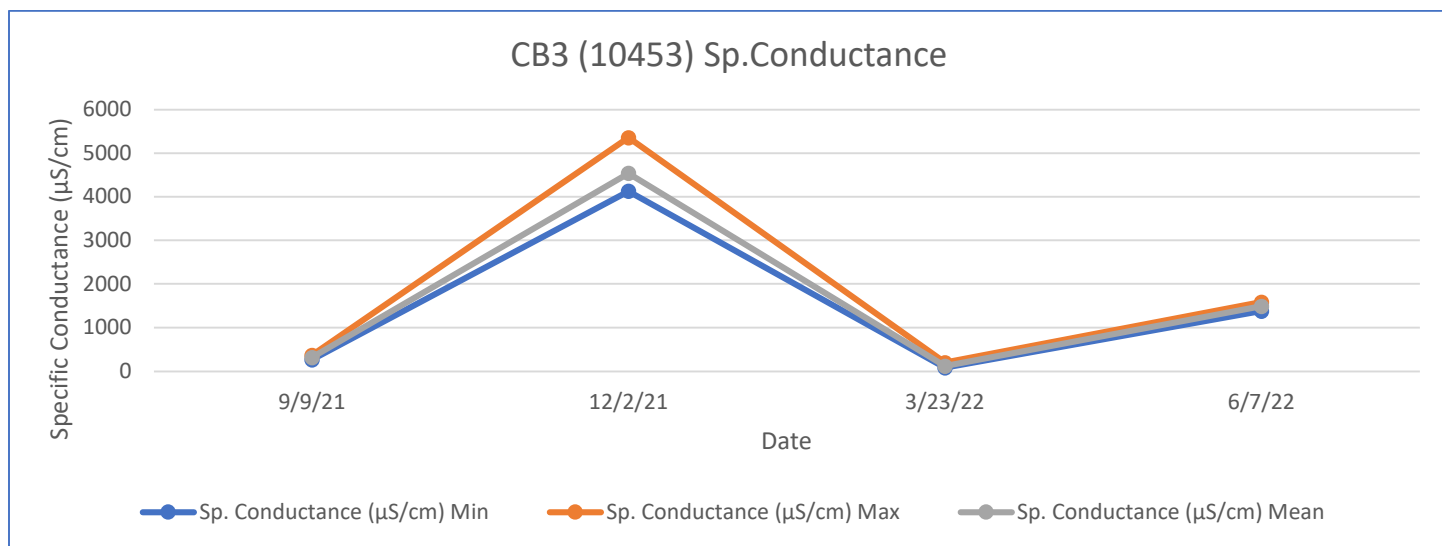


Figure 33. Site CB3 (10453) Specific Conductance over time.

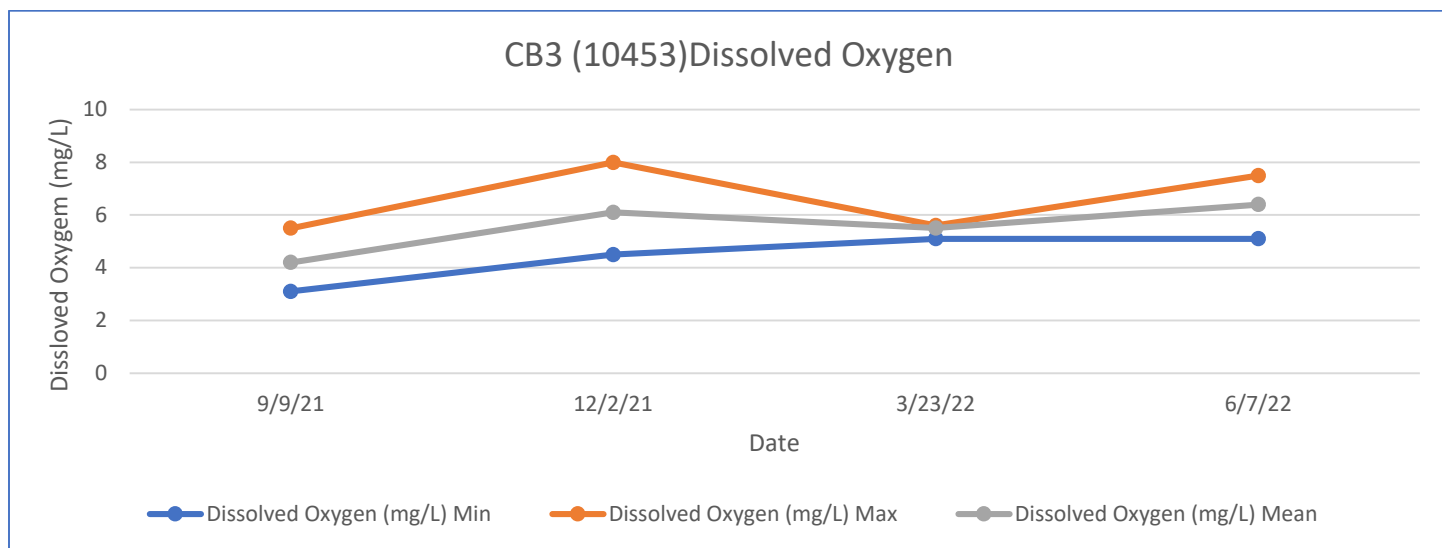


Figure 34. Site CB3 (10453) Dissolved Oxygen over time.

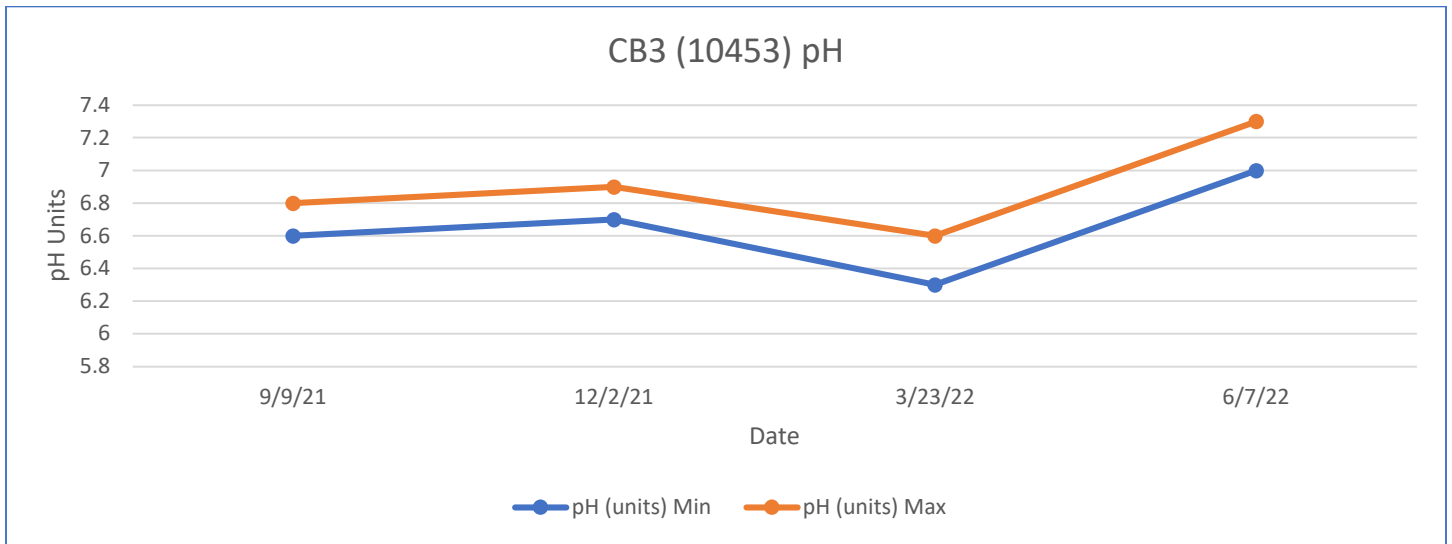


Figure 35. Site CB3 (10453) pH over time.

