Chapter 2 *PURPOSE AND NEEDS*

1. What are the purpose and needs of this project?

The main concern of residents and owners at Figure Eight Island are economic losses resulting from damages to structures and their contents due to hurricane and storm activity and the loss of beachfront land due to the ongoing shoreline erosion along portions of the ocean and estuarine shoreline. Current shoreline management strategies have not been successful in providing the long-term shoreline protection that the Figure "8" Beach HOA seeks. With a total tax value of property within the limits of Figure Eight Island of approximately $907,352,900 (based on the 2012 reappraisal), the Figure "8" Beach HOA sees the need for an improved shoreline protection plan. This valuation includes the valuation of 463 residential structures and property along with 93 vacant lots.

The purpose and needs of the Figure Eight Island Inlet and Shoreline Management Project are as follows:

- Reduce or mitigate erosion along 3.77 km (2.34 mi) of Figure Eight Island oceanfront shoreline south of Rich Inlet and 427 m (1,400 feet) of backbarrier shoreline on Figure Eight Island along Nixon Channel;
- Provide reasonable short-term protection to residential structures in response to any unpredicted shoreline change within the next five years;
- Provide long-term protection to Figure Eight Island homes and infrastructure over the next 30 years;
- Acquire compatible beach material in compliance with the North Carolina State Sediment Criteria for shore protection project;
- Maintain navigation conditions within Rich Inlet and Nixon Channel;
- Balance the needs of the human environment with the protection of existing natural resources;
- Maintain existing recreational resources; and
- Maintain the tax value of the homes and infrastructure on Figure Eight Island.

2. How is the Figure Eight Island shoreline managed today?

During the past several decades, the Figure "8" Beach HOA have had to address the continuing erosion problems associated with Rich and Mason Inlets and the Nixon Channel erosion hot-spot located on the estuarine side of the island. This long-term chronic erosion on the island had been exacerbated by the hurricane activity in the 1990s.

Since the mid-1980s, shoreline changes along a 3,000 ft segment of shoreline along the southern portion of Figure Eight Island has been in response to the migration of Mason Inlet to the south (Cleary and Jackson, 2004). In the fall and winter of 2001-2002, Mason Inlet was relocated approximately 2,500 ft to the north helping to alleviate severe erosion on the north end of Wrightsville Beach.

The estuarine shoreline along the northern portion of the island has also undergone significant changes since the mid-1980s when the Rich Inlet gorge began to migrate to the northeast from its southwest most position. The associated migration and deflection of Rich Inlet's ebb channel caused the thalwag to migrate toward the developed estuarine shoreline causing erosion problems which persist today. The migration of the channel within Rich Inlet, as described above, had resulted in high rates of erosion on the oceanfront shoreline along the northern portion of the island. A detailed summary of the history of Rich Inlet followed by a summary of shoreline protection activities on Figure Eight Island is discussed below.

Category 3 and 4 Hurricanes Affecting the North Carolina Coast

Name	Year	Landfall Location
Unnamed	1933	Ocracoke
Great Atlantic Hurricane	1944	Cape Hatteras
Hazel	1954	NC/SC Border
Connie	1955	Portsmouth
Ione	1955	Morehead City
Helene	1958	Offshore Outer Banks
Donna	1960	Emerald Isle
Diana	1984	Cape Fear
Gloria	1985	Offshore Hatteras Island
Emily	1993	Hatteras Island
Fran	1996	Cape Fear

(Hurricane Research Division, 2008).

RICH INLET HISTORY

Dr. William J. Cleary of the University of North Carolina at Wilmington (UNCW) conducted a detailed geomorphic analysis of Rich Inlet. The geomorphic analysis of the Inlet was conducted through interpretation of ortho-rectified aerial photographs collected between 1938 and 2007, as well as corresponding shoreline changes along Figure Eight and Hutaff Islands.

This study indicated that unlike many inlets in the region, Rich Inlet has migrated within a relatively narrow corridor of approximately 500 m (1,600 ft) from 1938 to present. This relative stability can likely be attributed to the Inlet's large tidal prism of 18 x 10^6 m^3 (636 x 10^6 ft^3) (with positive correlation between an inlet's tidal prism and inlet stability), as well as the topography of the underlying Oligocene siltstone with Rich Inlet likely occupying an ancestral location of Futch Creek during a lower stand of sea-level (Cleary, 2009).

