



Town of Holden Beach, North Carolina

Oceanfront and Inlets Management Plan



Prepared by:
Town of Holden Beach, North Carolina
Inlet and Beach Protection Board

October 2019

Assistance Provided by:

ATM | DESIGN
ENGINEERING
CONSULTING
APPLIED TECHNOLOGY & MANAGEMENT, INC.

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North Carolina

October 2019

Table of Contents

Executive Summary	1
1.0 Introduction	1-1
1.1 Background	1-1
1.1.1 Geographic Setting	1-1
1.1.2 Management Activities	1-2
1.1.3 Effects of Recent Climatic Events	1-7
1.1.4 Planning for Future Climatic Events and Sea Level Rise	1-8
1.1.5 Regulatory Framework	1-9
1.2 Focus Areas	1-9
1.3 Plan Goals	1-13
2.0 Focus Area Activities and Projects	2-1
2.1 Lockwood Folly (LWF) Inlet	2-1
2.1.1 Description	2-1
2.1.2 Management Activities since 2009	2-2
2.1.3 Projects/Actions to Achieve Goals	2-4
2.2 East End	2-4
2.2.1 Description	2-4
2.2.2 Management Activities since 2009	2-5
2.2.3 Projects/Actions to Achieve Goals	2-6
2.3 Central Reach	2-6
2.3.1 Description	2-6
2.3.2 Management Activities since 2009	2-7
2.3.3 Projects/Actions to Achieve Goals	2-7
2.4 West End	2-8
2.4.1 Description	2-8
2.4.2 Management Activities since 2009	2-8
2.4.3 Projects/Actions to Achieve Goals	2-8
2.5 Shallotte Inlet	2-9
2.5.1 Description	2-9
2.5.2 Management Activities since 2009	2-9
2.5.3 Projects/Actions to Achieve Goals	2-10
2.6 Borrow Areas / Sand Sources	2-10
2.6.1 Description	2-10
2.6.2 Management Activities to Date	2-12
2.6.3 Projects/Actions to Achieve Goals	2-12
2.7 Compilation of Focus Area Projects and Initiatives with Funding Options	2-12
3.0 Adaptive Management	3-1
3.1 Monitoring and Reporting	3-1
3.2 Evaluating Progress	3-2

3.3	Collaboration	3-2
3.4	New Regulations	3-3
4.0	Critical Event Response	4-1
5.0	Potential Funding Sources	5-1

Appendix

Appendix A –Technical Data

List of Tables

- Table 1-1. Holden Beach Nourishment Summary Data (1971 to 2015)
- Table 1-2. Summary of Holden Beach Nourishment Projects since 2001
- Table 1-3. Long-Term Erosion Rates at the Focus Areas
- Table 2-1. Evaluation Criteria for Projects and Initiatives
- Table 2-2. Focus Area Projects and Initiatives with Funding Options
- Table 5-1. Range of Costs for Dredging Projects and Potential Cost-Share Options
- Table 5-2. Federal Funding Opportunities
- Table 5-3. State Funding Opportunities
- Table 5-4. Non-Profit Funding Opportunities

List of Figures

- Figure 1-1. Holden Beach Nourishments Since 2001
- Figure 1-2. Focus Areas
- Figure 1-3. LWF Inlet Outer Ebb Channel Alignments and Bend-Widener
- Figure 1-4. Inlet Throat, Flood Shoal and Ebb Shoal at LWF Inlet

Executive Summary

The Town of Holden Beach (Town) has been proactive in beach management and maintenance activities since the 1950s. The Town understands and appreciates that a nourished beach contributes to the expanding federal, state and local tax bases; increases sales, income, and employment opportunities from resident and visitor spending; and enhances property values by protecting the developed shorefront from storm surges, preventing loss of upland property and protecting wildlife habitat. Further, beaches provide recreational opportunities and habitat for many species, including endangered and threatened marine turtles, birds and mammals.

The recreational component cannot be overstated. The 2016 North Carolina Beach and Inlet Management Plan (NC BIMP; see Appendix A) estimated the 2013/2014 beach recreation annual total economic impact for Holden Beach at \$80.4 million, which accounted for 942 jobs. Additionally, the NC BIMP included a study of losses attributed to 50 percent beach width loss and found that for Holden Beach, the 2013/2014 estimated *annual* loss (including output/sales/business activity) would be \$12.6 million.

The Town investigated sand source options and memorialized its technical approach to beach management in 2009 through the *Beach Management Planning and Borrow Area Investigation* (see Appendix A), also referred to as the Town's beach management plan. In 2018, the Town created the Inlet and Beach Protection Board (IBPB) to undertake the creation of a goal-based adaptive management plan for the Town's oceanfront and inlets. Through the identification and implementation of 15 goals, this 2019 plan acknowledges and addresses naturally occurring coastal erosion, changing sea levels, impacts from recent climatic events and establishes the baseline for community resiliency.

Nineteen projects and initiatives are identified for implementation within the next 10 years. These activities are integral to the Town's path forward to address coastal erosion and dune retreat, recover from recent climatic events and achieve coastal resiliency. IBPB evaluated the following criteria when determining the list of projects and initiatives: social, recreational, economic, environmental, technical, political and administrative effects.

Mechanisms are in place to monitor physical and financial conditions and to evaluate progress on an annual basis, which may result in adjustments to the overall plan, including the list of projects and initiatives.

1.0 Introduction

1.1 Background

In April 2018, the Mayor and Board of Commissioners enacted Ordinance No. 18-02 (see Appendix A) that created the IBPB to serve as an advisory board for the Town. Among its assigned powers and duties, the IBPB is to prepare and recommend a comprehensive long-term plan for the Town's role in the management, dredging and protection of the Lockwood Folly and Shallotte Inlets, including their respective navigational channels, and the management, protection and nourishment of the Town's ocean beaches and protective dune systems.

This document is the Town's comprehensive long-term (10-year) plan. IBPB intentionally limited the plan horizon to 10 years because the coast continually changes in response to wind, waves, and fluctuating sea levels, as well as human influences. Projects and activities identified in Section 2 are: a) focused on the short-term (first 5 years), b) in response to effects of three major hurricanes in 2016 and 2018, and c) focus on future resilience.

IBPB initiated the planning process in January 2019, utilizing existing technical data in the Town's 2009 pre-existing beach management plan and numerous coastal engineering reports that Applied Technology and Management, Inc. (ATM) prepared for the Town since 2009 (see Appendix A). Throughout the process, IBPB was a focused steward of the Town's inlets and oceanfront and will advocate for the plan through adaptive management and implementation. ATM will continue to assist the Town with adaptive management and implementation, including annual plan review and recommending adjustments, if needed.

1.1.1 Geographic Setting

Holden Beach is located midway between Wilmington, North Carolina, and Myrtle Beach, South Carolina. The Town is situated on a 9-mile-long Atlantic coastal barrier island, facing south onto the Long Bay region of Brunswick County. With over 8 miles of clean, sandy beaches and a year-round moderate temperature, the island attracts many visitors. However, long-term and episodic storm erosion continually threaten the coastal habitats, recreational beach, tourism and upland developments on the island.

The 2016 NC BIMP (see Appendix A) estimated the 2013/2014 beach recreation annual total economic impact for Holden Beach at \$80.4 million, which accounted for 942 jobs. Additionally, the NC BIMP included a study of losses attributed to 50 percent beach width loss and found that for Holden Beach, the 2013/2014 estimated *annual* loss (including output/sales/business activity) would be \$12.6 million.

1.1.2 Management Activities

Beach Nourishment

The Town has been proactive in beach management and maintenance activities since the 1950s, when at that time, it became necessary to mitigate the impacts of Hurricane Hazel. The first documented nourishment occurred in 1971. Significant erosion and the loss of more than 30 homes on the eastern end of Holden Beach in the 1990s were major factors for the Town to institute a nourishment and beach management program. Since 2001, the Town and U.S. Army Corps of Engineers (USACE) have placed an average of 180,000 cubic yards/year (cy/yr) of sand on the beach. This rate of sand placement has been effective at keeping pace with background erosion. The Town finalized a beach management plan in 2009, with the primary goal of no net reduction in sand volume from Holden Beach. Ancillary goals were to increase storm protection, increase the recreational beach area, and address hot spots. Table 1-1 summarizes beach nourishment activities in Holden Beach between 1971 to 2015, as published in the 2016 NC BIMP. Most of these nourishments are related to Lockwood Folly (LWF) Inlet crossing dredge projects although other projects are included, such as the 2001-2002 Wilmington Harbor deepening project.

Table 1-1. Holden Beach Nourishment Summary Data (1971 to 2015)

First Year of Record	Number of Times Nourished	Total Volume (cy)	Average Volume (cy/yr)	Cumulative Distance (mile)	Average Distance (mile/yr)	Total Cost (2015)	Average Cost (2015)
1971	49	4,661,045	76,411	18.2	0.30	\$29,483,876	\$483,342

Note: Total cost of project does not reflect the pro-rated share per entity.

Table 1-2 identifies nourishment projects undertaken by the Town and USACE since 2001. Prior to 2001, beach management efforts were sporadic and on a smaller scale. This table shows that the Town has conducted seven beach nourishment projects using upland sand sources, undertaken coordination with USACE to maximize fill placement from dredging the LWF Inlet

and the Atlantic Intracoastal Waterway (AIWW) crossing, and utilized an offshore sand source for the Central Reach Project in 2017. Figure 1-1 depicts the Holden Beach nourishments since 2001 with station locations.