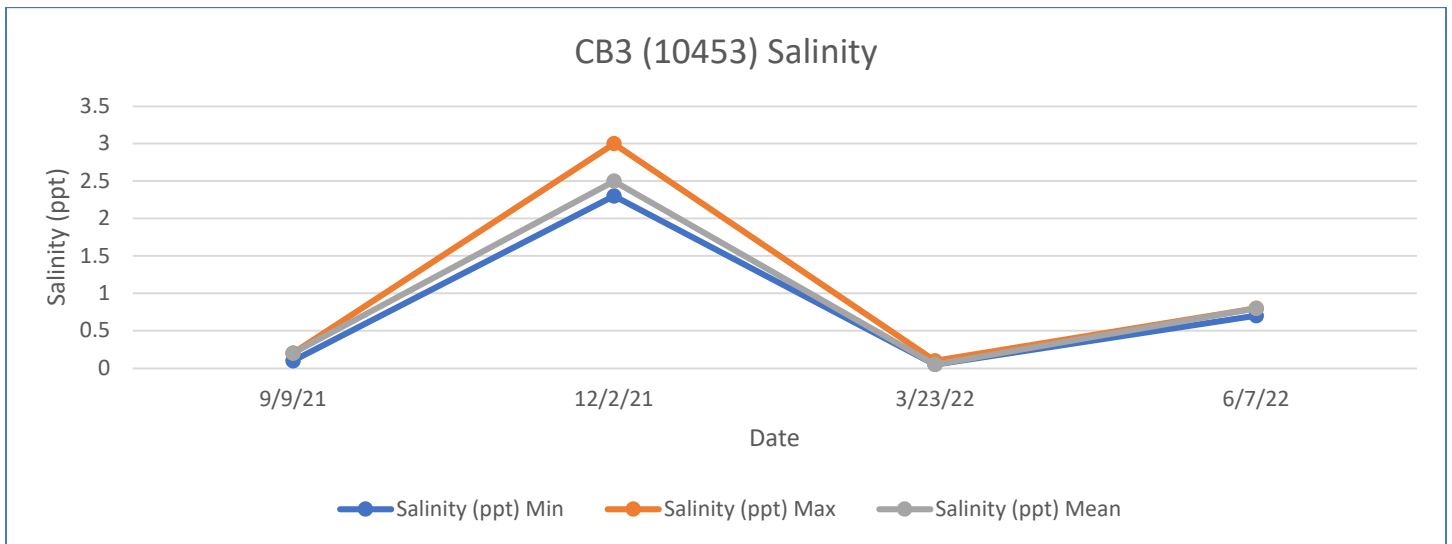
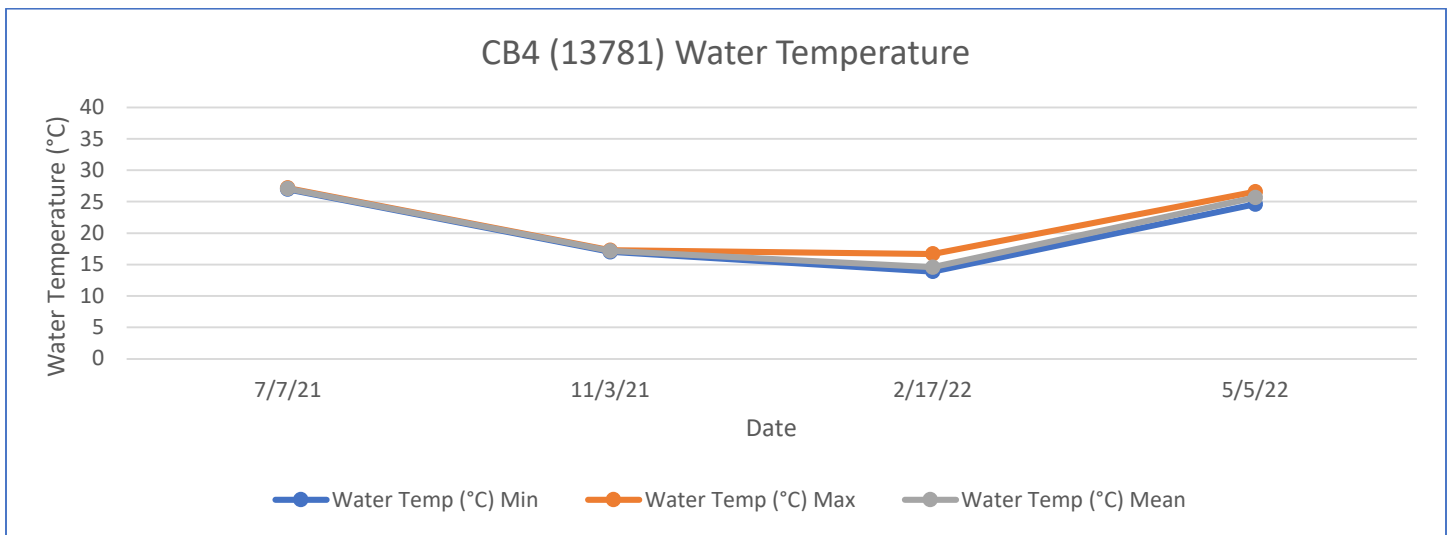


Figure 36. Site CB3 (10453) Salinity over time.

Table 12. Station 13781 (CB4) 24-hour results.

Date	Water temp (°C)			Sp. Conductance (µS/cm)			DO (mg/L)			pH (units)		Salinity (ppt)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
7/7/21	27.0	27.2	27.1	38	45	42	4.7	5.2	4.9	5.7	5.8	<0.1	<0.1	<0.1
11/3/21	17.0	17.3	17.2	33	38	36	7.4	7.5	7.4	5.2	5.3	<0.1	<0.1	<0.1
2/17/22	13.9	16.7	14.6	145	169	155	7.9	8.8	8.2	6.6	6.7	0.1	0.1	0.1
5/5/22	24.6	26.6	25.7	297	307	302	0.9	3.0	2.0	6.4	6.6	0.1	0.2	0.2

*Figure 37. Site CB4 (13781) Water temperature over time.*

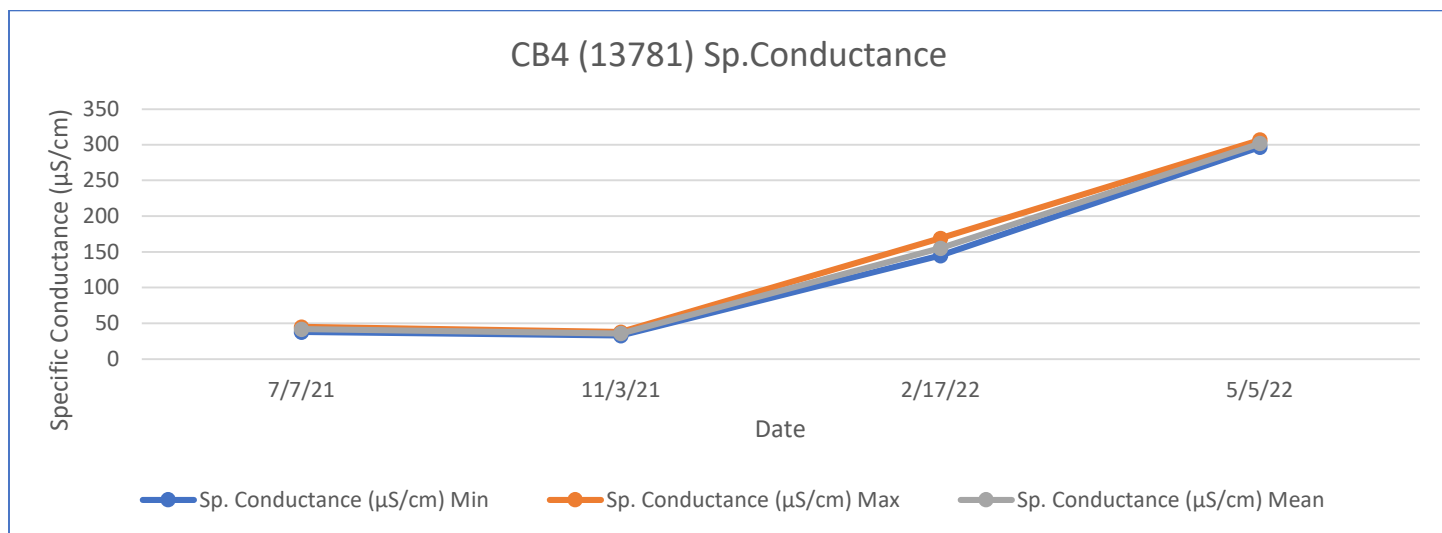


Figure 38. Site CB4 (13781) Specific Conductance over time.

