Pensacola Bay Paddling Trail Bacterial Study

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Technical Report to City of Pensacola

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Background

The City of Pensacola maintains 93 parks and open spaces designed to enhance the quality of life of all citizens and visitors of Pensacola. Several of these parks and open spaces are co-located near Pensacola Bay and Bayou Texar. The city is promoting ecotourism and outdoor activities in concert with the ongoing revitalization in the downtown area. This includes the new paddling trail, which when completed will allow the public to paddle from Sanders Beach Community Center along the western city waterfront, past the Port of Pensacola, along Project Green Shores (PGS) Phases I and II, under the new 3-Mile Bridge, and into the protected waters of Bayou Texar (Fig.1). The City of Pensacola owns several parcels of land along the waterfront; however, some parcels are unmarked and others inaccessible because they are overgrown or the interface between land and water has been hardened with riprap.

Figure 1. Early rendition (2018) of the proposed Pensacola Blue-way Paddling Trail.

Water quality along portions of older city waterfronts is often impaired from stormwater runoff, including nutrients, trash, and other pollutants. A multiyear study in the Pensacola Bay urban bayous (Grande, Chico, and Texar) revealed high levels of fecal contamination (Snyder 2006). At some locations, high concentrations occurred following rainfall events. Runoff from stormwater, septic, groundwater and from areas with older sewer lines were implicated as the major sources rather than from industrial or commercial marinas (Snyder 2006). Recently, water quality, specifically pathogens, has become a concern for community members after the City of Pensacola decided to develop the city parcel known as Bruce Beach into a recreational, water access park.

Enterococcus has been used by the Florida Department of Health as an indicator of the presence of fecal matter in water. While it is not a perfect predictor of disease occurrence such as gastro-enteritis or skin rashes (Hellein et al. 2011, Harwood et al. 2013), some studies have shown higher incidence of these conditions when *Enterococcus* levels are high (Byappanahalli et al 2015, González-Fernández et al 2021). The "Beach Action Value" (BAV) of 70 MPN/100 mL is used by the Florida Department of Health to determine whether beaches should be posted with warning signs about contact with the water. Routine beach water quality monitoring occurs biweekly between March and October at Sanders Beach, a site each in Bayous Chico and Texar. Bruce Beach sampling was also begun in 2021. However, other sites along the proposed paddling trail have not been monitored.

Based on sampling at Bruce Beach between February and June 2021, the City of Pensacola felt it was beneficial to expand the study to identify the potential sources of *Enterococcus* to sites along the proposed paddling trail. The City provided additional funding to examine *Enterococcus* levels at potential landing sites and near stormwater outfalls along Pensacola Bay.

Study Design and Methods

UWF began sampling 10-13 waterfront sites on November 17, 2021 through April 27, 2022. Hurricanes Sally (2020) and Ida (2021) closed several city-owned parcels (access points) that were sometimes inaccessible due to on-going construction activities. This report also includes a detail analysis of all data collected for Bruce Beach study (Feb 2021 to August 2021) and Bruce Beach samples collected during the Stormwater Study (August 2021 to February 2022) as reported in Albrecht et al. (2021). We also describe whether potential access points along the paddling trail are accessible from the water in Appendix 1.

Thirteen sampling sites were selected based on the following criteria: 1) launch ability (parking, waterfront access, safely launching vessel); 2) inland conveyances such as stormwater outfalls which may be contributing to the overall health of the water; and 3) access by recreational user groups to return to shore in case difficulties are encountered (e.g. Pop-up storms, currents, etc.).

At each site, water quality parameters were measured with a YSI Professional Plus multiparameter instrument. Grab water samples were collected for lab analysis of *Enterococcus*

bacteria. *Enterococcus* analyses were conducted using the Enterolert (QT) method. Analysis of samples began less than 6 h after collection in a NELAC certified laboratory: Wetlands Research Laboratory, University of West Florida (State of Florida Certification # E71969). The lower limit of detection was 10 MPN/100 mL. Samples with values greater than 24,196 MPN/100 mL could not be quantified with accuracy.

Grab water samples were collected at the three Bruce Beach locations (Washerwoman Creek, Sandy Shoreline and Mitigation Wetland) and analyzed for chlorophyll a, nitrate+nitrite (NO_3^-), nitrite (NO_2^-), ammonium (NH_4^+), and dissolved inorganic phosphate (DIP). Water samples were filtered through GF/F filters and the filter was extracted with 90% acetone for chlorophyll a and read on a fluorometer as in Welshmeyer (1994). Filtrate was analyzed for nitrate+nitrite as in Schnetger and Lehners (2014), ammonium as in Holmes et al. (1999) and nitrite and DIP as in Parsons et al. (1984).

Rainfall data were downloaded from the National Weather Service site at Pensacola Airport (NOAA 2022). Geometric means of *Enterococcus* were calculated so that results could be compared with Snyder (2006). Correlation analysis of *Enterococcus* with water quality parameters was done using R and the *ggally* package. Regression analysis of *Enterococcus* with 48-hour precipitation at each site was conducted as in Snyder (2006).

Results

Rainfall events were generally more numerous and higher between March 2021 and October 2021 than during the latter part of the study (Fig 3). Between February 2021 and October 2021, there were 45 events with rainfall greater than 0.5 inches, while there were only 12 events of that magnitude between November 2021 and April 2022. Hurricane Ida on August 30, 2021, as well as other events in September and early October resulted in high rainfall, often more than 3 inches.

Enterococcus levels at the sampling sites were higher following rain events than during dry period, with the highest values following rain events greater than 1 inch (Table 1). These dates also had more sites exceeding the BAV of 70 MPN/100 mL. Five sites had consistently high *Enterococcus* values and exceeded the BAV most of the times samples (Table 2). They were Sanders Beach Outfall at I Street, Joe Patti's Outfall at A Street, Spring Street Outfall, Bartram Park, and Upper Bayou Texar at the 12th Avenue Bridge. Geometric means at these locations exceeded 130 MPN/100 mL, with Sanders Beach Outfall at I Street having the highest value 344 MPN/100 mL). Over half the samples collected from Washerwoman Creek (29 out of 50) were above the BAV. Sites with consistently low values were Maritime Park, Palafox Pier and the three sites in lower Bayou Texar: Boat Launch at Oyster Barn, East Pensacola Heights, and Bayview Park.

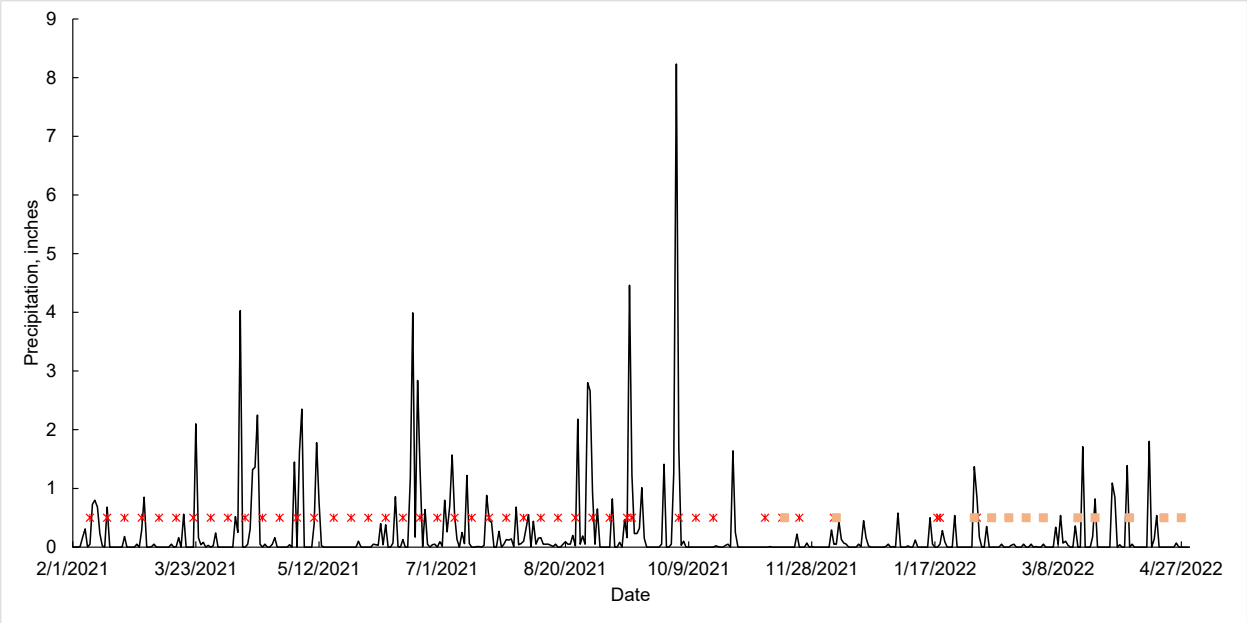

Figure 3 – Daily rainfall at Pensacola Airport between February 2021 and April 2022 (NOAA 2022). Red x indicates sampling date of Bruce Beach samples, orange square indicates date of Paddling trail samples.

The effects of rain events on *Enterococcus* levels were examined in several ways. When samples were separated into categories with and without rain, *Enterococcus* levels were higher following rain events at all sites except Palafox Pier and Mahogany Mill (Fig. 4). These differences were most obvious at three sites in lower Bayou Texar, which also had consistently low values during dry periods. To examine whether the amount of rain affected *Enterococcus* levels, 48-hour precipitation amount versus the log of *Enterococcus* was plotted (Fig. 5). Several sites in Bayou Texar and all 3 sites at Bruce Beach showed a consistent increase in *Enterococcus* with increased precipitation. There was no relationship at the Mahogany Mill site in Bayou Chico, similar to Snyder (2006). Sites along the Pensacola Bay waterfront varied in their response to precipitation amounts. A regression analysis of 48-hour precipitation amount versus the log of *Enterococcus* for each site revealed that the slopes were significant at $p = 0.05$ level for 9 sites and significant at $p = 0.1$ level for 3 sites (Table 3). Sites with the greatest slopes were Joe Patti's Outfall at A street, Spring Street Outfall, and Upper Bayou Texar at 12th Avenue Bridge which had slopes greater than 1. These slopes were higher than those reported in Snyder (2006), which had a longer study period and included rain events up to 2 inches.

