LIVE OAK POINT LIVING SHORELINES

2025 (Fall) Project and Reference Site Monitoring Report

USACE Permit No.:	SAJ-2011-00287
FDEP Permit No.:	0387876-001-EI-66
Permittee:	Northwest Florida Water Management District 81 Water Management Drive Havana, FL 32333-4712 POC: Robert Lide (robertlide@nwfwater.com)
Entity Conducting Monitoring: (Vegetation Only; All Other Monitoring Conducted by NWFWMD Staff)	Choctawhatchee Basin Alliance of Northwest Florida State College 109 South Greenway Trail Santa Rosa Beach, FL 32459-5415 POC: Rachel Gwin (gwinr@nwfsc.edu)
Project Location:	Live Oak Point Salt Marsh 30.43° North, -86.25° West (Project Site) 30.42° North, -86.27° West (Reference Site) Approximately 2 ½ Miles NW of Santa Rosa Beach Walton County, Florida

Contents

Synopsis

Live Oak Point contains the largest salt marsh system (approximately 1,000 acres) in Choctawhatchee Bay. However, its ecological integrity and long-term survival has been threatened by ongoing erosion and shoreline retreat. Analysis of historic aerials indicates that, since 1941, the salt marsh has retreated up to 300 FT along the northern edge. In situ measurements and analysis of more recent digital orthophoto quads (DOQs) show that, prior to implementation of a living shoreline (completed 2025), the rate of shoreline retreat was increasing and had averaged >4 FT per year since 2007.

The objectives of the Live Oak Point Living Shorelines (LOPLS) project are 1) halting loss of salt marsh habitat at Live Oak Point, 2) restoring salt marsh habitat in a strip parallel to the current shoreline protected by limerock / "Oyster Castle"[1] breakwaters, and 3) enhancing existing salt marsh habitat via improved buffers. To achieve these objectives, a living shoreline (consisting of breakwaters and supplemental plantings of appropriate marsh species) has been implemented along the northern edge of the Live Oak Point salt marsh.[2] Initial observations strongly suggest that the living shoreline is functioning as intended and that trajectories have been established that will result in all objectives being achieved.

Construction of approximately 4,130 FT of breakwaters, with supplemental plantings of appropriate marsh species (*Spartina patens, Juncus roemarianus, Spartina alterniflora*), commenced in August 2021 and was completed in August 2025. As component of the Northwest Florida Water Management District (NWFWMD) In-Lieu Fee (ILF) mitigation program (USACE Permit SAJ-2011-00287), the Live Oak Point Living Shorelines project is expected to generate up to 2.61 estuarine mitigation credits. Any credit generated is reserved for the sole use of the Florida Department of Transportation (FDOT).

This 2025 (Fall) Project and Reference Site Monitoring Report has been developed to comply with federal and state monitoring requirements. It is the ninth monitoring report for the reference site (monitoring commencing Fall 2021) and the fifth monitoring report for the project area (monitoring commencing Fall 2023; monitoring of the project area, as planned, commenced after substantial breakwater construction was completed). Parameters for the Fall 2025 project and reference site monitoring are vegetation cover, sediment accretion, panoramic and general photo documentation. Vertical drone photography of the project site was acquired 10/28/2025. The reference site has similar geomorphology, tidal range,

[1] Loose limerock was used for a majority of breakwater construction. "Oyster Castle" blocks (12" x 12" x 8" interlocking blocks made by the Allied Concrete Company using a proprietary mixture of concrete and crushed oyster shell that is said to facilitate oyster spat recruitment) were used in locations where submerged aquatic vegetation (SAV) prevented use of limerock (i.e., the "Oyster Castle" breakwaters have a smaller footprint than loose limerock and can be more precisely placed with less potential for disturbance to nearby SAV when compared with loose limerock).

[2] The NWFWMD contracted with the Choctawhatchee Basin Alliance of Northwest Florida State College (CBA) to implement the Live Oak Point Living Shorelines project (NWFWMD Contract 21-036). Construction occurred from August 2021 to August 2025.

elevations, and vegetation community structure when compared with the project site (the reference site is located approximately 3,000 FT southwest of the project site).

Results of the Fall 2025 vegetation monitoring continue to indicate strong similarity between the project site and the reference site. The Sorensen's Similarity Index comparing the project site with the reference site is 0.80 (1 = perfect similarity; 0 = no similarity). Vegetation diversity is limited at both sites (Simpson's Diversity Index at the Project Site = 0.68; Simpson's Diversity Index at the Reference Site = 0.72).[3] At both the project and reference sites, the low marsh is dominated by *Spartina alterniflora*, the mid marsh is dominated by *Spartina patens*, and the high marsh is dominated by *Juncus roemerianus*. At the project site, sediment is accumulating behind the newly constructed breakwaters, with *Spartina alterniflora* expanding in places. Oyster colonies are rapidly becoming established on the breakwaters and submerged aquatic vegetation (SAV), primarily *Halodule wrightii*, has moved in behind breakwaters in multiple locations. Planted vegetation has generally done well in locations protected by limerock breakwaters and now blends seamlessly with natural salt marsh expansion.

All monitoring reports for the Live Oak Point Living Shorelines project site and reference site are posted at https://www.nwfwater.com/Water-Resources/Regional-Wetland-Mitigation-Program/Regional-Mitigation-Plan/NWFWMD-Mitigation-Sites/Choctawhatchee-Watershed-Mitigation-Sites/Live-Oak-Peninsula-ILF/Living-Shorelines or any successor website.

[3] A Simpson's Diversity Index of 0 = infinite diversity; a Simpson's Diversity Index of 1 = no diversity.