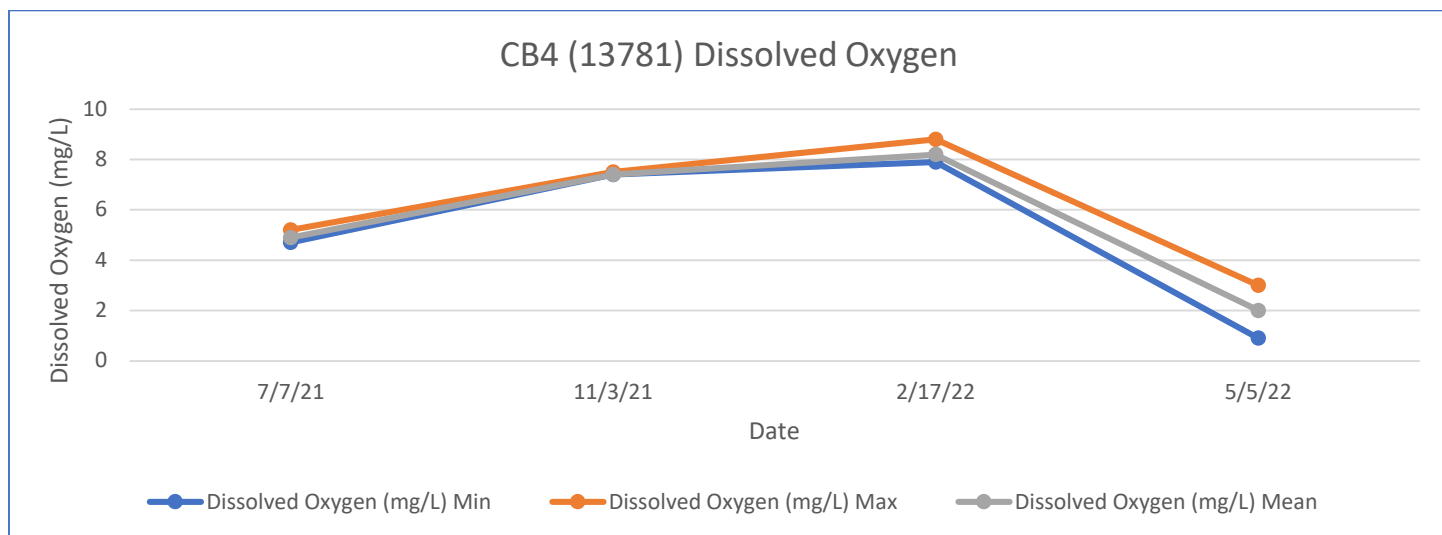


Figure 39. Site CB4 (13781) Dissolved Oxygen over time.

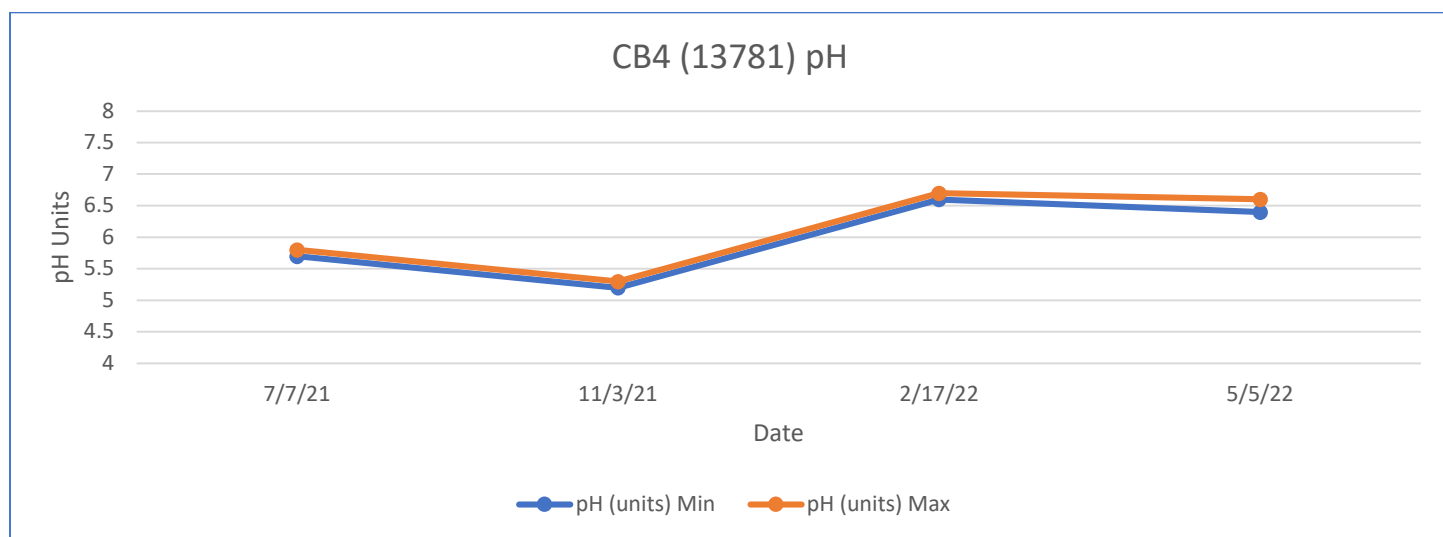


Figure 40. Site CB4 (13781) pH over time.

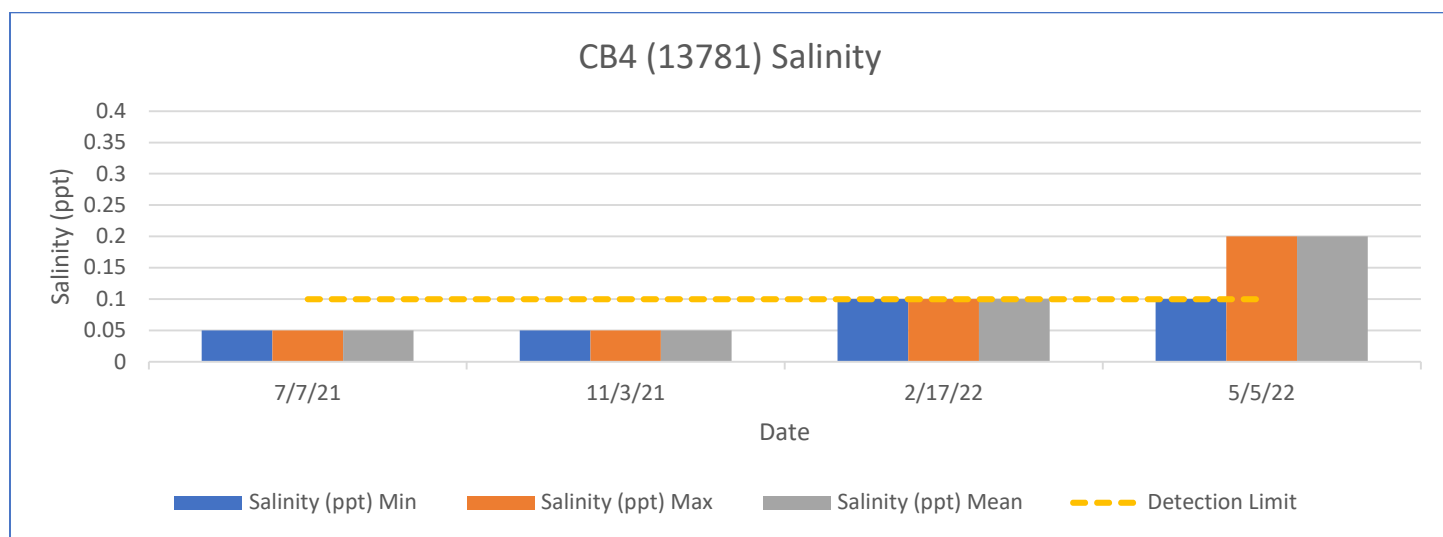
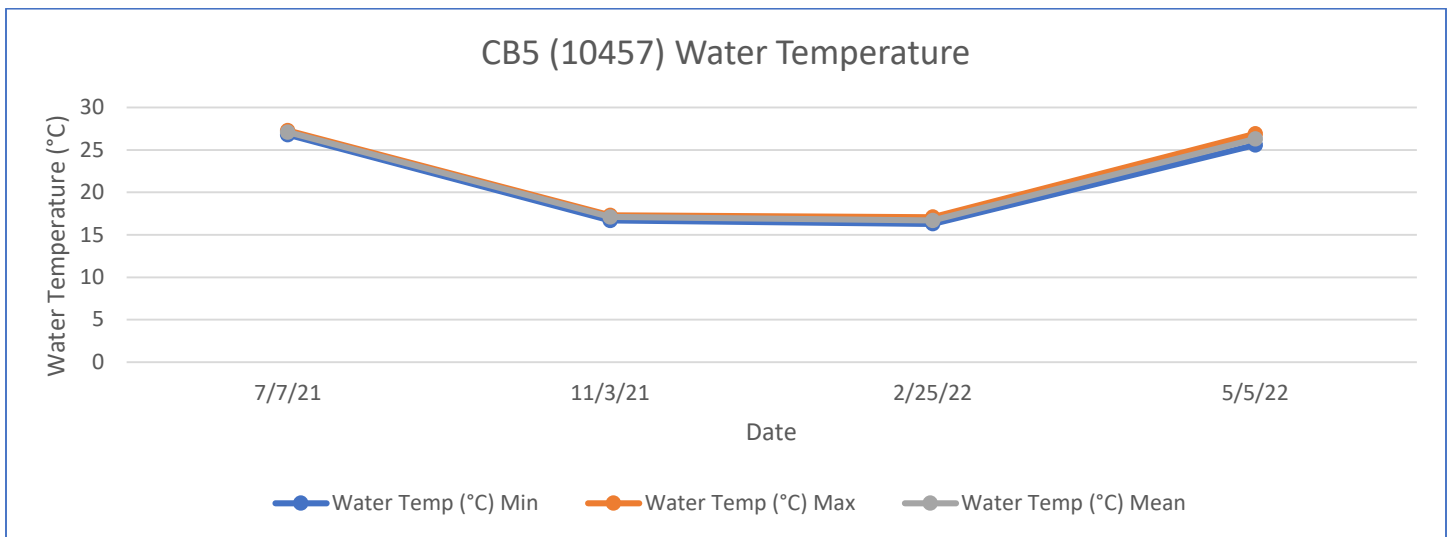


