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January 13, 2020

Iris Hill
Town Administrator
Town of Edisto Beach
2414 Murray St
Edisto Beach, SC 29438

RE: Hurricane *Dorian* Beach Damage Assessment [CSE 2485]

Dear Iris,

Hurricane *Dorian* impacted the shoreline of Edisto Beach around 5–6 September 2019. The storm produced high water levels (surge), increased wave energy, and tropical-storm-force winds as it passed inland. Offshore wave heights were measured at 7.5 meters (m) (~25 feet [ft]) during the storm. The storm passed just offshore of Edisto Beach, with the eye located about 70 miles offshore at 1200 UTC on 5 September. At that time, *Dorian* was a Category 3 storm with ~115 mph winds.

Figure 1 shows the water levels measured at Charleston Harbor during the storm event. The tide elevations were running higher than predicted prior to the storm (over +7.0 ft MLLW), then sharply decreased when the storm passed on the 5 September when the tide was nearly 2 ft below the predicted level. Water levels returned to normal conditions by 7 September.

CSE completed a post-storm survey to document changes to the beach profile and volume losses on 9 September 2019. Profiles were obtained from the landward sand limit to ~1,500 ft offshore (well beyond the local depth of closure). Profiles were obtained in each groin cell and at 600 ft spacing in the Edisto Beach State Park (Figure 2). The surveyed area encompassed the shoreline between the northern end of the state park camping area to South Edisto River, which includes all areas filled during the 2017 Edisto Beach Nourishment Project and has previously been determined to be a qualifying "engineered beach" by FEMA. The post-storm survey data are compared to a recent comprehensive monitoring survey CSE completed for the Town of Edisto Beach in late July 2019 that included profiles at the same locations as the post-storm survey.

For this analysis, the closure depth was established at –14 ft NAVD based on a review of comparative profiles over the past ~15 years. Repeated profiles along the front beach typically begin overlap near a depth of –13 ft NAVD, and the profile flattens near –14 ft NAVD. The volumes reported are sand volumes above –14 ft NAVD between the start of the beach profile and the closure depth.

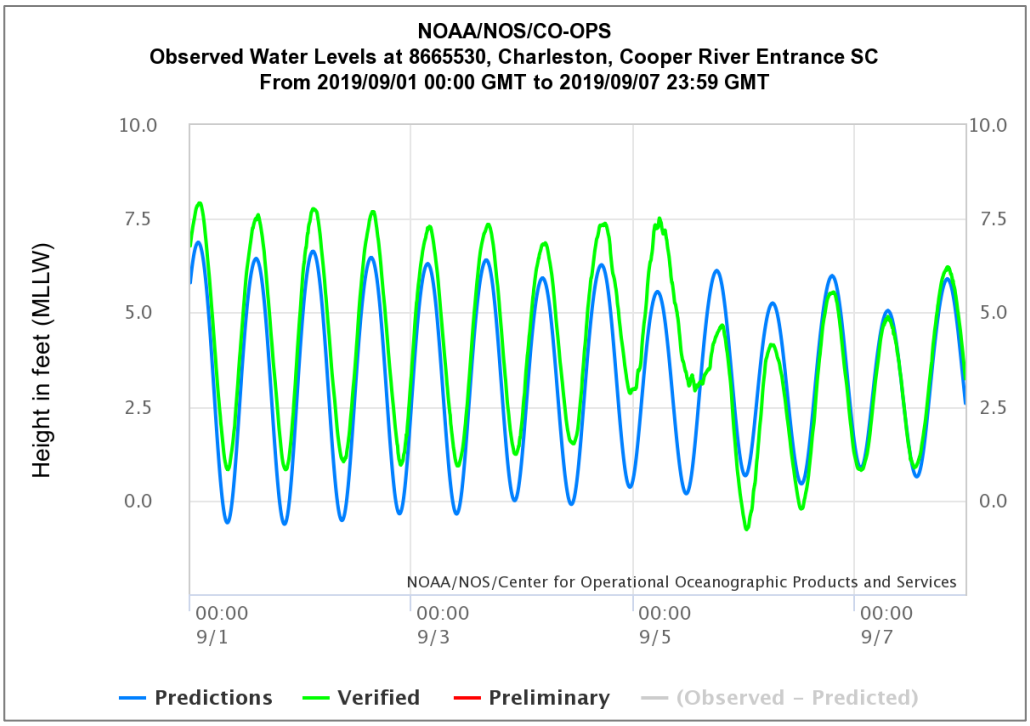


FIGURE 1. NOAA water level data from Charleston Harbor, SC.