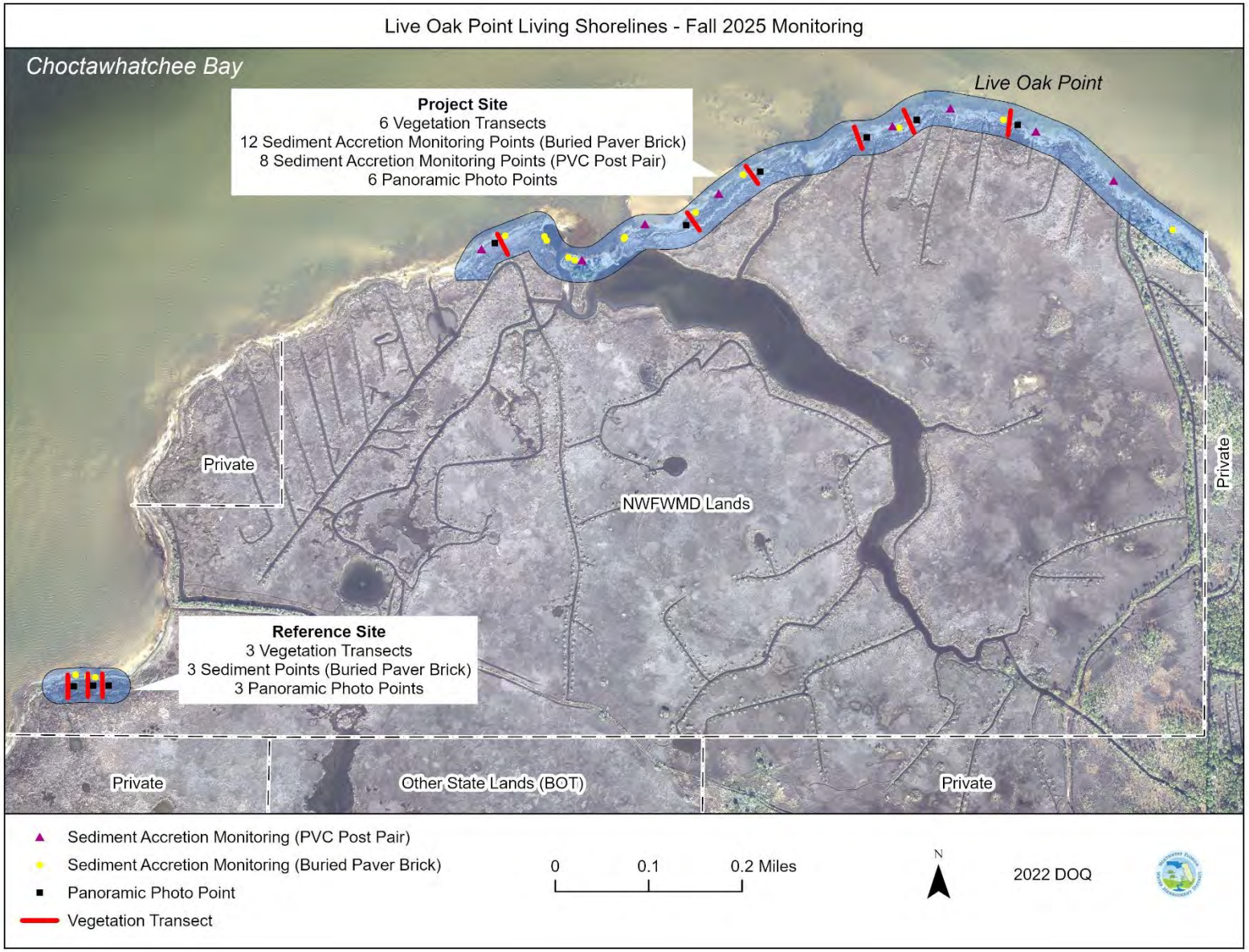


Figure 1. Fall 2025 Monitoring Overview

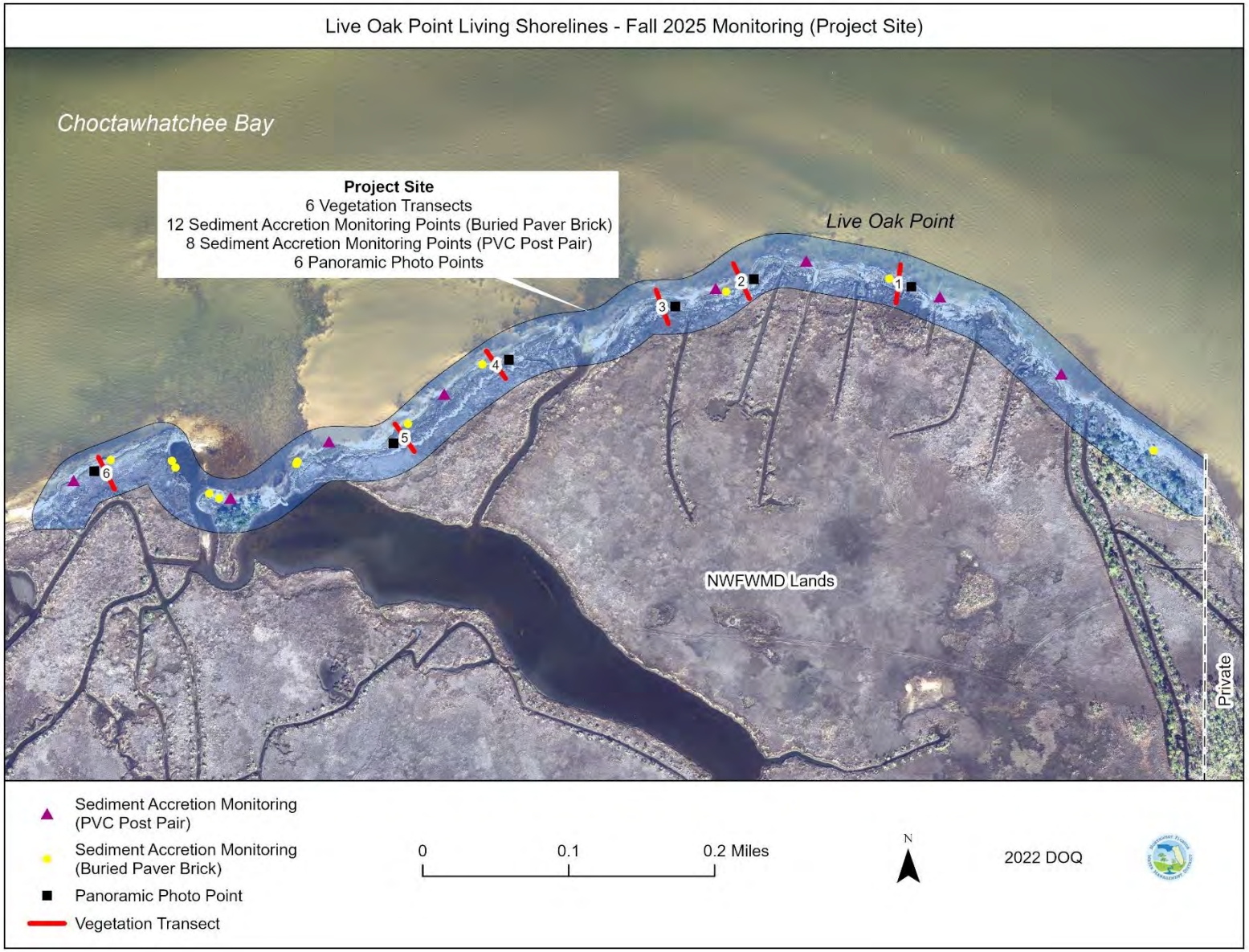


Figure 2. Fall 2025 Project Site Monitoring

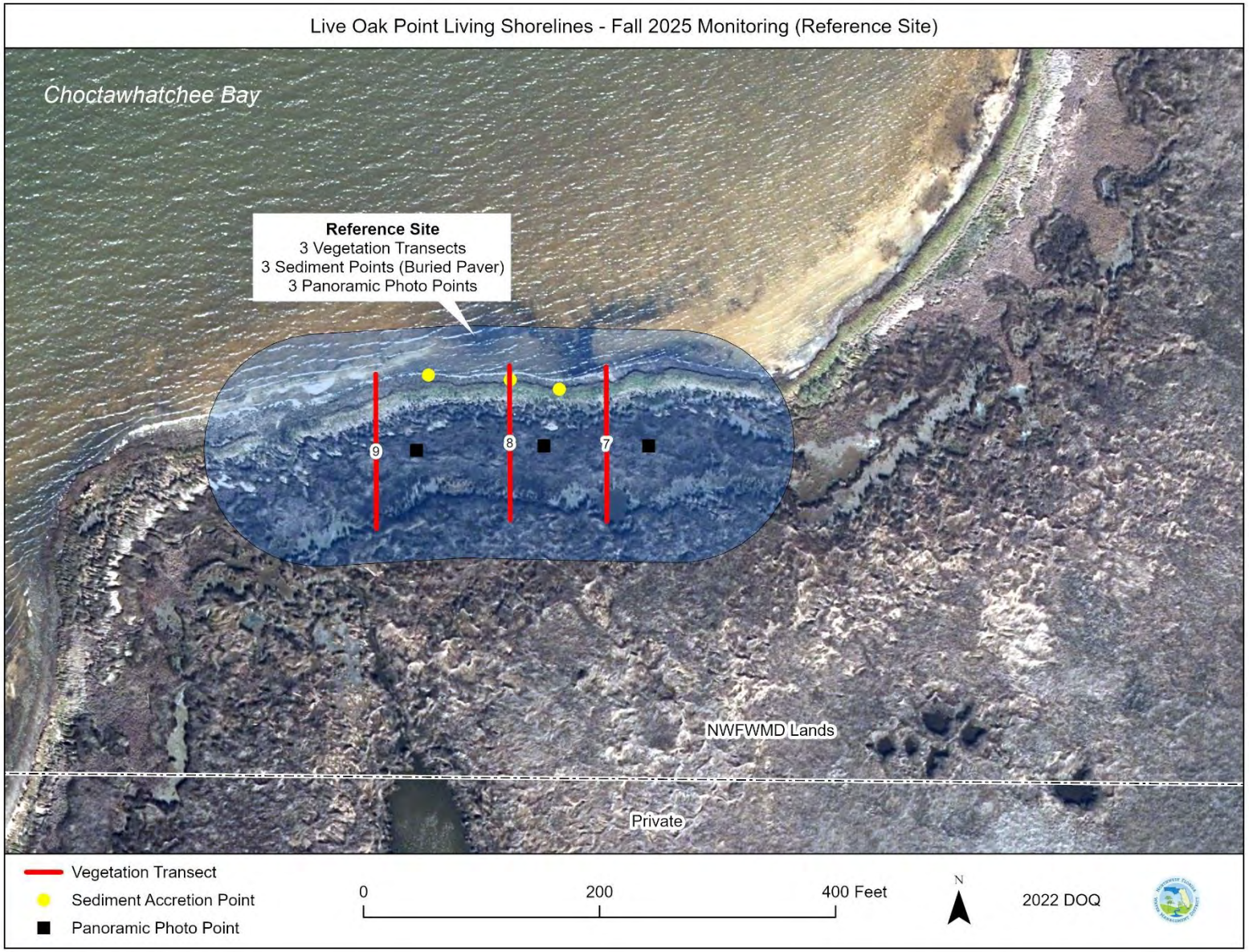


Figure 3. Fall 2025 Reference Site Monitoring

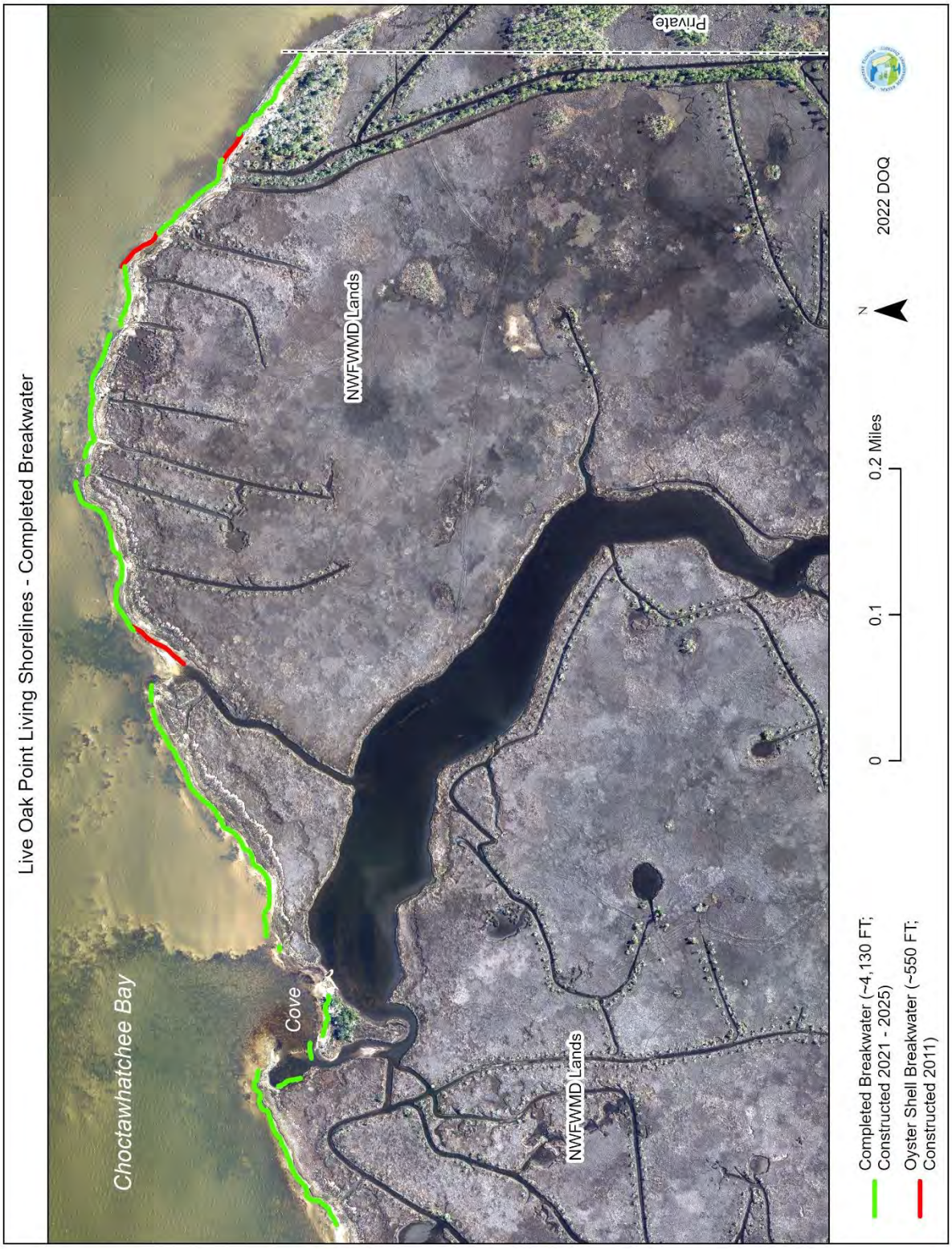


Figure 4. Completed Breakwater (Constructed 2021 – 2025)

Vegetation Monitoring

Vegetation cover at the project site and reference site was quantitatively measured on 10/28/2025 using a modified Daubenmire method.[4] Three (3) transects of variable length were previously established in the reference area and six (6) transects of variable length were previously established in the project area. Each transect began in the low marsh and extended into the high marsh. Twelve (12) 0.5-meter square ($0.25m^2$) quadrats were sampled along each transect. Four (4) quadrats were located in the low marsh, four (4) in the mid marsh, and four (4) in the high marsh. All plant species were identified in each quadrat. Percent cover of vegetation by species, bare ground, and duff layer, was visually estimated.

No exotic or invasive plants were present in any transect. Data collected on 10/28/2025 indicate that, at both the project site and reference site, the low marsh is dominated by *Spartina alterniflora*, the mid marsh by *Spartina patens*, and the high marsh by *Juncus roemerianus*.

Average percent cover of live vegetation (derived from vegetation transects) for the low marsh was 36% at the project site compared with 27% for the reference site; for the mid marsh it was 66% at the project site compared with 94% for the reference site; and for the high marsh it was 49% at the project site compared with 45% at the reference site.

Table 1. Percent Cover of Vegetation (Fall 2025; Project Site versus Reference Site)[5]

		Project Site	**Reference Site**
Low Marsh	Live Vegetation	36%	27%
	Bare Ground / Duff / Dead Vegetation	64%	74%
Mid Marsh	Live Vegetation	66%	94%
	Bare Ground / Duff / Dead Vegetation	34%	7%
High Marsh	Live Vegetation	49%	45%
	Bare Ground / Duff / Dead Vegetation	51%	55%

[4] Daubenmire, Rexford. 1959. A Canopy-coverage method of vegetational analysis. Northwest Science 33:43-64.
[5] Because of rounding, percentages may not add up to precisely 100%.

Simpson's Diversity Index ($D = 1 - \sum (P)^2$; where P = percent cover for a given species)[6] was similar at both the project site (D = 0.68) and the reference site (D = 0.72) and indicates limited species diversity consistent with typical saltmarsh habitat in Choctawhatchee Bay.[7]

Table 2. Simpson's Diversity Index (Fall 2025)

Species	**Project Site**		**Reference Site**	
	Percent Cover (P)	**P^2**	**Percent Cover (P)**	**P^2**
Iva frutescens (Marsh Elder)	0.0221	0.0004884	Not Present	Not Present
Juncus roemerianus (Needlerush)	0.3920	0.1536553	0.2851	0.0813028
Schoenoplectus pungens (Threesquare Bulrush)	0.0003	0.0000001	Not Present	Not Present
Spartina alterniflora (Smooth Cordgrass)	0.2307	0.0532054	0.1117	0.0124834
Spartina patens (Saltmeadow Cordgrass)	0.3398	0.1154498	0.3569	0.1273963
Sporobolus virginicus (Dropseed)	0.0152	0.0002308	0.2462	0.0606185
Total	1.000	0.3230298	1.000	0.28180102
Simpson's Diversity Index $(D) = 1 - \sum (P)^2$	0.68		0.72	

[6] Simpson, E.H. 1949. Measurement of Diversity. Nature, 163:688.

