North Carolina Estuarine Shoreline Mapping Project

Statewide and County Statistics

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Photo courtesy of: NOAA CCFHR

Table of Contents

Project Background

Introduction

The North Carolina Department of the Environment and Natural Resources (DENR) Division of Coastal Management (DCM) is charged with the management and conservation of the state's coastal resources. DCM has identified needs for enhancement of digital mapping products through Geographic Information Systems (GIS), specifically, the representation of the estuarine shorelines as well as modification of those shorelines. The digital shoreline will be used to evaluate rules and policies within DCM's designated areas of environmental concern (AECs) as well as various research ventures including: studying ecosystem function, analyzing shoreline change, and understanding cumulative effects of armoring estuarine areas. The mapping project will provide shoreline data and support DCM's goal of developing and implementing sustainable estuarine shoreline policies.

The project began in December of 2007 when DCM conducted the "North Carolina Estuarine Shoreline Mapping Summit" (Summit). During the Summit, various stakeholders discussed existing and future shoreline mapping initiatives, methodologies, imagery, data resources, and needs. DCM completed the Estuarine Shoreline Mapping Project (ESMP) methodology in June 2008 and began the mapping process in-house and through a contract with the East Carolina University (ECU) Department of Geological Sciences and the Institute for Coastal Science and Policy[1] . DCM and ECU completed the ESMP in June of 2012 after mapping more than 12,000 miles of North Carolina's estuarine shoreline in the 20 Coastal Area Management Act (CAMA) counties. The estuarine shoreline data can be viewed[2] or downloaded[3] from DCM's website.

The goal of the project was to classify North Carolina's estuarine shoreline by type and delineate all shoreline structures. The final product is a geospatial representation of the complete estuarine shoreline and structures for North Carolina's coastline. These shoreline characterizations allow DCM to generate county-level statistics and analyze data for the purpose of understanding the nature of shoreline types and frequency of shoreline structures. Structures along the estuarine shoreline may affect ecosystem function, water quality, fisheries, wetland habitats and other natural resources. Completed shoreline data has been made available on DCM's website for other DENR agencies, local governments, academic institutions, and interested stakeholders. This shoreline data will be updated and maintained by DCM when future imagery becomes available. Updating data will help DCM keep pace with changes along the estuarine shoreline and monitor future development trends. DCM intends for the ESMP to provide interested stakeholders with updated shoreline information and the ability to modify management policies to mitigate risk to estuarine environments and provide for resource conservation into the future.

[1] Geis and Bendell 2010
[2] Interactive Shoreline Mapping Site: http://ims.ncdenr.org/Website/ncshore/viewer.htm
[3] Data Download Page: http://dcm2.enr.state.nc.us/Maps/chdownload.htm

The purpose of this report is to summarize the estuarine shoreline data for the 20 Coastal Area Management Act (CAMA) counties of NC including shoreline types, stabilization structures, and access structures. Additional analyses have been performed to identify shoreline segments in front of armored shoreline, areas of shoreline where both rip-rap revetments and bulkheads have been installed, and extent of access structures over land verses over water.

Methodology

DCM and ECU completed a statewide delineation of the estuarine shoreline and associated structures using heads-up digitizing in ArcGIS®. The shoreline was digitized from geo-referenced, county-level aerial orthophotographs, and projected in NAD 1983 state plane feet. Each county was digitized using the most recent aerial imagery available for that county (Table 1). Technicians were instructed to digitize at a viewing extent of 1:300 to 1:500. At scales less than 1:300 the aerial image becomes fuzzy or pixilated and provides no additional benefits. Staying within the 1:300 to 1:500 ranges controls mapping detail and allows shoreline features to be clearly identified.

When digitizing, technicians use visual cues and pre-established digitizing rules to segment the shoreline into various shoreline types.[4] Technicians create a linear shapefile by approximating the land/water, vegetation/water, or structure/water interface. DCM's methodology does not attempt to standardize the timing of imagery (tidally) from one county's orthophotos to the next, but using established rules for apparent shoreline features allows a relatively consistent shoreline to be mapped. The final shoreline not only provides a demarcation of the land/water interface but also a characterization of shoreline type as it is segmented and attributed into 5 unique shoreline categories. The final estuarine shoreline delineation consists of three distinct shapefiles including a linear estuarine shoreline, and two structure shapefiles (one polyline and one polygon) for varying structure types.

To begin digitizing, technicians first create the linear estuarine shoreline. The county-level orthophotographs are loaded in ArcGIS® and then the land/water interface is approximated and traced using the Sketch Tool®. NC has a number of different types of combination shorelines ranging from sediment bank shoreline with fringing marsh to cord grass marshes with extensive mudflats. For the purpose of the mapping project, DCM created three broad natural shoreline type categories: swamp forest, marsh, and sediment bank. Two additional shoreline categories were generated by DCM for the purpose of the ESMP; these are modified and miscellaneous shorelines. Modified shorelines include those that have been altered with an erosion control structure such as a bulkhead or rip-rap revetment. Miscellaneous shorelines represent technician generated artifacts that only exist in a digital format. These artifacts are used to represent connecting lines between adjacent county shorelines and for the 20-ft upstream extent of estuarine water bodies. Technicians are instructed to follow tributaries, streams, creeks, etc to the first point where the water body narrows to 20 ft. The 20-ft stream width parallels the NC Stream Mapping Program's designation where double line streams become single line streams at an upstream width of 20 ft. Miscellaneous shoreline segments are not included in this data report since these segments do not represent a physical part of the shoreline.

[4] Geis and Bendell 2010

After the shoreline is delineated for the entire county, the digitizer then captures all shoreline stabilization structures. All linear estuarine shorelines that were attributed as "modified" are extracted then added to the polyline structure file to avoid duplication. All stabilizing structures that armor or protect the shoreline itself are incorporated into the polyline structure category. Stabilizing structures are either perpendicular or parallel to the shoreline. The modified structures along the shoreline, in addition to those located waterward and perpendicular to the shoreline, are digitized and characterized for the polyline structure layer. This layer includes: boat ramp, breakwater, groin, sill, rip-rap revetment, and bulkhead.

Shoreline access structures or polygon structures are those that are recreational or commercial in use, provide direct access to the water, and have a discernible length and width. Structures in this category are pile supported such as piers and wharves, or floating docks that provide boat access to the water. The entire polygon structure is captured regardless whether it is over water or not. This shows the total area of NC public trust waters that are covered by structures. After digitizing has been completed, structures are bisected with the shoreline to determine the extent of public trust coverage. Access structures are captured after the shoreline is digitized so that the polygons can be "snapped" to the shoreline. If this process is not completed, an apparent gap between the shoreline and the polygon structure will exist.

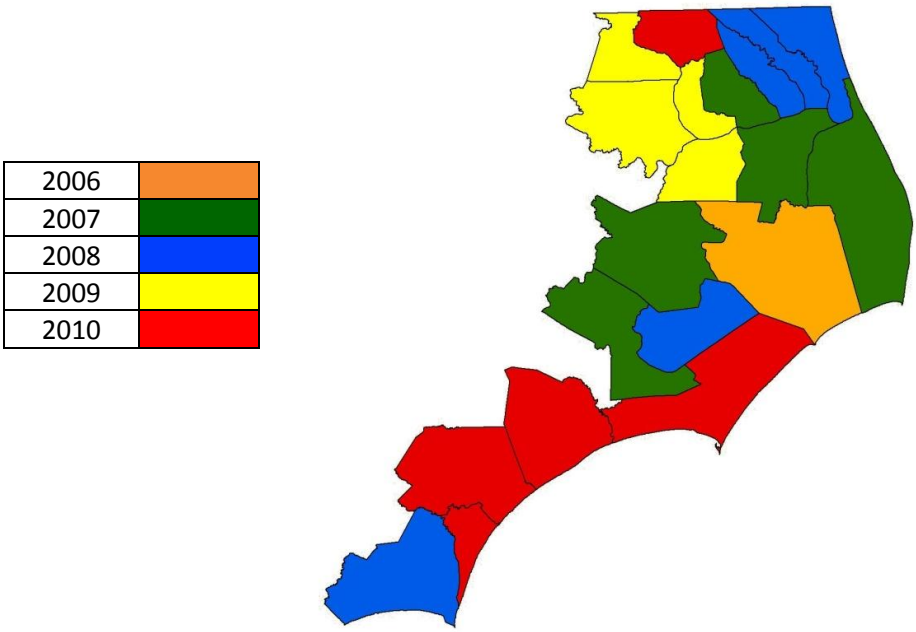
In order to ensure that the shoreline is as accurate as possible, DCM conducted a QA/QC procedure for every county as it was completed. During the QA/QC process the shoreline was scanned at a higher viewing extent (1:800 to 1:1,000) to check for any incorrect or missing pieces of data. In some instances there were areas of the shoreline that could not be identified from aerial photos. Either the image was unclear or the shoreline was obstructed in some way by tree cover or shaded by tree shadow. If this situation was found the segment in question was marked "field check." DCM field officers assisted in the process of identifying these unknown areas. In most cases the field officers had immense knowledge of the sites and knew the shoreline type of the segment in question. If the segment was still not able to be categorized, staff examined structure permits, additional aerial imagery, and in some cases the field reps went to the site to visually inspect what was there and reported back the correct shoreline type.

Imagery Inventory

Table 1: Inventory of Imagery

County	Resolution	Imagery Date
Beaufort	3 inch and 6 inch*	2007
Bertie	6 inch*	2009
Brunswick	6 inch	2008
Camden	6 inch*	2008
Carteret	6 inch	2010
Chowan	6 inch*	2009
Craven	6 inch*	2007
Currituck	6 inch	2008
Dare	3 inch and 1 foot	2007
Gates	6 inch	2010
Hertford	6 inch	2009
Hyde	6 inch and 1 foot	2006
New Hanover	6 inch	2010
Onslow	6 inch	2010
Pamlico	6 inch*	2008
Pasquotank	6 inch*	2008
Pender	6 inch	2010
Perquimans	6 inch*	2007
Tyrrell	1 foot	2007
Washington	6 inch*	2009

* Orthophotos for this county contain data in both 6-inch and 2-foot resolutions, or in some cases 6-inch, 1-foot and 2-foot resolutions. The best available resolution has been reported for these counties in Table 1. County orthophotos often represent imagery taken at multiple resolutions with the best resolution flown over urbanized areas and lower resolutions flown over more rural areas.



Shoreline Types

1. Swamp Forest

Swamp forests (Figure 1) are very poorly drained forested wetlands or shrub/scrub communities that are regularly, occasionally, seasonally, or semi-permanently flooded by lunar tides, wind tides, and/or overbank flow. In the estuarine system, swamp forests occur along the margins of freshwater and brackish sounds and along the lower reaches of coastal rivers and streams. Swamp forests can occur directly on the estuarine shoreline or grade down slope to marsh. This shoreline type is an expansive swamp forest with no sediment bank behind it, or if a sediment bank is present, it is landward enough that regular, non-storm event waves dissipate before reaching the bank. A common example of swamp forest is tidal cypress gum swamp. [5]

Figure 1. Swamp forest shorelines from aerial photographs.

Swamp forests are typically only identifiable on aerial photography by the presence of "trees in the water." Although the land/water interface is not exactly discernible from aerials because of tree shadow and overhanging tree canopies, the tree canopy edge is digitized as the shoreline. Individual or groups of trees in the water found away from the mainland are not digitized. If sea-level rise or erosion occurs too fast, swamp forest trees will drown, as they cannot adapt quickly enough. In this case, photography will show dead trees or remnants of dead trees standing or lying near the water's edge. The majority of swamp forest shorelines are found in northern counties including Bertie, Chowan, Gates, Hertford, Pasquotank, Perquimans, Tyrrell and Washington counties.

[5] Bendell 2006

2. Marsh

Coastal marshes (Figure 2), also known as wetlands, are low-lying meadows of herbaceous plants that occur along the margins of estuaries and along the shorelines of coastal rivers and streams. Most marshes along the estuarine shoreline are subject to regular or irregular flooding by lunar tides and/or wind-generated water level fluctuations. Some riverine flooding may be the most important source of hydrology in areas not subject to tidal flooding. Marsh plant species composition is highly dependent on salinity, with distinctly different marsh communities occurring within freshwater, brackish, and saline zones and within the regularly and irregularly flooded areas within each zone. Common coastal marsh species include: Cord Grass (*Spartina alterniflora*), Black Needlerush (*Juncus roemerianus*), Glasswort (*Salicornia spp*.), Salt Grass (*Distichlis spicata*), Sea Lavender (*Limonium spp*.), Bulrush (*Scirpus spp*.), Saw Grass (*Cladium jamaicense*), Cat-tail (*Typha spp*.), Salt Meadow Grass (*Spartina patens*), and Reed Grass (*Spartina cynosuroides*). [6]

Marsh shorelines, although easily recognizable from aerial photography, pose difficult situations when digitizing. Marshes can be either a narrow swath of vegetation along upland areas or an extensive area of coverage that includes a myriad of canals, cuts, and channels. Generally, the vegetation/water interface of marsh shorelines is easily identified by the contrast in color between the lighter, dry marsh shoreline and darker areas of water. Expansive marsh areas require more time to digitize to get a better understanding of the overall shoreline environment. Technicians were instructed to digitize all sinuous cuts through the marsh and overwash channels. If the marsh is a patchwork of wetland plants and water pathways, technicians digitize pathways as long as they are within the 20-foot upstream extent. Coastal marshes are the most dominant shoreline type in NC's estuarine system, representing 65% of the total shoreline mileage.

Figure 2. Marsh shorelines from aerial photographs.

[6] Bendell 2006

3. Sediment Bank

Sediment bank shorelines (Figures 3-4) are natural coastal areas that are devoid of wetland vegetation. Low sediment bank shorelines, which are less than 5 feet of vertical height, are dominant in the eastern portions of the estuaries and consist of unconsolidated sediment on top of a clay bed, which usually occurs at or slightly below sea-level. High sediment bank shorelines, or bluffs, are defined as over 5 feet of vertical height above the high tide line, are dominant in the westernmost portion of the estuarine system and consist of tight clay and moderately to tightly cemented sandstone near their base with unconsolidated water-bearing sands and clayey sand above. Bluff shorelines are characterized by a steep headland, escarpment, or cliff along the waterward edge. Depending on the bank composition, most high sediment bank shorelines have well-developed sand beaches.[7]

Figure 3. Sediment bank shoreline from aerial photograph, showing the wet/dry line.

Sediment bank shorelines can have numerous other characteristics/features associated with them, including, but not limited to: submerged aquatic vegetation, mud flats, oyster reefs, woody debris (from drowned and converted swamp forest), sandy beaches, and even small patches (not noticeable from aerial photography) of wetland vegetation. Many physical variables affect the position of the wet/dry line on sediment bank shorelines including: wave action, tides, groundwater seepage, and sediment size. In some cases, the wet/dry line will be equivalent to the high water line[8] . Sediment bank shorelines were the least identified natural shoreline type in NC (9.65%).

Figure 4. Low sediment bank shoreline (left) and high sediment bank shoreline (right).

[7] Riggs 2001
[8] Limber et al. 2007

4. Modified

Modified shorelines (Figure 5) are those with observable engineered erosion control structures. For example, bulkheads and riprap revetments are widely utilized to halt a loss of coastal property, to aid recreational activities, to keep shipping channels and ports open, for aesthetic purposes, or to simply hold the current shoreline in place. A variety of erosion control structures exist, and this category includes structures that are both parallel and perpendicular to the shoreline. Structures parallel to the shoreline include bulkheads, revetments, seawalls, and breakwaters. Structures perpendicular to the shoreline include jetties and groins. In addition to erosion control structures, modified shorelines often have recreational access structures associated with them such as boat docks, piers, or floating platforms.

Figure 5. Modified shoreline with a riprap revetment (left) and wooden bulkhead (right).

Structures can alter the shoreline's land/water interface when constructed parallel or perpendicular to the shoreline. These structures will be part of the digitized shoreline only when they are coincident with or make up the shoreline itself. Modified shorelines are generally easily digitized since highly developed areas often have structures approximating a straight line along vast expanses of shoreline. Modified shorelines commonly exhibit a precise linear structure/water interface that differs from natural shorelines that are irregular or meandering. Difficulty associated with delineating modified shorelines includes a technician's ability to differentiate structures from provided imagery. For example, breakwaters and sills can easily be confused with each other. Oyster bag sills can appear as subtle darker areas in the water and may be missed by the digitizer; other sills are overlooked if they are completely submerged during high tide. Approximately 600 miles or about 5% of the total 12,000 miles of estuarine shoreline are classified as modified.

Shoreline Stabilization Structure Types

1. Boat Ramp

Boat ramps (Figure 6) can be constructed from a variety of materials and slope from high ground to below low water to allow vessels to be placed into the water. Boat ramps are not typically considered shoreline stabilization structures, but they are classified as such for this project since they are not natural features and are coincident with the shoreline.

Figure 6: Examples of boat ramps.

2. Breakwater

Breakwaters (Figure 7) can be utilized near shore or offshore, are shore-parallel, and are designed to reduce wave energy and trap sand. Breakwaters are constructed from stone, riprap, concrete, or steel. Sediment can build up in the lee of the structure to the point that it is all high ground (above normal high water/normal water level).

Figure 7: Examples of breakwaters from aerial photographs.

3. Groin

Groins (Figure 8) are generally perpendicular or at oblique angles to the shoreline. Construction materials are typically timber, rock, concrete, vinyl, or steel structures designed to trap sand on the updrift side. Groins are constructed as either a single structure or in a series. From aerial view, a groin series will typically create a saw-toothed shaped shoreline.

Figure 8: Rock groin covered in oyster shell (left) and series of timber groins (right).

4. Jetty

Jetties (Figure 9) are designed to prevent sediment from accumulating in a channel, or for accommodating vessels through an inlet. They are shore-perpendicular and are constructed from timber, rock, concrete, vinyl, or steel structures designed to direct a current and stabilize an inlet. Jetties are longer than groins and are always associated with an inlet, canal, or basin entrance.

Figure 9: Examples of jetties from aerial photographs.

5. Sill

Sills (Figure 10) are constructed nearshore and shore-parallel to stabilize the landward natural shoreline. The structure is typically exposed at low tide and submerged at high tide to reduce wave action on the adjacent shoreline with the purpose of protecting or re-establishing marsh vegetation. Sills can be constructed from a variety of materials including timber, stone, and oyster shells. Well established stone sills will look identical to a sloped structure (riprap revetment for marsh protection). Some are difficult to identify from aerial imagery, especially if completely submerged, and are often mistaken for rip-rap revetments or breakwaters.

Figure 10: Timber sill protecting an existing marsh (left) and oyster shell sill from aerial photo (right).

6. Sloped Structure- Rip-Rap Revetment

Riprap revetments (Figure 11) or marsh enhancement riprap revetments are constructed from stone either along an existing sediment bank or waterward of an eroding wetland substrate. Any shore-parallel, watertight or porous structure designed to stabilize the shoreline and absorb wave energy with a sloped face is considered a revetment.

Figure 11: Examples of rock revetments.

7. Vertical Structure- Bulkhead

Any shore-parallel, watertight structure (bulkheads or seawalls) used to stabilize the shoreline in a vertical manner (Figure 12). Bulkheads are designed to retain or prevent the sliding of the land by driven timber, vinyl, or steel. Seawalls are concrete or stacked/grouted rock structures set on or in the ground to prevent flooding or overtopping of the land.

Figure 12: Steel sheetpile bulkhead (left) and digitized bulkhead from aerial photo (right).

Shoreline Access Structure Types

1. Bridge

A bridge (Figure 13) is a structure built to span bodies of water or other physical obstacles for the purpose of providing passage over the obstacle.

Figure 13: Examples of bridges from aerial photos.

2. Pier/Floating Dock/Wharf

Piers (Figure 14) are pile supported, shore perpendicular structures that provide access over a water body. Floating docks are platforms that rise and fall with the tides which are constructed from timber, plastic, concrete, or steel and are used to moor vessels. Wharves are also pile supported, but are shore-parallel structures that provide access over a water body, allow cargo to be loaded or unloaded from ships, or provide platforms for commercial shipping infrastructure such as railroads and cranes.

Figure 14: Piers from aerial photo (left), floating dock from aerial photo (right), and wharf (below).

Analysis Results

Statewide Statistics

Estuarine Shoreline

A total of 12,319.1 miles of estuarine shoreline were mapped in North Carolina's 20 CAMA counties. The majority of the shoreline was characterized as marsh (65.3%). Modified shorelines made up 4.9% of the total shoreline, or 601.0 miles.

Table 2: Shoreline length for North Carolina by shoreline type.

Shoreline Type	Miles	Percent
Swamp Forest	2,490.4	20.2
Marsh	8,038.5	65.3
Sediment Bank	1,189.3	9.7
Modified	601.0	4.9
Total	**12,319.1**	

Figure 15: Percent shoreline length by shoreline type for North Carolina.

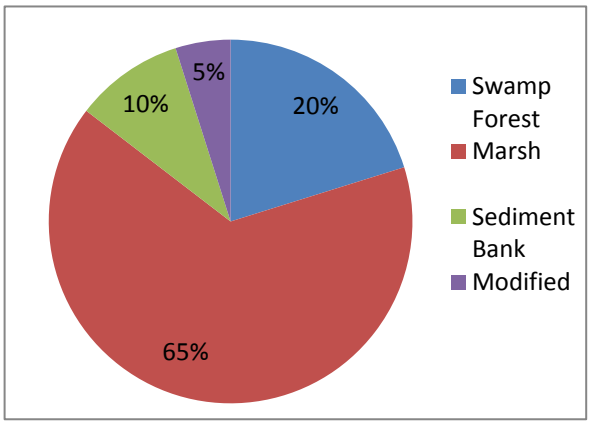


Table 3: Swamp forest shoreline statistics by county.

County	Miles	Percent
Total	**2,490.4**	**100%**
Beaufort	72.0	2.9%
Bertie	277.5	11.1%
Brunswick	92.0	3.7%
Camden	106.4	4.3%
Carteret	9.5	0.4%
Chowan	88.6	3.6%
Craven	269.7	10.8%
Currituck	60.3	2.4%
Dare	59.9	2.4%
Gates	130.9	5.3%
Hertford	174.4	7.0%
Hyde	54.7	2.2%
New Hanover	53.3	2.1%
Onslow	102.4	4.1%
Pamlico	54.5	2.2%
Pasquotank	129.4	5.2%
Pender	329.6	13.2%
Perquimans	155.0	6.2%
Tyrrell	200.7	8.1%
Washington	69.4	2.8%

Table 4: Marsh shoreline statistics by county.

County	Miles	Percent
Total	**8,038.5**	**100%**
Beaufort	475.6	5.9%
Bertie	5.1	<0.1%
Brunswick	748.1	9.3%
Camden	93.0	1.2%
Carteret	1,440.5	17.9%
Chowan	0.9	<0.1%
Craven	193.1	2.4%
Currituck	895.1	11.1%
Dare	685.6	8.5%
Gates	6.5	<0.1%
Hertford	3.4	<0.1%
Hyde	710.9	8.8%
New Hanover	665.6	8.3%
Onslow	882.5	11.0%
Pamlico	508.0	6.3%
Pasquotank	12.8	0.2%
Pender	642.5	8.0%
Perquimans	5.7	<0.1%
Tyrrell	63.2	0.8%
Washington	0.3	<0.1%

Table 5: Sediment bank shoreline statistics by county.

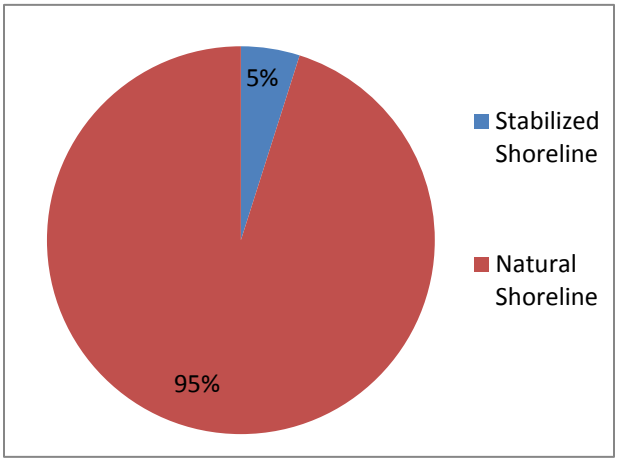
County	Miles	Percent
Total	**1,189.3**	**100%**
Beaufort	150.8	12.7%
Bertie	37.5	3.2%
Brunswick	64.1	5.4%
Camden	46.0	3.9%
Carteret	113.0	9.5%
Chowan	32.1	2.7%
Craven	56.4	4.7%
Currituck	83.2	7.0%
Dare	115.9	9.7%
Gates	7.9	0.7%
Hertford	26.0	2.2%
Hyde	80.8	6.8%
New Hanover	43.1	3.6%
Onslow	106.1	8.9%
Pamlico	31.9	2.7%
Pasquotank	45.7	3.8%
Pender	64.8	5.4%
Perquimans	46.2	3.9%
Tyrrell	31.5	2.6%
Washington	6.5	0.5%

Table 6: Modified shoreline statistics by county.

County	Miles	Percent
Total	**601.0**	**100%**
Beaufort	81.7	13.6%
Bertie	2.1	0.3%
Brunswick	37.6	6.3%
Camden	12.9	2.1%
Carteret	89.1	14.8%
Chowan	17.1	2.8%
Craven	27.7	4.6%
Currituck	61.8	10.3%
Dare	84.9	14.1%
Gates	0.2	<0.1%
Hertford	2.9	0.5%
Hyde	10.4	1.7%
New Hanover	20.0	3.3%
Onslow	30.0	5.0%
Pamlico	31.7	5.3%
Pasquotank	29.3	4.9%
Pender	10.8	1.8%
Perquimans	32.8	5.5%
Tyrrell	8.9	1.5%
Washington	9.0	1.5%

Stabilization Structures

Figure 16: Percent of shoreline stabilized vs. natural shoreline.



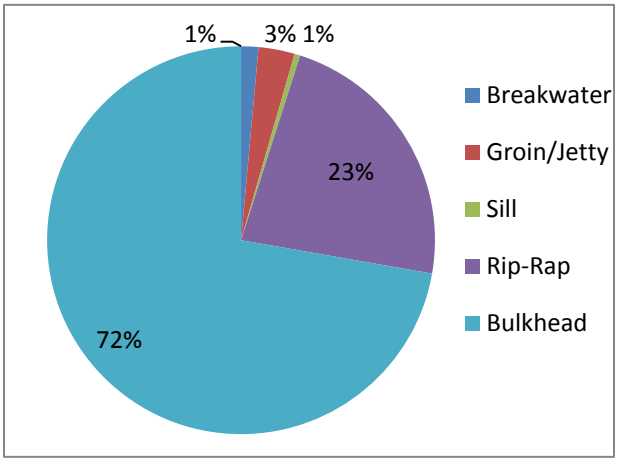


Figure 17: Percent stabilization structure by structure type.

Table 7: Shoreline stabilization statistics for North Carolina.

Stabilization Type	Total Length (miles)	Average (feet)	Minimum (feet)	Maximum (feet)	Total Count
Boat Ramp	6.1	20.2	1.5	887.2	2,075
Breakwater	10.4	181.6	6.8	5,531.7	302
Groin/Jetty	21.8	1.4	11.2	2,392.2	2,483
Sill	3.4	154.0	9.1	1,368.0	111
Rip-Rap	164.5	288.2	1.0	47,158.3	2,990
Bulkhead	520.7	586.0	1.1	5,415.4	8,008

Table 8: Boat ramp statistics by county.

County	Feet	Percent
Total	**32,084.0**	**100%**
Beaufort	3,427.7	10.7%
Bertie	331.0	1.0%
Brunswick	1,792.0	5.6%
Camden	462.7	1.4%
Carteret	6,219.9	19.4%
Chowan	442.4	1.4%
Craven	717.2	2.2%
Currituck	3,276.2	10.2%
Dare	2,313.1	7.2%
Gates	140.7	0.4%
Hertford	378.2	1.2%
Hyde	498.7	1.6%
New Hanover	763.1	2.4%
Onslow	5,592.5	17.4%
Pamlico	1,719.4	5.4%
Pasquotank	733.0	2.3%
Pender	1,465.5	4.6%
Perquimans	1,005.3	3.1%
Tyrrell	342.8	1.1%
Washington	463.6	1.4%

Table 9: Breakwater statistics by county.

County	Feet	Percent
Total	**54,841.7**	**100%**
Beaufort	220.9	0.4%
Bertie	0	0.0%
Brunswick	27,504.2	50.2%
Camden	97.0	0.2%
Carteret	0	0.0%
Chowan	167.5	0.3%
Craven	526.7	1.0%
Currituck	3,442.4	6.3%
Dare	15,498.2	28.3%
Gates	0	0.0%
Hertford	0	0.0%
Hyde	0	0.0%
New Hanover	956.0	1.7%
Onslow	1,729.6	3.2%
Pamlico	1,436.7	2.6%
Pasquotank	900.0	1.6%
Pender	35.1	0.1%
Perquimans	705.5	1.3%
Tyrrell	1,229.6	2.2%
Washington	392.8	0.7%

Table 10: Groin/Jetty statistics by county.

County	Feet	Percent
Total	**114,901.5**	**100%**
Beaufort	23,344.5	20.3%
Bertie	1,850.2	1.6%
Brunswick	5,498.4	4.8%
Camden	387.9	0.3%
Carteret	12,584.2	11.0%
Chowan	7,108.6	6.2%
Craven	3,346.4	2.9%
Currituck	7,183.4	6.3%
Dare	25,997.9	22.6%
Gates	71.0	0.1%
Hertford	74.7	0.1%
Hyde	1,053.0	0.9%
New Hanover	7,942.7	6.9%
Onslow	858.3	0.7%
Pamlico	7,792.5	6.8%
Pasquotank	3,821.9	3.3%
Pender	989.4	0.9%
Perquimans	1,004.1	0.9%
Tyrrell	2,568.3	2.2%
Washington	1,424.0	1.2%

Table 11: Sill statistics by county.

County	Feet	Percent
Total	**17,861.8**	**100%**
Beaufort	0	0.0%
Bertie	0	0.0%
Brunswick	351.1	2.0%
Camden	0	0.0%
Carteret	9,060.5	50.7%
Chowan	1,760.1	9.9%
Craven	818.8	4.6%
Currituck	873.7	4.9%
Dare	3,004.3	16.8%
Gates	0	0.0%
Hertford	0	0.0%
Hyde	215.3	1.2%
New Hanover	189.6	1.1%
Onslow	1,489.4	8.3%
Pamlico	99.1	0.6%
Pasquotank	0	0.0%
Pender	0	0.0%
Perquimans	0	0.0%
Tyrrell	0	0.0%
Washington	0	0.0%

Table 12: Rip-rap revetment statistics by county.

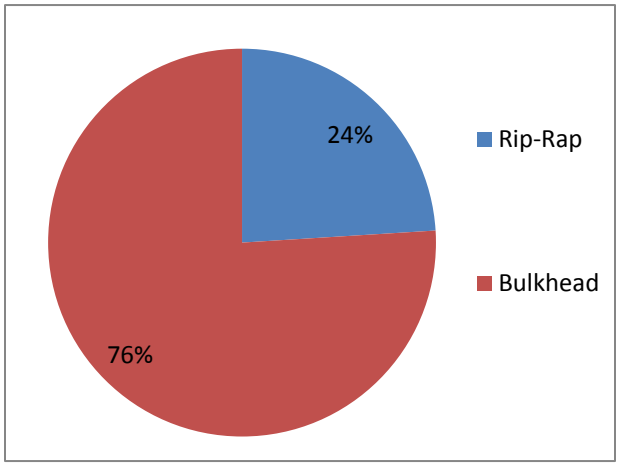
County	Miles	Percent
Total	**164.7**	**100%**
Beaufort	24.3	14.6%
Bertie	0.8	0.5%
Brunswick	15.5	9.4%
Camden	2.8	1.7%
Carteret	29.5	17.9%
Chowan	2.0	1.2%
Craven	10.5	6.4%
Currituck	7.6	4.6%
Dare	13.5	8.2%
Gates	0.2	0.1%
Hertford	0.1	0.1%
Hyde	3.0	1.8%
New Hanover	3.2	1.9%
Onslow	10.2	6.2%
Pamlico	17.9	10.9%
Pasquotank	8.0	4.9%
Pender	1.1	0.7%
Perquimans	6.9	4.2%
Tyrrell	5.3	3.2%
Washington	2.3	1.4%

Table 13: Bulkhead statistics by county.

County	Miles	Percent
Total	**520.7**	**100%**
Beaufort	65.2	12.5%
Bertie	5.3	1.0%
Brunswick	38.7	7.4%
Camden	10.1	1.9%
Carteret	70.3	13.5%
Chowan	16.3	3.1%
Craven	26.1	5.0%
Currituck	55.6	10.7%
Dare	81.7	15.7%
Gates	0.0	0.0%
Hertford	2.9	0.6%
Hyde	7.8	1.5%
New Hanover	24.0	4.6%
Onslow	24.1	4.6%
Pamlico	18.3	3.5%
Pasquotank	22.2	4.3%
Pender	12.4	2.4%
Perquimans	28.1	5.4%
Tyrrell	3.9	0.7%
Washington	7.5	1.4%

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 18 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in NC are categorized as bulkhead with 520.6 miles. Dare County has the greatest amount of bulkhead at 82 miles or 15.8% of the statewide total. Rip-rap revetments total 164.5 miles. Carteret County has the greatest amount of rip-rap revetments totaling 29.5 miles or 17.9% of the statewide total.

Figure 18: Shoreline stabilization structures that are coincident with the shoreline for North Carolina.



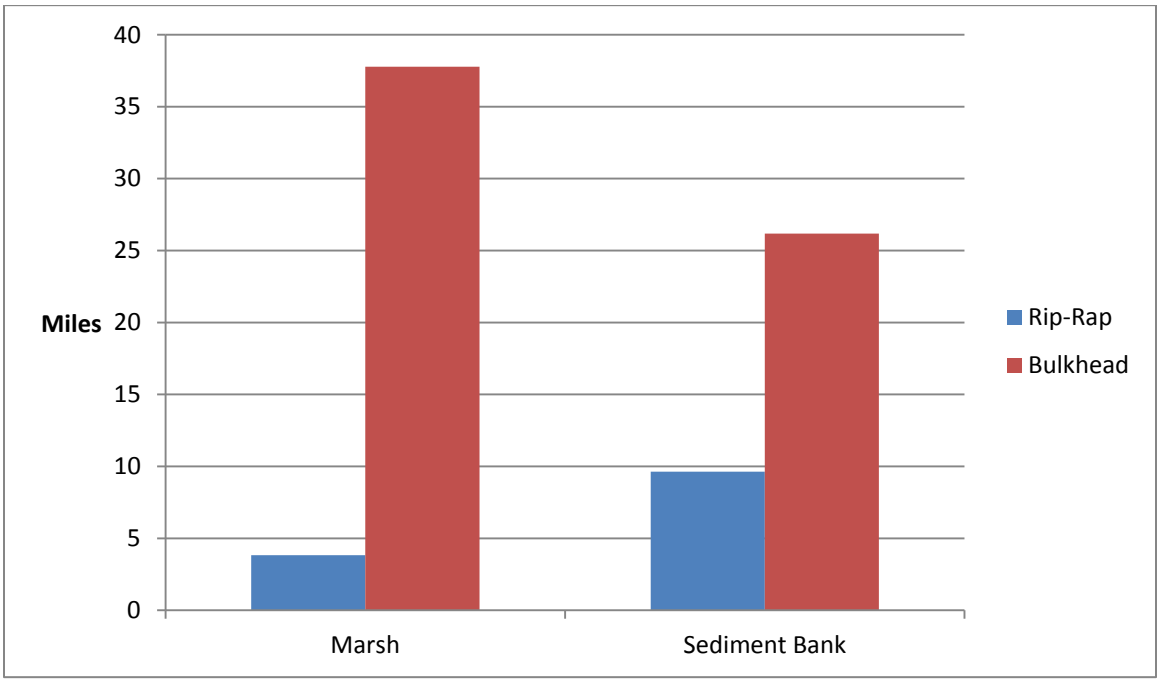
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 14 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In North Carolina, 41.6 miles of marsh and 35.8 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 14: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	199,486	20,212
Average	205	158
Minimum	3	3
Maximum	3,076	1,166
Total Count	975	128

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	138,248	50,789
Average	154	194
Minimum	2	2
Maximum	5,314	2,334
Total Count	899	262

Figure 19: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 15 below.

Table 15: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	41,631
Average	154.5
Minimum	4.0
Maximum	990.7
Total Count	285

Shoreline Access Structures

There are 28,341 shoreline access structures (Table 16) mapped within North Carolina. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (98%). These structures also represent 88% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 74,583 ft^2.

Table 16: Area of shoreline access structures within North Carolina.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	546	25,426	13,957,045	0.58	320.4
Pier/Floating Dock/Wharf	27,795	879	24,465,451	0.02	561.6
Total	**28,341**		**38,422,497**		**882.1**

Table 17: Bridge statistics by county.

County	Acres	Percent
Total	**320.4**	**100%**
Beaufort	8.6	2.7%
Bertie	13.3	4.2%
Brunswick	14.9	4.7%
Camden	6.6	2.1%
Carteret	26.8	8.4%
Chowan	19.1	6.0%
Craven	40.4	12.6%
Currituck	7.7	2.4%
Dare	85.7	26.7%
Gates	0.8	0.2%
Hertford	1.8	0.6%
Hyde	6.9	2.2%
New Hanover	54.6	17.0%
Onslow	0.1	<0.1%
Pamlico	3.1	1.0%
Pasquotank	1.4	0.4%
Pender	5.4	1.7%
Perquimans	5.6	1.7%
Tyrrell	8.6	2.7%
Washington	9.0	2.8%

Table 18: Pier/Floating Dock/Wharf statistics by county.

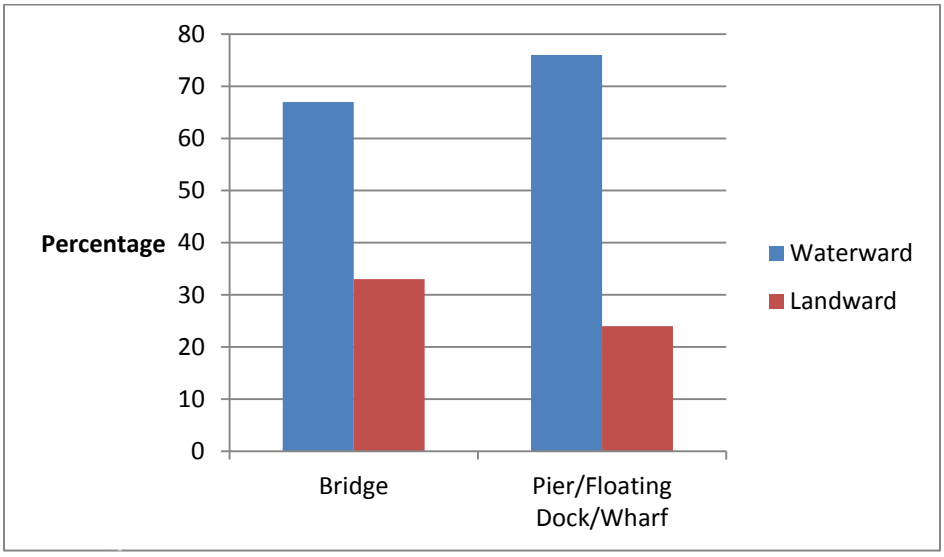
County	Acres	Percent
Total	**561.6**	**100%**
Beaufort	55.5	9.9%
Bertie	3.2	0.6%
Brunswick	103.3	18.4%
Camden	5.2	0.9%
Carteret	106.9	19.0%
Chowan	10.5	1.9%
Craven	25.7	4.6%
Currituck	16.7	3.0%
Dare	46.9	8.4%
Gates	0.1	<0.1%
Hertford	3.8	0.7%
Hyde	4.8	0.9%
New Hanover	79.5	14.2%
Onslow	1.1	0.2%
Pamlico	32.1	5.7%
Pasquotank	10.8	1.9%
Pender	31.4	5.6%
Perquimans	14.8	2.6%
Tyrrell	14.8	2.6%
Washington	5.0	0.9%

In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile.

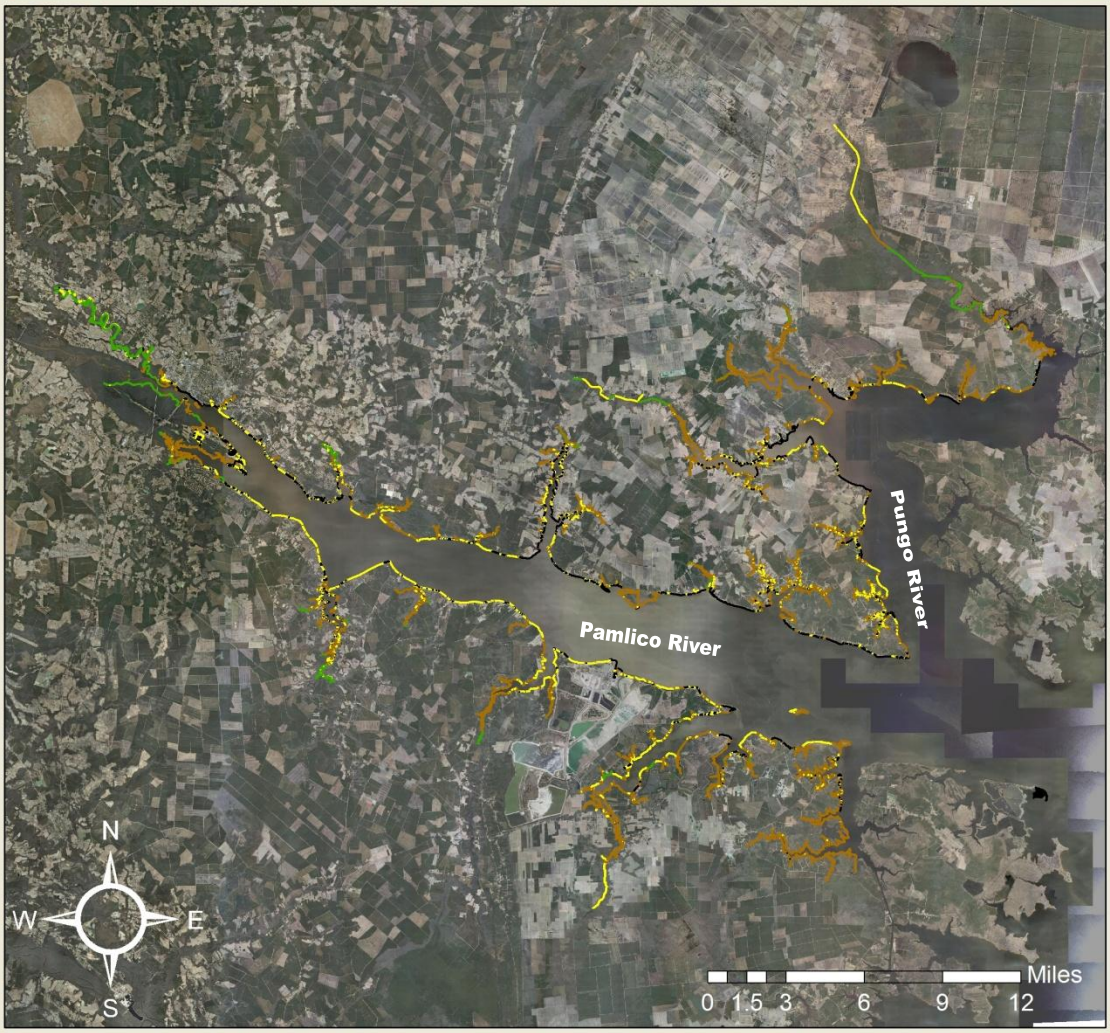
Table 19: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	Feet^2	Acres
Bridge	9,377,930	215.6
Pier/Floating Dock/Wharf	18,643,991	428.6
Total	**28,021,922**	**644.2**

Figure 20: Percent of shoreline access structures located landward and waterward of the shoreline.



Beaufort County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Beaufort County Statistics

Estuarine Shoreline

A total of 780.1 miles of estuarine shoreline were mapped within Beaufort County. The majority of the shoreline was characterized as marsh (61.0%). Modified shorelines made up 10.5% of the total shoreline, or 81.7 miles.

Figure 21: Percent shoreline length by shoreline type for Beaufort County.

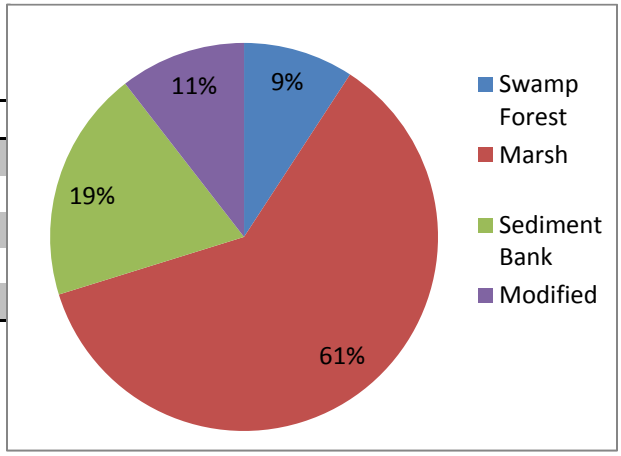
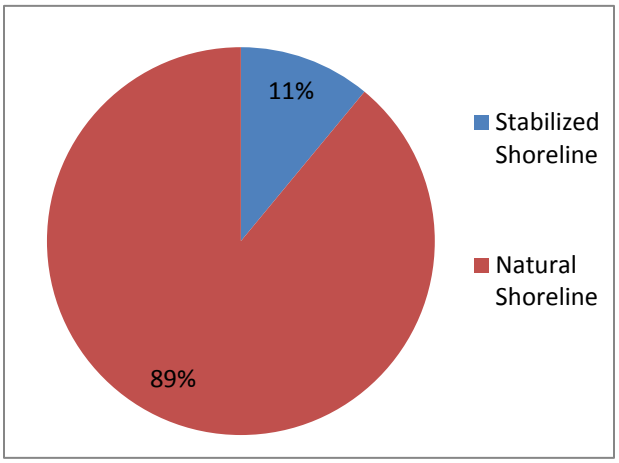


Table 20: Shoreline length for Beaufort County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	380,396	72.0	9.2
Marsh	2,511,189	475.6	61.0
Sediment Bank	796,077	150.8	19.3
Modified	431,312	81.7	10.5
Total	**4,118,974**	**780.1**	

Stabilization Structures

Figure 22: Percent of shoreline stabilized vs. natural shoreline.