FIGURE 2. Location of beach profiles (dotted lines) surveyed annually and following Hurricane *Dorian*. See the line numbers in the Table 2.

Engineered Beach Information

Title: Edisto Beach Management Program

Original Project: 2006 project totaling 694.900 cubic yards (cy) of sand along 15,500 linear feet (lf) of beach (Groin 1 to Groin 27). Permit No. 2005-1W-182

Maintenance Project

Permit No: 2015–00528 from SCDHEC-OCRM and USACE

Volume: 1,006,000 cy

Length: 19,000 lf (including 3,300 lf in the Edisto Beach State Park and 15,700 lf along the Town)

Construction Dates: 25 Jan – 14 April 2017

Nourishment Cost: $12,198,780 including $2,683,800 mobilization

Groin Extensions: 23 Extensions totaling 1,630 lf; 10,130 tons of armor stone; 1,165 lf sheet pile with concrete cap; 37,800 sq ft marine mattress

Groin Extension Cost: $5,424,642.29

Engineering/Permitting/Monitoring Cost: $814,414

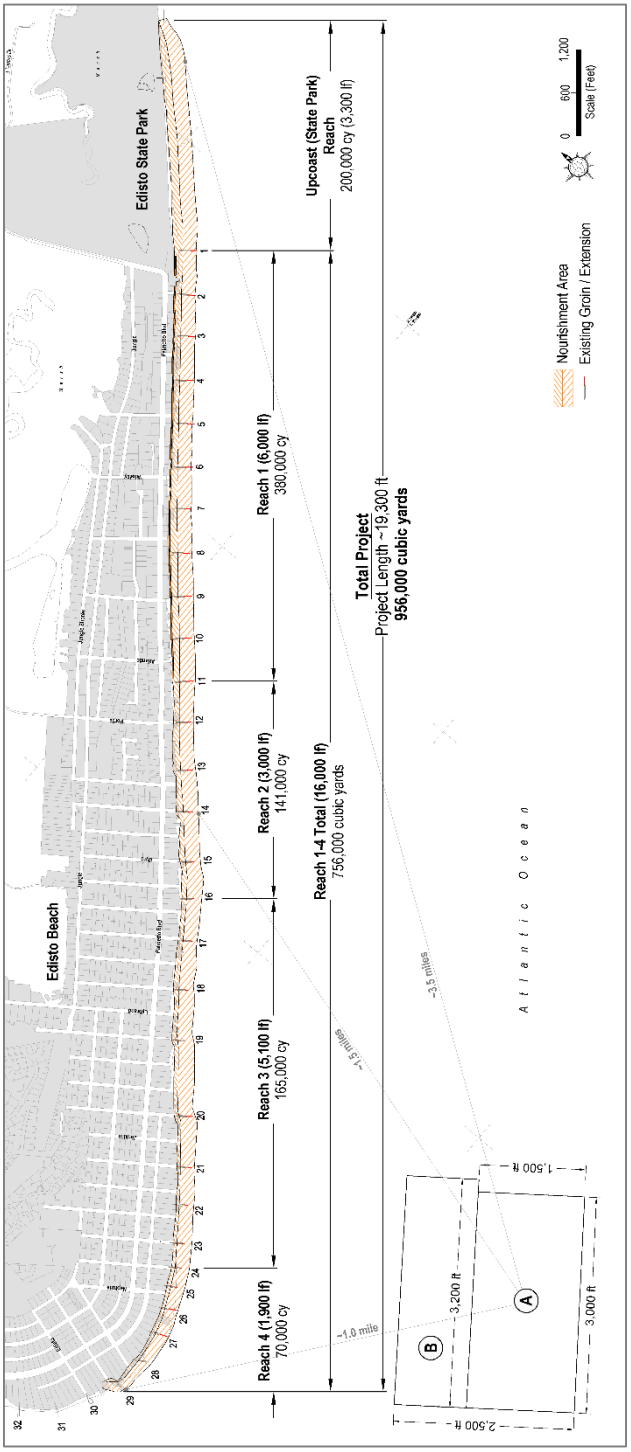
Northern Project limit: 32° 30'35.26"N 80° 17'16.85"W