Figure 41. Site CB4 (13781) Salinity over time.

Table 13. Station 10457 (CB5) 24-hour results.

Date	Water temp (°C)			Sp. Conductance (µS/cm)			DO (mg/L)			pH (units)		Salinity (ppt)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
7/7/21	26.8	27.3	27.1	24	28	27	4.9	5.3	5.1	5.4	5.6	<0.1	<0.1	<0.1
11/3/21	16.7	17.3	17.1	36	40	38	7.4	7.6	7.5	5.4	5.6	<0.1	<0.1	<0.1
2/25/22	16.3	17.1	16.7	193	221	209	6.2	6.8	6.4	6.6	6.7	0.1	0.1	0.1
5/5/22	25.6	26.9	26.3	319	343	328	3.3	5.5	4.2	6.8	6.9	0.2	0.2	0.2

*Figure 42. Site CB5 (104567) Water temperature over time.*

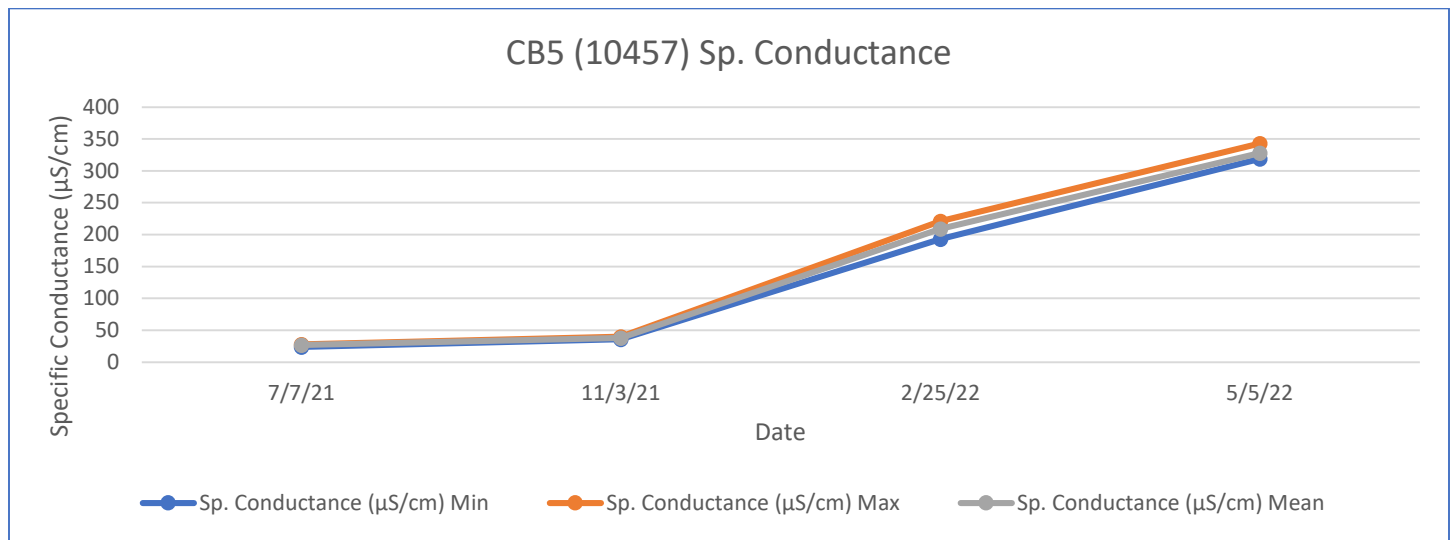


Figure 43. Site CB5 (10457) Specific Conductance over time.

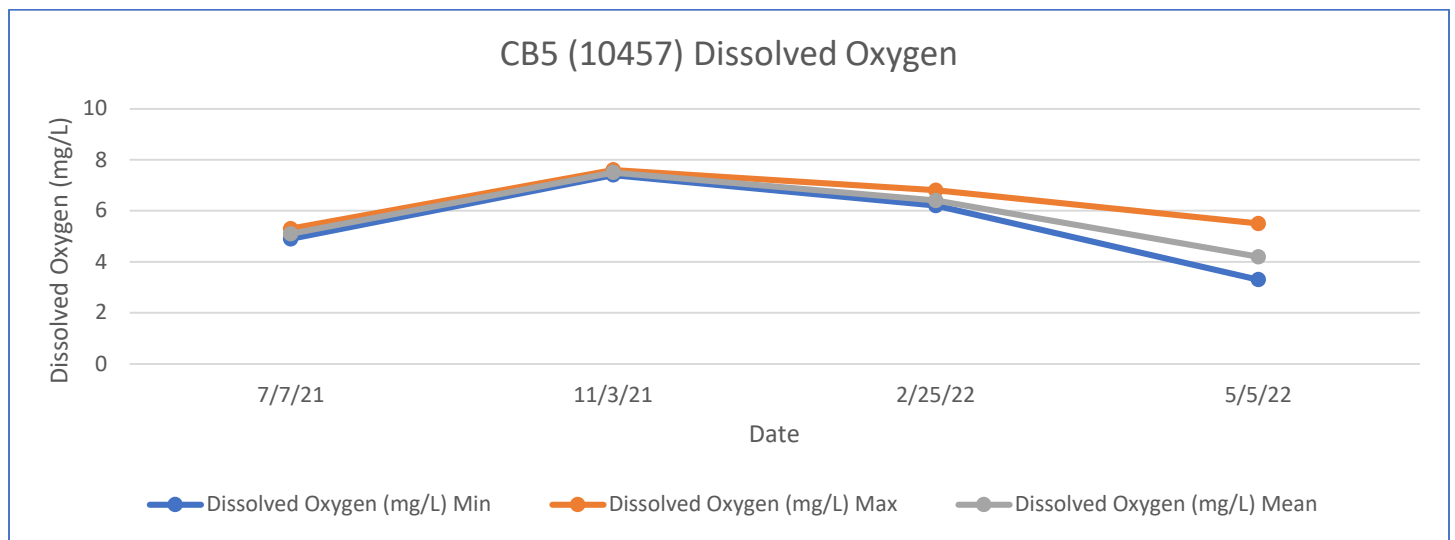


Figure 44. Site CB5 (10457) Dissolved Oxygen over time.

