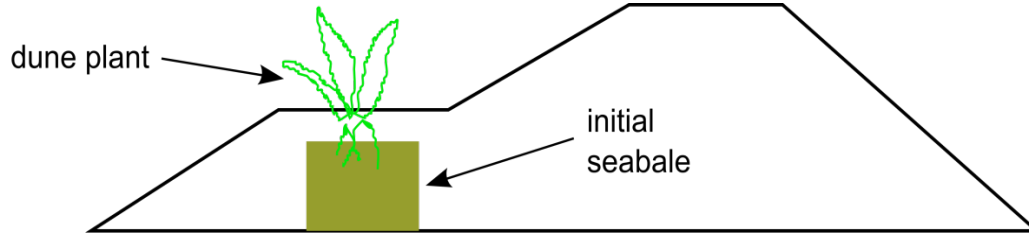




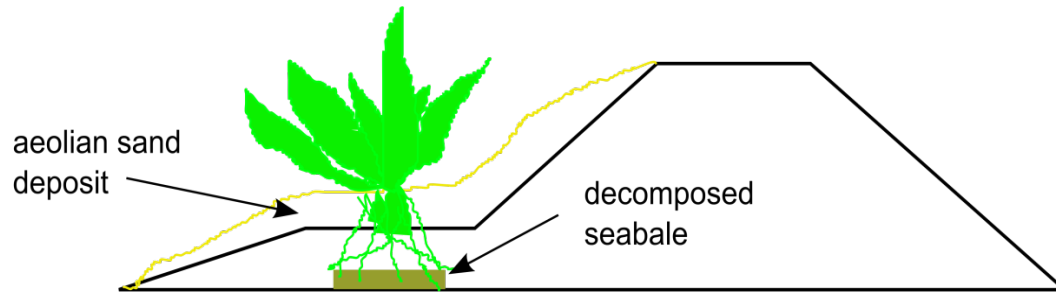
Engineered Dune Field Research:

1. Innovative Technology Seabale Dunes (CEPRA)
2. Dune Volume/Geometry Relation to Hydrodynamic and Beach Profile Parameters