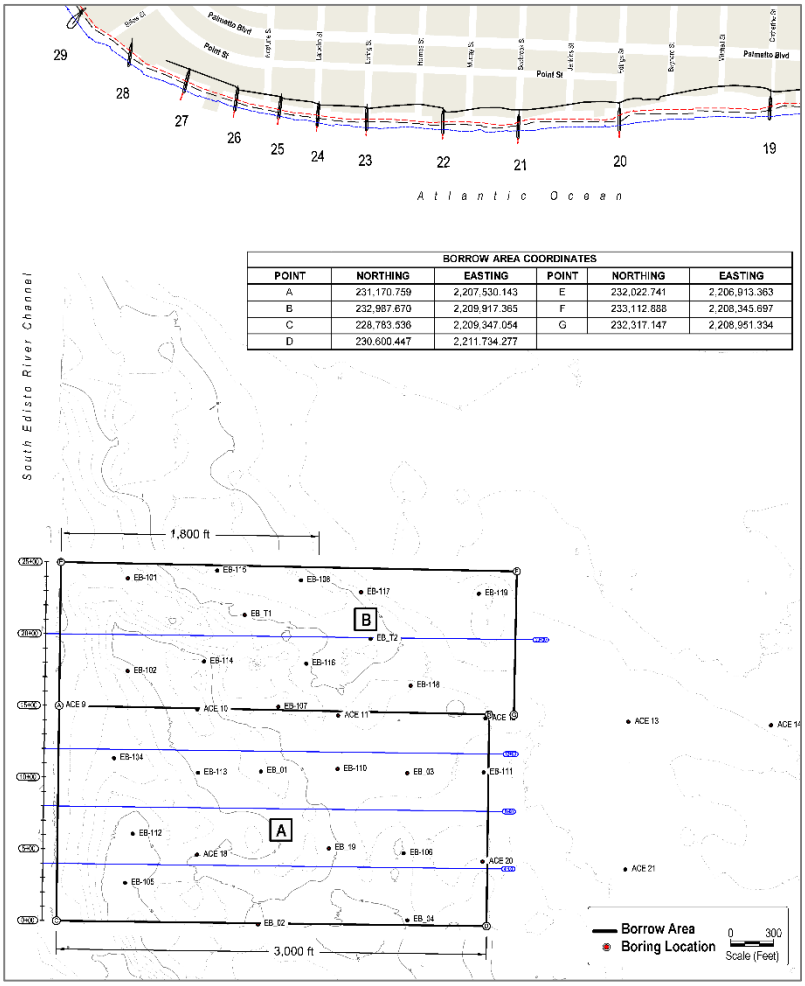
Northern Town Limit: 32° 30'11.03"N 80° 17'46.01"W

Southern Project Limit: 32° 28'42.29N 80° 20'12.94"W

Figure 3 shows the design plan for the 2017 maintenance project. (Note that the design volume is 956,000 cy due to a 50,000 cy volume increase by the Town through a change order during construction.) The limits of the fill are shaded, including the design berm and slope. The borrow area used in the project is also shown in Figure 3. Latitude and Longitude for the borrow area corners are provided in Table 1.