Table 1 - Sampling dates for Paddling trail study. Rainfall in inches in 48 hours preceding sampling. Geometric mean of Enterococcus samples. Number of stations with Enterococcus samples less than 70 MPN/100 mL. Number of stations with Enterococcus samples greater than 70 MPN/100 mL.

Date sampled	48 h rainfall, inches	Geometric mean	Stations < 70 MPN/100 mL	Stations > 70 MPN/100 mL
17 Nov 2021	0.04	31	8	4
8 Dec 2021	0.32	169	3	10
19-Jan-22	0	50	8	3
2-Feb-22	0.15	84	6	8
9-Feb-22	0.36	93	6	6
16-Feb-22	0	30	13	3
23-Feb-22	0.01	27	14	2
2-Mar-22	0	42	10	4
16-Mar-22	0	45	10	7
23-Mar-22	1.02	591	1	14
6-Apr-22	1.41	232	4	12
20-Apr-22	0.01	81	7	8
27-Apr-22	0.08	30	12	4

Table 2 – Sites sampled for Paddling trail study from Nov 17, 2021 to April 27, 2022. Bruce Beach sites from Feb 8, 2021 to April 27, 2022 are included. Number of times each site was sampled. *Enterococcus* geometric mean, minimum value, maximum value, number of times that site was less than 70 MPN/100 mL and greater than 70 MPN/100 mL at each site is reported.

Site	Count	Geometric mean	Min	Max	<70 MPN/ 100 mL	>70 MPN/ 100 mL
Mahogany Mill	13	67	20	323	8	5
Sanders Beach Boat Launch	13	50	10	3448	8	5
Sanders Beach Outfall ('I' Street)	12	344	10	5794	2	10
Joe Patti's Outfall ('A' Street)	13	281	10	9804	3	10
Maritime Park (West Side Bulkhead)	13	18	10	249	11	2
Spring Steet Outfall	13	210	20	3654	4	9
Palafox Pier	8	21	10	272	7	1
Bartram Park	13	194	41	1565	2	11
Mouth of Bayou Texar (Trestle)	13	77	20	420	8	5
Boat Launch (Oyster Barn)	10	33	10	183	7	3
East Pensacola Heights (across from Bayview Park)	9	35	10	420	7	2
Bayview Park	13	36	10	275	10	3
Upper Bayou Texar (12th Ave Bridge)	12	134	20	3448	4	8
Bruce Beach						
Bruce Beach - Washerwoman Creek	50	112	10	24196	21	29
Bruce Beach - Sandy Shoreline	50	59	10	9208	30	20
Bruce Beach - Mitigated Wetland	50	59	10	4160	29	21

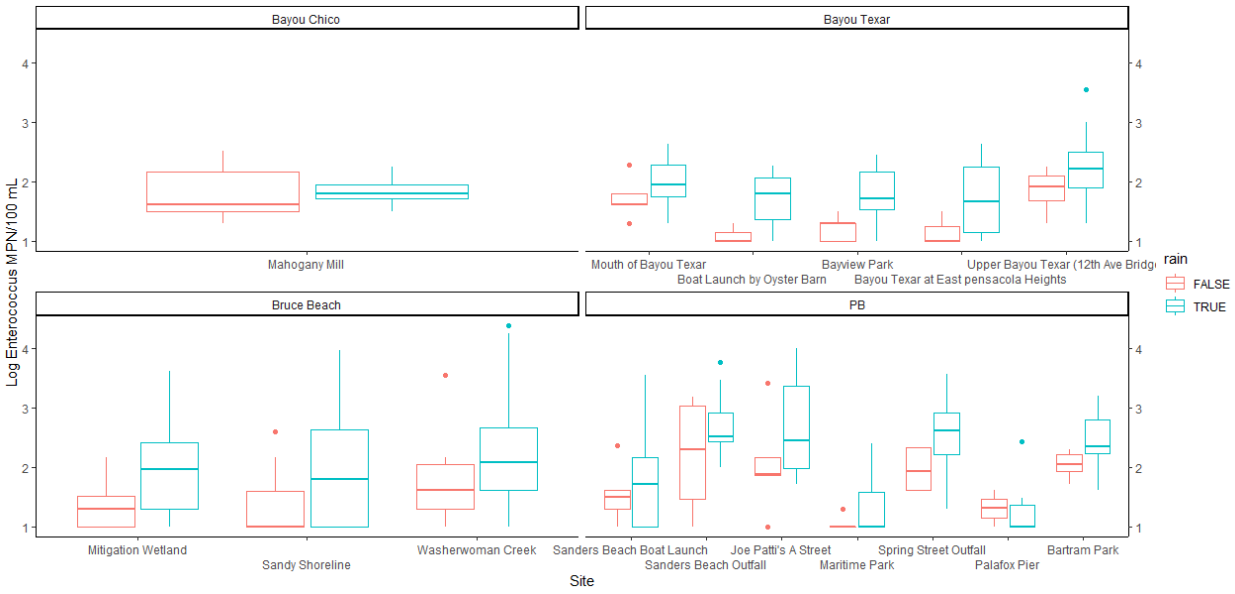

Figure 4 – Box plot of the log *Enterococcus* levels at each site in Bayou Chico, Bayou Texar, Bruce Beach, and Pensacola Bay (PB). Red boxes indicate samples collected when there was no rain in the previous 48 hours and blue boxes indication samples collected following rain events. Line indicates median, lower and upper bounds of box are 25th and 75th percentiles, lower and upper whiskers are 1.5*interquartile range, dots indicate individual values outside whiskers.

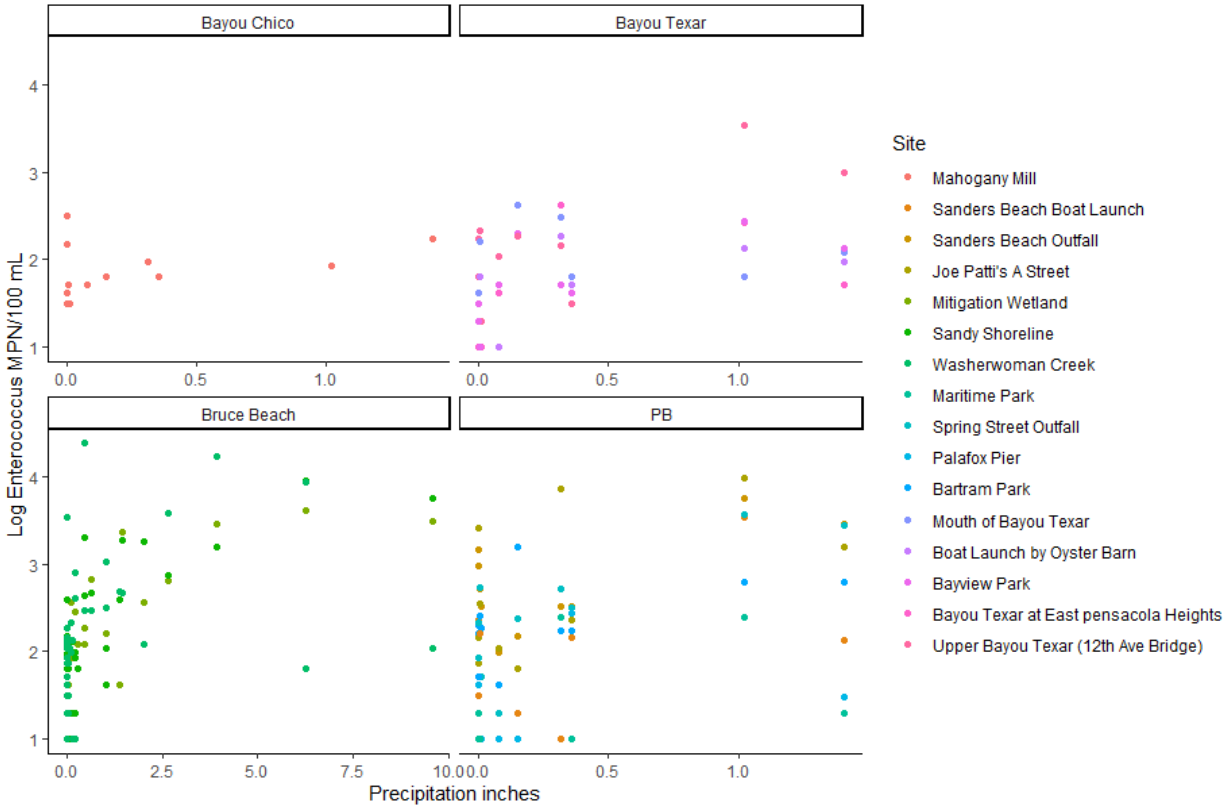

Figure 5 – Scatterplot of precipitation versus log *Enterococcus* at each site in Bayou Chico, Bayou Texar, Bruce Beach and Pensacola Bay (PB) sites.

Table 3 – Regression statistics of log *Enterococcus* versus precipitation for sampling sites. Values with significant slopes in boldface.

