



Town of Kitty Hawk

North Carolina

Town of Kitty Hawk Shore Protection Project



Photograph obtained by Aptim Coastal Planning & Engineering of North Carolina, Inc. (September 5, 2017).

Beach Maintenance Plan

October 2017
Updated February 2018

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TOWN OF KITTY HAWK
SHORE PROTECTION PROJECT MAINTENANCE PLAN

EXECUTIVE SUMMARY

The Town of Kitty Hawk has initiated a shore protection project aimed at: 1) reducing the vulnerability of public infrastructure including NC 12, town roads between NC 12 and U.S. Highway 158, and utilities to storm-induced erosion; 2) reducing flooding in many non-oceanfront areas throughout the Town during ocean overwash conditions, including portions of NC 12 and U.S. Highway 158; and 3) reducing the vulnerability of homes within the Town that front the Atlantic Ocean and are exposed to wave events during nor'easters and other large storm events. In order to accomplish these goals, the Town is taking steps to maintain its oceanfront beach and dune to a configuration that: 1) provides a reasonable level of storm damage reduction; 2) provides a reasonable level of flood reduction; and 3) mitigates long term erosion that could threaten public infrastructure and private property as well as recreational opportunities and biological resources. A key aspect to the long term success of the project is the implementation of a maintenance program to document construction achievements and project performance. This document details the maintenance program established by the Town.

The Town successfully completed the initial construction of the Shore Protection Project in October 2017. Periodic maintenance or renourishment is included in the Town's maintenance plan for the Shore Protection Project. The renourishments are expected to occur on a 5 year cycle and will initially involve dredging of Borrow Area A offshore Kill Devil Hills and Nags Head. The Dept. of the Army and North Carolina Division of Coastal Management permits issued for the initial construction will require modifications to use Borrow Area A for future maintenance. Likewise, the Town will be required to obtain a new lease from the Bureau of Ocean Energy Management (BOEM) to use Borrow Area A for maintenance events. The Town has already made these agencies aware of their intentions to use Borrow Area A in the future. The estimated volume of material required for maintenance of the Kitty Hawk project is 645,000 CY every five (5) years. Post-construction surveys of Borrow Area A show that sufficient sand is available for future maintenance.

Project monitoring has been implemented to track performance of the placed material and is used to update nourishment requirements. The initial baseline monitoring event was conducted in December 2017 and the Year-1 annual monitoring event was conducted in June 2018. The maintenance plan may be updated throughout the monitoring phase to reflect changes in the overall project. Given the presence of nearshore depressions or troughs located offshore of the project area, the Town has also incorporated shore parallel bathymetric surveys into their monitoring protocol to track movement of sand within the system. The beach profile surveys and supplemental shore-parallel bathymetric surveys have been designed and are conducted to capture changes along the active profile of the beach both within the project area and adjacent to the project.

This Maintenance Plan serves as documentation that the Town of Kitty Hawk's Shore Protection Project meets the criteria established by 44 CFR 206.226(j)(2). The Maintenance Plan has been developed in a way consistent with the Public Assistance Program and Policy Guide – FP-104-009-2 (January 2018). This Maintenance Plan will be updated regularly to reflect results of monitoring, construction of additional projects, maintenance events and changes in schedules.

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SHORE PROTECTION PROJECT MAINTENANCE PLAN

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INTRODUCTION

The Town of Kitty Hawk is focused on a long-term shoreline management program. The Town's stated purpose for implementing a beach nourishment project is threefold: 1) reduce the vulnerability of public infrastructure including NC 12, town roads between NC 12 and U.S. Highway 158, and utilities to storm-induced erosion; 2) reduce flooding in many non-oceanfront areas throughout the Town during ocean overwash conditions, including portions of NC 12 and U.S. Highway 158; and 3) reduce the vulnerability of homes within the Town that front the Atlantic Ocean and are exposed to wave events during nor'easters and other large storm events. Flooding is a major concern as it can render routes impassable which greatly limits the ability for emergency personnel to respond. In order to accomplish these stated goals, the Town is taking steps to maintain its oceanfront beach and dune to a configuration that: 1) provides a reasonable level of storm damage reduction; 2) provides a reasonable level of flood reduction; and 3) mitigates long term erosion that could threaten public infrastructure and private property as well as recreational opportunities and biological resources.

An Erosion and Shoreline Management Design study was completed for the Town of Kitty Hawk in 2015 (CPE-NC, 2015A). The study evaluated potential management options for the oceanfront shoreline. The recommendation of the resulting design report was a beach nourishment project along the entire length of the Town's ocean shoreline. The recommended design for the beach nourishment was a 60-foot wide design berm constructed at elevation 6.0 ft. NAVD88 and a "starter dune" with a crest elevation of 14.0 ft. NAVD88. In addition to the design parameters, the project was also designed to include 5 years of advanced nourishment to account for predicted background erosion of the project during the maintenance interval. Furthermore, the project design called for a 1,000 ft. taper section into the neighboring Town of Southern Shores.