Table 1-2. Summary of Holden Beach Nourishment Projects since 2001

No.	Date	Responsible Entity	Beach Stations Nourished	Approx. Volume of Material Placed (cy)	Total Project Cost (\$)	Cost per cy (\$)	Nourishment Material Source
1	12/8/01 – 2/20/02	USACE	87+00 – 192+00	525,000	1,823,850	3.47	Wilmington Harbor Deepening Project
2	3/7/02 – 4/30/02	Holden Beach	66+00 – 90+00 175+00 – 271+00	141,700	779,350	5.50	Oyster Harbor upland site
3	March/April 2002	USACE	20+00 – 30+00	32,000	114,240	3.57	LWF crossing at AIWW
4	Winter 2002/2003	Holden Beach	90+00 – 175+00	30,000	72,000	2.40	Boyd Street disposal area
5	9/16/04 – 11/2/04	USACE	15+00 – 40+00	113,230	834,566	7.37	LWF crossing at AIWW
6	December 2003 – April 2004	Holden Beach	46+00 – 68+00 215+00 – 238+00	123,000	922,500	7.50	Smith borrow site
7	5/5/06 – 5/24/06	USACE	15+00 – 40+00	62,853	490,899	7.81	LWF crossing at AIWW
8	Early 2006	Holden Beach	Eastern Reach	42,000	346,500	8.25	Smith borrow site
9	Early 2006	Holden Beach	Western Reach	3,200	26,400	8.25	Smith borrow site
10	1/24/08 – 3/28/08	Holden Beach	60+00 – 95+00 245+00 – 270+00	201,000	1,658,250	8.25	Smith borrow site
11	2008/2009	USACE	20+00 – 40+00	100,000	858,000	8.58	LWF crossing at AIWW
12	3/24/09 – 4/30/09	Holden Beach	55+00 – 110+00 210+00 – 255+00	190,000	1,683,100	8.86	Smith borrow site
13	Spring 2010	USACE	20+00 – 55+00	140,000	1,400,655	9.04	LWF crossing at AIWW
14	February 2011	USACE	20+00 – 40+00	32,000	385,920	12.06	LWF crossing at AIWW
15	January 2012	USACE	20+00 – 30+00	25,000	160,884	6.44	LWF crossing at AIWW
16	2/10/14 – 2/27/14	USACE	18+00 – 50+00	93,000	1,169,425	12.57	LWF crossing at AIWW
17	2/27/14 – 3/15/14	Holden Beach	50+00 – 73+00	95,000	1,222,763	12.87	LWF crossing at AIWW

No.	Date	Responsible Entity	Beach Stations Nourished	Approx. Volume of Material Placed (cy)	Total Project Cost (\$)	Cost per cy (\$)	Nourishment Material Source
18	9/4/15 – 9/15/15	Holden Beach	Nearshore 60+00 – 90+00	24,000	308,908	12.87	Lockwood Folly Outer Navigation Channel
19	1/3/17 – 3/17/17	Holden Beach	45+00 – 257+00	1,310,000	15,570,500	11.89	Offshore sand source
20	March 2017	Holden Beach and USACE	20+00 – 45+00	120,000	875,000	7.29	LWF crossing at AIWW
21	Sep-17	USACE	Nearshore	16,000	24,000	7.75	Lockwood Folly Outer Navigation Channel
22	February/ March 2019	Holden Beach	Nearshore	30,000	205,714	6.86	Lockwood Folly Outer Navigation Channel
Approximate total since 2001:				3,463,983			

Note: Costs are not adjusted for inflation.

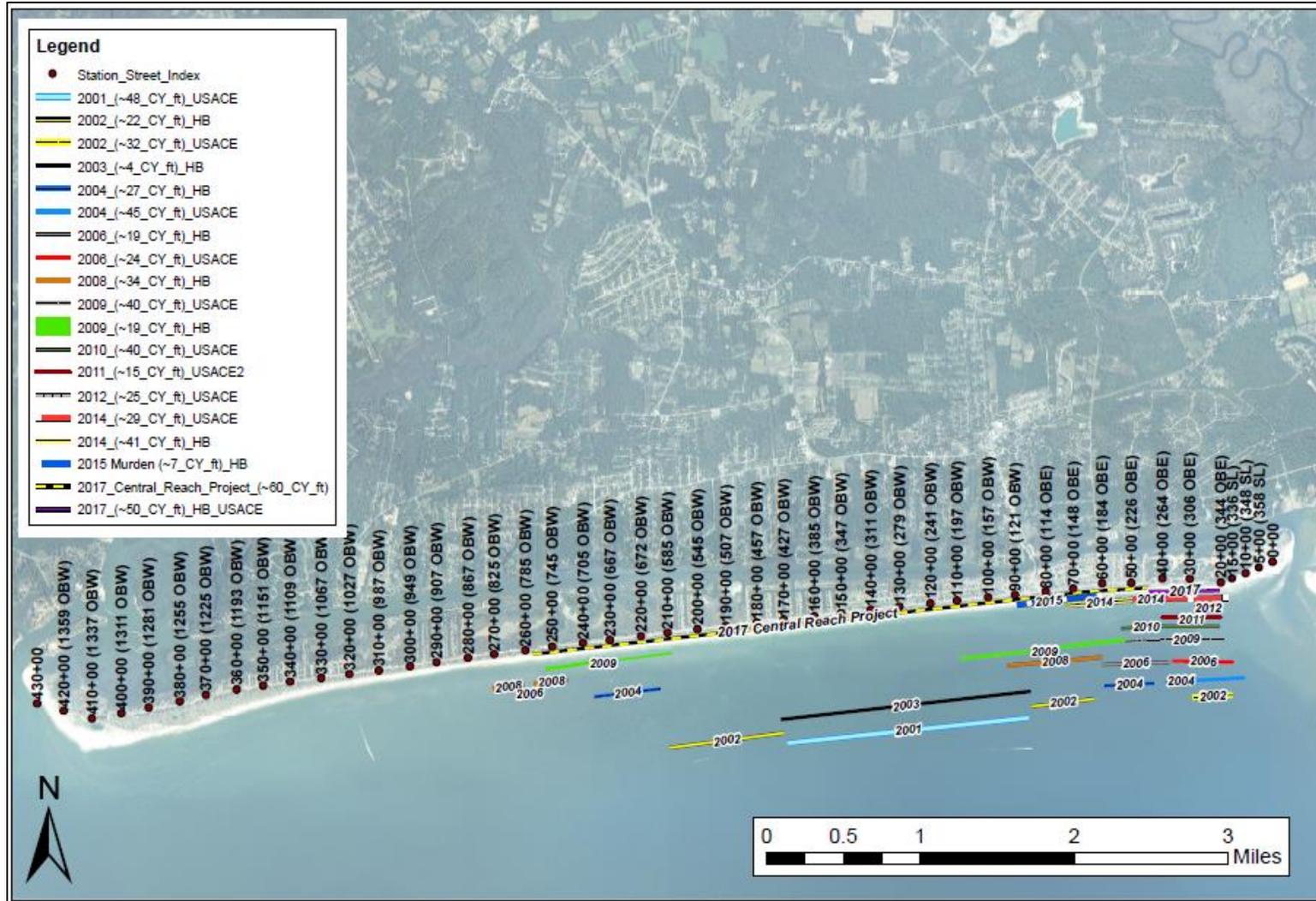


Figure 1-1. Holden Beach Nourishments Since 2001
 Stations begin at LWF Inlet (0+00) and are generally at 1,000 FT intervals, ending at Shallotte Inlet (430+00)

Dune Enhancement

The Town has been proactive in dune enhancement and maintenance activities for decades. The Town has served as the primary funding mechanism for dune vegetation and fencing projects on an island-wide basis; however, significant recent and past contributions have been made by the Holden Beach Renourishment Association. Extensive American beach grass, sea oat and bitter panicum planting efforts in 2010 and 2011 moved the toe of the vegetated dune seaward and generally strengthened the dune system. In winter 2010, approximately 100,000 American beach grass sprigs were planted, followed by the planting/sprigging of 79,500 sea oats/bitter panicum in the summer. In winter 2011, approximately 60,000 American beach grass sprigs were planted, followed by the planting/sprigging of 79,000 sea oats/bitter panicum in the summer. Approximately four tons of fertilizer was applied in 2010 and 2011 to ensure dune vegetation health. Sand fencing was also added in significant quantities (18,000 linear feet). Dune walkover improvements were completed to accommodate the expanding dune habitat and to ensure a continuous dune system, which is important in minimizing vulnerable areas that can more easily breach during storm events. While the majority of dune enhancement activities are nourishment-related, dune planting and maintenance activities have been an annual occurrence over the last decade by the Holden Beach Renourishment Association.

During Hurricane Matthew in October 2016, the combination of storm surge and large swells created wave run-up conditions that directly impacted the dune system. Dune sand losses were calculated to be approximately 123,000 cy along the entire shoreline of Holden Beach. The dune line retreated an average of 43 feet, and dune retreat was up to 200 feet on the West End in some places. The area of vegetation lost was established at 41.1 acres, with half the loss in the Central Reach.

As part of the Central Reach Project in 2017, dune vegetation planting and sand fencing components offset damage by Hurricane Matthew. Also, as a result of the Central Reach Project, a static vegetation line (SVL) was established as required by the North Carolina Division of Coastal Management (NCDCM).

Inlet Management

Dredging and sand bypassing are the primary focus of inlet management in North Carolina (NC BIMP, 2016). USACE Wilmington District maintains 308 miles of federally mandated channels

including the AIWW, rivers, small harbors, and seven major inlets along the coast, including LWF and Shallotte Inlets. The Town has advocated management activities at the LWF and Shallotte Inlets for decades. In recent years, federal funding has not been available to dredge the shallow draft navigational channels as often as needed. State authorizations allow the Town an additional option for maintaining (at current USACE templates) the LWF Inlet crossing (LWFIX), the inlet throat, and the outer channel beyond the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) line.