Site	R^2	Slope	p value	Intercept	p value	geomean at 0 rain
Mahogany Mill	0.13	0.24	0.26	1.80	8.58E-09	63.8
Sanders Beach Boat Launch	0.31	0.93	0.06	1.47	8.05E-05	29.7
Sanders Beach Outfall	**0.43**	**0.88**	**0.03**	2.41	3.83E-07	256.6
Joe Patti's A Street	**0.34**	**1.17**	**0.05**	2.17	1.15E-05	148.1
Mitigation Wetland	**0.47**	**0.30**	**0.00**	1.57	7.23E-24	37.2
Sandy Shoreline	**0.48**	**0.34**	**0.00**	1.54	1.59E-21	35.0
Washerwoman Creek	**0.13**	**0.15**	**0.01**	1.97	1.13E-20	94.2
Maritime Park	0.25	0.57	0.10	1.12	4.75E-05	13.3
Spring Street Outfall	**0.63**	**1.18**	**0.00**	2.05	8.45E-08	113.2
Palafox Pier	0.05	0.24	0.64	1.28	5.07E-03	19.2
Bartram Park	0.27	0.52	0.08	2.16	2.34E-08	146.2
Mouth of Bayou Texar	0.06	0.23	0.43	1.79	2.44E-07	61.5
Boat Launch by Oyster Barn	**0.44**	**0.69**	**0.04**	1.30	3.19E-05	19.9
Bayview Park	**0.50**	**0.73**	**0.01**	1.40	3.70E-07	25.4
Bayou Texar at East Pensacola Heights	0.32	0.69	0.14	1.30	2.26E-03	20.0
Upper Bayou Texar (12th Ave Bridge)	**0.56**	**1.08**	**0.01**	1.81	2.72E-06	64.1

Mixing of freshwater runoff with water from Pensacola Bay generally led to lower *Enterococcus* values. Salinity and the log of *Enterococcus* were negatively correlated ($r = -0.25$, $p<0.001$). This relationship was most obvious in the sites collected along the Pensacola Bay waterfront (Fig. 6). There was no relationship between *Enterococcus* and salinity in Bayou Chico. In the mid reaches of Bayou Texar, *Enterococcus* levels were often highest at salinities between 8-12, particularly following rain events (Fig. 6). Snyder (2006) suggested that precipitation greater than 1.5 inches in 48 hours may dilute fecal contaminants at some sites. Since most of the rain events during the Paddling trail study (November 2021-April 222) were less than 1.5 inches, this pattern could not be observed. In the longer time series from Bruce Beach which had higher rain events up to 10 inches, this may have occurred at Washerwoman Creek where a few *Enterococcus* levels were relatively low despite high precipitation (Fig. 7). In contrast, the highest *Enterococcus* values at the Bruce Beach Sandy Shoreline and Mitigation Wetland occurred during both high precipitation and low salinity (Fig. 7).

Temperature is another environmental factor that may influence *Enterococcus* and they were positively correlated ($r = 0.24$, $p<0.001$). At the Bruce Beach sites, this relationship was stronger

(r = 0.31, p<0.001). *Enterococcus* levels at Bruce Beach locations were positively correlated with chlorophyll a concentration (r=0.19, p<0.05), although this was a weak relationship. *Enterococcus* was not correlated with any of the nutrients (data not shown). Chlorophyll a concentration at Washerwoman Creek averaged 6.5 µg/L, higher than the Bruce Beach sites on Pensacola Bay (Appendix 2). Nitrate+nitrite, ammonium, and dissolved inorganic phosphate were about 3 times higher in Washerwoman Creek than the two sites on Pensacola Bay (Appendix 2).

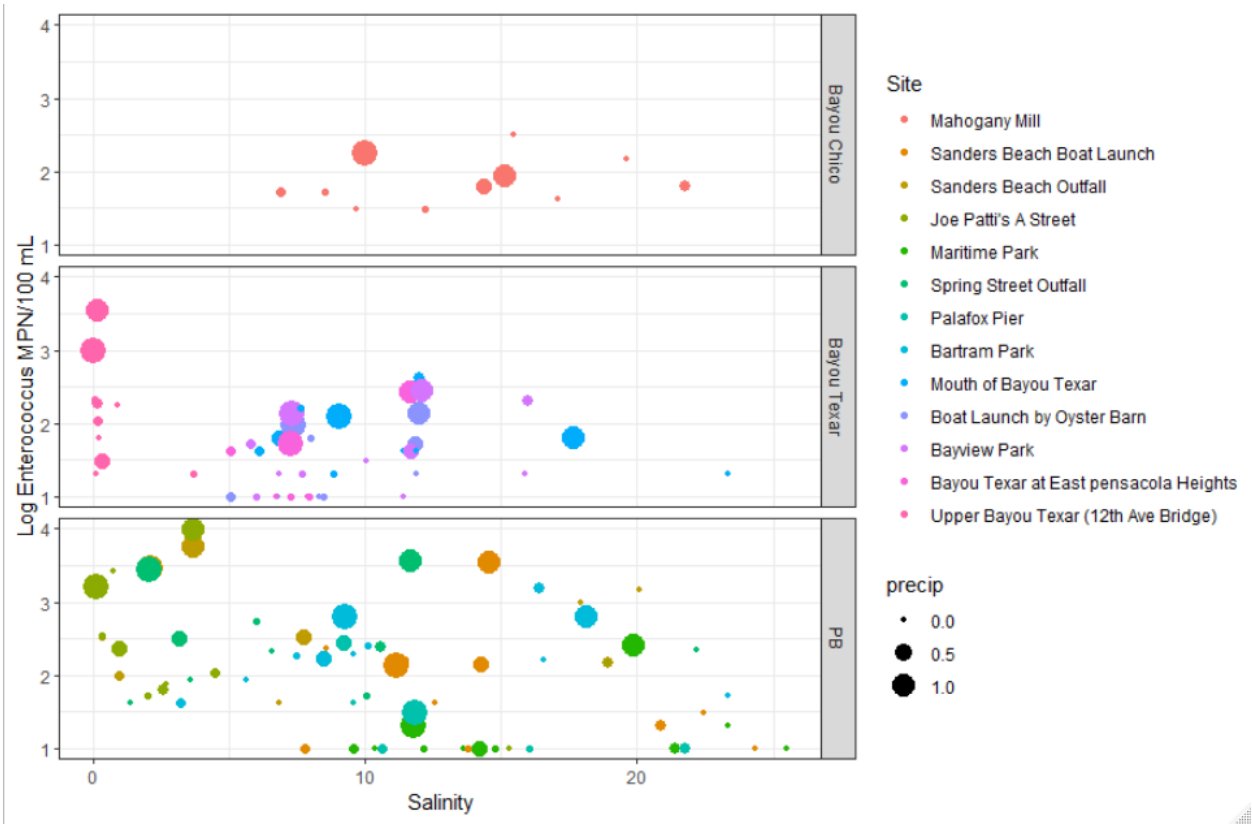

Figure 6 – Scatterplot of salinity versus log *Enterococcus* at each site in Bayou Chico, Bayou Texar, Pensacola Bay (PB) sites. Size of dots is proportional to amount of precipitation in 48 hours before sampling.

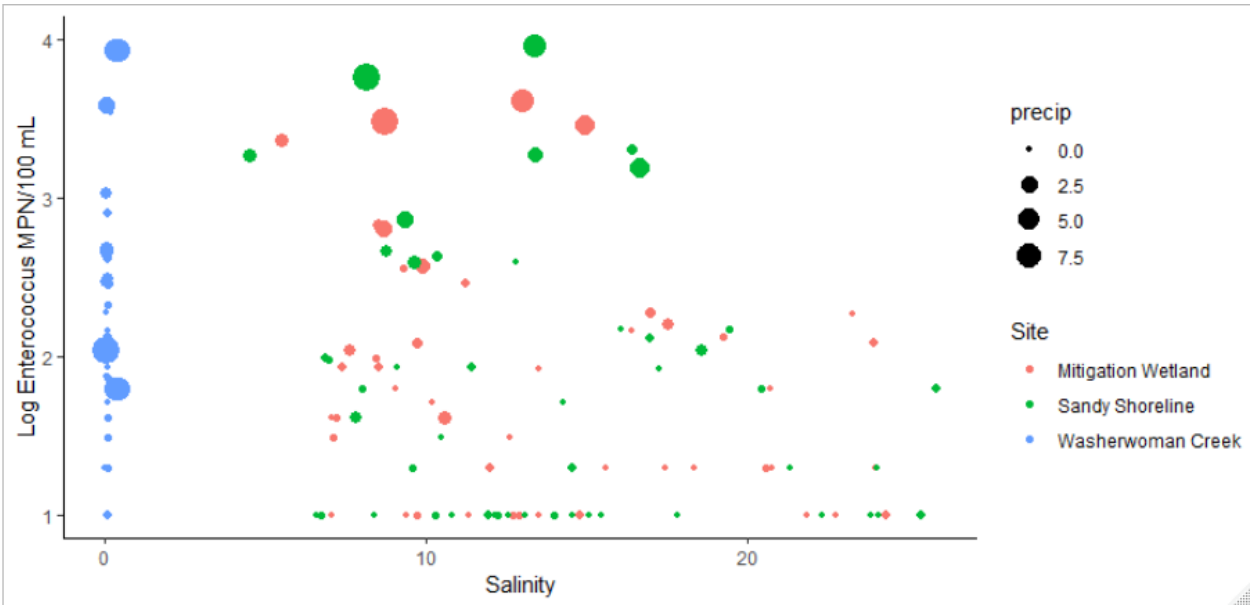

Figure 7 – Scatterplot of salinity versus log *Enterococcus* at each site in Bruce Beach. Size of dots is proportional to amount of precipitation in 48 hours before sampling. Note change in precipitation scale from Figure 6.

Conclusions

The results from this study are very similar to Snyder (2006) which found high bacterial levels in the urban bayous associated with residential areas. Snyder (2006) observed the highest levels in areas served with septic systems and where infrastructure is old. The magnitude of *Enterococcus* from this study and Snyder (2006) were also similar. Four of the Paddling trail stations were the same as the Snyder data collected between 1999-2003. They are Mahogany Mill, East Pensacola Heights, Bayview Park and Upper Bayou Texar (12th Ave Bridge). The geomeans from both studies were similar at three of the sites. At Upper Bayou Texar (12th Ave Bridge), our value was lower (134) compared to the 283 reported in Snyder (2006). There was more variation between the two studies in the maximum values, although they were the same order of magnitude.

Values from sites near stormwater outfalls was consistent with our study of stormwater drains in downtown showing significant bacterial contamination in the downtown Pensacola stormwater system (Albrecht et al. 2022). Well flushed locations along the Pensacola Bay such as the Maritime Park and Palafox Pier had lower levels of *Enterococcus* than poorly flushed areas such as Bartram Park and the Spring Street Outfall.

Recommendations

- Posting and public outreach at Paddling trail put-in locations
- Continued testing between ECUA and City of Pensacola for leakage between sewer and stormwater systems

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Appendix 1 – Detailed description of characteristics of sampling sites

Figure 1. Final Pensacola Blue-way Paddling Trail route

Hardening the shoreline is a stabilization method intended to protect the landward shoreline from wave action generated by storms and tropical events. This approach has now evolved into a 'hybrid' method in which wave breaks are moved further offshore and vegetation is allowed to colonize the land and water interface. Recent coastal restoration projects have proven that moving the subsurface structures further offshore serves to mitigate wave energy and protect the shoreline, especially vegetated shorelines (PGS I). Today, these offshore subsurface reef structures are being designed to remain just below the water's surface (aesthetics) and have incorporated activities such as a paddling trail through carefully engineered 'sediment islands' which have been planted with native grasses to create stabilized areas (PGS 2).