In the summer of 2016, prior to project construction, an erosional hotspot was observed within the northern taper section of the Kitty Hawk project. The Town of Southern Shores approached both Kitty Hawk and the Town's engineering firm regarding the possibility of designing and permitting a beach fill project that would cover the approximately 1,500-foot long hotspot area in Southern Shores. In January 2017, the Town of Kitty Hawk agreed to modify their USACE permit to allow for the modification of the project to include the 1,500 ft. portion of the Town of Southern Shores as well as a 1,000 ft. taper. This resulted in a 2,500 ft. section of the project being located within the Town of Southern Shores. The design specifications for the fill placed in Southern Shores included a 1,500 ft. main fill section, which consisted of a variable width berm with elevation 6.0 ft. NAVD88, and a 1,000-foot long taper on the north end.

Initial construction of the beach nourishment project was completed in October 2017. The project included placement of 1,845,000 cy of beach compatible sand, which equates to an average fill density of approximately 86 cy/lf, along 21,400 feet or approximately 4.1 miles. Sand used to construct the project was dredged from an offshore borrow source. Following the construction of the project, the Town implemented a maintenance program to monitor the performance of the Shore Protection Project and determine when periodic renourishment is needed to maintain the project.

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Documentation of the construction and subsequent monitoring events has been archived as evidence of the Town’s commitment towards maintaining the Shore Protection Project. This information is required for eligibility under the Public Assistance (PA) program administered by FEMA. If the project is impacted by a presidentially declared disaster or emergency, justification that the maintenance plan has been implemented must be provided to receive federal aid. This stipulation is mandated by 44 CFR 206.226(j)(2), which states:

Work on an improved beach may be eligible under the following conditions:

- (i) The beach was constructed by the placement of sand (of proper grain size) to a designed elevation, width, and slope; and,*
- (ii) A maintenance program involving periodic renourishment of sand must have been established and adhered to by the applicant.*

The amount of sand replacement eligible for FEMA funding is limited to the material volume lost as a result of the declared disaster or emergency. Pre- and post-storm profiles are used to determine the eligible volume of sand. According to and Public Assistance Program and Policy Guide – FP-104-009-2 (January 2018), profile surveys must extend at least to the seaward edge of the sub-aqueous nearshore zone (closure depth). The Kitty Hawk monitoring surveys generally extend to a depth of -30 ft. NAVD88; whereas the established depth of closure for the project is -24 ft. NAVD88.

This Maintenance Plan serves as documentation that the Town of Kitty Hawk’s Shore Protection Project meets the criteria established by 44 CFR 206.226(j)(2). The Maintenance Plan has been developed in a way consistent with Public Assistance Program and Policy Guide – FP-104-009-2 (January 2018). The Maintenance Plan includes a description of the project design, construction activities to date, anticipated volume and cost for maintenance, schedule of maintenance and the monitoring protocols being employed by the Town of Kitty Hawk. This Maintenance Plan will be updated regularly to reflect results of monitoring, construction of additional projects, maintenance events and changes in schedules.

CONSTRUCTION EVENTS

Beach Fill

The initial construction of the Town of Kitty Hawk Shore Protection Project was completed in October 2017. The project included the construction of a 60-foot wide design berm constructed at elevation 6.0 ft. NAVD88 along the entire Kitty Hawk oceanfront from baseline Station 0+00 to 189+00. A “starter dune” with a crest elevation ranging between 12.0 ft. to 14.0 ft. NAVD88 and a variable crest width was also constructed along the majority of the Town’s oceanfront. A 1,500 ft. berm only fill section was constructed from Station 0+00 to Station -15+08 in Southern Shores to account for the erosion hot spot. This section had a 6.0 ft. elevation variable width berm based on an average fill density of 53 cy/lf. The project also included a 1,000-foot long taper on the north end, which extended from Stations -15+08 to -25+08. To the south of the Town of Kitty Hawk boundary, the Town of Kill Devil Hills constructed a beach nourishment project along a portion of their oceanfront shore. In total, the Kitty Hawk project placed sand from baseline station 189+00 (southern Town boundary) to -25+08 (approximately 400 ft. north of Skyline Rd. in