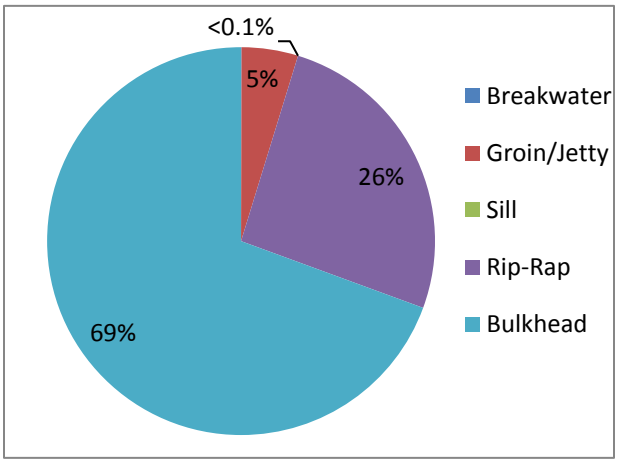


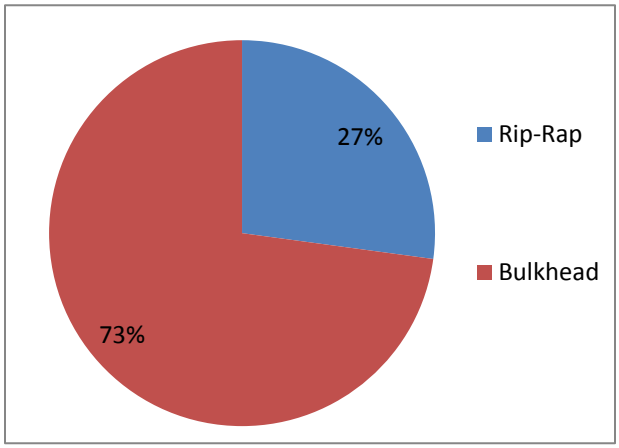
Figure 23: Percent stabilization structure by structure type.

Table 21: Shoreline stabilization statistics for Beaufort County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	3,428	12.8	1.5	58.1	250
Breakwater	221	31.6	10.2	50.8	7
Groin/Jetty	23,344	28.4	1	398.0	823
Sill	0	0	0	0	0
Rip-Rap	128,228	221.5	1	3,937.7	579
Bulkhead	344,381	218.1	1.1	4,095.4	1,579

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 24 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Beaufort County were categorized as bulkhead with 65.2 miles. Rip-rap revetments totaled 24.3 miles.

Figure 24: Shoreline stabilization structures that are coincident with the shoreline for Beaufort County



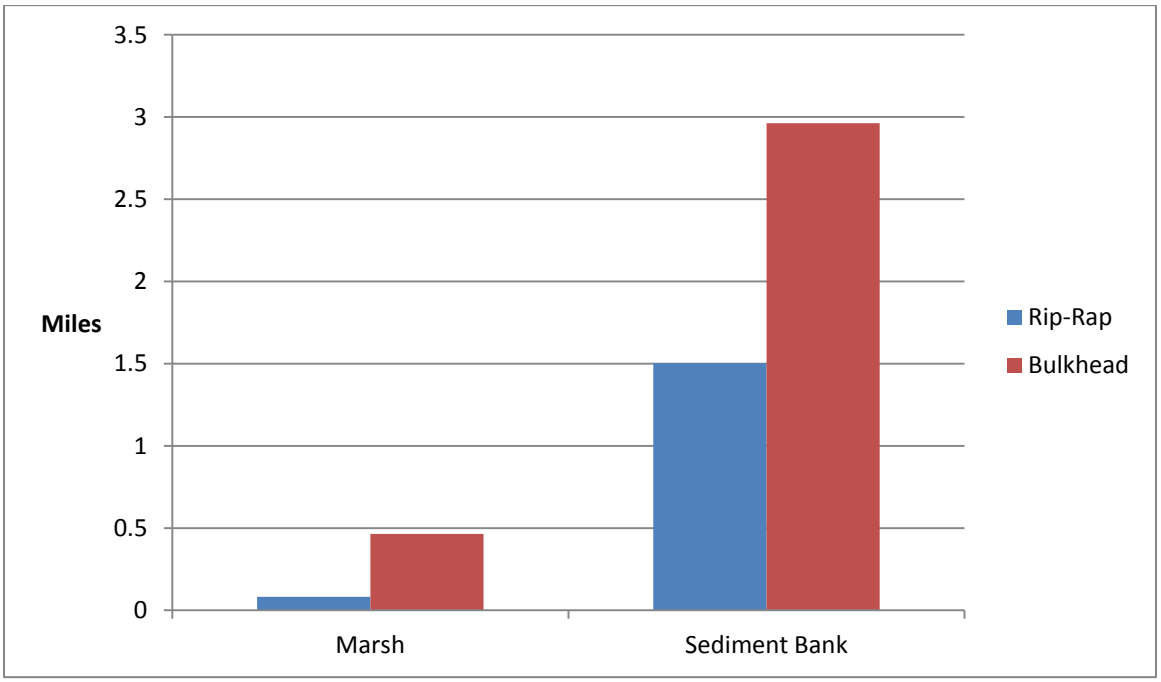
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 22 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Beaufort County, 0.6 miles of marsh and 4.5 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 22: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	2,451	433
Average	70	62
Minimum	3	8
Maximum	389	102
Total Count	35	7

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	15,641	7,936
Average	106	241
Minimum	3	5
Maximum	1,096	2,334
Total Count	147	33

Figure 25: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 23 below.

Table 23: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	16,354
Average	144.7
Minimum	7.3
Maximum	697.7
Total Count	113

Shoreline Access Structures

There are 2,903 shoreline access structures (Table 24) mapped within Beaufort County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (98%). These structures also represent 87% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 74,583 ft^2.

Table 24: Area of shoreline access structures within Beaufort County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	59	6,367	375,681	0.15	8.6
Pier/Floating Dock/Wharf	2,844	849.4	2,415,890	0.02	55.5
Total	**2,903**		**2,791,572**		**64.1**

Figure 26: Percent of total number of shoreline access structures.

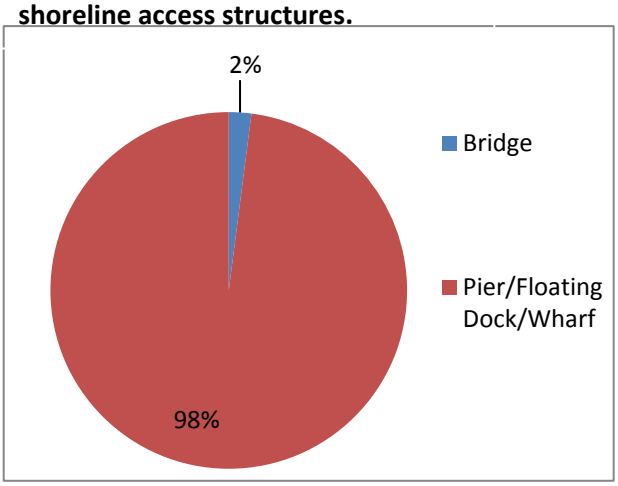
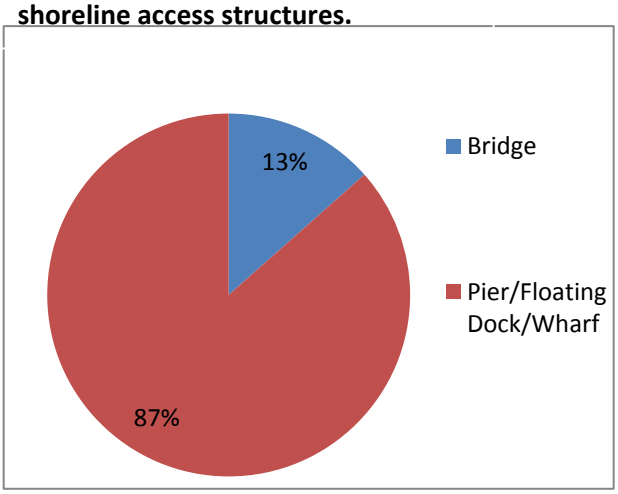


Figure 27: Percent total area of shoreline access structures.

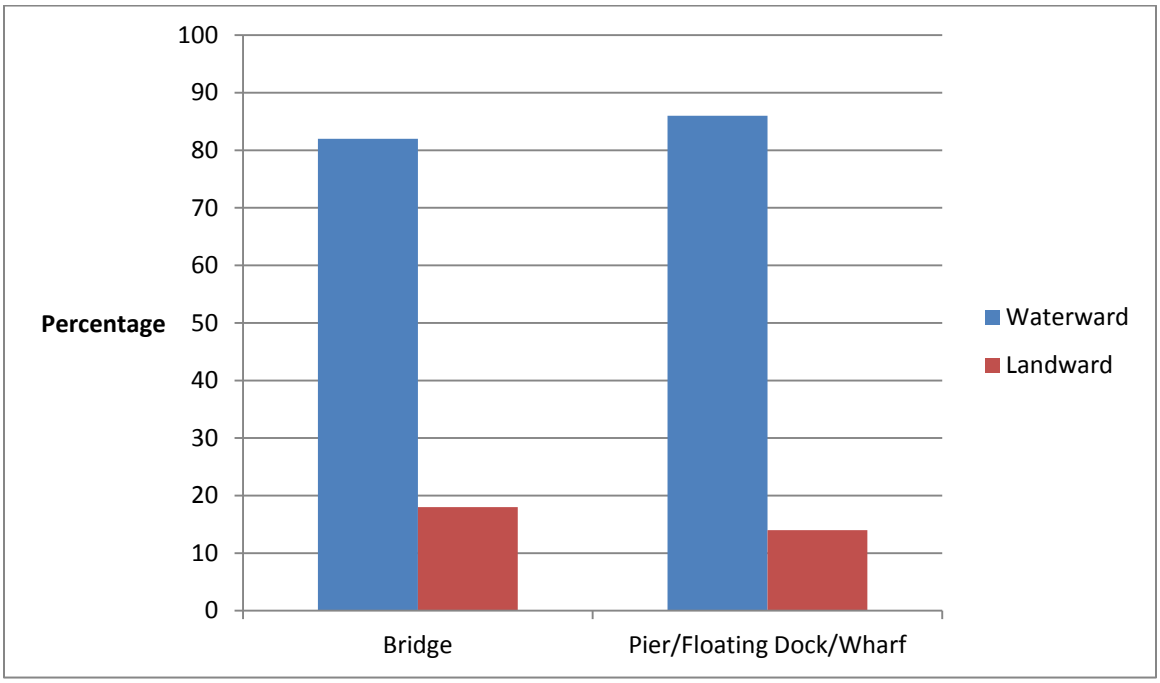


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Beaufort County, about 55 acres of Public Trust Waters are covered by shoreline access structures.

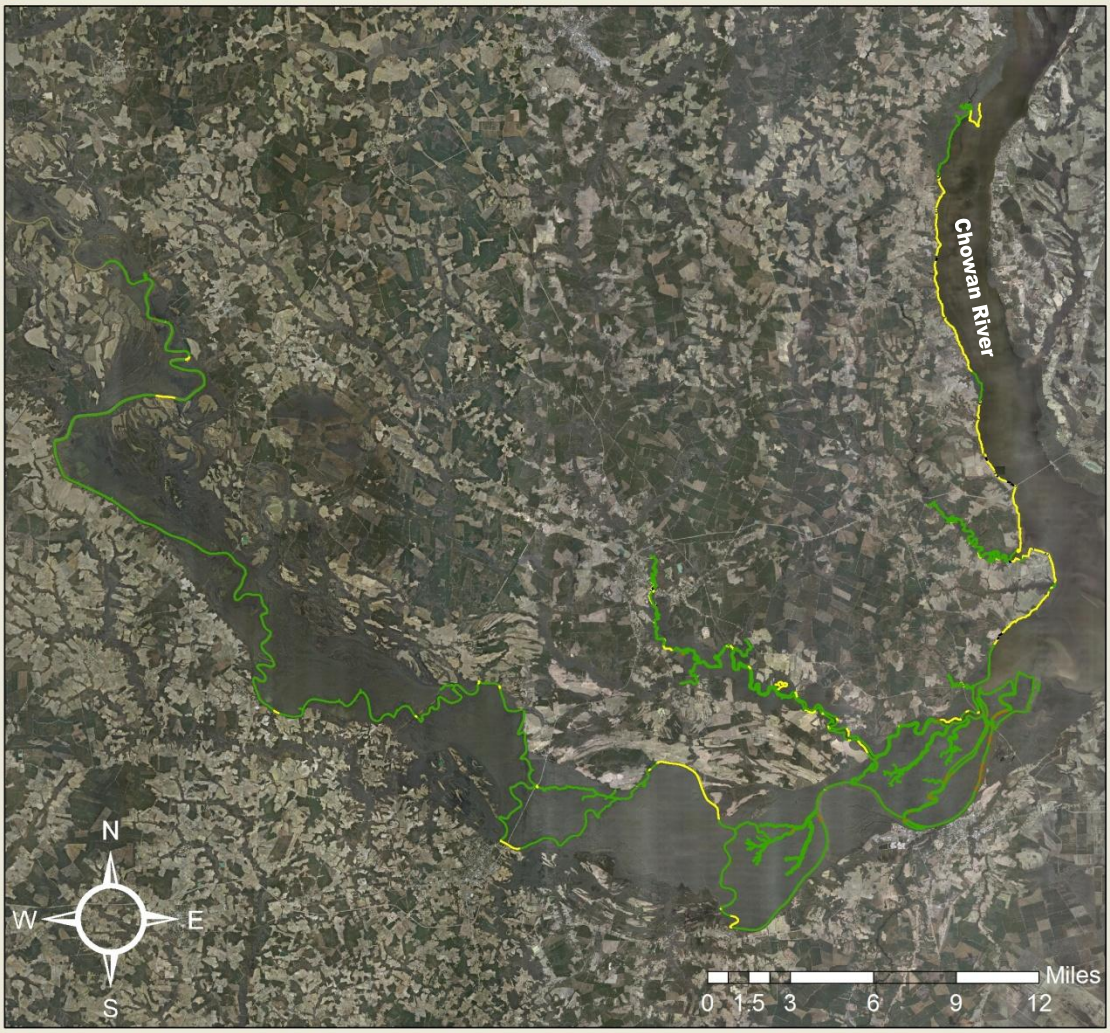
Table 25: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	306,545	7.0
Pier/Floating Dock/Wharf	2,086,129	47.9
Total	**2,392,674**	**54.9**

Figure 28: Percent of shoreline access structures located landward and waterward of the shoreline.



Bertie County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Bertie County Statistics

Estuarine Shoreline

A total of 322.2 miles of estuarine shoreline were mapped within Bertie County. The majority of the shoreline was characterized as swamp forest (86.1%). Modified shorelines made up 0.7% of the total shoreline, or 2.1 miles.

Figure 29: Percent shoreline length by shoreline type for Bertie County.

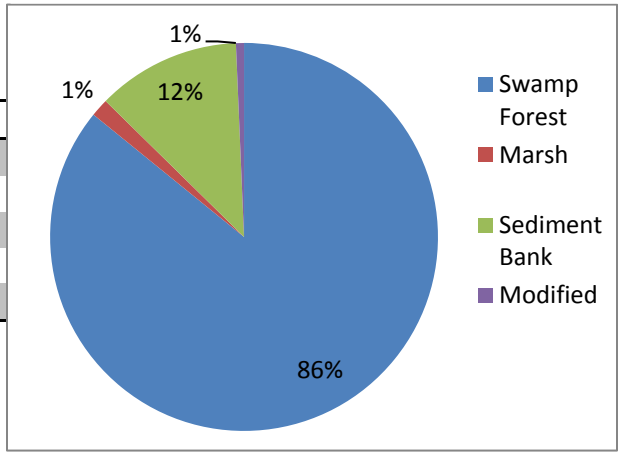
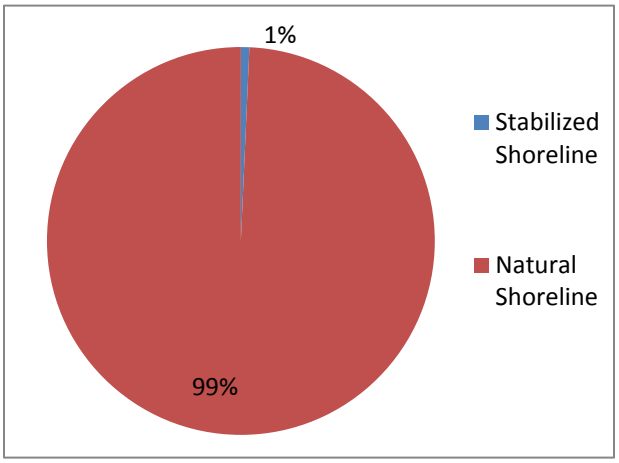


Table 26: Shoreline length for Bertie County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	1,465,295	277.5	86.1
Marsh	26,914	5.1	1.6
Sediment Bank	198,070	37.5	11.6
Modified	11,337	2.1	0.7
Total	**1,701,616**	**322.2**	

Stabilization Structures

Figure 30: Percent of shoreline stabilized vs. natural shoreline.



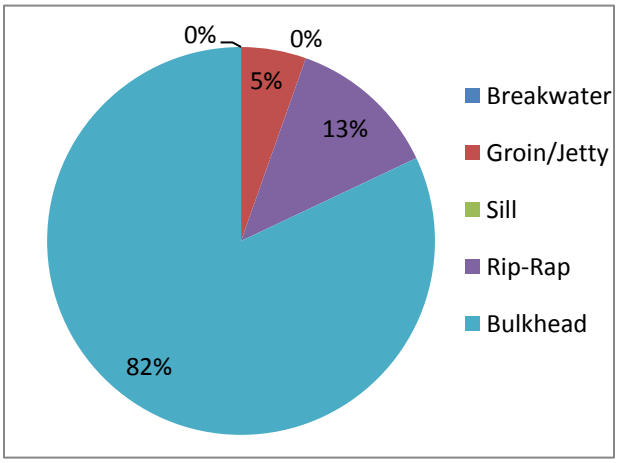


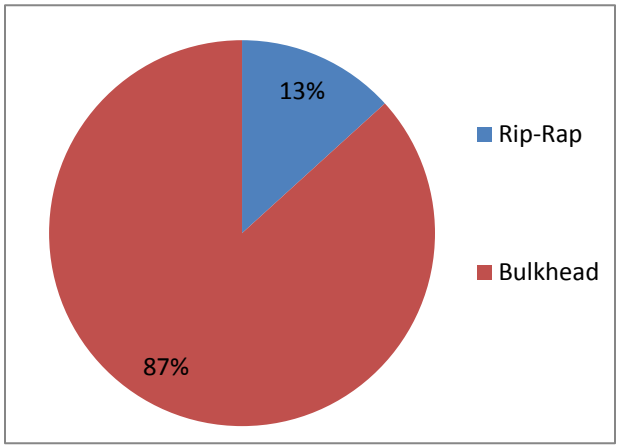
Figure 31: Percent stabilization structure by structure type.

Table 27: Shoreline stabilization statistics for Bertie County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	331	18.4	10.5	40.8	18
Breakwater	0	0	0	0	0
Groin/Jetty	1,850	28.9	10.0	130.3	64
Sill	0	0	0	0	0
Rip-Rap	4,280	138.1	23.1	898.2	31
Bulkhead	27,980	383.3	18.6	5,339.1	73

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 32 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Bertie County were categorized as bulkhead with 5.3 miles. Rip-rap revetments totaled 0.8 miles.

Figure 32: Shoreline stabilization structures that are coincident with the shoreline for Bertie County



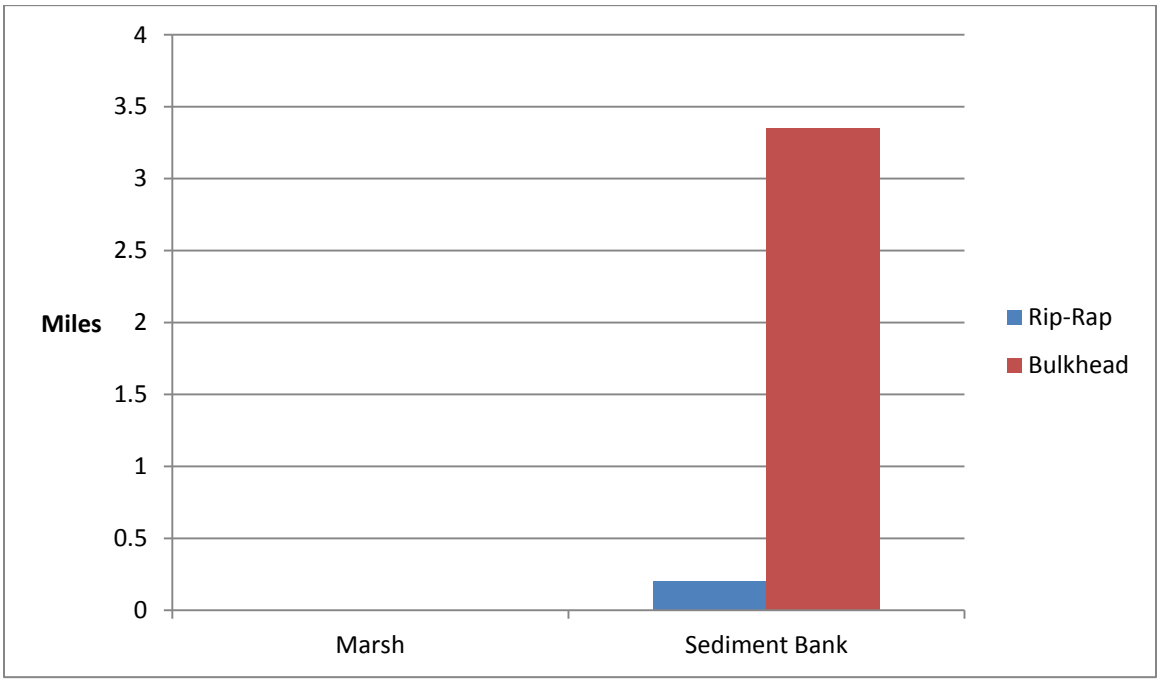
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 28 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Bertie County, 0 miles of marsh and 3.5 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 28: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	0	0
Average	0	0
Minimum	0	0
Maximum	0	0
Total Count	0	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	17,676	1,067
Average	478	152
Minimum	37	34
Maximum	5,314	251
Total Count	37	7

Figure 33: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 29 below.

Table 29: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	171.4
Average	171.4
Minimum	171.4
Maximum	171.4
Total Count	1

Shoreline Access Structures

There are 173 shoreline access structures (Table 30) mapped within Bertie County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (92%). However, bridges represent 80% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 254,738 ft^2.

Table 30: Area of shoreline access structures within Bertie County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	14	41,358	579,006	0.95	13.3
Pier/Floating Dock/Wharf	159	885	140,751	0.02	3.2
Total	**173**		**719,757**		**16.5**

Figure 34: Percent of total number of shoreline access structures.

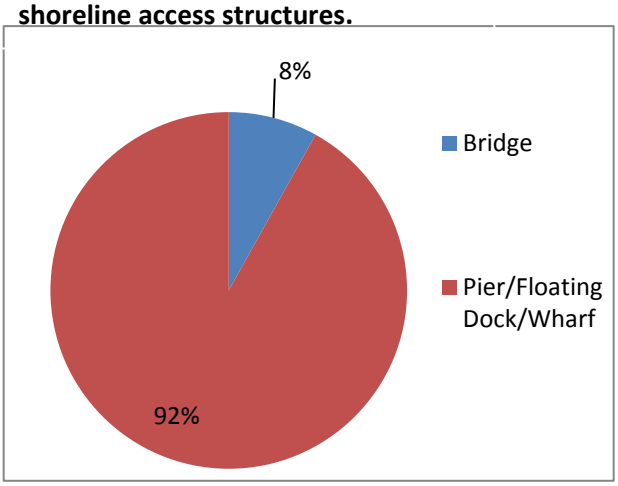
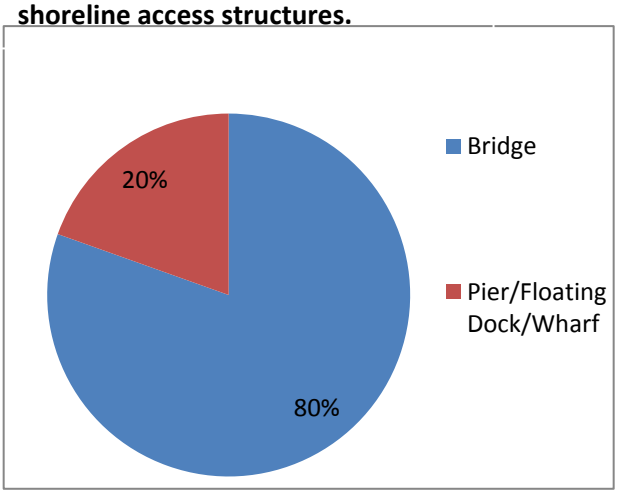


Figure 35: Percent total area of shoreline access structures.

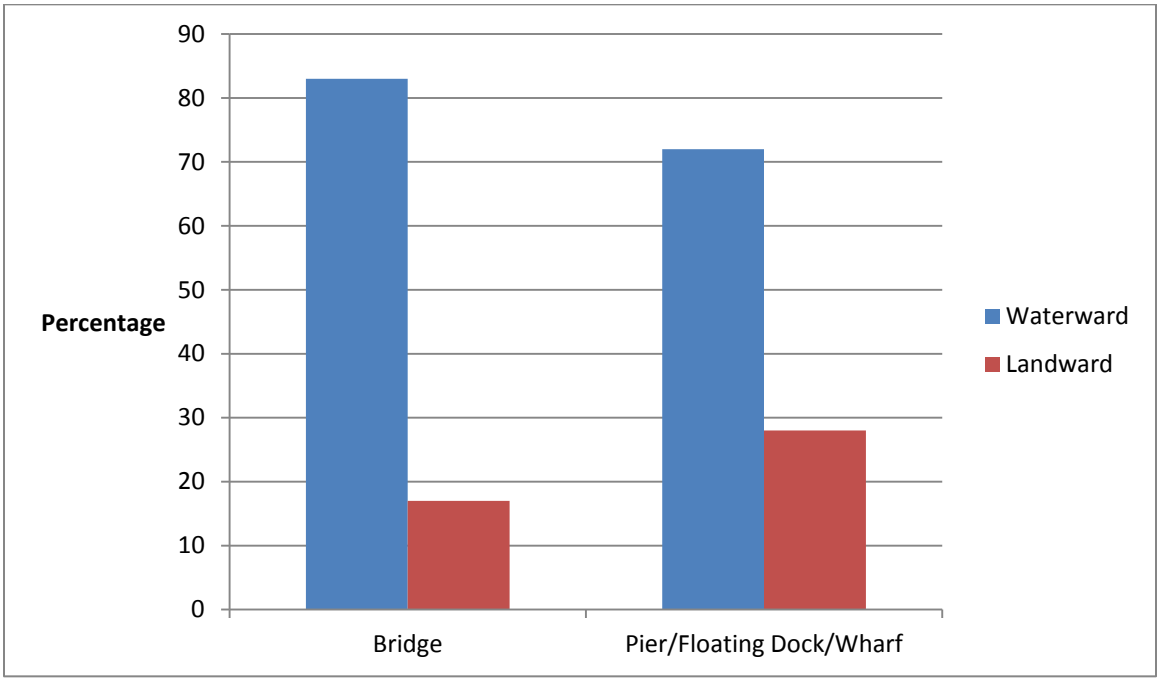


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Bertie County, about 14 acres of Public Trust Waters are covered by shoreline access structures.

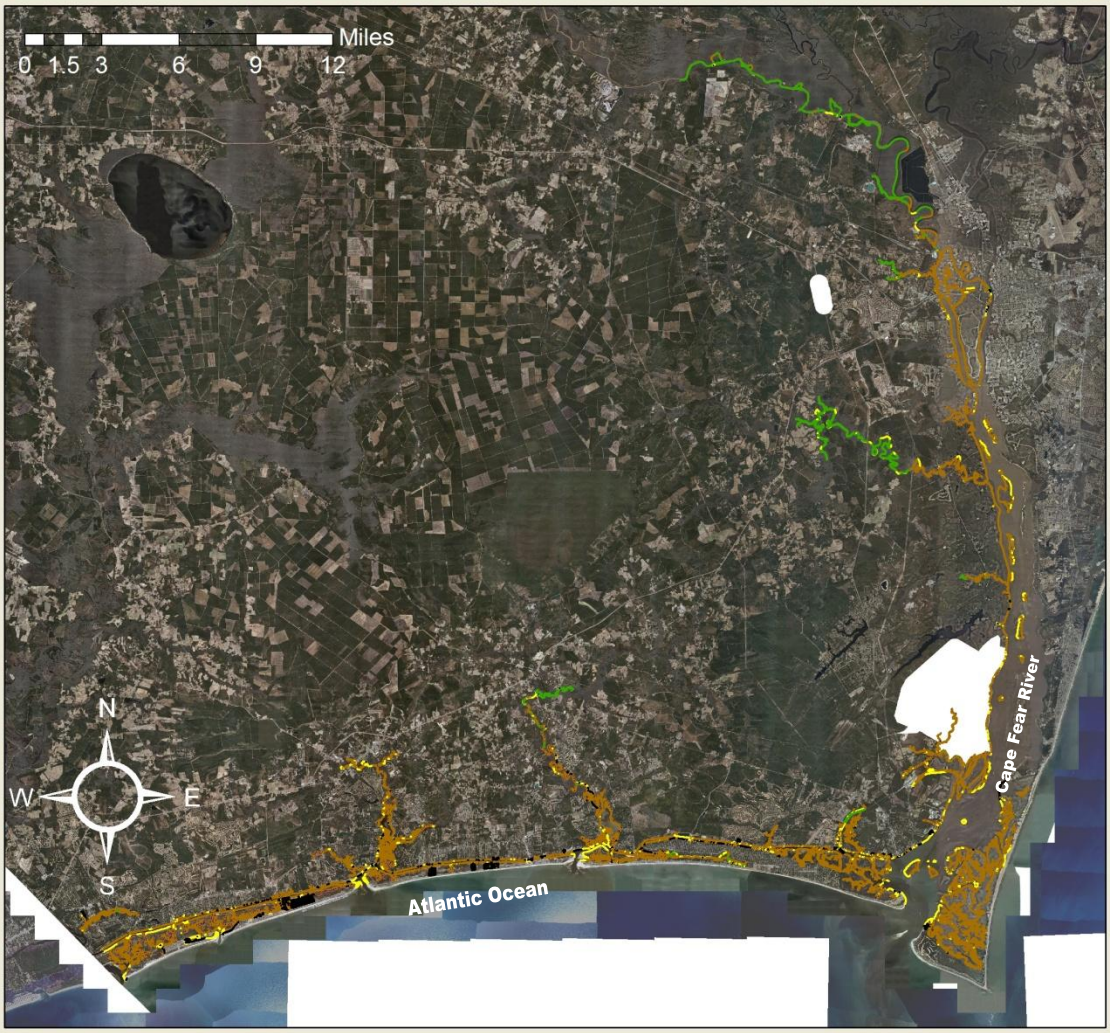
Table 31: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	485,984	11.2
Pier/Floating Dock/Wharf	101,689	2.3
Total	**587,674**	**13.5**

Figure 36: Percent of shoreline access structures located landward and waterward of the shoreline.



Brunswick County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Brunswick County Statistics

Estuarine Shoreline

A total of 941.8 miles of estuarine shoreline were mapped within Brunswick County. The majority of the shoreline was characterized as marsh (79.4%). Modified shorelines made up 4.0% of the total shoreline, or 37.6 miles.

Figure 37: Percent shoreline length by shoreline type for Brunswick County.

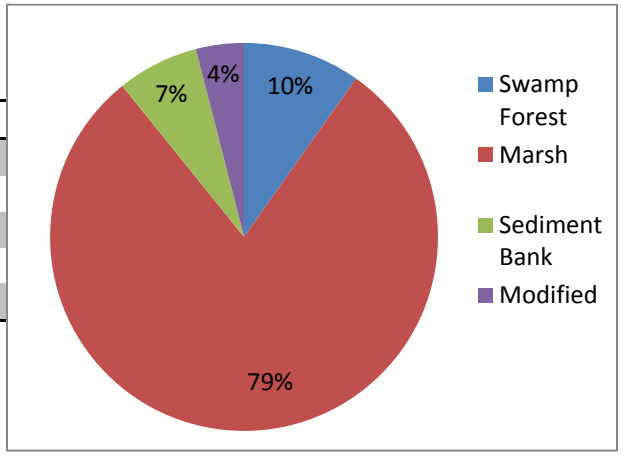
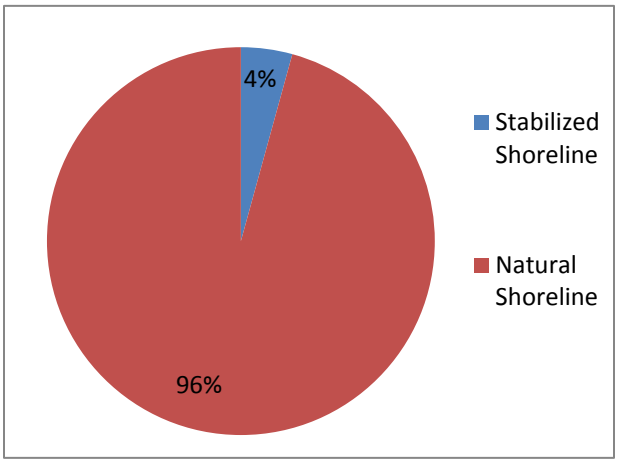


Table 32: Shoreline length for Brunswick County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	485,703	92.0	9.8
Marsh	3,949,906	748.1	79.4
Sediment Bank	338,302	64.1	6.8
Modified	198,548	37.6	4.0
Total	**4,972,459**	**941.8**	

Stabilization Structures

Figure 38: Percent of shoreline stabilized vs. natural shoreline.



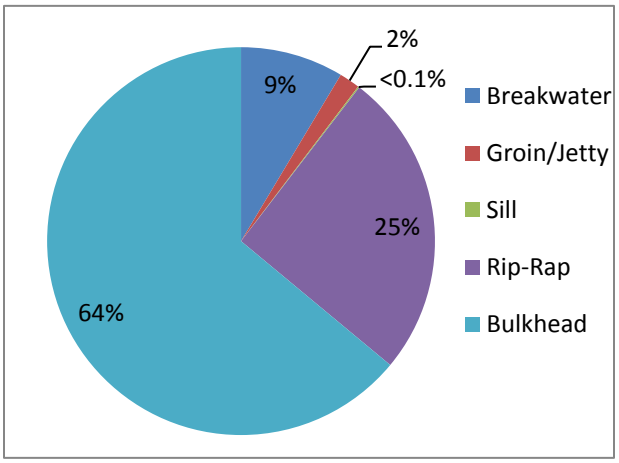


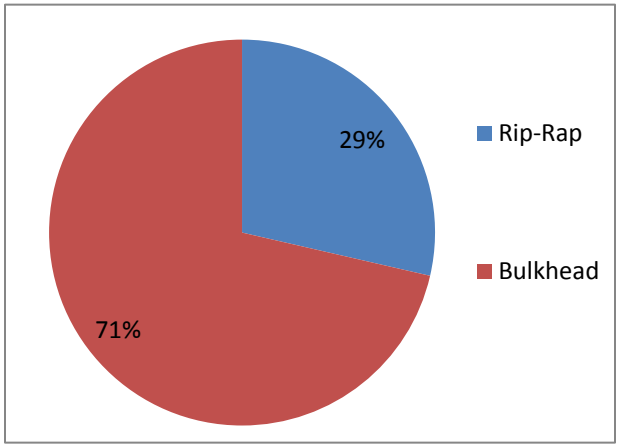
Figure 39: Percent stabilization structure by structure type.

Table 33: Shoreline stabilization statistics for Brunswick County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	1,792	18.5	7.9	70.5	97
Breakwater	27,504	833.5	19.2	5,531.2	33
Groin/Jetty	5,498	122.2	10.3	2,392.2	45
Sill	351.1	351.1	351.1	351.1	1
Rip-Rap	81,825	699.4	3.3	47,158.3	117
Bulkhead	204,513	645.2	2.3	15,513.3	317

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 40 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Brunswick County were categorized as bulkhead with 38.7 miles. Rip-rap revetments totaled 15.5 miles.

Figure 40: Shoreline stabilization structures that are coincident with the shoreline for Brunswick County



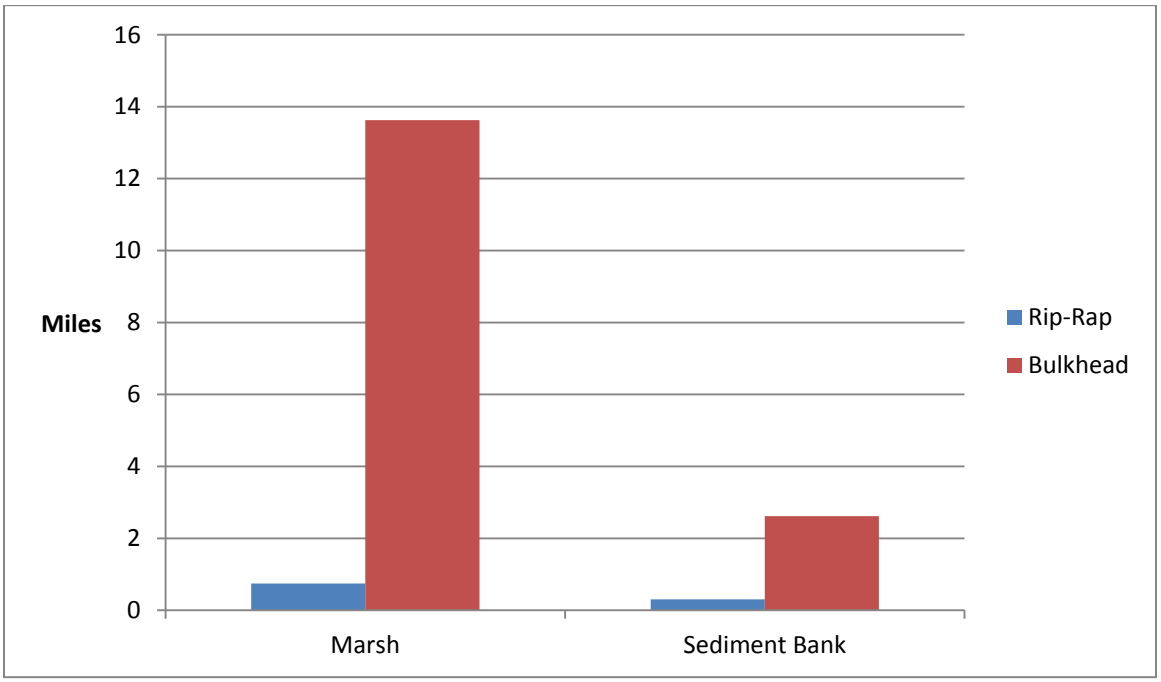
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 34 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Brunswick County, 14.3 miles of marsh and 2.9 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 34: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	71,930	3,939
Average	253	188
Minimum	15	44
Maximum	1,414	683
Total Count	284	21

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	13,810	1,597
Average	266	123
Minimum	10	54
Maximum	2,320	304
Total Count	52	13

Figure 41: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 35 below.

Table 35: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	1,444
Average	288.7
Minimum	42.4
Maximum	990.7
Total Count	5

Shoreline Access Structures

There are 4,277 shoreline access structures (Table 36) mapped within Brunswick County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (99%). These structures also represent 87% of the total area of shoreline access structures. The largest single structure is a pier with an area of 335,347 ft^2.

Table 36: Area of shoreline access structures within Brunswick County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	40	16,277	649,096	0.37	14.9
Pier/Floating Dock/Wharf	4,237	1,061	4,498,938	0.02	103.3
Total	**4,277**		**5,148,034**		**118.2**

Figure 42: Percent of total number of shoreline access structures.

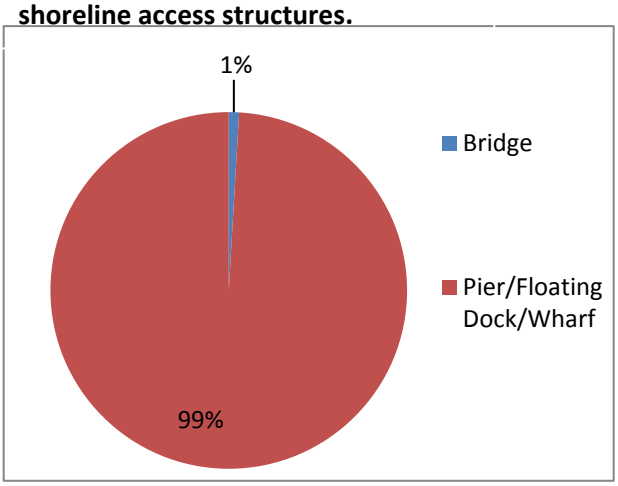
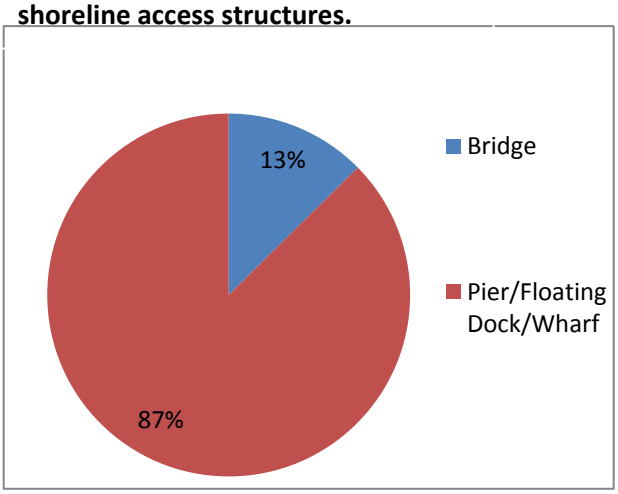


Figure 43: Percent total area of shoreline access structures.

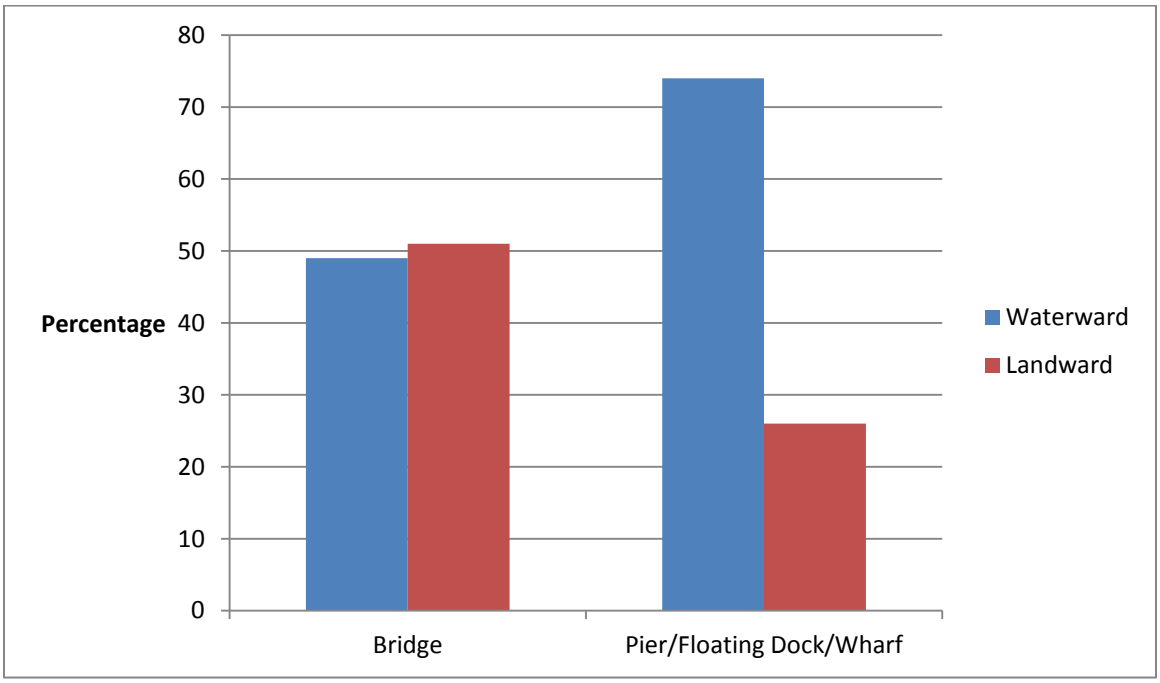


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Brunswick County, about 84 acres of Public Trust Waters are covered by shoreline access structures.