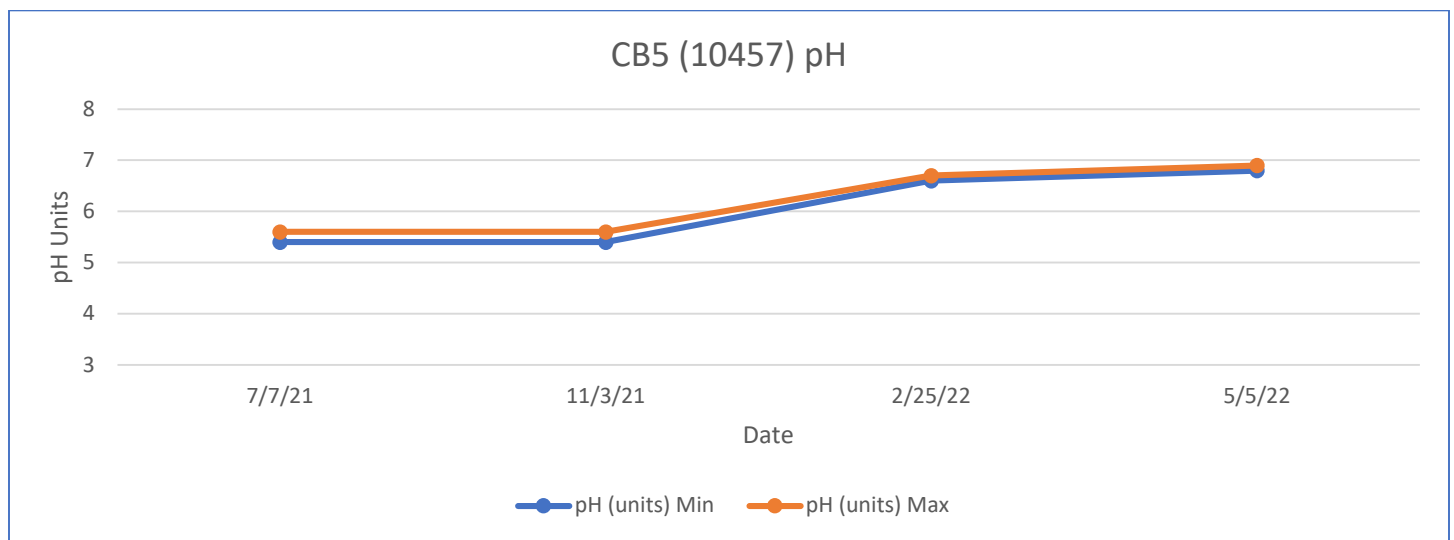


Figure 45. Site CB5 (10457) pH over time.

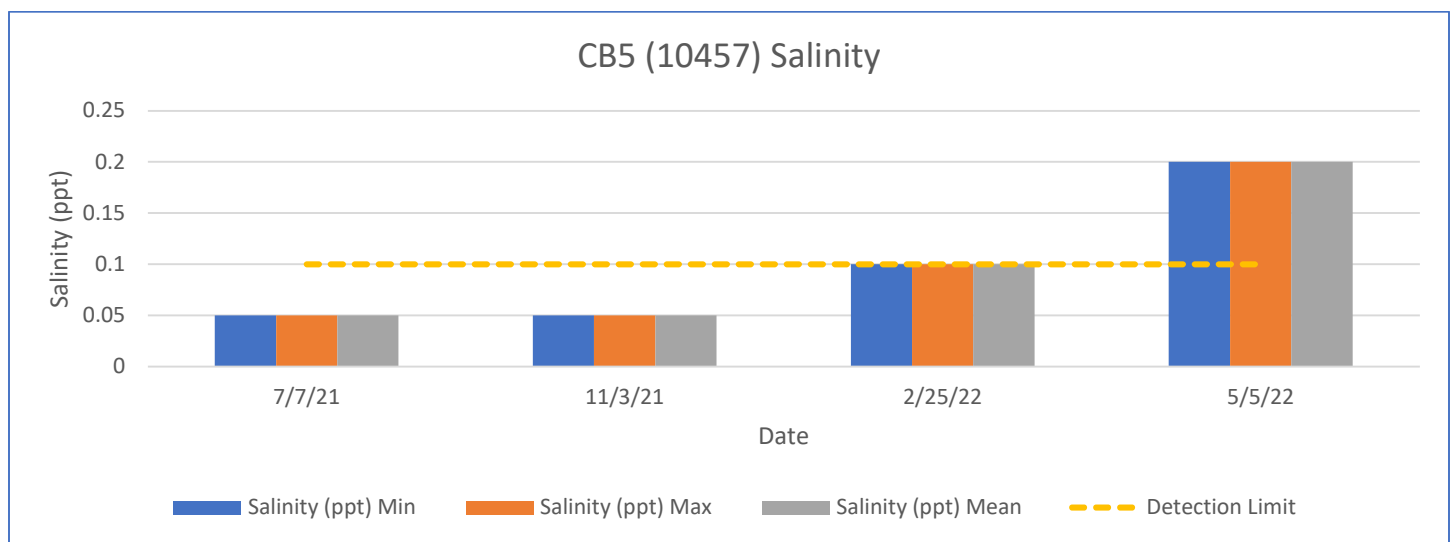


Figure 46. Site CB5 (10457) Salinity over time.

24-Hour Sampling Results

Since sampling began in July 2021, each 24-hour station has had four sampling events. Each of the six sites have had one event during the critical period and at least one sampling in both the index and non-index periods.

Results have been very similar between the minimum, maximum and mean values at most sites. The larger differences in results have occurred for specific conductance and dissolved oxygen.

Tidal Determination

Tidal determination sites within the Adams Bayou watershed.

Station 16049 (GG) – Gum Gully at Haliburton Rd. upstream of the confluence with Adams Bayou.

Station 15107 (AB7) – Adams Bayou at FM 3247 NW of Orange, TX.

Station 14964 (AB8) – Adams Bayou at FM 1078 NW of Orange, TX.

Table 14. Station 16049 (GG) tidal results

Date	Surface Water Temp (°C)	Bottom Water Temp (°C)	Surface Sp. Cond. (µS/cm)	Bottom Sp. Cond. (µS/cm)	Surface Salinity (ppt)	Bottom Salinity (ppt)	% Pool Coverage	Flow Severity
7/15/21	27.8	NA	351	NA	0.2	NA	100	3
8/25/21	29.2	NA	1,190	NA	0.6	NA	100	3
9/23/21	22.0	21.8	763	767	0.4	0.4	100	3
10/14/21	26.0	25.8	303	315	0.2	0.2	100	3
11/9/21	14.2	13.9	1,340	1,340	0.7	0.7	100	3
12/9/21	16.1	16.0	523	531	0.3	0.3	100	3
1/20/22	13.2	13.2	82	82	<0.1	<0.1	100	3
2/23/22	18.6	NA	1,595	NA	0.8	NA	100	2
3/23/22	15.6	NA	203	NA	0.1	NA	100	3
4/6/22	22.3	22.2	1,023	1,027	0.5	0.5	100	3
5/19/22	27.6	27.4	1,700	1,710	0.9	0.9	100	3
6/23/22	30.5	29.0	1206	1221	0.6	0.6	100	3

NA = not applicable



Figure 47. Gum Gully at Halliburton Road.

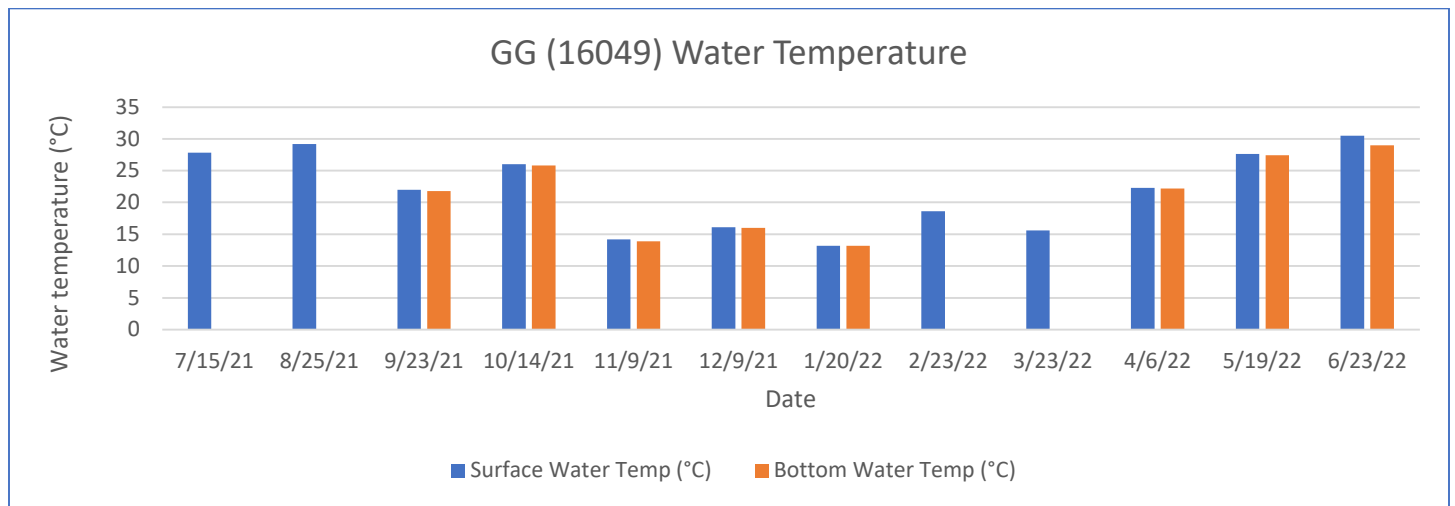


Figure 48. Site GG (16049) Surface and Bottom Water Temperature over time.