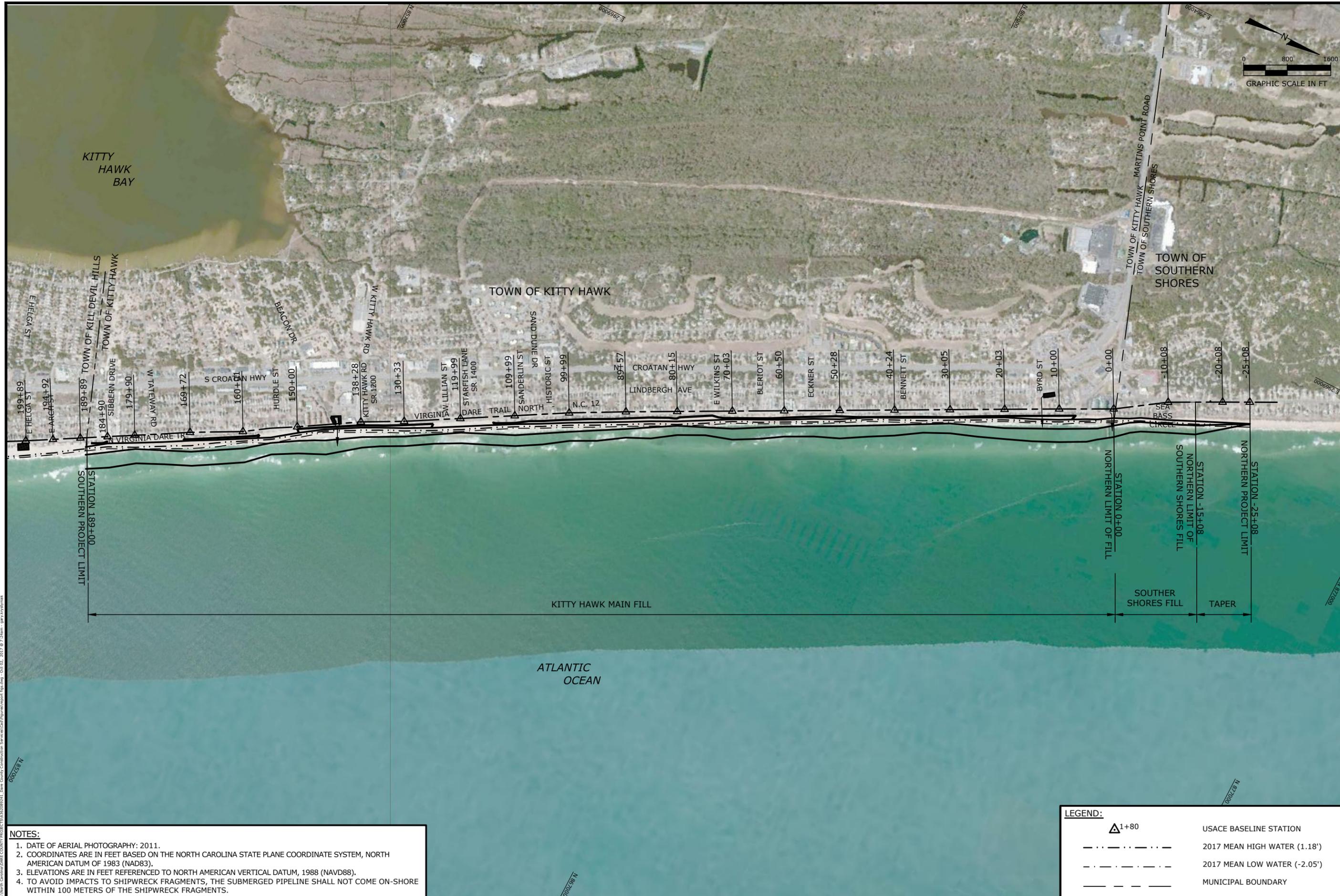
TOWN OF KITTY HAWK
SHORE PROTECTION PROJECT MAINTENANCE PLAN

Southern Shores). Figure 1 shows the extent of the project including the main fill construction template, the southern shores fill section, the northern taper, and the construction baseline. Sand used to construct the project was dredged from the permitted offshore borrow area referred to as Borrow Area A, using trailing suction hopper dredges (Figure 2).

The beach fill constructed between June and October 2017 included placement of 1,845,000 cy of beach compatible sand, which equates to an average fill density of approximately 86 cy/lf, along 21,400 feet of beach (approximately 4.1 miles). The volume placed included both the volume necessary to construct the designed dune and berm as well as the volume needed for advanced fill. Advanced fill is the sacrificial portion of the fill required to protect the design section from anticipated sediment losses during the time between subsequent maintenance cycles. The volume of advanced fill needed was based on background erosion rates, anticipated diffusion losses and a five (5) year maintenance cycle. Ultimately, the performance of the beach fill dictates when constructed sections require maintenance, which is referred to as renourishment.