Offshore, sub-surface structures provide suitable habitat for encrusting organisms such as oysters and barnacles. These organisms are referred to as reef builders because they recruit more organisms including crabs, snails, and fish which contribute to diverse and rich habitats. The positive benefits that nature provides are deemed, ecosystem services. Utilizing the hybrid approach, described above, renders additional ecosystem services such as carbon sequestration, flood protection, erosion control, and allows emergent vegetation to up take nutrients while also trapping sediments.

The following table summarizes the overall access into and out of the water as a paddler (non-motorized vessel), with the following score of 1-5, where 1 = poor, 3 = mediocre, and 5 = excellent.

Site Name	Launch Ability Safe Ingress/Egress	Inland Stormwater Conveyances (Obvious)	Landing Opportunities (Sandy Shoreline vs Riprap)	Number of times during the study where bacteria levels were above Human Health Threshold levels, also in percent w/i parentheses.
Mahogany Mill Boat Launch	5	No	5	5 of 13 events (38%)
Sanders Beach Boat Launch	4	Yes (w/in 10 M)	5	5 of 13 events (38%)
'I Street' Sanders Beach Outfall	1	Yes	1	10 of 12 events (83%)
'A Street' Joe Patties	1	Yes	1	10 of 13 events (77%)
Maritime Park Bulkhead (west end)	1	No	1	2 of 13 events (15%)
Spring Street Outfall	1	Yes	2	9 of 13 events (69%)
Palafox Pier	1	Unknown	1	1 of 8 events (13%)
Bartram Park	2	Yes (w/in 10 M)	3 (small access point)	11 of 13 events (85%)
Bayou Texar Mouth (Trestle)	4	Yes, but unknown if it is active	4	5 of 13 events (28%)
Bayou Texar Boat Launch (Oyster Barn)	5	Yes, but unknown if it is active	5	3 of 10 events (30%)
East Pensacola Heights	2	Unknown	3	2 of 9 events (22%)
Bayview Park Pier	5	Yes (w/in 10 M)	5	3 of 13 events (23%)
Upper Bayou Texar (12th Ave Bridge)	2	Unknown	2	8 of 12 events (67%)

Several sampling locations had some obvious comparisons, such as Mahogany Mill, Sanders Beach, Bayou Texar Mouth, Bayou Texar Boat Launch, and Bayview Park are all maintained by the city or county specifically to launch vessels. During this study period, only Mahogany Mill and Bayview Park Pier had been repaired from the 2020 Storm damage.

Maritime Park and Palafox Pier were the deepest stations sampled from shore and closest to the channel.

1. Mahogany Mill is located near the mouth of Bayou Chico, sandwiched between the old Barrancas Bridge and the new Bayou Chico Bridge, along the south shore. This site is just outside of the city limits but offers the public safe launching of non-motorized vessels in protected waters, as well parking for 50 vehicles and boat trailers. A ½ mile paddle eastward leaves the bayou and enters Pensacola Bay system.

2. Sanders Beach Boat Launch located along the north shore of Pensacola Bay just east of the mouth of Bayou Chico (south K Street). This site has no protection from the south and the open waters of the bay and was inoperable as a boat launch during the study period due to Hurricane Sally's (2020) waterfront destruction.

3. Sanders Beach Outfall is located where 'I Street' dead ends into the bay and where a stormwater outfall discharges via a cement culvert into the surface waters. To access this site, 3-4M riprap armoring had to be crossed, making it an unsuitable access point.

4. Joe Pattie's 'A Street' stormwater outfall discharges into a daylighted rock lined canal that empties into a protected water inlet mainly used by shrimp and fishing boats to unload their catch directly to the Joe Pattie Fish house. The daylighted rock lined canal is located adjacent to a petroleum tank farm, on the eastern bank. The western bank adjoins the parking lot for fish market. At the time of this study, the site was not suitable for paddlers to enter/exit the water.

5. Maritime Park headwall pier provided access to the Bruce Beach inlet area along the westernmost portion of the park. This site was also heavily damaged by Hurricane Sally and was under constant construction during the sampling effort. Bruce Beach park area is designed for entrance and exit of the water and beachfront area.

6. The Spring Street outfall is located where Spring Street crosses Main Street and discharges into the Point Royal and Maritime Park inlet. The cement culvert flows into an antiquated brick lined square structure (~3x3M) developed in the early 1900s to capture sediments. This structure is visible during winter low tides. The eastern shoreline (Point Royal) is lined with riprap to the south and extends beyond the land to provide safe harbor for Baylen Slips Marina. The westward shoreline is primarily the Maritime Park bulkhead, which does not offer public access from the water to the land.

7. The Palafox Pier is located at the southernmost point of Palafox Street. This extension into Pensacola Bay is also a bulkhead and does not allow for any access to land from the water. This area was also impacted by Hurricane Sally and access to the water was intermittent throughout this study due to construction activities.

8. Bartram Park is located just east of the Port of Pensacola and has a private marina adjacent to the park. This small park has a small sandy portion of the waterfront area which provides access from the water to land, otherwise it is armored by riprap. Project Green Shores Phase II was installed during the sampling effort and is just to the east of the Bartram Park area.

9. The mouth of Bayou Texar is located on the eastern side of the new 3-mile bridge. This site is just south of the train trestle and is also a boat launch. The site has a small sandy shoreline, a pier which also sustained damage from Hurricanes Sally and Ida, and an antiquated parking area.

10. Bayou Texar Boat Ramp (Stanley and Strong Streets) site is just north of the Cervantes Street Bridge along the eastern shoreline. This location has parking for ~30 vehicles and boat trailers and offers a good ingress and egress for non-motorized and motorized vehicles.

11. East Pensacola Heights Waterfront Park is located where Perry Ave and Bayou Blvd converge on the eastern side of Bayou Texar. This small tucked away waterfront access is hidden from the road but has a small pier that was built by good Samaritans from the EPH community.

12. Bayview Park is located on the western shore of Bayou Texar and has recently updated the community center. A large waterfront pier is located due south of the new building and extends 32 M into the bayou. The popular dog beach is located just west of the pier, and public boat launch and kayak access areas are located to the east. A floating dock makes a handy location for paddlers to access land.

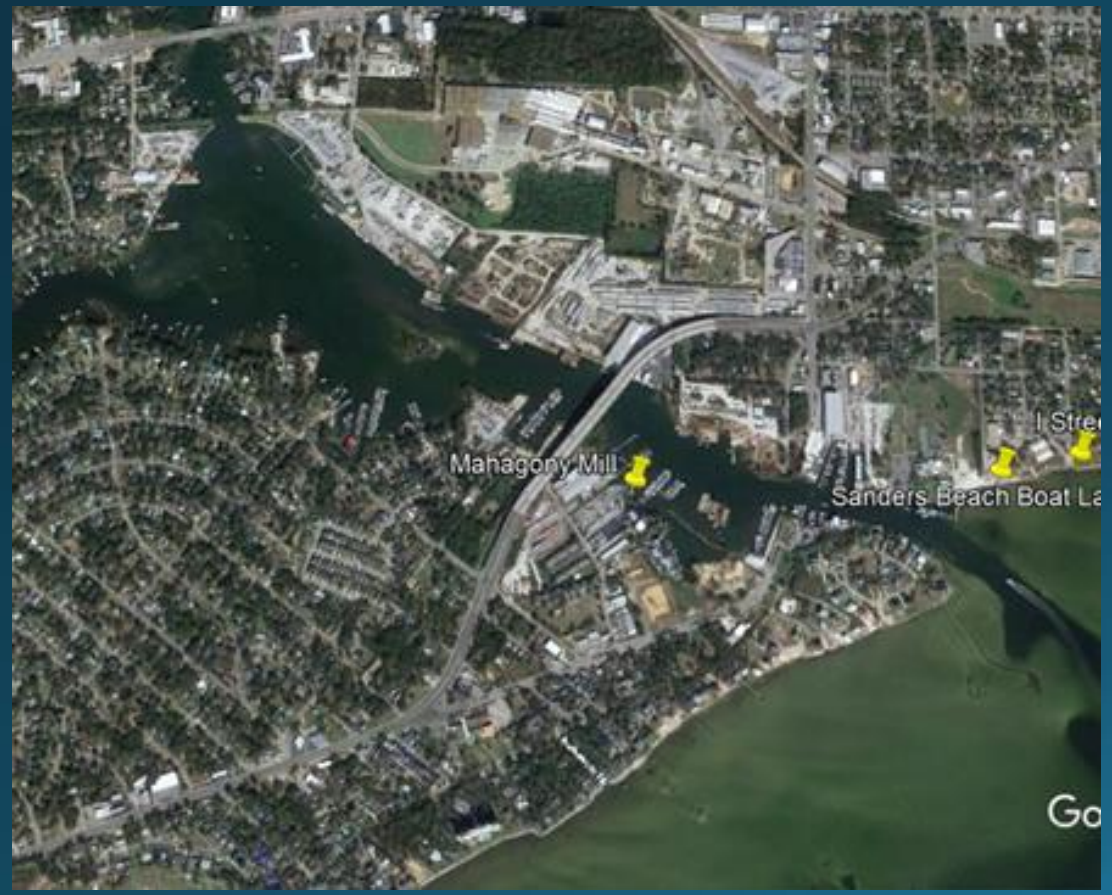
13. Upper Bayou Texar, 12th Avenue Bridge delineates the area where Carpenter Creek becomes a braided system to the west and east of the bridge, the area opens into a larger body of water which are the upper headwaters of the bayou. A small sandy area on the upstream, along the south side of the bridge affords limited access to exit the water, but this is not properly maintained for public access.

