



PHOTO 6 — South Nags Head (Reach 3): **[UPPER]** 23 February 2011 before nourishment showing condemned houses at Seagull Drive in the surf zone; **[MIDDLE]** 17 August 2011 after nourishment. Note a pond left in front of the condemned houses due to regulations precluding nourishment over exposed sandbags. **[LOWER]** 21 November 2011 after Hurricane *Irene* and project completion. Note the pond in front of the houses was filled naturally by overwash during fall northeasters. Also note rhythmic shoreline in November following passage of fall hurricanes and extratropical storms, reflecting irregular offshore bar morphology.

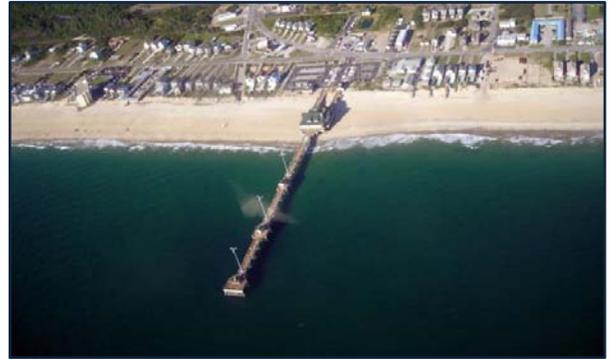


PHOTO 7 — Jennette's Pier (Reach 1): (upper) 23 February 2011, before the beach nourishment project; (middle left) 22 July, nourishment under the pier is completed; (middle right) 17 August, ten days before Hurricane *Irene*; (middle) 2 September six days after *Irene*; and (lower) 21 November, four weeks after project completion.

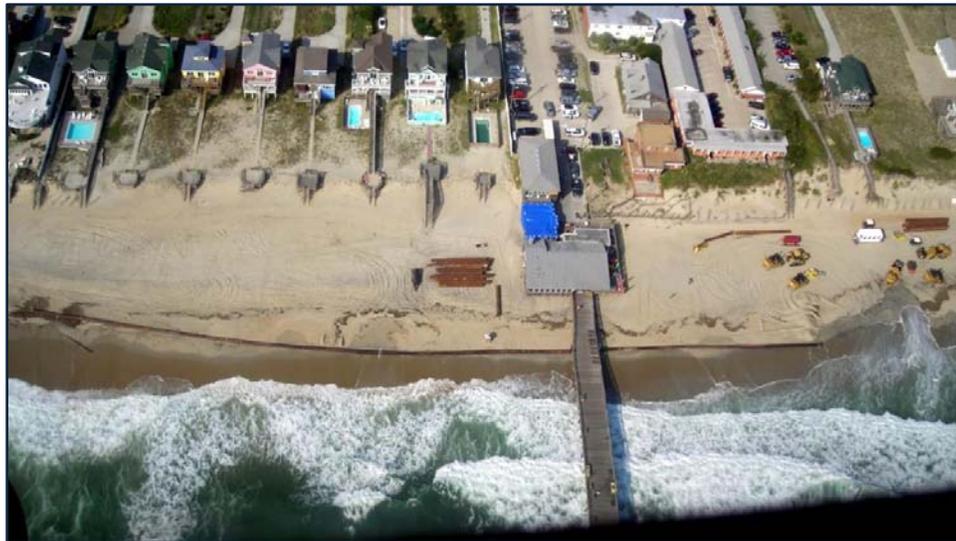
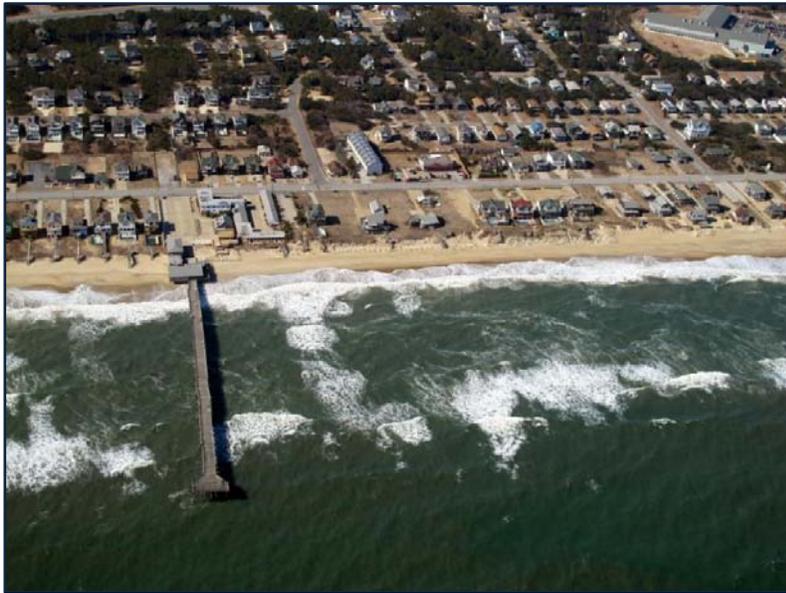


PHOTO 8 — Nags Head Pier (Reach 1)

[UPPER] 23 February 2011 before the beach nourishment project.