Sand Fencing

As part of the project, sand fencing has been installed along the entire portion of the project located within the Town of Kitty Hawk. One (1) row of angled 10-foot sand fencing sections was installed, staggered along the dune and oriented at 45-degree angles from the shoreline. Sand fencing installed in the southern portion of the project between Stations 150+00 and 188+69 and between Stations 1+00 to 6+50 at the north end of the project area, was installed at the toe of the existing dune or in line with existing sand fencing (Figure 3). The goal of the sand fencing installed between Stations 150+00 and 188+69 was to build up the width of the existing dune (Figure 4). Sand fencing installed between Stations 6+50 and 150+00 was installed at the seaward dune crest in order to build up the height of the dune. The sand fence is composed of evenly spaced thin wooden vertical slats connected with twisted wire. The sections are four feet in height and supported by three wooden stakes or posts per 10 foot section, one stake at each end and one in the middle. The sand fencing is untreated, unfinished, biodegradable, and neutral in color (beige, tan, natural wood finish).



- NOTES:**
1. DATE OF AERIAL PHOTOGRAPHY: 2011.
 2. COORDINATES ARE IN FEET BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD83).
 3. ELEVATIONS ARE IN FEET REFERENCED TO NORTH AMERICAN VERTICAL DATUM, 1988 (NAVD88).
 4. TO AVOID IMPACTS TO SHIPWRECK FRAGMENTS, THE SUBMERGED PIPELINE SHALL NOT COME ON-SHORE WITHIN 100 METERS OF THE SHIPWRECK FRAGMENTS.

LEGEND:

	USACE BASELINE STATION
	2017 MEAN HIGH WATER (1.18')
	2017 MEAN LOW WATER (-2.05')
	MUNICIPAL BOUNDARY

Reference Files:	Checked by:	Reviewed by:	Submitted by:	Comm. No.:
JD	JD	KW	KW	6362089241
Dgn by:				
Date:	7/31/17			
PAS/NOTED				

REVISIONS	No.	Date	Description

KITTY HAWK
 NOURISHMENT PROJECT LIMITS
 DARE COUNTY, NORTH CAROLINA
 OVERALL PLAN VIEW

DRAWING NO.
OV-1

SHEET 1 OF 1

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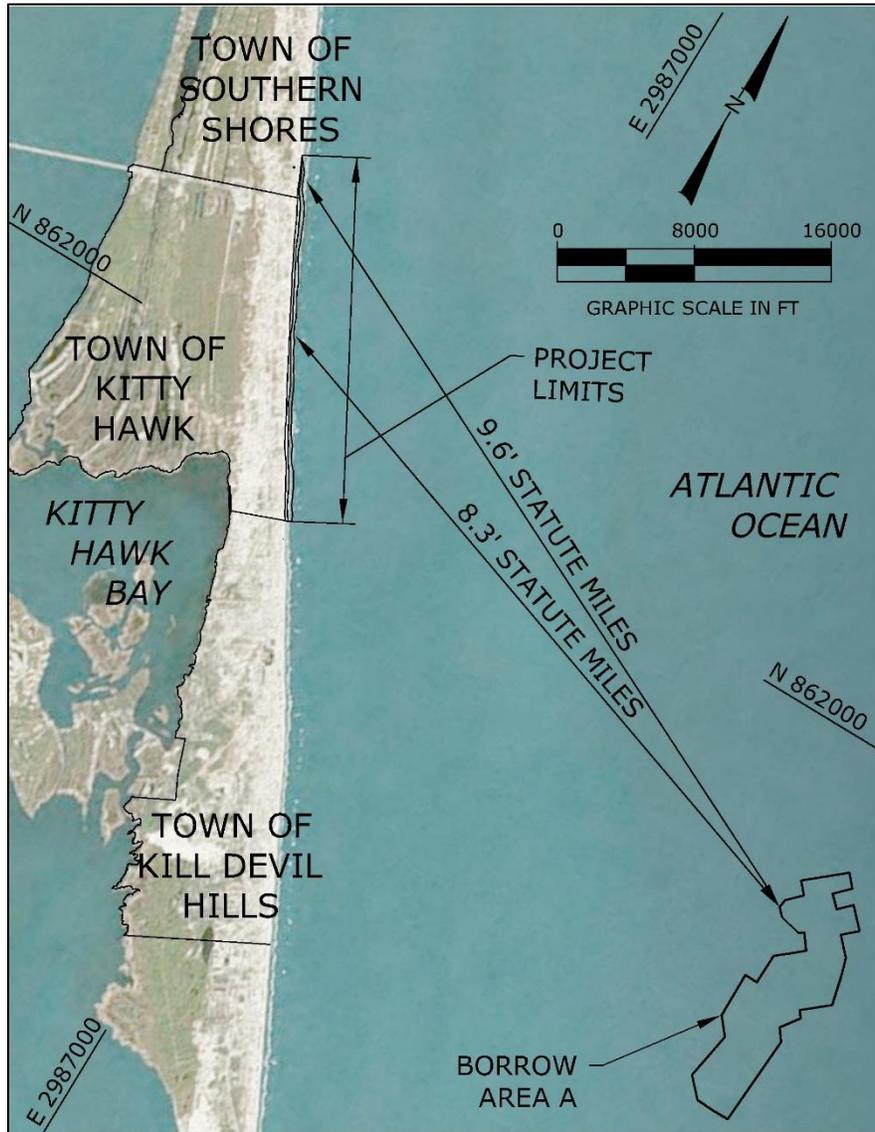