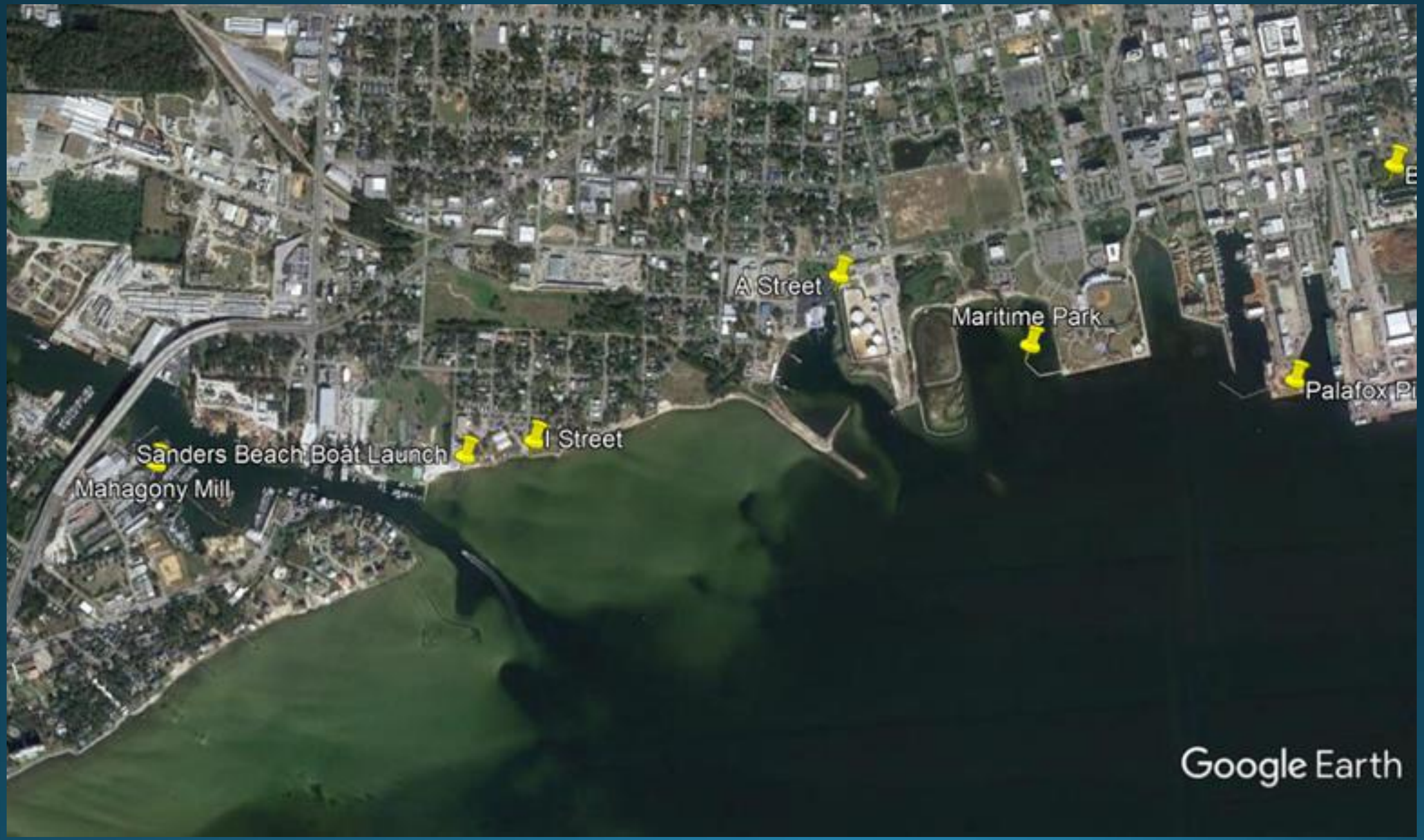
Pensacola Bay Paddling Trail Bacterial Study

Nov 2021 – April 2022


Pensacola Bay Paddling Trail
Launch Points
Baars Park
-87.2059
30.4594
Baars Park - Bayview Park
15000 ft, 2.8 mi
Bayview Park
-87.188
30.4326
Bayview Park - city property across from Bayview Park
1200 ft, 0.2 mi
city property across from Bayview Park - Bayou Texar Boat Ramp
3500 ft, 0.7 mi
Bayou Texar Boat Ramp
-87.1064
30.4264
Bayou Texar Boat Ramp - 17th Ave Boat Ramp
4000 ft, 0.8 mi
17th Ave Boat Ramp
-87.1936
30.4199
17th Ave Boat Ramp - Bartram Park
8400 ft, 1.6 mi
Bartram Park
-87.209
30.408
Baylen Slip
-87.2143
30.4062
Baylen Slip - Bruce Beach
4400 ft, 0.8 mi
Bruce Beach
-87.2223
30.4044
Bartram Park - Baylen Slip
7700 ft, 1.4 mi
Sanders Beach
-87.2374
30.4
Bruce Beach - Sanders Beach
6500 ft, 1.2 mi
0 0.25 0.5 Miles
PENSACOLA

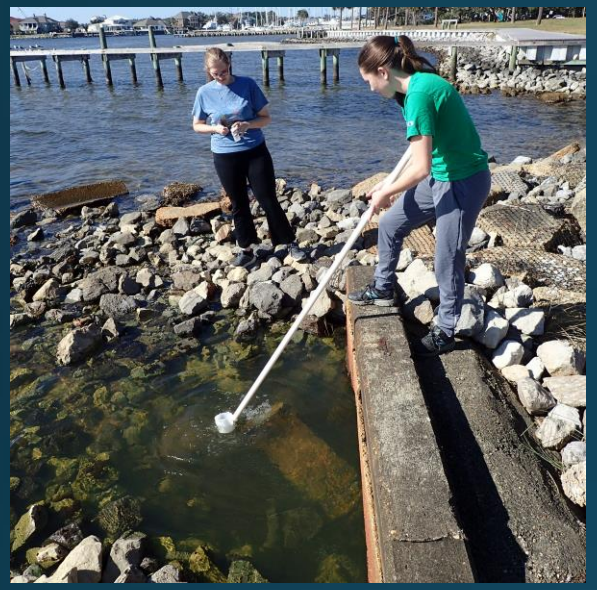
Mahogany Mill Boat Launch – Easy Launch




A Street
Maritime Park
Palafox Pi
I Street
Sanders Beach Boat Launch
Mahagony Mill
Google Earth

Sanders Beach Boat Launch - Site was under Construction

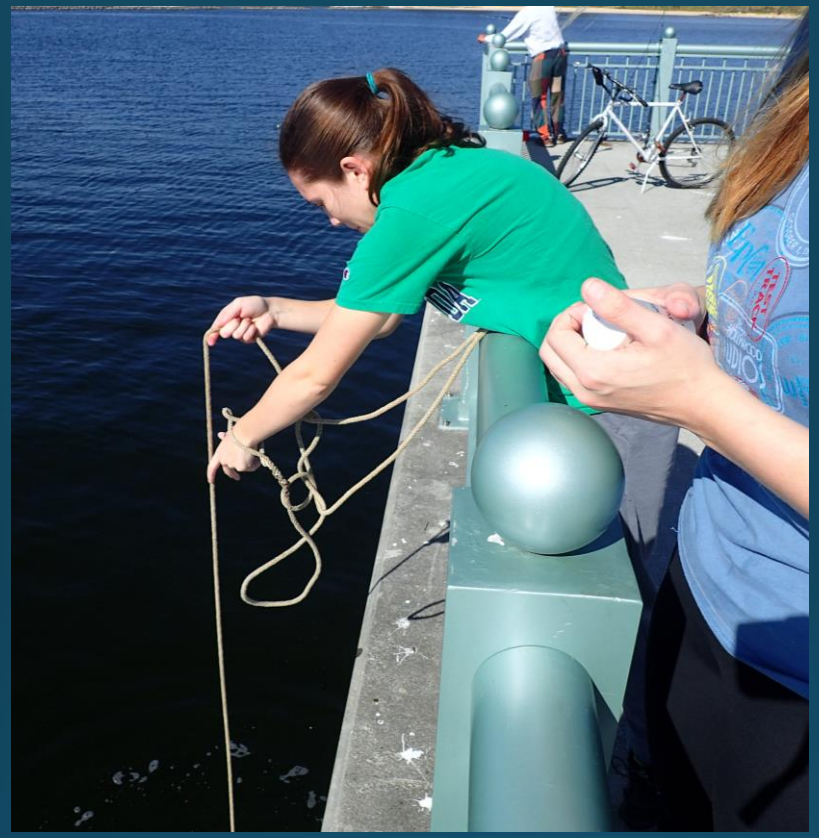
‘I Street’ Sanders Beach Outfall No Access to Shore



Condition of the Coast Line

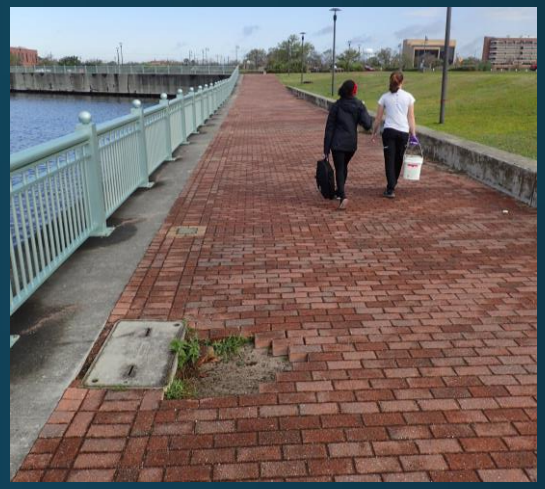
‘A Street’ Joe Patties
No Safe Access/Egress

- A Street dead ends into a rock lined conveyance which has a tank farm to the east and a rock lined berm to the west until it enters a small embayment.
- Fishing and shrimp boats use this cove as a protected water and to unload their catch to the fish market.
- Trash floating and submerged was noted upon every visit to this station.