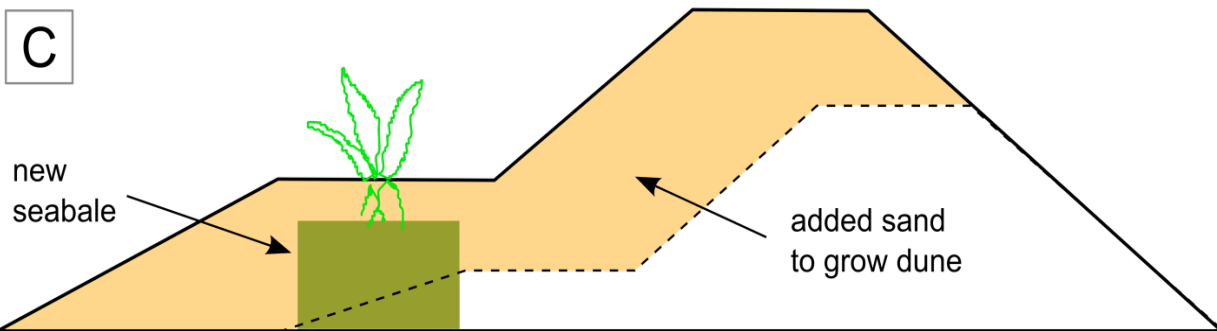
A



B



C





15 ft mark: An average distance from seawall base to back toe of the Dune

50 ft mark: An average distance from front toe of the Dune to MLW

2015 Galveston Seawall Beach Expansion

Pre-Project vs Post-Project

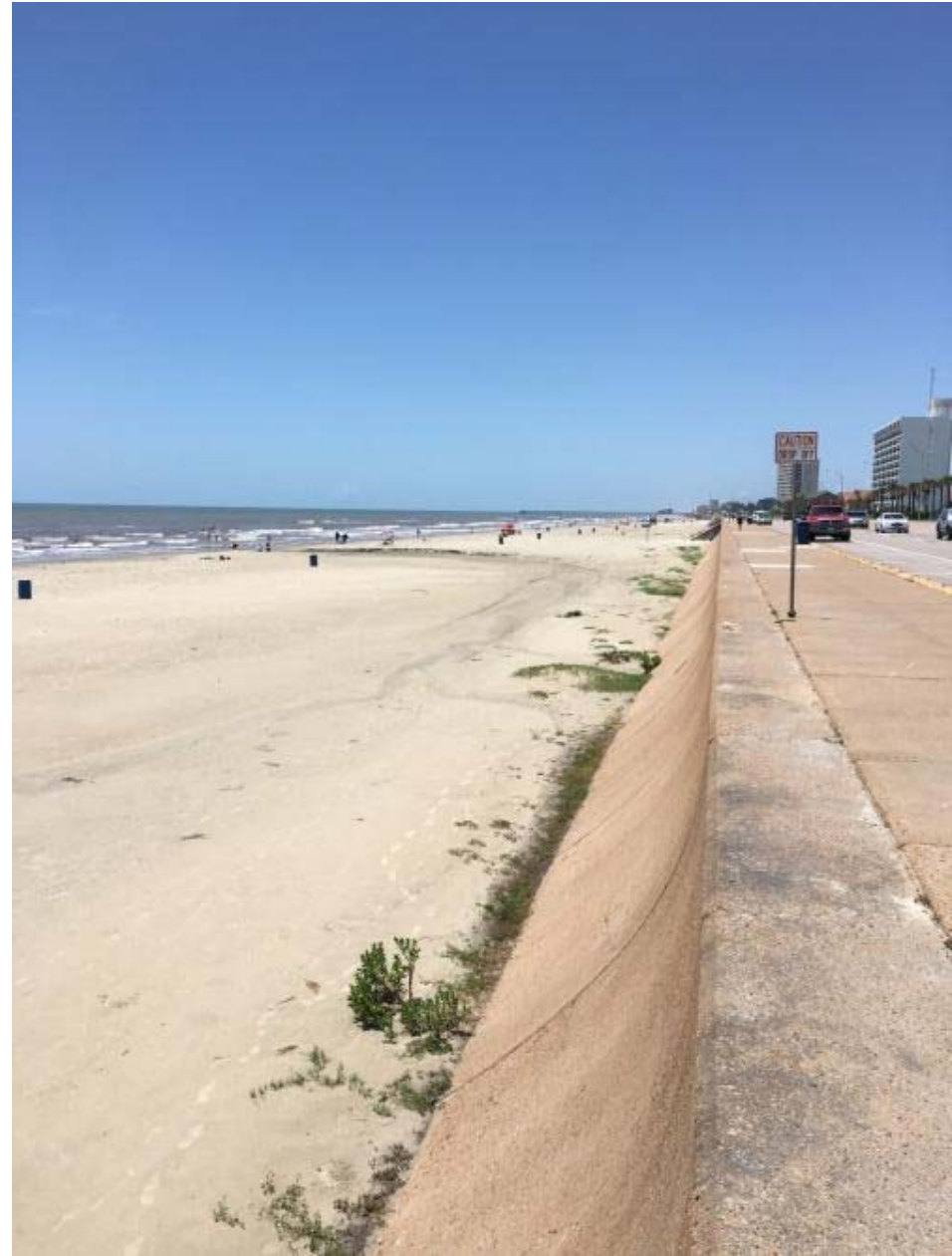


- Completed Sections
- 0 to 1200 ft - End September
 - 1300 to 3200 ft - 16 October
 - 3300 to 4900 ft - 18 November

A pre-project survey was done of the existing location along the Seawall between 61st and 81st street. As each section of beach was completed a survey was conducted to document the status of the beach fill. The beach gains can be seen in the graphics.