Figure 2. Map showing the location of offshore borrow area used for the construction of the 2017 Kitty Hawk Shore Protection Project.

Funding

The project was funded through revenue derived from the Dare County Beach Nourishment Fund, the Town of Kitty Hawk, the Town of Southern Shores and an assessment by the Town of Southern Shores to property owners located in the Southern Shores fill section. The Town of Kitty Hawk's portion of the project was raised through a combination of General Fund appropriation and Municipal Service Districts (MSDs). The Town of Southern Shores' portion was funded through its General Fund and an assessment on oceanfront property owners in the Southern Shores Fill section of the project.

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Figure 3. Examples of sand fencing placed between Stations 188+69 and 150+00 and 6+50 and 1+00 in Kitty Hawk. The photograph on the left shows sand fencing placed at the toe of the dune and the photograph on the right shows sand fencing placed in line with existing sand fencing.

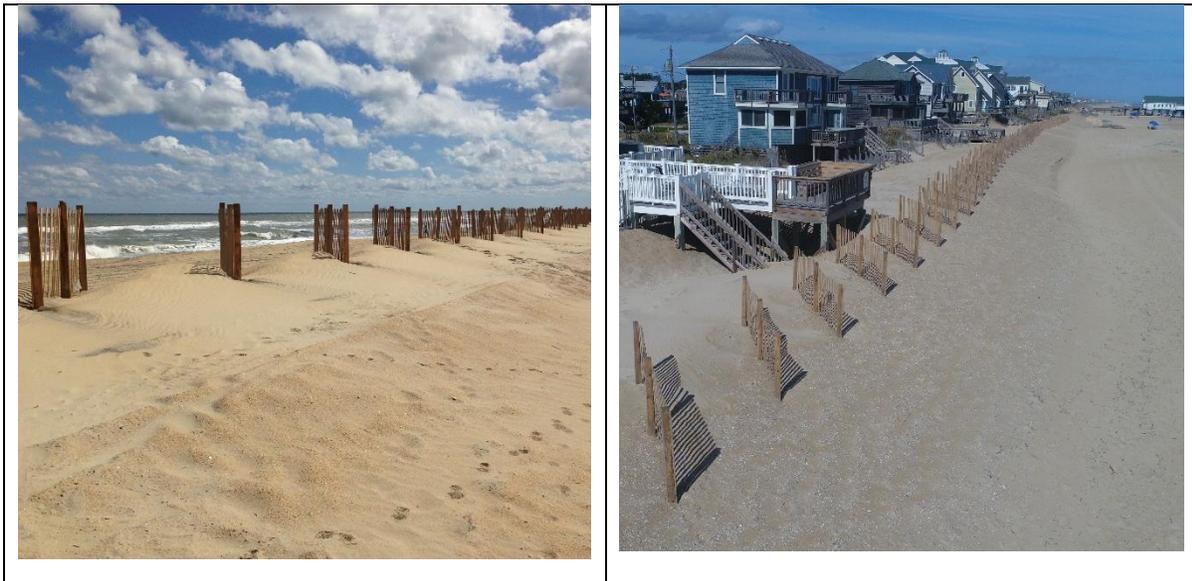


Figure 4. Examples of sand fencing placed between Stations 150+00 and 6+50 in Kitty Hawk.

MAINTENANCE

Beach profile surveys are conducted annually to assess the performance of the Shore Protection Project. As-built surveys of the Kitty Hawk Shore Protection Project were provided by the construction contractor, which represents conditions along each profile as sections of the project were constructed. The first post-construction survey of the project was conducted in December

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2017 following completion of the Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills projects. Data from the December 2017 survey represents the baseline condition of the project (APTIM, 2018). The Year-1 beach profile surveys were conducted in June 2018 and the annual monitoring report was completed in February 2019 (APTIM, 2019).