[MIDDLE] 2 September 2011, six days after Hurricane *Irene*; discharge point was just north of the pier.

[LOWER] 21 November 2011, four weeks after construction was completed.



PHOTO 9 — Outer Banks Pier (Reach 2): (upper) 22 July 2011, before the beach nourishment project; (middle) 3 August, just pumping through the pier and the discharge point was south of the pier; (lower) 17 August, pumping from south of the pier; (lower left) 2 September, six days after Hurricane *Irene*; (lower right) 21 November, four weeks after construction was completed.



PHOTO 10 — Surfside Drive (Reach 3): (upper) 23 February 2011, before the nourishment project; (center left) 22 July, after nourishment project; (center right) 17 August, ten days before Hurricane *Irene*; (lower left) 2 September, six days after *Irene*; and (lower right) 24 November, four weeks after the project was completed.

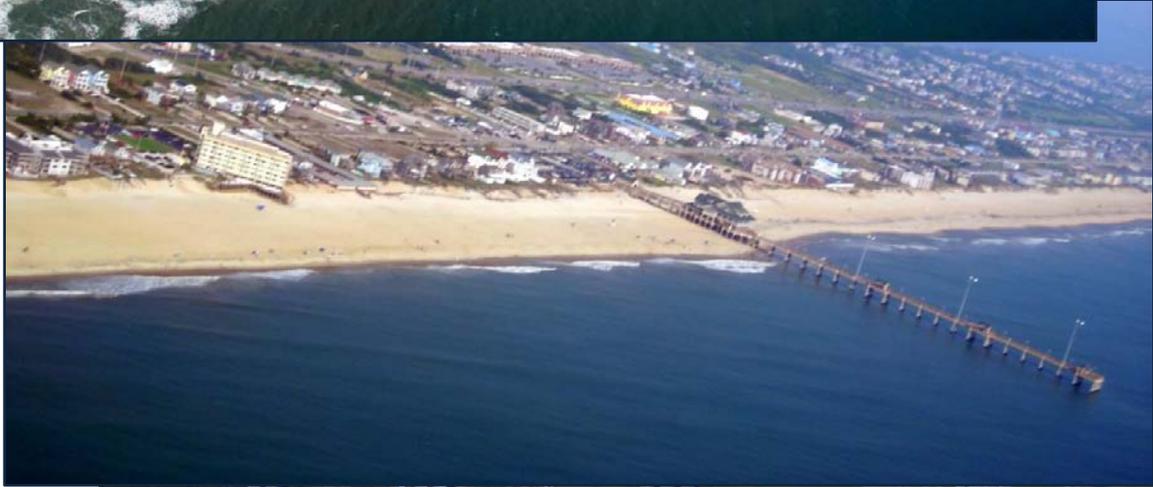


PHOTO 11 — Comfort Inn: (upper) 23 February 2011, before the beach nourishment project; (center) 22 July, shortly after pumping in front of the hotel; (lower) 17 August, ten days before Hurricane *Irene*; (bottom left) 2 September, six days after *Irene*; (bottom right) 21 November, four weeks after project completion.



PHOTO 12 — First load of sand was pumped at 8:20 pm on 24 May 2011 by dredge *Liberty Island*. The discharge point was at station 728+00 near Forbes Street.



PHOTO 13 — Last load of sand was pumped at 8:20 am on 27 October 2011 by dredge *Padre Island*. The discharge point was at station 585+00 in Nags Head historic district.



PHOTO 14 – [UPPER LEFT] GLDD project manager Dave Allen (first from left with red safety hat) and CSE project director Tim Kana (first from right), project engineer Haiqing Kaczkowski (second from right) and on-site representative Dennis Burns (second from left) were on site observing the completion of the construction on 27 October 2011.

[UPPER RIGHT] GLDD's survey equipment Coastal Research Amphibious Buggy (CRAB) was collecting data on 27 October 2011.