69th Street

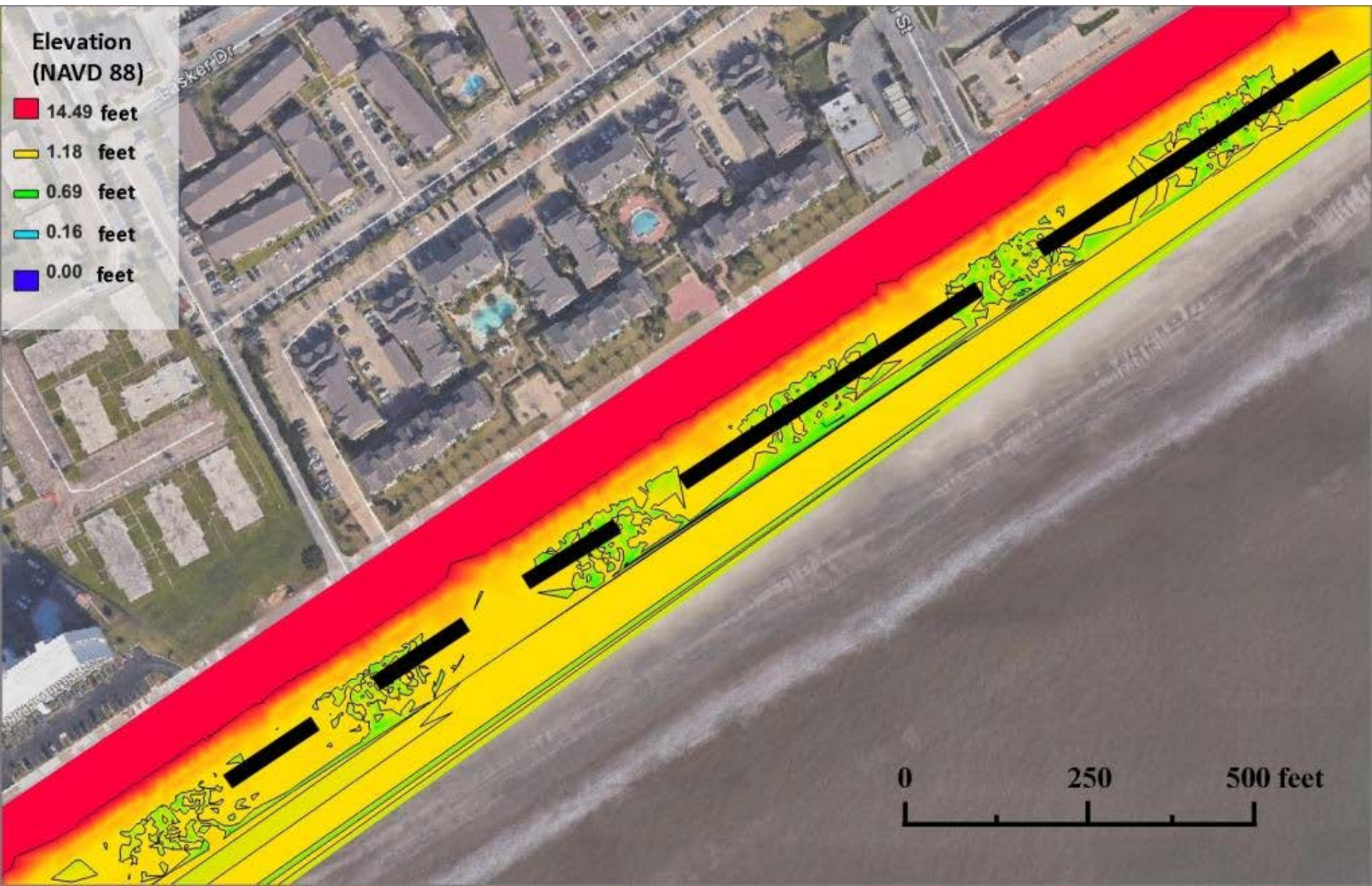




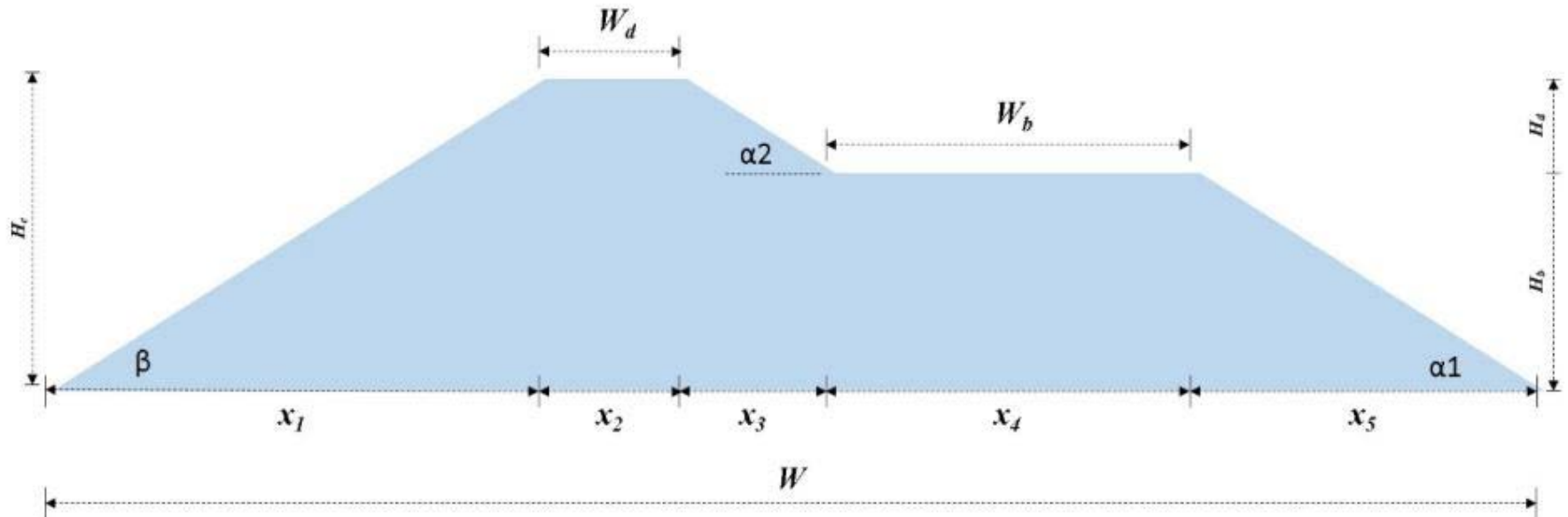
69th Street







Dune Cross-Section





Parameters	Type Dunes							Note
	Pilot Dune	Segment 01		Segment 02	Segment 03-1	Segment 03-2	Segment 03-3	
		100% volume	100% volume	75% volume	50% volume	25% volume		
L	800.0	800.0	500.0	500.0	150.0	150.0	150.0	length of dune
W (ft)	22.0		25.0	25.0	21.8	17.8	12.5	total width of dune base
H _c (ft)	5.5		6.3	6.3	5.4	4.4	3.1	height of dune crest above base
a	3.5		3.5	3.5	3.5	3.5	3.5	proportional constant defining H _b (i.e., H _b :H _d = a:b)
b	2.0		2.0	2.0	2.0	2.0	2.0	proportional constant defining H _d (i.e., H _b :H _d = a:b)
tan(α ₁)	0.7		0.7	0.7	0.7	0.7	0.7	frontal slope of berm H _b /x ₁
tan(α ₂)	0.7		0.7	0.7	0.7	0.7	0.7	frontal slope of dune H _d /dx ₃
tan(β)	0.7		0.7	0.7	0.7	0.7	0.7	back slope of dune H _c /x ₅
W _b (ft)	5.0		5.7	5.7	4.9	4.0	2.8	width of berm crest = x ₂
W _d (ft)	2.0		2.3	2.3	2.0	1.6	1.1	width of dune crest = x ₄
H _b (ft)	3.5		4.0	4.0	3.5	2.8	2.0	height of berm above base
H _d (ft)	2.0		2.3	2.3	2.0	1.6	1.1	height to the dune crest above H _b
x ₁ (ft)	7.9		8.9	8.9	7.8	6.3	4.5	
x ₂ (ft)	2.0		2.3	2.3	2.0	1.6	1.1	
x ₃ (ft)	2.9		3.2	3.2	2.8	2.3	1.6	
x ₄ (ft)	5.0		5.7	5.7	4.9	4.0	2.8	