Beach profile surveys are conducted along beach profiles at approximately 1,000 foot intervals. Figure 5 shows the location of these beach profiles. The monitoring surveys generally extend to a depth of -30 ft. NAVD88; whereas the established depth of closure for the project is -24 ft. NAVD88.

The ocean floor offshore of the Kitty Hawk project area is characterized by nearshore depressions or troughs. The presence of these troughs were evident based on data plotted from a 2009 multibeam survey conducted by the US Army Corps of Engineers Field Research Facility (USACE-FRF). The features were also present on a plot of the data collected by Aptim Coastal Planning & Engineering of North Carolina, Inc. (APTIM) during a single-beam bathymetric survey conducted in December 2017/February 2018. Comparison of the 2009 USACE-FRF survey with the 2017/2018 APTIM survey indicated the troughs were mobile, i.e., they appeared to migrate north to south along the coast. Given the potential influence of the troughs on the volume change results computed using beach profile surveys only, the Town of Kitty Hawk has incorporated a supplemental bathymetric survey into their monitoring protocol. This survey is conducted annually with the beach profile surveys. The supplemental bathymetric survey includes a series of shore parallel survey lines spaced approximately 200 feet apart. The survey area generally covers the offshore bottom from about the -10-foot NAVD88 contour seaward for a distance of about 3,000 feet.

The Kitty Hawk Shore Protection Project includes a 60-foot wide design berm constructed at elevation 6.0 ft. NAVD88 along the entire Kitty Hawk oceanfront from baseline Station 0+00 to 188+69. A “starter dune” with a crest elevation ranging between 12.0 ft. to 14.0 ft. NAVD88 and a variable crest width was also constructed along the majority of the Town’s oceanfront. A 1,500 ft. berm only fill section was constructed from Station 0+00 to Station -15+08 in Southern Shores to account for the erosion hot spot. This section had a 6.0 ft. elevation variable width berm based on an average fill density of 57 cy/lf. The project also included a 1,000-foot long taper on the north end, which extended from Stations -15+08 to -25+08. The project included five (5) years of advanced fill. Annual monitoring will assess the volume of sand in excess of the design that remains in place to determine the timing of, and volume needed for, subsequent beach renourishment. Construction of the October 2017 project, which was combined with construction of projects within the Towns of Duck and Kill Devil Hills, used sand from Borrow Area A located offshore of Kill Devil Hills and Nags Head (Figure 2); however, sufficient sand is anticipated to be available in Borrow Area A to provide maintenance of the Kitty Hawk Shore Protection Project, as well as similar projects in Duck and Kill Devil Hills.

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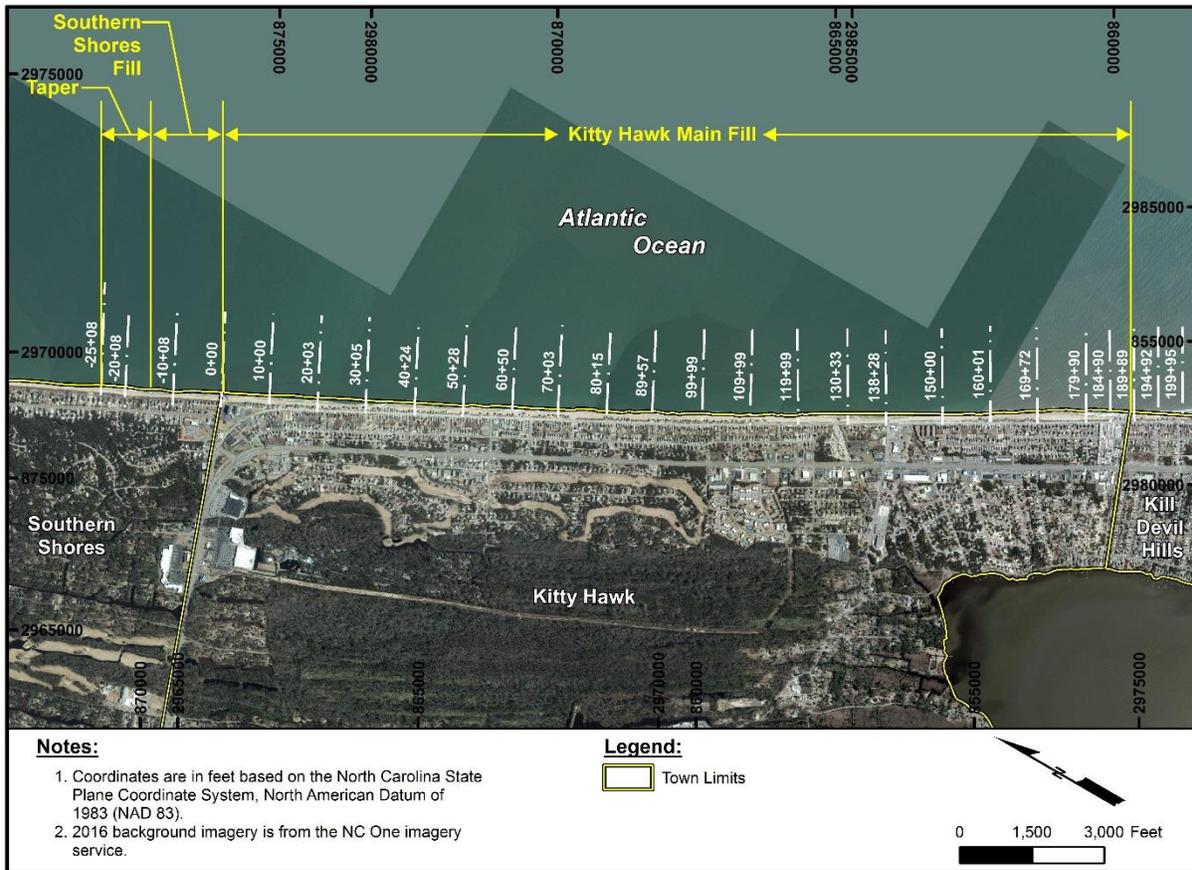