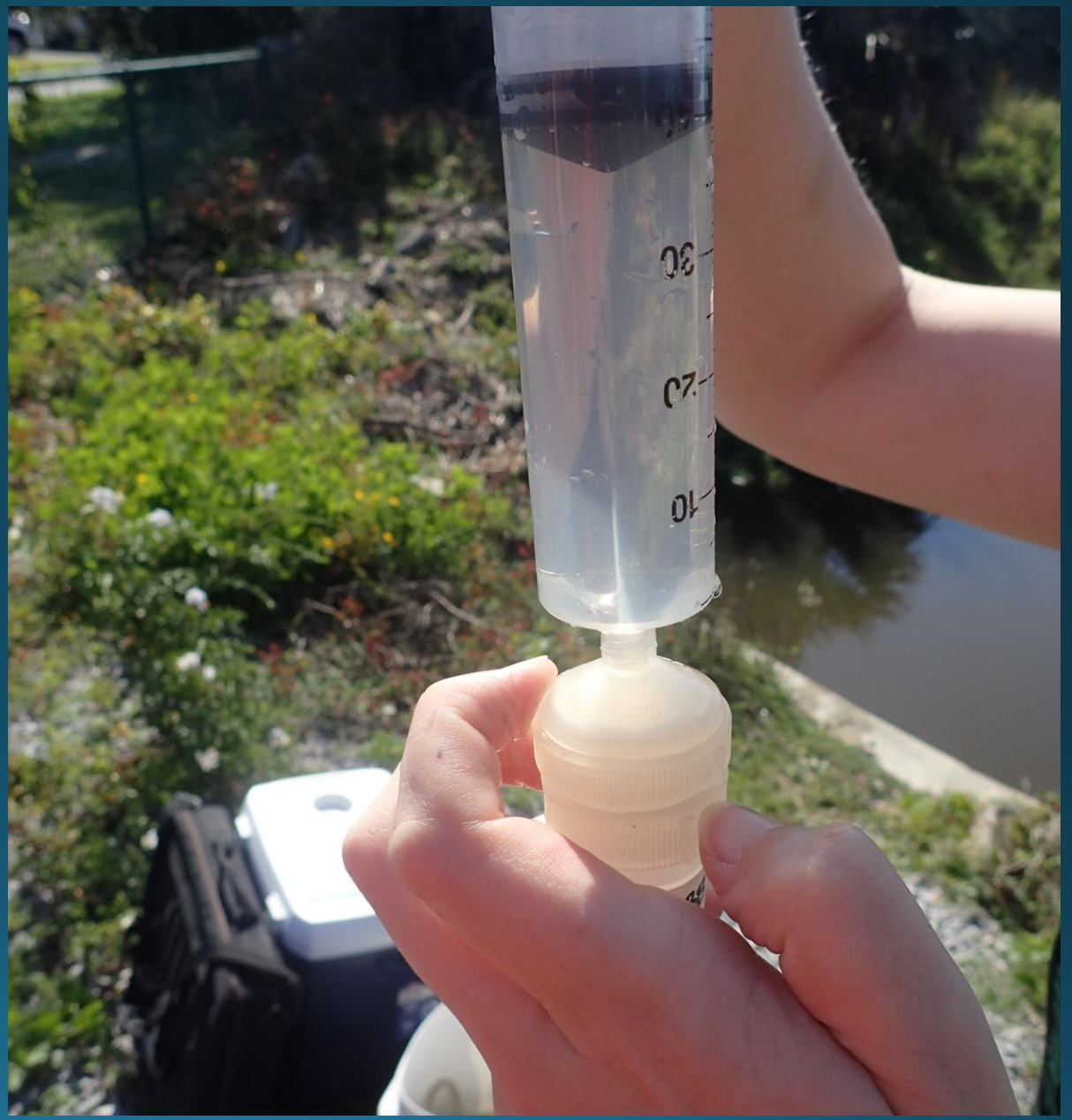



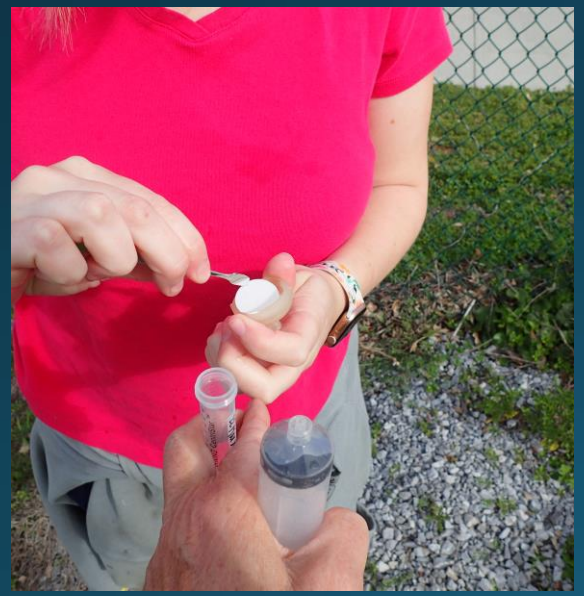

Maritime Park Bulkhead (west end)
No Safe Access/Egress

Maritime Park Bulkhead – Overlooking Bruce Beach

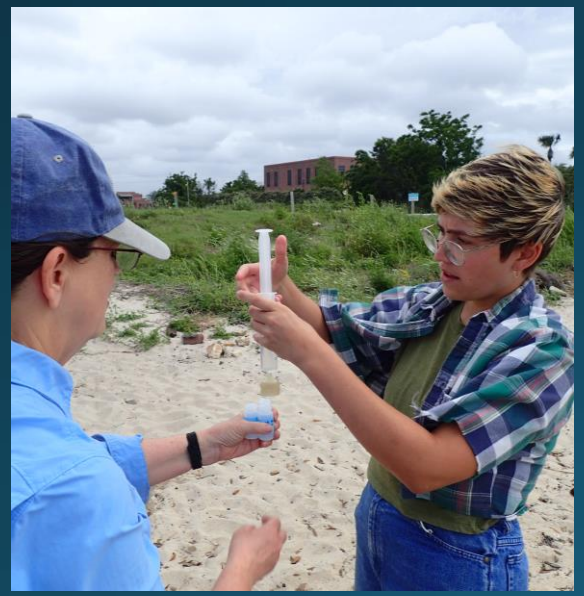


Bruce Beach –
Easy Access/Egress


30
20
10

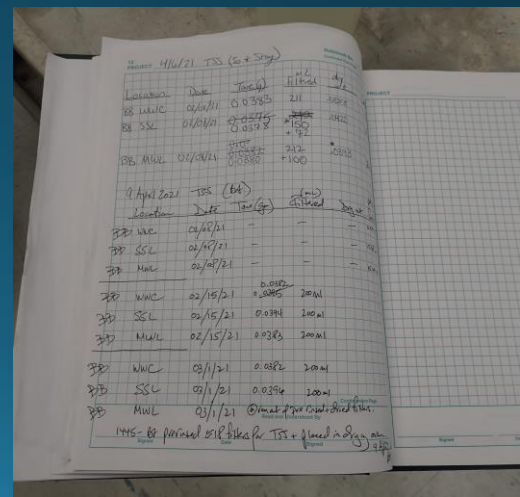



ALMIGHTY



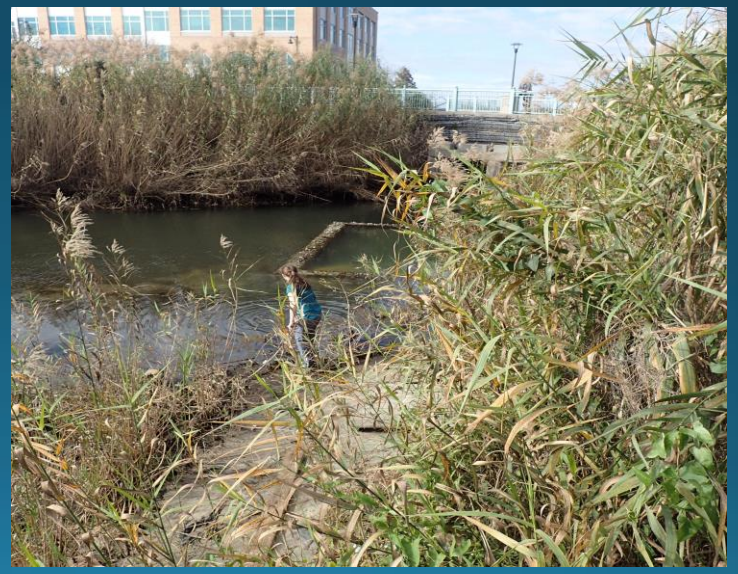

Bawse


BB SSL 1 Mar 2021



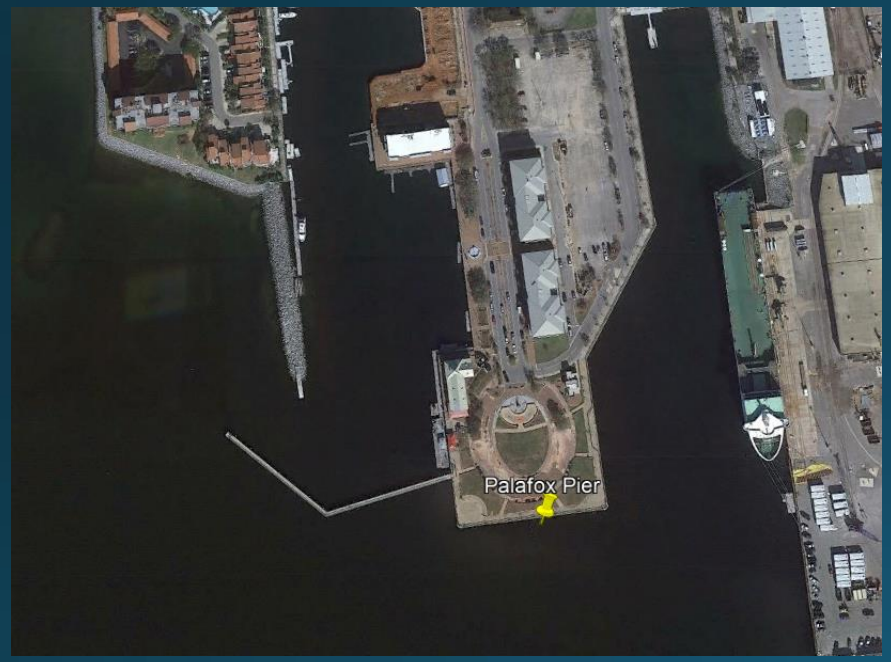

Bartram Park
Spring Street Outfall
Maritime Park
Palafox Pier
Google Earth

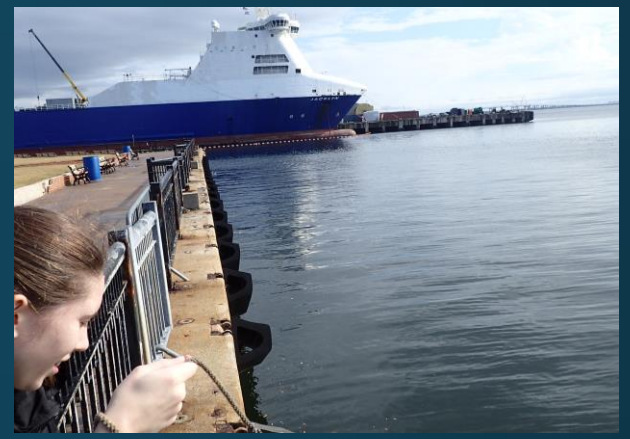