The Town of Edisto Beach is committed to long-term beach preservation via beach nourishment on a regular cycle. The Town's Local Comprehensive Beach Management Plan identifies a planned renourishment interval of 14–16 years following the installation of groin extensions as part of the 2017 project. The 2017 project was a maintenance project for the original 2006 nourishment project. At that time, the planned renourishment interval was 10 years, and the Town set aside accommodation tax each year to support the nourishment project (typically $200,000 per year). The Town initiated permitting activities for the maintenance project in 2014, with the design based on results of annual monitoring efforts sponsored by the Town following the 2006 project. The design of the maintenance project considered the localized erosion rates along the project area, existing setbacks of structures, and remaining sand volumes from the 2006 project. The project also was designed to restore protective dunes that were destroyed during Hurricane *Matthe*w in the fall of 2016. Since 2006, the Town has regularly provided maintenance to the 2006 beach nourishment project via the installation of dune plantings and sand fencing. The Town also has responded to major storm events that eroded the dunes along portions of the island by rebuilding the dunes and adding additional vegetation and sand fence.





BORROW AREA COORDINATES

POINT	NORTHING	EASTING	POINT	NORTHING	EASTING
A	231,170.759	2,207,530.143	E	232,022.741	2,206,913.363
B	232,987.670	2,209,917.365	F	233,112.888	2,208,345.697
C	228,783.536	2,209,347.054	G	232,317.147	2,208,951.334
D	230,600.447	2,211,734.277			

FIGURE 3. Design plan for the 2017 maintenance project. Note 50,000 cy of additional sand were added to the design during construction.

TABLE 1. Borrow Area coordinates for the 2017 maintenance project. The 2006 original project utilized the inner portion of the borrow area shown in Figure 4.

Vertex	X	Y	LATITUDE	LONGITUDE
A	2208427	230033.4	32.46365678° N	80.32427135° W
B	2209921	233024.5	32.47185087° N	80.31936639° W
C	2207519	231227	32.46695365° N	80.32719132° W
D	2210815	231850.3	32.46860733° N	80.31649316° W
E	2206913	232022.7	32.46915153° N	80.32913809° W
F	2209459	233928.1	32.47434254° N	80.32084397° W
G	2210059	233128.1	32.47213292° N	80.31891567° W

Table 2 provides volume change values for each profile and sums for the Town's engineered beach area (Reach 1 through Reach 4). Overall, the engineered beach lost 34,383 cy of sand to closure depth (–14 ft NAVD). The most significant areas of erosion were along the north end of the Town's beach, Cells 11 through 14 (600–1000 block), and cell 17. Figure 4 shows the beach unit volume changes in the project area from pre-storm (July 2019) and post-storm (September 2019). The Town's portion of the recent beach project includes Reaches 1–4 (Lines 2-80).

The total volume loss for the storm (34,383 cy) includes background erosion. The project area averages a loss of 41,278 cy per year, as determined from total losses between 2006 and 2015. Applying this value over five weeks (the interval between pre- and post-storm surveys), yields a five-week loss of 3,969 cy. Subtracting the background erosion from the measured losses provides a **total storm-induced loss of 30,414 cy**.

Profiles for the pre-nourishment, post-nourishment, and pre- and post-*Dorian* beach conditions are provided in Attachment A. The plots show the movement of contours, dune erosion, and overall volume change for each profile. Post-storm photos are provided at the end of this letter.

TABLE 2. Beach volume changes occurring during Hurricane *Dorian*.