Although the relative position of the inlet has been stable over the past century, fluctuations in orientation of the main ebb-channel have forced subsequent periods of erosion and accretion on the adjacent shorelines of Figure Eight and Hutaff Islands (Cleary, 2009). Between 1938 and 1993, the main ebb-channel was oriented in a southeasterly direction between azimuths of approximately 112° to 181° (Figure 2.1). During this period, the Rich Inlet ebb-tide delta was aligned with the main ebb-channel in a more southerly orientation providing a wave sheltering effect for the north end of Figure Eight Island. This corresponded to the creation of a one-mile zone of accretion along the oceanfront shoreline immediately south of Rich Inlet.

From 1993 to 2000, the ebb-channel shifted to a more northeasterly alignment with a maximum azimuth of 83° in October 2000 (Figure 2.2). With this shift came a northward migration of the ebb-tide delta, exposing the north end of Figure Eight Island to wave attack. During this period, extensive erosion occurred along the northern 1,400 m (4,500 ft) of the island with a maximum of 150 m (500 ft) of shoreline retreat. Subsequently, during this time period the northward migration of the ebb-tide delta provided wave sheltering to the south end of Hutaff Island leading to accretion of the shoreline with a maximum progradation of 120 m (390 ft).

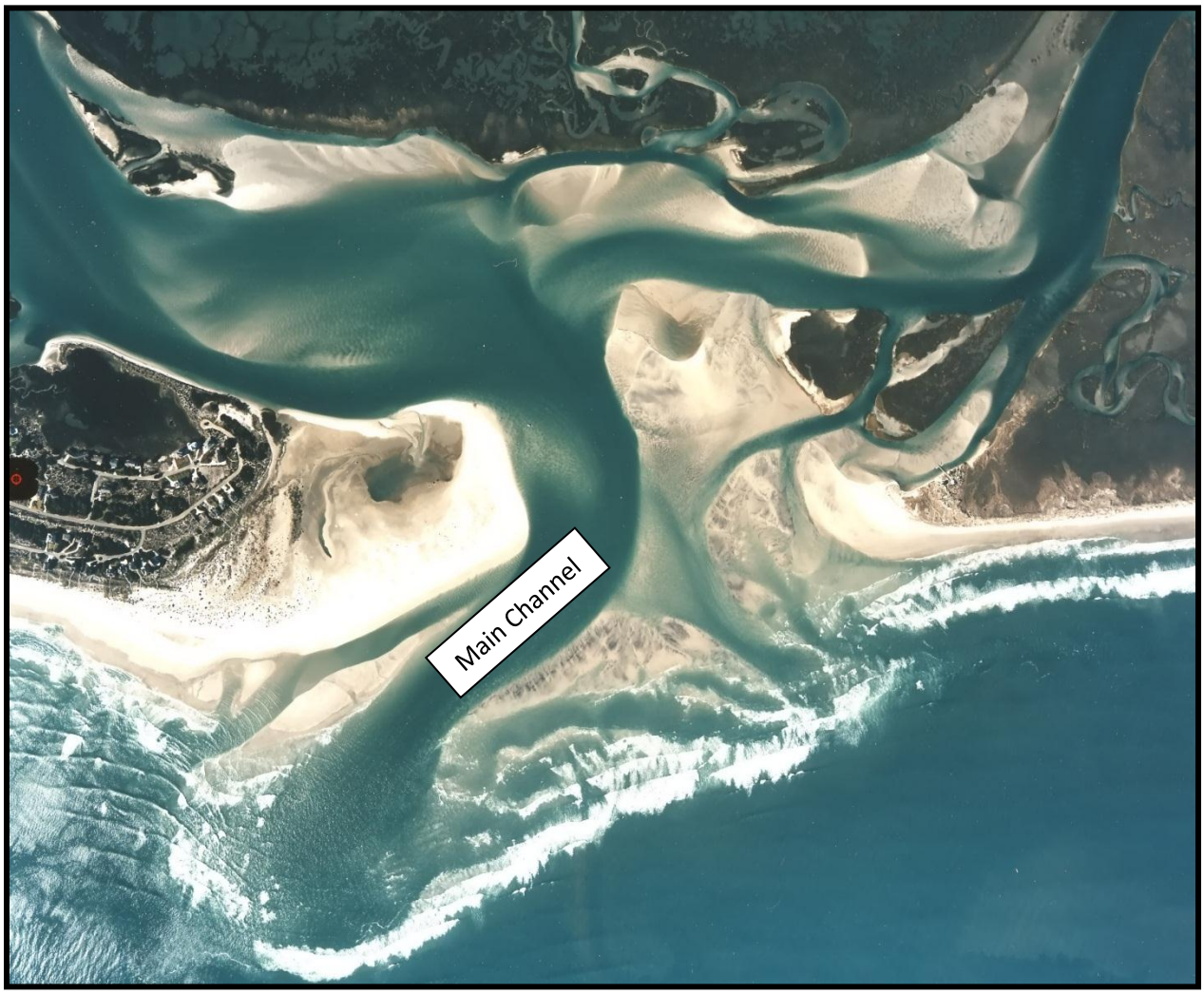

Figure 2.1- Southeasterly Orientation of the Main Channel within Rich Inlet as of November 1993

Figure 2.2- Northeasterly Orientation of the Main Channel within Rich Inlet as of March 1999

An ebb-tide delta breach in late 2000 resulted in a deflection of the main ebb-channel to a shore-normal position, with further southward deflection to an azimuth of 190° in 2003. Since March 2003, the throat segment of the ebb channel reversed its migration direction and shifted to the southwest toward Figure Eight Island (Cleary, 2009). Since 2004, the general configuration of the ebb delta has changed slightly while the inlet has widened to its most expansive dimension since 1956. During the period between 2002 and 2007, erosion was the norm along the oceanfront shoreline of Figure Eight Island within the inlet hazard area despite shoreline armoring (sandbags) and the placement of 250,000 cubic yards of beach fill along the northernmost 6,100 ft of the island in March 2001.