A beneficial outcome of USACE's dredging of the LWFIX at the AIWW is the use of dredged sediment for nourishment purposes. As reflected in Table 1-2, Holden Beach has been the recipient of dredged sediment from several USACE dredging projects.

1.1.3 Effects of Recent Climatic Events

Holden Beach naturally experiences shoreline retreat due to long-term erosion through littoral sediment transport, sea level rise, and storm-related recession. Tidal currents, wave focusing, and storage of sediment in the ebb and flood shoals of LWF and Shallotte Inlets also affect the shoreline. In recent years, Holden Beach has been affected by severe climatic events: Hurricane Matthew (October 2016), Hurricane Florence (September 2018) and Hurricane Michael (October 2018).

Hurricane Matthew (October 2016)

Holden Beach suffered significant erosion and damage to the upper beach and dune systems. Overall, Holden Beach lost approximately 336,000 cy of material above -5 feet referenced to the National Geodetic Vertical Datum (NGVD), with the most significant erosion at the western half. Dune sand losses were calculated to be approximately 123,000 cy along the entire shoreline of Holden Beach. The area of vegetation lost was established at 41.1 acres, with half of the losses occurring along the Central Reach (also referred to as the engineered beach). Similar to the engineered beach mitigation projects following Hurricanes Hanna (2008) and Irene (2011), Federal Emergency Management Agency (FEMA) assistance was implemented to help reimburse the cost of 131,000 cy of sand placement in the Central Reach. FEMA also participated in dredge mobilization/demobilization and dune fencing/vegetation costs.

Hurricane Florence (September 2018)

The entire shoreline of Holden Beach suffered a loss of approximately 1,453,000 cy from Hurricane Florence, with 723,000 cy of that loss within the Central Reach.

Hurricane Michael (October 2018)

Just a month later, the entire shoreline of Holden Beach suffered an additional loss of approximately 783,000 cy from Hurricane Michael, with approximately 389,000 of that loss within the Central Reach.

1.1.4 Planning for Future Climatic Events and Sea Level Rise

The 2015 North Carolina Sea Level Rise Assessment Report (see Appendix A) concluded that sea level is rising across the coast of North Carolina. The rate of local sea level rise varies, depending on location (spatially) and the time frame for analysis (temporally). The report further indicates that recent research into the frequency of coastal flooding has shown that, regardless of the rate of rise, as the mean sea level increases, communities should expect more frequent flooding of low-lying areas. The report recommends that agencies work in an open and informed manner with the scientific community, local landowners and political bodies, and other affected stakeholders to consider acceptable levels of risk.

The desired outcome of this plan is to protect and achieve resiliency of Holden Beach's oceanfront and inlets by protecting property, infrastructure, beachfront, dunes, low-lying areas, and the intracoastal waterway. Integral to coastal protection and resilience is acknowledgement that future climatic events will occur, and sea level rise will have an effect on coastal management. For example, sea level rise will likely increase storm surge, that when combined with large swells, create wave run-up conditions that impact the dune system and contribute to further beach erosion and washovers.

The projects and activities identified in Section 2 and adaptive management strategies outlined in Section 3 reflect proactive actions to help offset future impacts. These actions include identifying sand sources, managing sediment, exploring innovative shoreline protection options (e.g., living shorelines, dune vegetation enhancement, extending the engineered beach, etc.), monitoring, and evaluating progress.

1.1.5 Regulatory Framework

Coastal management in Holden Beach is subject to local (town ordinances, comprehensive land use plan and zoning regulations), state [North Carolina Department of Environmental Quality (NCDEQ)], and federal [USACE, U.S. Environmental Protection Agency (EPA), National Marine Fisheries Service, U.S. Department of Interior (Bureau of Ocean Energy Management), and U.S. Fish and Wildlife Service] regulations and permitting.

The state of North Carolina has a robust management program for its 20 coastal counties, including Brunswick County, where Holden Beach is located. This program is a result of the Coastal Area Management Act passed by the North Carolina General Assembly in 1974 that created the Coastal Resources Commission (CRC). The CRC establishes and revises rules and policies (including designating areas of environmental concern and inlet hazard areas) related to development and specific types of projects within the coastal counties. Holden Beach has designated areas of environmental concern, subject to stringent permitting requirements associated with development and coastal projects, such as beach nourishment, dredging, dune creation and stabilization, and oceanfront erosion response.

1.2 Focus Areas

Holden Beach is a 9-mile barrier island that includes 8 miles of oceanfront shoreline and inlets to the intracoastal waterway on its east and west ends. IBPB delineated six geographic sections or focus areas to enable easier planning and management (see Figure 1-2). Descriptions of these focus areas are provided in Section 2.

Figure 1-3 depicts outer ebb channel alignments over the last 10 years at LWF Inlet as well as the bend-widener. Figure 1-4 depicts the inlet throat, flood shoal and outer shoal at the LWF Inlet based on a 2019 survey.