Line Number	Line Name	July 2019 (pre-storm)	September 2019 (post-storm)	Unit Volume Change	Distance to Next Station	Total Volume Change
		cy/ft			ft	cy
100	2700	245.8	244.0	-1.8	600	-2,250
98	2100	269.1	263.4	-5.7	600	-3,472
96	1500	276.8	270.9	-5.8	600	-3,847
94	900	251.5	244.5	-7.0	600	1,685
92	300	236.8	249.4	12.6	600	3,084
2	01+300	201.5	199.2	-2.3	598	-4,189
5	02+300	227.2	215.5	-11.7	593	-4,821
8	03+300	208.7	204.1	-4.6	603	-1,195
11	04+300	205.8	206.4	0.6	605	-3,010
14	05+300	215.9	205.4	-10.6	590	-5,302
17	06+300	225.6	218.2	-7.4	591	-3,247
20	07+300	216.8	213.2	-3.6	616	-2,792
23	08+300	247.0	241.6	-5.5	601	-2,086
26	09+300	281.3	279.8	-1.5	596	378
29	10+300	287.1	289.8	2.8	599	-2,182
32	11+300	260.1	250.1	-10.0	575	-5,115
35	12+300	227.4	219.6	-7.8	645	-4,467
38	13+300	220.8	214.7	-6.1	586	-4,072
41	14+350	205.0	197.2	-7.8	667	-1,789
44	15+245	188.2	190.6	2.4	530	535
47	16+300	199.4	199.0	-0.4	587	-3,166
50	17+300	195.3	184.9	-10.4	678	-4,427
53	18+300	192.0	189.3	-2.7	694	833
56	19+525	213.5	218.6	5.1	1055	2,907
59	20+350	191.4	191.9	0.4	693	629
62	21+265	187.3	188.7	1.4	528	2,273
65	22+268	193.4	200.6	7.2	490	2,497
68	23+220	179.1	182.1	3.0	296	1,336
70	24+190	180.3	186.3	6.0	309	1,739
72	25+200	175.8	181.0	5.2	255	302
73	26+115	179.1	176.2	-2.8	580	-2,311
76	27+290	184.5	179.4	-5.1	430	6,196
78	28+277	179.4	213.3	33.9	277	5,043
104	29+90	251.6	254.1	2.5	430	-388
106	30+85	185.1	180.9	-4.3	970	-4,490
80	CSE2130B	220.0	215.0	-5.0	0	0
Total Change Along Town Portion of Beach* (cy)						-34,383
Total Change Along Town Portion of Beach Accounting for Background Erosion* (cy)						-30,414

*Total does not include the State Park or areas outside of the engineered beach area