In 2010, the bar channel naturally shifted again to an alignment toward Figure Eight Island resulting in accretion along the north end of Figure Eight (Figure 2.3). While this orientation has proved favorable for Figure Eight Island in the short term, based on the past history of the inlet channel, the bar channel can reasonably be expected to again shift back toward Hutaff Island which will result in another round of erosion on the north end of Figure Eight. Predicting the time when any shifting would occur is not possible due to variability and contingency on weather and storm events.

Figure 2.3- Southeasterly Orientation of the Main Channel within Rich Inlet as of July 2012

Dr. William Cleary's analysis of inlet and shoreline geomorphology has shown that fluctuation of Rich Inlet's main ebb-channel can be well correlated to patterns of erosion and accretion along the adjacent shorelines. When the ebb-channel is deflected to the south, the ebb-tide delta migrates southward resulting in accretion along the northern portion of Figure Eight Island and erosion along the southern portion of Hutaff Island. However, severe northward deflection of the ebb-channel leads to erosion along the northern portion of Figure Eight Island and accretion along the southern portion of Hutaff Island.

SHORELINE PROTECTION HISTORY

At least 31 shoreline protection projects have occurred along Figure Eight Island since 1977 (Table 2.1). These projects have included beach nourishment events, beach scraping (bulldozing to form protective berms and dunes), bulkheading, and the installation of sandbags. The material utilized for the majority of the beach nourishment projects was acquired from the maintenance of Mason Inlet, Nixon Channel, the Intracoastal Waterway (AIWW), and Banks Channel.

Nourishment activities increased during mid to late 1990's due to changes to Mason and Rich Inlet systems and the frequency of storm activity. However, the change to the orientation of Rich Inlet along with the increased rate of storm activity in the late 1990's during this time period exasperated the long-term chronic erosion occurring along the northern extremity of the developed oceanfront downdrift of Rich Inlet, the southern 2,500 ft of developed shoreline updrift of Mason Inlet, and the 1,000 ft long developed estuarine shoreline fronting Nixon Channel (Cleary and Jackson, 2004).