[7] Percent cover of bare ground, duff, and dead vegetation excluded from Simpson's Diversity Index (D) calculations; D = 0 indicates infinite diversity and D = 1 indicates zero diversity.

Sorensen's Similarity Index (SI = 2C / A + B; where A = the number of species at the project site, B = the number of species at the reference site, and C = the number of species common to both sites)[8] was 0.80, indicating strong species composition similarity between the project site and reference site.

Table 3. Sorensen's Similarity Index (Fall 2025; Project Site and Reference Site)

A = Number of Species at Project Site	6
B = Number of Species at Reference Site	4
C = Number of Species in Common Between Project Site and Reference Site	4
Sorensen's Similarity Index (SI) = 2C / (A + B) = 2(4) / (6 + 4) = 8 / 10 = 0.80	

[8] Sorensen, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species and its application to analyses of the vegetation on Danish commons. Kongelige Danske Videnskabernes Selskab. 5 (4): 1–34. Values 0.80 – 1.00 = Very High Similarity; 0.60 – 0.79 = High Similarity; 0.40 – 0.59 = Moderate Similarity; 0.20 – 0.39 = Low Similarity; 0.00 – 0.19 = Very Low Similarity.

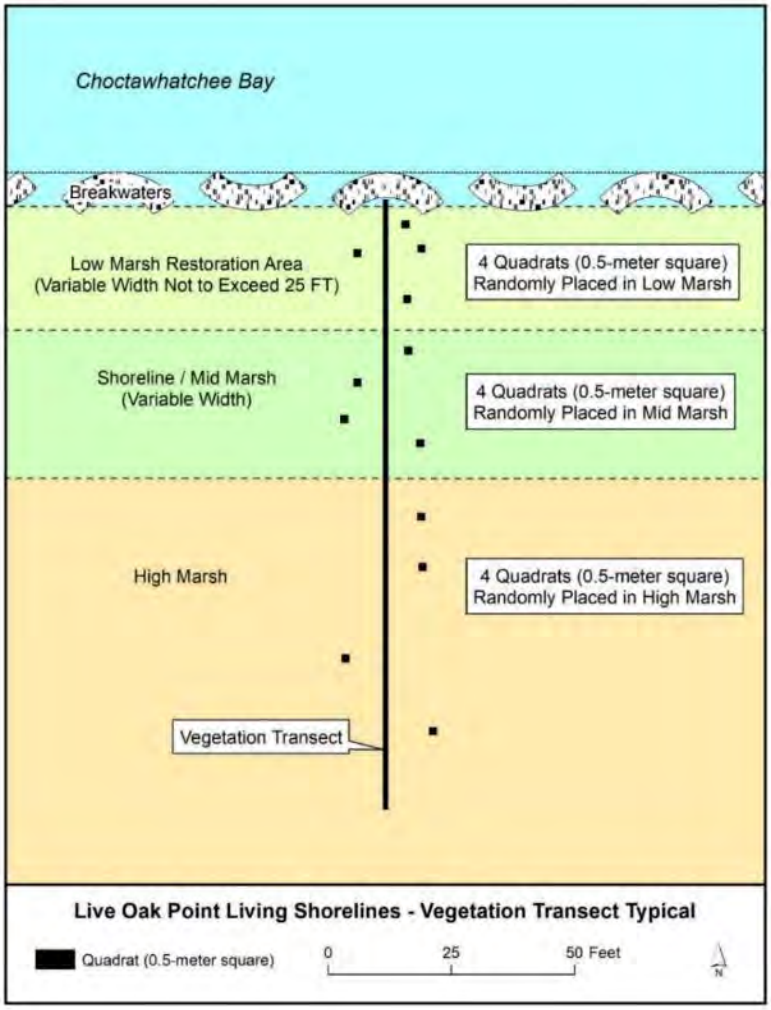


Figure 5. Vegetation Transect Sampling Design (Breakwaters Not Present at Reference Site)

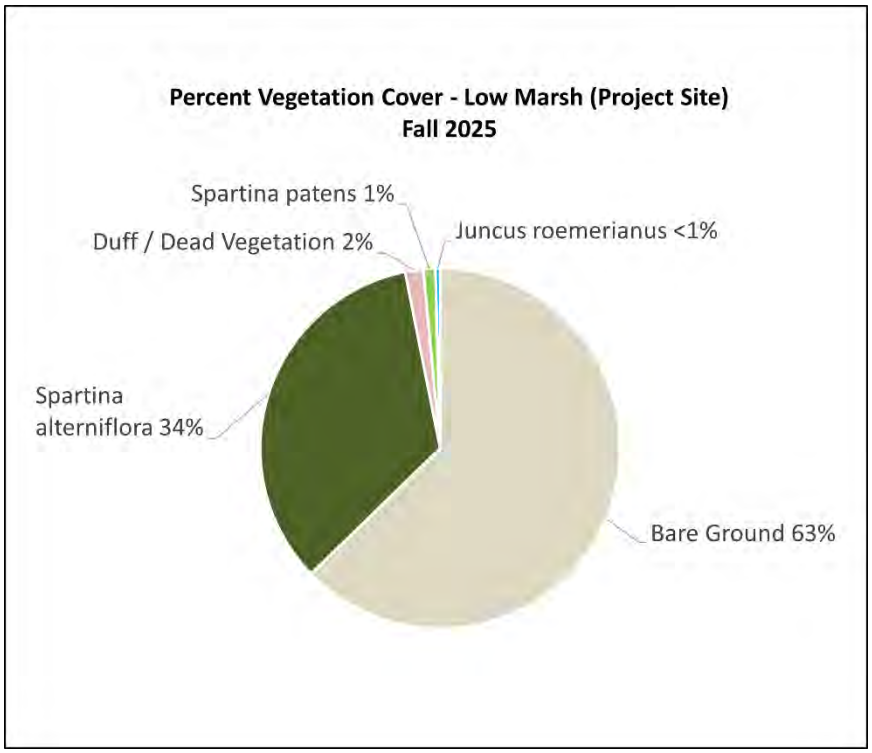


Figure 6. Project Site Low Marsh Vegetation (Average of Transects T1 - T6)

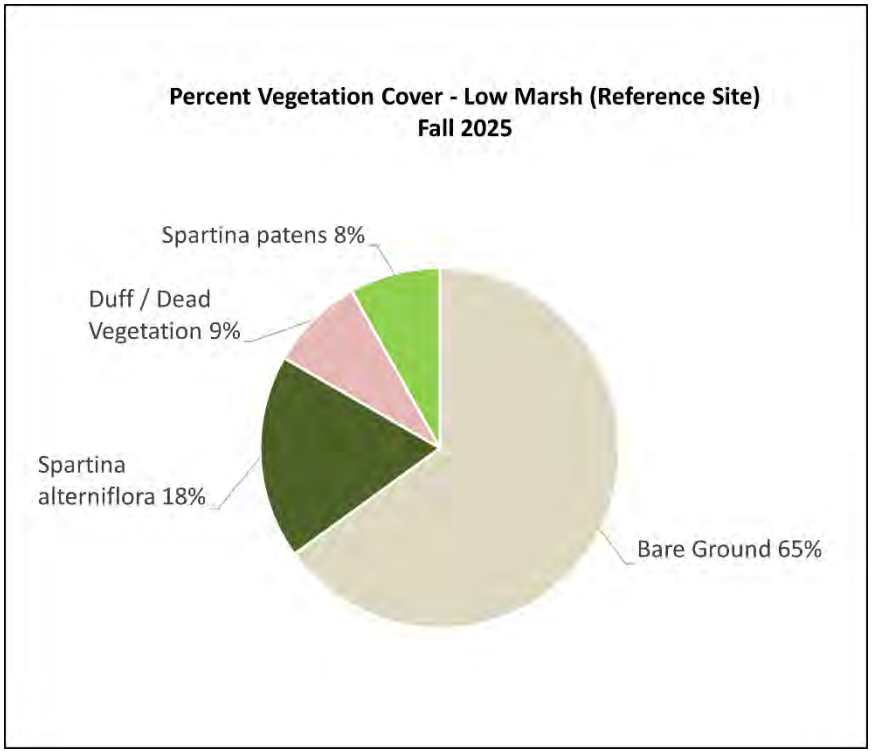


Figure 7. Reference Site Low Marsh Vegetation (Average of Transects T7 - T9)

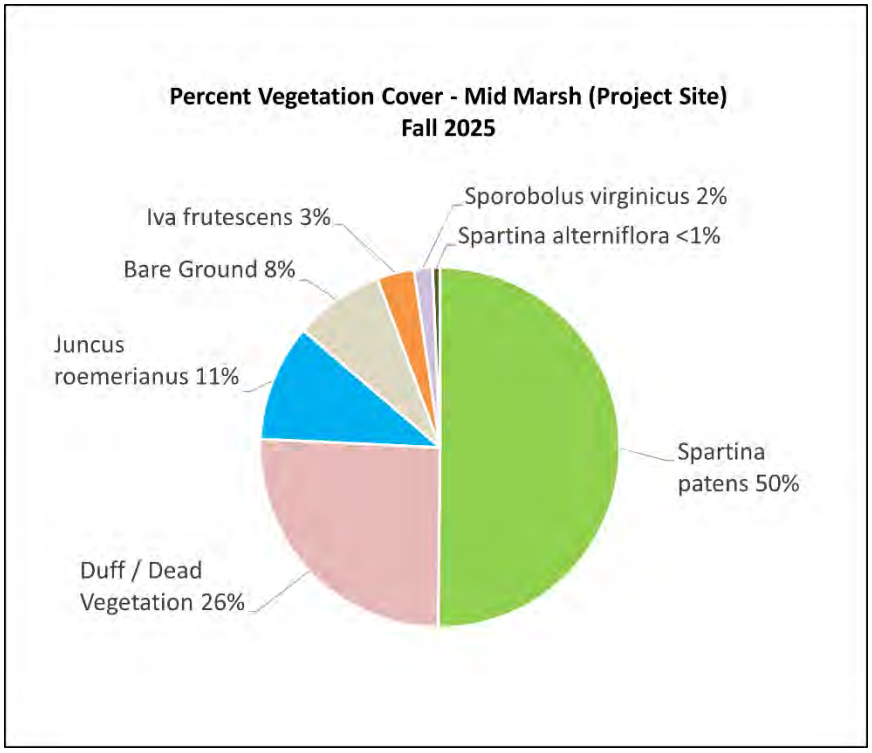


Figure 8. Project Site Mid Marsh Vegetation (Average of Transects T1 - T6)