Spring Street Outfall

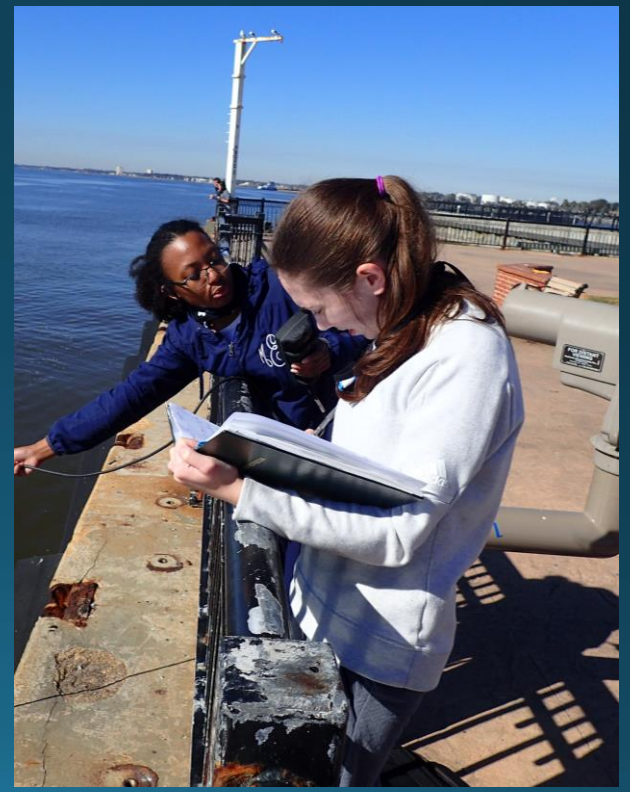


No Safe Access or Egress

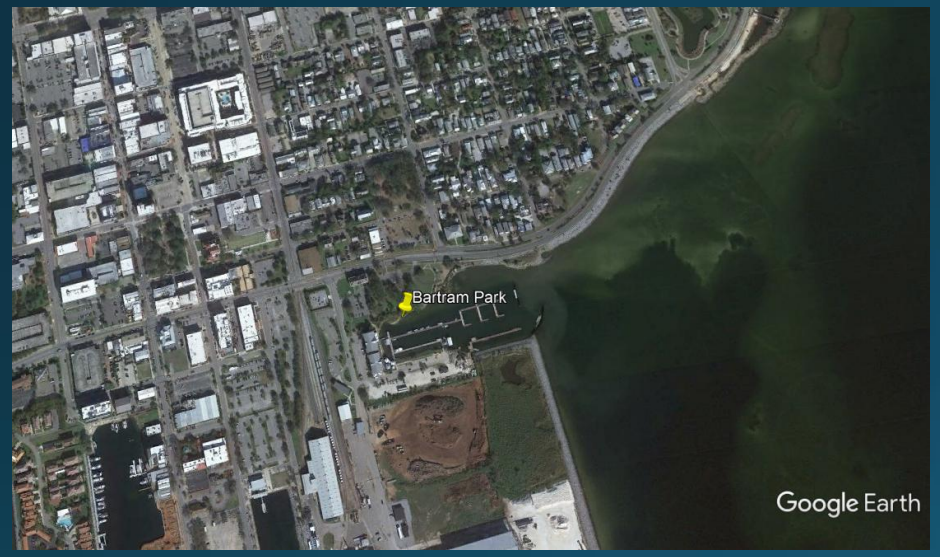
Palafox Pier –
No Safe Access/Egress





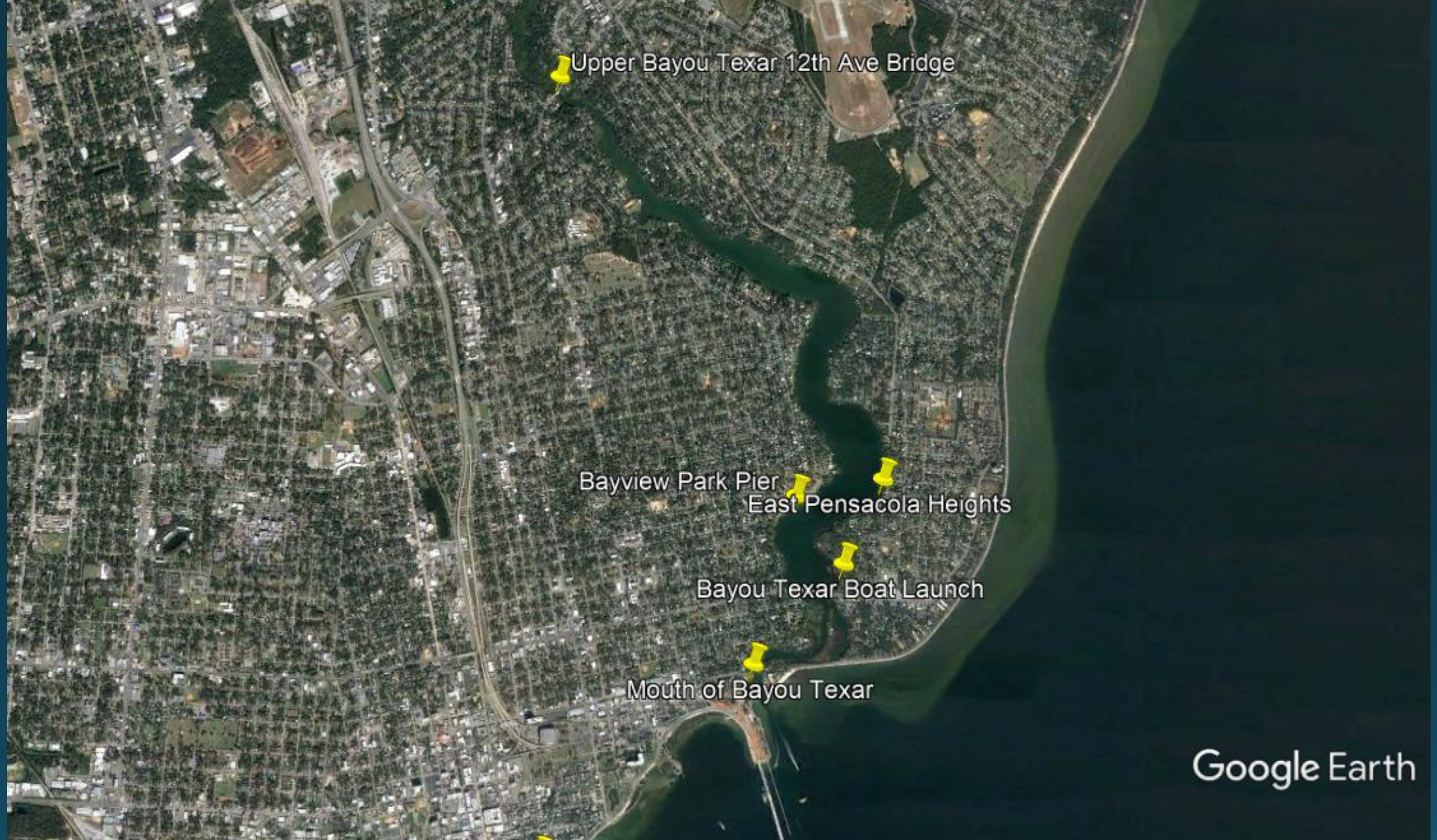


Bartram Park – Minimal Access/Egress



Project Green Shores Phase II under construction

No Safe Access or Egress


Upper Bayou Texar 12th Ave Bridge
Bayview Park Pier
East Pensacola Heights
Bayou Texar Boat Launch
Mouth of Bayou Texar
Google Earth

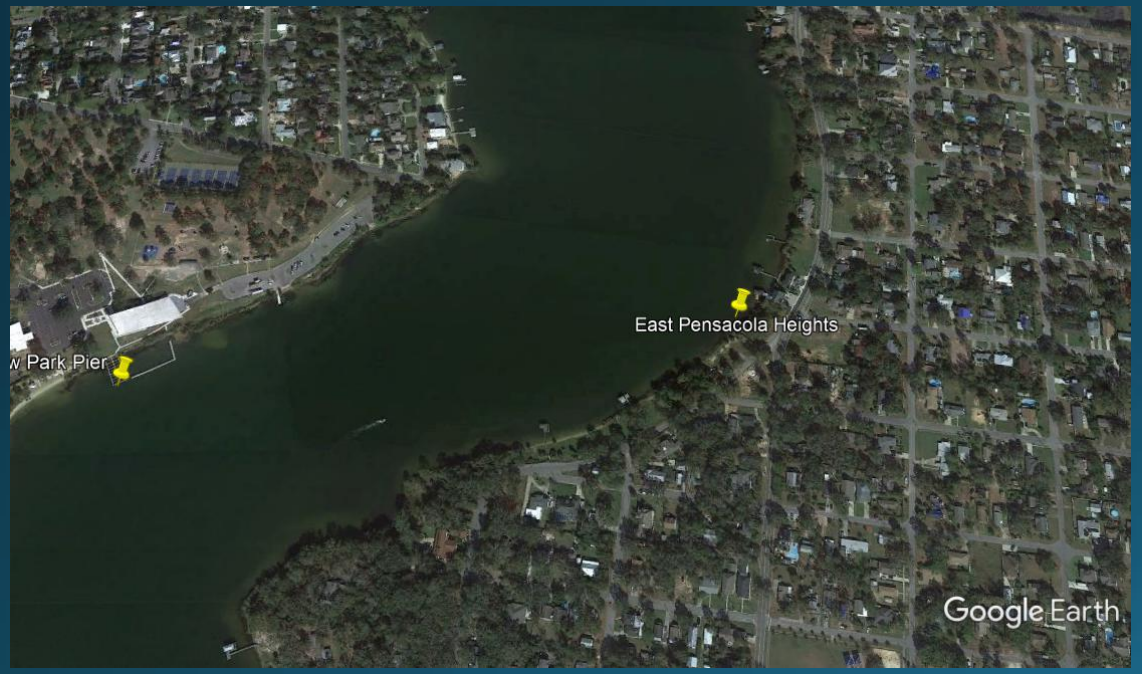
Bayou Texar Mouth (Trestle) Access and Egress Possible