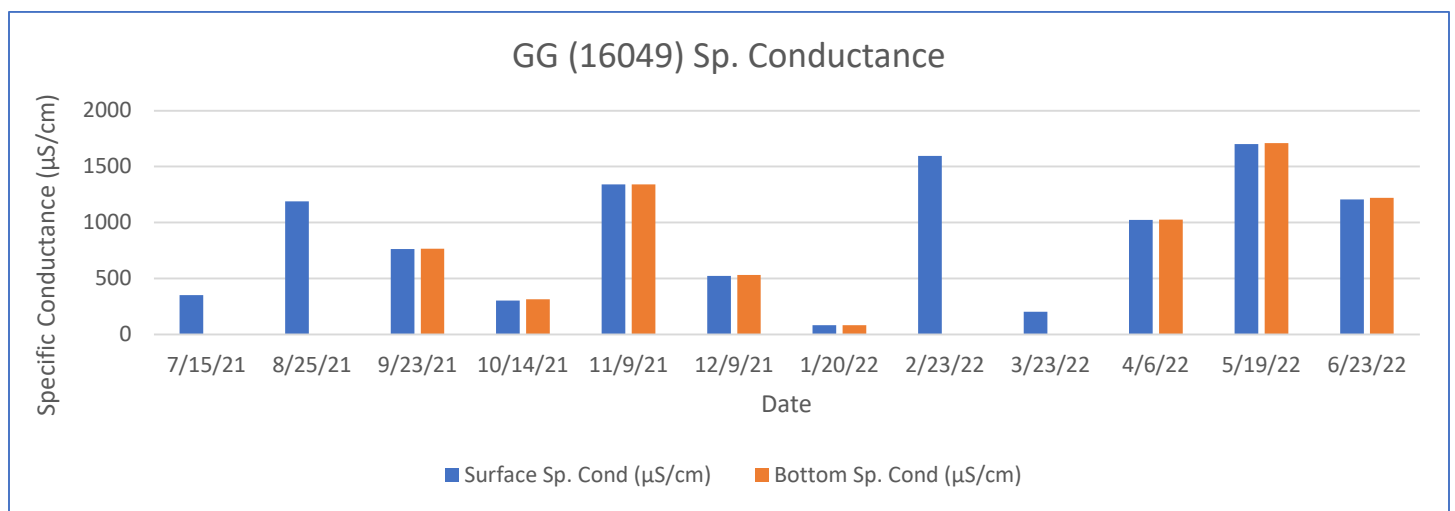


Figure 49. Site GG (16049) Surface and Bottom Specific Conductance over time.

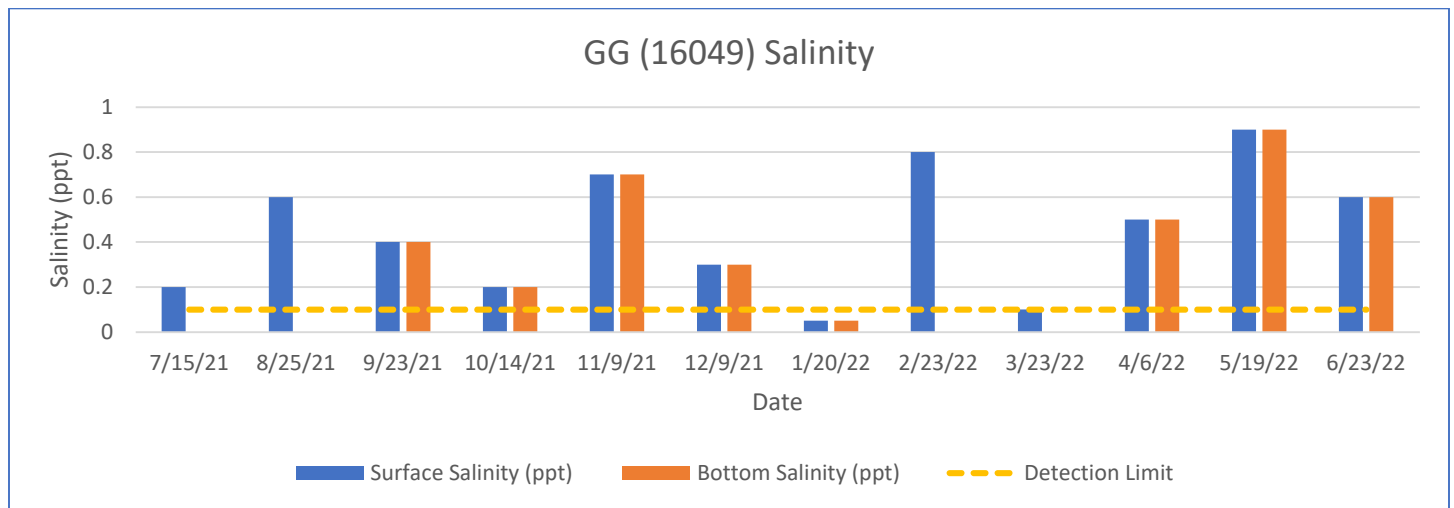


Figure 50. Site GG (16049) Surface and Bottom Salinity over time.

Table 15. Station 15107 (AB7) tidal results

Date	Surface Water Temp (°C)	Bottom Water Temp (°C)	Surface Sp. Cond. (µS/cm)	Bottom Sp. Cond. (µS/cm)	Surface Salinity (ppt)	Bottom Salinity (ppt)	% Pool Coverage	Flow Severity
12/9/21	16.8	16.7	509	508	0.3	0.3	100	3
1/20/22	14.9	15.0	63	64	<0.1	<0.1	100	5
2/23/22	16.9	17.0	617	622	0.3	0.3	100	3
3/23/22	17.1	16.9	125	136	0.1	0.1	100	3
4/6/22	22.0	21.4	349	348	0.2	0.2	100	3
5/19/22	28.6	28.2	717	722	0.4	0.4	100	3
6/23/22	30.2	30.2	483	483	0.2	0.2	100	3

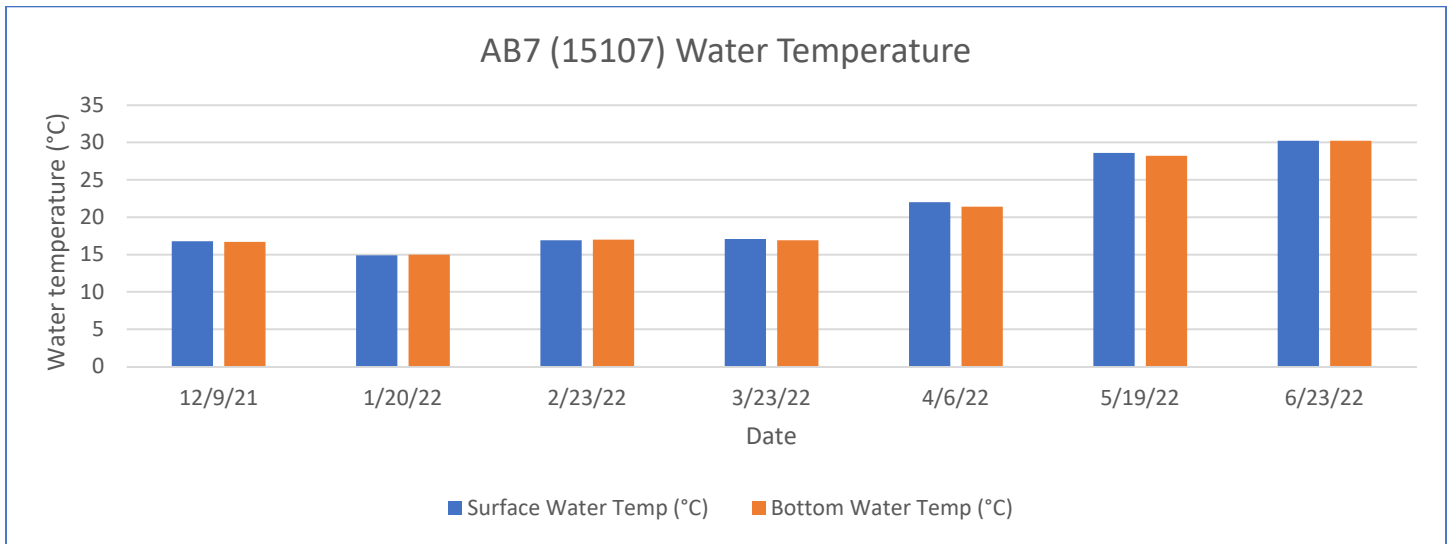


Figure 51. Site AB7 (15107) Surface and Bottom Water temperature over time.