Figure 5. Map of Kitty Hawk Shore Protection Project Monitoring Beach Profiles.

RENOURISHMENT REQUIREMENTS

During the design of the Kitty Hawk Shore Protection Project, Aptim Coastal Planning & Engineering of North Carolina, Inc. (APTIM – previously referred to as CPE-NC) conducted an analysis of background erosion losses and diffusion losses to determine the volume of advanced fill to include in the project design. Based on these analyses, the design of the Kitty Hawk main fill and taper included approximately 337,900 cy of advanced fill (CPE-NC, 2015A). This was based on a calculated rate of loss of approximately 16.9 cy/ft. over 5 years. The Southern Shores Fill section assumed the same rate of loss. Based on that assumption the advanced fill for the 1,500 ft. fill section of Southern Shores is approximately 25,350 cy. More recent analysis conducted by APTIM for the Town of Kitty Hawk and Dare County to determine future renourishment costs assumed a renourishment volume of 645,000 cy. This volume assumes an average fill density of 30 cy/f and includes the Southern Shores portion of the project. APTIM has estimated that the cost to conduct maintenance of the Kitty Hawk Shore Protection project in 2022, which includes maintenance of the 1,500 ft. fill section of Southern Shores, would be \$9,791,000. This cost estimate only accounts for the construction cost to place 645,000 cy of sand. This cost does not reflect engineering or environmental permitting costs for the maintenance event.

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During the permitting of the Kitty Hawk Shore Protection Project, APTIM conducted a comprehensive marine sand search and borrow area design (CPE-NC, 2015B). Two borrow sites, referred to as Borrow Areas A and C, were designed during the investigation. Borrow Area A, shown in Figure 2, is located on the Outer Continental Shelf (OCS) between 5.0 and 6.5 miles offshore of the Towns of Kill Devil Hills and Nags Head in water depths between 50 and 60 ft. (NAVD88). The borrow area covers 1,173 acres and initially contained approximately 16,335,000 cy of sand. The mean grain size of the sand was found to be 0.36 mm with a sorting value of 0.90. The sand in the borrow area was characterized as fine to medium grained quartz sand with trace silt, shell hash, and shell fragments. The average wet Munsell color value was determined to be 5 and dry color value 6. The borrow area was broken up into 6 different cuts with cut depths ranging from -58.5 to -68.0 ft. NAVD88.

The U.S. Army Corps of Engineers and North Carolina Division of Coastal Management issued permits for the Towns of Kitty Hawk as well as Duck, Southern Shores and Kill Devil Hills to use this borrow area for the initial construction of their Shore Protection Project. Furthermore, since the borrow site is located in Outer Continental Shelf (OCS) waters, a lease from the Bureau of Ocean Energy Management (BOEM) was required to use the sand in the permitted borrow site. A sufficient volume of sand is still present within the permitted dimensions of Borrow Area A to provide sand for future maintenance events.

MONITORING PROTOCOL

A monitoring plan has been developed and is being implemented for the Kitty Hawk Shore Protection Project. Topographic and hydrographic surveys of the beach profiles will be conducted to monitor project performance and potential impacts. The beach profile surveys include the fill area and adjacent shoreline as shown in Figure 5.