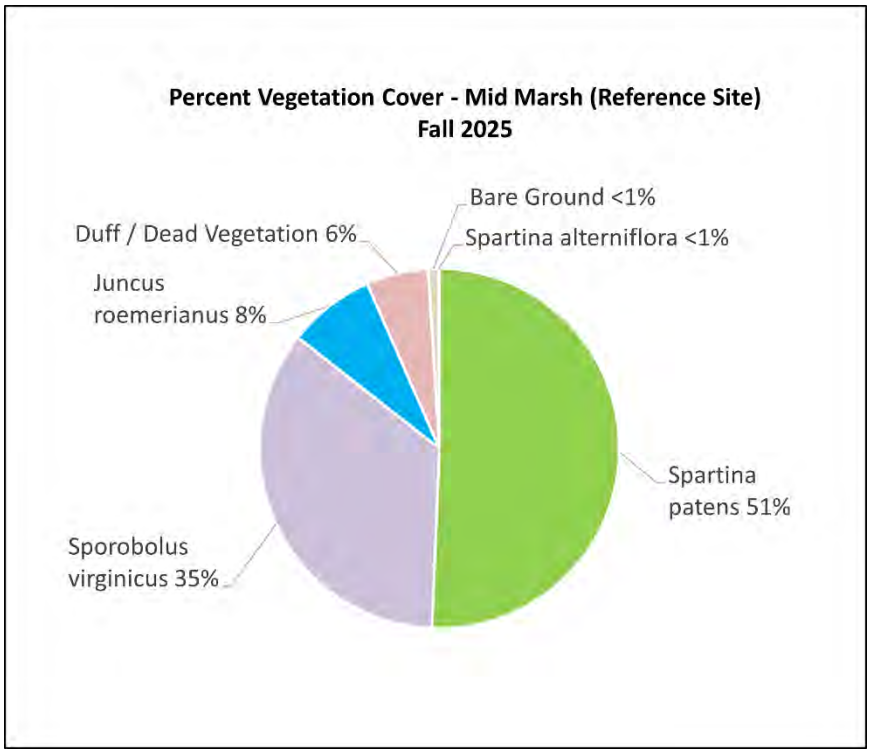


Figure 9. Reference Site Mid Marsh Vegetation (Average of Transects T7 - T9)

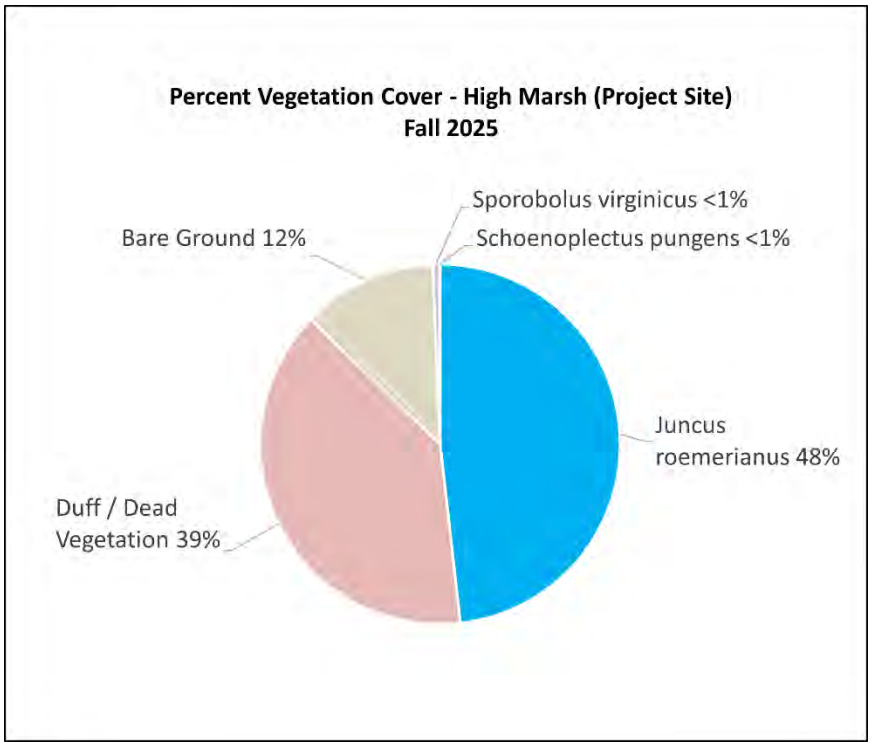


Figure 10. Project Site High Marsh Vegetation (Average of Transects T1 - T6)

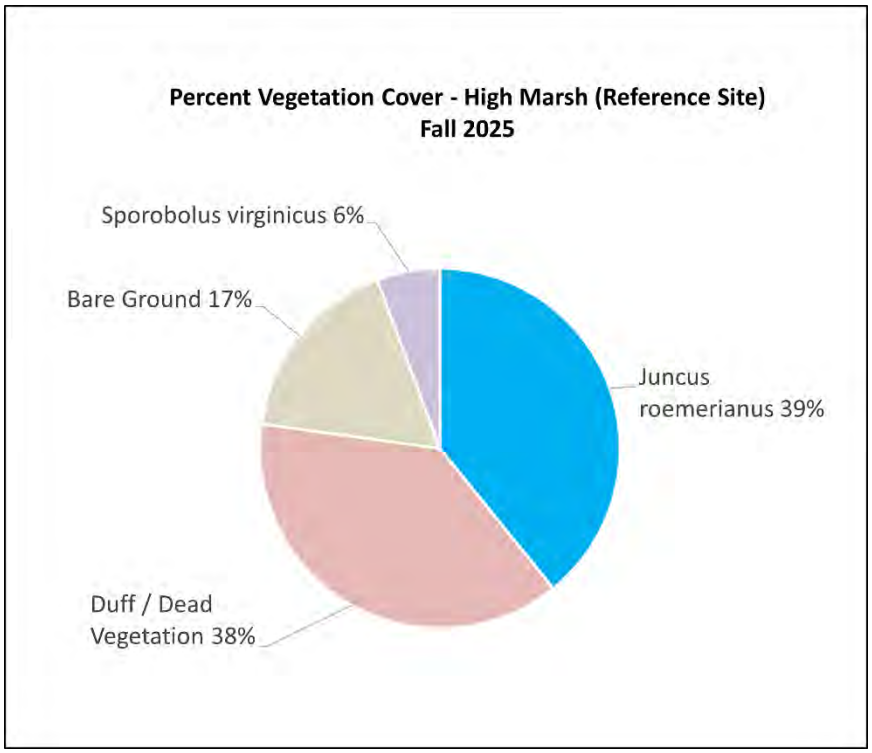


Figure 11. Reference Site High Marsh Vegetation (Average of Transects T7 - T9)

Table 4. Reference Site and Project Site Vegetation (Fall 2025) by Marsh Zone

Species	Project Site			Reference Site		
	Low Marsh	**Mid Marsh**	**High Marsh**	**Low Marsh**	**Mid Marsh**	**High Marsh**
Iva frutescens (Marsh Elder)	0%	3.33%	0%	0%	0%	0%
Juncus roemerianus (Needlerush)	0.42%	10.50%	48.21%	0%	7.83%	39.17%
Schoenoplectus pungens (Threesquare Bulrush)	0%	0%	0.04%	0%	0%	0%
Spartina alterniflora (Smooth Cordgrass)	34.13%	0.67%	0%	18.33%	0.08%	0%
Spartina patens (Saltmeadow Cordgrass)	1.08%	50.17%	0%	8.17%	50.67%	0%
Sporobolus virginicus (Dropseed)	0%	1.67%	0.63%	0%	34.92%	5.67%
Bare Ground	62.75%	8.08%	12.13%	65.00%	0.92%	17.17%
Duff / Dead Vegetation	1.63%	25.58%	39.00%	8.50%	5.58%	38.00%

*Due to rounding, percentages may not sum to precisely 100%.

Sediment Accretion Monitoring

To estimate vertical sediment accretion in the existing marsh of the reference area and project area, fifteen sediment accretion monitoring points (i.e., buried paving bricks) were established, with systematic data collection beginning May 2023.[9] Each point, assigned a unique ID of SB1 through SB15, consists of a 4" x 7" concrete paving brick buried approximately 20± cm below the vegetated ground surface. Measurements are made by inserting a thin metal rod into the ground until it contacts the buried paving brick, retracting the rod, and then measuring the rod against a meter stick. By design, these points are located within the existing marsh and not within the marsh restoration zone (i.e., they are not placed in the area between the breakwaters and the existing marsh/shoreline).[10]

Use of buried markers (e.g., buried paving bricks) is commonly used to monitor sediment accretion in salt marsh habitat. Our experience at the Live Oak Point Living Shorelines project suggests that useful data may be generated at a very coarse level. However, this technique appears inappropriate for obtaining trends at millimeter resolutions. Although measurements from May 2023 to October 2025 indicate an annual average accretion rate of 22 mm per year in the existing marsh at the reference site, whereas data from the project site indicate an annual average loss of 16 mm per year in the existing marsh (Table 5), visual observations strongly suggest little to no measurable change in the surface elevation in the existing marsh at either the project site or the reference site. The unevenness of the marsh surface at the monitoring points, the potential for continued settling of soil after burial of the paving brick, possible surface compaction from animals or human foot traffic, and imprecise leveling of the buried paving brick, make measurement resolutions in the millimeter range highly problematic.

Given the limitations of the buried markers (paver bricks) in the existing salt marsh, and to expand the monitoring to include the marsh restoration/marsh expansion zone located between breakwater segments and the current shoreline, eight additional monitoring stations using a different design were established on 11/25/2024. Referred to here as "PVC post pairs," each station (assigned a unique ID of SP1 through SP8) consists of two 2" DIA, SCH 40 PVC pipes (10-FT length) driven approximately 7 ½ FT into the underlying sandy sediments, placed approximately 7 FT apart, and forming a line approximately perpendicular to the existing shoreline. During monitoring events, a rigid cross bar (marked in 1-FT intervals) is temporarily placed on the two PVC posts. At each station, height from the bottom of the cross bar to the sediment surface is measured at six 1-FT intervals (decreasing height measurements over time indicate accretion of sediment).

[9] Earlier attempts at measuring sediment accretion either washed out or were vandalized.

[10] When monitoring protocols for this project were being developed to comply with permit conditions, it was initially decided not to place sediment accretion monitoring points within the zone between the breakwaters and existing marsh because of expected volatility in sediment accumulation and movement within this area. Sediment accretion monitoring has since been expanded to include the zone between the breakwaters and existing marsh.

Monitoring of the PVC post pairs within the marsh expansion zone (Table 6 & Table 7) began on 11/25/2024 with most recent measurements taken on 10/24/2025. Over the course of 333 days (11/25/2024 – 10/24/2025), average sediment accretion, as measured by the PVC post pairs (SP 1 – SP8), was 4.3 cm (average annualized rate of sediment accretion is 47 mm, well in excess of the 3± mm estimated rate of annual sea level rise for northwest Florida[11]).

[11] Sea level rise for the Panama City area has been estimated by National Oceanic and Atmospheric Administration area at 3.13 mm per year (Station 8729108; Panama City, Florida; Relative Sea Level Trend; 3.13 mm ±0.58 mm per year; 1973 to 2024.