In response to the accelerated erosion rates, the Figure "8" Beach HOA nourished the area north of Bridge Road six (6) times between 1993 and 2011, with the cumulative volume of all six (6) fills totaling approximately 1.8 million cubic yards. The timeframe of these recent events corresponds with the increased erosion rate associated with the shifting of the ebb tide channel to a more northerly direction. Due to the extremely high erosion rates just south of Rich Inlet, the beach fills placed in this area did not provide long-lasting protection and eventually forced the oceanfront property owners on Surf Court, Inlet Hook Road, and Comber Road to install temporary sandbag revetments. Based on the permit conditions, all of the temporary sandbag revetments were to be removed by April 2008; however, statewide legal challenges to the rule have delayed their removal.

The ineffectiveness of the past beach nourishment attempts along the extreme north end of Figure Eight Island emphasizes the need to address the inlet related process that impacts the area (Figures 2.4 and 2.5). Without some change in the inlet's impact, future nourishment operations on the extreme north end of Figure Eight Island will suffer the same fate as the past efforts. Shoreline management issues south of Bridge Road on Figure Eight Island are being addressed through actions associated with the maintenance of the Mason Inlet Relocation Project and the periodic disposal of material removed to maintain the navigation channel in Banks Channel.

In total, the aforementioned shoreline protection projects along Figure Eight Island have placed well over 4 million cubic yards of material along the oceanfront shoreline along Figure Eight Island.

Table 2.1 - Shoreline Protection Project History on Figure Eight Island

Project Date	Type of Project	Volume (c.y.)	Source	Region
June 1977	Dredge/Fill and Bulkhead	13,000	Banks Channel	Mason Inlet
June 1983	Dredge and Nourishment	90,000	Nixon Channel and Rich Inlet	North End*
March 1985	Dredge and Nourishment	46,300	Mason Inlet Connecting Channel	South End
January 1986	Dredge and Nourishment	250,000	Mason Inlet and Banks Channel	South End
January 1987	Beach Scraping	N/A	N/A	South End
March 1987	Beach Scraping	N/A	N/A	South End
April 1987	Beach Scraping	N/A	N/A	South End
January 1990	Beach Scraping	N/A	N/A	Island-Wide**
November 1992	Dredge and Nourishment	343,000	Banks Channel near Mason Inlet	South End
February 1993	Beach Nourishment	274,000	Nixon Channel	North End*
December 1994	Beach Scraping	N/A	N/A	Island-Wide**
November 1996	Beach Scraping	N/A	N/A	Island-Wide**
January 1997	Storm Recovery	250,000	Nixon Channel	North End*
March 1998	Channel Dredging	450,000	Banks Channel and Middle Sound	Island-Wide**
September 1998	Beach Scraping	N/A	N/A	Middle of Island
March 1999 and early 2000	Beach Nourishment	785,000	Cameron Disposal Island and Banks Channel	South End
January 2000	Sandbag Placement	N/A	N/A	North End*
March 2000	Beach Scraping	N/A	N/A	North End*
September 2000	Beach Scraping	N/A	N/A	North End*
October 2000	Beach Scraping	N/A	N/A	North End*
November 2000	Beach Scraping	N/A	N/A	North End*
November 2001	Beach Scraping and Sandbags	N/A	N/A	North and South End
March 2001	Beach Nourishment	350,000	Nixon Channel	North End*
Jan.-Feb. 2002	Mason Inlet Relocation	390,000	Mason Inlet	South End
March 2003	Channel Dredging	50,000	Masons Inlet & AIWW	South End
March 2003	Beach Nourishment	30,000	Banks Channel & AIWW	South End
February 2005	Channel Dredging	183,000	Mason Inlet	South End
November 2005	Beach Nourishment	261,235	Nixon Channel	North End*
February 2006	Beach Nourishment	179,175	Banks Channel	South End
April 2006	Beach Nourishment	148,969	Mason Creek & AIWW	South End