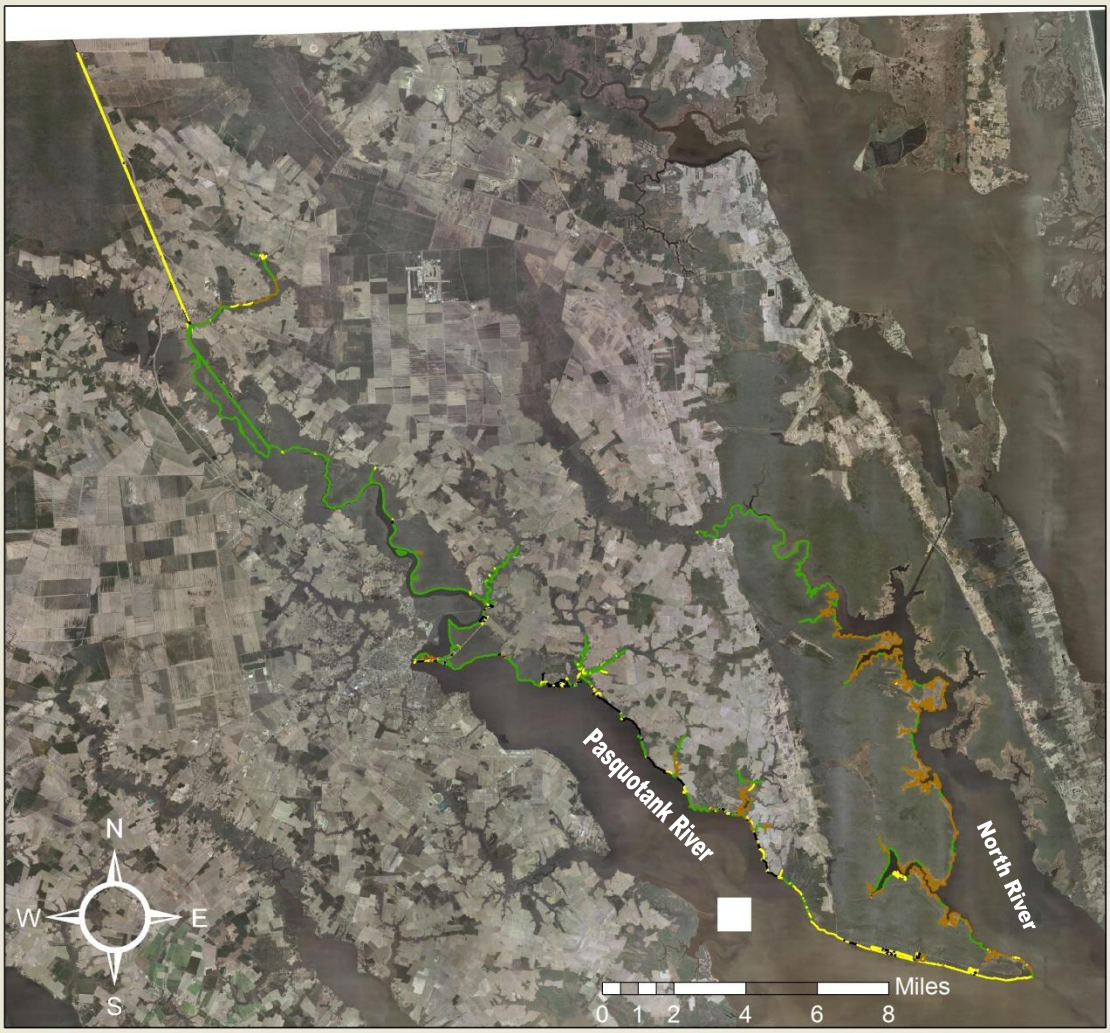
Table 37: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	317,749	7.3
Pier/Floating Dock/Wharf	3,322,188	76.3
Total	**3,639,937**	**83.6**

Figure 44: Percent of shoreline access structures located landward and waterward of the shoreline.



Camden County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Camden County Statistics

Estuarine Shoreline

A total of 258.3 miles of estuarine shoreline were mapped within Camden County. The majority of the shoreline was characterized as swamp forest (41.2%). Modified shorelines made up 5.0% of the total shoreline, or 12.9 miles.

Figure 45: Percent shoreline length by shoreline type for Camden County.

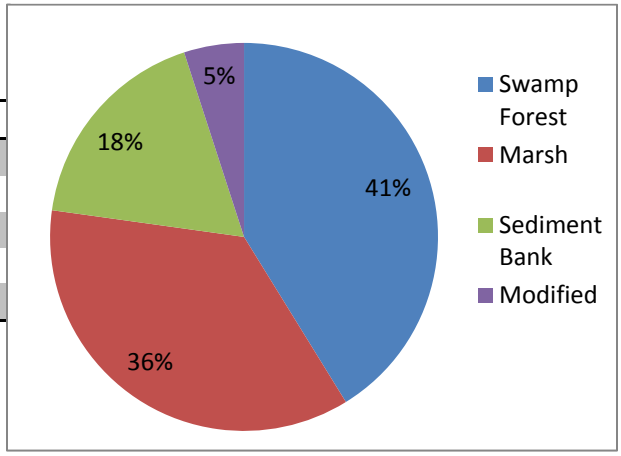
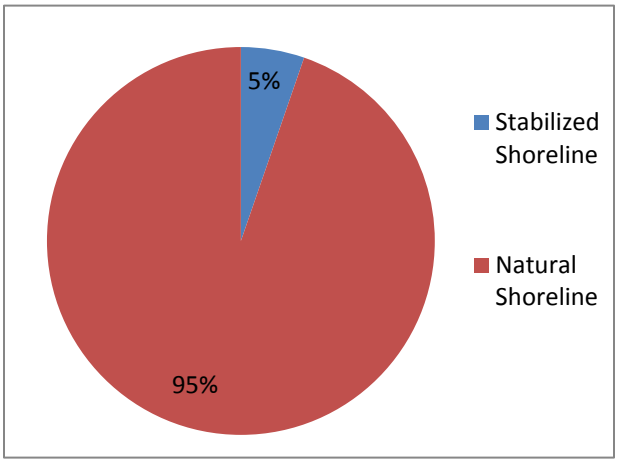


Table 38: Shoreline length for Camden County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	561,774	106.4	41.2
Marsh	490,805	93.0	36.0
Sediment Bank	242,748	46.0	17.8
Modified	67,877	12.9	5.0
Total	**1,363,204**	**258.3**	

Stabilization Structures

Figure 46: Percent of shoreline stabilized vs. natural shoreline.



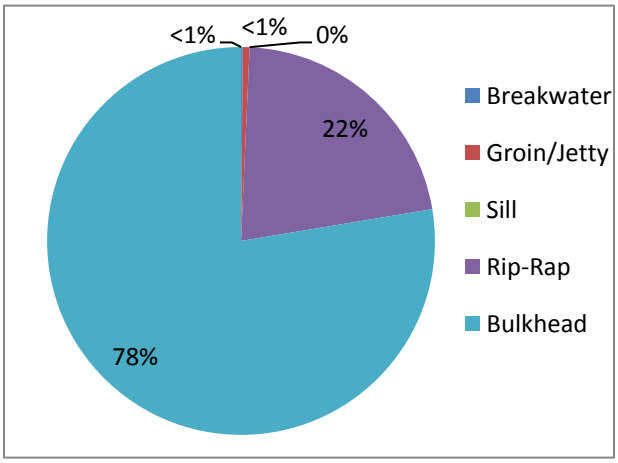


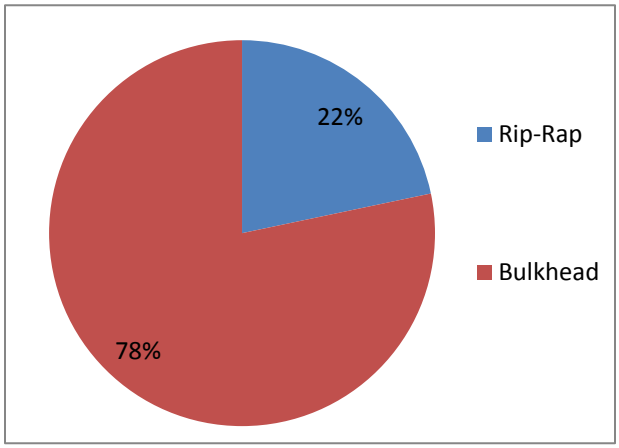
Figure 47: Percent stabilization structure by structure type.

Table 39: Shoreline stabilization statistics for Camden County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	463	13.6	6.1	45.3	34
Breakwater	97	48.5	31.1	66.0	2
Groin/Jetty	388	24.3	5.8	55.4	16
Sill	0	0	0	0	0
Rip-Rap	14,865	252.0	7.6	1,314.6	59
Bulkhead	53,251	388.7	1.5	2,764.3	137

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 48 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Camden County were categorized as bulkhead with 10.1 miles. Rip-rap revetments totaled 2.8 miles.

Figure 48: Shoreline stabilization structures that are coincident with the shoreline for Camden County



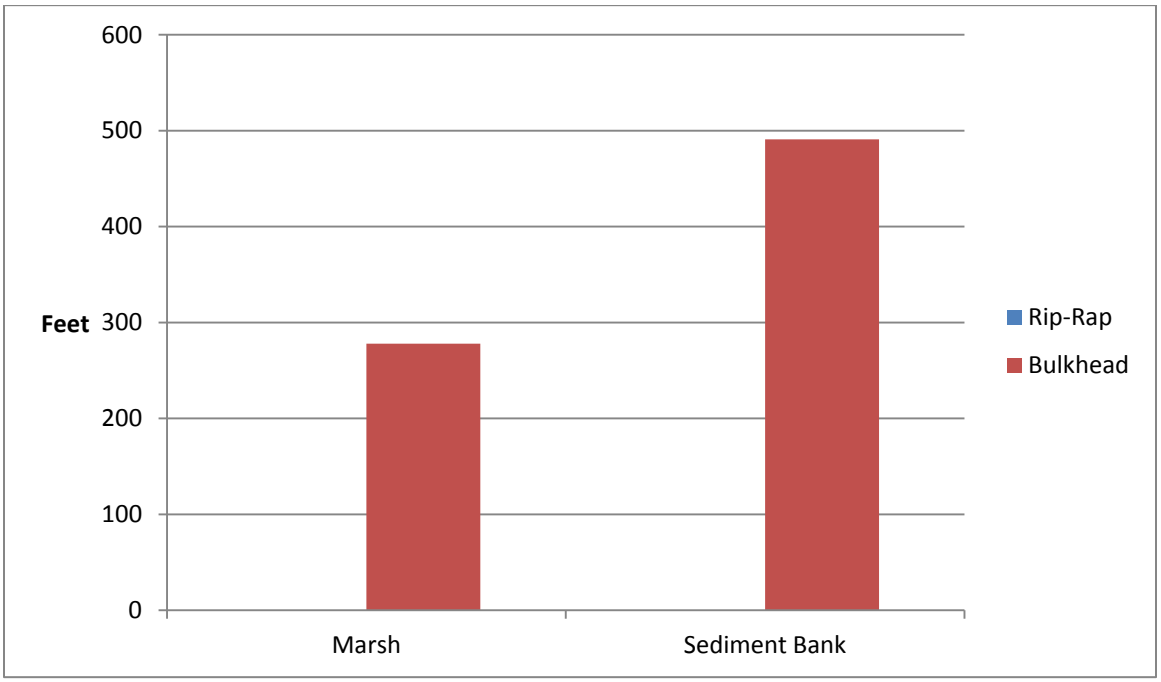
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 40 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Camden County, 278 feet of marsh and 491 feet of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 40: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	278	0
Average	278	0
Minimum	278	0
Maximum	278	0
Total Count	1	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	491	0
Average	123	0
Minimum	9	0
Maximum	289	0
Total Count	4	0

Figure 49: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 41 below.

Table 41: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	78.7
Average	78.7
Minimum	78.7
Maximum	78.7
Total Count	1

Shoreline Access Structures

There are 281 shoreline access structures (Table 42) mapped within Camden County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (92%). However, bridges represent 56% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 88,791 ft^2.

Table 42: Area of shoreline access structures within Camden County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	22	13,074	287,629	0.30	6.6
Pier/Floating Dock/Wharf	259	869	224,940	0.02	5.2
Total	**281**		**512,569**		**11.8**

Figure 50: Percent of total number of shoreline access structures.

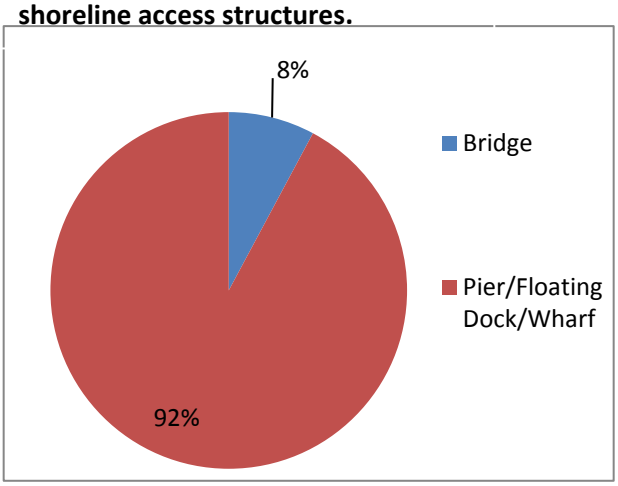
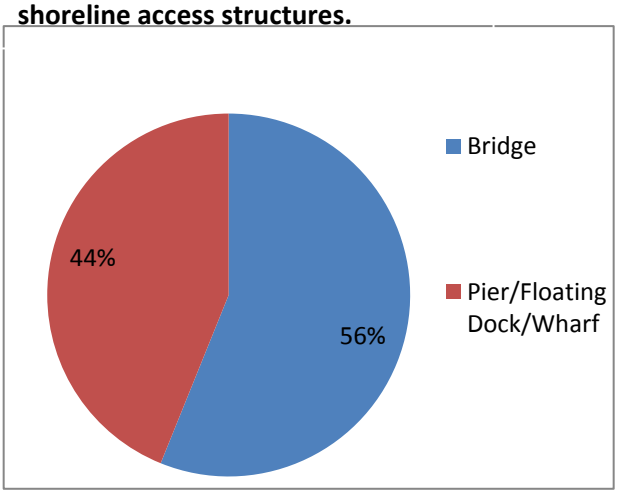


Figure 51: Percent total area of shoreline access structures.

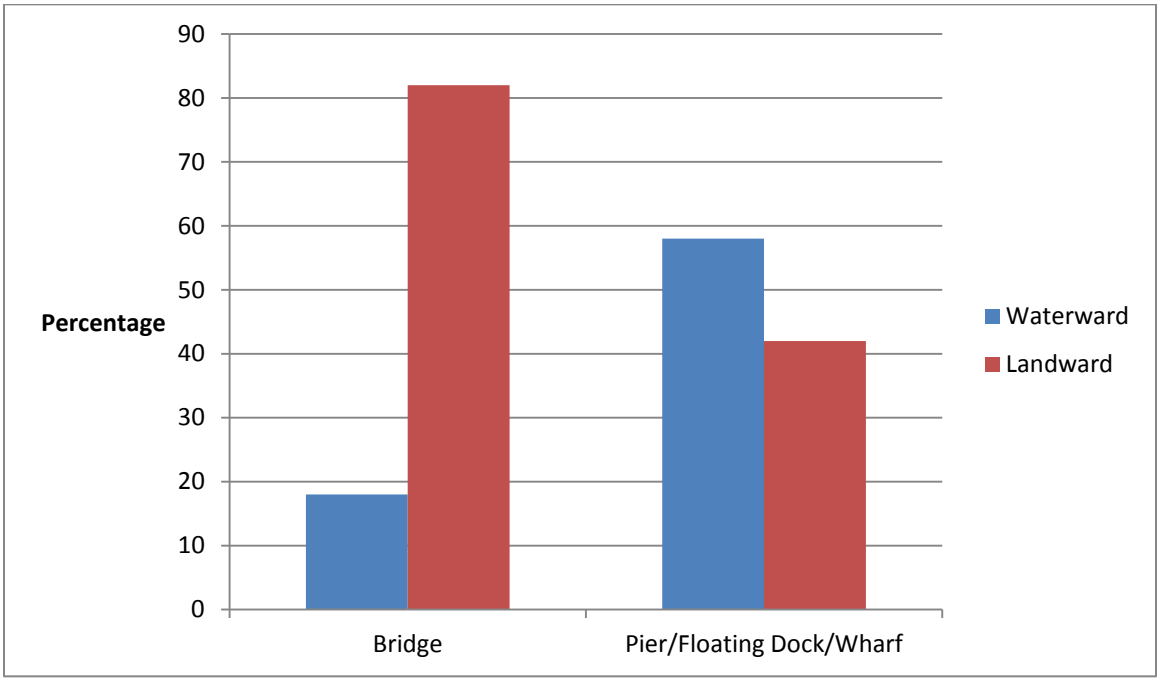


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Camden County, about 8 acres of Public Trust Waters are covered by shoreline access structures.

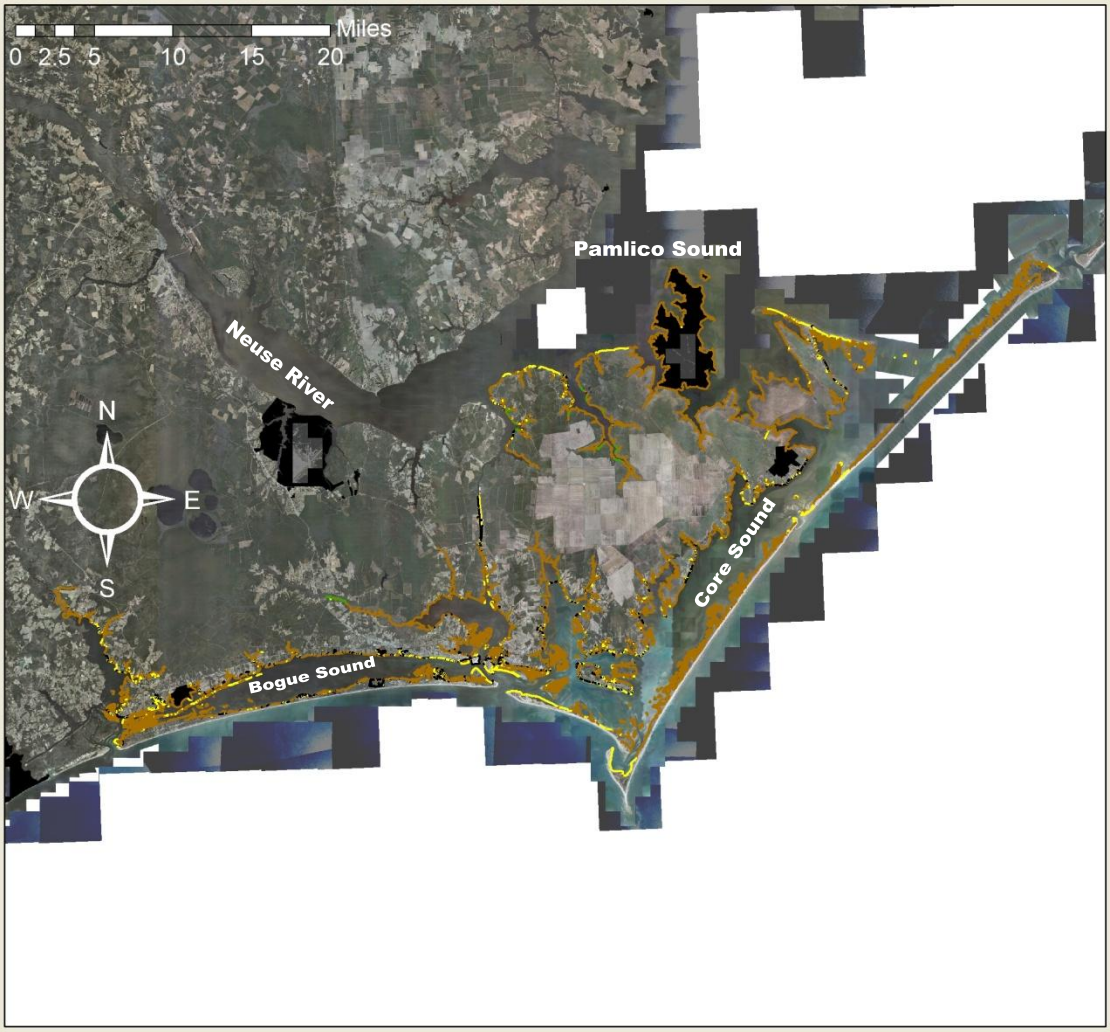
Table 43: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	52,699	1.2
Pier/Floating Dock/Wharf	129,807	3.0
Total	**182,506**	**4.2**

Figure 52: Percent of shoreline access structures located landward and waterward of the shoreline.



Carteret County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Carteret County Statistics

Estuarine Shoreline

A total of 1,652.1 miles of estuarine shoreline were mapped within Carteret County. The majority of the shoreline was characterized as marsh (87.2%). Modified shorelines made up 5.4% of the total shoreline, or 89.1 miles.

Figure 53: Percent shoreline length by shoreline type for Carteret County.

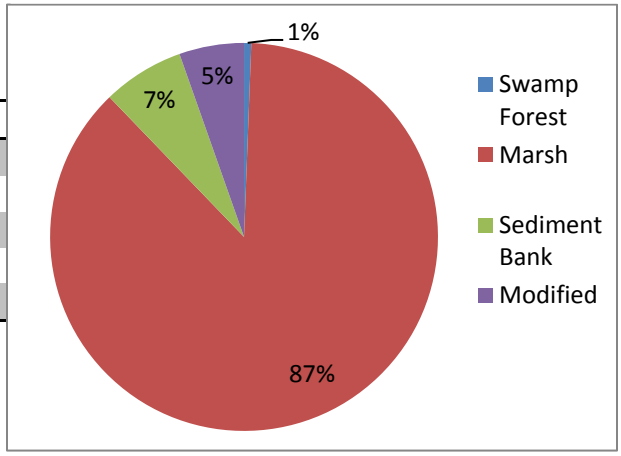
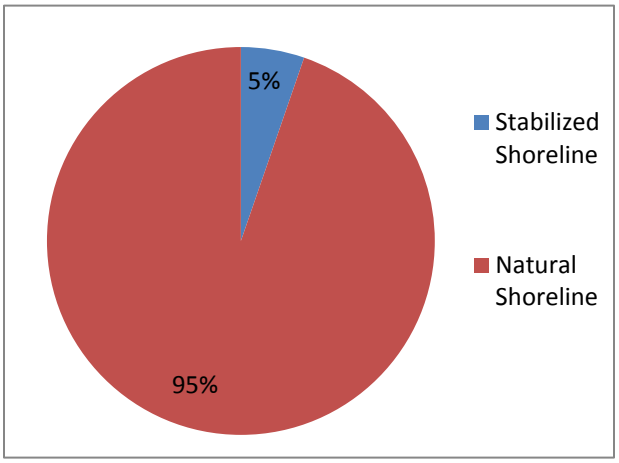


Table 44: Shoreline length for Carteret County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	50,324	9.5	0.6
Marsh	7,606,064	1,440.5	87.2
Sediment Bank	596,435	113.0	6.8
Modified	470,389	89.1	5.4
Total	**8,723,212**	**1,652.1**	

Stabilization Structures

Figure 54: Percent of shoreline stabilized vs. natural shoreline.



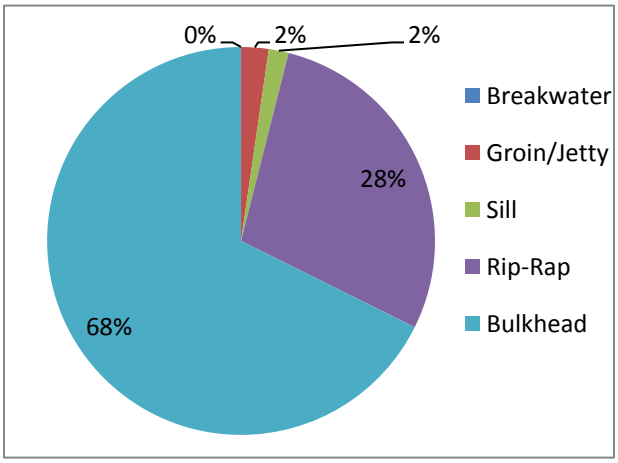


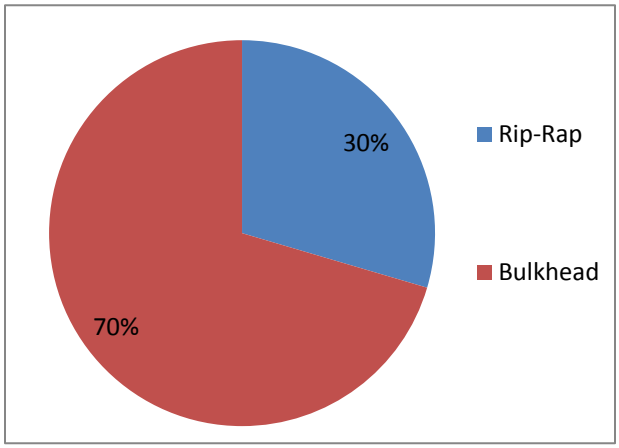
Figure 55: Percent stabilization structure by structure type.

Table 45: Shoreline stabilization statistics for Carteret County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	6,220	17.5	6.0	887.2	355
Breakwater	0	0	0	0	0
Groin/Jetty	12,584	111.4	11.3	1,573.3	113
Sill	9,060	238.4	20.3	1,337.6	38
Rip-Rap	155,788	281.7	7.1	4,048.6	553
Bulkhead	371,323	318.2	7.1	5,912.6	1,167

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 56 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Carteret County were categorized as bulkhead with 70.3 miles. Rip-rap revetments totaled 29.5 miles.

Figure 56: Shoreline stabilization structures that are coincident with the shoreline for Carteret County.



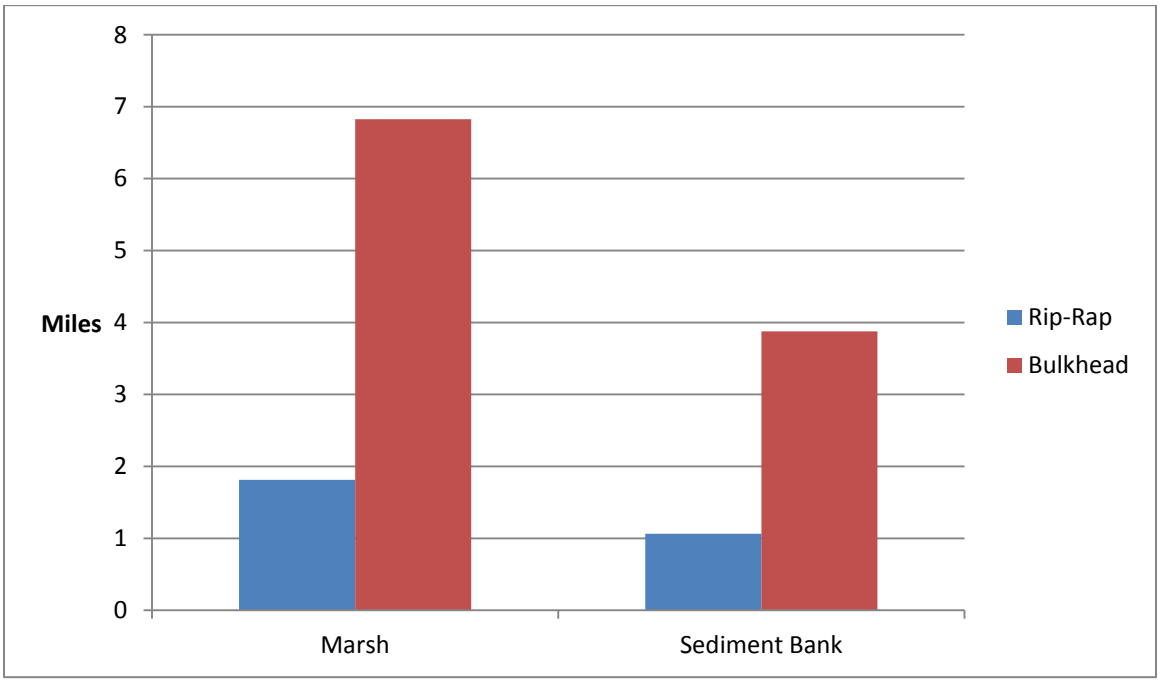
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 46 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Carteret County, 8.6 miles of marsh and 4.9 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 46: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	36,042	9,574
Average	210	181
Minimum	9	15
Maximum	1,721	1,166
Total Count	172	53

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	20,468	5,620
Average	184	144
Minimum	17	21
Maximum	1,066	330
Total Count	111	39

Figure 57: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 47 below.

Table 47: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	2,739
Average	152.2
Minimum	47.0
Maximum	318.4
Total Count	18

Shoreline Access Structures

There are 5,913 shoreline access structures (Table 48) mapped within Carteret County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (99%). These structures also represent 80% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 247,316 ft^2.

Table 48: Area of shoreline access structures within Carteret County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	79	14,755	1,165,618	0.33	26.8
Pier/Floating Dock/Wharf	5,834	798	4,655,649	0.02	106.8
Total	**5,913**		**5,821,267**		**133.6**

Figure 58: Percent of total number of shoreline access structures.

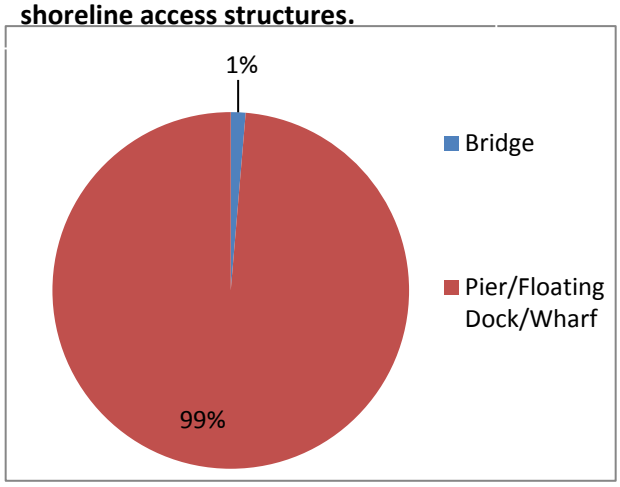
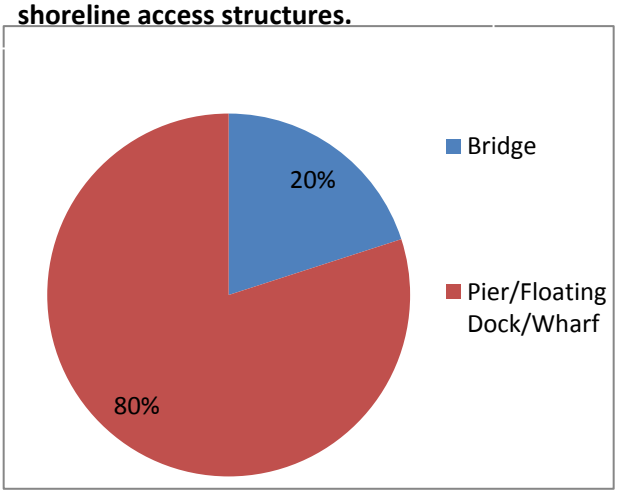


Figure 59: Percent total area of shoreline access structures.

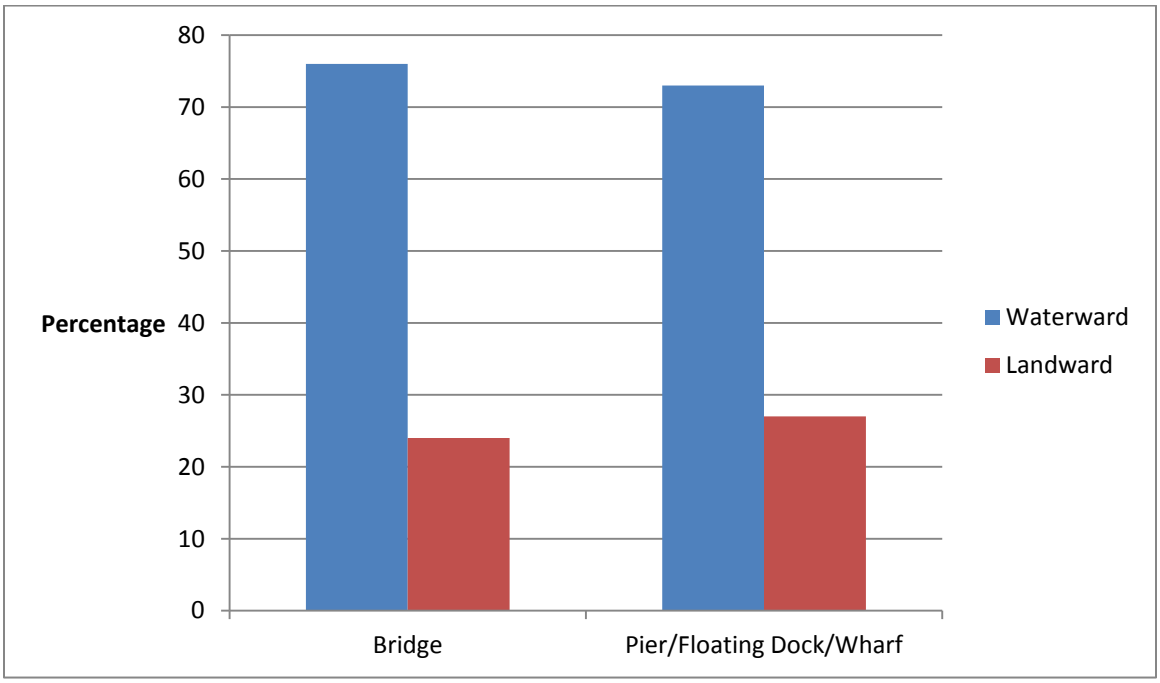


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Carteret County, about 98 acres of Public Trust Waters are covered by shoreline access structures.

Table 49: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	882,004	20.2
Pier/Floating Dock/Wharf	3,389,099	77.8
Total	**4,271,104**	**98.0**

Figure 60: Percent of shoreline access structures located landward and waterward of the shoreline.



Chowan County

Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Chowan County Statistics

Estuarine Shoreline

A total of 138.8 miles of estuarine shoreline were mapped within Chowan County. The majority of the shoreline was characterized as swamp forest (63.9%). Modified shorelines made up 12.4% of the total shoreline, or 17.1 miles.

Figure 61: Percent shoreline length by shoreline type for Chowan County.

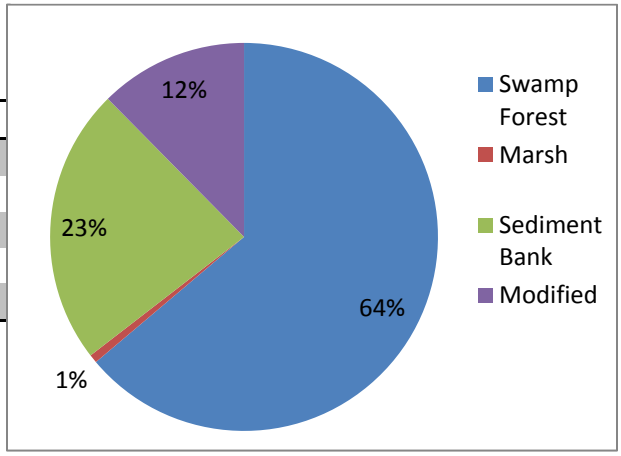
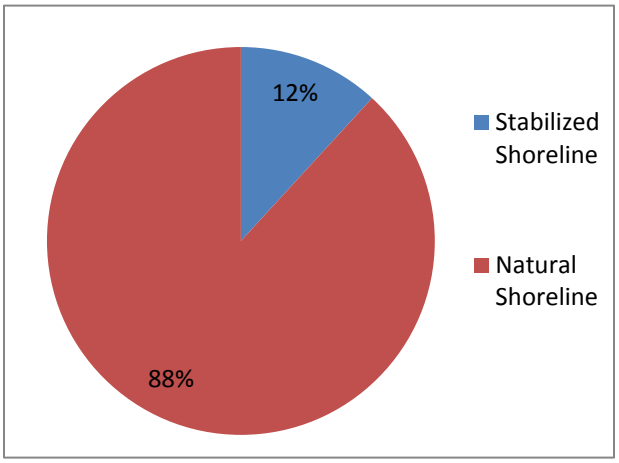


Table 50: Shoreline length for Chowan County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	468,043	88.6	63.9
Marsh	4,795	0.9	0.7
Sediment Bank	169,523	32.1	23.1
Modified	90,545	17.1	12.4
Total	**732,906**	**138.7**	

Stabilization Structures

Figure 62: Percent of shoreline stabilized vs. natural shoreline.



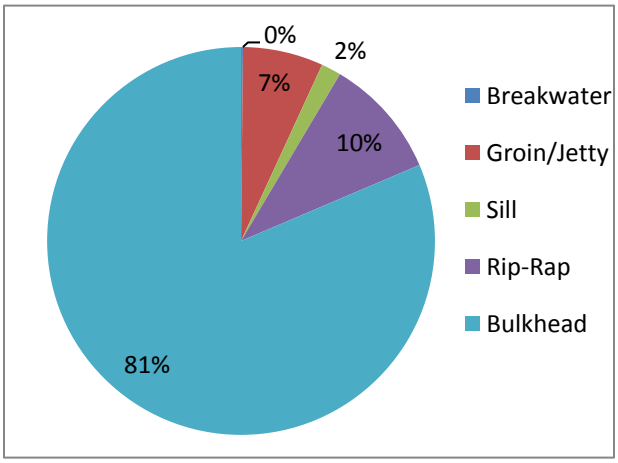


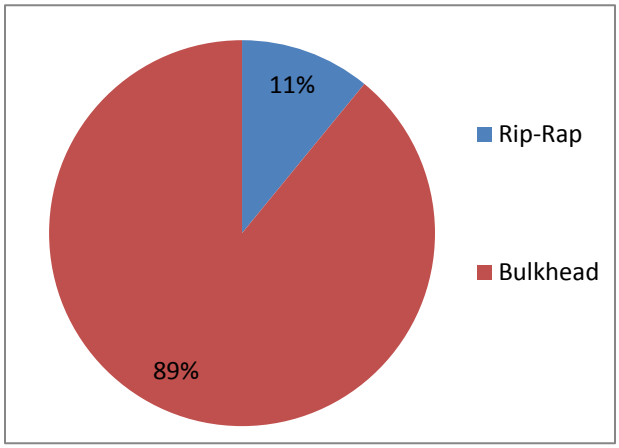
Figure 63: Percent stabilization structure by structure type.

Table 51: Shoreline stabilization statistics for Chowan County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	442	19.2	9.3	49.0	23
Breakwater	168	83.7	25.8	141.7	2
Groin/Jetty	7,109	44.7	8.4	387.9	159
Sill	1,760	293.4	40.4	1,368.0	6
Rip-Rap	10,674	154.7	1.0	1,182.7	69
Bulkhead	86,295	504.7	6.5	4,660.9	171

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 64 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Chowan County were categorized as bulkhead with 16.3 miles. Rip-rap revetments totaled 2.0 miles.

Figure 64: Shoreline stabilization structures that are coincident with the shoreline for Chowan County.



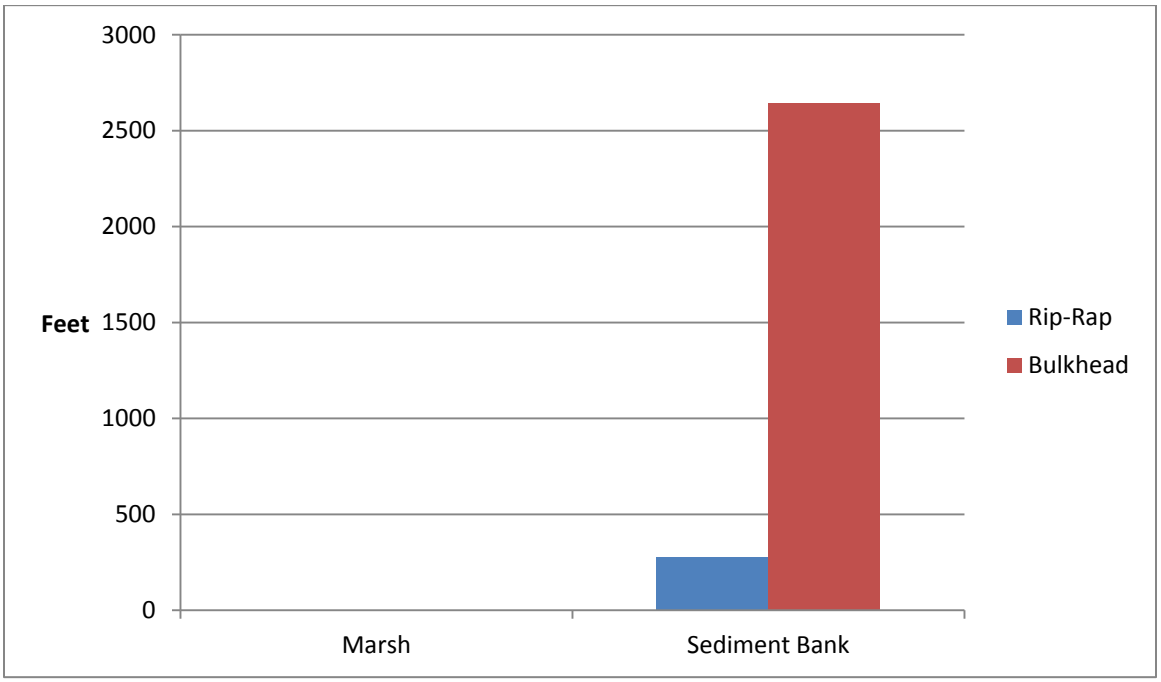
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 52 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Chowan County, 0 miles of marsh and 0.55 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 52: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	0	0
Average	0	0
Minimum	0	0
Maximum	0	0
Total Count	0	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	2,644	275
Average	106	138
Minimum	16	49
Maximum	461	227
Total Count	25	2

Figure 65: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 53 below.

Table 53: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	1,343
Average	96.0
Minimum	30.0
Maximum	254.6
Total Count	14

Shoreline Access Structures

There are 580 shoreline access structures (Table 54) mapped within Chowan County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (97%). However, bridges represent 64% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 409,105 ft^2.

Table 54: Area of shoreline access structures within Chowan County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	17	48,878	830,922	1.12	19.1
Pier/Floating Dock/Wharf	563	816	459,209	.02	10.5
Total	**580**		**1,290,131**		**29.6**

Figure 66: Percent of total number of shoreline access structures.

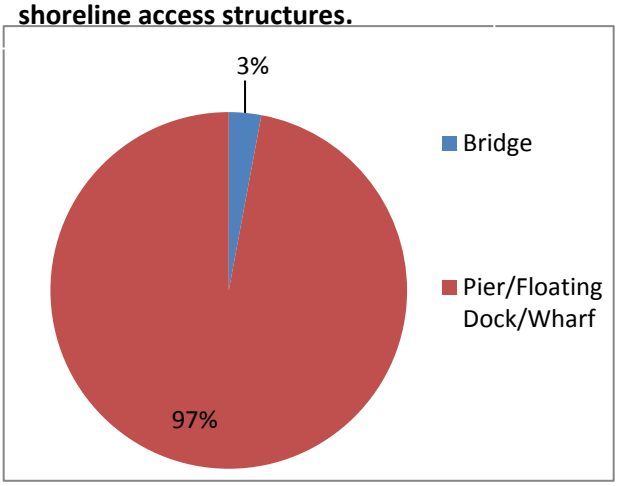
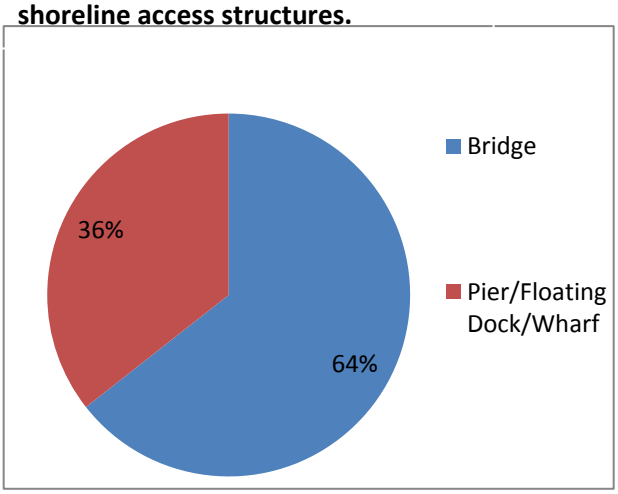


Figure 67: Percent total area of shoreline access structures.

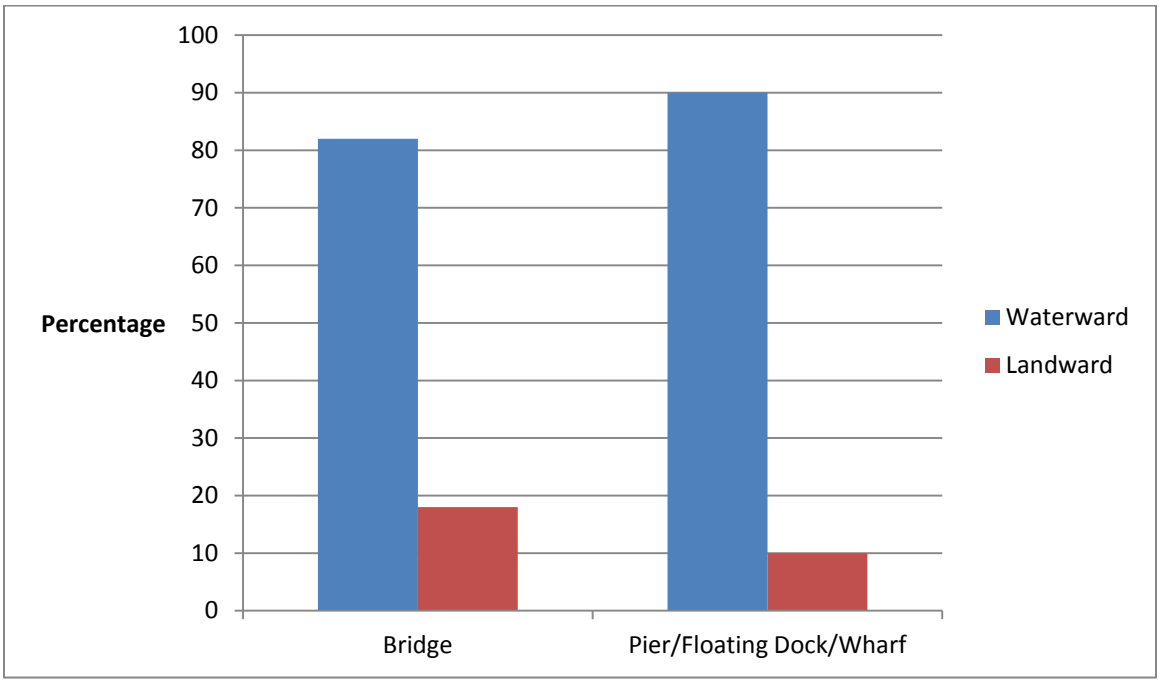


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Chowan County, about 25 acres of Public Trust Waters are covered by shoreline access structures.