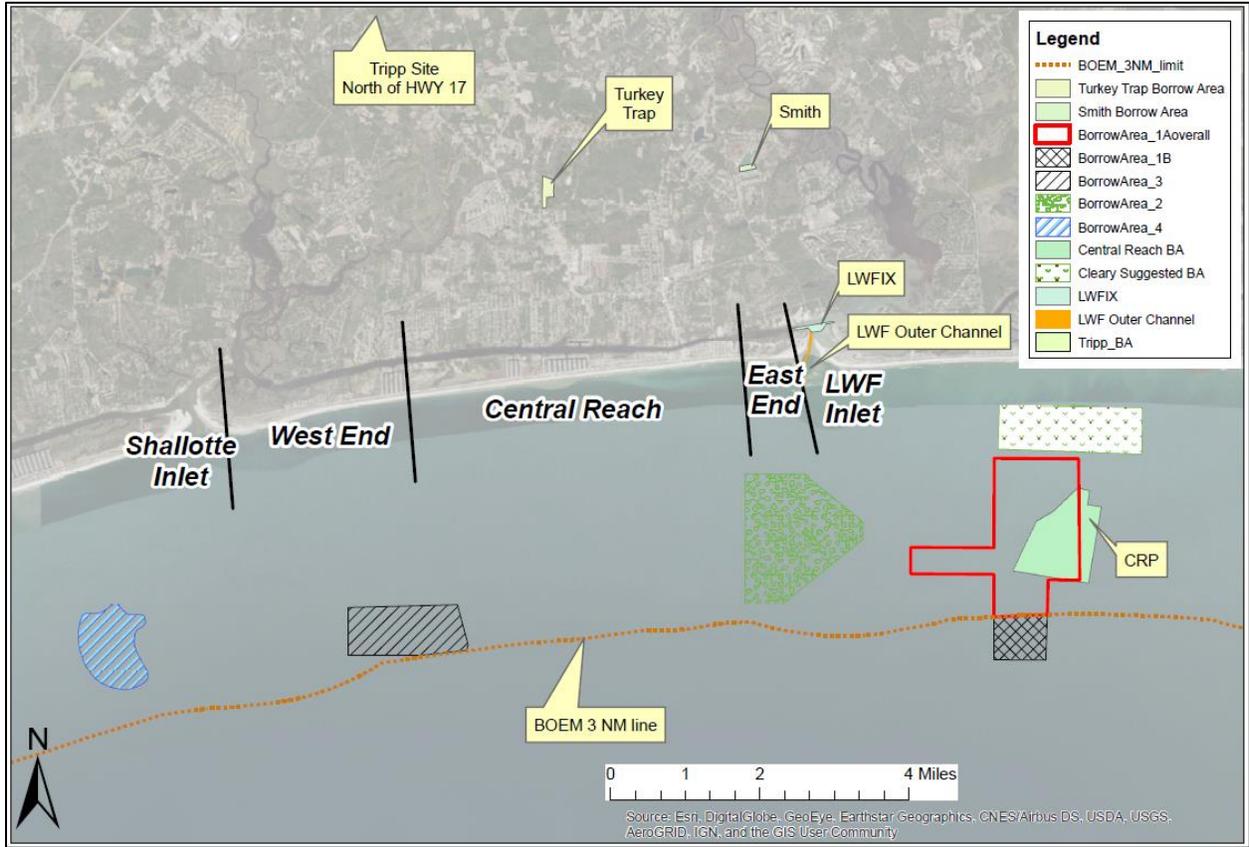


Figure 1-2. Focus Areas

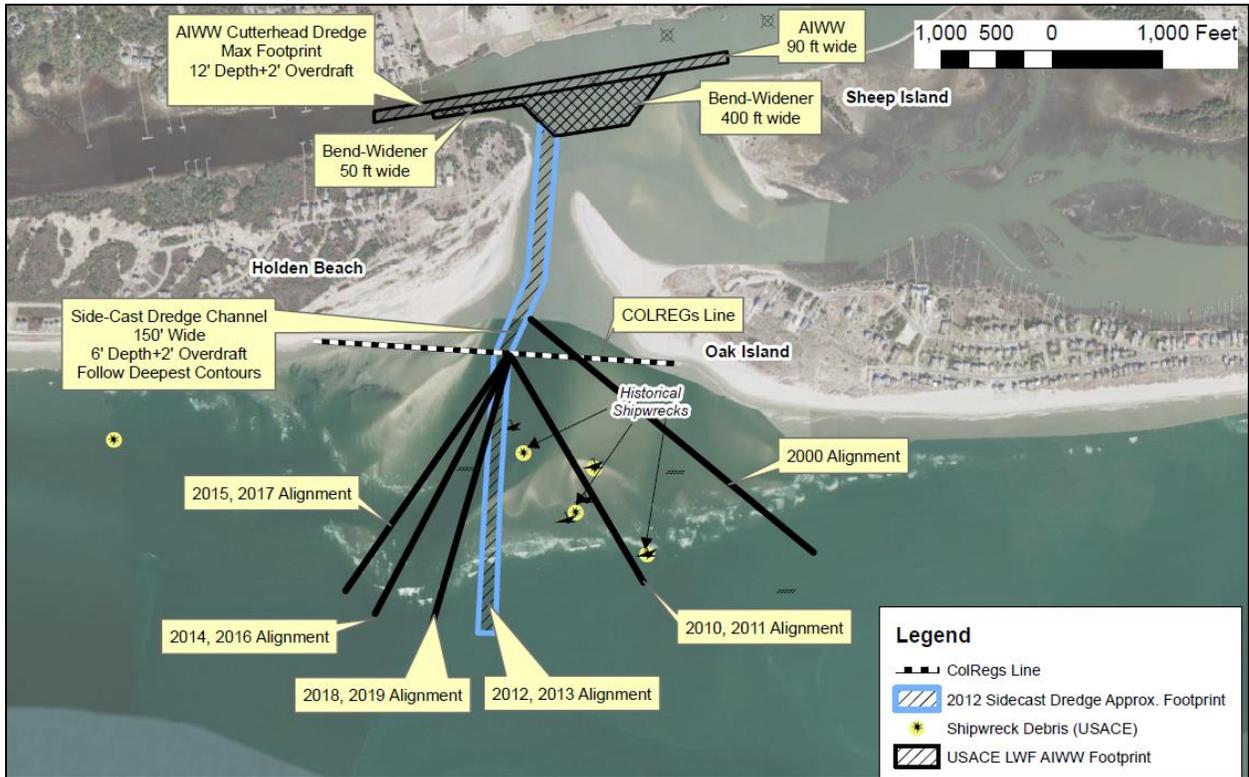
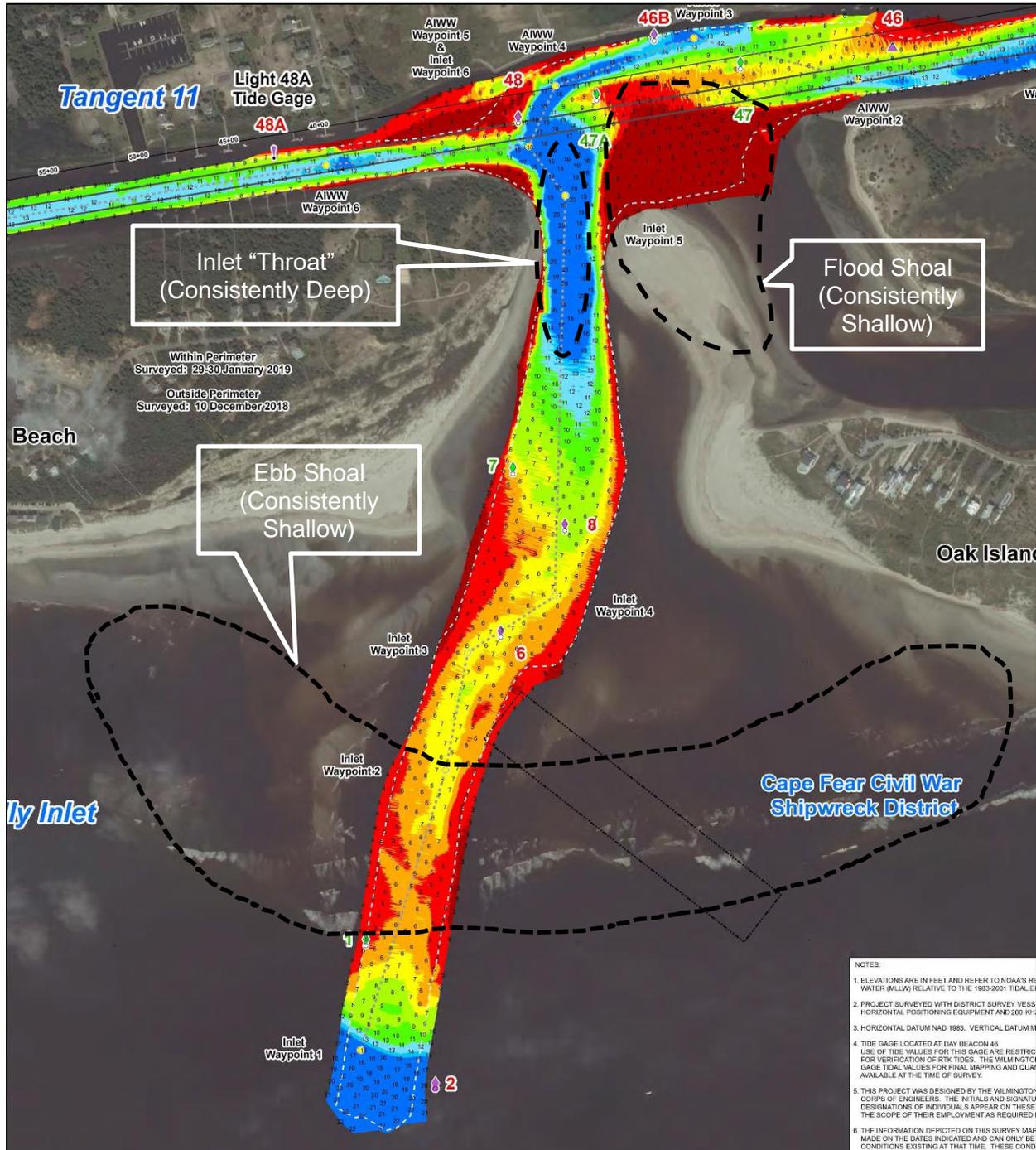


Figure 1-3. LWF Inlet Outer Ebb Channel Alignments and Bend-Widener



**Figure 1-4. Inlet Throat, Flood Shoal and Ebb Shoal at LWF Inlet
(Image Source: USACE Wilmington Navigation Branch)**

The inlet throat is consistently deep (18-20 feet MLLW) on USACE surveys. The ebb and flood shoals are consistently shallow and typically require dredging for safe navigation. The ebb shoal

typically consists of several shallow sandbars that slowly migrate across the inlet from the Oak Island side to the Holden Beach side.

The January 2019 *North Carolina Oceanfront Setback Factors and Long-Term Average Annual Erosion Rate Update Study: Methods Report* (Appendix A) provides updated long-term annual average shoreline change rates. Specific to Holden Beach, the report states that approximately 2 miles (25 percent) of the shoreline has measured accretion, whereas 6 miles (75 percent) is eroding. Although down slightly from the last study in 2011 (59 percent), most (55 percent) of the measured erosion is 2 feet per year or less. Long-term erosion rates at the East End, Central Reach and West End focus areas based on the 2019 report are summarized in Table 1-3.

Table 1-3. Long-Term Erosion Rates at the Focus Areas

Focus Area	Long-Term Erosion Rate
East End	-5 to -7 ft/yr
Central Reach	-1 to -3 ft/yr
West End	0 to -1 ft/yr

1.3 Plan Goals

IBPB completed a series of goal-setting exercises that resulted in the formulation of 15 prevailing goals for this plan.

1. Recognize and prioritize the importance of the inlets, beach and dune system by:
 - a. Protecting life and property from storms and sea level rise.
 - b. Protecting the ad valorem tax base and providing significant economic revenue through tourism occupancy taxes and property taxes.
 - c. Providing and protecting habitat for important plants and animals.
 - d. Providing and protecting a healthy environment for recreation and improved quality of life of all citizens.
 - e. Protecting town infrastructure.
2. No net reduction in sand volume while increasing storm protection, increasing the recreational beach area, and addressing hot spots.
3. Create and maintain a strong and healthy vegetated dune system from inlet to inlet to protect life, property, infrastructure, and the Town's tax base and revenue sources.
4. Create a comprehensive, long-range management plan for the strengthening, protection, preservation, restoration, and enhancement of the inlet, beach and dune systems.

5. Promote the wise use of the Town's oceanfront.
6. Encourage the use of soft strategies that can provide shoreline protection without potential long-term effects and avoid the use of hard erosion control devices (e.g., terminal groin) along oceanfront shoreline (but allow living shorelines along inlet shorelines and marshes).
7. Encourage the use of evolving and innovative techniques for beach and inlet protection, restoration, strengthening and monitoring that do not adversely impact the long-term health of the beach and dune systems.
8. Research, evaluate and apply emerging techniques for beach and inlet protection, restoration, strengthening, and monitoring.
9. Promote carefully planned nourishment as an option for beach preservation and restoration.
10. Encourage and participate in intergovernmental coordination and collaboration on long-term coastal management planning with academic institutions and non-governmental coastal organizations to enhance the preservation of the inlets, beach and dune systems.
11. Establish or enhance guidelines for critical event response in terms of emergency management of the beach and dune systems following a significant storm event or flooding event.
12. Provide framework for the Town to manage its oceanfront and inlets.
13. Encourage the use of legislative advocates to facilitate communications to position the Town to receive federal and state appropriations to offset costs associated with implementing this plan.
14. Adaptively manage the inlets by the Town securing perpetual easements if needed for inlet dredging and sand placement.
15. Prevent and minimize flooding in low-lying areas (effective FEMA flood maps indicate that approximately 90 percent of Holden Beach is within the 100-year floodplain; approximately 10 percent is within the 500-year floodplain).