[MIDDLE and LOWER] Dredge *Liberty Island* completed 499 loads with a reported volume of ~2.2 million cy (almost half of the total contract volume).



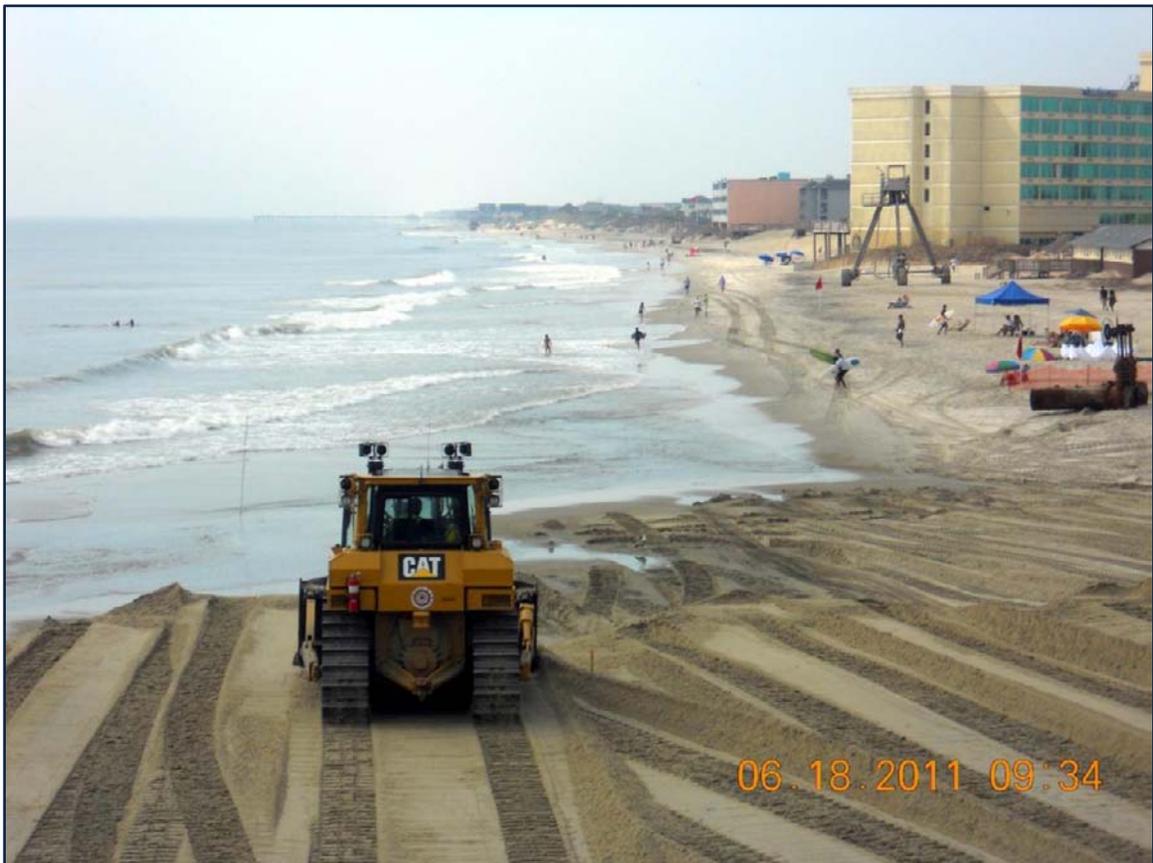


PHOTO 15 — Looking south from Jennette's Pier: (upper) 9 June 2011, before the nourishment project; (lower) 18 June, during construction.