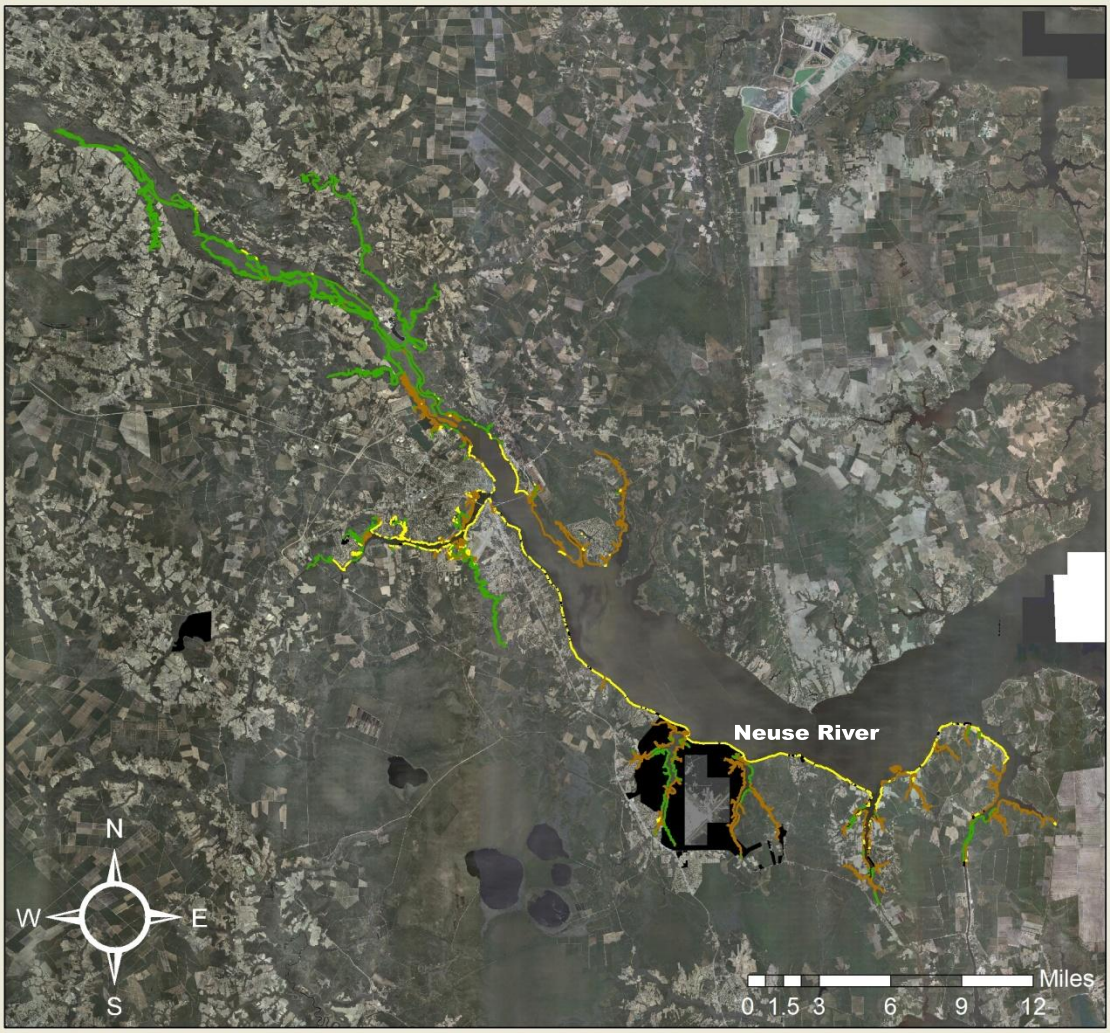
Table 55: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	685,207	15.7
Pier/Floating Dock/Wharf	472,612	10.8
Total	**1,157,819**	**26.5**

Figure 68: Percent of shoreline access structures located landward and waterward of the shoreline.



Craven County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Craven County Statistics

Estuarine Shoreline

A total of 546.9 miles of estuarine shoreline were mapped within Craven County. The majority of the shoreline was characterized as swamp forest (49.3%). Modified shorelines made up 5.1% of the total shoreline, or 27.7 miles.

Figure 69: Percent shoreline length by shoreline type for Craven County.

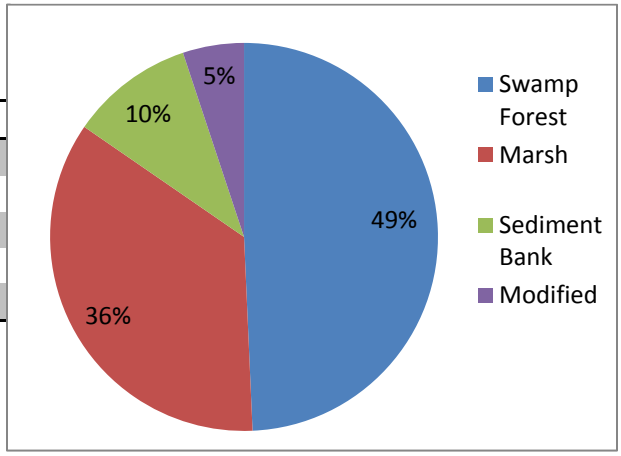
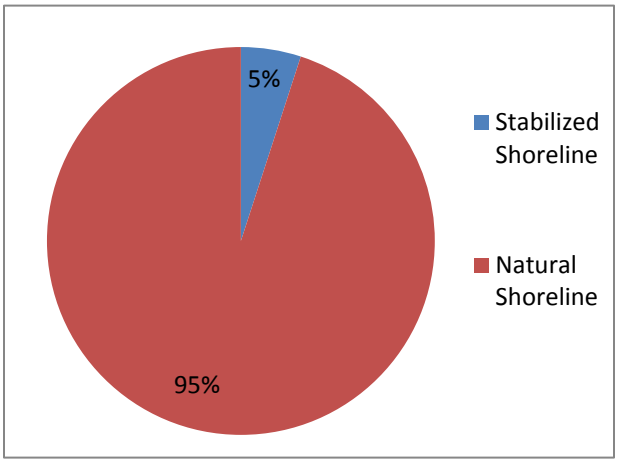


Table 56: Shoreline length for Craven County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	1,424,128	269.7	49.3
Marsh	1,019,769	193.1	35.3
Sediment Bank	297,695	56.4	10.3
Modified	146,138	27.7	5.1
Total	**2,877,730**	**546.9**	

Stabilization Structures

Figure 70: Percent of shoreline stabilized vs. natural shoreline.



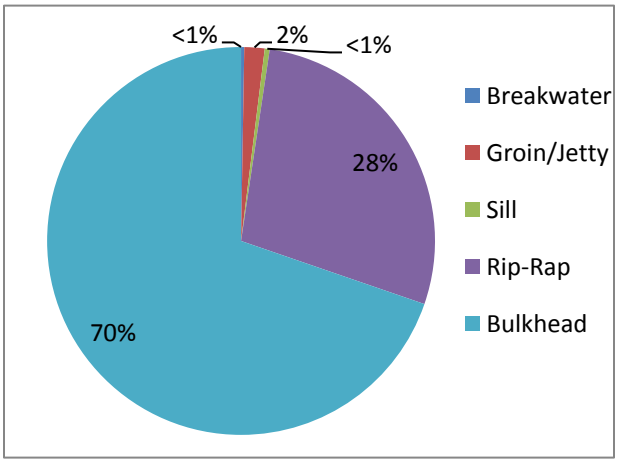


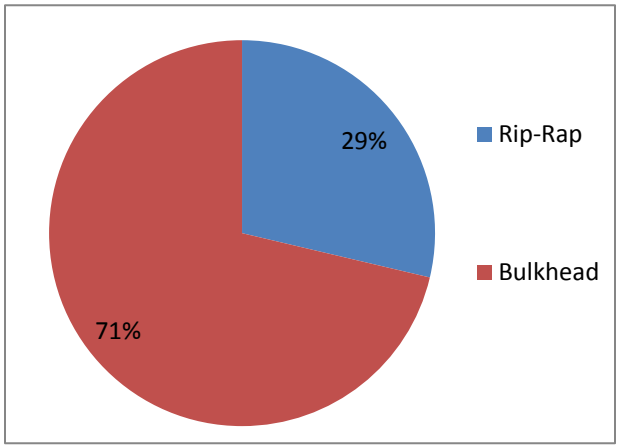
Figure 71: Percent stabilization structure by structure type.

Table 57: Shoreline stabilization statistics for Craven County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	717	13.8	6.9	35.0	52
Breakwater	527	75.2	28.4	191.9	7
Groin/Jetty	3,346	44.6	14.6	391.1	75
Sill	819	68.2	15.6	218.0	12
Rip-Rap	55,211	221.7	1.1	1,861.8	249
Bulkhead	137,958	317.9	2.1	5,341.8	434

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 72 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Craven County were categorized as bulkhead with 26.1 miles. Rip-rap revetments totaled 10.5 miles.

Figure 72: Shoreline stabilization structures that are coincident with the shoreline for Craven County.



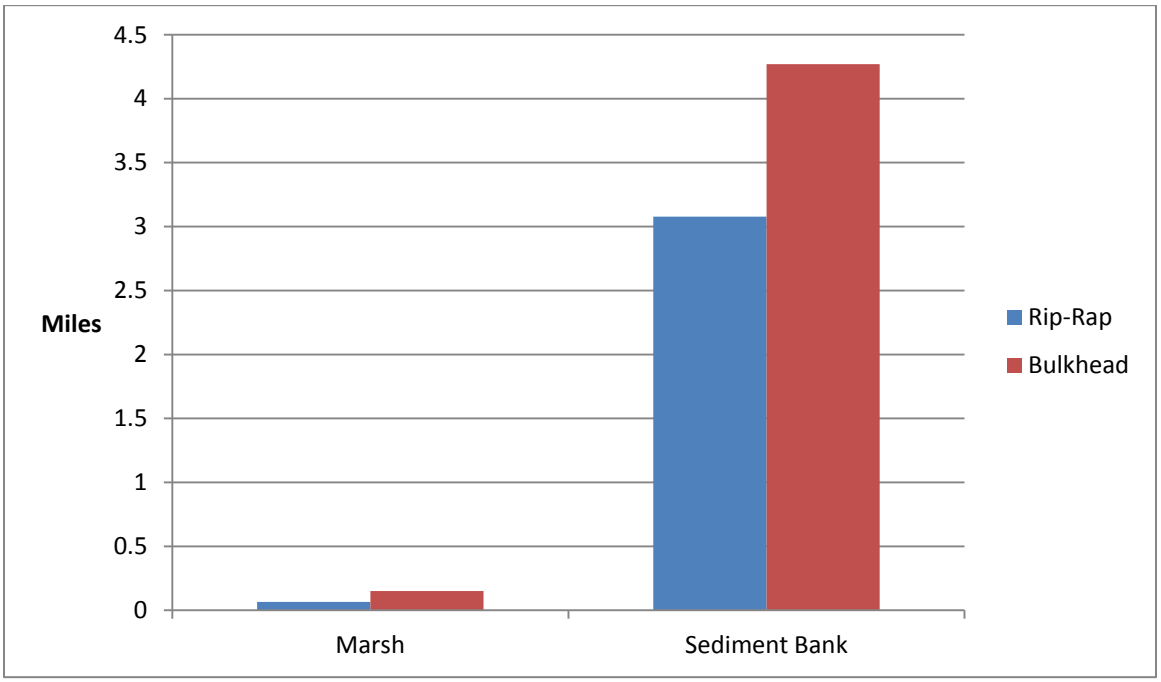
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 58 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Craven County, 0.2 miles of marsh and 7.3 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 58: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	794	346
Average	113	115
Minimum	57	41
Maximum	234	190
Total Count	7	3

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	22,544	16,250
Average	172	258
Minimum	14	23
Maximum	1,264	1,369
Total Count	131	63

Figure 73: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 59 below.

Table 59: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	5,770
Average	160.2
Minimum	39.8
Maximum	720.7
Total Count	36

Shoreline Access Structures

There are 1,524 shoreline access structures (Table 60) mapped within Craven County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (98%). However, bridges represent 61% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 511,101 ft^2.

Table 60: Area of shoreline access structures within Craven County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	27	65,147	1,758,981	1.5	40.4
Pier/Floating Dock/Wharf	1,497	747	1,118,848	0.02	25.7
Total	**1,524**		**2,877,829**		**66.1**

Figure 74: Percent of total number of shoreline access structures.

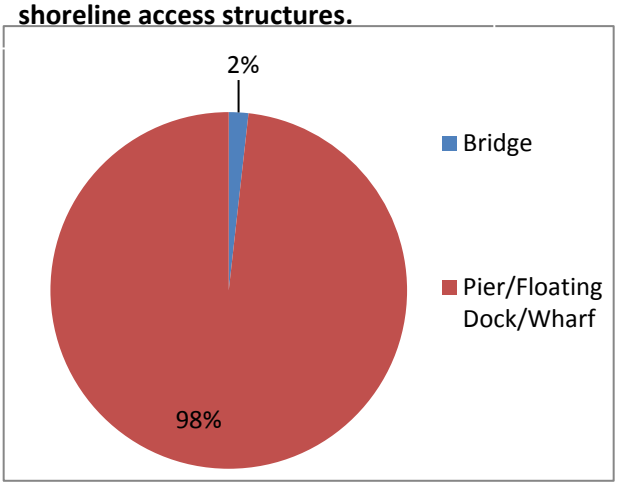
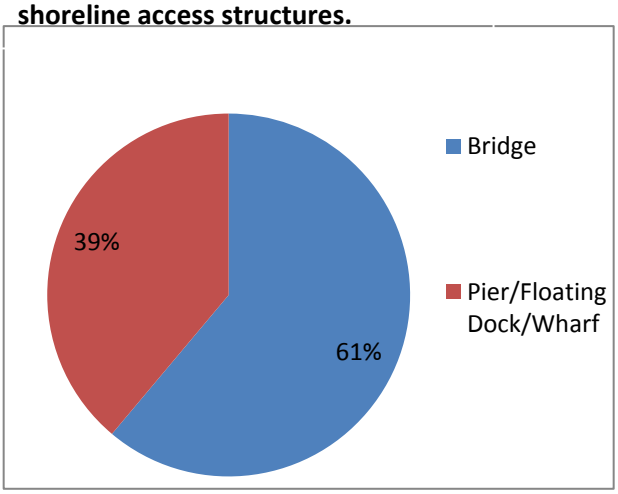


Figure 75: Percent total area of shoreline access structures.

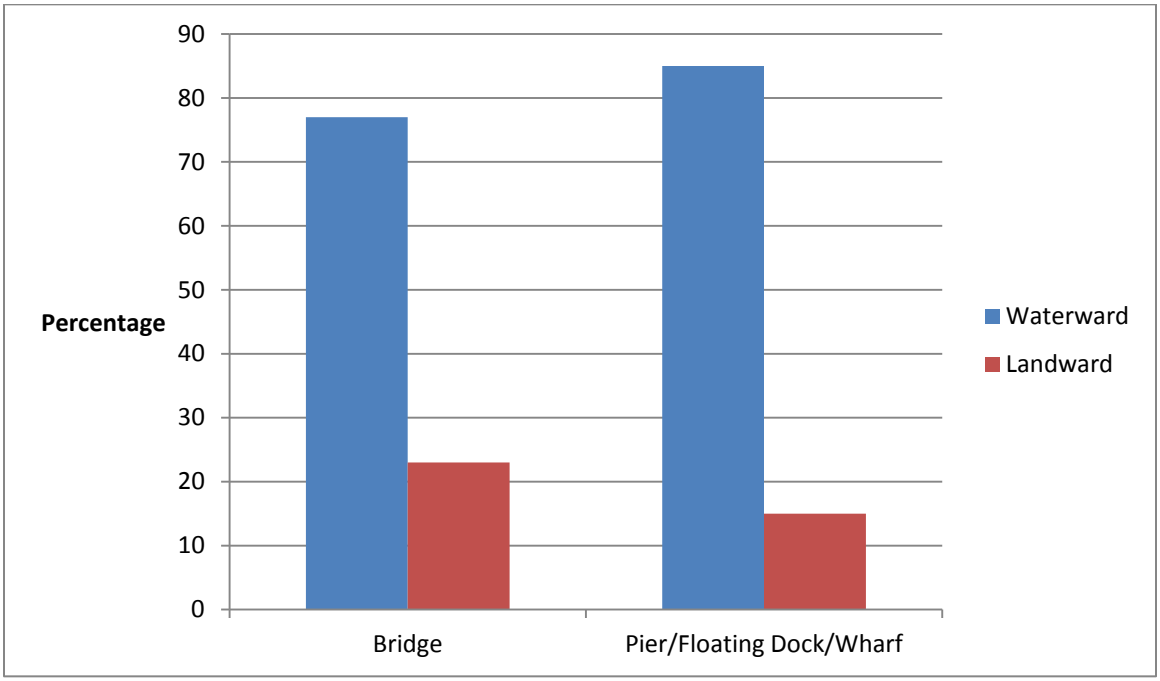


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Craven County, about 53 acres of Public Trust Waters are covered by shoreline access structures.

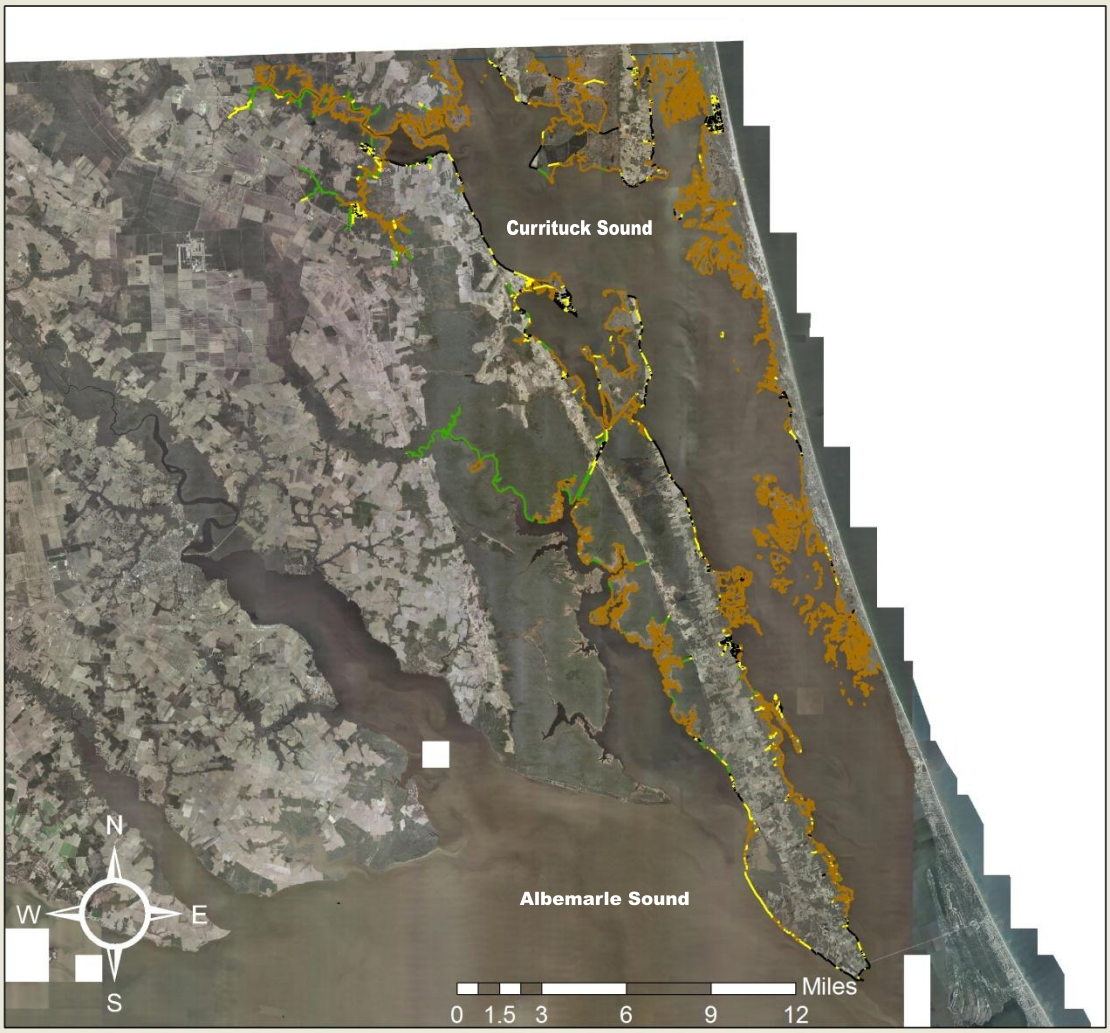
Table 61: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	1,357,404	31.2
Pier/Floating Dock/Wharf	951,745	21.8
Total	**2,309,149**	**53.0**

Figure 76: Percent of shoreline access structures located landward and waterward of the shoreline.



Currituck County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Currituck County Statistics

Estuarine Shoreline

A total of 1,100.4 miles of estuarine shoreline were mapped within Currituck County. The majority of the shoreline was characterized as marsh (81.3%). Modified shorelines made up 5.6% of the total shoreline, or 61.8 miles.

Figure 77: Percent shoreline length by shoreline type for Currituck County.

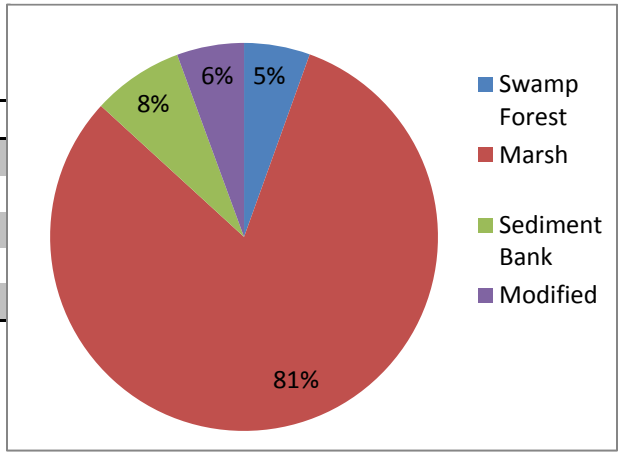
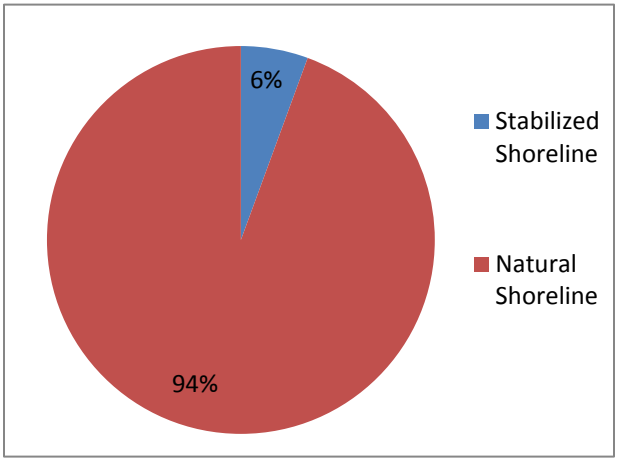


Table 62: Shoreline length for Currituck County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	318,455	60.3	5.5
Marsh	4,726,141	895.1	81.3
Sediment Bank	439,133	83.2	7.6
Modified	326,295	61.8	5.6
Total	**5,810,024**	**1,100.4**	

Stabilization Structures

Figure 78: Percent of shoreline stabilized vs. natural shoreline.



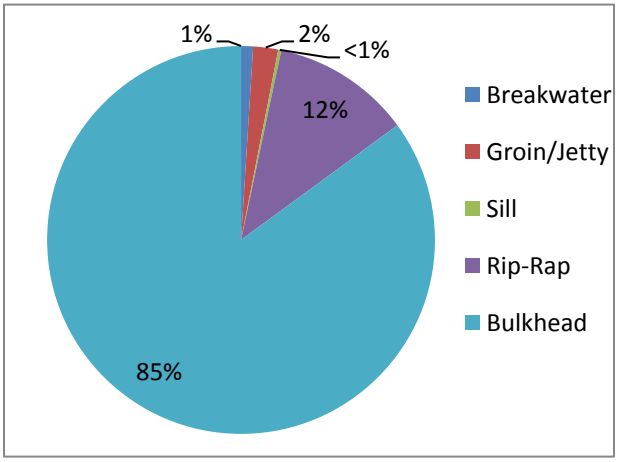


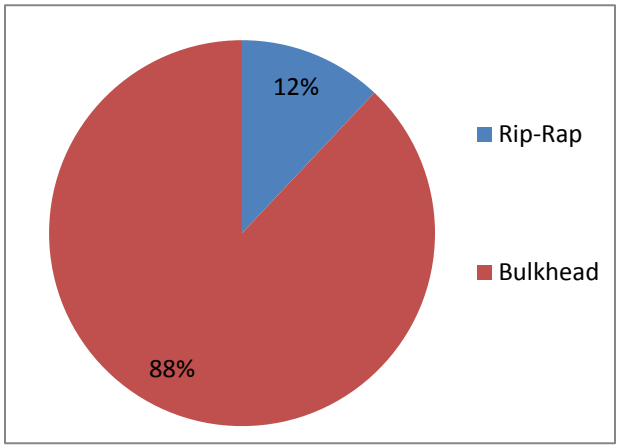
Figure 79: Percent stabilization structure by structure type.

Table 63: Shoreline stabilization statistics for Currituck County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	3,276	13.0	4.2	49.2	252
Breakwater	3,442	107.6	14.5	293.4	32
Groin/Jetty	7,183	36.3	1.4	294.8	198
Sill	873	87.4	28.0	187.6	10
Rip-Rap	40,030	279.9	4.3	1,918.1	143
Bulkhead	293,623	402.8	3.0	4,664.0	729

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 80 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Currituck County were categorized as bulkhead with 55.6 miles. Rip-rap revetments totaled 7.6 miles.

Figure 80: Shoreline stabilization structures that are coincident with the shoreline for Currituck County.



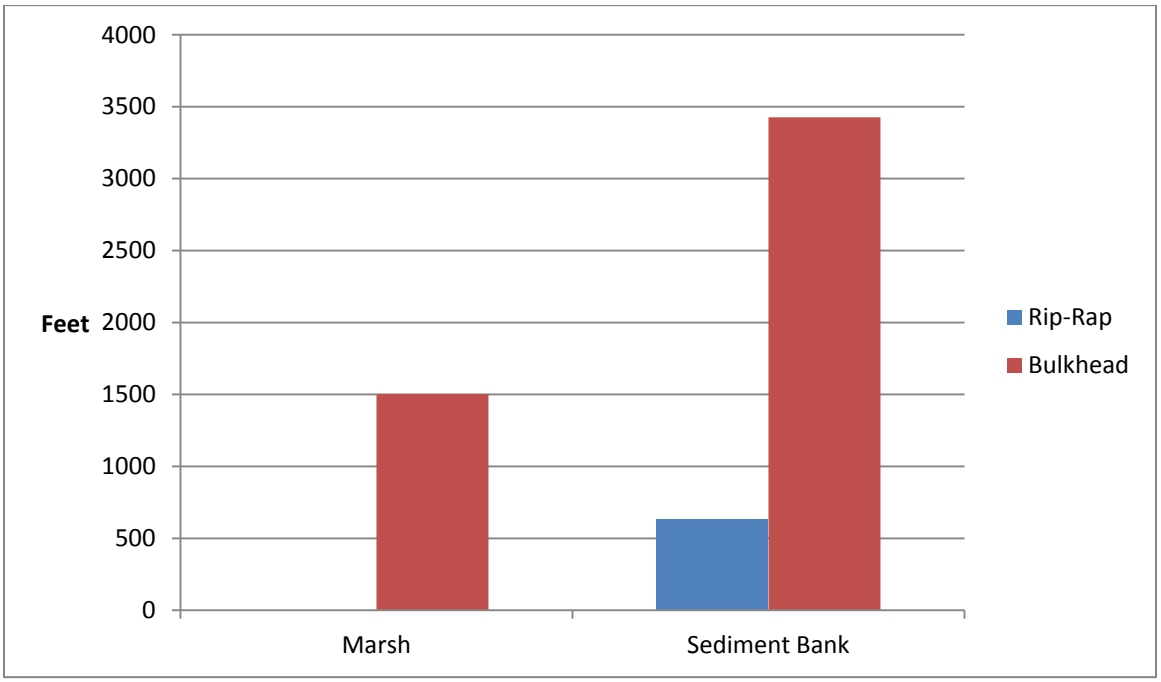
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 64 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Currituck County, 0.28 miles of marsh and 0.77 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 64: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	1,503	0
Average	150	0
Minimum	35	0
Maximum	378	0
Total Count	10	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	3,426	634
Average	143	158
Minimum	13	20
Maximum	575	311
Total Count	24	4

Figure 81: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 65 below.

Table 65: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	736
Average	122.6
Minimum	59.1
Maximum	162.9
Total Count	6

Shoreline Access Structures

There are 1,502 shoreline access structures (Table 66) mapped within Currituck County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (98%). These structures also represent 68% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 146,565 ft^2.

Table 66: Area of shoreline access structures within Currituck County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	31	10,887	337,502	0.25	7.7
Pier/Floating Dock/Wharf	1,471	496	729,326	0.02	16.7
Total	**1,502**		**1,066,828**		**24.4**

Figure 82: Percent of total number of shoreline access structures.

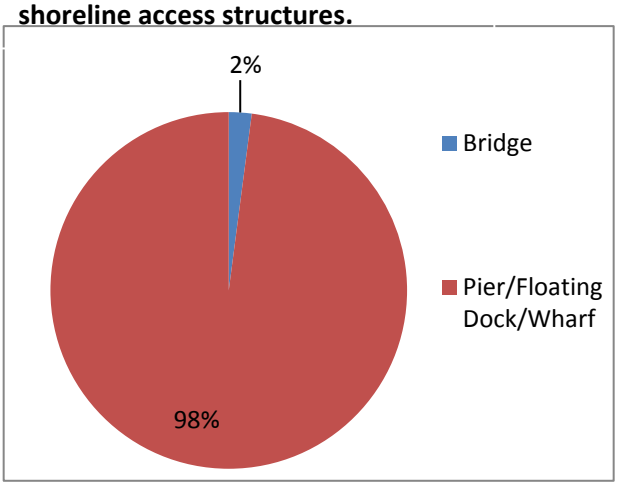
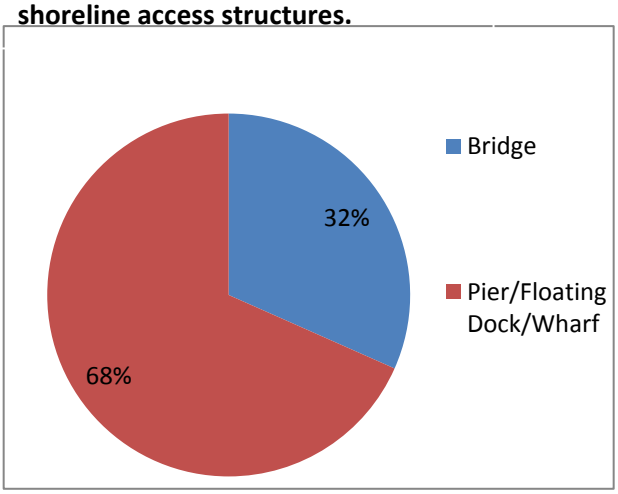


Figure 83: Percent total area of shoreline access structures.

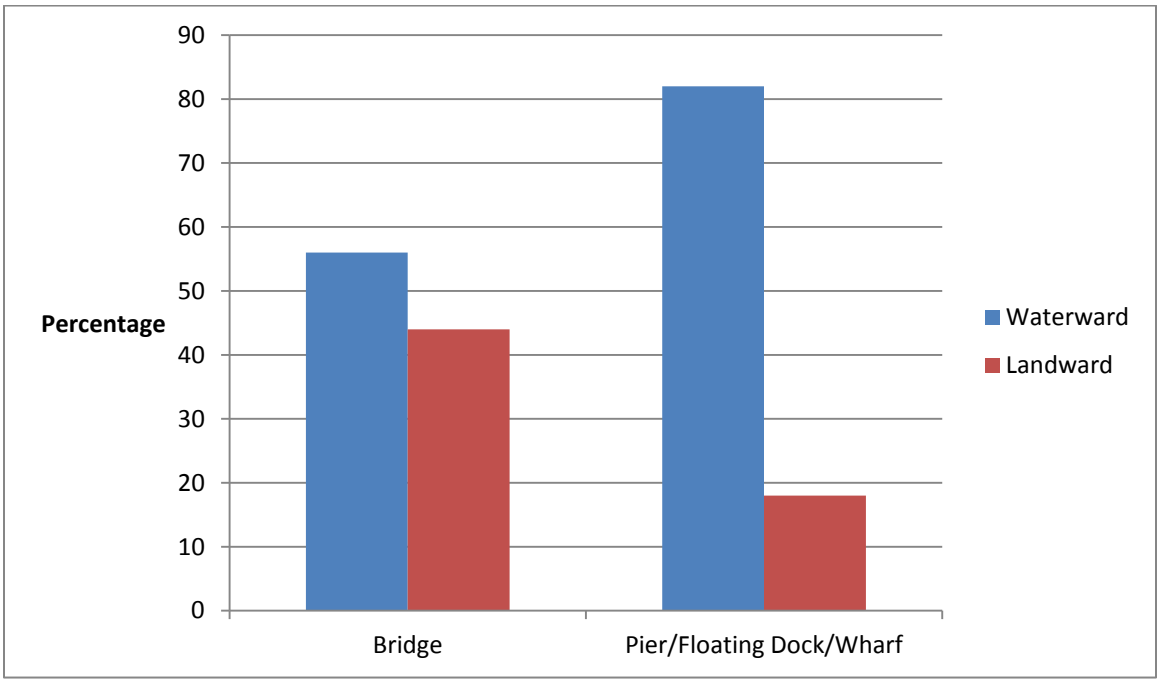


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Currituck County, about 18 acres of Public Trust Waters are covered by shoreline access structures.

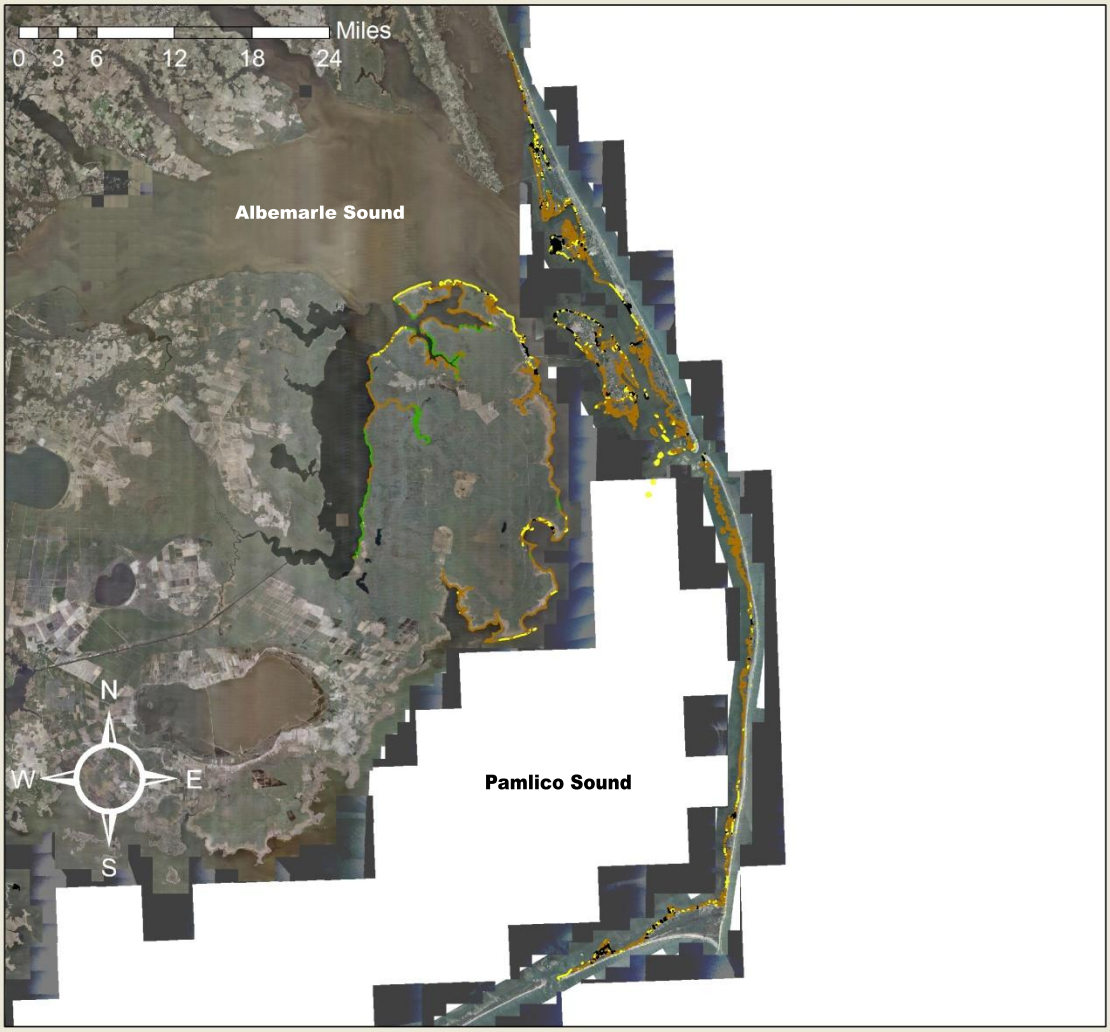
Table 67: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	190,175	4.4
Pier/Floating Dock/Wharf	594,886	13.7
Total	**785,061**	**18.1**

Figure 84: Percent of shoreline access structures located landward and waterward of the shoreline.



Dare County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Dare County Statistics

Estuarine Shoreline

A total of 946.2 miles of estuarine shoreline were mapped within Dare County. The majority of the shoreline was characterized as marsh (72.5%). Modified shorelines made up 9.0% of the total shoreline, or 84.9 miles.

Figure 85: Percent shoreline length by shoreline type for Dare County.

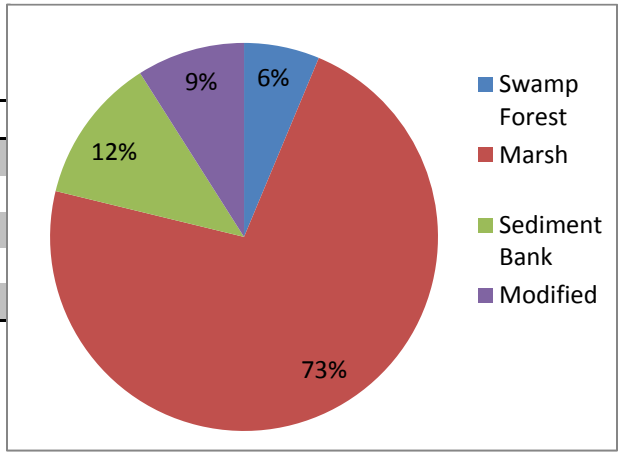
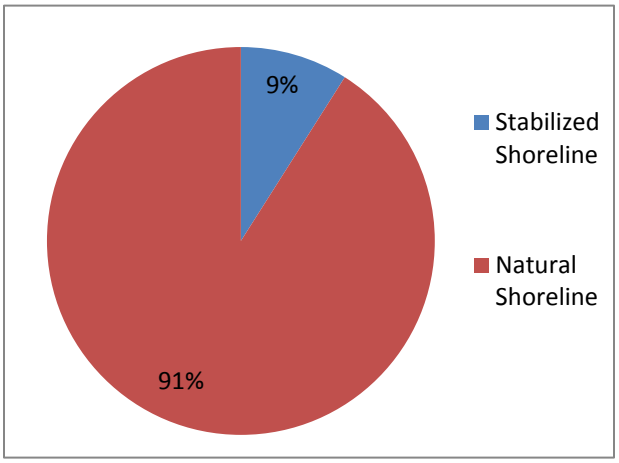


Table 68: Shoreline length for Dare County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	316,116	59.8	6.3
Marsh	3,619,766	685.6	72.5
Sediment Bank	611,733	115.9	12.2
Modified	448,392	84.9	9.0
Total	**4,996,008**	**946.2**	

Stabilization Structures

Figure 86: Percent of shoreline stabilized vs. natural shoreline.



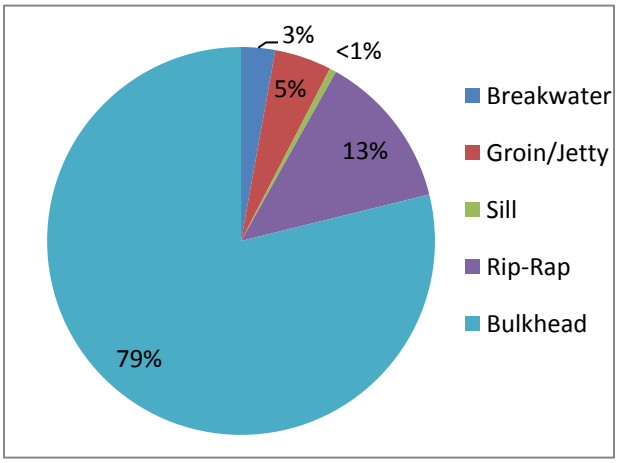


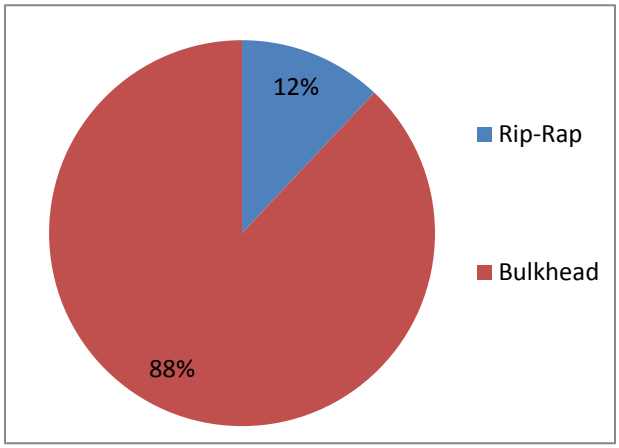
Figure 87: Percent stabilization structure by structure type.

Table 69: Shoreline stabilization statistics for Dare County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	2,313	15.1	5.0	99.3	153
Breakwater	15,498	111.5	11.0	690.1	139
Groin/Jetty	25,998	47.3	9.7	1,380.0	550
Sill	3,004	167.0	44.1	945.1	18
Rip-Rap	71,126	280.0	11.3	2,456.0	254
Bulkhead	431,308	486.8	6.4	20,143.1	886

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 88 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Dare County were categorized as bulkhead with 81.7 miles. Rip-rap revetments totaled 13.5 miles.

Figure 88: Shoreline stabilization structures that are coincident with the shoreline for Dare County.



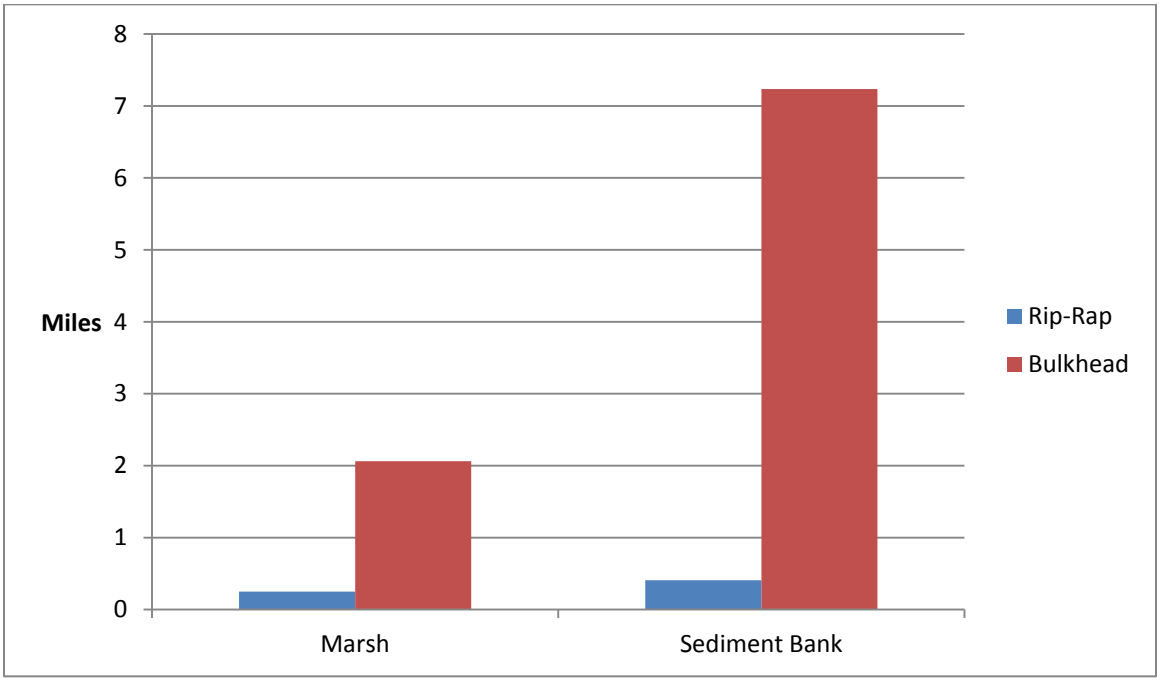
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 70 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Dare County, 7.5 miles of marsh and 2.5 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 70: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	38,200	1,325
Average	210	102
Minimum	8	3
Maximum	1,317	329
Total Count	182	13

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	10,894	2,159
Average	89	86
Minimum	5	2
Maximum	411	385
Total Count	123	25

Figure 89: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 71 below.