February 2009	Beach Nourishment	295,000	Nixon Channel	North End*
Spring 2009	Channel Dredging	176,000	Mason Inlet	South End
Jan-Mar 2011	Channel Dredging	275,000	Nixon Channel	North End*

***North end is defined as the area between the inlet gorge shoulder to Bridge Road**
****Island wide includes the majority of the oceanfront shoreline at Figure Eight Island**

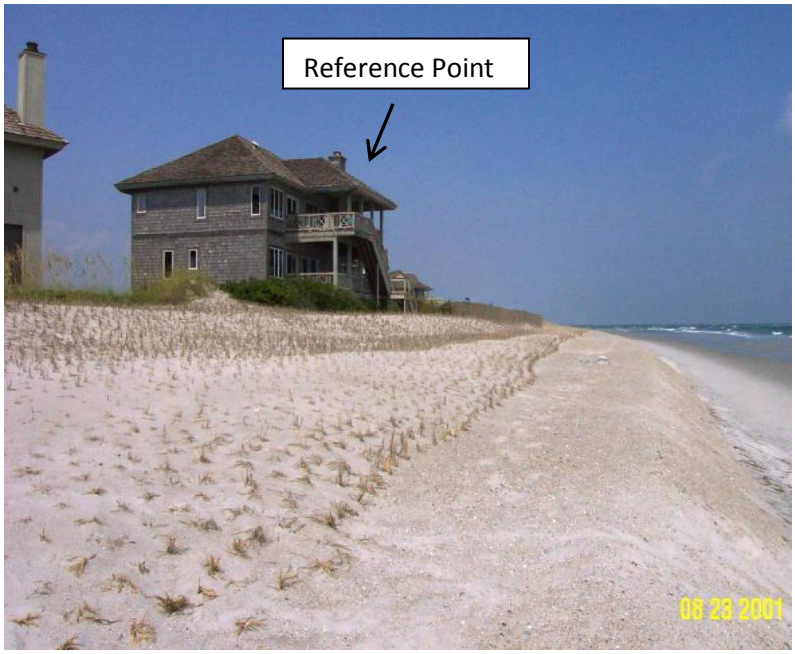

Figure 2.4. North End of Figure Eight Island after Nourishment Event in 2001

Figure 2.5. Evidence of Rapid Erosion Approximately One Month Following 2001 Nourishment

Sandbags protecting a home along the northern portion of Figure Eight Island, March 18, 2008

(Jarrett, 2008)

According to the Figure "8" Beach HOA, sandbag revetments were installed around 20 homes on the north end of Figure Eight Island between 2003 and 2010, however, one of the homes, located at 13 Comber Road, was relocated in 2010 leaving 19 homes along the north end of the island with sandbag revetments. Until the channel within Rich Inlet reconfigured to its current orientation, these structures had been considered imminently threatened as defined by State Standard Rule 15A NCAC 7H .0308 (NCDCM, 2007a) (Figure 2.6). The basic premise of this rule is that a structure in the Ocean Hazard Area is considered imminently threatened when its foundation is less than 6.1 m (20 ft) from the toe of the erosion scarp (see Figure 1.2 as depicted in the North Carolina CAMA Handbook [2003]). Figure 2.7 depicts the location of each residential structure on Figure Eight Island protected by sandbags. As of 2008, the potential loss of these threatened structures could reduce the total tax base by $12.4 million (Table 2.2). However, this amount may in fact be less than $12.4 million as the land on which the threatened homes lost due to erosion would most likely retain some unknown value. At this time, these homes are no longer imminently threatened. However, should the inlet reconfigure to a more northeasterly location, erosion rates would be expected to increase along the northern portion of Figure Eight Island's oceanfront shoreline putting these homes at risk again.

The area north of Bridge Road contains 116 oceanfront parcels and 134 non-oceanfront parcels. Presently, there are only ten (10) undeveloped oceanfront parcels and thirty-one (31) undeveloped non-oceanfront parcels north of Bridge Road. As of 2008, the total tax value of all the oceanfront parcels north of Bridge Road (structure and land) was approximately $237 million. The twenty-seven (27) oceanfront parcels located on Surf Court, Comber Road, and Inlet Hook Road- the area directly impacted by the changes in Rich Inlet- have a total tax value of $48.4 million. At the current tax rate for New Hanover County, the oceanfront parcels would generate approximately $1 million/year in ad valorem taxes.