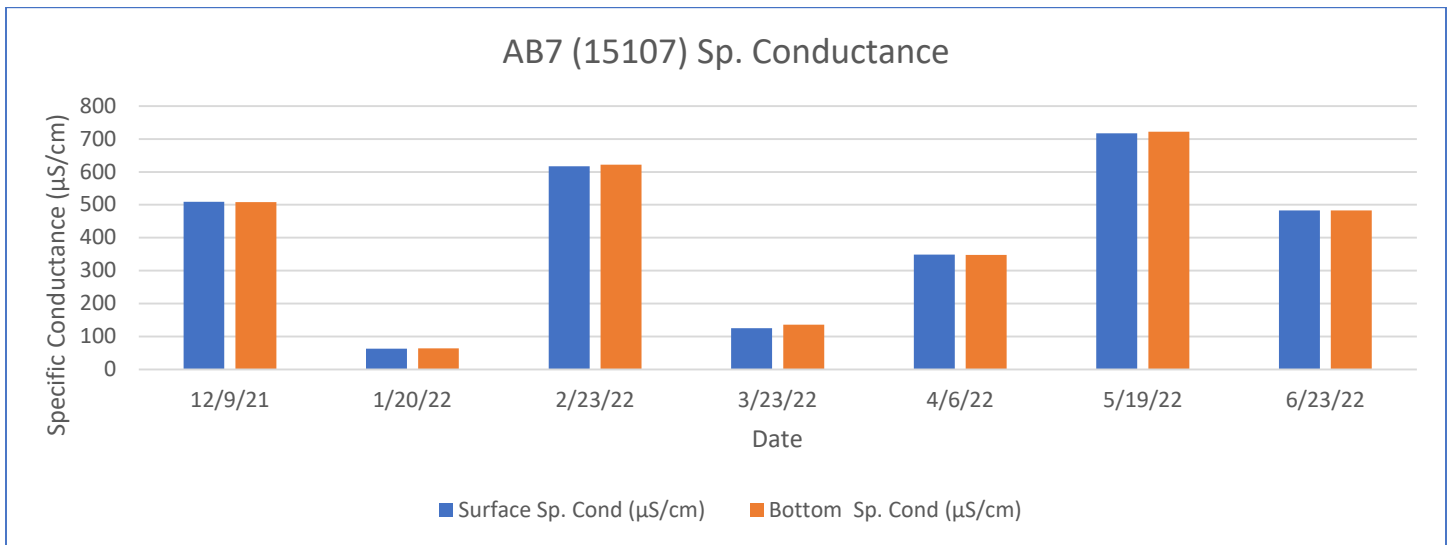


Figure 52. Site AB7 (15107) Surface and Bottom Specific Conductance over time.

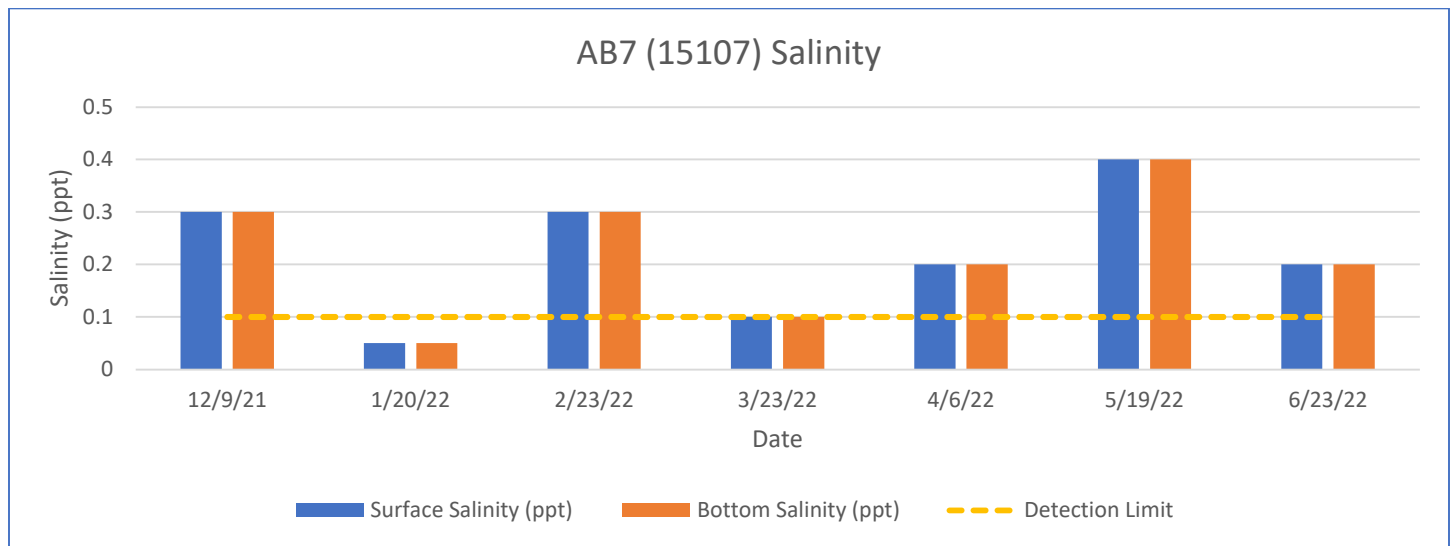


Figure 53. Site AB7 (15107) Surface and Bottom Salinity over time.

Table 16. Station 14964 (AB8) tidal results

Date	Surface Water Temp (°C)	Bottom Water Temp (°C)	Surface Sp. Cond. (µS/cm)	Bottom Sp. Cond. (µS/cm)	Surface Salinity (ppt)	Bottom Salinity (ppt)	% Pool Coverage	Flow Severity
12/9/21	16.3	16.1	179	179	0.1	0.1	100	3
1/20/22	15.2	15.2	56	55	<0.1	<0.1	100	3
2/23/22	16.3	16.3	597	597	0.3	0.3	100	3
3/23/22	16.7	16.7	95	95	<0.1	<0.1	100	3
4/6/22	20.3	20.2	317	317	0.2	0.2	100	3
5/19/22	25.9	25.9	616	616	0.3	0.3	100	3
6/23/22	28.3	28.3	550	550	0.3	0.3	100	3

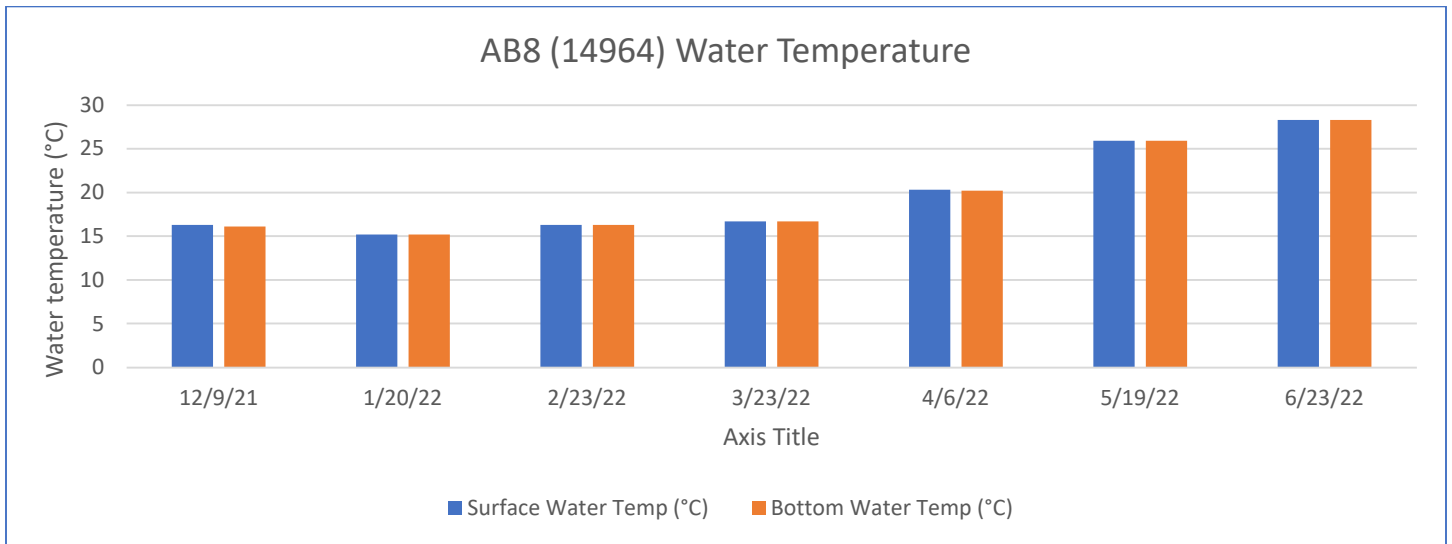


Figure 54. Site AB8 (14964) Surface and Bottom Water Temperature over time.