Table 71: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	7,342
Average	136.0
Minimum	4.0
Maximum	410.2
Total Count	54

Shoreline Access Structures

There are 3,060 shoreline access structures (Table 72) mapped within Dare County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (98%). However, bridges represent 65% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 1,861,960 ft^2.

Table 72: Area of shoreline access structures within Dare County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	52	71,831	3,735,236	1.65	85.7
Pier/Floating Dock/Wharf	3,008	679	2,041,705	0.02	46.9
Total	**3,060**		**5,776,941**		**132.6**

Figure 90: Percent of total number of shoreline access structures.

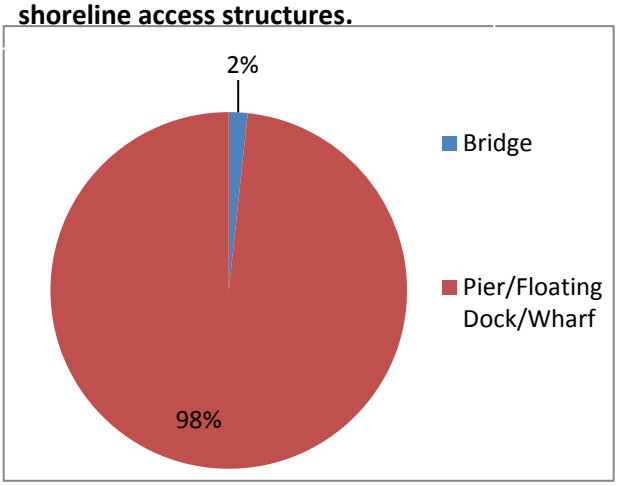
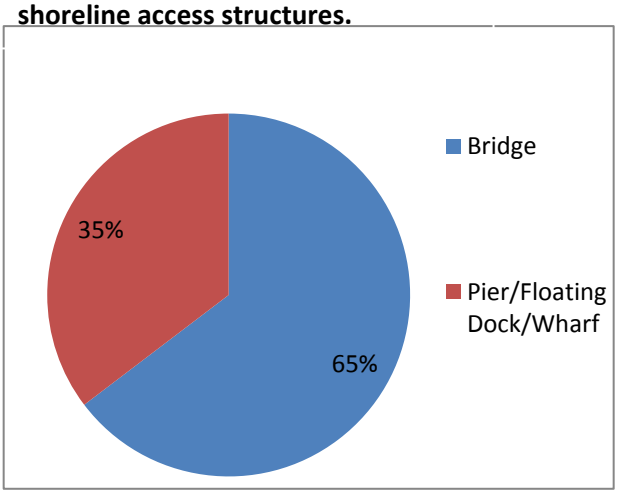


Figure 91: Percent total area of shoreline access structures.

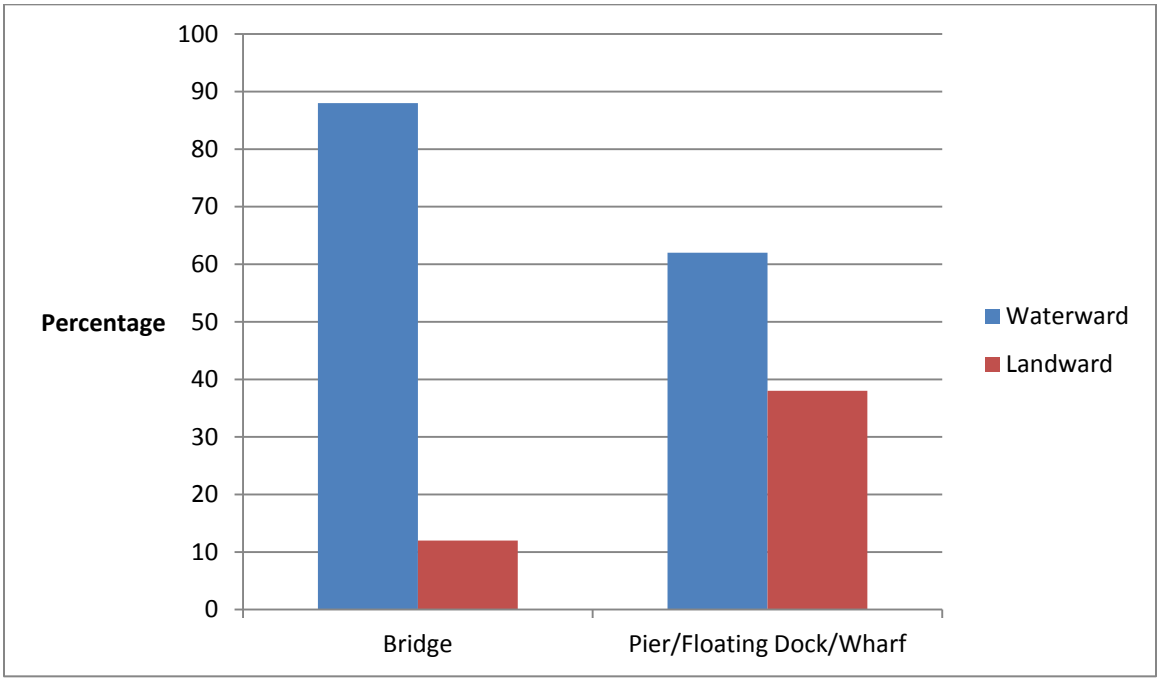


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Dare County, about 105 acres of Public Trust Waters are covered by shoreline access structures.

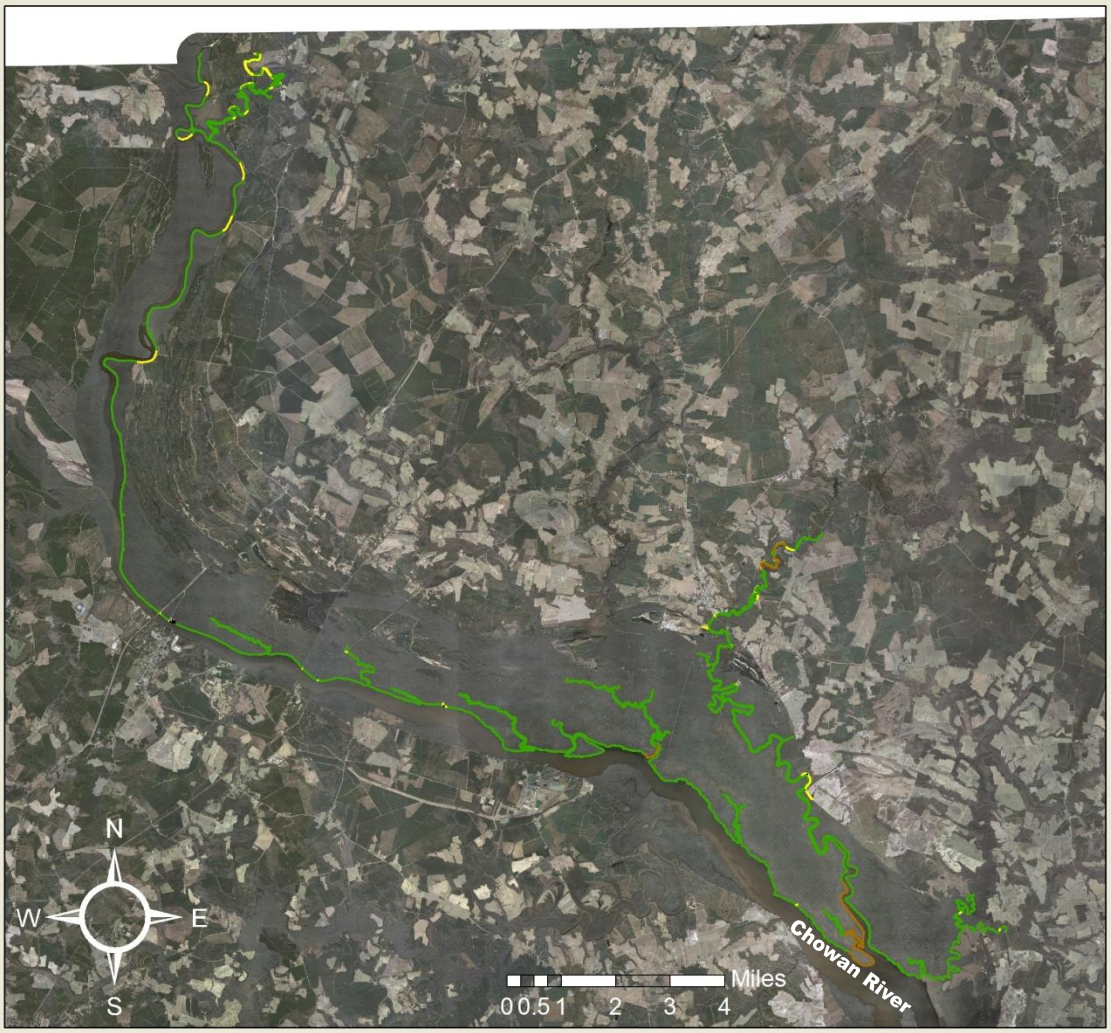
Table 73: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	3,292,557	75.6
Pier/Floating Dock/Wharf	1,266,726	29.1
Total	**4,558,283**	**104.7**

Figure 92: Percent of shoreline access structures located landward and waterward of the shoreline.



Gates County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Gates County Statistics

Estuarine Shoreline

A total of 145.5 miles of estuarine shoreline were mapped within Gates County. The majority of the shoreline was characterized as swamp forest (90.0%). Modified shorelines made up 0.14% of the total shoreline, or 0.2 miles.

Figure 93: Percent shoreline length by shoreline type for Gates County.

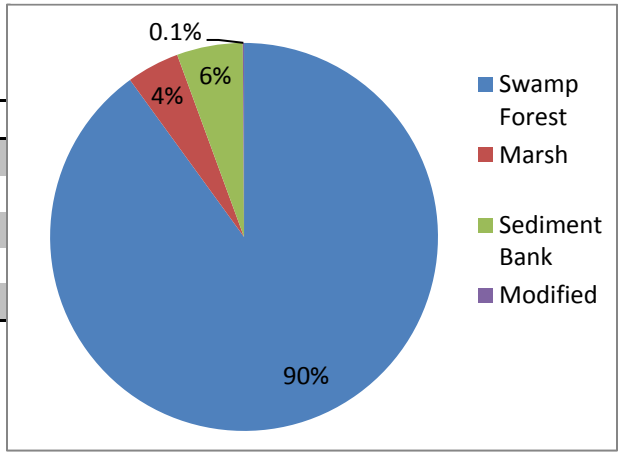
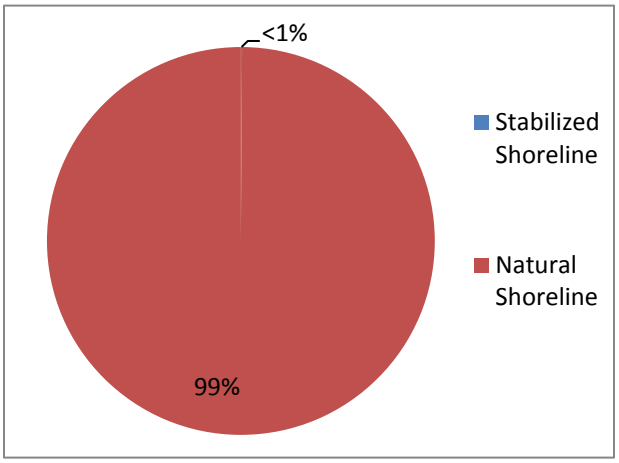


Table 74: Shoreline length for Gates County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	691,278	130.9	90.0
Marsh	34,070	6.5	4.4
Sediment Bank	41,895	7.9	5.5
Modified	1,068	0.2	0.1
Total	**768,311**	**145.5**	

Stabilization Structures

Figure 94: Percent of shoreline stabilized vs. natural shoreline.



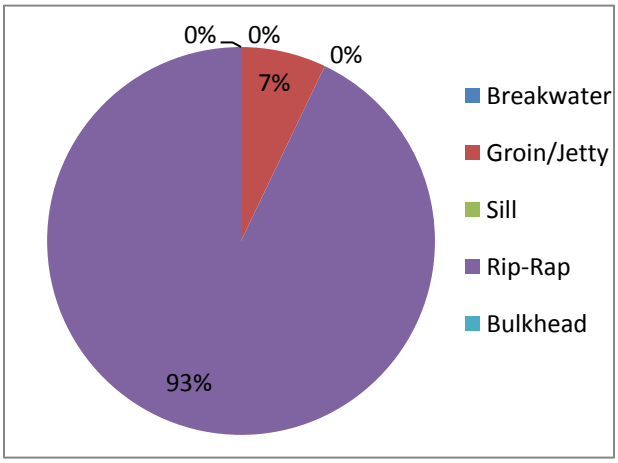


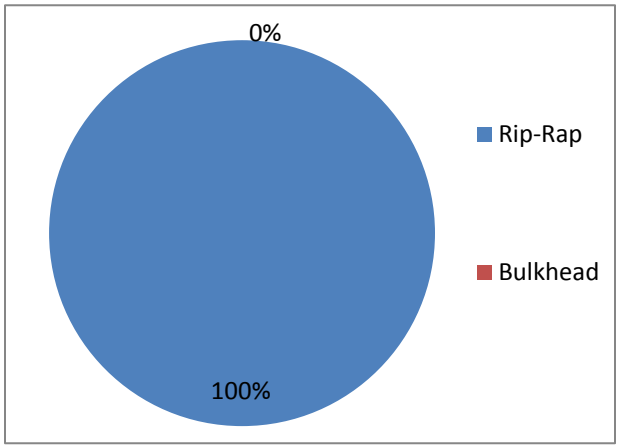
Figure 95: Percent stabilization structure by structure type.

Table 75: Shoreline stabilization statistics for Gates County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	141	23.5	7.9	42.1	6
Breakwater	0	0	0	0	0
Groin/Jetty	71	35.5	30.8	40.3	2
Sill	0	0	0	0	0
Rip-Rap	928	463.8	191.7	735.9	2
Bulkhead	0	0	0	0	0

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 96 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. All of the structures coincident with the shoreline delineation in Gates County were categorized as riprap revetments with 0.18 miles. There are no bulkheads in the county.

Figure 96: Shoreline stabilization structures that are coincident with the shoreline for Gates County.



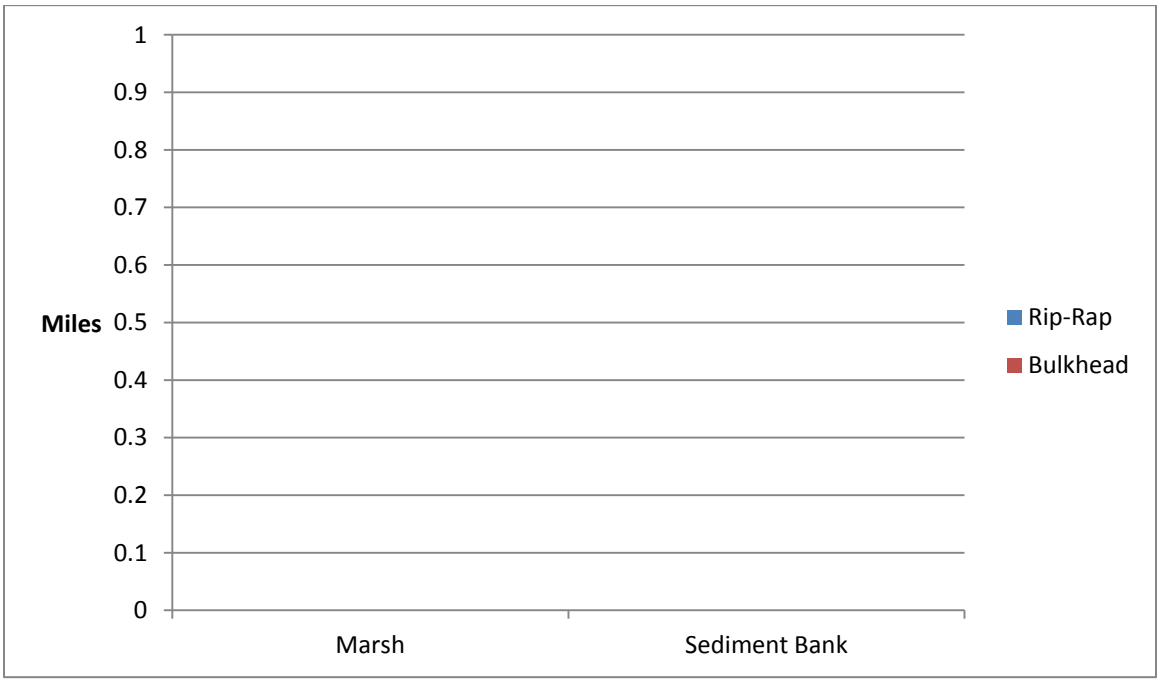
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 76 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Gates County, there are no marsh or sediment bank shoreline segments that are waterward of either bulkhead or rip-rap structures.

Table 76: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	0	0
Average	0	0
Minimum	0	0
Maximum	0	0
Total Count	0	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	0	0
Average	0	0
Minimum	0	0
Maximum	0	0
Total Count	0	0

Figure 97: Natural shoreline by type waterward of stabilized shoreline.



There are no shoreline segments in Gates County that are modified with both bulkhead and rip-rap structures (Table 77).

Table 77: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	0
Average	0
Minimum	0
Maximum	0
Total Count	0

Shoreline Access Structures

There are 17 shoreline access structures (Table 78) mapped within Gates County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (76%). However, bridges represent 84% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 24,064 ft^2.

Table 78: Area of shoreline access structures within Gates County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	4	8,195	32,782	0.19	0.75
Pier/Floating Dock/Wharf	13	475	6,172	0.01	0.14
Total	**17**		**38,954**		**0.89**

Figure 98: Percent of total number of shoreline access structures.

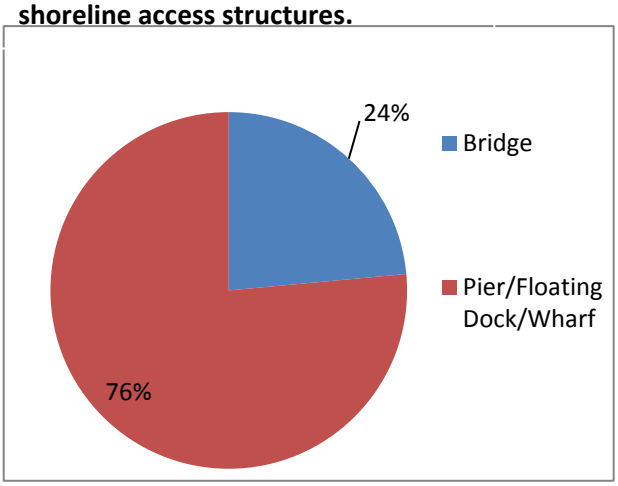
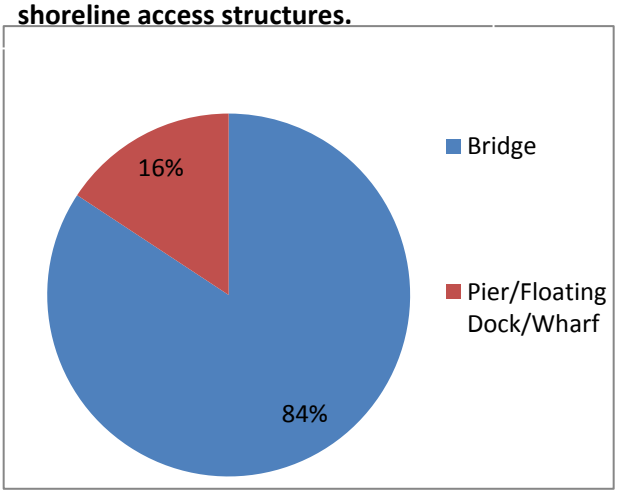


Figure 99: Percent total area of shoreline access structures.

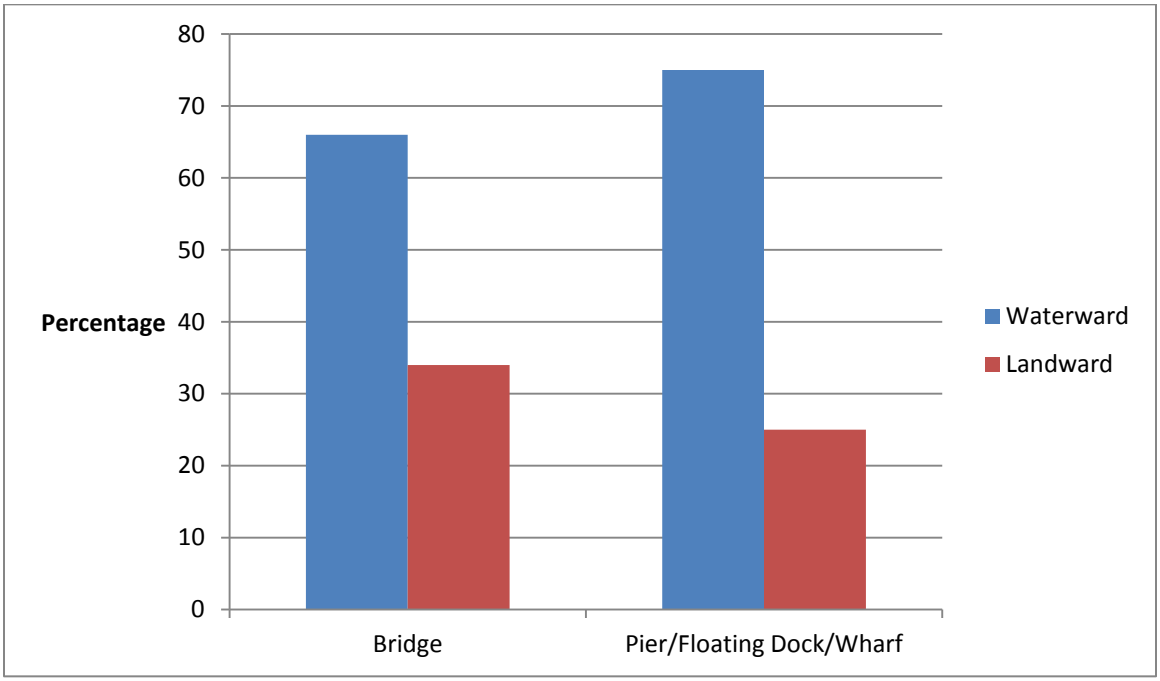


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Gates County, less than 1 acre of Public Trust Waters is covered by shoreline access structures.

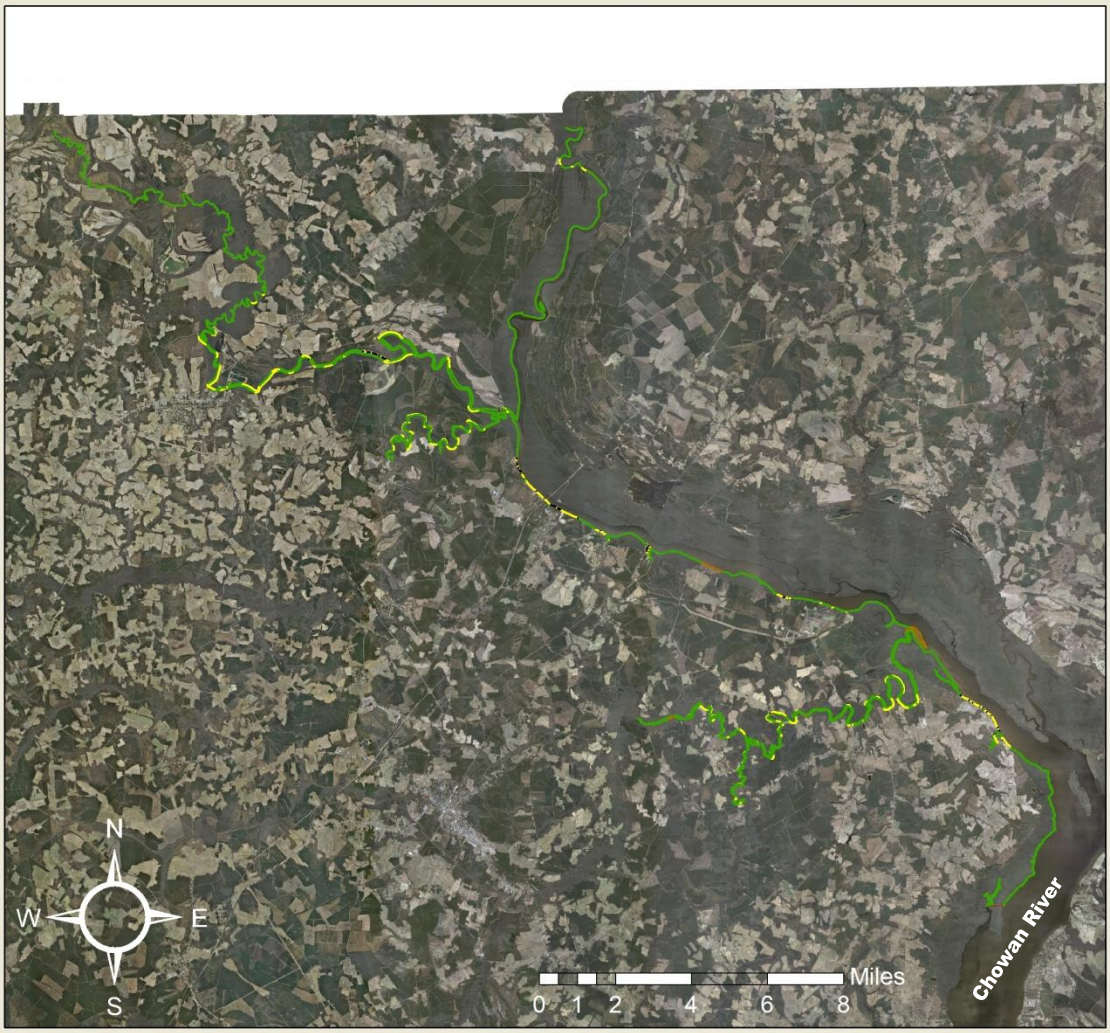
Table 79: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	21,556	0.49
Pier/Floating Dock/Wharf	4,631	0.11
Total	**26,187**	**0.60**

Figure 100: Percent of shoreline access structures located landward and waterward of the shoreline.



Hertford County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Hertford County Statistics

Estuarine Shoreline

A total of 206.7 miles of estuarine shoreline were mapped within Hertford County. The majority of the shoreline was characterized as swamp forest (84.4%). Modified shorelines made up 1.4% of the total shoreline, or 2.9 miles.

Figure 101: Percent shoreline length by shoreline type for Hertford County.

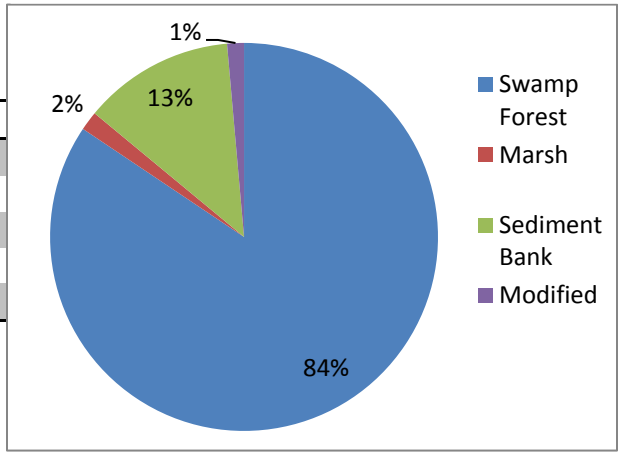
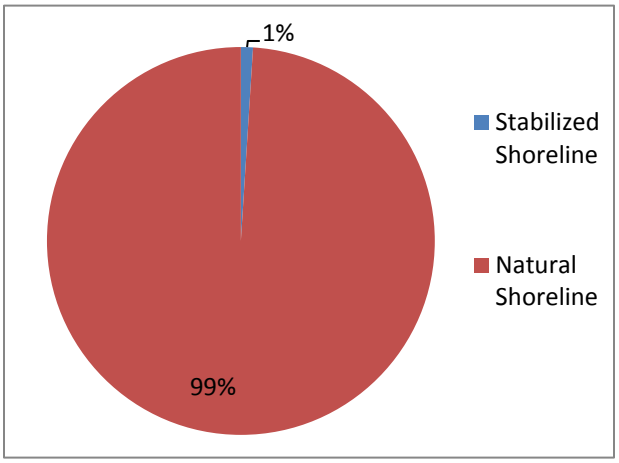


Table 80: Shoreline length for Hertford County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	920,675	174.4	84.4
Marsh	17,813	3.4	1.6
Sediment Bank	137,077	26.0	12.6
Modified	15,347	2.9	1.4
Total	**1,090,912**	**206.7**	

Stabilization Structures

Figure 102: Percent of shoreline stabilized vs. natural shoreline.



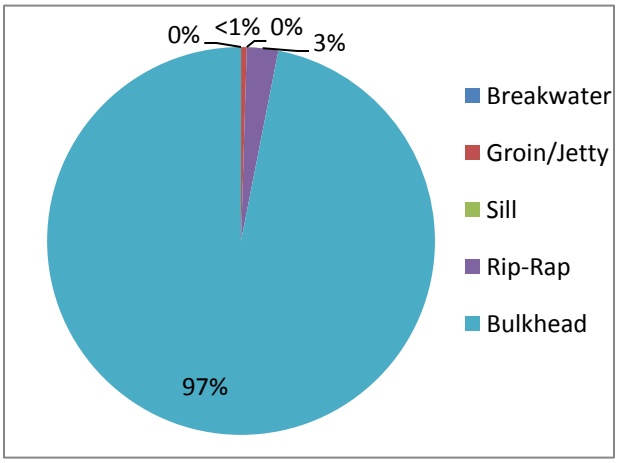


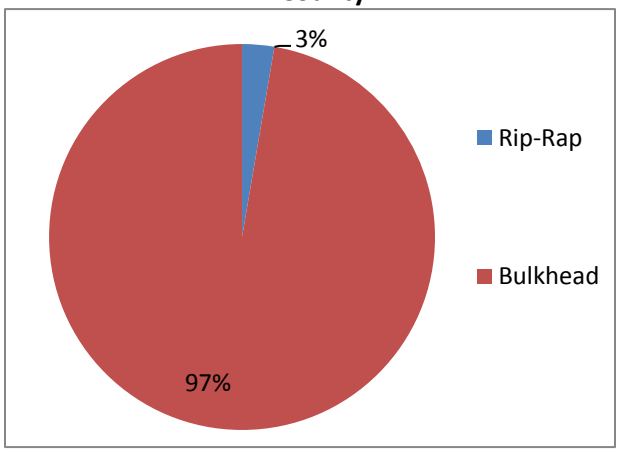
Figure 103: Percent stabilization structure by structure type.

Table 81: Shoreline stabilization statistics for Hertford County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	378	14.5	6.9	35.2	26
Breakwater	0	0	0	0	0
Groin/Jetty	75	18.7	6.4	33.5	4
Sill	0	0	0	0	0
Rip-Rap	413	68.9	31.3	140.0	6
Bulkhead	15,319	204.3	1.5	702.8	75

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 104 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Hertford County were categorized as bulkhead with 2.9 miles. Rip-rap revetments totaled 0.08 miles.

Figure 104: Shoreline stabilization structures that are coincident with the shoreline for Hertford County.



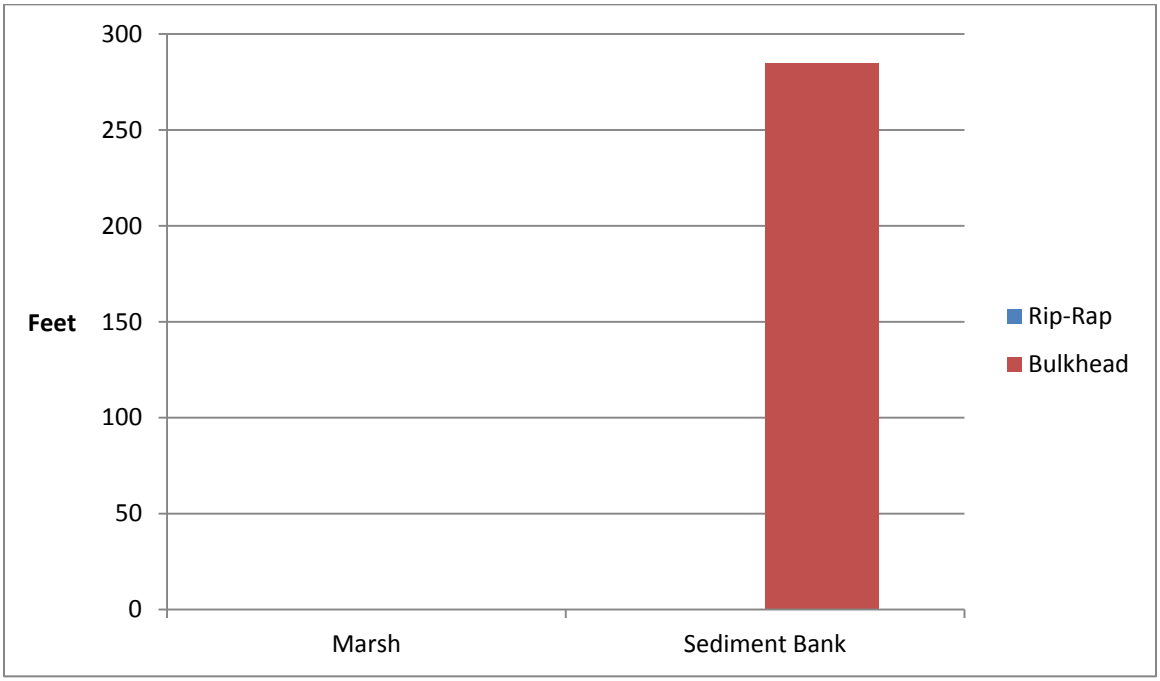
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 82 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Hertford County, 0 feet of marsh and 285 feet of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 82: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	0	0
Average	0	0
Minimum	0	0
Maximum	0	0
Total Count	0	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	285	0
Average	48	0
Minimum	15	0
Maximum	82	0
Total Count	6	0

Figure 105: Natural shoreline by type waterward of stabilized shoreline.



There are no shoreline segments in Hertford County that are modified with both bulkhead and rip-rap structures (Table 83).

Table 83: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	0
Average	0
Minimum	0
Maximum	0
Total Count	0

Shoreline Access Structures

There are 182 shoreline access structures (Table 84) mapped within Hertford County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (97%). These structures also represent 68% of the total area of shoreline access structures. The largest single structure is a pier with an area of 25,137 ft^2.

Table 84: Area of shoreline access structures within Hertford County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	6	12,814	76,882	0.29	1.8
Pier/Floating Dock/Wharf	176	937	164,939	0.02	3.8
Total	**182**		**241,821**		**5.6**

Figure 106: Percent of total number of shoreline access structures.

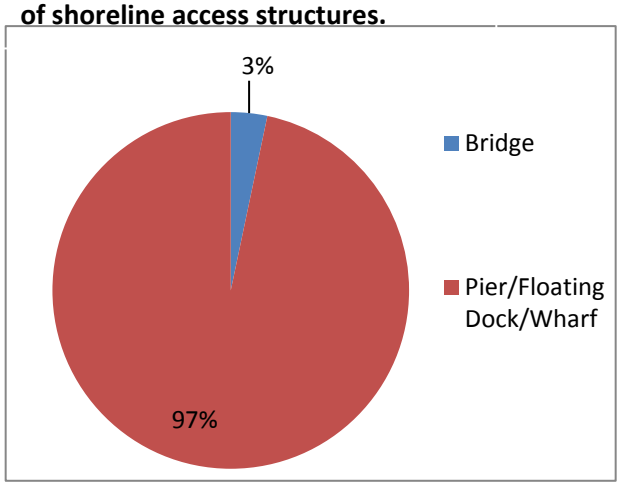
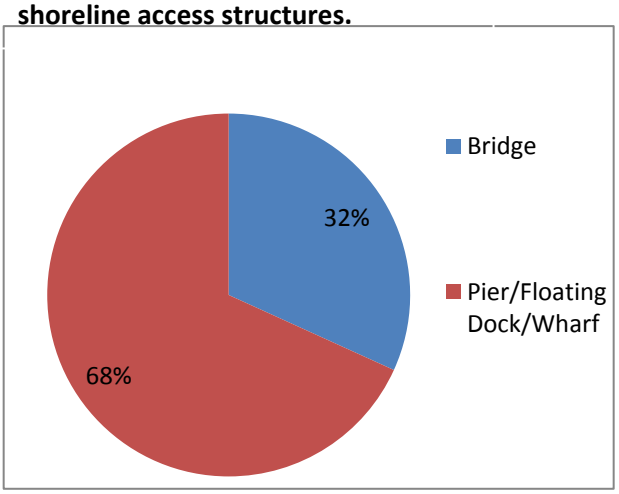


Figure 107: Percent total area of shoreline access structures.

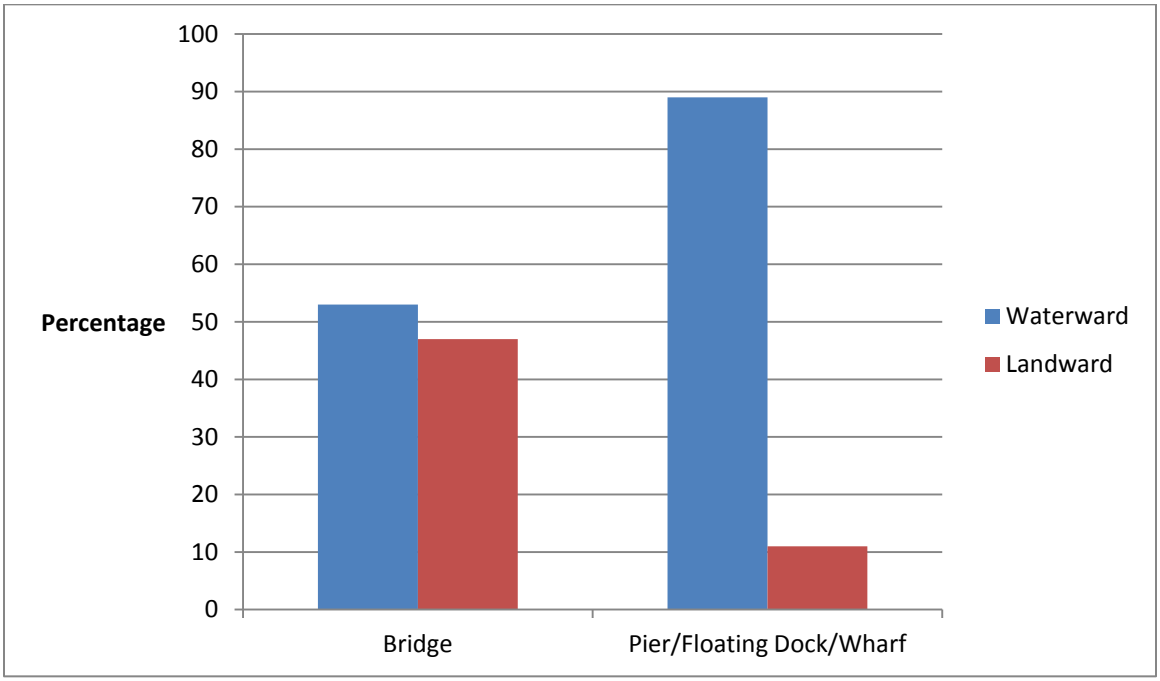


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Hertford County, about 4 acres of Public Trust Waters are covered by shoreline access structures.

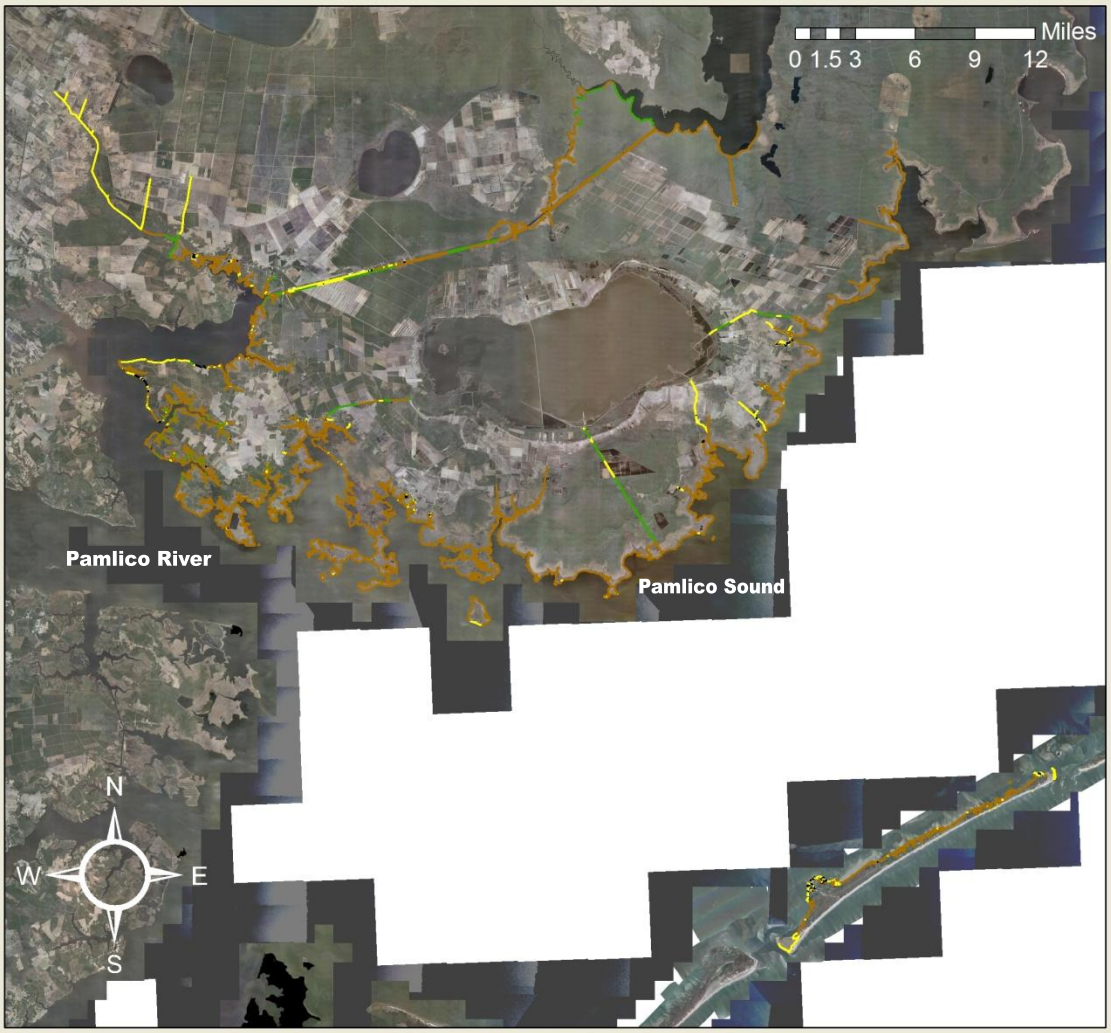
Table 85: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	40,856	.94
Pier/Floating Dock/Wharf	146,907	3.4
Total	**187,763**	**4.3**

Figure 108: Percent of shoreline access structures located landward and waterward of the shoreline.



Hyde County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Hyde County Statistics

Estuarine Shoreline

A total of 856.8 miles of estuarine shoreline were mapped within Hyde County. The majority of the shoreline was characterized as marsh (83.0%). Modified shorelines made up 1.2% of the total shoreline, or 10.4 miles.

Figure 109: Percent shoreline length by shoreline type for Hyde County.

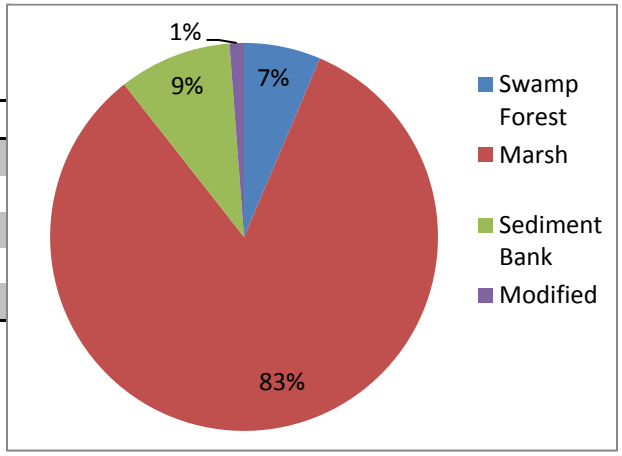
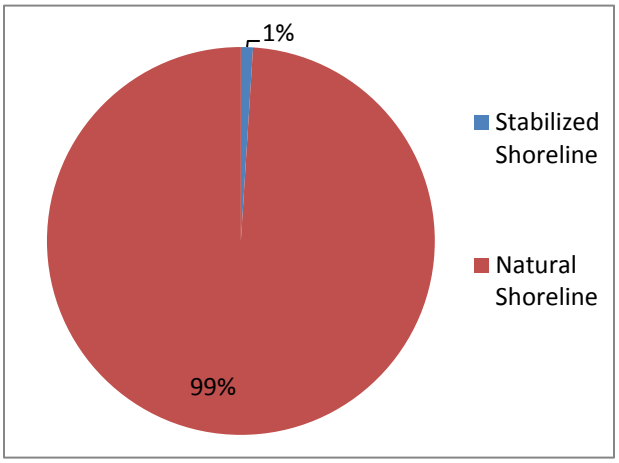


Table 86: Shoreline length for Hyde County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	288,877	54.7	6.4
Marsh	3,753,806	710.9	83.0
Sediment Bank	426,777	80.8	9.4
Modified	54,903	10.4	1.2
Total	**4,524,363**	**856.8**	

Stabilization Structures

Figure 110: Percent of shoreline stabilized vs. natural shoreline.