x ₅ (ft)	5.0		5.7	5.7	4.9	4.0	2.8	
A (ft ³ /ft)	71.7	68.0	92.6	92.6	70.1	46.7	23.2	area of dune cross section or volume per unit length (L=1)
V (ft ³)	57371.4	54400.0	46303.1	46303.1	10514.1	7002.4	3472.7	volume of entire dune (sand only)
V (yd ³)	2124.9	2014.8	1714.9	1714.9	389.4	259.3	128.6	volume of entire dune (sand only)
volume ratio (%)			100.0	100.0	75.7	50.4	25.0	
Subtotal							4207.2	
Total							5100	with 20 % margin, rounded up



Specific CEPRA Project Tasks:

- Modify existing beach raking equipment for optimized Sargassum pick-up and compaction into bales or utilize existing equipment to pick-up and compact Sargassum.
- Collect and compress Sargassum wrack with minimal beach sand disturbance.
- Restore/build 800-ft long prototype dune section on Galveston Island for continued research and monitoring regarding re-application of seabales.
- Survey and monitor the project location over the 1.5-year duration of the project (video monitoring, quarterly beach and dune profiles, and hydrodynamic forcing conditions). Beach profiles will be collected in cooperation with a professional TX licensed surveyor.
- Sample dune sediment and vegetation quarterly to track sediment composition, seabale compaction and plant growth.