2.0 Focus Area Activities and Projects

This section includes the following information for each focus area: description, management activities since 2009 (effective date of Town’s pre-existing beach management plan) and new proposed projects/actions to achieve goals. Note that only a subset of these items are selected to be pursued at this time. Those selected are indicated at Section 2.7. Projects not selected at this time remain listed for reference and possible action in the future.

In addition to continuing proactive maintenance activities and implementing preventative measures based on review of the annual monitoring reports, triggers for future actions include observed changes to:

- Background erosion
- Shoreline
- Beach width
- Volume of sand in the dune and beach areas
- High tide line to dune line
- Flooding at interior of island
- Dune vegetation line

Future actions to be undertaken by the Town will be determined by the Board of Commissioners.

2.1 Lockwood Folly (LWF) Inlet

2.1.1 Description

LWF Inlet is a navigable channel that is federally authorized as a shallow draft inlet located at the eastern end of Holden Beach and separates Holden Beach from Oak Island.

LWF Inlet has been historically stable with respect to its location (i.e., it is not migrating), although adjacent shorelines are characterized by some of the largest inlet-induced erosion rates in southeastern North Carolina.

USACE historically conducts two basic routine maintenance activities at the inlet: outer bar sidecast dredging and LWFIX cutter-head dredging and beach fill placement. State

authorizations allow the Town an additional option for maintaining (at current USACE templates) the LWFIX crossing, the inlet throat, and the outer channel beyond the COLREGs line. The permits for this effort were issued in May 2016 and will expire in December 2019 (with the ability to obtain extensions). The authorizations include all currently approved dredge material management locations, including shoreline beneficial placement, nearshore placement and/or upland confined disposal placement.

The NCDEQ Shallow Draft Inlet (SDI) Program has provided the Town with permits to dredge the inner and outer portions of the inlet. These permits essentially allow the Town, with potential help from the county and state, to perform the same inlet maintenance activities that USACE currently performs (i.e., LWFIX dredging, outer channel sidecasting). The permits currently limit any beach fill projects to only one placement event before permit modification.

2.1.2 Management Activities since 2009

USACE typically dredges the LWFIX and AIWW annually or biennially (every other year) and typically sidecast dredges the outer LWF Inlet once per quarter, if adequate funding is available and safe navigation is a concern. In recent years, USACE has reduced the dredging frequency to once every 6 months or even longer intervals. Management activities completed since 2009 (effective date of the Town's pre-existing beach management plan) are provided in the following paragraphs. It is noted that the Town has received the beneficial use of dredged sediment from several USACE dredging projects at LWFIX. These projects are reflected in the East End focus area (Section 2.2).

2019 – Outer Bar Dredging and Nearshore Placement with Shallow Draft Hopper

The *Murden* dredger was last used in February and March 2019 to clear the outer ebb channel. This resulted in placement of approximately 30,000 cy of dredged material in the nearshore. Nearshore placement generally occurs in approximately 8-15 feet of water between 500 and 800 feet from shore. The nearshore placement generally occurs between Ferry Road (~Station 60+00) and the Holden Beach bridge (~Station 90+00).

2019 – Outer Bar Sidecast Dredging

The *Merritt* dredger was used in February and June 2019 to clear portions of the outer ebb channel. Sidecast dredging merely moves dredged material about 100 feet from where it is

excavated. The *Merritt* is recently back from an extended maintenance/drydock. Now that it is back in operation, both the *Merritt* and *Murden* are available to USACE for outer ebb channel navigation maintenance.

2017 – Outer Bar Dredging and Nearshore Placement with Shallow Draft Hopper

The *Murden* dredger was used in September 2017 to clear the remaining portions of the outer ebb channel of LWF Inlet that resulted in the placement of dredged material in the Holden Beach nearshore in an authorized location (i.e., between the bridge and Ferry Road).

2015 – Outer Bar Dredging and Nearshore Placement with Shallow Draft Hopper

The Town performed a pilot project using the *Murden* dredger that resulted in placement of approximately 24,000 cy of dredged material in the nearshore between the bridge and Ferry Road [~3,000 linear feet (LF) of shoreline]. The Town performed additional surveys of the nearshore disposal project area in an effort to document the onshore migration of this placed sand. The nearshore placement resulted in mounds generally 2-3 feet high. Subsequent surveys found the mounds to have dispersed; however, their onshore movement could not be detected as this is a relatively small amount of material that quickly assimilated into the littoral system. Nonetheless, ATM believes this nearshore placement is the best disposal option and is favored over sidecaster dredging. The Town has also begun acquiring nearshore dredged material drop points from the *Murden* for a database. This USACE data has been acquired for the 2017 and 2019 *Murden* projects.

The *Merritt* (sidecaster) was generally preferred by USACE over the *Murden* or *Currituck* (shallow draft hopper dredges) prior to the *Merritt*'s extended drydocking (approximately 2017 to 2018).

Prior to the state's shallow draft dredging memorandum of agreement with USACE in 2013, federal funding severely limited USACE shallow draft dredging from 2009 to 2013. This prompted the U.S. Coast Guard to remove navigation buoys from LWF Inlet on several occasions.

2.1.3 Projects/Actions to Achieve Goals

IBPB considered the following management actions. Items 1, 2, 3, 4 and 7 have been translated into projects (Section 2.7). The remaining action options will be re-evaluated during the annual plan review in 2020.

1. Monitoring
2. Inlet crossing sand placement
3. Advocating legislative engagement for cost-share opportunities or appropriations
4. Updating historical report on inlet changes [University of North Carolina Wilmington (UNCW) and ATM]
5. Argos real time camera monitoring (UNCW and ATM)
6. Investigating engineering the estuarine inlet to reduce dredging frequency
7. Securing perpetual easements required for dredging
8. Dredging for beneficial placement every year, every other year, or as needed (USACE)
9. Expanding the LWFIX dredging to include the bend-widener dredging for additional navigation and nourishment benefits

2.2 East End

2.2.1 Description

The East End shoreline reach is approximately 0.8 mile in length and extends from LWF Inlet to McCray Street.

The beach and dune system in this area experiences chronic and episodic erosion, with the highest beach erosion rates in Holden Beach. Erosion is prominent due to the continual shifting and reorientation of the main ebb and flood channel(s) of LWF Inlet. Storm damage and property loss are also correspondingly historically high in this reach. The long-term erosion rate of the East End shoreline is -5 to -7 ft/yr.

The USACE LWFIX Eastern Reach Project (sand placement from USACE dredging) that has been so successful since 2010 is now in jeopardy because the Town of Oak Island is interested in the sand and has less required easements. To resume sand placement on Holden Beach, the

Town acquired the necessary easements (most parcels are non-buildable lots on the active beach).

2.2.2 Management Activities since 2009

Management activities completed since 2009 (effective date of the Town's pre-existing beach management plan) are as follows.

USACE LWFIX Eastern Reach Project

- 2017 – Placement of approximately 120,000 cy of dredged material on approximately 2,400 LF of shoreline. The dredged material was placed immediately adjacent to the eastern taper of the Central Reach Project.
- 2014 – Placement of approximately 95,000 cy of dredged material from LWFIX (this is known as the Town's "piggyback project" that utilized dredged sediment from the 400-foot bend-widener) and an additional 93,000 cy from USACE on approximately 2,400 LF of shoreline.
- 2012 – Placement of 25,000 cy of dredged material on approximately 2,400 LF of shoreline.
- 2011 – Placement of 32,000 cy of dredged material on approximately 2,400 LF of shoreline.
- 2010 – Placement of 140,000 cy of dredged material on approximately 2,400 LF of shoreline.

Dune Management

Dunes are generally managed along the entire oceanfront on an as-needed basis and especially following nourishment events. The Eastern End has higher erosion rates and a narrower dune system where planting and fencing occur relatively frequently. In 2014 and 2017, approximately 22,000 plants were installed along 0.5 mile of the Eastern Reach as part of the USACE LWFIX Eastern Reach Project.

In 2014 and 2015, UNCW conducted a fertilizer/microbe study on the east end of Holden Beach. The study included 3,000 sea oat sprigs and investigated the effects of various fertilizer levels/types and mycorrhizae presence/absence on dune vegetation growth and overall health.

Approximately 75 percent of the plants were lost due to erosion or flooding. However, some valuable lessons were gleaned from the experiment and, while this specific fertilizer/mycorrhizae study has concluded, additional UNCW graduate studies on the topic of dune enhancement continue.

2.2.3 Projects/Actions to Achieve Goals

IBPB considered the following management actions, all of which have been translated into projects (Section 2.7).

1. Undertake another piggyback project with the next USACE LWFIX federal dredging project to maximize sand placement while minimizing the costs by use of a dredge already onsite for the federal project
2. Undertake erosion control projects including the engineered beach concept, similar to Central Reach
3. Use mats for walkway stability and dune protection on Town-owned property, and encourage use of mats by private property owners for walkway stability and dune protection
4. Advocate legislative engagement for cost-share opportunities or appropriations
5. Monitor
6. Coordinate with UNCW to conduct dune vegetation mapping and monitoring
7. Investigate vegetation enhancements (species and locations)
8. Study dune breaches to understand primary dune enhancement/secondary dune placement
9. Evaluate the pros/cons of extending the “engineered beach” template to the east

2.3 Central Reach

2.3.1 Description

The Central Reach is approximately 4.5 miles in length between 240 Ocean Boulevard East (~Station 44+00) and 867 Ocean Boulevard West (~Station 280+00).