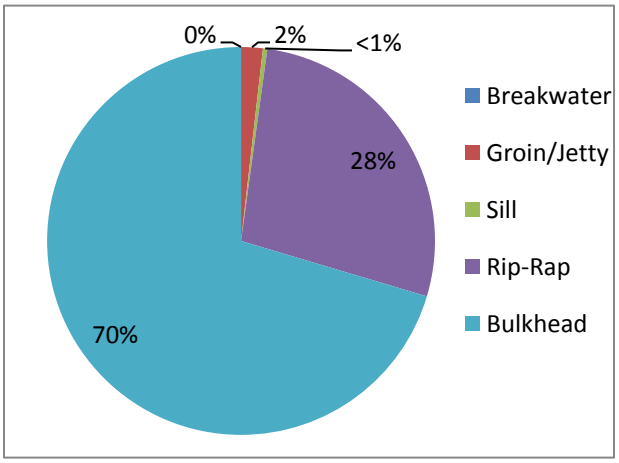


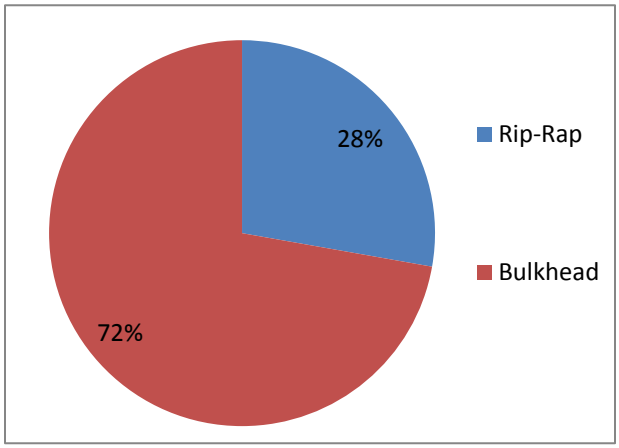
Figure 111: Percent stabilization structure by structure type.

Table 87: Shoreline stabilization statistics for Hyde County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	498	22.7	7.5	59.4	22
Breakwater	0	0	0	0	0
Groin/Jetty	1,053	87.8	20.6	309.3	12
Sill	215	71.8	59.0	95.4	3
Rip-Rap	16,007	381.1	6.2	2,003.3	42
Bulkhead	41,067	297.6	1.4	2,138.6	138

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 112 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Hyde County were categorized as bulkhead with 7.8 miles. Rip-rap revetments totaled 3.0 miles.

Figure 112: Shoreline stabilization structures that are coincident with the shoreline for Hyde County.



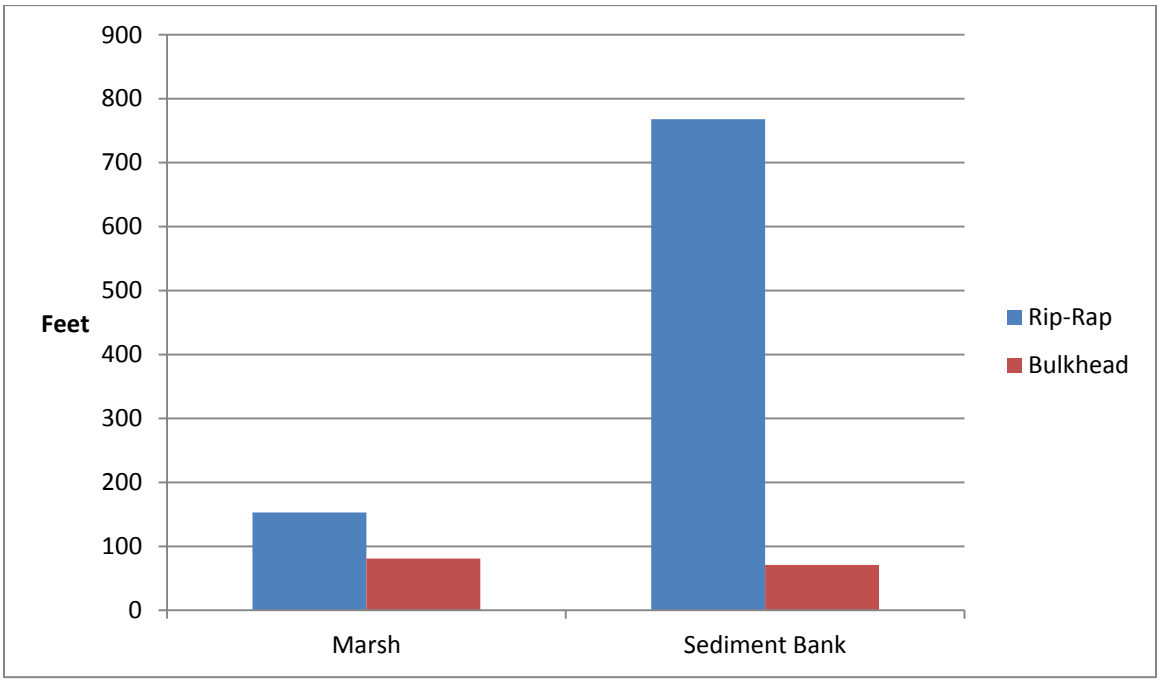
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 88 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Hyde County, 234 feet of marsh and 840 feet of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 88: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	81	153
Average	81	76
Minimum	81	6
Maximum	81	146
Total Count	1	2

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	72	768
Average	24	192
Minimum	6	89
Maximum	36	296
Total Count	3	4

Figure 113: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 89 below.

Table 89: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	121.8
Average	121.8
Minimum	121.8
Maximum	121.8
Total Count	1

Shoreline Access Structures

There are 343 shoreline access structures (Table 90) mapped within Hyde County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (81%). However, bridges represent 59% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 122,264 ft^2.

Table 90: Area of shoreline access structures within Hyde County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	65	4,615	299,994	0.11	6.9
Pier/Floating Dock/Wharf	278	748	207,823	0.02	4.8
Total	**343**		**507,817**		**11.7**

Figure 114: Percent of total number of shoreline access structures.

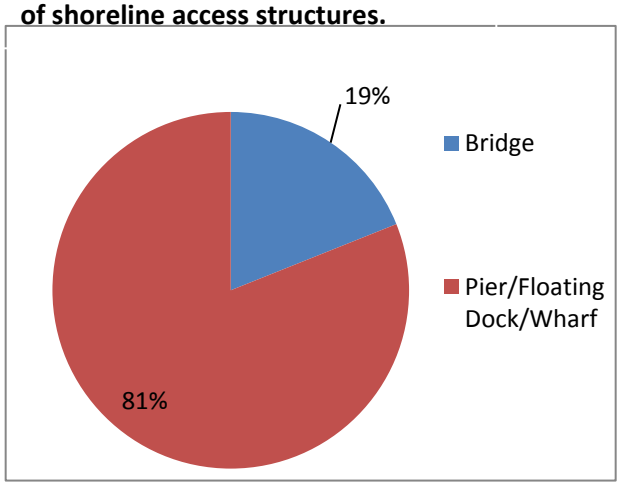
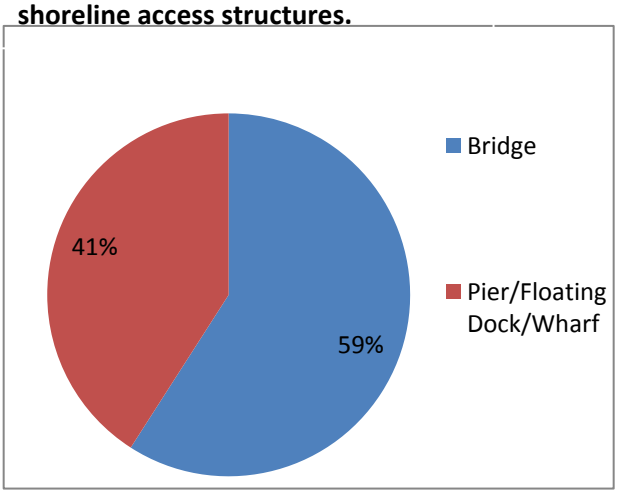


Figure 115: Percent total area of shoreline access structures.

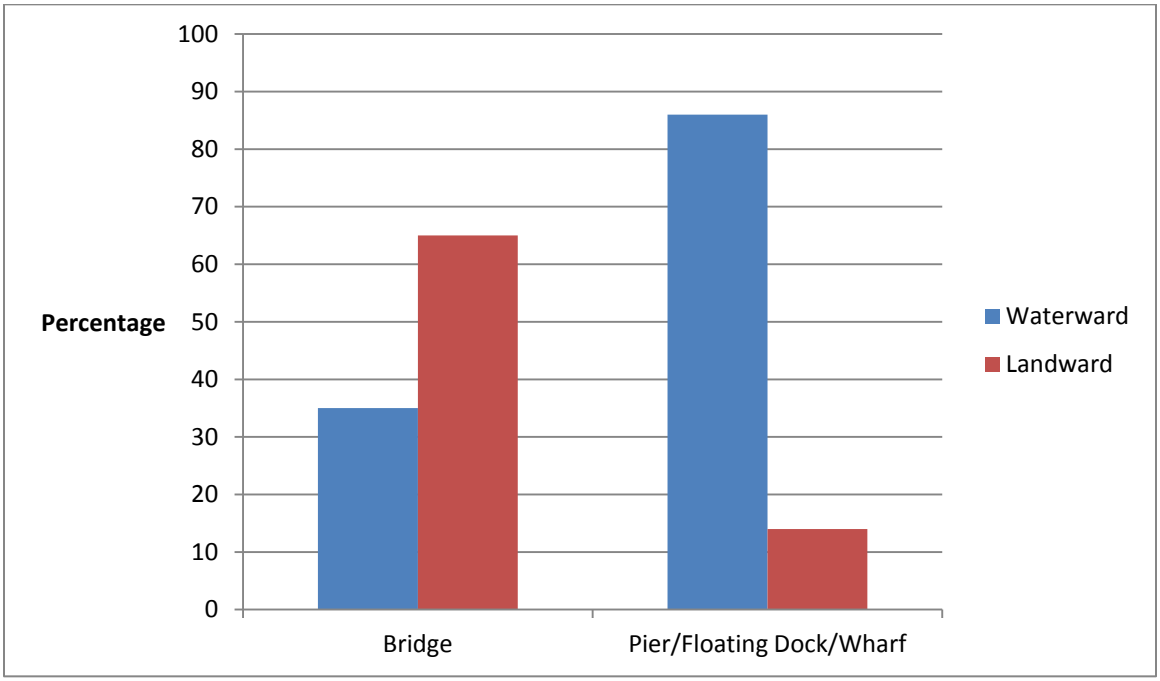


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Hyde County, about 6 acres of Public Trust Waters are covered by shoreline access structures.

Table 91: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	104,878	2.4
Pier/Floating Dock/Wharf	179,456	4.1
Total	**284,334**	**6.5**

Figure 116: Percent of shoreline access structures located landward and waterward of the shoreline.



New Hanover County

Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

New Hanover County Statistics

Estuarine Shoreline

A total of 781.9 miles of estuarine shoreline were mapped within New Hanover County. The majority of the shoreline was characterized as marsh (85.1%). Modified shorelines made up 2.6% of the total shoreline, or 20.0 miles.

Figure 117: Percent shoreline length by shoreline type for New Hanover County.

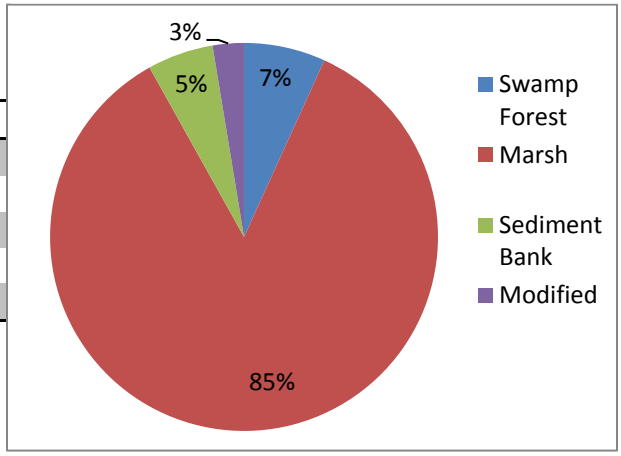
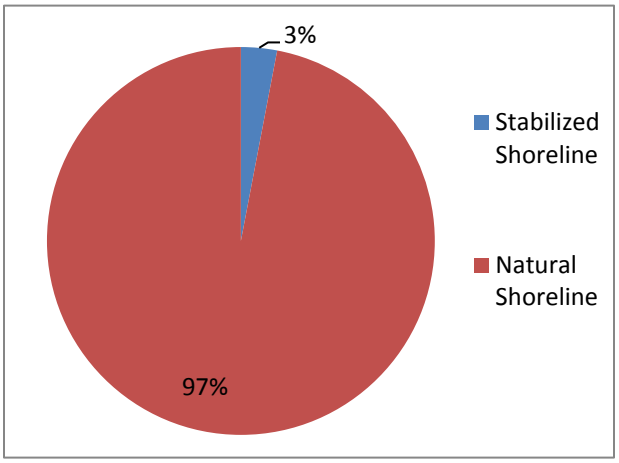


Table 92: Shoreline length for New Hanover County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	281,585	53.3	6.8
Marsh	3,514,289	665.6	85.1
Sediment Bank	277,339	43.1	5.5
Modified	105,374	20.0	2.6
Total	**4,128,587**	**781.9**	

Stabilization Structures

Figure 118: Percent of shoreline stabilized vs. natural shoreline.



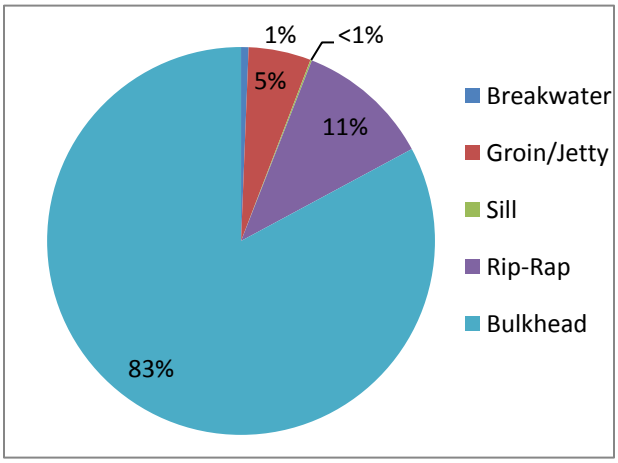


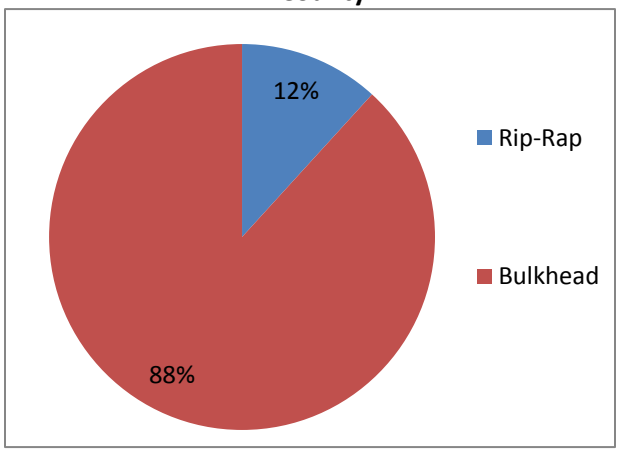
Figure 119: Percent stabilization structure by structure type.

Table 93: Shoreline stabilization statistics for New Hanover County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	763	21.2	8.6	113.4	36
Breakwater	956	318.7	140.9	537.9	3
Groin/Jetty	7,943	193.7	11.4	2,090.6	41
Sill	190	15.8	9.8	19.3	12
Rip-Rap	17,082	328.5	17.6	2,567.0	52
Bulkhead	126,491	536.0	3.5	6,976.2	236

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 120 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in New Hanover County were categorized as bulkhead with 24.0 miles. Rip-rap revetments totaled 3.2 miles.

Figure 120: Shoreline stabilization structures that are coincident with the shoreline for New Hanover County.



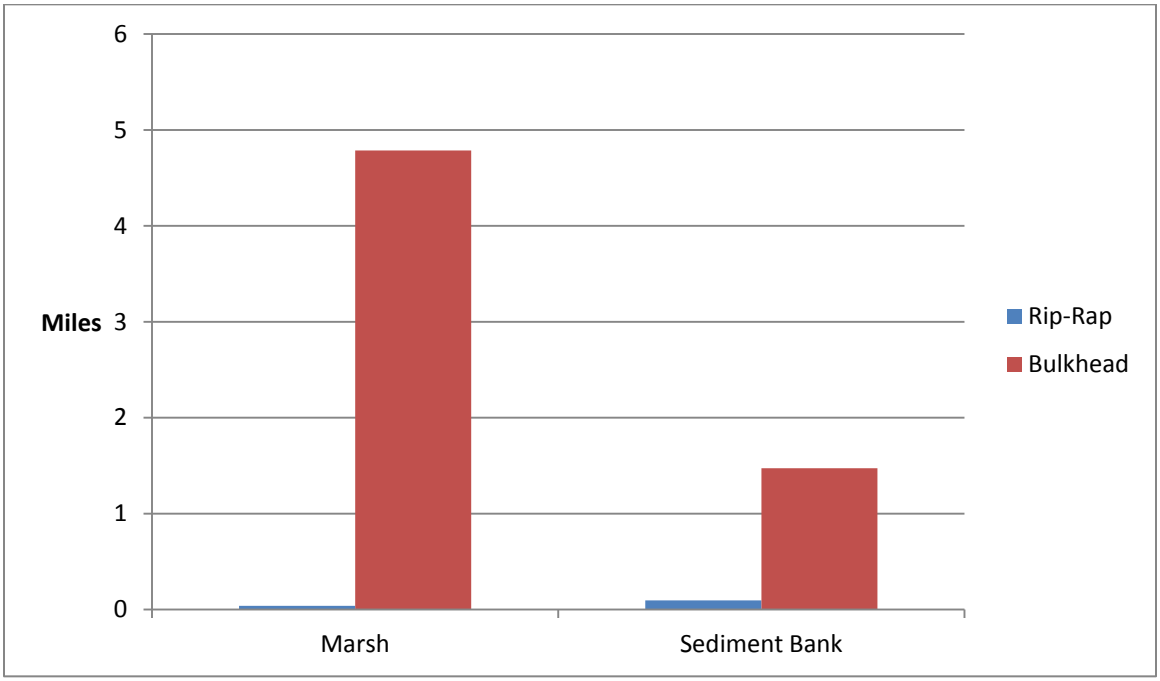
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 94 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In New Hanover County, 4.8 miles of marsh and 1.6 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 94: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	25,265	207
Average	207	207
Minimum	10	207
Maximum	3,076	207
Total Count	122	1

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	7,781	503
Average	222	251
Minimum	20	8
Maximum	1,622	494
Total Count	35	2

Figure 121: Natural shoreline by type waterward of stabilized shoreline.



There are no shoreline segments in New Hanover County that are modified with both bulkhead and rip-rap structures (Table 95).

Table 95: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	0
Average	0
Minimum	0
Maximum	0
Total Count	0

Shoreline Access Structures

There are 2,194 shoreline access structures (Table 96) mapped within New Hanover County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (98%). These structures also represent 59% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 784,391 ft^2.

Table 96: Area of shoreline access structures within New Hanover County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	33	72,022	2,376,731	1.65	54.6
Pier/Floating Dock/Wharf	2,161	1,602	3,462,070	0.04	79.5
Total	**2,194**		**5,838,801**		**134.1**

Figure 122: Percent of total number of shoreline access structures.

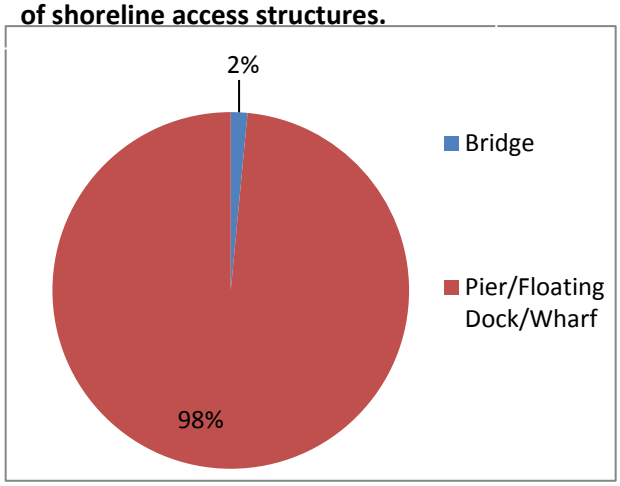
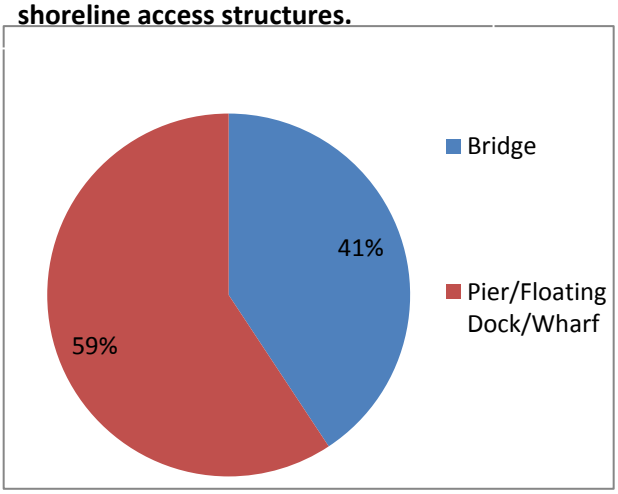


Figure 123: Percent total area of shoreline access structures.

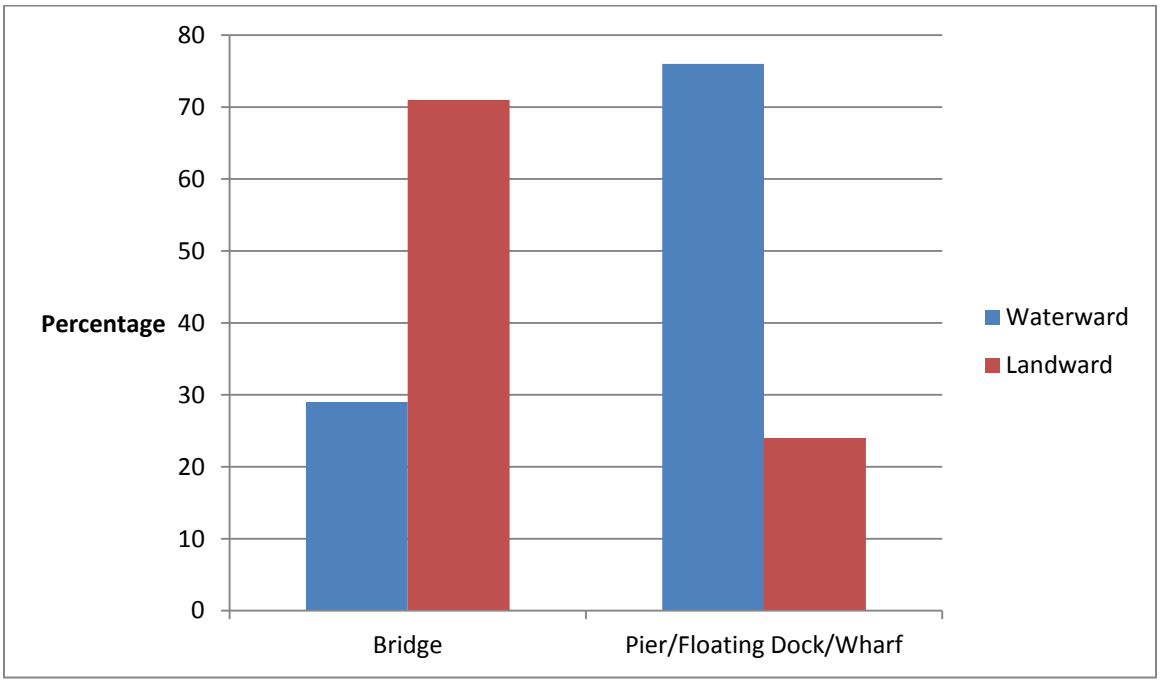


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In New Hanover County, about 76 acres of Public Trust Waters are covered by shoreline access structures.

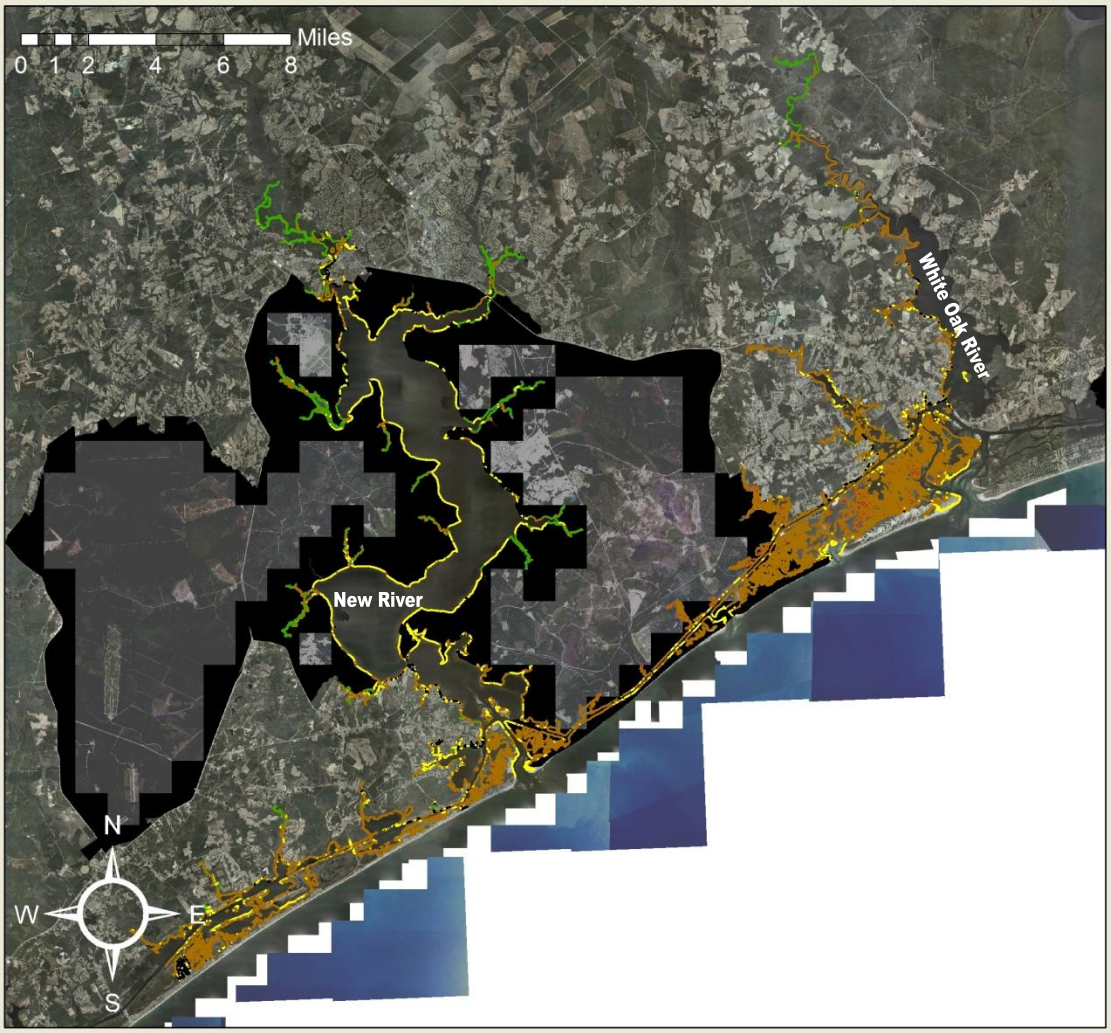
Table 97: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	697,529	16.0
Pier/Floating Dock/Wharf	2,613,733	60.0
Total	**3,311,262**	**76.0**

Figure 124: Percent of shoreline access structures located landward and waterward of the shoreline.



Onslow County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Onslow County Statistics

Estuarine Shoreline

A total of 1,121.0 miles of estuarine shoreline were mapped within Onslow County. The majority of the shoreline was characterized as marsh (78.7%). Modified shorelines made up 2.7% of the total shoreline, or 30.0 miles.

Figure 125: Percent shoreline length by shoreline type for Onslow County.

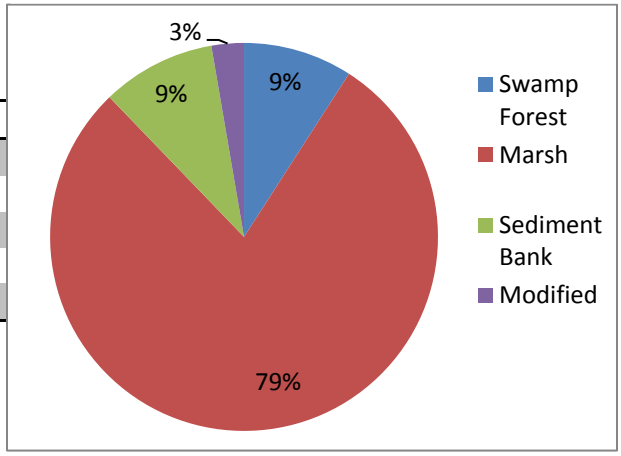
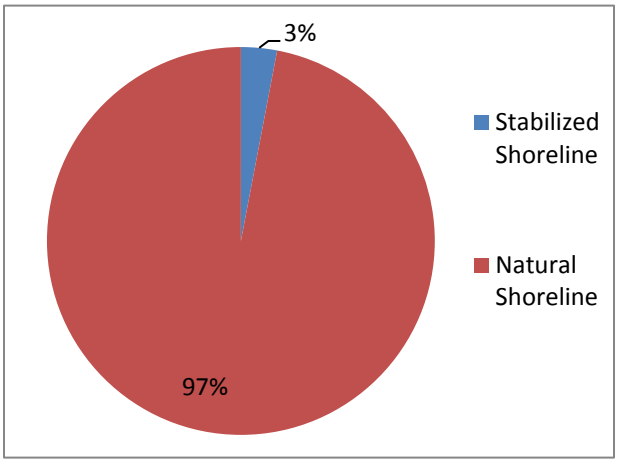


Table 98: Shoreline length for Onslow County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	540,830	102.4	9.1
Marsh	4,659,463	882.5	78.7
Sediment Bank	559,955	106.1	9.5
Modified	158,351	30.0	2.7
Total	**5,918,599**	**1,121.0**	

Stabilization Structures

Figure 126: Percent of shoreline stabilized vs. natural shoreline.



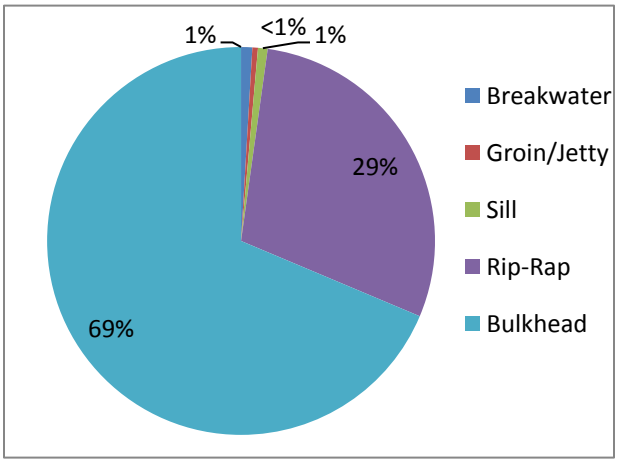


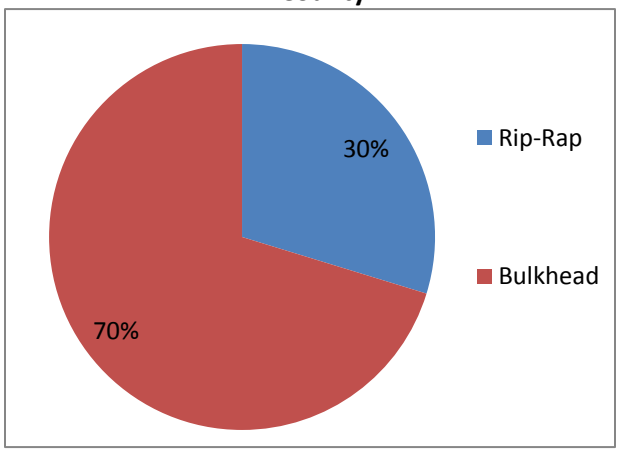
Figure 127: Percent stabilization structure by structure type.

Table 99: Shoreline stabilization statistics for Onslow County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	5,592	15.4	3.6	149.4	363
Breakwater	1,730	52.4	6.8	174.4	33
Groin/Jetty	858	61.3	12.8	147.0	14
Sill	1,489	148.9	9.1	537.3	10
Rip-Rap	54,012	341.9	13.2	5,365.0	158
Bulkhead	127,246	226.8	10.3	2,800.2	561

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 128 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Onslow County were categorized as bulkhead with 24.1 miles. Rip-rap revetments totaled 10.2 miles.

Figure 128: Shoreline stabilization structures that are coincident with the shoreline for Onslow County.



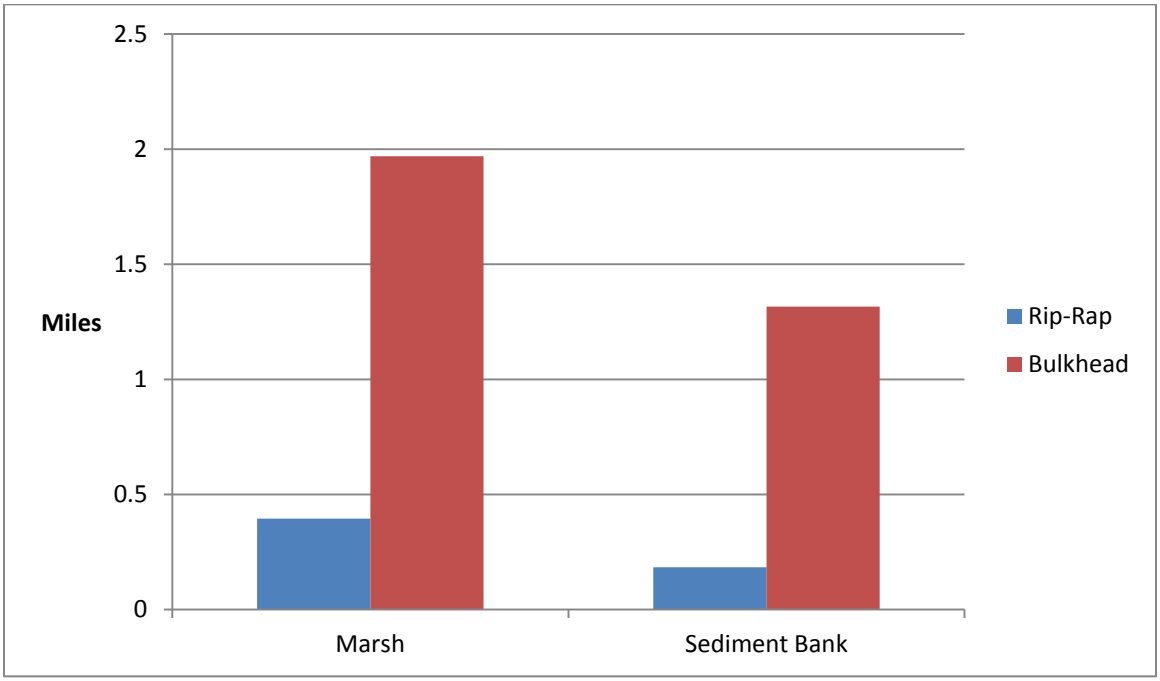
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 100 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Onslow County, 2.4 miles of marsh and 1.5 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 100: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	10,395	2,087
Average	153	209
Minimum	12	21
Maximum	681	563
Total Count	68	10

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	6,948	969
Average	97	97
Minimum	8	19
Maximum	455	300
Total Count	72	10

Figure 129: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 101 below.

Table 101: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	1,635
Average	183.7
Minimum	45.8
Maximum	537.2
Total Count	9

Shoreline Access Structures

There are 69 shoreline access structures (Table 102) mapped within Onslow County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (97%). These structures also represent 89% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 4,475 ft^2.

Table 102: Area of shoreline access structures within Onslow County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	2	2,929	5,858	0.07	0.13
Pier/Floating Dock/Wharf	67	703	47,076	0.02	1.08
Total	**69**		**52,934**		**1.21**

Figure 130: Percent of total number of shoreline access structures.

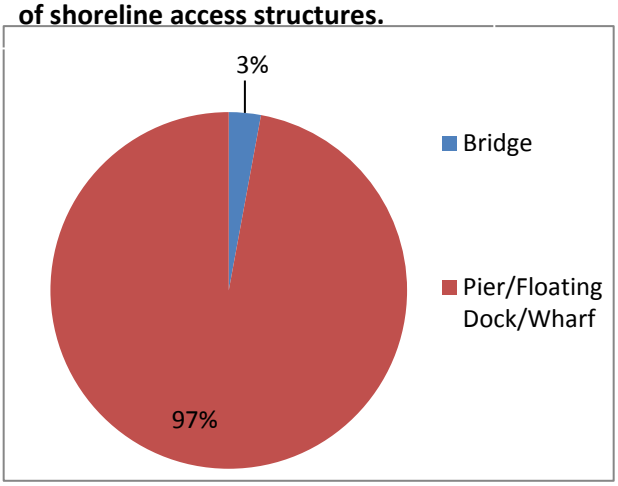
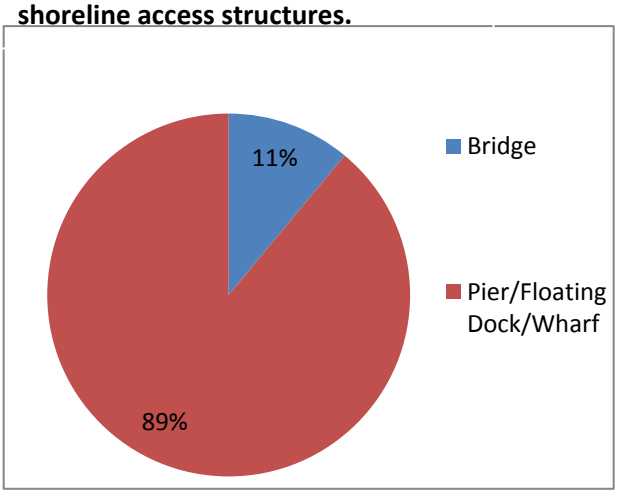


Figure 131: Percent total area of shoreline access structures.

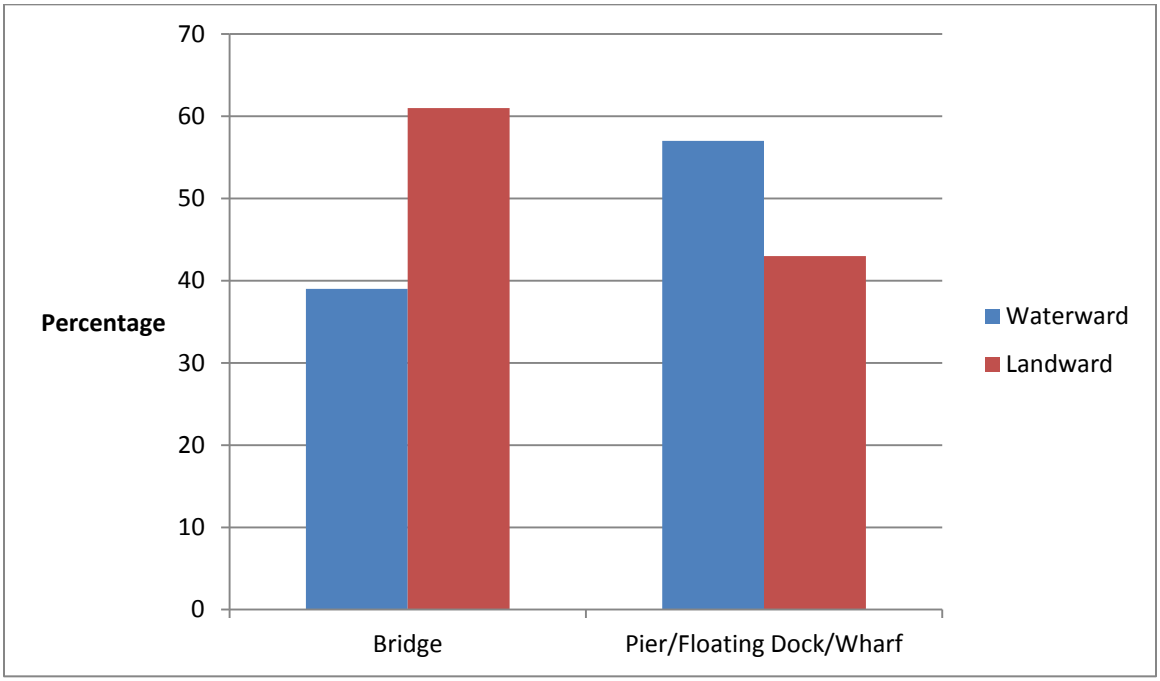


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Onslow County, less than 1 acre of Public Trust Waters is covered by shoreline access structures.

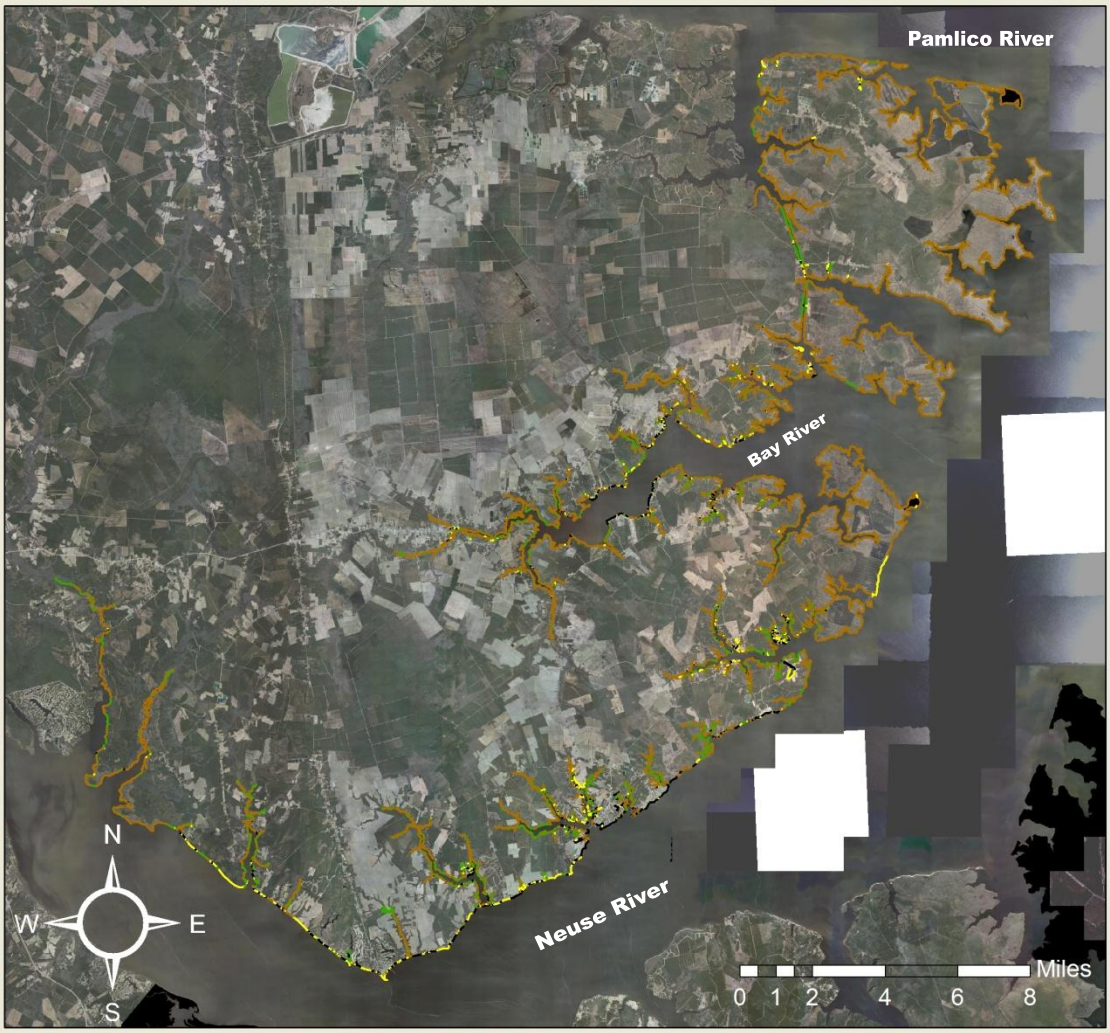
Table 103: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	2,259	0.05
Pier/Floating Dock/Wharf	26,973	0.62
Total	**29,232**	**0.67**

Figure 132: Percent of shoreline access structures located landward and waterward of the shoreline.



Pamlico County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Pamlico County Statistics

Estuarine Shoreline

A total of 626.1 miles of estuarine shoreline were mapped within Pamlico County. The majority of the shoreline was characterized as marsh (81.1%). Modified shorelines made up 5.1% of the total shoreline, or 31.7 miles.

Figure 133: Percent shoreline length by shoreline type for Pamlico County.