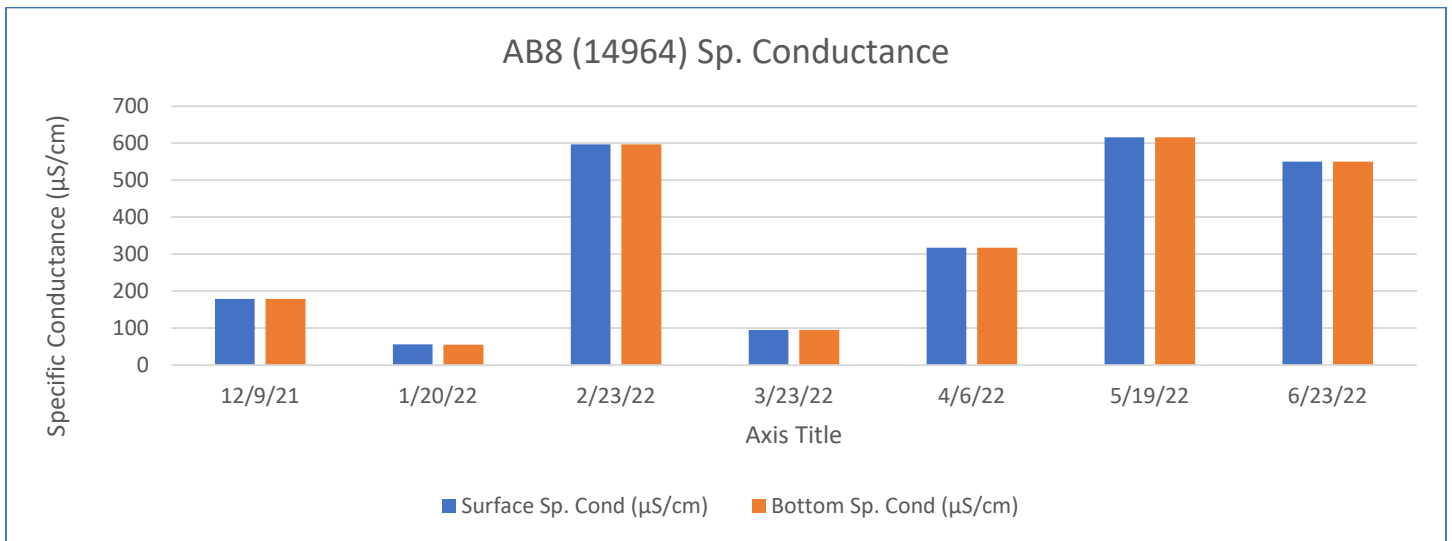


Figure 55. Site AB8 (14964) Surface and Bottom Specific Conductance over time.

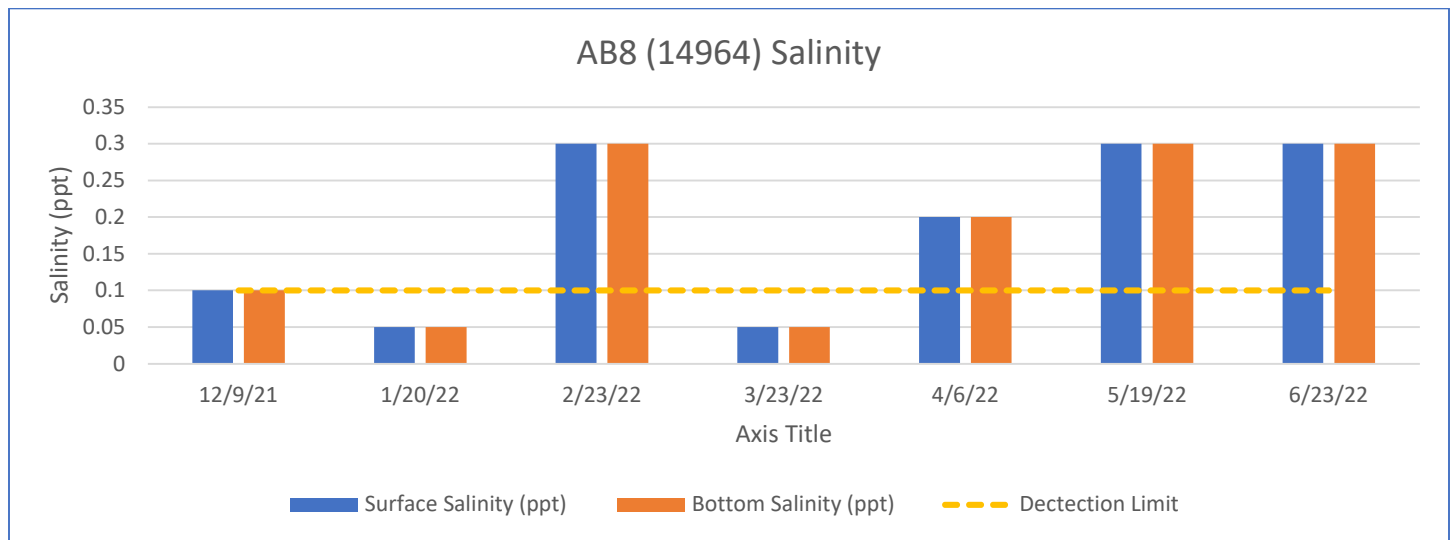


Figure 56. Site AB8 (14964) Surface and Bottom Salinity over time.

Tidal Determination Results

Monthly grab samples for specific conductance, temperature and salinity were taken at two sites in Adams Bayou Above Tidal (0508A_01) and one site in Gum Gully (0508B_01) to determine tidal influence in these areas. Parameters were collected at the surface and bottom at each site.

The recorded surface and bottom values at each site were very similar. All the salinity measurements taken were less than 1.0 ppt. Salinity values of less than the detection limit of 0.1 ppt were recorded once at Site 15107 and twice at Site 14964.

The percent pool coverage was recorded as 100% at all sites for each sampling event.

This component of the project will conclude at the end of August 2022.

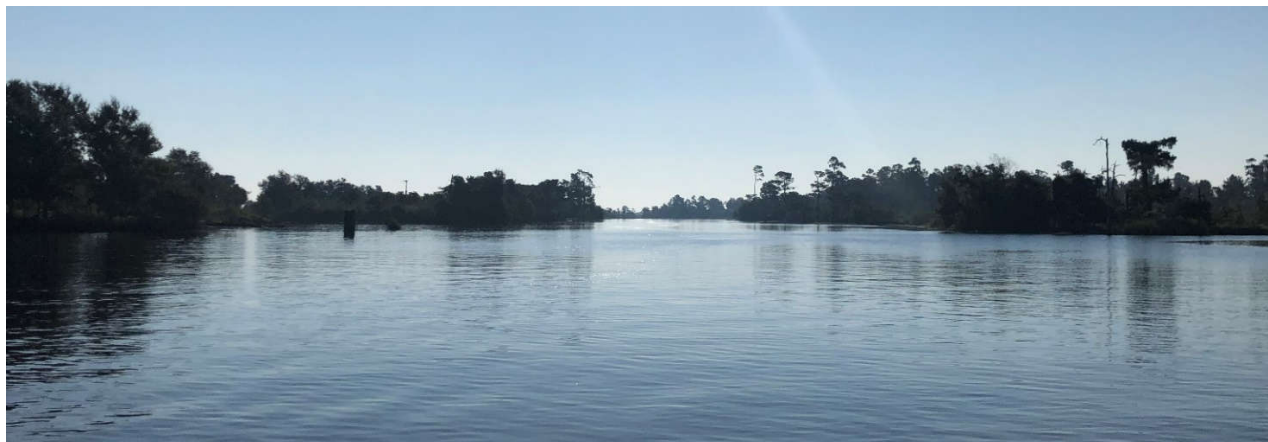


Figure 57. Adams Bayou at FM 1006.