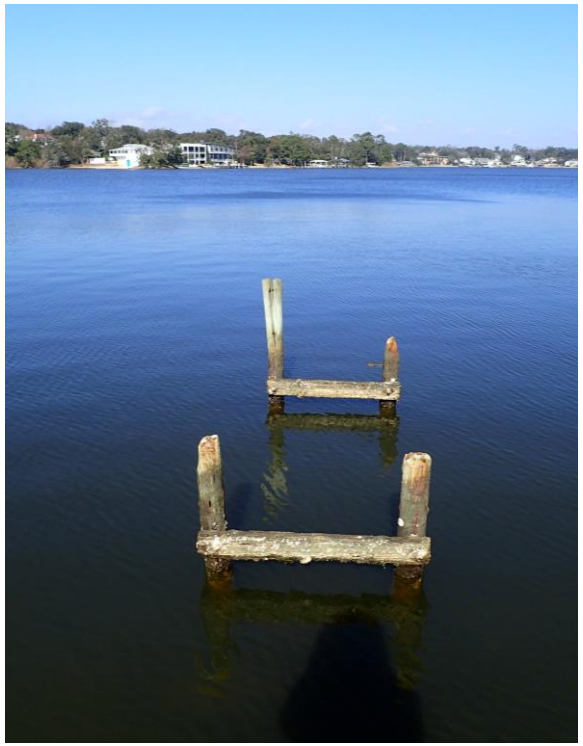
Bayou Texar Boat Launch (Oyster Barn)

- Since the conclusion of the monitoring project, both the restaurant (Oyster Barn) and the boat pier have been demolished.
- This boat launch continues to be a safe and popular site for accessing the water.

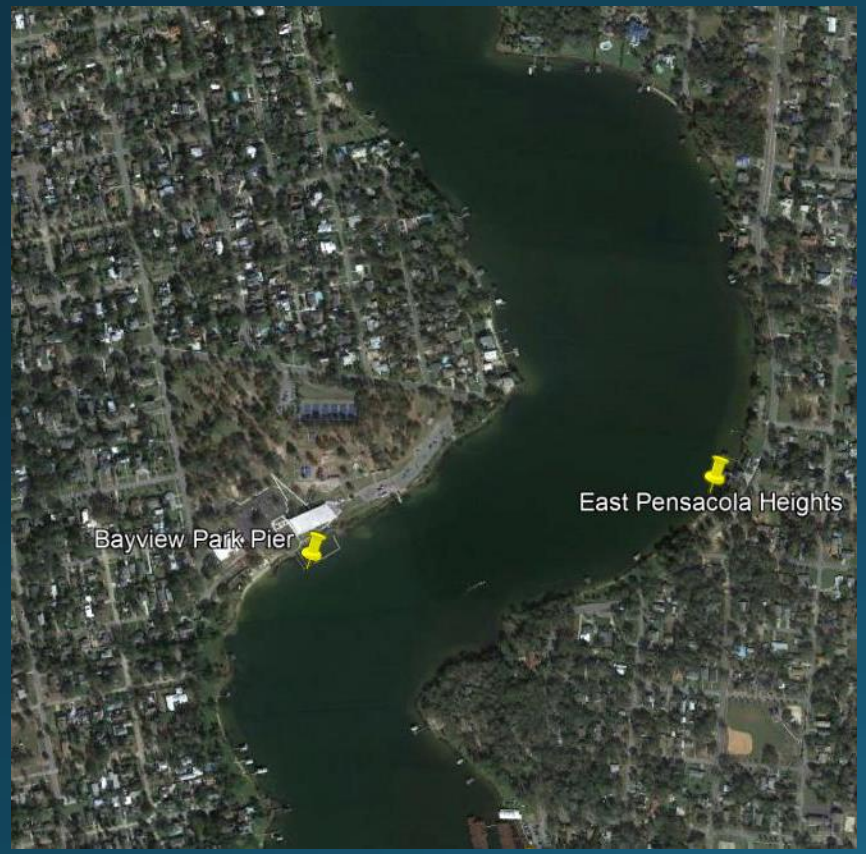
East Pensacola Heights

East Pensacola Heights
Minimal Access at this Site



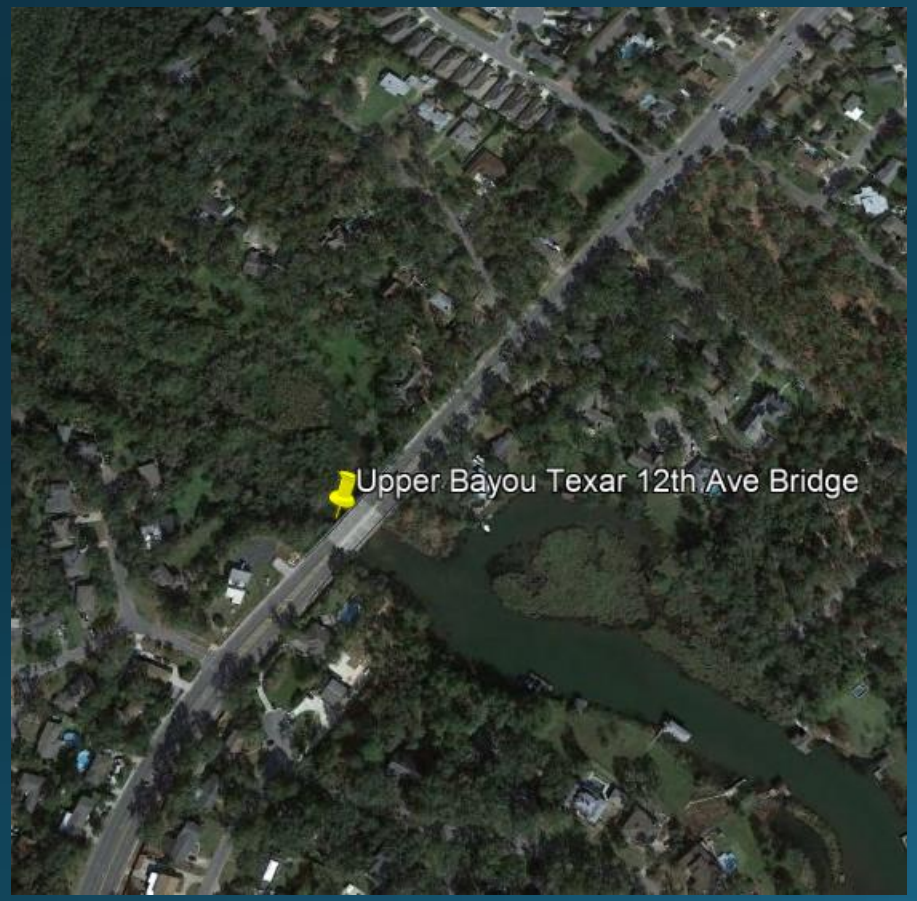


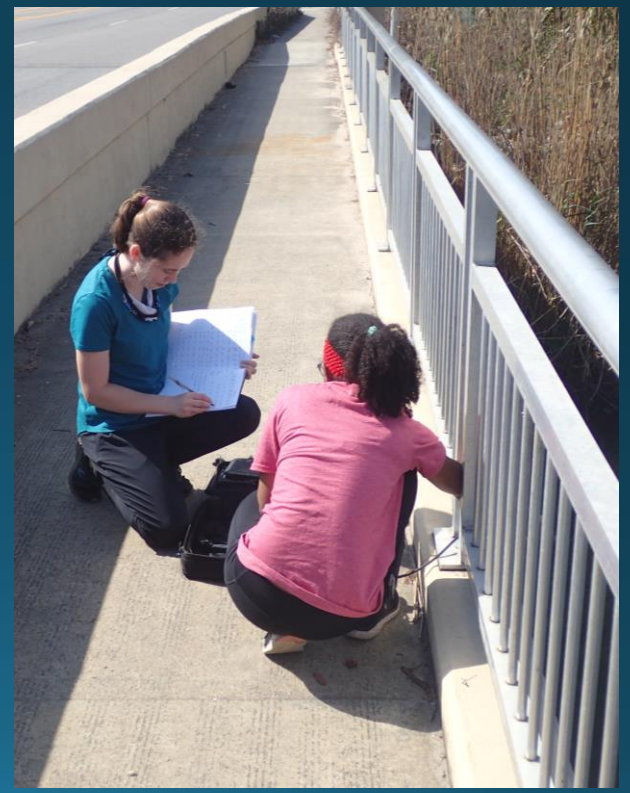
Bayview Park –
Safe Access and Egress



Upper Bayou Texar (12th Ave Bridge)

No Safe Access/Egress





Appendix 2

Average chlorophyll a and nutrient concentrations ± S.E. at Bruce Beach sites between February 2021 and April 2022.

Site	Chlorophyll a µg/L	NO_3^- µg N/L	NO_2^- µg N/L	NH_4^+ µg N/L	DIP µg P/L
Mitigation Wetland	4.07 ± 0.31	39.7± 5.4	1.38 ± 0.27	38.4 ± 5.7	4.18 ± 1.09
Sandy Shoreline	4.18± 0.31	40.9± 5.3	1.60 ± 0.26	31.0 ± 5.9	4.44 ± 1.12
Washerwoman Creek	6.52± 0.32	130.7± 5.3	2.70 ± 0.23	114.4 ± 5.6	17.02 ± 1.06