The Central Reach is the Town’s engineered beach and, as such, federal funds can be used for restoration and mitigation. The Central Reach suffered relatively large erosional losses between 2015 and 2016, and Hurricane Matthew caused significant erosion and damage to the shoreline in October 2016. This was remedied through the Central Reach Project in 2017 (which was bid

and contracted prior to Hurricane Matthew). However, Hurricanes Florence and Michael in 2018 caused further significant erosion and damage. The long-term erosion rate of the Central Reach shoreline is -1 to -3 ft/yr.

2.3.2 Management Activities since 2009

Beach fill management activities completed since 2009 (effective date of the Town's pre-existing beach management plan) are provided in the following paragraphs.

Central Reach Project (2017)

This project resulted in placement of approximately 1.31 million cubic yards along approximately 4.1 miles (22,000 LF) of shoreline. This project utilized an offshore borrow area and represents the largest beach fill project to date in Holden Beach. The dredge project was completed at a favorable rate of ~\$12 per cubic yard (\$15.6 million total). Dune vegetation planting and sand fencing were project components that stabilized and restored the dune system that Hurricane Matthew damaged. The "starter dune" fill component was fenced and vegetated along the entire Central Reach shoreline (4.1 miles). Approximately 381,000 plants, primarily sea oat sprigs, were installed along the Central Reach.

Truck Haul Project (2009)

This project resulted in the placement of 190,000 cy of upland fill along approximately 10,000 LF of Central Reach shoreline. This project was classified as FEMA engineered beach mitigation for Hurricane Hanna (2008).

2.3.3 Projects/Actions to Achieve Goals

IBPB considered the following management actions, all of which have been translated into projects (Section 2.7).

1. Remediate/mitigate effects of Hurricanes Florence and Michael by initiating the Central Reach Reimbursement Project
2. Complete critical event response assessments
3. Use mats for walkway stability and dune protection on Town-owned property and encourage use of mats by private property owners for walkway stability and dune protection
4. Advocate legislative engagement for cost-share opportunities or appropriations

5. Monitor
6. Coordinate with UNCW to conduct dune vegetation mapping and monitoring
7. Investigate vegetation enhancements (species and locations)
8. Study dune breaches to understand primary dune enhancement/secondary dune placement

2.4 West End

2.4.1 Description

The West End shoreline reach is approximately 3 miles in length and extends from 867 Ocean Boulevard West to 1367 Ocean Boulevard West near Shallotte Inlet.

This reach has been historically stable/accretional and receives sand from the eastern projects as it migrates westward (downdrift). However, some areas of the shoreline have experienced dune erosion and vegetation loss in recent years and could benefit from proactive dune enhancement efforts. The shoreline experienced erosion of the dry beach and surf zone (about 81,000 cy) likely as a result of Hurricane Matthew in 2016. Otherwise, fluctuations in volumes can be attributed to net westerly sand transport, shoreline undulations, inlet-related processes (including shoreline orientation/curvature and shoal formation), and extreme storm conditions. The long-term erosion rate of the West End shoreline is 0 to -1 ft/yr.

2.4.2 Management Activities since 2009

Since this reach has been historically stable/accretional and receives sand from the eastern projects as it migrates westward, the Town has not undertaken management activities, with the exception of dune planting and fencing.

2.4.3 Projects/Actions to Achieve Goals

IBPB considered the following management actions, all of which have been translated into projects (Section 2.7).

1. Additional monitoring of the dunes for proactive protection measures
2. Use mats for walkway stability and dune protection on Town-owned property and encourage use of mats by private property owners for walkway stability and dune protection
3. Advocate legislative engagement for cost-share opportunities or appropriations

4. Coordinate with UNCW to conduct dune vegetation mapping and monitoring
5. Investigate vegetation enhancements (species and locations)
6. Study dune breaches to understand primary dune enhancement/secondary dune placement
7. Collaborate with North Carolina State University (NC State) on the conversion of 50 acres owned by NC State to a maritime forest
8. Evaluate the pros/cons of extending the “engineered beach” template to the west

2.5 Shallotte Inlet

2.5.1 Description

The Shallotte Inlet is a navigable channel located at the western end of Holden Beach that separates Holden Beach from Ocean Isle (downdrift shoreline).

Shallotte Inlet is a borrow area for Ocean Isle’s USACE Coastal Storm Damage Reduction (CSDR) project. Approximately 625,000 cy is dredged from Shallotte Inlet every 4 to 5 years. As a result of this CSDR project, Shallotte Inlet is not a designated shallow draft inlet and, therefore, is not maintained by USACE from a navigation perspective.

Several homes on the extreme western end of Holden Beach near Station 420+00 (approximately 1359 Ocean Boulevard West) are close enough to Shallotte Inlet that close monitoring of inlet migration and USACE/Ocean Isle nourishment activities in Shallotte Inlet is warranted. Note that the most recent Ocean Isle nourishment project was in 2014, and another is scheduled for 2019 (SAW-2016-01642).

Ocean Isle was issued a permit for a terminal groin along the East End, but this permit is currently under appeal.

2.5.2 Management Activities since 2009

Since the USACE Ocean Isle nourishments use Shallotte Inlet as a borrow area, shoreline monitoring occurs to assess any potential effects on the Holden Beach shoreline. USACE typically dredges the inlet every 4 years, resulting in approximately 625,000 cy of dredged material for placement at Ocean Isle. Large dredging projects at Shallotte Inlet (similar to the 1.8 million cy project in 2001) have the potential to detrimentally affect the Holden Beach shoreline.

2.5.3 Projects/Actions to Achieve Goals

IBPB considered the following management actions, all of which have been translated into projects (subsection 2.7).

1. Additional transect monitoring to document changes due to dredging and/or terminal groin projects
2. Update historical report on inlet changes (UNCW and ATM)
3. Track status of Ocean Isle terminal groin permit

2.6 Borrow Areas / Sand Sources

2.6.1 Description

Figure 1-1 reflects locations of known, viable upland, offshore and AIWW (LFWIX) borrow areas/sand sources.

The Town has been actively assessing available borrow areas since 2001 and has focused on upland sources, offshore area and the LWF Inlet (AIWW source). Characteristics of these borrow areas are described in the following paragraphs.

Upland Sources

Although the last upland-sourced beach nourishment occurred several years ago, the use of upland borrow areas remains a feasible alternative for Holden Beach. Fill projects utilizing upland borrow areas can be extremely valuable for unplanned/emergency mitigation efforts, such as the responses to Hurricanes Hanna and Irene. Additionally, truck haul projects do not involve the expensive mobilization/demobilization costs associated with offshore dredges and can occur much more quickly.

Potential negative aspects of upland borrow areas include variations in sand color, practical volume limitations, and placement methods (i.e., trucking). Additionally, the North Carolina Department of Transportation (NCDOT) requires permitting and has the ability to shut down operations or require roadway mitigation.

The Town owns the Turkey Trap Road upland borrow site (38 acres; 3.6 miles from beach; yield of approximately 460,000 cy of material). Other potential borrow area sites include the Smith

borrow site (4 miles from beach; approximately 250,000 cy) and the Tripp site (64 acres; 13 miles from beach; 1.2 mcy).

Offshore Borrow Areas

The Central Reach Project utilized an offshore borrow area approximately 5 miles southeast of the Holden Beach project shoreline. The Central Reach offshore borrow area is approximately 590 acres in size and is located between about 1.8 and 3 miles offshore of western Oak Island and to the southeast of LWF Inlet. This offshore borrow area was delineated based on the need for enough sand for at least two large nourishments. Following the project, it is estimated that at least 500,000 cy of material is still available for future nourishments.

Additional offshore borrow area reconnaissance is underway. The Central Reach Project borrow area was the preferred location of several potential borrow areas initially evaluated in 2008-2009. However, given Oak Island's interest in using this borrow area, as well as the recent placement of artificial reef material to the east of this borrow area, other locations will likely require reevaluation. Additionally, due to the Central Reach Project borrow area location offshore (2 to 3 miles) and depths (35 to 40 feet), it is not anticipated that any substantial amount of sand will "fill in" the used portions of the borrow area in the near future. Therefore, the portions of the Central Reach Project borrow area that have been dredged more than 2 feet deep likely cannot be reused in the future.

Overall, offshore borrow areas have the following characteristics:

- Suitable for large projects (greater than 500,000 cy)
- Sand color and grain size typically very compatible
- Fast production rates and longer lifecycles (every 5 to 10 years)
- Large ocean-certified hopper dredge mobilization/demobilization costs (\$1 to \$4 million)

LWF Inlet (AIWW)

The LWFIX borrow area has been a source of beneficial dredged material since the 1970s. The Town of Oak Island is now interested in receiving dredged material from the borrow area. Holden Beach and Oak Island are each obtaining the necessary easements required for eligibility to receive the dredged material.

2.6.2 Management Activities to Date

The Town continues to evaluate potential locations for additional offshore sand sources. The Town is also obtaining the necessary easements required for eligibility to receive dredged material from USACE dredging at LWFIX.

2.6.3 Projects/Actions to Achieve Goals

The Town is currently undertaking an offshore borrow area investigation that will re-examine the potential borrow areas/sand sources identified in 2009-2011 and investigate potential borrow areas in the Bureau of Ocean Energy Management (BOEM) jurisdiction and possibly Jay Bird Shoals.

2.7 Compilation of Focus Area Projects and Initiatives with Funding Options

This section reflects short-term (1 to 5 years) and long-term (6 to 10 years) projects and initiatives identified for Town implementation for the focus areas. Most of the projects are short-term projects in response to effects of Hurricane Matthew in 2016 and Hurricanes Florence and Michael in 2018. IBPB considered the criteria in Table 2-1 during the selection process.