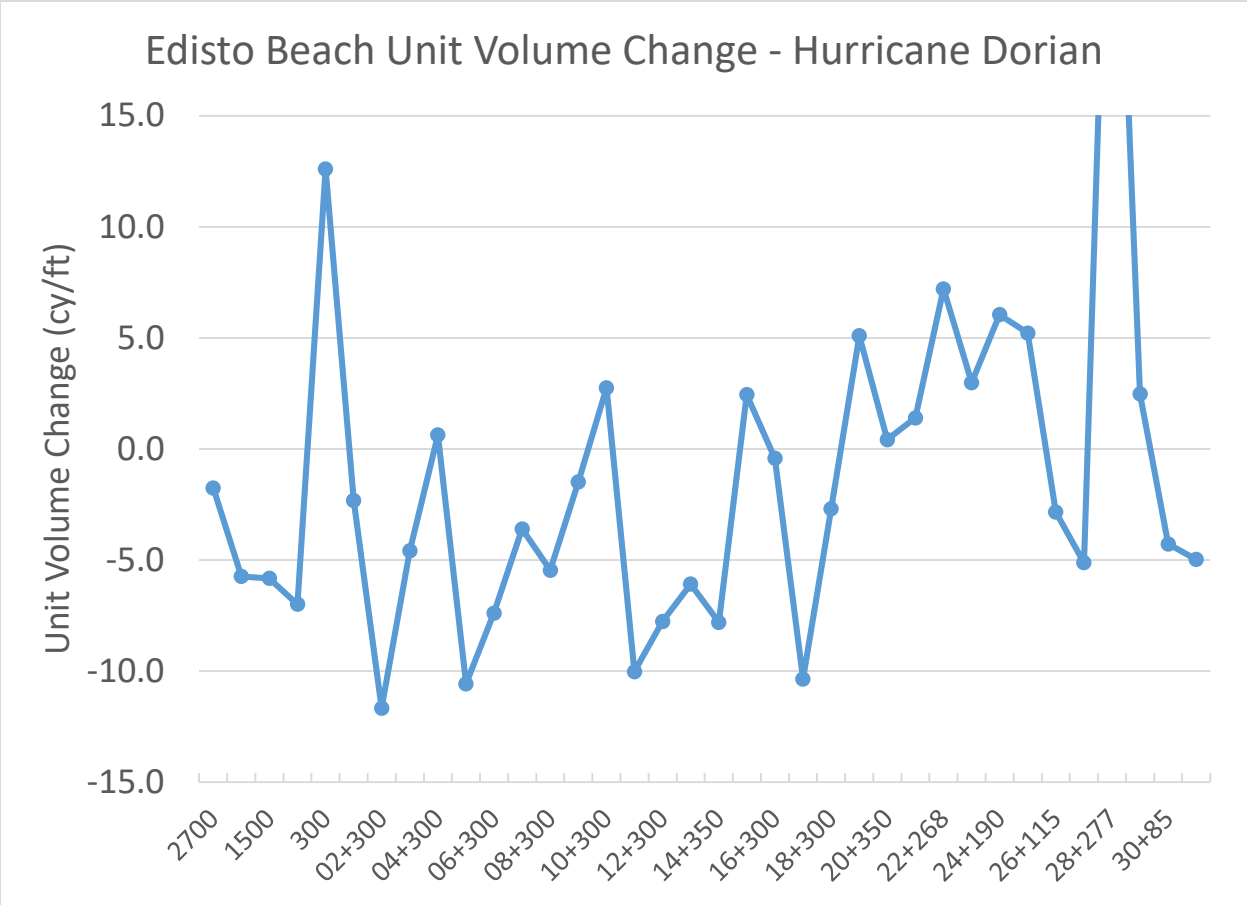


FIGURE 4. Beach volume changes occurring during Hurricane *Dorian*.

Restoration Plan

To restore the sand quantity lost from the project area, the Town of Edisto Beach intends to add the same quantity of sand to the beach using sand imported from an upland source. CSE has identified an inland borrow pit within a feasible hauling distance that has sufficient beach compatible sand volume for the restoration effort. The borrow pit is located at 6381 Hyde Park Rd, Ravenel, SC 29470, and has previously been approved by SCDHEC-OCRM for use on the beach. The sand within the borrow source is clean, fine-grained sand with an average grain size of ~0.200 millimeters (mm). The native beach sand was established by sampling four cross-shore locations along the active beach and dune at each groin cell along the Town. The mean grain size for the native beach was 0.487 mm, while the mean grain size for 2017 project borrow area was 0.65-0.72 mm (these numbers were skewed by a few coarse samples). The 2017 post-project beach tested at a mean grain size of 0.508 mm, close to the pre-project condition. The proposed restoration borrow sand is finer than the native beach sand; however, it is within the sand size range typically found along many South Carolina beaches. CSE believes this sand will work well for the scope of restoration considered in this project, which will focus on restoring the dune area. The finer grain size will allow aeolian transport to facilitate dune growth.

The restoration project will replace sand lost from the design dune and berm constructed in 2017. Figure 5 shows a typical design drawing of the 2017 nourishment project. At this location, the project called for a base quantity fill density of 50 cy/ft with a dune constructed at +10 ft NAVD. Prior to construction, the dune height was increased to +11 ft NAVD and the fill density was increased to ~60 cy/ft due to the impacts of Hurricane *Matthew* in 2016.