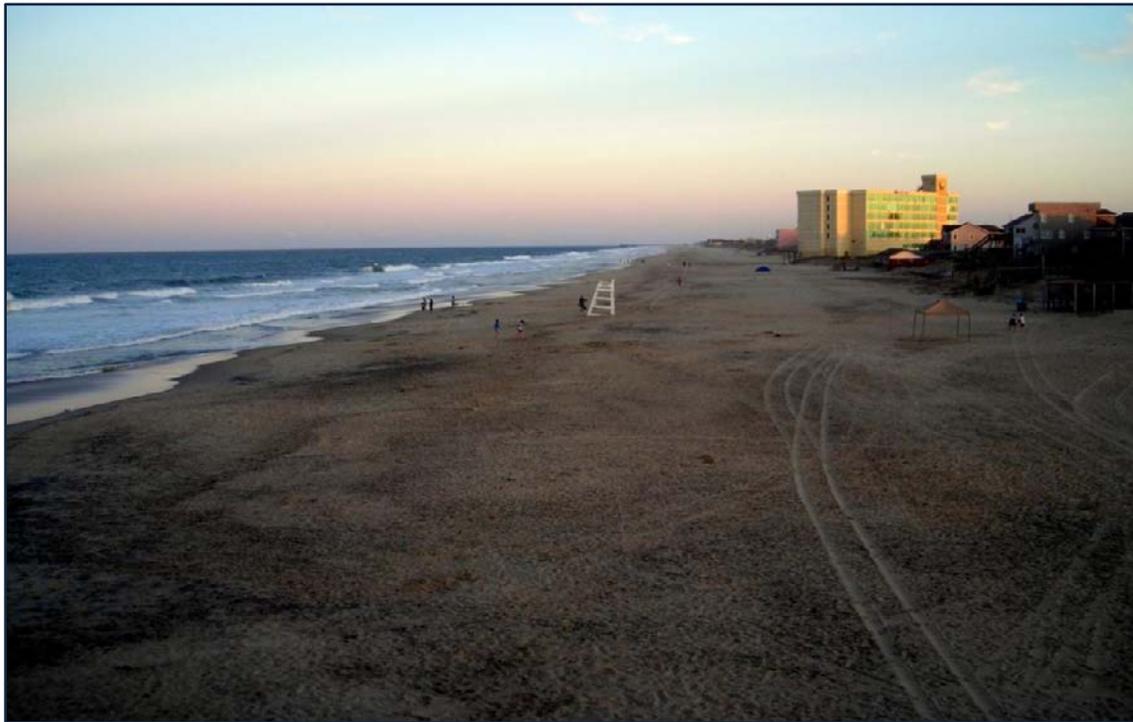


PHOTO 16 — Looking south from Jennette's Pier: (upper) 20 July 2011, a month after the nourishment project; (lower) 31 August, four days after Hurricane *Irene*.



PHOTO 17 — Looking south from Jennette's Pier: (upper) 22 September 2011, three months after the nourishment project; (lower) 27 October, the day of the project completion.



PHOTO 18 — Governor Street: (upper) 21 July 2011, pumping operations were in front of the public beach access; (lower) 22 July, 24 hours after the pumping operations. A dozer was pushing up sand to make a ramp over the discharging pipes.



PHOTO 19 — [UPPER] First submerged pipe landing point at station 728+50 near Forbes Street (20 May 2011). [LOWER] GLDD's D7 dozer dragging a pipe to smooth the newly nourished beach before it is re-opened to the public on (22 June 2011).



PHOTO 20 — Pumping through Outer Banks Pier (photo by Marvin Demers, Nags Head citizen, 2 August 2011).



PHOTO 21 — Mean high water (MHW) survey at Sea Gull Drive on 27 May 2011: (upper) base station set up by a professional surveyor Katy C Marchello of Quible & Associates; (lower) MHW point (the pink flag in the lower part of the image) marked by KC Marchello.



PHOTO 22 — CSE's land and boat survey to determine before-dredging condition and pump volumes. (upper) CSE chief of field data collection Philip McKee standing with an RTK-GPS (Trimble™ Model R8 GNSS) in hand (photo by ST Traynum, 6 June 2011). (lower) CSE survey boat (*Congaree River*) collecting data near Glidden Street during favorite conditions (10 June 2011).



PHOTO 23 — [UPPER] Doug Piatkowski (first from left, USACE representative) inspected the *Liberty Island* on 24 May 2011 before the dredge started operations. Dave Allen (center, GLDD project manager) and Cliff Ogburn (first from right, town manager of Nags Head) accompanied him during the inspection. (Photo by CSE – SB Traynum)

[LOWER] Raleigh Blend (first from left, USACE project manager) and Josh Pelletier (second from left, USACE representative) visited the *Liberty Island* and the *Texas* on 17 August 2011. Their visit was accompanied by Roberta Thuman (center, Town of Nags Head representative), Dave Allen (first from right, GLDD project manager), and Tim Kana (second from right, CSE project director). (Photo by CSE – HL Kaczowski)



PHOTO 24

[UPPER] NCDCM representatives, Lynn Mathis (right) and John Cece (left) placing CAMA stakes along the toe lines of sandbags that were subject to removal. (3 June 2011)

[LOWER] CAMA stakes along the toe lines of sandbags that were subject to removal. (3 June 2011).





PHOTO 25 — Sea turtle monitoring on the beach: [UPPER] One of the sea-turtle monitoring crews under the direction of Ms. Christian Legner (left, 3 June 2011). [LOWER] NEST volunteers relocated a loggerhead turtle nest found near McCall Street on 29 June 2011.