Table 2-1. Evaluation Criteria for Projects and Initiatives

Category	Criteria
Social	Will the citizens be behind this effort?
	Is this action equitable?
Technical	Can the action be implemented from a technical point of view?
Political	Does this action have political support?
Administrative	Does the Town have the operational control to implement?
	Can this action be implemented in a timely manner?
Economic	Is it cost-effective? Does the benefit exceed the cost?
	Does funding exist or can it be acquired to finance the action?
Recreational	Does this action enhance recreational opportunities?
Environmental	Will the action increase the resilience of the natural environment?

Table 2-2. Focus Area Projects and Initiatives (Town is the Responsible Entity) with Funding Options in Order of Begin Date

No.	Project/Initiative Name	Focus Area	Estimated Begin Date	Estimated End Date	Description	Estimated Project Cost	Estimated Maintenance Cost	Potential Funding Sources
1	Perpetual Easements	LWF Inlet East End	Spring 2019	May 31, 2019	Secure perpetual easements required for USACE LWFIX dredging	\$44,000	Not Applicable	Town
2	Offshore Borrow Areas/Sand Sources Investigations	Borrow Areas/Sand Sources	May 2019	April 2020	Re-examine potential borrow areas/sand sources identified in 2009-2011, investigate potential sources in BOEM jurisdiction and Jay Bird Shoals	\$170,000	Not Applicable	Town
3	Inlet Crossing Sand Placement	LWF Inlet East End	Fall/Winter 2019	Fall/Winter 2019	LWFIX Sand placement along East End	TBD (bids not yet received)	TBD	USACE
4	Bend-Widener Piggyback Project	East End LWF Inlet	Fall/Winter 2019	March 30, 2020	Undertake another piggyback project in which Town utilizes bend widener as a sand source while USACE dredges LFWIX	\$1.165 million	TBD	State (\$776,705) Town (\$388,295) <i>A County contribution may offset Town cost.</i>
5	Dune Vegetation Map and Monitor	East End Central Reach West End	FY 19/20	FY 19/20	UNCW will establish baseline conditions via map and bi-annually use a drone to assess conditions	\$7,700	\$4,800/year	Town
6	Vegetation Enhancements	East End Central Reach West End	FY 19/20	FY 19/20	Implement existing vegetation enhancement projects and explore further vegetation enhancement (species and locations)	\$70,000	TBD	Town
7	Update Historical Report on Inlet Changes	LWF Inlet Shallotte Inlet	FY 19/20	FY 19/20	UNCW and ATM	\$7,700	\$2,400/year	Town

No.	Project/Initiative Name	Focus Area	Estimated Begin Date	Estimated End Date	Description	Estimated Project Cost	Estimated Maintenance Cost	Potential Funding Sources
8	Transect Monitoring	Shallotte Inlet	April 2020	October 2020	Conduct additional transect monitoring	\$3,000	Not Applicable	Town
9	Central Reach Reimbursement (CRR)	Central Reach	Winter 2020	Spring 2021	Remediate/mitigate impacts from Hurricanes Florence and Michael	\$25 million	TBD	FEMA reimbursements
10	Coastal Mats	East End Central Reach West End	Annual	Annual	Use mats for walkway stability and dune protection on Town-owned property; encourage use of mats by private property owners for walkway stability and dune protection	\$5,475	TBD	Town
11	Permit Compliance Monitoring	All Focus Areas	Annual	Annual	Continue permit-required compliance monitoring	Variable (project-specific)	Not Applicable	Town
12	Legislative Advocate	All Focus Areas	Annual	Annual	Advocate legislative engagement for cost-share opportunities or appropriations	\$83,700	Not Applicable	Town
13	Permit Tracking	All Focus Areas	Annual	Annual	Track status of Ocean Isle terminal groin permit; track adjacent municipalities and the County for potential effects to the Town	TBD	Not Applicable	Town
14	Erosion Control	East End West End	TBD	TBD	Evaluate pros/cons to potentially extend the Central Reach engineered beach concept	TBD	TBD	Town (with possible supplemental state funding)
15	Additional Dune Monitoring	West End	TBD	TBD	Conduct additional dune monitoring for proactive protection measures	TBD	Not Applicable	Town
16	Maritime Forest	West End	TBD	TBD	Collaborate with NC State on the conversion of 50 acres owned by NC State to a maritime forest	TBD	TBD	Town NC State Grants

No.	Project/Initiative Name	Focus Area	Estimated Begin Date	Estimated End Date	Description	Estimated Project Cost	Estimated Maintenance Cost	Potential Funding Sources
17	Dune Breach Study	East End Central Reach West End	TBD	TBD	Study dune breaches to understand primary dune enhancement/secondary dune placement	TBD	Not Applicable	Town
18	Critical Event Response	All Focus Areas	As Needed	As Needed	As needed consulting services to complete critical event response assessments	TBD	Not Applicable	Town
19	USACE Federal Nourishment Project	East End Central Reach West End	TBD	TBD	Federal beach nourishment for majority of shoreline due to Hurricane Florence impacts	TBD	Not Applicable	Federal (PL116-20)

Note: Projects are presented in order of estimated begin date, not in order of priority.

3.0 Adaptive Management

This Oceanfront and Inlets Management Plan will not be static. Rather, IBPB will annually recommend adjustments to the plan to the Board of Commissioners based on effects of climatic events (hurricanes, rise in sea level, critical event response), potential damage (nor'easters), opportunities (funding, collaboration), and consequences (new regulations, delayed projects). Key activities that will assist IBPB in adaptively managing the protection and restoration of the oceanfront and inlets are provided in the following sections.

3.1 Monitoring and Reporting

The Town annually documents nourishment and dune project performance and environmental effects through annual field surveys, analyses, and monitoring reports in accordance with regulatory agency permit conditions, as well as to remain eligible for FEMA mitigation funding related to engineered beaches (Central Reach). Secondary objectives are to identify erosional areas of shoreline that warrant future nourishment consideration and dune vegetation areas that warrant maintenance or restoration.

The most recent annual monitoring report was prepared in October 2018 and summarizes the mid-2017 to mid-2018 beach management activities, as well as compares the most recent beach profile survey (April 2018) with beach profile surveys collected from 2000 through 2017. Beach profile data are used to assess the status of the beach through an evaluation of volume and contour change and to establish rates of change with respect to nourishment projects and historical background erosion rates.

A comparison of the April 2018 survey to the April 2017 survey indicates the entire island experienced a net gain of approximately 440,000 cy (note that this comparison occurred prior to Hurricanes Florence and Michael in September and October 2018, respectively). This gain was unexpected since no nourishment activities had occurred over this time. The gain was due to onshore movement of material from deeper water (greater than 12 feet) and represents a recovery from Hurricane Matthew erosion. The Central Reach Project and the LWFIX Eastern Reach Project brought much-needed additional material into the Holden Beach littoral system in 2017. The equilibration and both eastward and westward spreading of this material were observed as contributing to beach growth for much of the Holden Beach shoreline as well.

Historical annual losses have been documented at 100,000 to 200,000 cy/yr for Holden Beach. The losses from Hurricane Matthew alone in 2016 were on par with this erosional trend.

3.2 Evaluating Progress

Separate and distinct from permit-required monitoring and reporting is the evaluation of progress. Each year, IBPB will recommend adjustments to the plan to the Board of Commissioners. IBPB will review the projects and initiatives identified in this plan to determine if they are being implemented as anticipated or intended. IBPB's evaluation will include identification of the following:

- Successful actions
- Barriers or obstacles to implementation
- Modifications to proposed timelines based on new information related to impacts and funding (such as the currently pending possible USACE General Re-evaluation Report – see PL116-20)
- New regulations (such as the final definitions and maps for inlet hazard areas)
- Triggers for new or modified actions based upon observed changes in background erosion, shoreline, beach width, volume of sand in the dune and beach areas, high tide to dune line, dune vegetation line, static vegetation line or interior island flooding

Based upon the evaluation, and upon action by the Board of Commissioners, the plan will be amended accordingly. A revision history will be tracked in table format and included at Appendix A.

3.3 Collaboration

IBPB identified a goal of encouraging and participating in intergovernmental coordination and collaboration on long-term coastal management planning with academic institutions and non-governmental coastal organizations to enhance the preservation of the inlets, beach and dune systems. IBPB currently collaborates with UNCW on baseline beach and inlet research and has identified a potential opportunity with NC State to develop a maritime forest to benefit the West End focus area. IBPB members and Town staff actively monitor and participate in activities associated with the Coastal Resources Commission; American Shore and Beach Preservation Association; North Carolina Sea Grant; North Carolina Beach Inlet and Waterway Association; Brunswick Shoreline Protection Consortium; and USACE. IBPB and Town staff will continue to

seek additional intergovernmental coordination and collaboration opportunities, which will be reported as part of the plan's annual review in 2020.

3.4 New Regulations

New regulations and permitting requirements could potentially affect plan implementation. Examples include revised sediment criteria and requirements for a project-specific static vegetation line (the seaward limit of stable dune vegetation that is the baseline for setback distances) or final definitions and maps for inlet hazard areas. IBPB and Town staff will stay abreast of regulations and permitting criteria to evaluate potential implications to plan implementation.

4.0 Critical Event Response

IBPB identified a goal of establishing or enhancing guidelines for critical event response in terms of emergency management of the beach and dune systems following a significant storm event or flooding event. IBPB proposes the following guidance to emergency response strategies for how the Town should respond and prioritize actions in addition to operation and maintenance activities:

1. Restore the beach by truck haul, not by beach scraping.
2. Rebuild dunes with existing upland sand sources.

5.0 Potential Funding Sources

The Town’s annual budget should continue to include recurring funding for critical event response by staff and consultants and ongoing funding for the annual beach and dune field surveys, analyses, and monitoring reports required for permit compliance.