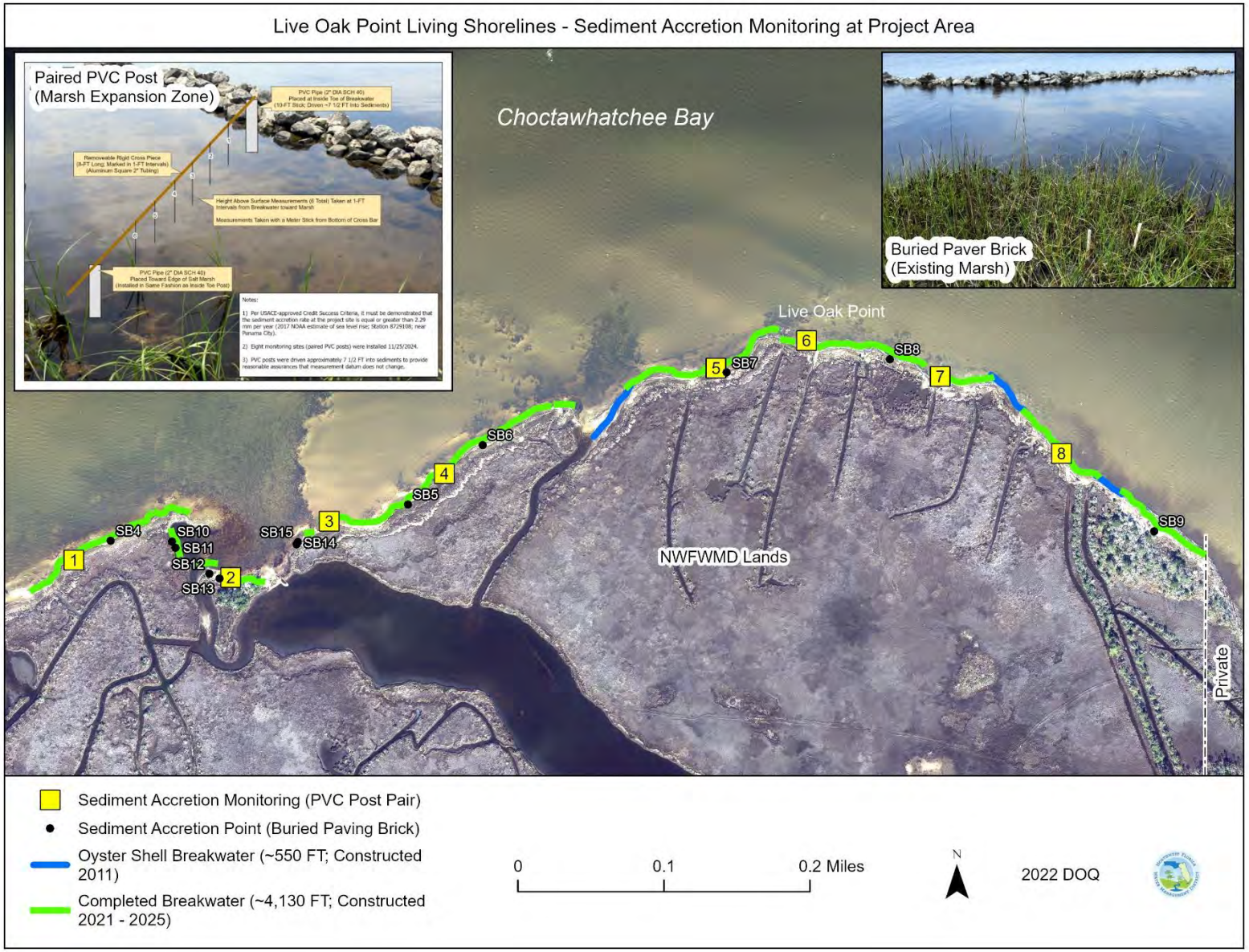


Figure 12. Sediment Accretion Monitoring at Project Site

Table 5. Vertical Sediment Accretion Monitoring (Buried Paver Brick; Existing Marsh)

		Average Depth Below Ground Surface (cm)										
Site	**Point**	**4 MAY 2023**	**18 MAY 2023**	**21 JLY 2023**	**18 OCT 2023**	**3 MAY 2024**	**15 OCT 2024**	**11 APR 2025**	**15 APR 2025**	**24 OCT 2025**	**Change in Ground Surface Elevation (mm)**	**Annualized Rate of Change (mm/yr)**
Reference Site	SB-1	17.1	15.8	16.6	17.4	19.2	20.7	23.8	-	22.6	55	22
	SB-2B	-	19.0	18.0	18.1	18.0	18.2	M	M	M	-	-
	SB-3B	-	18.1	17.2	17.3	17.5	M	M	M	M	-	-
	Average:	17.1	17.6	17.3	17.6	18.2	19.5	23.8	-	-	55	22
Project Site	SB-4	21.2	-	21.4	21.1	20.7	19.5	19.2	19.4	20.9	-4	-1
	SB-5	20.7	-	19.4	17.6	17.0	15.7	-	15.2	15.0	-57	-23
	SB-6	17.3	-	16.9	16.8	16.3	16.2	-	16.3	15.8	-15	-6
	SB-7	19.9	-	19.2	19.8	18.9	15.2	-	14.3	12.3	-75	-30
	SB-8	24.5	-	24.1	23.8	23.9	NF	-	14.9	5.6	-189	-76
	SB-9	11.6	-	6.9	2.8	9.3	NF	-	E	NF	-	-
	SB-10	27.0	-	27.2	25.7	25.6	25.2	-	25.1	25.1	-19	-8
	SB-11	17.7	-	17.4	16.3	15.6	15.1	-	15.2	NF	-	-
	SB-12	8.3	-	10.0	8.5	4.9	7.6	-	5.9	5.5	-28	-11
	SB-13	12.7	-	12.7	11.0	E	E	-	E	E	-	-
	SB-14	15.0	-	14.9	14.5	14.5	14.3	-	14.2	13.8	-12	-5
	SB-15	11.2	-	10.9	10.8	12.7	14.7	-	15.7	14.7	36	14
	Average:	17.2	-	16.8	15.7	16.3	15.9	-	15.6	14.3	-40	-16

Table 6. Vertical Sediment Accretion Monitoring (PVC Post Pairs SP1 – SP4; Marsh Expansion Area)*

Live Oak Point Living Shorelines Sediment Accretion Monitoring (PVC Post Pairs SP1 - SP4)								
Sediment PVC Post Pair	**Measurement Position**	**11/25/2024 (cm)**	**12/16/2024 (cm)**	**4/11/2025 (cm)**	**8/28/2025 (cm)**	**10/24/2025 (cm)**	**Surface Elevation Change (cm) 11/25/2024 - 10/24/2025 333 Days**	**Note**
SP1	1FT	72.6	69.6	64.8	58.3	58.1	14.5	Breakwater Segment Installed at This Location 2021/22
	2FT	72.5	69.4	64.3	58.2	57.7	14.8	
	3FT	70.5	66.8	63.0	59.1	58.3	12.2	
	4FT	68.2	66.8	63.0	58.9	58.5	9.7	
	5FT	65.9	65.5	62.0	59.8	58.8	7.1	
	6FT	64.7	65.0	62.8	62.8	60.2	4.5	
	AVG:	**69.1**	**67.2**	**63.3**	**59.5**	**58.6**	**10.5**	
SP2	1FT	73.5	71.8	74.8	73.6	75.2	-1.7	Breakwater Segment Installed at This Location 2024/25
	2FT	75.9	70.5	71.4	70.5	71.0	4.9	
	3FT	69.8	68.9	69.1	70.2	69.8	0.0	
	4FT	72.6	70.8	68.2	68.5	70.1	2.5	
	5FT	66.9	66.4	68.8	67.9	70.0	-3.1	
	6FT	66.8	65.8	68.0	67.6	70.0	-3.2	
	AVG:	**70.9**	**69.0**	**70.1**	**69.7**	**71.0**	**-0.1**	
SP3	1FT	88.9	89.1	89.5	86.6	87.3	1.6	Breakwater Segment Installed at This Location 2021/22
	2FT	90.6	89.2	90.0	87.0	88.1	2.5	
	3FT	88.3	89.3	91.0	87.3	88.3	0.0	
	4FT	88.6	89.8	91.0	88.6	88.8	-0.2	
	5FT	88.7	89.5	91.0	88.8	88.4	0.3	
	6FT	89.0	89.6	91.5	88.2	89.6	-0.6	
	AVG:	**89.0**	**89.4**	**90.7**	**87.8**	**88.4**	**0.6**	
SP4	1FT	78.5	74.7	82.6	78.4	78.4	0.1	Breakwater Segment Installed at This Location 2021/22
	2FT	79.4	75.6	81.6	79.8	77.9	1.5	
	3FT	79.4	76.6	81.8	79.4	79.0	0.4	
	4FT	81.5	77.6	81.2	79.6	78.6	2.9	
	5FT	81.9	79.6	80.7	80.5	79.3	2.6	
	6FT	84.1	81.0	81.0	80.7	82.0	2.1	
	AVG:	**80.8**	**77.5**	**81.5**	**79.7**	**79.2**	**1.6**	

*Measurements are from crossbar down to sediment surface. Decreasing distance from crossbar to surface equals increasing sediment elevation.

Table 7. Vertical Sediment Accretion Monitoring (PVC Post Pairs SP5 - SP8; Marsh Expansion Area)*

Live Oak Point Living Shorelines Sediment Accretion Monitoring (PVC Post Pairs SP5 - SP8)								
Sediment PVC Post Pair	**Measurement Position**	**11/25/2024 (cm)**	**12/16/2024 (cm)**	**4/11/2025 (cm)**	**8/28/2025 (cm)**	**10/24/2025 (cm)**	**Surface Elevation Change (cm) 11/25/2024 - 10/24/2025 333 Days**	**Note**
SP5	1FT	86.1	78.0	76.7	75.5	71.2	14.9	Breakwater Segment Installed at This Location 2021/22
	2FT	84.5	80.1	74.9	72.7	69.9	14.6	
	3FT	86.2	80.6	74.4	74.0	69.3	16.9	
	4FT	81.1	80.4	74.1	71.6	68.5	12.6	
	5FT	80.7	80.1	73.4	69.9	68.6	12.1	
	6FT	80.4	78.3	73.6	68.8	68.6	11.8	
	AVG:	**83.2**	**79.6**	**74.5**	**72.1**	**69.4**	**13.8**	
SP6	1FT	86.0	90.8	92.8	92.4	76.6	9.4	Breakwater Segment Installed at This Location AUG 2025
	2FT	85.3	90.4	92.0	91.5	79.0	6.3	
	3FT	84.4	87.8	90.0	90.5	80.7	3.7	
	4FT	83.3	87.6	90.0	90.6	82.9	0.4	
	5FT	83.2	87.6	88.7	89.0	83.7	-0.5	
	6FT	84.3	87.3	87.9	89.3	85.4	-1.1	
	AVG:	**84.4**	**88.6**	**90.2**	**90.6**	**81.4**	**3.0**	
SP7	1FT	78.5	74.5	70.3	75.2	83.1	-4.6	Breakwater Segment Installed at This Location 2021/22
	2FT	79.5	73.5	69.2	71.6	81.6	-2.1	
	3FT	80.4	75.0	69.5	70.9	79.2	1.2	
	4FT	80.2	75.8	69.0	70.8	74.2	6.0	
	5FT	82.6	77.3	71.0	71.0	70.3	12.3	
	6FT	80.4	79.4	73.0	69.5	69.6	10.8	
	AVG:	**80.3**	**75.9**	**70.3**	**71.5**	**76.3**	**3.9**	
SP8	1FT	86.1	87.9	82.7	88.1	88.6	-2.5	Breakwater Segment Installed at This Location 2021/22
	2FT	87.0	87.2	82.4	81.8	88.1	-1.1	
	3FT	87.8	87.0	83.9	83.6	88.2	-0.4	
	4FT	90.0	88.4	85.9	83.9	88.1	1.9	
	5FT	92.3	90.3	86.7	83.4	88.4	3.9	
	6FT	92.8	91.5	88.0	86.9	89.8	3.0	
	AVG:	**89.3**	**88.7**	**84.9**	**84.6**	**88.5**	**0.8**	

*Measurements are from crossbar down to sediment surface. Decreasing distance from crossbar to surface equals increasing sediment elevation.