PHOTO 26 — [UPPER] After the project's completion, CSE staff placed stakes as guidance for sand-fencing installation at Reach 3. Tim Kana (right, CSE project director) measuring the distance from the toe of dune, and Steven Traynum (left, CSE senior physical scientist) hammering in a stake.

[LOWER] New sand fencing was installed in December 2011 along Reach 3 following CSE's recommendation in compliance with CAMA's regulations for 10-ft sections at 45 degree angles. (Photo by the Town of Nags Head)

10.0 MONITORING & MAINTENANCE RECOMMENDATIONS

In accordance with FEMA Publication 321 (Appendix B) and Code of Federal Regulations 44 CFR 206.226(j), a maintenance program involving periodic renourishment of sand must be established and adhered to by the Town of Nags Head to qualify for FEMA assistance. On 25 August 2011, the Town of Nags Head adopted a Beach Monitoring and Maintenance Plan, the purpose of which is to track the physical condition of the beach after nourishment, quantify sand volume changes, and determine whether the project qualifies for emergency renourishment following declared disasters. It also is intended to identify erosion hot spots and recommend small-scale maintenance renourishment, placement of sand fencing, and/or sand scraping so as to increase the life of the project.

A condition of FEMA post-storm beach restoration funding is that the applicant (Town of Nags Head) have in place a monitoring and maintenance plan. Certain thresholds are specified for renourishment, including:

- Net sand losses due to a storm (declared disaster) measured within defined project limits which, for Nags Head, span 10.0 miles of oceanfront between the foredune and the -19 feet (ft) NAVD offshore contour.
- Chronic sand losses equating to more than 50 percent of the placed sand (ie - >2.3 million cubic yards).

CSE recommends that the Town of Nags Head conduct an annual assessment of the physical condition of the nourished shoreline. The beach should be surveyed semi-annually the first year and annually in subsequent years using the transect plan initiated by the USACE and CSE. Physical condition surveys should include the following:

- Beach and inshore profiles at minimum 500-ft spacing at USACE/CSE stations, including upcoast and downcoast areas to track the spread of nourishment sand to adjacent areas.
- Data analysis to determine nourishment volumes remaining by reach and volumes remaining with respect to the renourishment threshold.
- Sediment sample collection and analysis for monitoring the as-built quality of sand on the beach and verify that it meets the NCCRC sediment criteria for nourishment projects.
- Aerial photography to document the general conditions of the shoreline each year and periodic controlled vertical photography approximately once per three years.

- Contour movement analysis and mapping to illustrate for the community the shift over time of key reference contours including local mean high water, the edge of the dry-sand beach, and the face of the foredune.
- Compaction testing for three years, prior to the turtle nesting season.
- Resurvey of borrow areas every approximately two years to determine the degree of infilling and sediment modification after dredging.

Such surveys will give the Town an annual assessment of the beach condition and will reveal problem areas or erosion hot spots that require attention. These annual surveys are the primary means of documenting the performance of the nourishment and quantifying the volume of sand remaining within the project boundaries. Annual surveys also serve to document the beach condition prior to the occurrence of a major erosion event, such as a hurricane. Should a major storm event occur, a post-storm survey should be completed for damage assessment as soon after the storm as possible. Since the project is an engineered beach fill, the annual and post-storm surveys could provide a basis for reimbursement and reconstruction of the beach with federal disaster funds under a community assistance grant (eg – FEMA Category G post-storm restoration funds).

Benthic monitoring of the biological response of the nourished beach and borrow areas is required by the state permit (CAMA 45-10). The benthic monitoring is being conducted by CZR Incorporated (CZR, Wilmington NC). Pre-project benthic sampling events have been completed in accordance with permit requirements representing spring, summer, fall, and winter conditions. A biological monitoring report covering results of four seasonal sampling events was submitted to the Town and resource agencies on 29 September 2011 including sampling events in June 2010 (spring), August 2010 (summer), November 2010 (fall), and April 2011 (winter). [Note: Weather precluded sampling in March as had been planned for the winter event.]

The Town has approved CZR's post-dredging biological monitoring proposal for the first year after the completion of the project. Four seasonal monitoring activities will be conducted between fall 2011 and summer 2012. A statistical report comparing the first year's post-project data with the pre-project data involving four seasonal events will be submitted to the resource agencies for review. The first post-project sampling event occurred in December 2011 (fall), and the remaining three sampling events are expected to occur in winter (March 2012), spring (May 2012) and summer (August 2012) (respectively).

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