It is acknowledged that significant legislative efforts will be needed for the Town to receive federal and state appropriations to offset costs associated with implementing this plan since there is not currently a dedicated funding source for the state’s beach preservation fund. Federal cost-sharing on beach preservation projects typically requires a 35 percent match by the state or local sponsor. Dredging projects can be partially funded through the state’s water resources development grant process. The Town successfully obtained 50 percent cost-share on the 2014 LWFIX piggyback dredging project. A range of costs associated with dredging projects is provided in Table 5-1.

Table 5-1. Range of Costs for Dredging Projects and Potential Cost-Share Options

Sand Source	Minimum Cost per CY	Maximum Cost per CY	Notes	Cost-Share Options	
				State Dredging Fund	FEMA
Upland	\$8.00	\$50.00	Haul distance and double handling are major cost factors. Town’s 2009 truck haul project cost approximately \$8.50/cy.	No	Yes
LWFIX	\$5.00	\$10.00	Smaller dredges and short pipe distance	Yes	No
Offshore	\$10.00	\$25.00	Large dredges and larger projects. Demand for dredge equipment is a major cost factor.	No	Yes
Outer Ebb Shoal	No beach placement; inlet management		Sidecast or shallow draft hopper dredge. Cost is typically a per day fee.	Yes	No

Note: 67 percent cost share by NC through the state dredging fund; 75 percent match by FEMA through mitigation grant. Brunswick County has provided a share of local funding for some of the Town’s dredging projects.

The Town will continue to explore all funding opportunities, including grants from federal and state sources and non-profit organizations. Potential opportunities are identified in Tables 5-2 through 5-4.

Table 5-2. Federal Funding Opportunities

Federal Funding Opportunity	Description and Details
US Fish and Wildlife Service (FWS) Coastal Program	The FWS Coastal Program partners with communities to provide technical and financial assistance to assess, protect and restore or enhance priority coastal habitats for the benefit of fish and wildlife. The program is delivered through a network of 24 field offices in priority coastal habitats along the Atlantic, Pacific, Gulf of Mexico coasts and in the Great Lakes.
FEMA Hazard Mitigation Grant Program	FEMA provides funds to local governments, tribes and some non-profits to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Grants given through the states to local governments following an official Presidential disaster declaration are used to implement long-term hazard mitigation measures that provide a long-term solution to a specific risk. FEMA will pay up to 75 percent of the project cost and the remaining 25 percent must be funded through the state, local government applicants or individual property owners. In-kind services and materials can be used.
FEMA Pre-Disaster Mitigation Grant Program	FEMA provides annual funding to support states, territories, Indian tribal governments, communities and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. A 25 percent local match is required (to a 75 percent federal contribution). This is a cost reimbursement program.
USACE Hurricane and Storm Damage Reduction Projects	The intent is to protect multiple public or private properties and facilities and for the protection of single non-federal public properties against damages caused by storm-driven waves and currents. This allows federal participation in the cost of protecting shores from hurricane and storm damage. The funding sources is continuing authority given by the U.S. Congress to USACE. There is a total of \$30 million available nationwide per fiscal year; the federal funding limit per project is \$5 million.
USACE PL116-20	Federal funding specific to Hurricane Florence for a beach nourishment project and/or a 50-year beach nourishment study.
USACE Emergency Streambank and Shoreline Protection	This program is designed to implement projects to protect public or not-for-profit public facilities and/or services that are open to all, have been properly maintained but threatened by natural processes on stream banks and shorelines, and are essential and important enough to merit federal participation in their protection. A total of \$15 million available nationwide per fiscal year. The federal funding limit per project is \$1.5 million. Total project costs, including any planning and design costs in excess of \$100,000, are cost-shared. The maximum non-federal contribution is 50 percent.
National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management Coastal Resilience Grant	This competitive grant program funds projects that are helping coastal communities and ecosystems prepare for and recover from extreme weather events, climate hazards, and changing ocean conditions. All project proposals undergo a rigorous merit review and selection process by a panel of subject matter experts. Funding is typically available on an annual cycle.
National Fish and Wildlife Federation (NFWF) National Coastal Resilience Fund	In partnership with NOAA, NFWF invested \$30 million in 2018 and will award approximately \$29 million in 2019 in grants to create, expand, and restore natural systems in areas that will both increase protection for communities from coastal storms, sea- and lake-level changes, inundation, and coastal erosion while also improving valuable habitats. Grant awards range from \$125,000 to \$3 million and require a 1:1 cost-share match.

Table 5-3. State Funding Opportunities

State Funding Opportunity	Description and Details
NC Division of Coastal Management - Planning and Management Grants	Planning and management grants to support local governments in addressing a specific topic that can change with each year. Grants may apply to a variety of activities focusing on issues such as natural hazards and storm recovery, wetlands, marine debris and public access programs. Application deadlines are typically in September.
NC Division of Coastal Management - Public Beach and Waterfront Access Project Grants	A three-step grant application process to help fund local government projects such as land acquisition as well as construction or reconstruction (not general repair or maintenance) of boardwalks, dune crosses, parking structures, boat ramps, docks, public bathrooms, and other infrastructure that supports increased public access to the beach or waterfront. Pre-applications are typically due in April.
NC Water Resources Development Grant Program - Shallow Draft Navigation Channel Dredging Projects	Cost-share of dredging projects designed to keep shallow draft navigation channels located in state waters navigable and safe. Funding provided from the Shallow Draft Navigation Channel Dredging and Aquatic Weed Fund must be primarily for general or recreational navigation purposes. Additional project outcomes from a navigation project such as beneficial placement of beach compatible material must be a secondary reason for the project (if applicable). The cost-share for dredging projects in Tier 2 and 3 counties is 66.67 percent state and 33.33 percent local.

Table 5-4. Non-Profit Funding Opportunities

Non-Profit Funding Opportunity	Description and Details
North Carolina Sea Grant	Various grant programs including the South Atlantic Regional Research on Coastal Community Resilience that provides grants to conduct research that addresses the priorities of the Sea Grant programs of Florida, Georgia, South Carolina and North Carolina, and the NOAA Office for Coastal Management in the South Atlantic Region. Projects must be related to the resilience of coastal communities to natural hazards, including both contemporary disasters such as hurricanes, storm surge and coastal flooding, and future hazards associated with sea level rise and climate change.
The Wildlife Conservation Society's Climate Adaptation Fund	Funding for on-the-ground projects that focus on implementing conservation actions for climate adaptation at a landscape scale. Public agencies may partner with eligible non-profits to submit proposals. There is a 1:1 match ranging from \$50,000 to \$250,000, with a maximum 50 percent match funding from in-kind sources.
The Kresge Foundation	This foundation's environmental program invests in projects that revolve around the following strategies: 1) building the field of climate change adaptation, 2) fostering development of place-based adaptation strategies, and 3) informing and promoting climate-wise policies and practices. The foundation primarily accepts grants by invitation only; however, preliminary applications can be submitted that include background information on the proposal.
The Doris Duke Charitable Foundation (DDCF)	DDCF's Environmental Program strives to meet four main strategies through grant awards: 1) enabling strategic wildlife habitat conservation in an era of climate change, 2) reducing impacts on the landscape from increased energy development and energy demand, 3) encouraging land stewardship and sustainability, and 4) helping to build a clean-energy economy.

Appendix A

Technical Data

The below technical materials will be available for download from the Town's website at:
<http://hbtownhall.com/inlet---beach-protection-board.html>.

1. Town of Holden Beach Ordinance 18-02 (Inlet and Beach Protection Board)
2. Beach Management Planning and Borrow Area Investigation, August 2009 (ATM; referred to as "Town Beach Management Plan")
3. Holden Beach Tropical Storm Hanna Analysis (ATM; January 2009)
4. Holden Beach Hurricane Irene Coastal Damage Assessment (ATM; November 2011)
5. Holden Beach Annual Beach Monitoring Report (ATM; October 2015)
6. Holden Beach Annual Beach Monitoring Report (ATM; September 2016)
7. Holden Beach Hurricane Matthew Coastal Damage Assessment (ATM; December 2016)
8. Holden Beach Annual Beach Monitoring Report (ATM; September 2017)
9. Holden Beach Annual Beach Monitoring Report (ATM; October 2018)
10. Updated Holden Beach Hurricane Florence Coastal Damage Assessment (ATM; January 2019)
11. Updated Holden Beach Hurricane Michael Coastal Damage Assessment (ATM; March 2019)
12. Lockwood Folly Inlet Sediment Plan (ATM; May 2019)
13. North Carolina Beach and Inlet Management Plan 2016 Update Report (Moffatt & Nichol; December 2016)
14. North Carolina Sea Level Rise Assessment Report 2015 Update to the 2010 Report and 2012 Addendum (NC Coastal Resources Commission Science Panel; March 2015)
15. North Carolina 2019 Oceanfront Setback Factors & Long-Term Average Annual Erosion Rate Update Study: Methods Report (NC Dept. of Environment and Natural Resources - Division of Coastal Management; January 2019)
16. North Carolina 2011 Long-Term Average Annual Oceanfront Erosion Rate Update Study: Methods Report (NC Dept. of Environment and Natural Resources - Division of Coastal Management; Updated 10/30/12)
17. Plan Revision History (table)
18. Spatial Data and Maps (NC Division of Coastal Management; Current)
<https://deq.nc.gov/about/divisions/coastal-management/coastal-management-data/spatial-data-maps>