The Town of Kitty Hawk has also incorporated a supplemental bathymetric survey into their monitoring protocol. This survey is conducted annually with the beach profile surveys. The supplemental bathymetric survey includes a series of shore parallel survey lines spaced approximately 200 feet apart. The survey area generally covers the offshore bottom from about the -10-foot NAVD88 contour seaward for a distance of about 3,000 feet.

Annual monitoring surveys will be conducted along the constructed project on an annual basis to monitor the performance of the project. Supplemental beach profile surveys may also be required following significant storm events. Reports for each monitoring event will be archived by the Town. The reports will contain volumetric and shoreline change calculations to describe how the project is performing. Erosion rates and shoreline change rates along the beach will be documented throughout the monitoring process. The monitoring results will also be used to identify erosion 'hot spots' and to estimate sediment needs for future maintenance events.

CONCLUSION

The Town of Kitty Hawk has initiated a shore protection project aimed at: 1) reducing the vulnerability of public infrastructure including NC 12, town roads between NC 12 and U.S.

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Highway 158, and utilities to storm-induced erosion; 2) reducing flooding in many non-oceanfront areas throughout the Town during ocean overwash conditions, including portions of NC 12 and U.S. Highway 158; and 3) reducing the vulnerability of homes within the Town that front the Atlantic Ocean and are exposed to wave events during nor'easters and other large storm events. In order to accomplish these goals, the Town is taking steps to maintain its oceanfront beach and dune to a configuration that: 1) provides a reasonable level of storm damage reduction; 2) provides a reasonable level of flood reduction; and 3) mitigates long-term erosion that could threaten public infrastructure and private property as well as recreational opportunities and biological resources. The project has and will continue to provide flood reduction, storm damage reduction and mitigation of long-term erosion. Part of the project includes implementing this maintenance program to document construction achievements and project performance. Anticipated future costs have been estimated and are also included in the maintenance plan.

The Town successfully completed the initial construction of the Shore Protection Project in October 2017. Periodic maintenance or renourishment is included in the Town's maintenance plan for the Shore Protection Project. The renourishments are expected to occur on a 5 year cycle and will initially involve dredging of Borrow Area A offshore Kill Devil Hills and Nags Head. The Dept. of the Army and North Carolina Division of Coastal Management permits issued for the initial construction will require modifications to use Borrow Area A for future maintenance. Likewise, the Town will be required to obtain a new lease from BOEM to use Borrow Area A for maintenance events. The Town has already made these agencies aware of their intentions to use Borrow Area A in the future. The estimated volume of material required for maintenance of the Kitty Hawk project is 645,000 CY every five (5) years. Post-construction surveys of Borrow Area A show that sufficient sand is available for future maintenance.

Project monitoring has been implemented to track performance of the placed material and is used to update nourishment requirements. The initial baseline monitoring event was conducted in December 2017 following the completion of beach nourishment projects in Southern Shores and Kitty Hawk. Year-1 beach profile surveys were conducted in June 2018. The Town of Kitty Hawk has also incorporated a supplemental bathymetric survey into their monitoring protocol. The beach profile and shore parallel bathymetric surveys that will result in acquisition of data needed to assess the project, have been designed and will be conducted to capture changes along the active profile of the beach both within the project area and adjacent to the project.

This Maintenance Plan serves as documentation that the Town of Kitty Hawk's Shore Protection Project meets the criteria established by 44 CFR 206.226(j)(2). The Maintenance Plan has been developed in a way consistent with the Public Assistance Program and Policy Guide – FP-104-009-2 (January 2018). This Maintenance Plan will be updated regularly to reflect results of monitoring, construction of additional projects, maintenance events and changes in schedules.

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REFERENCES

Aptim Coastal Planning & Engineering of North Carolina (APTIM), 2018. 2017 Dare County Beach Nourishment Project – Project Completion Report. Prepared For: The Town of Kill Devil Hills, North Carolina. Prepared For: The Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills, Wilmington, NC.

Aptim Coastal Planning & Engineering of North Carolina (APTIM), 2019. Town of Kitty Hawk & Kill Devil Hills, North Carolina 2018 Shoreline & Volume Change Monitoring Report. Prepared For: The Towns of Kitty Hawk and Kill Devil Hills, North Carolina, 34 pgs.

CPE-NC (2015A) Town of Kitty Hawk, North Carolina Erosion and Shoreline Management Design Report. Prepared For: The Town of Kitty Hawk, North Carolina, 79 pgs.

CPE-NC (2015B) Comprehensive Marine Sand Search and Borrow Area Design Report. Prepared For: The Towns of Duck Kitty Hawk and Kill Devil Hills, North Carolina, 49 pgs.

FEMA, 2018. Public Assistance Program and Policy Guide FP-104-009-2 / January 2018, 207 pgs.