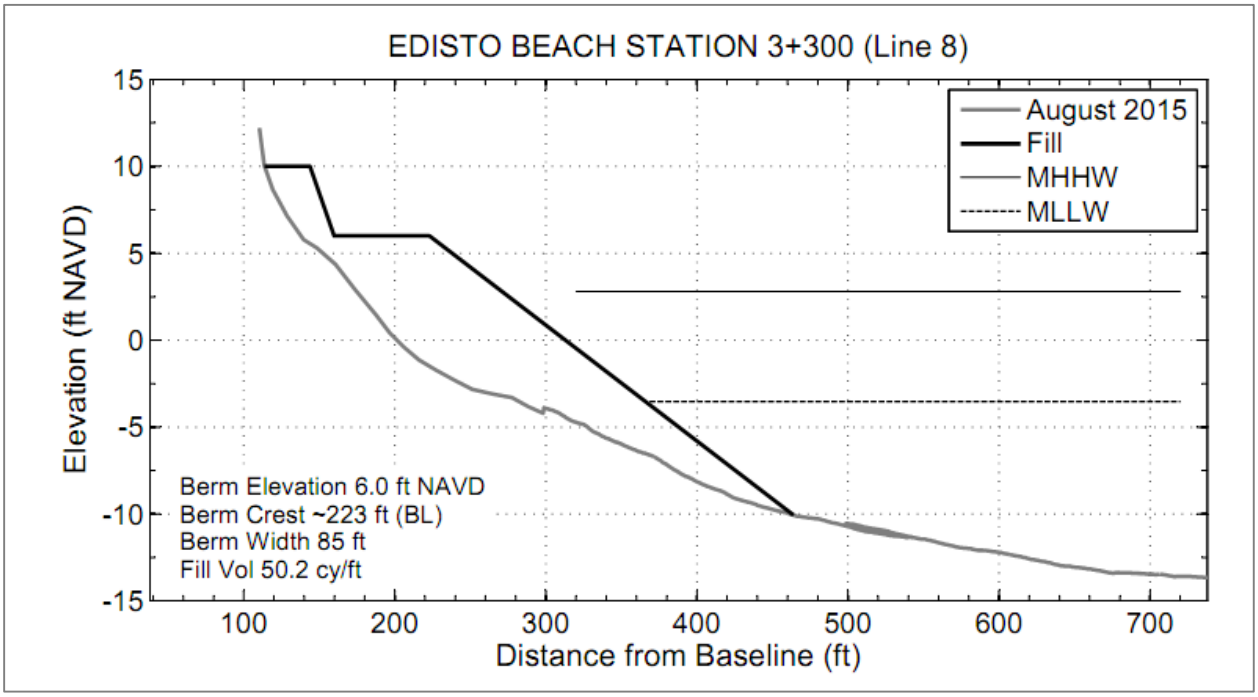


FIGURE 5. Typical design profile of the 2017 beach nourishment project at Edisto Beach, SC.

CSE believes the restoration work may be accomplished via a modification to the existing permit for the 2017 nourishment project, or under an existing general permit from SCDHEC-OCRM for dune restoration (GP–17–SMD). A permit would likely require 30–45 days to be issued or amended. The permit requires that work be conducted between 1 November and 30 April to avoid impacts to nesting or hatching sea turtles. CSE believes that up to 1,500 cy of sand could be delivered to the beach by truck per day, so the proposed project would require a minimum of 24 days. To complete the project prior to 30 April 2020 would require the project to start by 1 April 2020. Following that date, the project would not be able to start again until 1 November 2020.

At this time, CSE does not believe that Hurricane *Dorian* resulted in significant destruction of dune plants installed by the Town. As the state does not require plantings as part of dune restoration, CSE does not believe the Town is eligible to receive reimbursement for costs associated with installing new plantings as part of the repair work.

CSE estimates the cost for a truck haul project to include hauling and placement of sand at $20 per cubic yard, mobilization of grading equipment for $5,000, and permit coordination and project management (engineering, bidding, surveys, and monitoring) to be $50,000. The cost for post-storm assessments and surveys, and CSE's coordination with FEMA is $15,000. For a 30,414 cy project, the total sand cost is $613,280 and the total project cost is $678,280. Table 3 provides an Engineer's Estimate of Probable Cost for the project and any associated engineering, administration, and monitoring.

TABLE 3. Beach volume changes occurring during Hurricane *Dorian*.