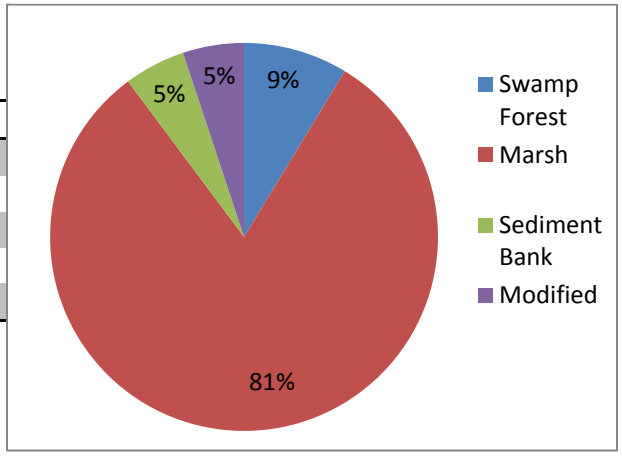
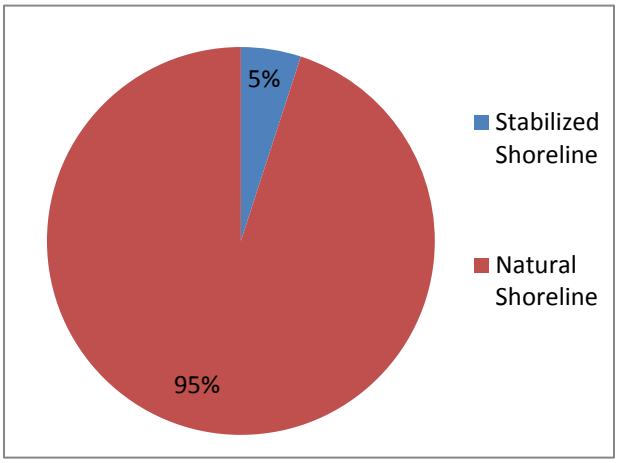


Table 104: Shoreline length for Pamlico County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	287,500	54.5	8.7
Marsh	2,682,248	508.0	81.1
Sediment Bank	168,249	31.9	5.1
Modified	167,505	31.7	5.1
Total	**3,305,502**	**626.1**	

Stabilization Structures

Figure 134: Percent of shoreline stabilized vs. natural shoreline.



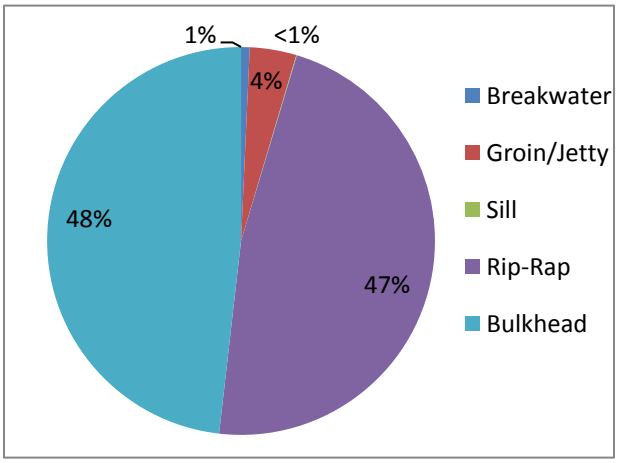


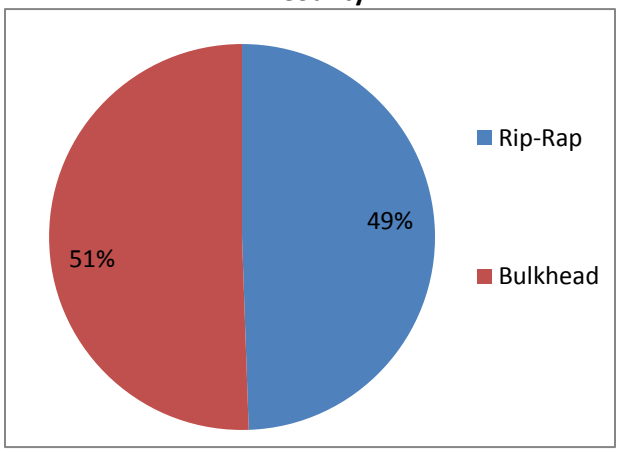
Figure 135: Percent stabilization structure by structure type.

Table 105: Shoreline stabilization statistics for Pamlico County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	1,719	13.3	6.0	40.7	129
Breakwater	1,437	75.6	11.4	160.9	19
Groin/Jetty	7,792	51.3	7.5	636.2	152
Sill	99.1	99.1	99.1	99.1	1
Rip-Rap	94,487	267.7	2.5	3,110.9	353
Bulkhead	96,568	191.2	4.1	2,381.8	505

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 136 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Pamlico County were categorized as bulkhead with 18.3 miles. Rip-rap revetments totaled 17.9 miles.

Figure 136: Shoreline stabilization structures that are coincident with the shoreline for Pamlico County.



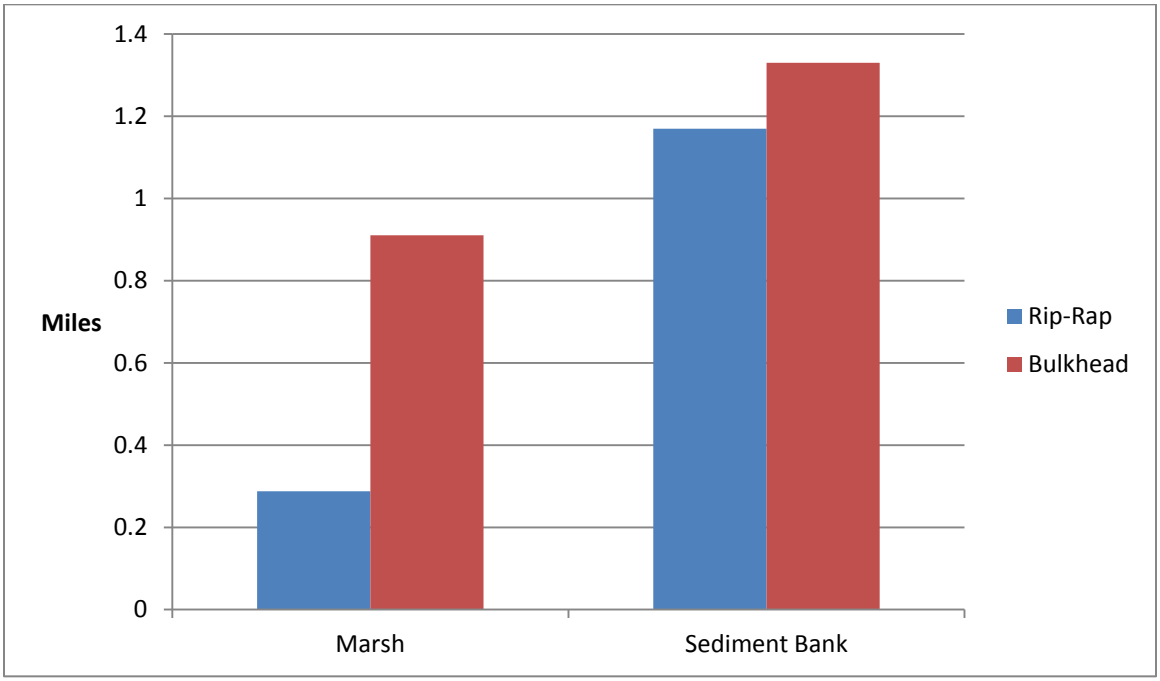
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 106 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Pamlico County, 1.2 miles of marsh and 2.5 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 106: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	4,808	1,520
Average	123	117
Minimum	7	53
Maximum	573	267
Total Count	39	13

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	7,024	6,176
Average	190	167
Minimum	15	14
Maximum	1,889	679
Total Count	37	37

Figure 137: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 107 below.

Table 107: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	2,088
Average	189.8
Minimum	39.5
Maximum	502.6
Total Count	11

Shoreline Access Structures

There are 1,824 shoreline access structures (Table 108) mapped within Pamlico County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (99%). These structures also represent 91% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 58,591 ft^2.

Table 108: Area of shoreline access structures within Pamlico County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	23	5,804	133,500	0.13	3.1
Pier/Floating Dock/Wharf	1,801	777	1,398,567	0.02	32.1
Total	**1,824**		**1,532,067**		**35.2**

Figure 138: Percent of total number of shoreline access structures.

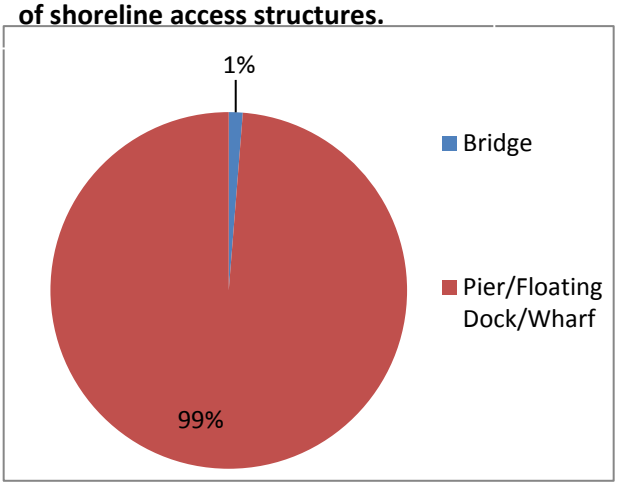
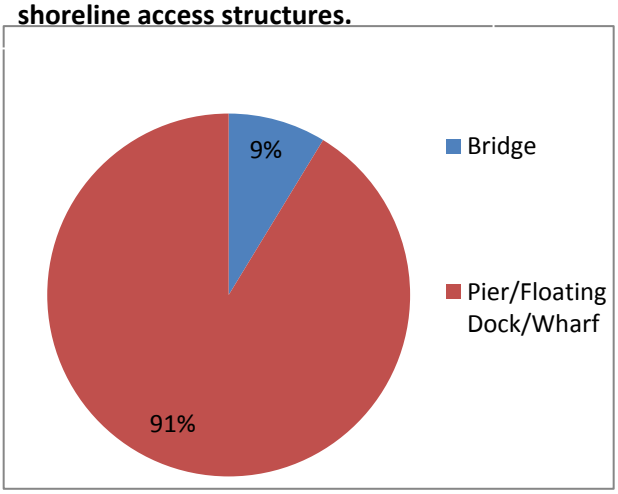


Figure 139: Percent total area of shoreline access structures.

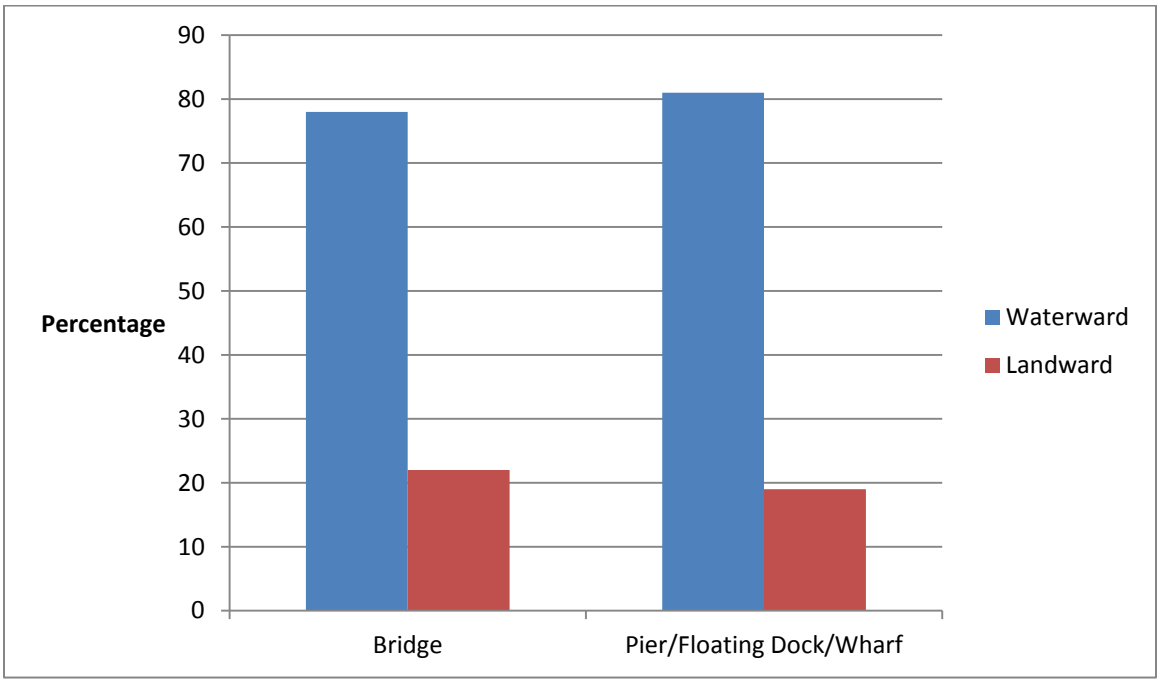


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Pamlico County, about 29 acres of Public Trust Waters are covered by shoreline access structures.

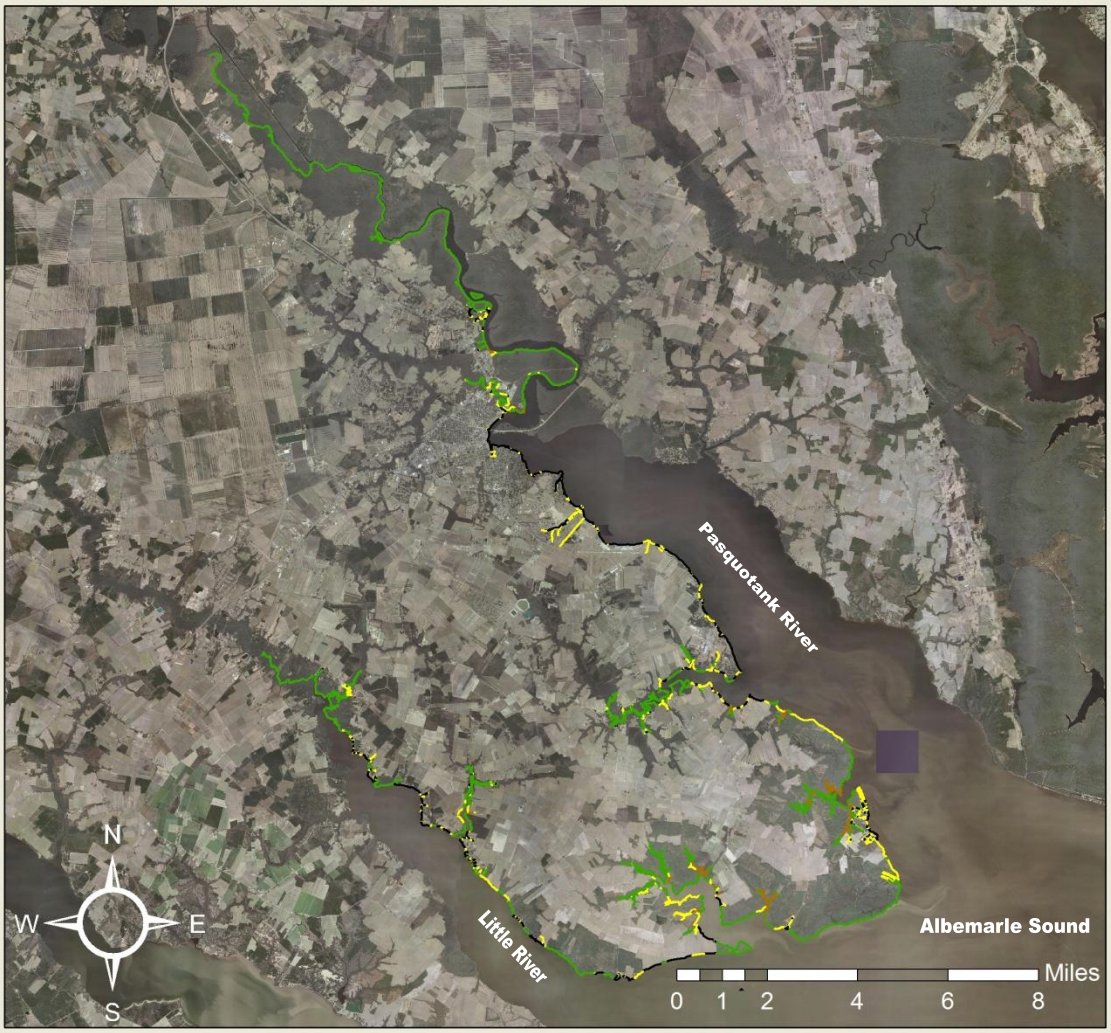
Table 109: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	103,912	2.4
Pier/Floating Dock/Wharf	1,140,164	26.2
Total	**1,244,076**	**28.6**

Figure 140: Percent of shoreline access structures located landward and waterward of the shoreline.



Pasquotank County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Pasquotank County Statistics

Estuarine Shoreline

A total of 217.2 miles of estuarine shoreline were mapped within Pasquotank County. The majority of the shoreline was characterized as swamp forest (59.6%). Modified shorelines made up 13.5% of the total shoreline, or 29.3 miles.

Figure 141: Percent shoreline length by shoreline type for Pasquotank County.

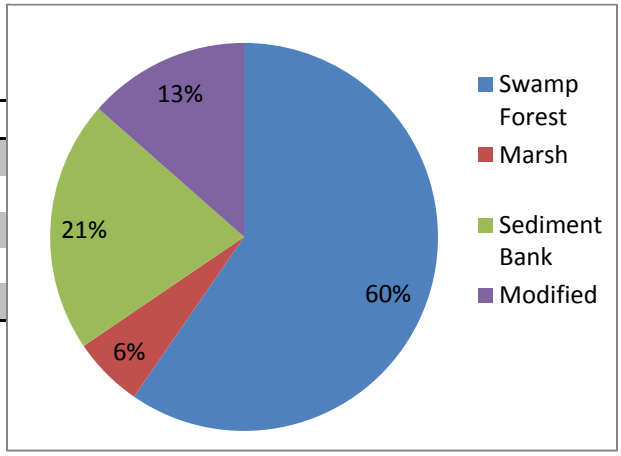
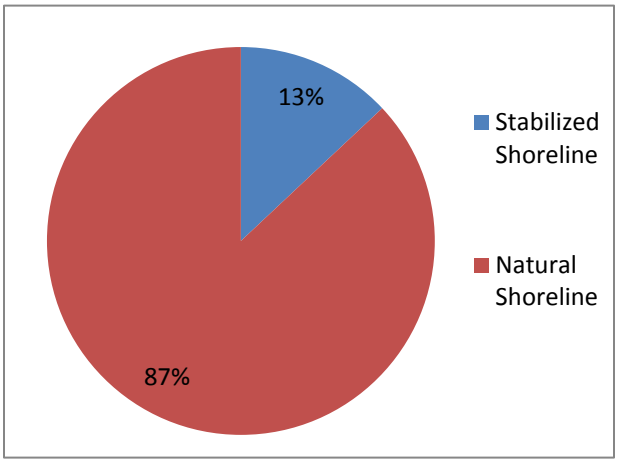


Table 110: Shoreline length for Pasquotank County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	683,273	129.4	59.6
Marsh	67,797	12.8	5.9
Sediment Bank	241,322	45.7	21.0
Modified	154,671	29.3	13.5
Total	**1,147,065**	**217.2**	

Stabilization Structures

Figure 142: Percent of shoreline stabilized vs. natural shoreline.



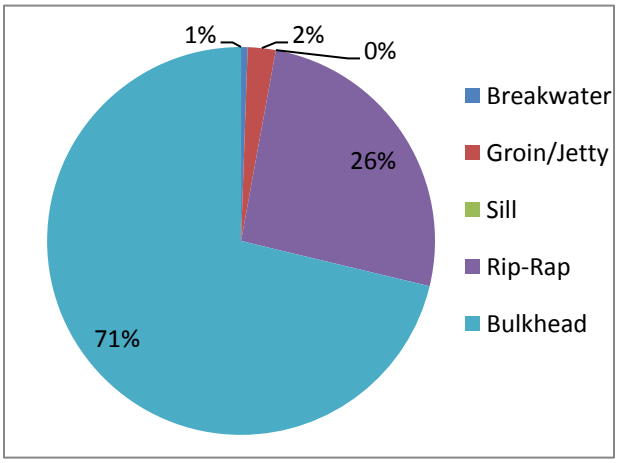


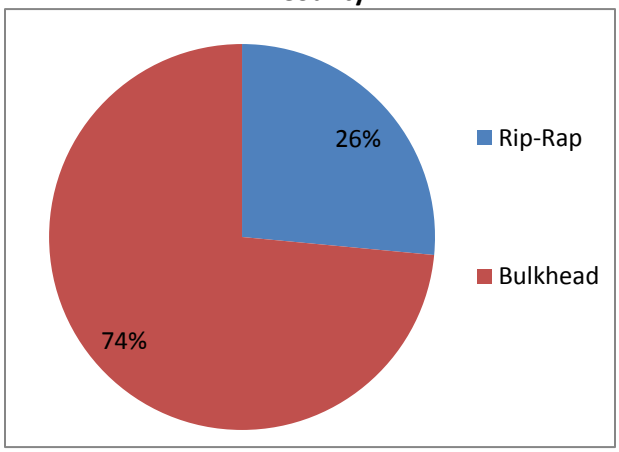
Figure 143: Percent stabilization structure by structure type.

Table 111: Shoreline stabilization statistics for Pasquotank County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	733	13.6	7.3	34.1	54
Breakwater	900	64.3	46.9	102.5	14
Groin/Jetty	3,822	65.9	6.8	365.1	58
Sill	0	0	0	0	0
Rip-Rap	42,471	393.3	5.7	3,930.3	108
Bulkhead	116,953	414.7	2.0	414.7	282

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 144 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Pasquotank County were categorized as bulkhead with 22.2 miles. Rip-rap revetments totaled 8.0 miles.

Figure 144: Shoreline stabilization structures that are coincident with the shoreline for Pasquotank County.



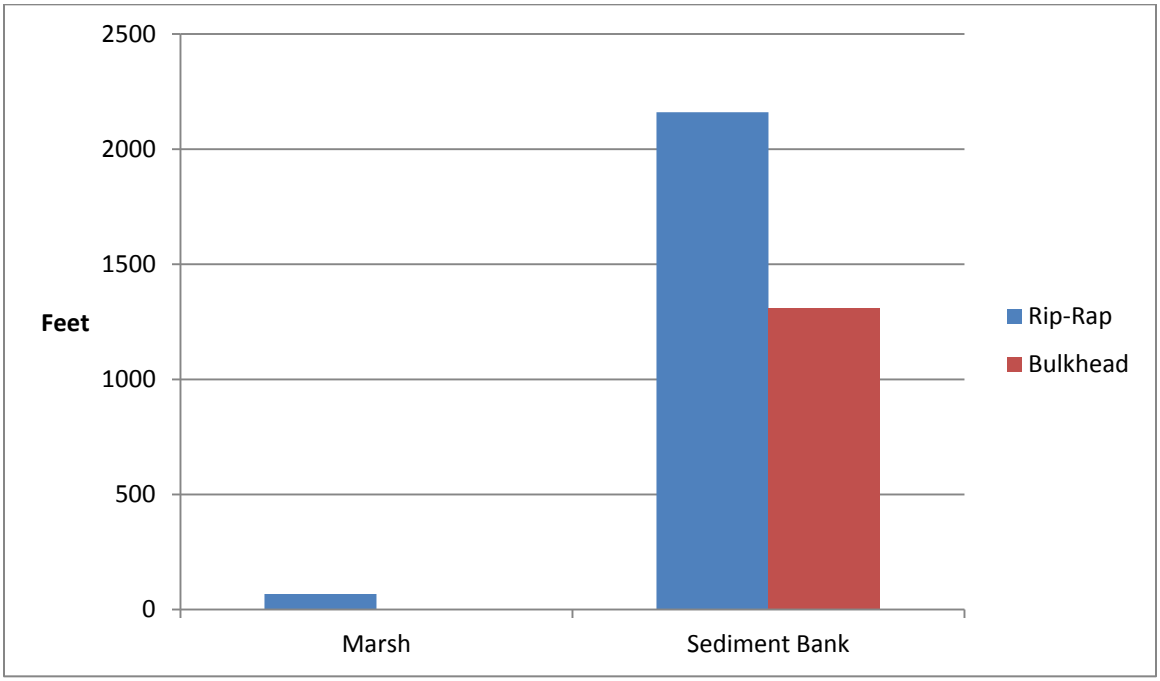
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 112 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Pasquotank County, 68 feet of marsh and 3,471 feet of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 112: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	0	68
Average	0	68
Minimum	0	68
Maximum	0	68
Total Count	0	1

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	1,310	2,161
Average	82	309
Minimum	5	15
Maximum	741	1,427
Total Count	16	7

Figure 145: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 113 below.

Table 113: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	67.3
Average	33.6
Minimum	8.5
Maximum	58.7
Total Count	2

Shoreline Access Structures

There are 505 shoreline access structures (Table 114) mapped within Pasquotank County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (95%). These structures also represent 88% of the total area of shoreline access structures. The largest single structure is a pier with an area of 20,845 ft^2.

Table 114: Area of shoreline access structures within Pasquotank County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	23	2,742	63,077	0.06	1.4
Pier/Floating Dock/Wharf	482	974	469,691	0.02	10.8
Total	**505**		**532,768**		**12.2**

Figure 146: Percent of total number of shoreline access structures.

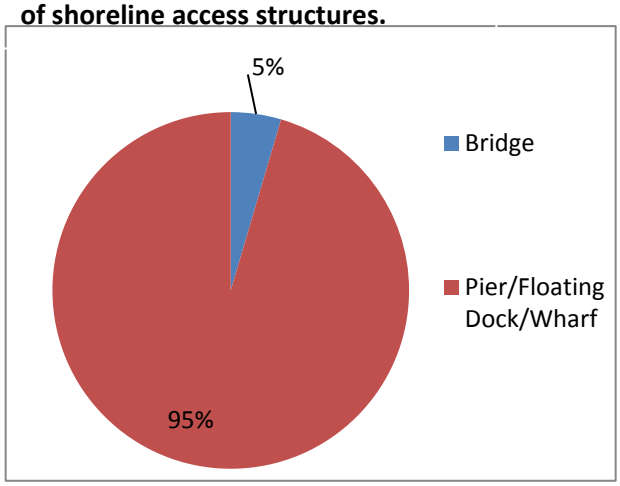
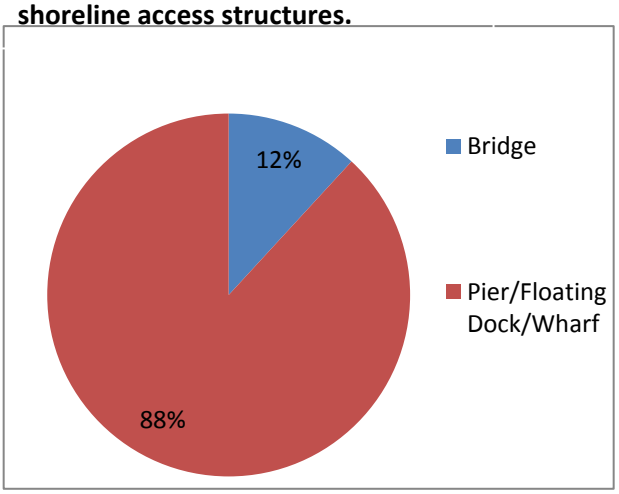


Figure 147: Percent total area of shoreline access structures.

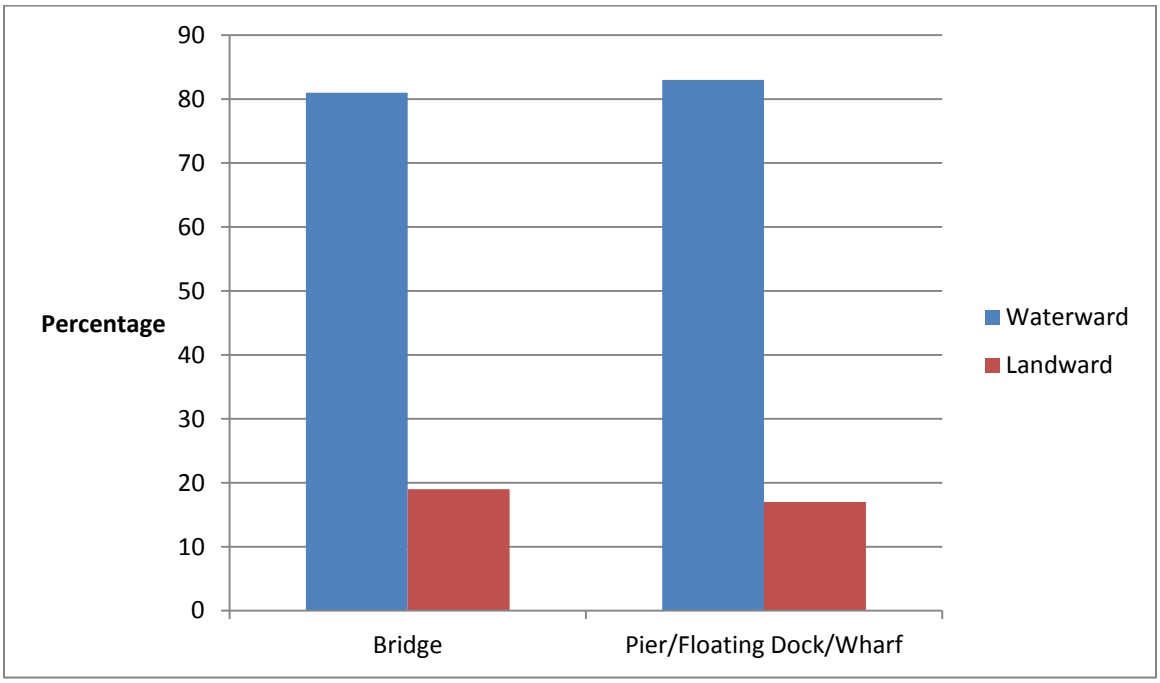


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Pasquotank County, about 10 acres of Public Trust Waters are covered by shoreline access structures.

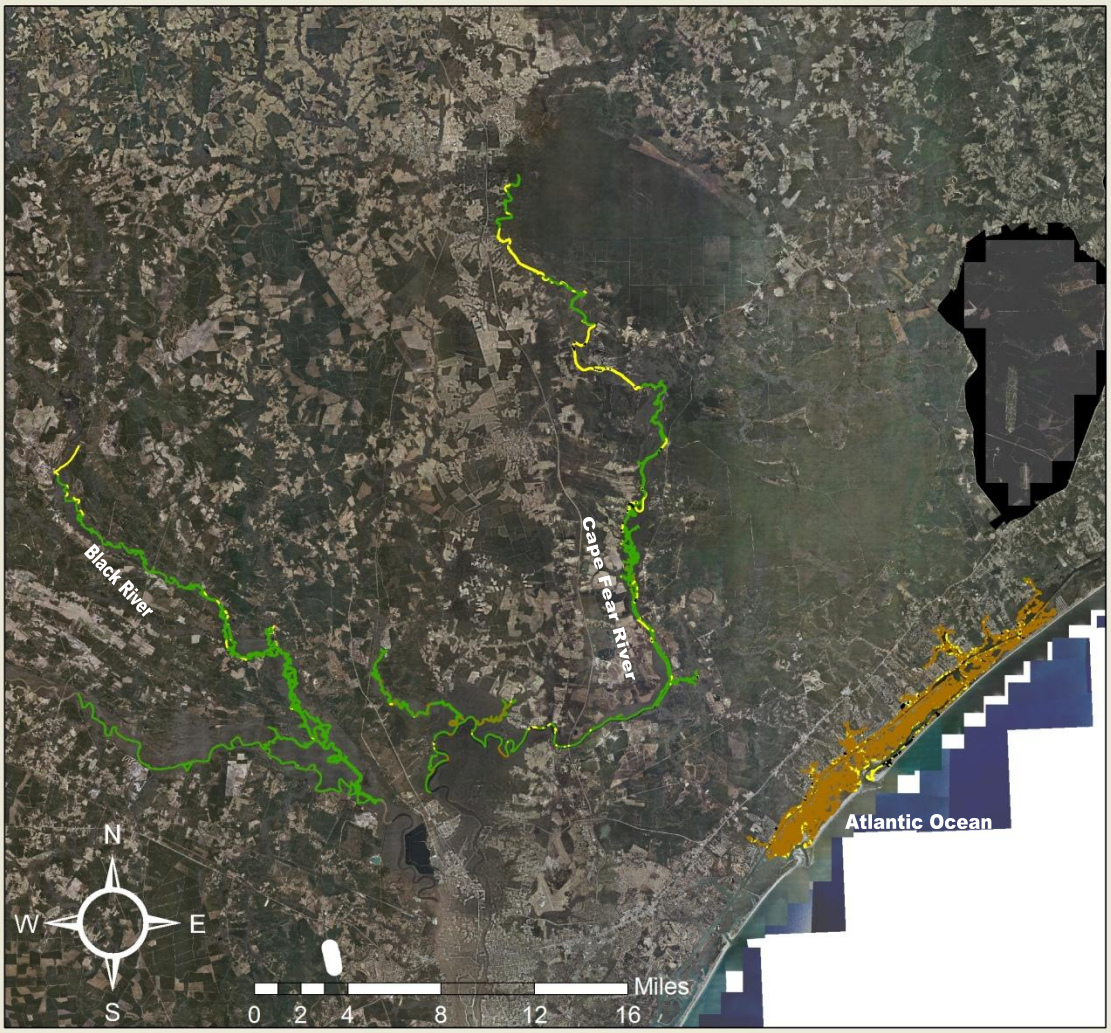
Table 115: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	51,477	1.2
Pier/Floating Dock/Wharf	391,286	9.0
Total	**442,763**	**10.2**

Figure 148: Percent of shoreline access structures located landward and waterward of the shoreline.



Pender County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Pender County Statistics

Estuarine Shoreline

A total of 1,047.8 miles of estuarine shoreline were mapped within Pender County. The majority of the shoreline was characterized as marsh (61.3%). Modified shorelines made up 1.0% of the total shoreline, or 10.8 miles.

Figure 149: Percent shoreline length by shoreline type for Pender County.

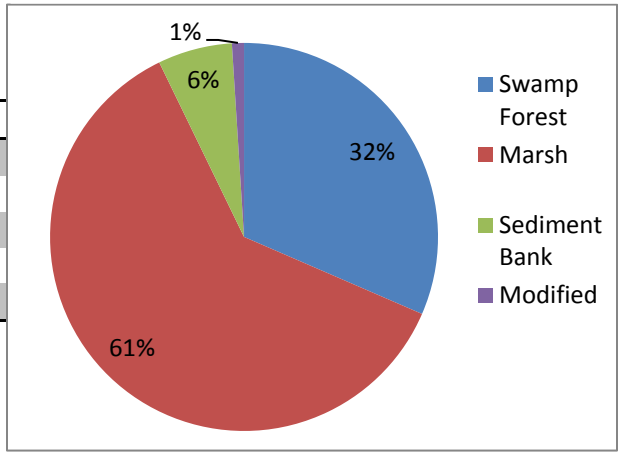
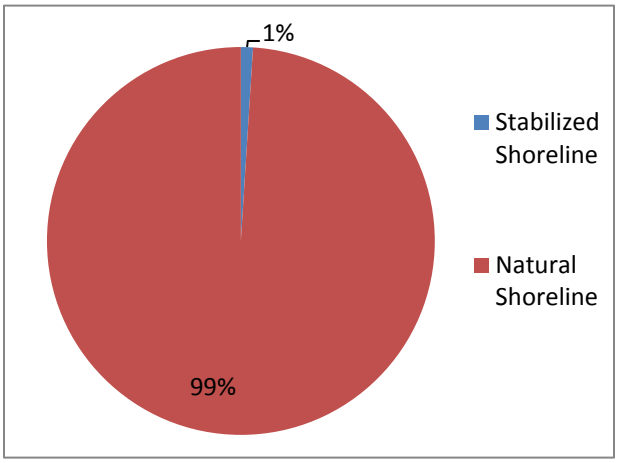


Table 116: Shoreline length for Pender County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	1,740,456	329.6	31.5
Marsh	3,392,603	642.5	61.3
Sediment Bank	342,132	64.8	6.2
Modified	56,968	10.8	1.0
Total	**5,532,159**	**1,047.8**	

Stabilization Structures

Figure 150: Percent of shoreline stabilized vs. natural shoreline.



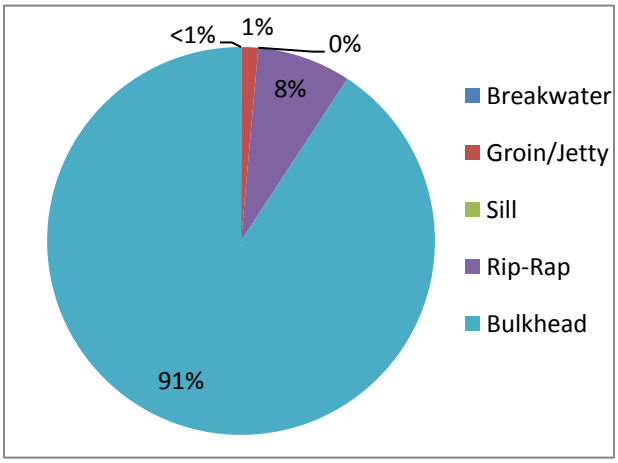


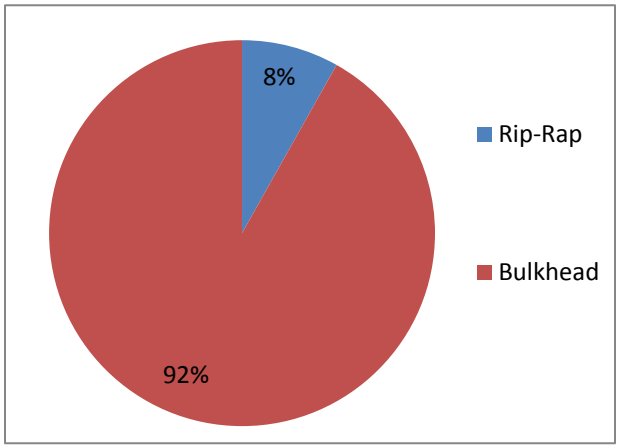
Figure 151: Percent stabilization structure by structure type.

Table 117: Shoreline stabilization statistics for Pender County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	1,465	15.9	6.8	69.3	92
Breakwater	35	35.1	35.1	35.1	1
Groin/Jetty	989	66.0	5.2	302.2	15
Sill	0	0	0	0	0
Rip-Rap	5,639	144.6	15.1	778.1	39
Bulkhead	65,452	308.7	14.6	3,369.0	212

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 152 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Pender County were categorized as bulkhead with 12.4 miles. Rip-rap revetments totaled 1.1 miles.

Figure 152: Shoreline stabilization structures that are coincident with the shoreline for Pender County.



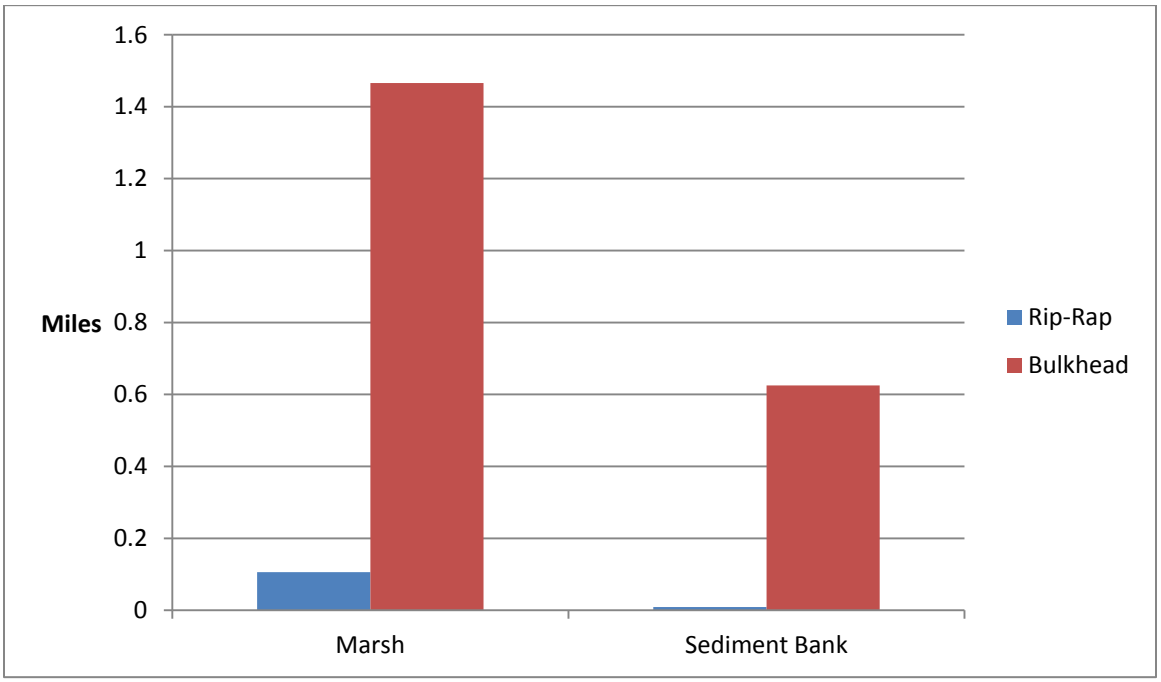
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 118 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Pender County, 1.6 miles of marsh and 0.6 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 118: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	7,738	561
Average	143	140
Minimum	9	40
Maximum	936	267
Total Count	54	4

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	3,302	47
Average	87	47
Minimum	2	47
Maximum	492	47
Total Count	38	1

Figure 153: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 119 below.

Table 119: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	529
Average	75.5
Minimum	19.0
Maximum	137.9
Total Count	7

Shoreline Access Structures

There are 1,715 shoreline access structures (Table 120) mapped within Pender County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (99%). These structures also represent 85% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 43,446 ft^2.

Table 120: Area of shoreline access structures within Pender County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	17	13,951	237,165	0.32	5.4
Pier/Floating Dock/Wharf	1,698	805	1,366,658	0.02	31.4
Total	**1,715**		**1,603,823**		**36.8**

Figure 154: Percent of total number of shoreline access structures.

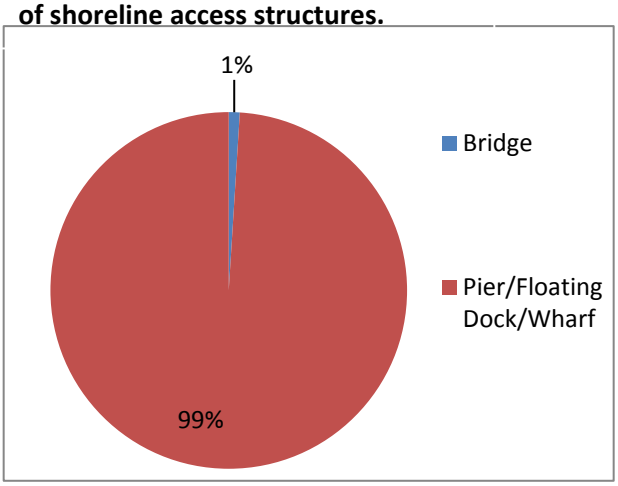
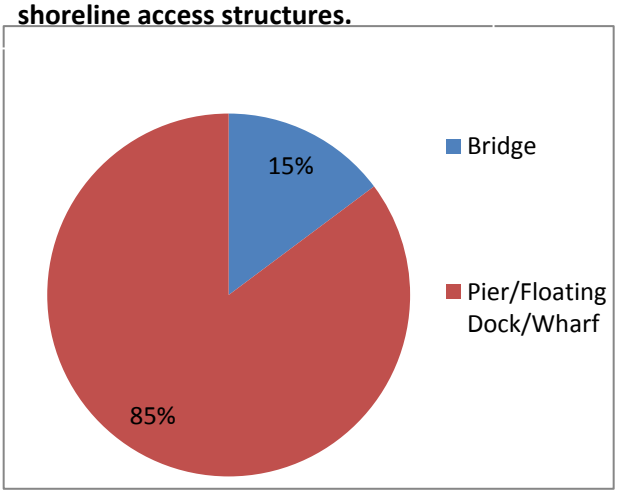


Figure 155: Percent total area of shoreline access structures.

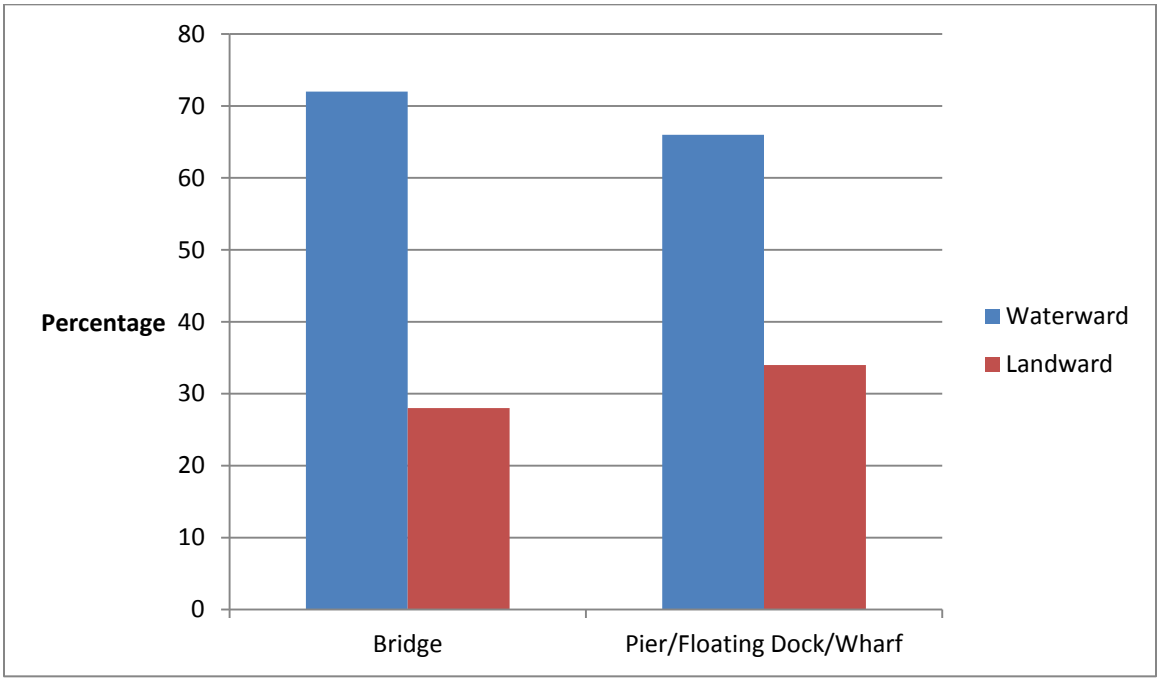


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Pender County, about 25 acres of Public Trust Waters are covered by shoreline access structures.