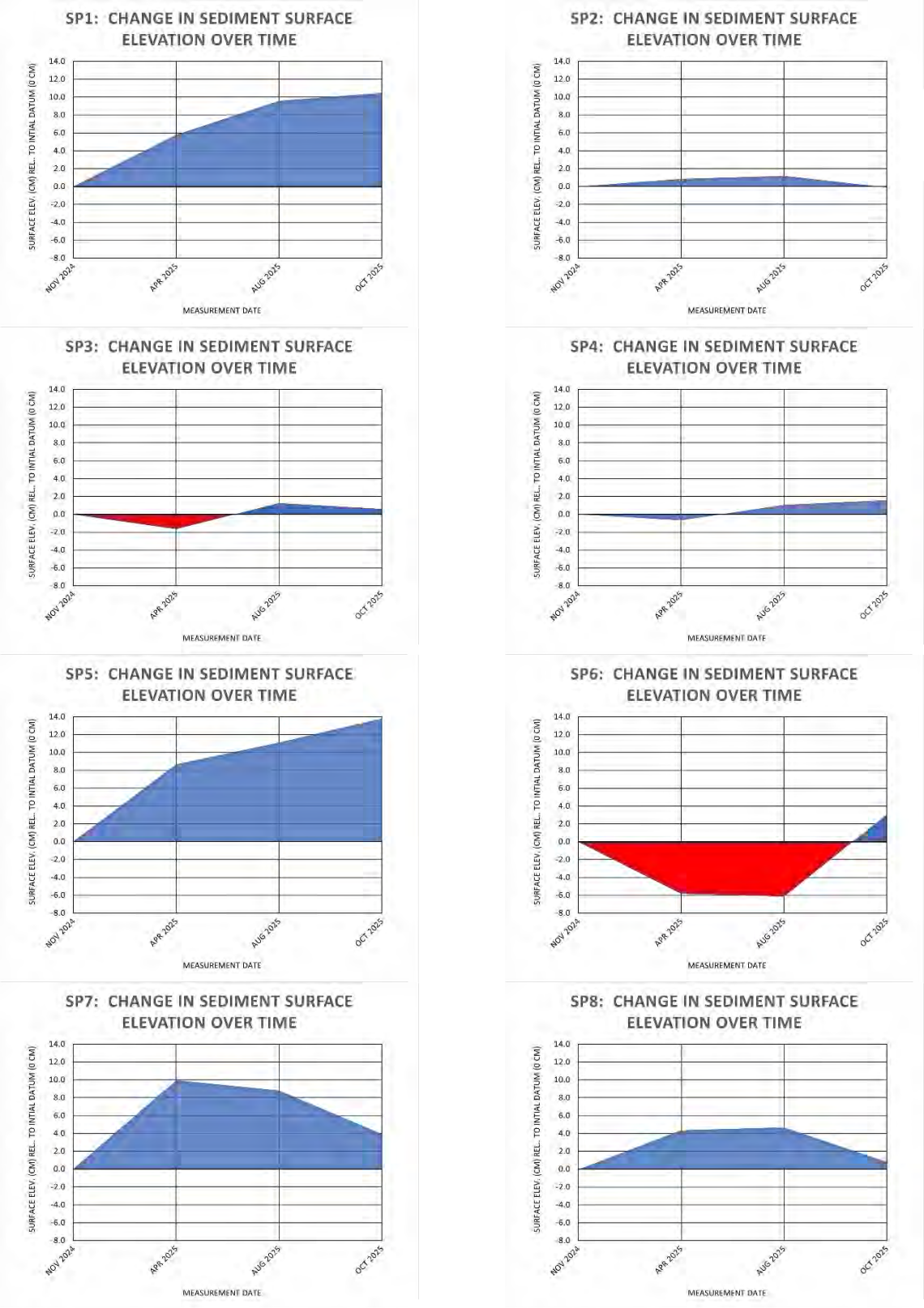


Figure 13. Sediment Accretion Over Time (PVC Post Paris)

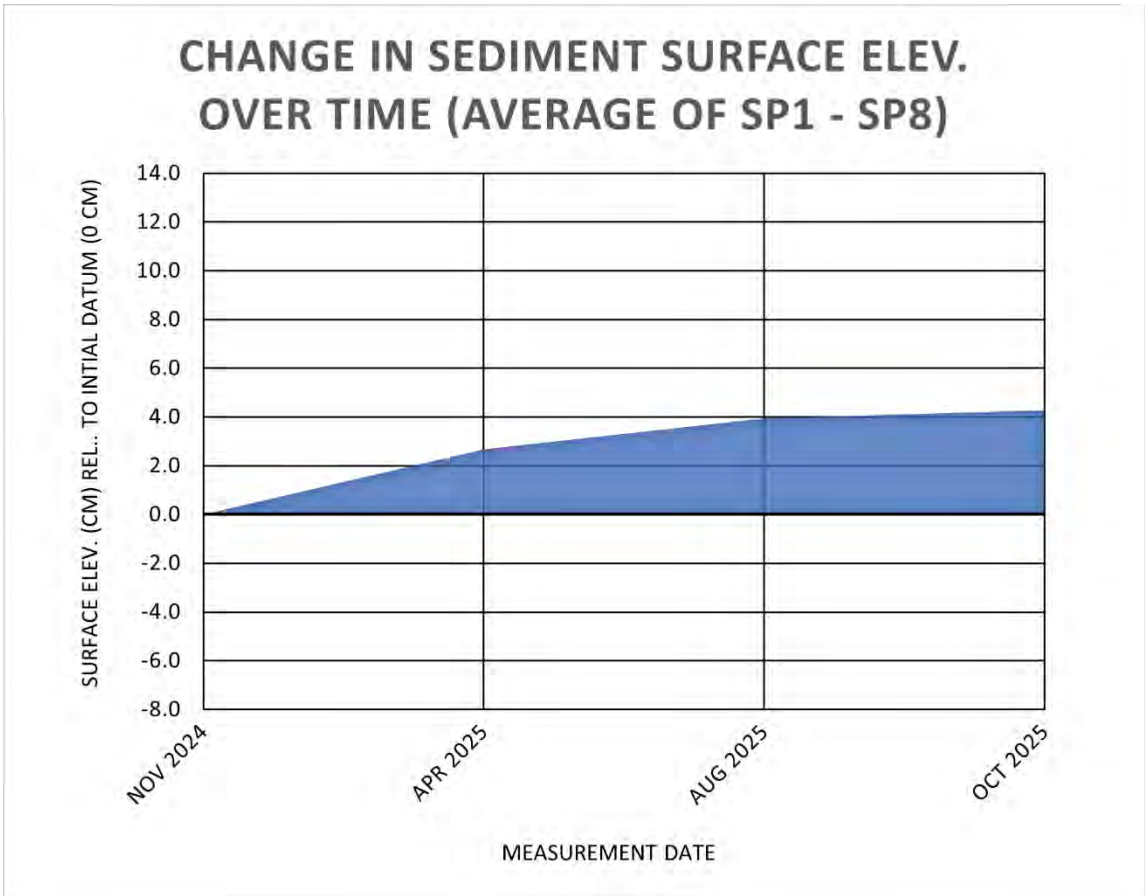


Figure 14. Sediment Accretion Over Time (Average of SP1 - SP8)

Panoramic Photo Monitoring

Project Site Photo Photos

Figure 15. Project Site Photo Point T1 – 10/24/2025

Figure 16. Project Site Photo Point T2 – 10/24/2025

Figure 17. Project Site Photo Point T3 – 10/24/2025

Figure 18. Project Site Photo Point T4 – 10/24/2025

Figure 19. Project Site Photo Point T5 – 10/24/2025

Figure 20. Project Site Photo Point T6 – 10/24/2025

Reference Site Photos

Figure 21. Reference Site Photo Point T7 – 10/24/2025

Figure 22. Reference Site Photo Point T8 – 10/24/2025

Figure 23. Reference Site Photo Point T9 – 10/24/2025

Other Photo Documentation

Figure 24. Marsh Expansion Behind Limerock Breakwaters (8/28/2025)

Figure 25. Fall 2025 Vegetation Monitoring (10/28/2025)

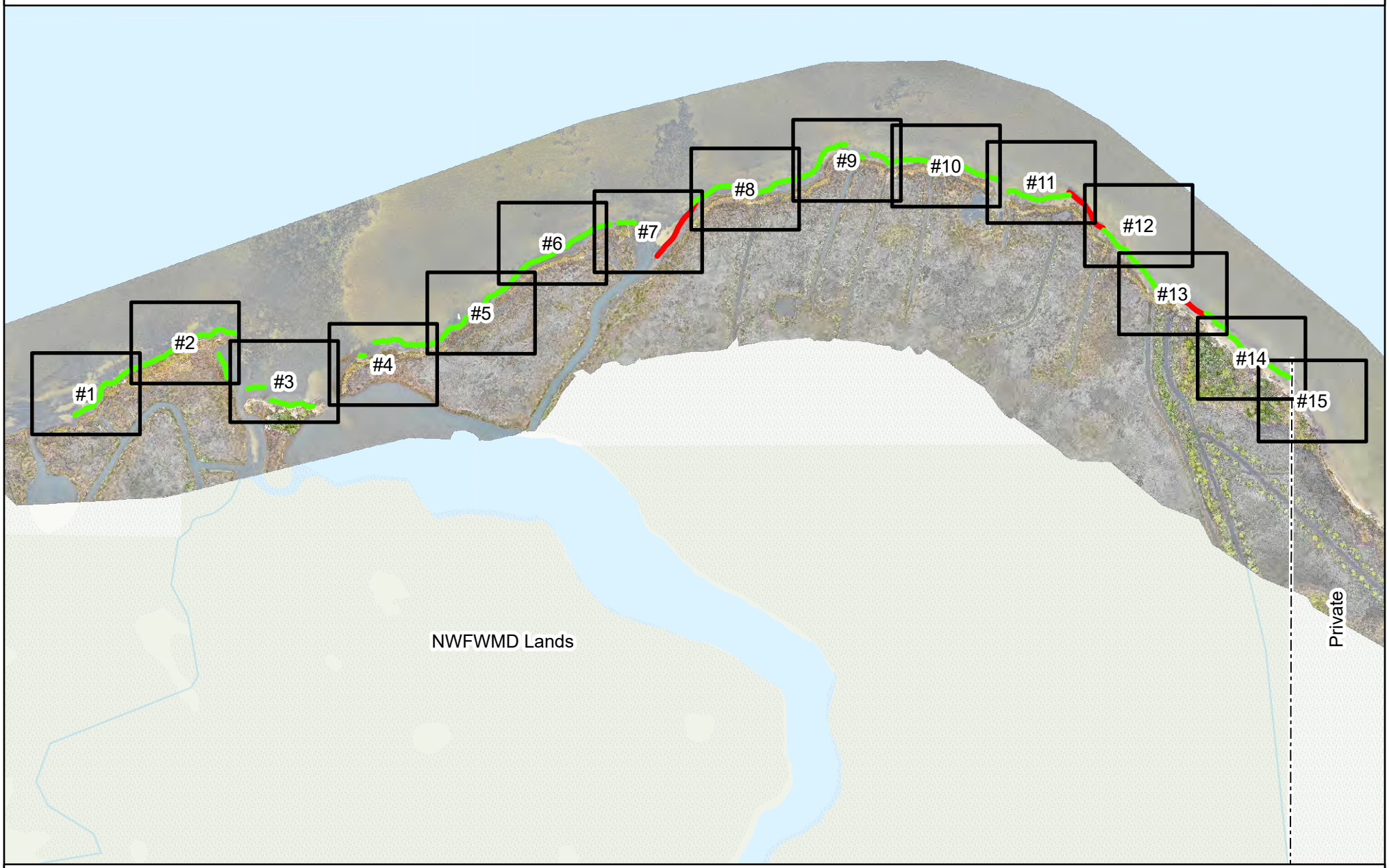
Figure 26. Sediment Accretion Monitoring Station (PVC Post Pairs; Station SP-1) and Marsh Expansion Between Breakwater and Shore (10/24/2025)

Figure 27. Oyster Colonization on Breakwater (10/24/2025)

Figure 28. Submerged Aquatic Vegetation (*Halodule wrightii*) Colonization Behind Limerock Breakwater (10/24/2025)

Figure 29. Drone Operations at Live Oak Point (10/28/2025)

Live Oak Point Living Shorelines - Drone Imagery (October 28,2025)



Map Inset (e.g., #1)

Completed Breakwater (~4,130 FT; Constructed 2021 - 2025)

Oyster Shell Breakwater (~550 FT; Constructed 2011)