Engineers Estimate of Probable Cost				
	Quantity	Unit Cost ($)	Unit	Total Cost ($)
Mobilization	1	5,000	Lump Sum	$ 5,000.00
Material	30,414	10	Cubic Yard	$ 304,140.00
Delivery	30,414	6	Cubic Yard	$ 182,484.00
Grading	30,414	2	Cubic Yard	$ 60,828.00
Contractor Management	30,414	2	Cubic Yard	$ 60,828.00
Permitting	1	15,000	Lump Sum	$ 15,000.00
Construction Administration	1	20,000	Lump Sum	$ 20,000.00
Surveys/Permit Compliance	1	15,000	Lump Sum	$ 15,000.00
Post-Dorian Engineering Services	1	15,000	Lump Sum	$ 15,000.00
			Total Project Cost	**$ 678,280.00**

CSE believes this restoration and repair alternative is feasible and warranted, and that the Town of Edisto Beach should qualify for FEMA Category G funds to be reimbursed for the work. Please let me know if you have any questions or need additional information.

Sincerely,

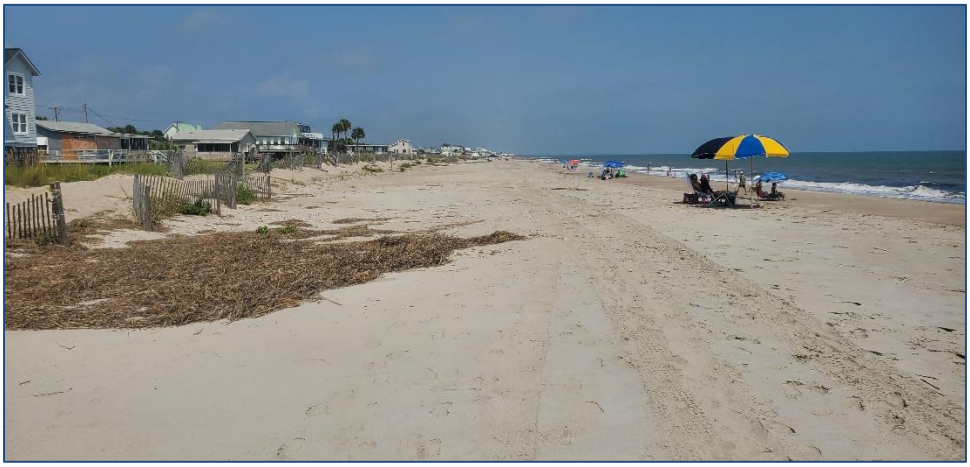
Coastal Science & Engineering (CSE)

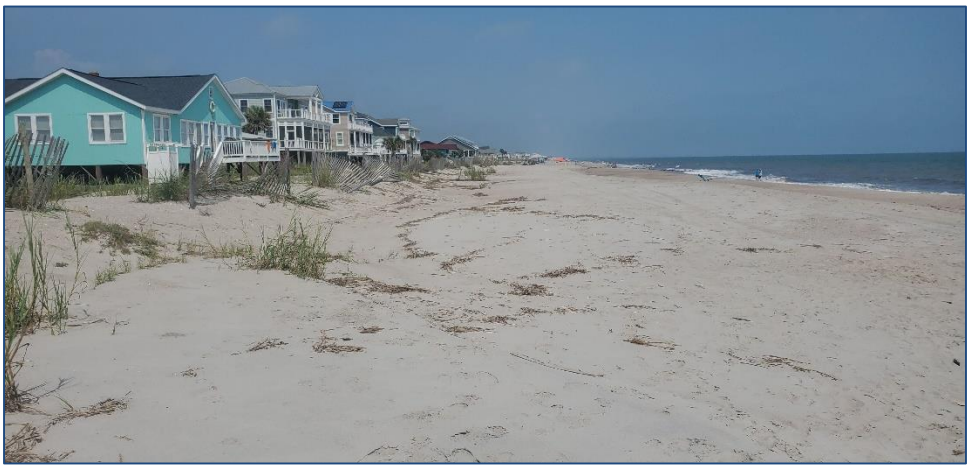
Steven B Traynum
Coastal Scientist / Project Manager

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 24737 HAIQING LIU KACZKOWSKI

Haiqing Kazckowski
Project Engineer

Aerial photo of Edisto Beach following the passage of *Hurricane* Dorian.





Ground photos of Edisto Beach on 9 September 2019 showing wrack lines at the toe of the dune. Note that much of the vegetation remained in place; however, there was some apparent damage to some sections of sand fencing.