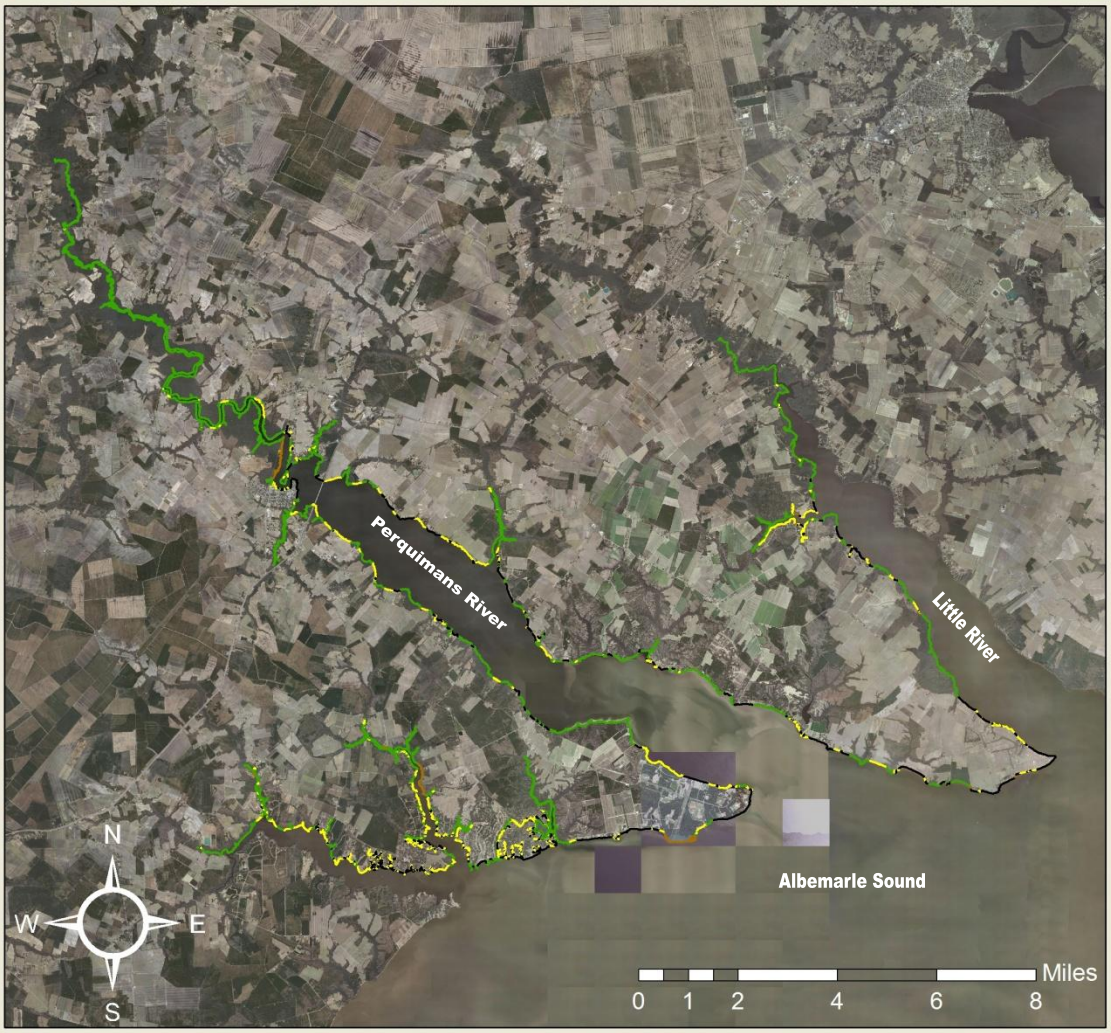
Table 121: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	169,901	3.9
Pier/Floating Dock/Wharf	901,227	20.7
Total	**1,071,128**	**24.6**

Figure 156: Percent of shoreline access structures located landward and waterward of the shoreline.



Perquimans County



Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Perquimans County Statistics

Estuarine Shoreline

A total of 239.7 miles of estuarine shoreline were mapped within Perquimans County. The majority of the shoreline was characterized as swamp forest (64.7%). Modified shorelines made up 13.7% of the total shoreline, or 32.8 miles.

Figure 157: Percent shoreline length by shoreline type for Perquimans County.

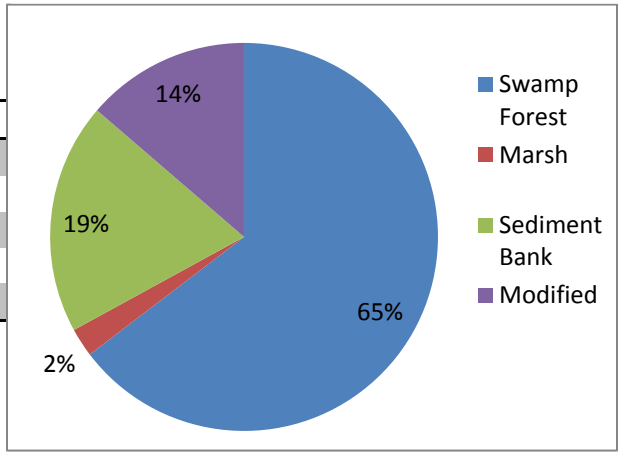
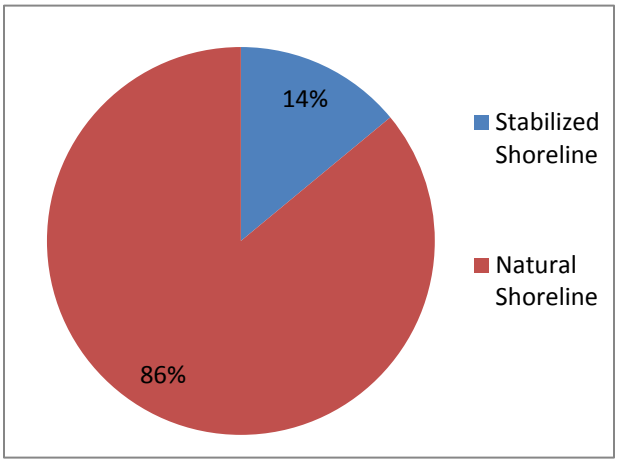


Table 122: Shoreline length for Perquimans County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	818,434	155.0	64.7
Marsh	30,053	5.7	2.4
Sediment Bank	243,910	46.2	19.3
Modified	173,256	32.8	13.7
Total	**1,265,653**	**239.7**	

Stabilization Structures

Figure 158: Percent of shoreline stabilized vs. natural shoreline.



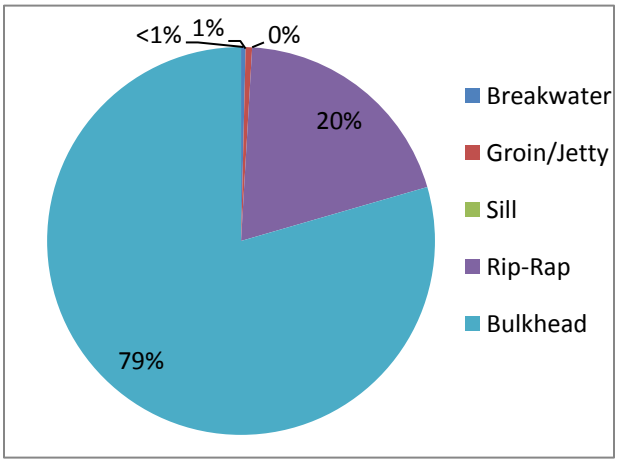


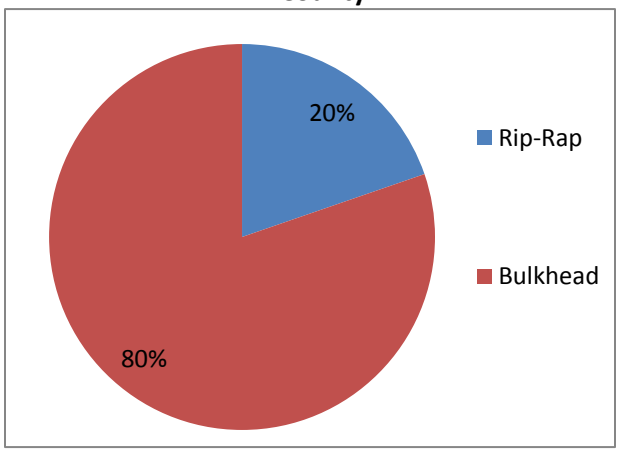
Figure 159: Percent stabilization structure by structure type.

Table 123: Shoreline stabilization statistics for Perquimans County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	1,005	15.5	8.6	39.0	65
Breakwater	705	176.4	47.3	555.0	4
Groin/Jetty	1,004	45.6	6.5	274.1	22
Sill	0	0	0	0	0
Rip-Rap	36,550	380.7	1.9	380.7	96
Bulkhead	148,259	402.8	1.7	402.9	368

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 160 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Perquimans County were categorized as bulkhead with 28.1 miles. Rip-rap revetments totaled 6.9 miles.

Figure 160: Shoreline stabilization structures that are coincident with the shoreline for Perquimans County.



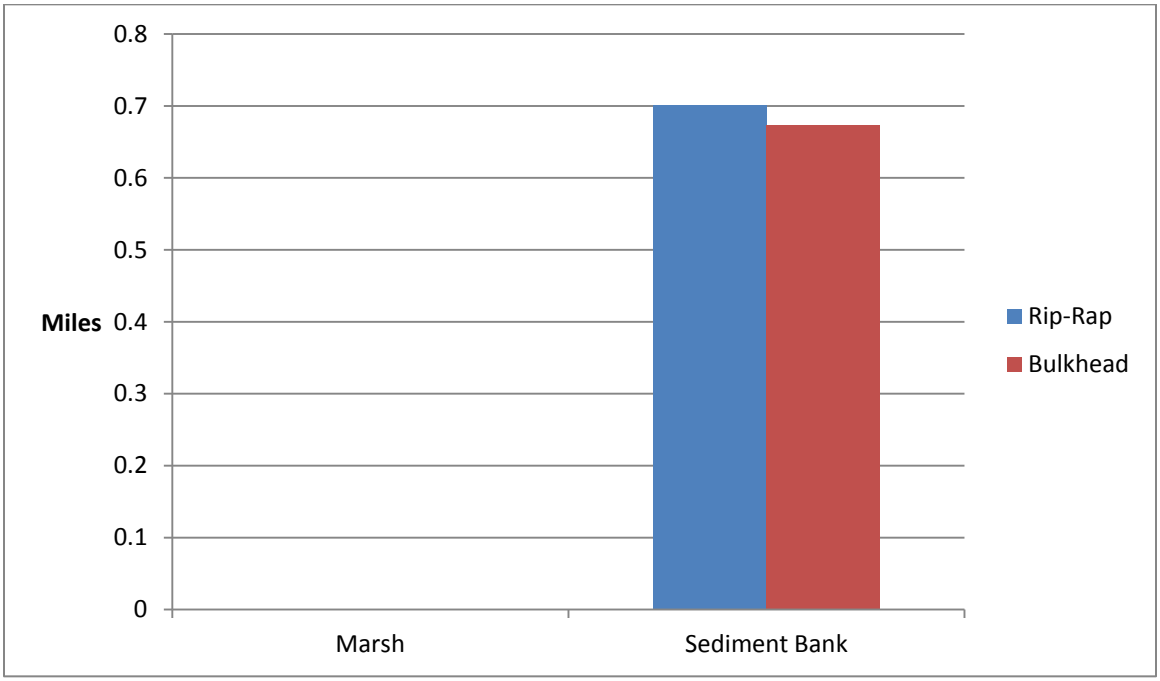
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 124 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Perquimans County, 0 miles of marsh and 1.4 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 124: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	0	0
Average	0	0
Minimum	0	0
Maximum	0	0
Total Count	0	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	3,554	3,704
Average	119	285
Minimum	9	31
Maximum	358	745
Total Count	30	13

Figure 161: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 125 below.

Table 125: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	190.9
Average	190.9
Minimum	190.9
Maximum	190.9
Total Count	1

Shoreline Access Structures

There are 813 shoreline access structures (Table 126) mapped within Perquimans County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (99%). These structures also represent 73% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 101,750 ft^2.

Table 126: Area of shoreline access structures within Perquimans County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	8	30,588	244,704	0.70	5.6
Pier/Floating Dock/Wharf	805	803	646,462	0.02	14.8
Total	**813**		**891,166**		**20.4**

Figure 162: Percent of total number of shoreline access structures.

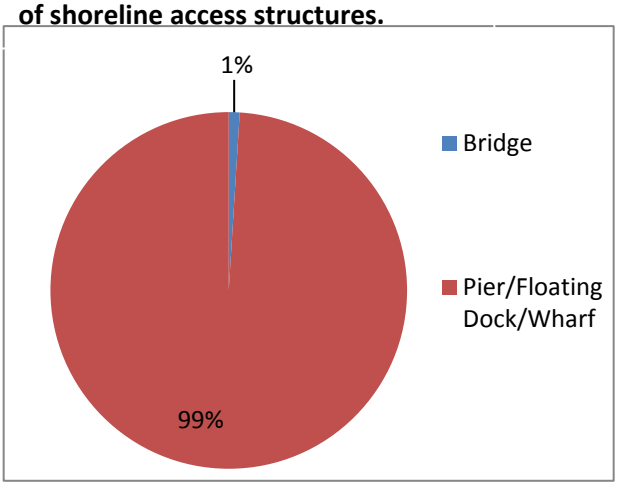
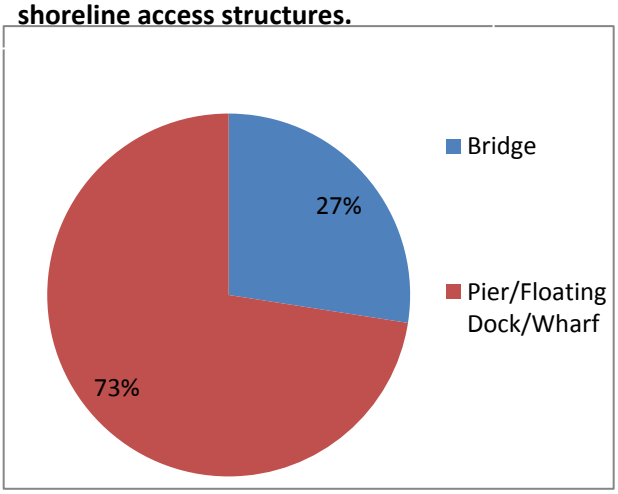


Figure 163: Percent total area of shoreline access structures.

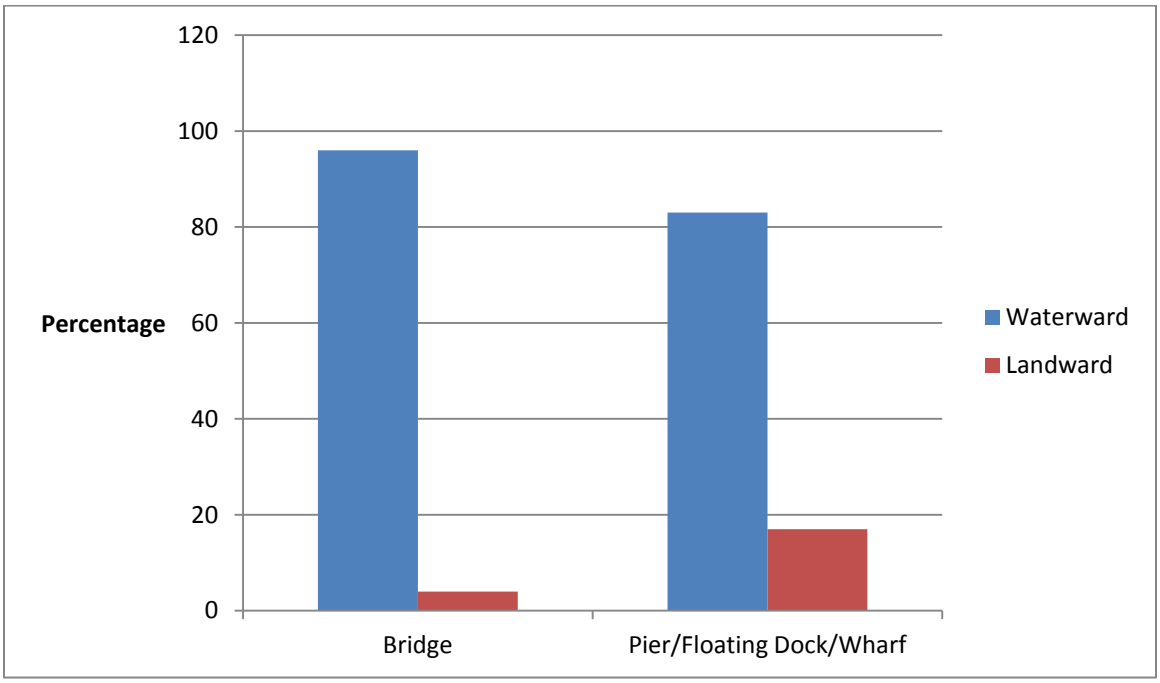


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Perquimans County, about 18 acres of Public Trust Waters are covered by shoreline access structures.

Table 127: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	233,544	5.4
Pier/Floating Dock/Wharf	533,637	12.3
Total	**767,181**	**17.7**

Figure 164: Percent of shoreline access structures located landward and waterward of the shoreline.



Tyrrell County

Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Tyrrell County Statistics

Estuarine Shoreline

A total of 304.3 miles of estuarine shoreline were mapped within Tyrrell County. The majority of the shoreline was characterized as swamp forest (65.9%). Modified shorelines made up 2.9% of the total shoreline, or 8.9 miles.

Figure 165: Percent shoreline length by shoreline type for Tyrrell County.

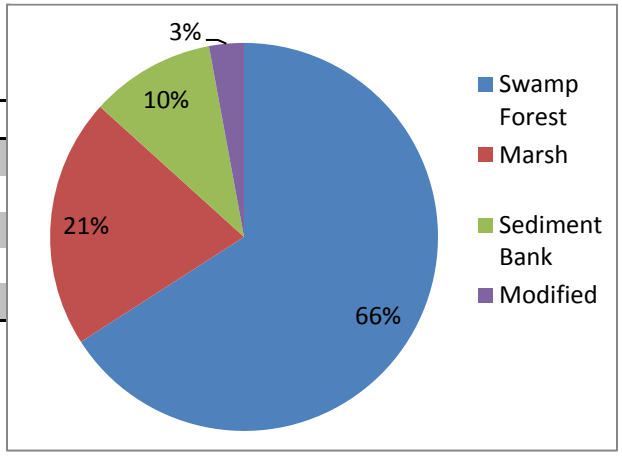


Table 128: Shoreline length for Tyrrell County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	1,059,535	200.7	65.9
Marsh	333,908	63.2	20.8
Sediment Bank	166,466	31.5	10.4
Modified	47,105	8.9	2.9
Total	**1,607,014**	**304.3**	

Stabilization Structures

Figure 166: Percent of shoreline stabilized vs. natural shoreline.

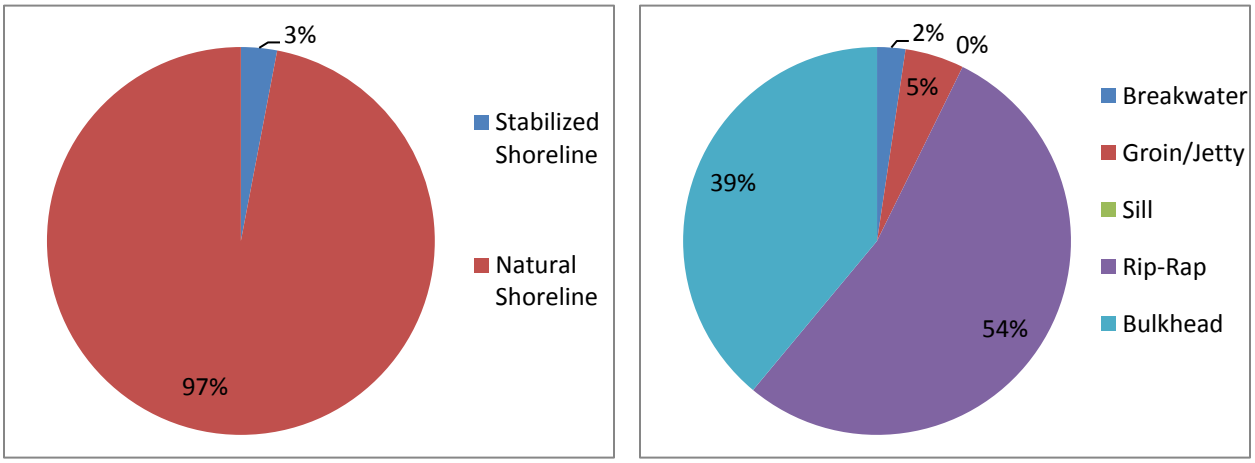


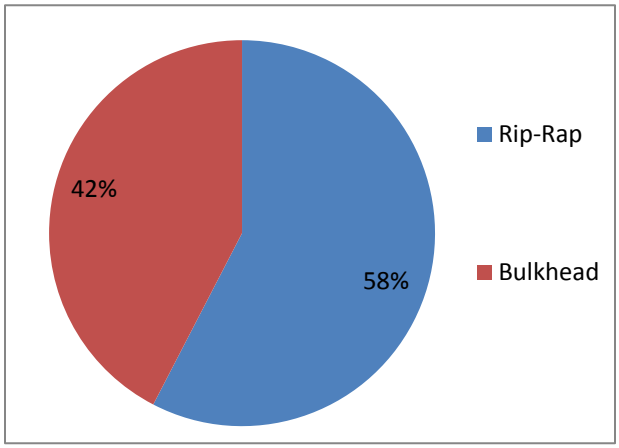
Figure 167: Percent stabilization structure by structure type.

Table 129: Shoreline stabilization statistics for Tyrrell County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	343	13.7	8.0	47.2	25
Breakwater	1,230	614.8	313.4	916.2	2
Groin/Jetty	2,568	41.4	13.7	512.4	62
Sill	0	0	0	0	0
Rip-Rap	28,061	492.3	11.4	2,073.6	57
Bulkhead	20,333	290.5	9.9	937.4	70

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 168 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Tyrrell County were categorized as rip-rap revetments with 5.3 miles. Bulkheads totaled 3.9 miles.

Figure 168: Shoreline stabilization structures that are coincident with the shoreline for Tyrrell County.



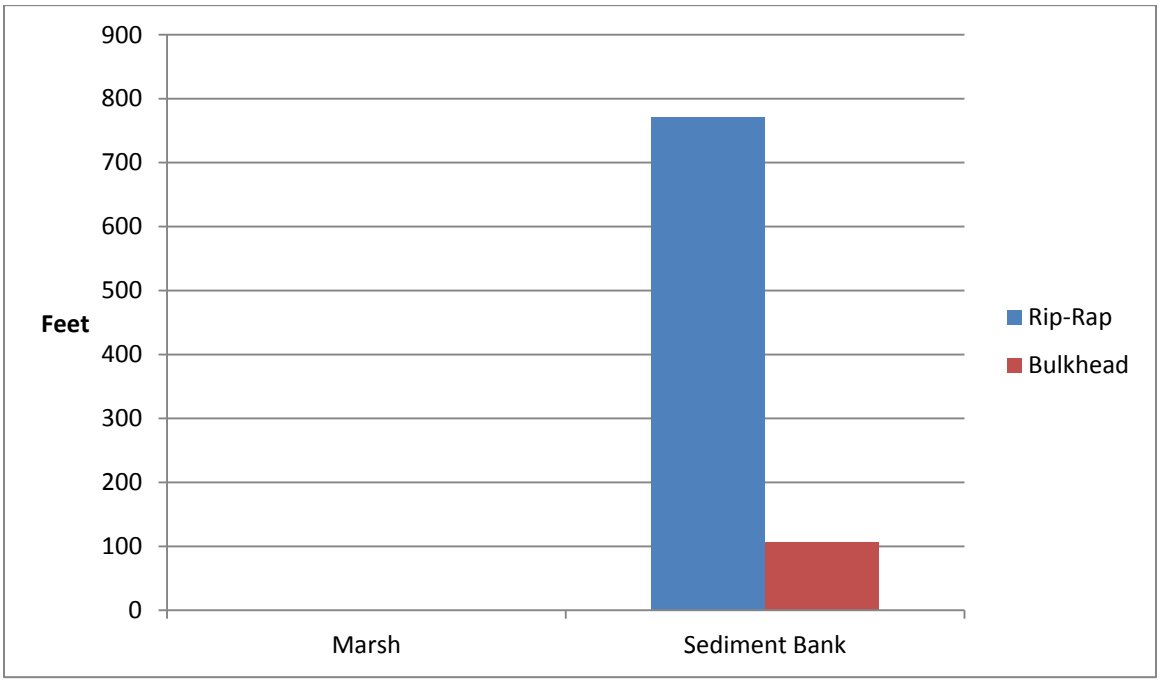
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 130 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Tyrrell County, 0 miles of marsh and 1.6 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 130: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	0	0
Average	0	0
Minimum	0	0
Maximum	0	0
Total Count	0	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	106	771
Average	53	96
Minimum	40	5
Maximum	66	290
Total Count	2	8

Figure 169: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 131 below.

Table 131: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	504
Average	168.0
Minimum	43.1
Maximum	253.4
Total Count	3

Shoreline Access Structures

There are 188 shoreline access structures (Table 132) mapped within Tyrrell County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (95%). However, bridges represent 66% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 226,733 ft^2.

Table 132: Area of shoreline access structures within Tyrrell County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	9	41,388	372,490	0.95	8.6
Pier/Floating Dock/Wharf	179	1,069	191,439	0.02	4.4
Total	**188**		**563,929**		**13.0**

Figure 170: Percent of total number of shoreline access structures.

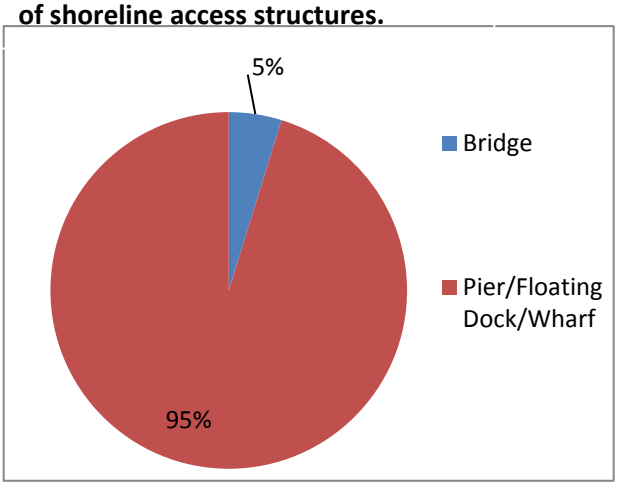
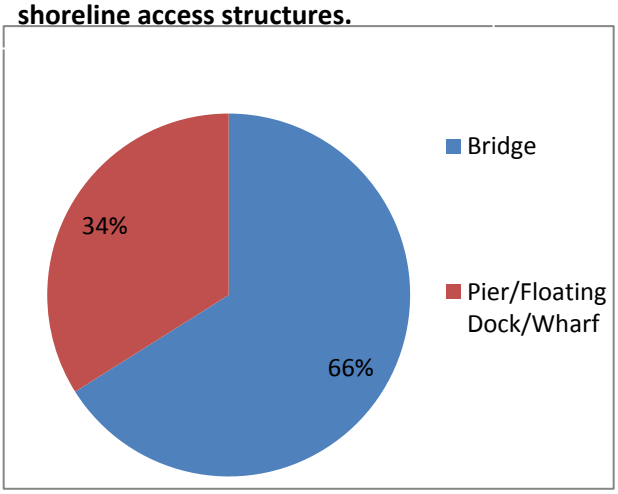


Figure 171: Percent total area of shoreline access structures.

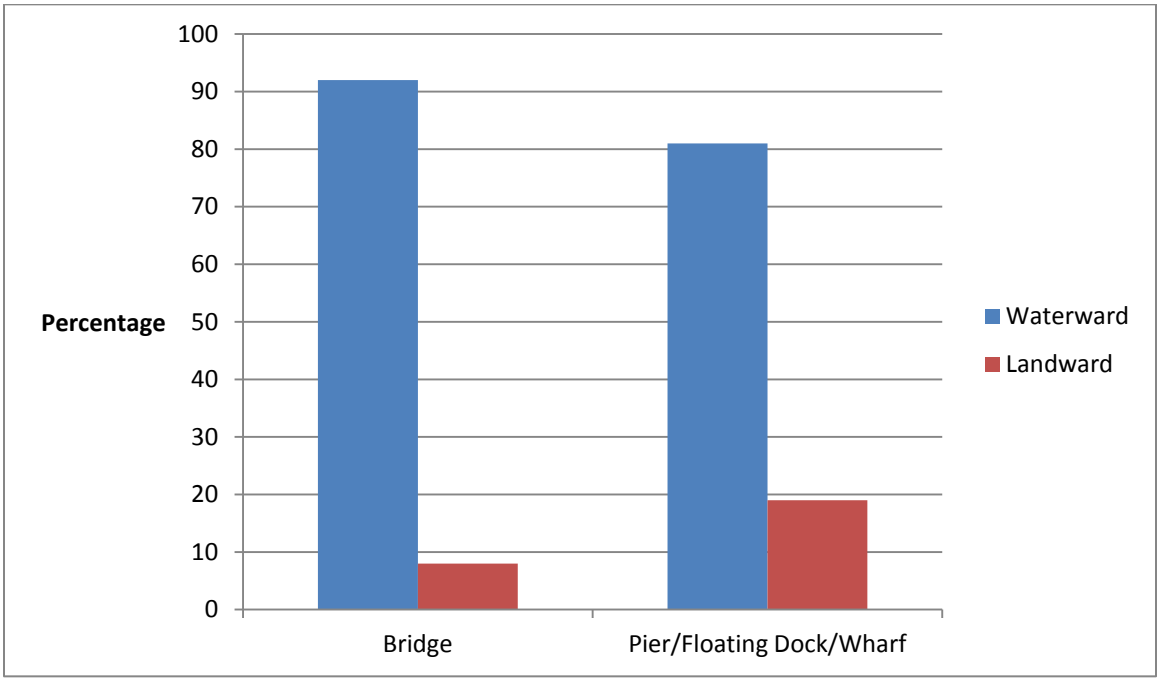


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Tyrrell County, about 12 acres of Public Trust Waters are covered by shoreline access structures.

Table 133: Summary of polygon structures located over NC Public Trust Waters. Area values are in $feet^2$.

Structure Type	$Feet^2$	Acres
Bridge	342,349	7.9
Pier/Floating Dock/Wharf	155,260	3.6
Total	**497,609**	**11.5**

Figure 172: Percent of shoreline access structures located landward and waterward of the shoreline.



Washington County

Legend

Shoreline Type

- Marsh
- Modified
- Sediment Bank
- Swamp Forest

NC DIVISION OF COASTAL MANAGEMENT

Washington County Statistics

Estuarine Shoreline

A total of 85.2 miles of estuarine shoreline were mapped within Washington County. The majority of the shoreline was characterized as swamp forest (81.4%). Modified shorelines made up 10.6% of the total shoreline, or 9.0 miles.

Figure 173: Percent shoreline length by shoreline type for Washington County.

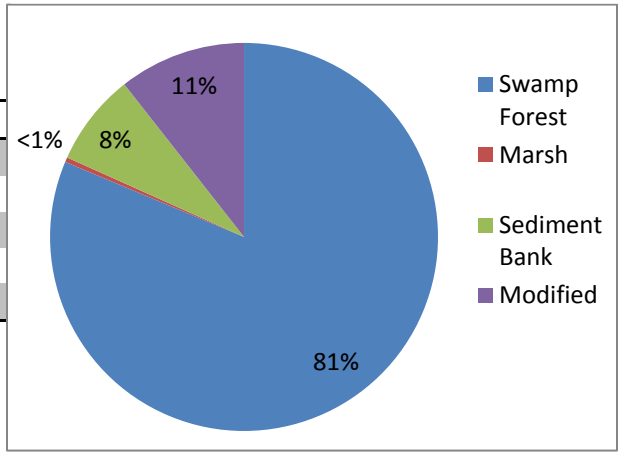
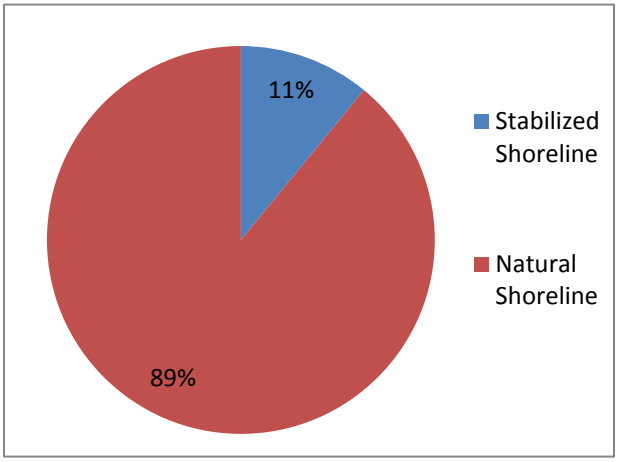


Table 134: Shoreline length for Washington County by shoreline type.

Shoreline Type	Feet	Miles	Percent
Swamp Forest	366,589	69.4	81.4
Marsh	1,827	0.3	0.4
Sediment Bank	34,473	6.5	7.7
Modified	47,756	9.0	10.6
Total	**450,645**	**85.2**	

Stabilization Structures

Figure 174: Percent of shoreline stabilized vs. natural shoreline.



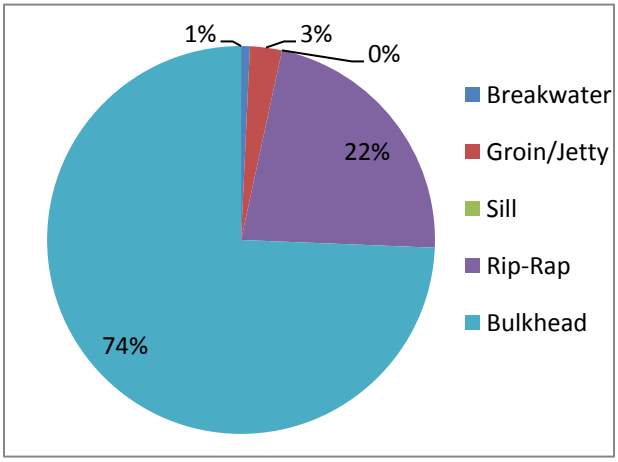


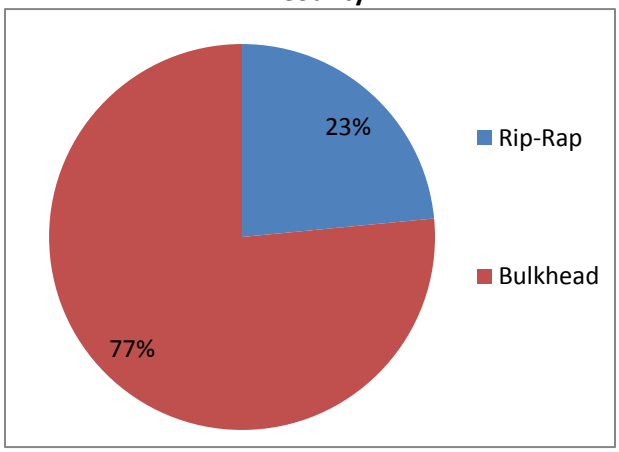
Figure 175: Percent stabilization structure by structure type.

Table 135: Shoreline stabilization statistics for Washington County. Length values are in feet.

Stabilization Type	Total Length	Average	Minimum	Maximum	Total Count
Boat Ramp	464	20.2	9.7	49.9	23
Breakwater	393	98.2	47.6	221.4	4
Groin/Jetty	1,424	24.6	11.2	79.5	58
Sill	0	0	0	0	0
Rip-Rap	11,921	518.3	37.1	2,979.3	23
Bulkhead	39,847	586.0	9.4	5,415.4	68

The shoreline stabilization category can be further broken down into riprap revetment and bulkhead. Figure 176 displays this breakdown. These structures are only those that are coincident with the shoreline delineation. The majority of the structures coincident with the shoreline delineation in Washington County were categorized as bulkhead with 7.5 miles. Rip-rap revetments totaled 2.3 miles.

Figure 176: Shoreline stabilization structures that are coincident with the shoreline for Washington County.



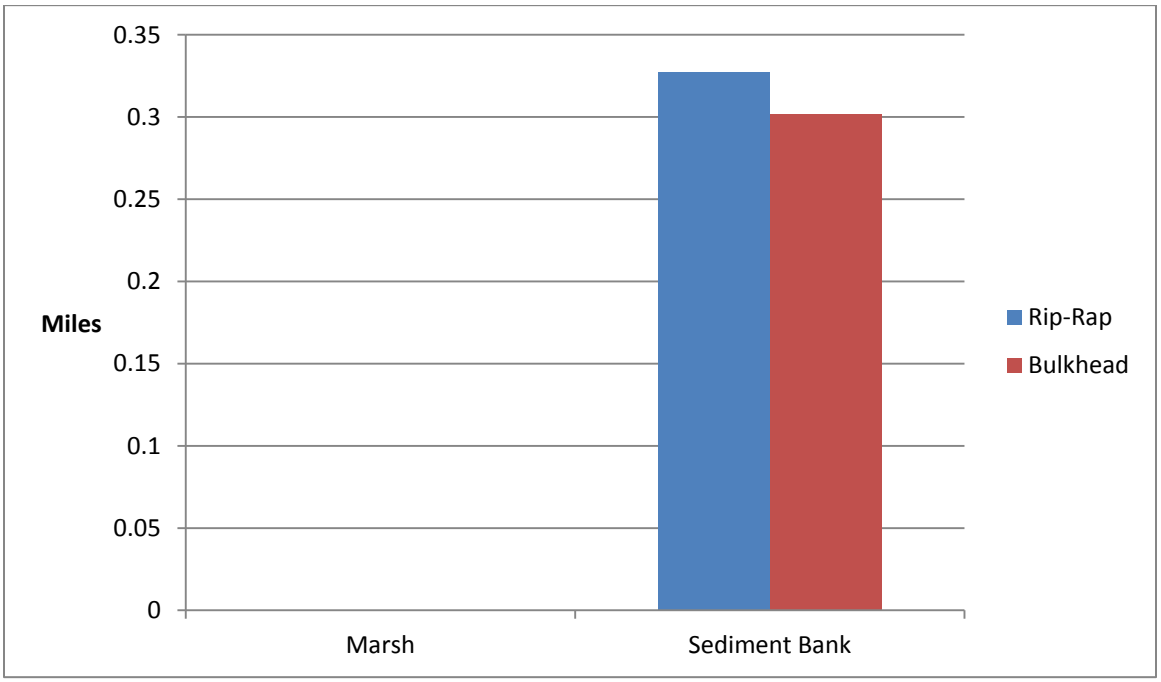
Additional analysis was performed to identify segments of natural shorelines that were digitized waterward of stabilizing structures. Table 136 shows these statistics. These areas are important to document because the landward movement of these segments of natural shoreline and their associated habitats are restricted by the stabilizing structure. In Washington County, 0 miles of marsh and 0.6 miles of sediment bank shorelines are waterward of either bulkhead or rip-rap structures. Areas where natural shoreline features are backed by stabilizing structures are classified as "Modified," but they are also noted as having either marsh or sediment bank waterward of the structures.

Table 136: Natural shoreline by type waterward of stabilized shoreline. Length values are in feet.

Marsh Shoreline	Bulkhead	Rip-Rap
Total Length	0	0
Average	0	0
Minimum	0	0
Maximum	0	0
Total Count	0	0

Sediment Bank Shoreline	Bulkhead	Rip-Rap
Total Length	1,729	1,592
Average	102	398
Minimum	18	190
Maximum	301	598
Total Count	17	4

Figure 177: Natural shoreline by type waterward of stabilized shoreline.



Some shoreline segments are modified with both bulkhead and rip-rap structures. The lengths of these segments are listed in Table 137 below.

Table 137: Length of shoreline modified with both bulkhead and rip-rap.

	Feet
Total Length	475
Average	158.2
Minimum	39.7
Maximum	303.2
Total Count	3

Shoreline Access Structures

There are 278 shoreline access structures (Table 138) mapped within Washington County. These structures are either bridges, which cross a water body and provide access from one side to the other, or piers, floating docks, or wharves, which provide access to the water from one side of a water body. The majority of the structures fall into the category of piers, floating docks, or wharves (95%). However, bridges represent 64% of the total area of shoreline access structures. The largest single structure is a bridge with an area of 231,235 ft^2.

Table 138: Area of shoreline access structures within Washington County.

Structure Type	Total Number of Structures	Average Area in $Feet^2$	Total Area in $Feet^2$	Average Area in Acres	Total Area in Acres
Bridge	15	26,280	394,193	0.60	9.0
Pier/Floating Dock/Wharf	263	834	219,299	0.02	5.0
Total	**278**		**613,492**		**14.0**

Figure 178: Percent of total number of shoreline access structures.

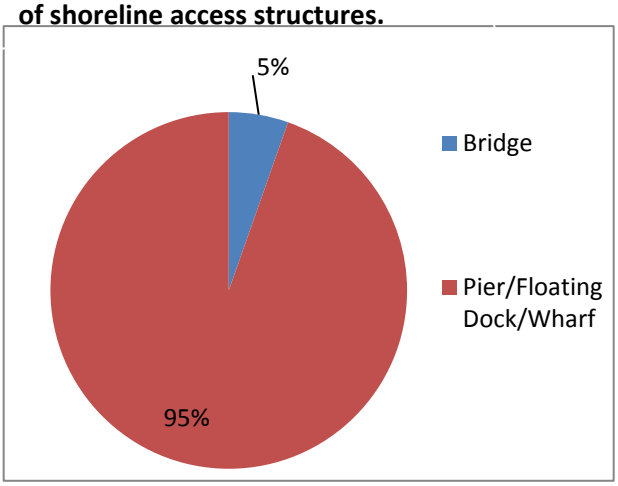
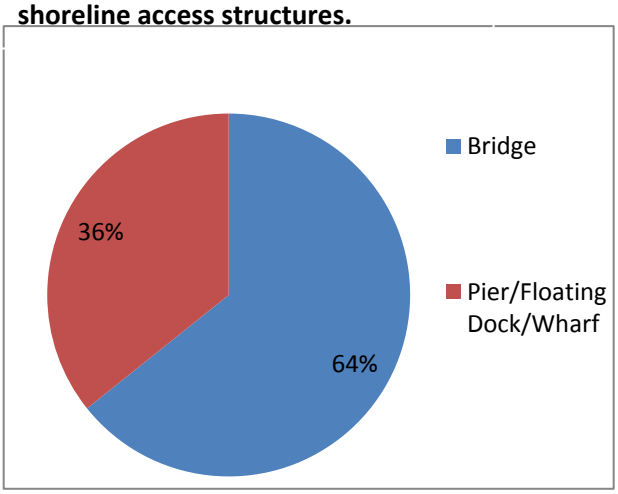


Figure 179: Percent total area of shoreline access structures.

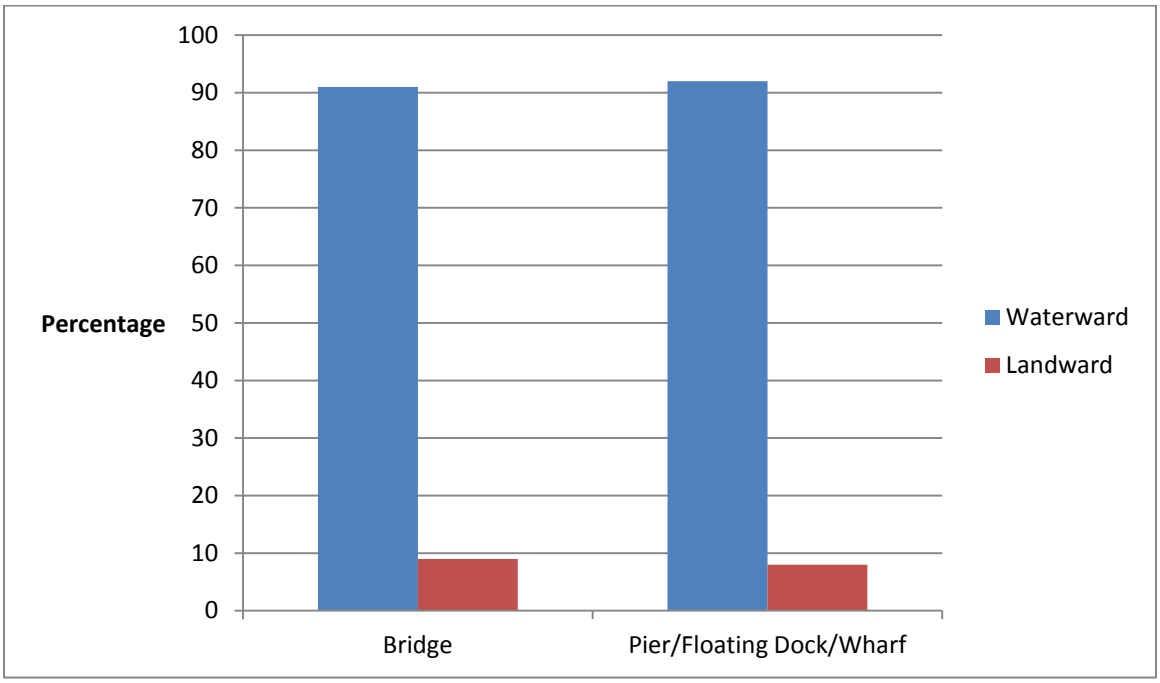


In order to calculate the total area of NC Public Trust Waters that are covered by access structures, the polygon shapefile was bisected with the linear estuarine shoreline shapefile. In Washington County, about 13 acres of Public Trust Waters are covered by shoreline access structures.

Table 139: Summary of polygon structures located over NC Public Trust Waters.

Structure Type	$Feet^2$	Acres
Bridge	358,105	8.2
Pier/Floating Dock/Wharf	201,273	4.6
Total	**559,378**	**12.8**

Figure 180: Percent of shoreline access structures located landward and waterward of the shoreline.



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