0 0.1 0.2 Miles

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #1

Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #2

Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #3

Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #4

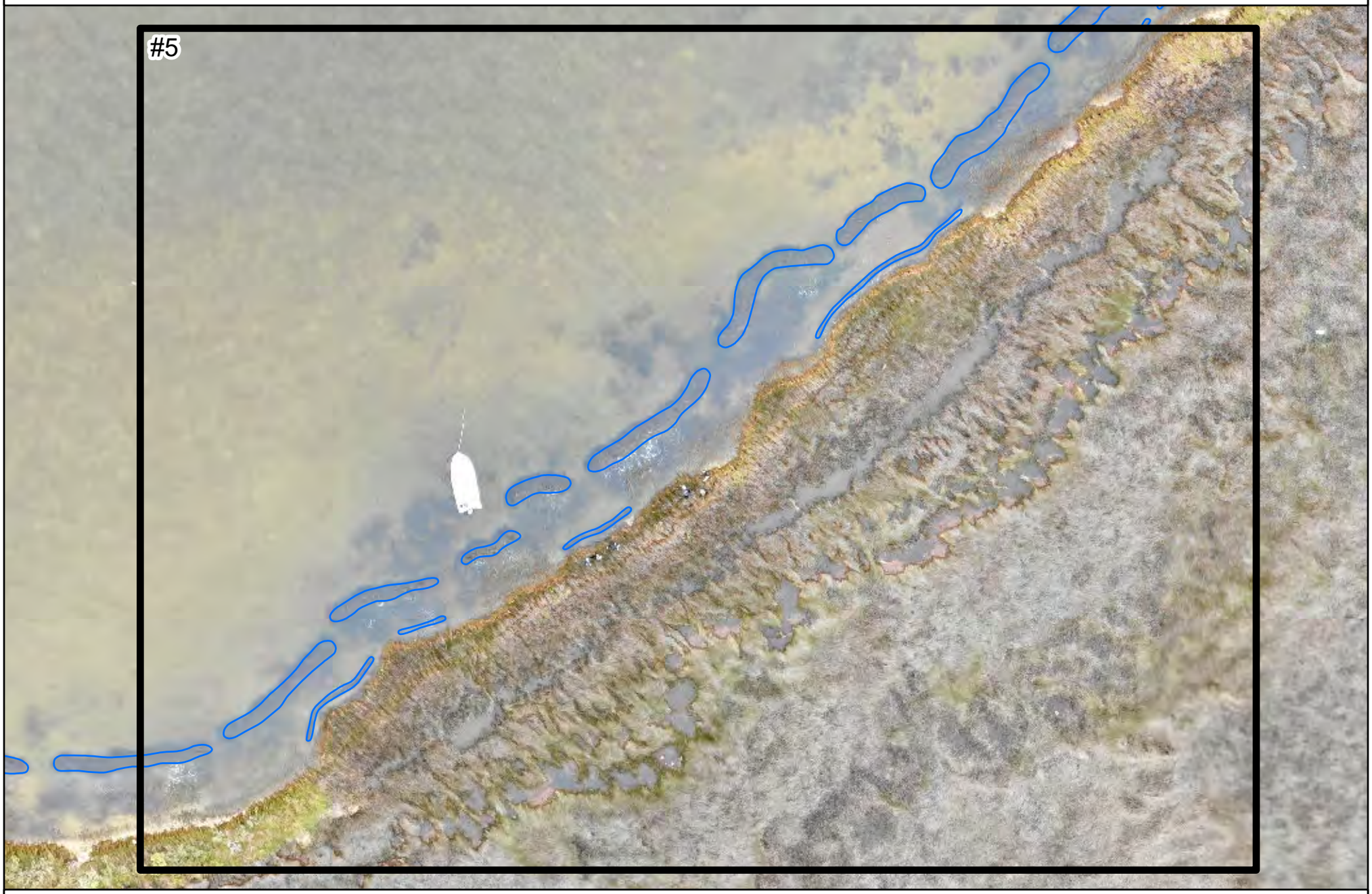
Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #5



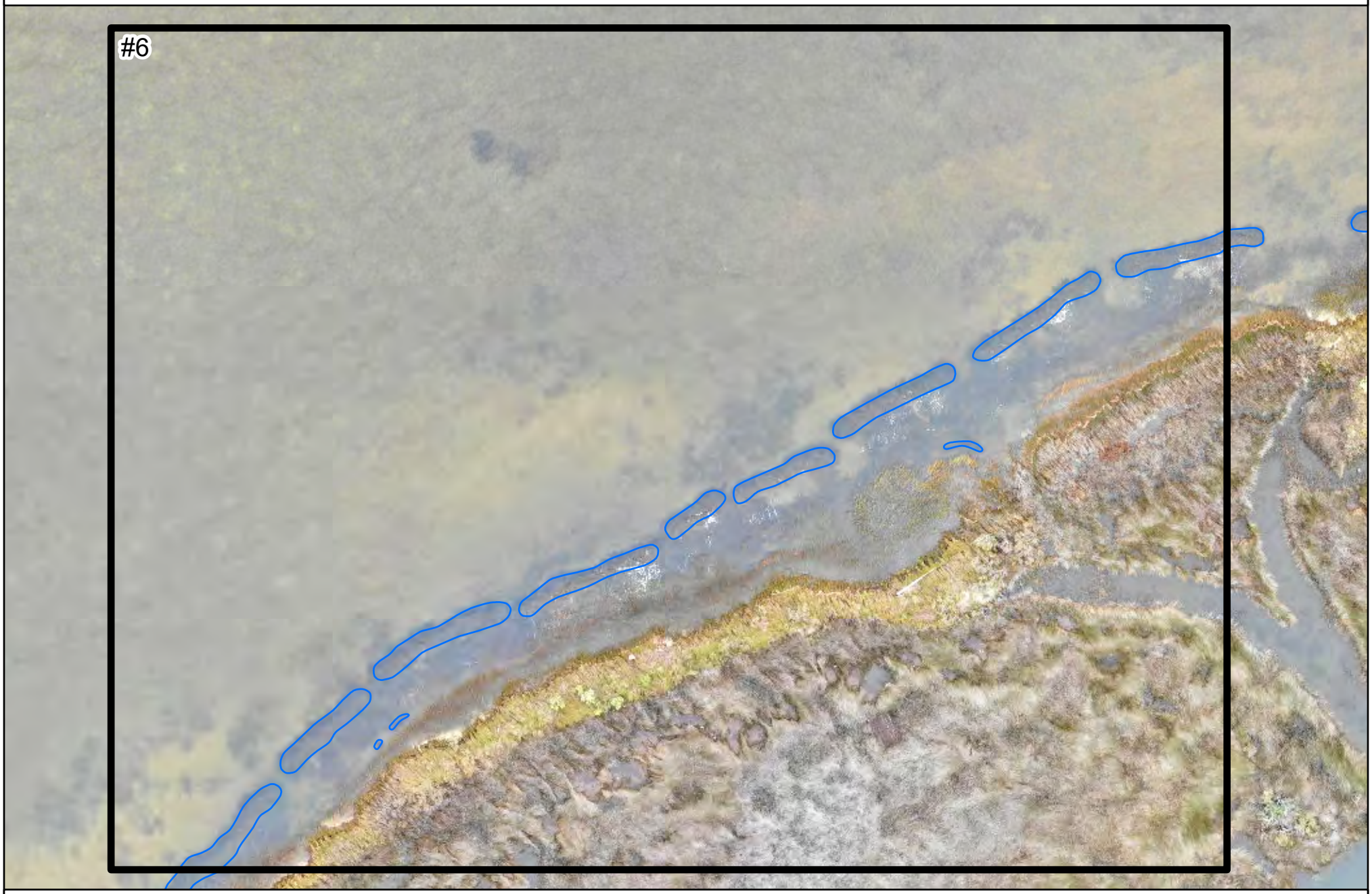
Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #6



Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #7

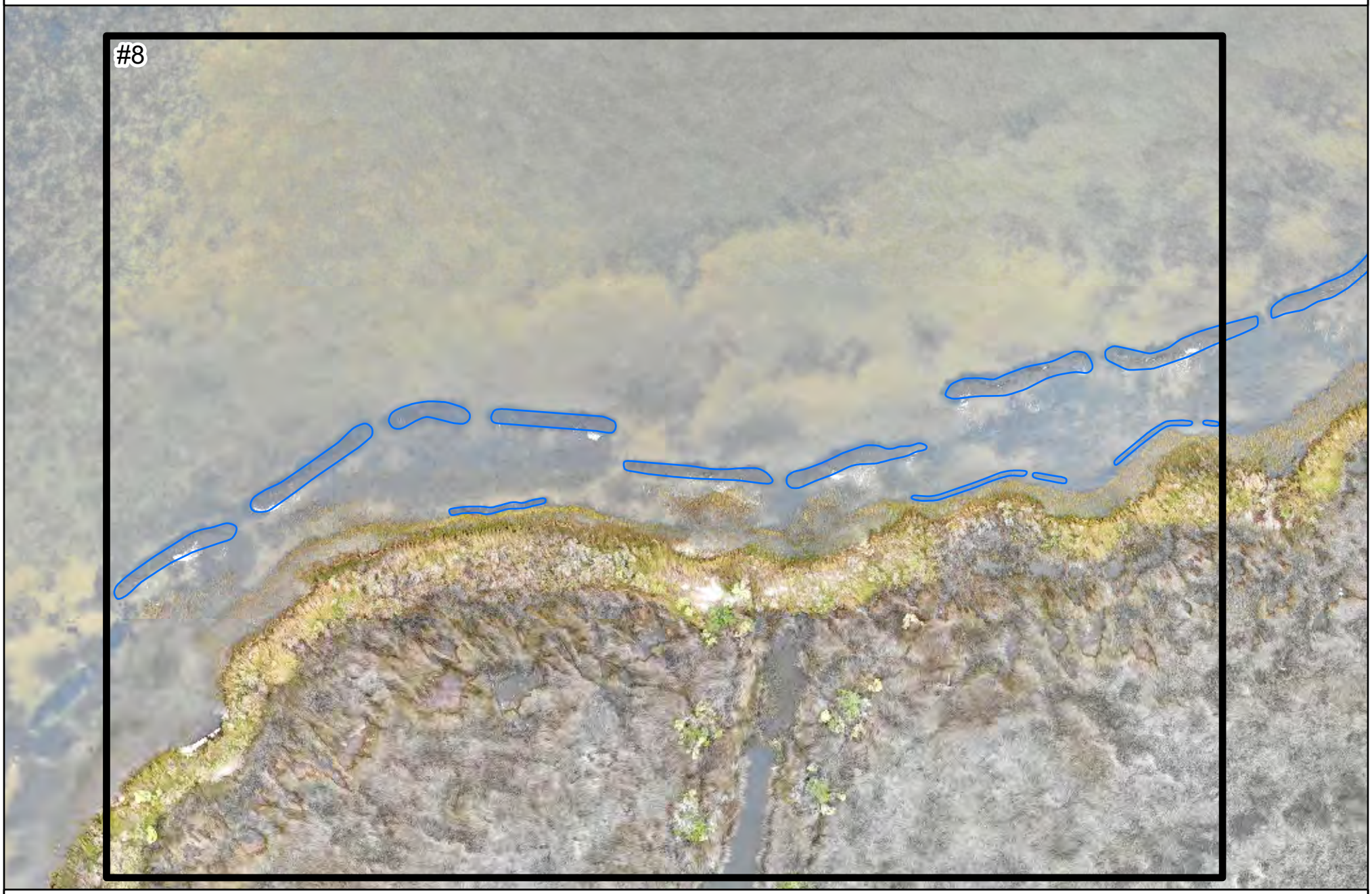
Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #8



Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #9

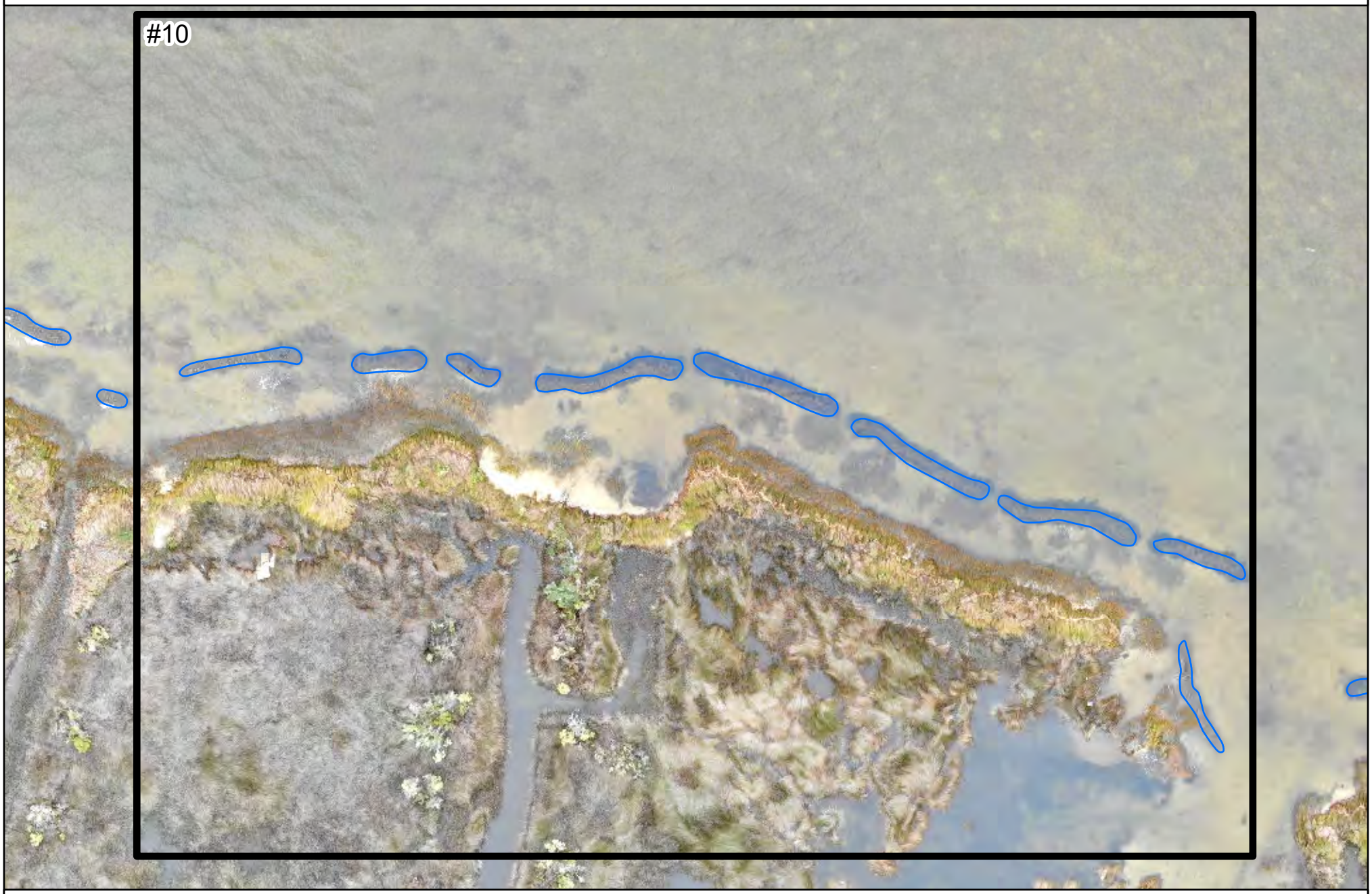
Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #10



Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #11

Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #12

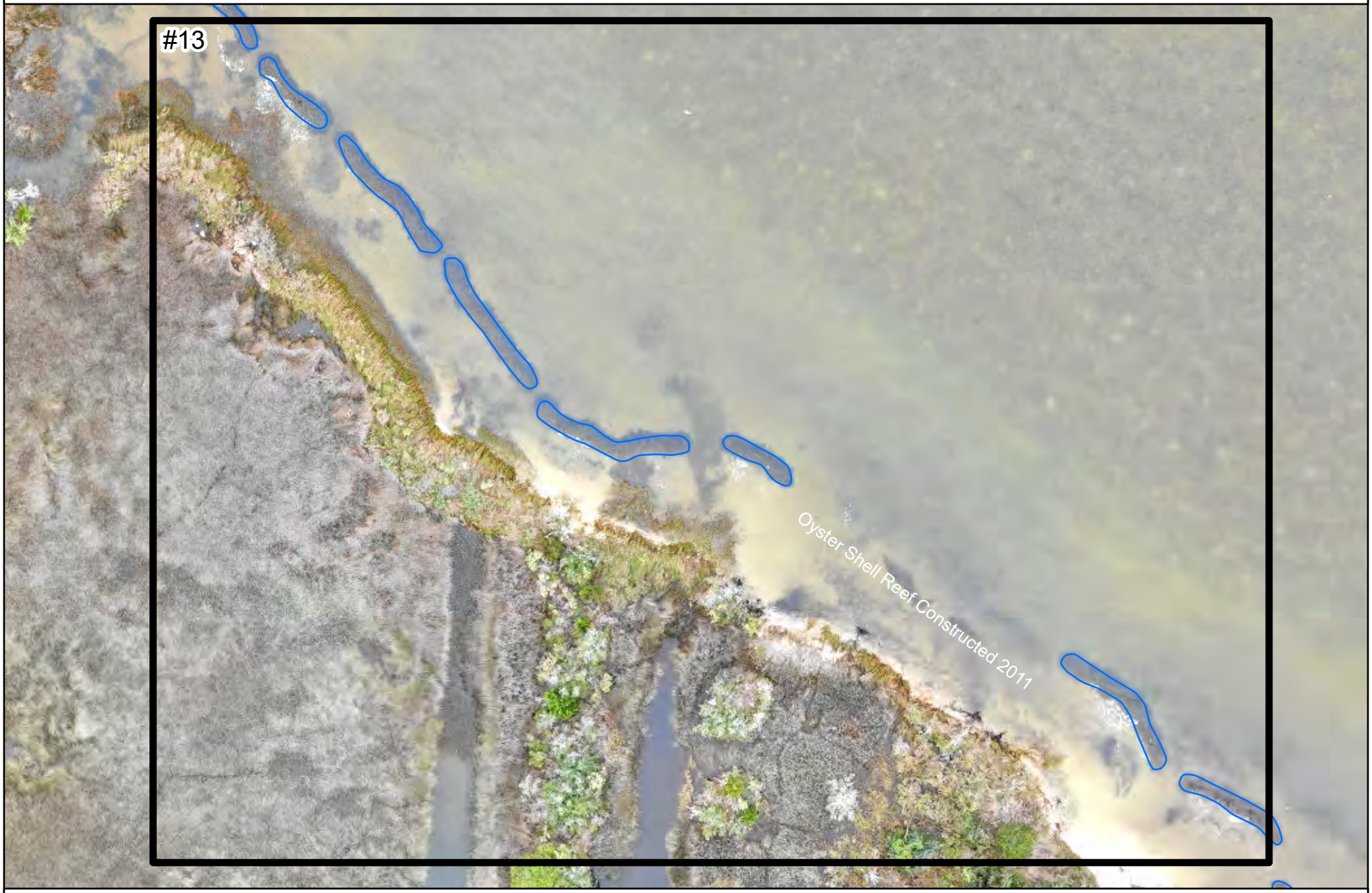
Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #13



Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #14

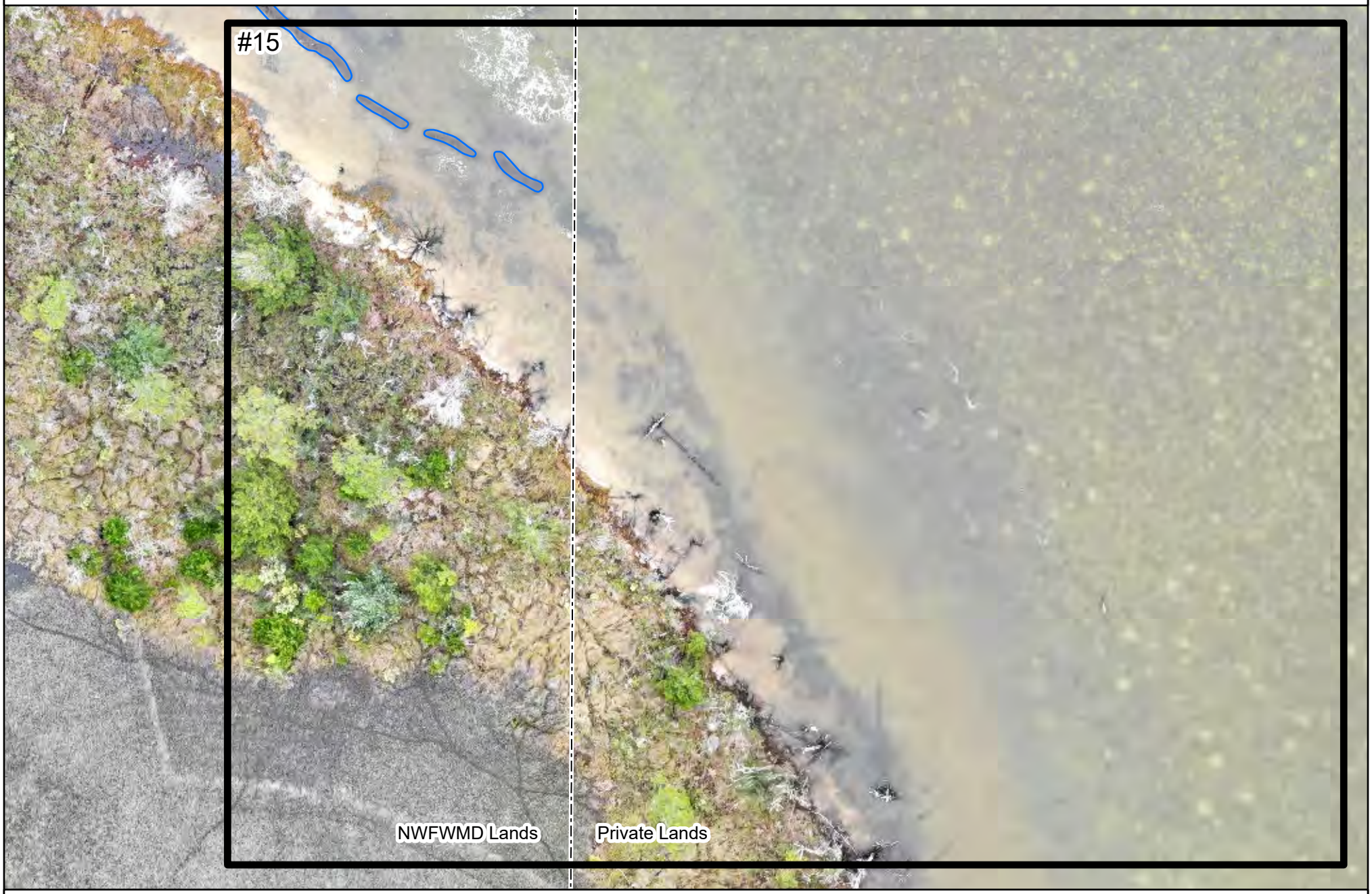
Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N

Live Oak Point Living Shorelines - Drone Imagery Map Inset #15



Breakwater Segment

Drone Imagery Acquired 28 October 2025

0 50 100 Feet

N