In general, Beach Road North is not in any immediate danger of being lost to long-term erosion. However, the road could eventually be subjected to storm overwash and occasional washouts during severe storm events should the inlet relocate and expose the northern part of Figure Eight Island to high rates of erosion again. Surf Court, Comber Road, and Inlet Hook Road, all located within 915 m (3,000 ft) south of Rich Inlet, could also eventually be damaged or lost to long-term erosion, particularly once the oceanfront property owners remove the existing sandbag revetments (see Figure 2.6). Surf Court lies approximately 76 m (250 ft) from the shoreline while Comber Road and Inlet Hook Road are only 38 m (125 ft) and 33 m (100 ft) from the shoreline, respectively. Given the shoreline recession rates observed between 1999 and 2007, these roads could become threatened and eventually undermined if the channel within the inlet reconfigures once more to the northeast.

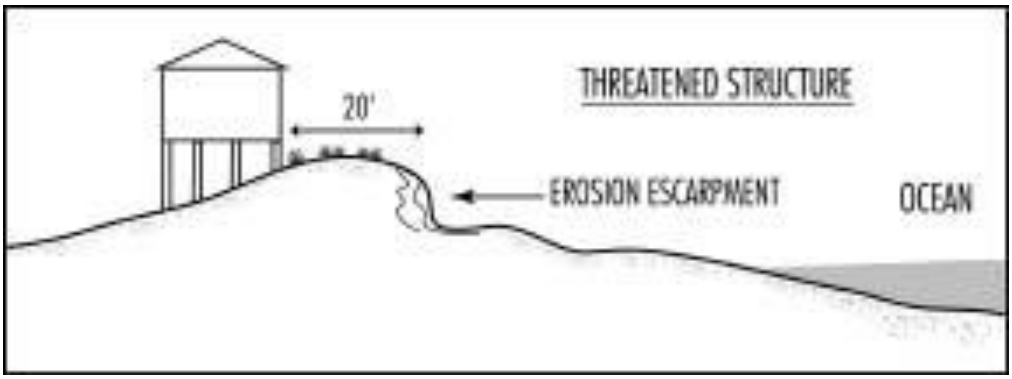

Figure 2.6 - Diagram Depicting Imminently Threatened Structures (NCDCM, 2003a)

Table 2.2 - Analysis of Threatened Structures on Figure Eight Island

Address	Property Value [a]	Structure Value [a]	Total Appraised Value
5 Comber	$328,100	$379,400	$707,500
6 Comber	$322,900	$490,400	$813,300
7 Comber	$44,500	N/A[b]	$44,500
8 Comber	$287,000	$302,000	$589,000
9 Comber	$317,300	$269,800	$587,100
10 Comber	$334,500	$348,200	$682,700
11 Comber	$336,200	$402,100	$738,300
12 Comber	$346,400	$330,100	$676,500
14 Comber	$340,100	$315,400	$655,500
15 Comber	$336,100	$227,400	$563,500
16 Comber	$296,000	$349,500	$645,500
17 Comber	$323,000	$197,300	$520,300
3 Inlet Hook	$341,900	$240,100	$582,000
4 Inlet Hook	$340,200	$349,900	$690,100
5 Inlet Hook	$347,100	$353,800	$700,900
6 Inlet Hook	$362,100	$346,900	$709,000
7 Inlet Hook	$429,800	$289,000	$718,800
8 Inlet Hook	$488,400	$245,000	$733,400
544 Beach Road North	$701,600	$343,200	$1,044,800
Total	**$6,623,200**	**$5,779,500**	**$12,402,700**

[a] 2012 Property and Structure value information was provided by the New Hanover County GIS database (http://etax.nhcgov.com/Main/Home.aspx).

[b] N/A denotes those structures in which a value was not provided in the Town's tax database or through the New Hanover County GIS database.

Figure 2.7 – Location of Imminently Threatened Residential Structures on Figure Eight Island